image not representative of the study site

FEN CONSULTING

FRESHWATER ASSESSMENT

FOR THE PROPOSED 240 MW LESAKA 1 SOLAR ENERGY FACILITY, NEAR LOERIESFONTEIN, HANTAM MUNICIPALITY, NORTHERN CAPE

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EXECUTIVE SUMMARY

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed by SiVEST (Pty) Ltd to conduct a specialist freshwater ecological assessment to inform the Environmental Authorisation (EA) processes as part of the Environmental Impact Assessment (EIA) phase for the proposed 240 MW Lesaka 1 Solar Energy Facilities (SEF) (hereafter referred to as 'the proposed SEF") on portion 0 of Kluitjeskraal farm 264 (hereafter the "study area") ~ 34 km north of Loeriesfontein, Hantam Municipality, Northern Cape.

The proposed SEF involves an array of solar modules which will generate electricity to feed into the national grid at the Helios Main Transmission Substation (MTS) which is approximately 13 km north east of the study area. A desk-based analysis identified points of interest for verification in the field which confirmed a dense and intricate drainage network of episodic drainage line Hydrogeomorphic (HGM) types that were categorised as follows:

Freshwater HGM Type	Description
Preferential Flow Path (PFP)	Episodic systems in which surface water flow incises small channels or "rills" on the land surface in which the water supply is insufficient to support the establishment of a floral community, that relies on an increased abundance of water within the effective rooting zone. PFPs drain off of steep terrain units such as mountain slopes and form the headwaters of larger episodic systems.
Episodic Drainage Lines (EDL) without Riparian Vegetation	Episodic systems in which surface water flow incises small channels that support some vegetation that relies on an increased abundance of water within the effective rooting zone, but not to the degree that a riparian vegetation margin can form. These systems typically drain moderately sloped terrain units such as mountain foot slopes and collect to form larger episodic drainage lines in the landscape.
Episodic Drainage Lines with Riparian vegetation	Episodic systems in which surface water flow incises channels with a noticeable but not necessarily consistent riparian vegetation margin. These systems drain terrain of moderate to limited gradient and collect to form episodic rivers and their main tributaries in the landscape.
Episodic Rivers with Riparian Vegetation	Episodic systems in which surface water flow incises a large channel with a dense and consistent riparian vegetation margin. These systems drain very gently sloping terrains in the valley bottom position and are the largest fluvial systems in the landscape.

Only the episodic drainage lines and rivers with riparian vegetation can, from an ecological perspective, be classified as watercourses (freshwater ecosystems) due to the expression of a riparian response by vegetation and the presence of alluvial soil. Preferential flow paths (PFPs) are unlikely to have catchments which are large enough to generate a flood response and are not considered freshwater ecosystems from an ecological perspective. Episodic drainage lines without riparian vegetation may, on a system specific basis be considered freshwater ecosystems should they be subject to a 1:100 year floodline, as determined by a suitably qualified professional. Nevertheless, PFPs and drainage lines, not defined as watercourses still function as waterways, through the episodic conveyance of water through the landscape. These systems are still considered important for the hydrological functioning of the larger episodic tributaries and rivers and must ideally be protected to manage the pattern, flow and timing of water in the landscape, implying that runoff from the project area must be carefully managed.

The very high aquatic biodiversity sensitivity of the major part of the investigation area, as designated by the Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental Screening Tool was partially verified due to the absence of wetlands and estuaries in the field. The proponent has however made suitable provision for the protection of no -go areas and areas of high and moderate sensitivity in accordance with the derived PES of these freshwater HGM types.

Existing anthropogenic impacts within this remote landscape include sheep farming, informal and formal gravel road and Transnet railway line freshwater ecosystem crossings, and most notably, infestation by *Prosopis* alien invasive shrubs. These impacts pressurise the lower lying episodic drainage lines and rivers most, particularly in terms of the generation of increased sediment inputs from destabilised soil. The Present Ecological State (PES) of the assessed freshwater HGM types ranged from a Class B (Largely Natural) to Class C (Moderately Modified).

Notwithstanding these impacts, and the episodic nature of these freshwater HGM types, the hydrological importance together with the provision of temporary aquatic freshwater corridors and the likelihood that these systems provide important refuge and migratory corridors for smaller mammals and avifauna must be acknowledged. The designated provincial and national conservation importance of the study area must also be taken into consideration.

The National Environmental Management Act (Act 107 of 1998), as amended (NEMA) Impact Assessment was applied to the proposed SEF layout in the determination to apply for EA, which was informed by the footprints of the freshwater HGM types, their Zones of Regulation (ZoR) and determined development setback buffers as per Macfarlane et al. (2014), ultimately for the classification of environmental sensitivities against which the Impact Assessment can be rated.

The Impact Assessment identified that the Negative High and Medium Impacts in the construction, operation and decommissioning phases with mitigation can be lowered to a Negative Low Impact, on condition of strict adherence to general and project-specific suggested mitigation measures. Only the proposed access roads pose direct impacts to freshwater ecosystems, but the layout was proposed in a manner to, as far as possible, avoid and minimise crossings. All other infrastructure falls outside of the 32 m NEMA Zone of Regulation (ZoR).

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place (and the implementation of good housekeeping practices as per Appendix F), the significance of impacts arising from the proposed SEF development can be adequately managed and the project considered for authorisation by the relevant Competent Authorities.

MANAGEMENT SUMMARY

FEN Consulting (Pty) Ltd was appointed by SiVEST (Pty) Ltd to conduct a specialist freshwater ecological assessment to inform the EA processes for the proposed 240 MW Lesaka 1 SEF ~ 34 km north of Loeriesfontein, Hantam Municipality, Northern Cape (Figures 1 and 2).

This proposed SEF involves an array of solar modules which will generate electricity to feed into the national grid at the Helios Main Transmission Substation (MTS), of which the following components are being applied for under the EIA phase (this report):

- An array of solar modules within 4 proposed buildable areas, spanning ~ 582 ha in total
- BESS x 1 of up to 120 MW / 480 MW with up to four hours of storage and 6 ha in footprint,
- Operations building – 20 m x 10 m = 200 m^2,
- Workshop building – 15 m x 10 m = 150 m^2,
- Stores – 15 m x 10 m = 150 m^2,
- Temporary laydown area and construction camp = 300 m x 215 m = 64 500 m^2,
- Internal Access roads to the site and between project components of up to 5 m and 6 m respectively, this can increase to 8 m around bends. The roads will be placed with a corridor of up to 20 m wide to accommodate cable trenches, stormwater channels (as required), and turning circles/bypass areas of up to 20 m in some sections. Existing roads will be upgraded wherever needed, and new roads will be constructed where necessary;
- Overhead or underground LV and MV cabling of up to 33 kV, and
- A 33/132 kV onsite IPP substation utilised for the collection and connection of the internal LV and MV reticulation of the SEF facility.

Following the Public Participation Process (PPP), the DFFE requested that the Lesaka 1 grid infrastructure (MTS proposed footprint, Overhead Power Line (OHPL) and Line In Line Out (LILO) connection) be included in the final Environmental Impact Assessment (this report).

The purpose of this freshwater assessment is to assist with informing the EA processes for the proposed SEF 1 development and associated freshwater ecosystems and has two primary objectives:

- To define the proposed SEF 1 area in terms of freshwater ecosystem coverage and characteristics, including mapping thereof, the PES, areas of increased Ecological Importance and Sensitivity (EIS) and ecological service provision; and
- To define freshwater ecosystem sensitivities, using a combination of freshwater ecosystem footprints, their associated Zones of Regulation (ZoR) and determined setback buffers as per Macfarlane et al. (2014) in conjunction with the preliminary SEF layout to inform an Impact Assessment that summarises the risk of the various SEF activities on the receiving environment. A list of development alternatives were provided during the Scoping phase of which the most appropriate layout that can be achieved was chosen and summarised in the Impact Assessment of the EIA phase (this report).

A desktop study was conducted, in which freshwater ecosystems 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 4 of this report.

The subsequent field assessment took place between the 4th and 6th of October 2022 to ground truth the identified freshwater ecosystems associated with the proposed SEF and identified the following freshwater HGM types associated within the study area as per Table A below:

Table A: Freshwater Ecosystem HGM categories associated with the study area.

Freshwater HGM Type	Description
Preferential Flow Path (PFP)	Episodic systems in which surface water flow incises small channels or ''rills'' on the land surface in which the water supply is insufficient to support the establishment of a floral community, that relies on an increased abundance of water within the effective rooting zone. PFPs drain off of steep terrain units such as mountain slopes and form the headwaters of larger episodic systems.
Episodic Drainage Lines without Riparian Vegetation	Episodic systems in which surface water flow incises small channels that support some vegetation that relies on an increased abundance of water within the effective rooting zone, but not to the degree that a riparian vegetation margin can form. These systems typically drain moderately sloped terrain units such as mountain foot slopes and collect to form larger episodic drainage lines in the landscape.
Episodic Drainage Lines with Riparian vegetation	Episodic systems in which surface water flow incises channels with a noticeable but not necessarily consistent riparian vegetation margin. These systems drain terrain of moderate to limited gradient and collect to form episodic rivers and their main tributaries in the landscape.
Episodic Rivers with Riparian Vegetation	Episodic systems in which surface water flow incises a large channel with a dense and consistent riparian vegetation margin. These systems drain very gently sloping terrains in the valley bottom position and are the largest fluvial systems in the landscape.

Only the episodic drainage lines and rivers with riparian vegetation can, from an ecological perspective, be classified as watercourses (freshwater ecosystems) due to the expression of a riparian response by vegetation and the presence of alluvial soil. Preferential flow paths (PFPs) are unlikely to have catchments which are large enough to generate a flood response and are not considered freshwater ecosystems from an ecological perspective. Episodic drainage lines without riparian vegetation may, on a system specific basis be considered freshwater ecosystems should they be subject to a 1:100-year floodline, as determined by a suitably qualified professional. Nevertheless, PFPs and drainage lines, not defined as watercourses still function as waterways, through the episodic conveyance of water through the landscape. These systems are still considered important for the hydrological functioning of the larger episodic tributaries and rivers and must ideally be protected to manage the pattern, flow and timing of water in the landscape, implying that runoff from the project area must be carefully managed.

Existing anthropogenic impacts within this remote landscape include sheep farming, informal and formal gravel road and Transnet railway line freshwater ecosystem crossings, and most notably, infestation by *Prosopis* alien invasive shrubs. These impacts pressurise the lower lying episodic drainage lines and rivers most, particularly in terms of the generation of increased sediment inputs from destabilised soil.

The results of the ecological assessment of the freshwater HGM types are discussed in Section 5 of this report and are summarised in Table B below.

Table B: Summary of results of the field assessment as discussed in Section 5.

Freshwater HGM Type	Present Ecological State (PES)		Ecoservices (supply importance)	Ecological Importance and Sensitivity (EIS)
Episodic drainage lines without riparian vegetation	Considered to be in a largely natural condition (PEC Class B) based on field observations of the ecological drivers (hydrology, geomorphology, biota and water quality.)		➢ Sediment trapping ➢ Erosion control ➢ Biodiversity maintenance	Moderate
Episodic drainage lines with riparian vegetation	**Instream IHI** B/C (Largely natural to moderately modified)	**Riparian IHI** D (Largely Modified)	➢ Sediment trapping ➢ Erosion control ➢ Biodiversity maintenance	Moderate
Episodic rivers with riparian vegetation	**Instream IHI** C (Moderately modified)	**Riparian IHI** E (Seriously Modified)	➢ Sediment trapping ➢ Erosion control ➢ Harvestable resources	Moderate

Notwithstanding these impacts, and the episodic nature of these freshwater HGM types, the hydrological importance together with the provision of temporary aquatic freshwater corridors and the likelihood that these systems provide important refuge and migratory corridors for smaller mammals and avifauna must be acknowledged. Furthermore, the ecological conservation importance of the study area is recognised nationally in the 2011 NFEPA and 2018 National Biodiversity Assessment databases, and provincially in the 2016 Northern Cape Critical Biodiversity Areas assessment.

The DFFE National Web-Based Environmental Screening Tool designated the majority of the investigation area as having a very high aquatic biodiversity sensitivity due to the presence of FEPA catchments, rivers, wetlands and estuaries. This is partially verified, as no wetlands and estuaries occur within the investigation area. However, the DWAF (1999) EIS tool for riparian watercourses determined an overall moderate EIS for the various freshwater HGM types, with the EDLs in the upland areas being more sensitive than the ephemeral rivers to alien invasive vegetation invasion. The proponent has however made suitable provision for the protection of no -go areas and areas of high and moderate sensitivity in accordance with the derived PES of these freshwater HGM types.

The Impact Assessment identified that the Negative High and Medium Impacts in the construction, operation and decommissioning phases with no mitigation can be lowered to a Negative Low Impact, on condition of strict adherence to general and project-specific suggested mitigation measures.

Only the proposed access roads pose direct impacts to freshwater ecosystems, but the layout was proposed in a manner to, as far as possible, avoid and minimise crossings. All other infrastructure falls outside of the 32 m NEMA Zone of Regulation (ZoR), except the LILO connection support towers will be placed within the 32 m NEMA ZoR, but outside of the 25 m development setback (see below).

The results of the Impact Assessment are shown below in Table C.

Phase	Environmental Parameter	Direct Impacts – new infrastructure		Direct impacts – road upgrades		Indirect impacts – within 100m ZoR (GN509)	
CONSTRUCTION	Impact Significance as per suggested Mitigation	Before	After	Before	After	Before	After
	Habitat and biota	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
	Geomorphological processes	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
	Hydrological functioning & surface water quality	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
OPERATION	Environmental Parameter	Direct Impacts				Indirect Impacts	
	Impact Significance as per suggested Mitigation	Before		After		After	
	Habitat and biota	(-) M		(-) L		(-) L	
	Geomorphological processes, hydrological functioning and surface water quality	(-) M		(-) L		(-) L	
DECOMMISSION	**Environmental Parameter**	Direct and Indirect Impacts					
	Impact Significance as per suggested Mitigation	Before				After	
	Habitat and biota	(-) M				(-) L	
	Geomorphological processes, hydrological functioning and surface water quality	(-) L				(-) L	

The following pertinent mitigation measures are summarised.

- Two episodic rivers with riparian vegetation will be crossed by newly proposed access roads; therefore additional precautionary measures should be taken in terms of erosion and sediment control and dissipation (refer to bullets 2, 5 and 7 below);
- All construction works for the freshwater ecosystem road crossings must be supervised by a freshwater ecologist that must ensure that weather conditions are sufficiently dry enough such that no diversion of flow is necessary to proceed with construction – this is imperative to maintain a low impact significance;
- Construction activities in the freshwater ecosystem will potentially result in bank destabilisation, and cause bank incision and sedimentation of the freshwater ecosystem, therefore, sediment control devices should be installed downgradient of the construction site in the freshwater ecosystem and all excess sediment is to be removed once construction activities have been completed;
- For the solar arrays near episodic drainage lines, a 25 m setback to be allowed to ensure sufficient space for erosion and sediment control and dissipation near these episodic

features, as these areas are subjected to greater amounts of runoff compared to non-developed areas during high rainfall events; and
  - Existing roads and newly authorised freshwater ecosystem crossings should be utilised to gain access to the proposed construction area. No indiscriminate crossing of the freshwater ecosystems outside of the existing crossing points or driving in unmarked areas through the buffer zones of the freshwater ecosystems may be permitted;
  - Development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential;
  - New road crossings must intersect the freshwater ecosystem at a right angle (perpendicular) to minimise disturbance to the freshwater ecosystem;
  - Soil excavated as part of trenching must be stockpiled immediately upstream of the trench and backfilled as soon as possible with the removed material and suitably compacted to avoid any erosion and preferential flow paths from forming;
  - During excavation activities, the topsoil and vegetation that is removed should be stockpiled separately from other material outside of the 32 m NEMA ZoR;
  - The LILO support towers must have rock packed (or similar erosion protection methods) installed around their vertices to ensure that any potential preferential flow paths continue to drain to their intended downstream reaches, and to protect the downstream freshwater ecosystems from any potential erosion generated around these vertices. The relevant support towers must be monitored to ensure that the erosion protection structure has not failed, and in the event that it has, must be reconstructed; and
  - After construction of the surface infrastructure, the area surrounding the surface infrastructure must be revegetated with suitable indigenous vegetation (terrestrial vegetation) to prevent the establishment of alien vegetation species and their potential spread into the freshwater ecosystems.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place (and the implementation of general construction management and good housekeeping practices, as per Appendix F), the significance of impacts arising from the proposed SEF development can be adequately managed and the project considered for authorisation by the relevant Competent authorities.

DOCUMENT GUIDE

The table below provides the specialist reporting requirements for areas designated as having a very high aquatic biodiversity sensitivity 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 (DFFE) screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA).

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 2 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 2
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 2
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: Tables 7-9
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	NA – this report summarises only the preferred development footprints
2.4	Assessment of impacts – a detailed assessment of the potential impact(s) of the SEF 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: Tables 7-9
2.4.4	How will the development impact on the functionality of the aquatic feature including:	Section 7: Table 12

	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 soils, etc).	
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: Tables 7-9
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: Tables 7-9
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 160 km south west of the study area
3.	The report must contain as a minimum the following information:	
3.1	Contact detail of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Appendix g
3.2	A signed statement of independence by the specialist.	Appendix g
3.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 3.1
3.4	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Section 3, Appendix C
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 SEF development.	Section 7
3.8	Any direct, indirect and cumulative impacts of the SEF development on site.	
3.9	The degree to which impacts, and risks can be mitigated.	
3.10	The degree to which impacts, and risks can be reversed.	
3.11	The degree to which the impacts and risks can cause loss of irreplaceable resources.	
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.	
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the SEF development and if the SEF development should receive approval or not.	Section 9
3.16	Any conditions to which this statement is subjected.	Section 9

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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 soils).
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils 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.
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. It must be noted that the term watercourse is synonymous with freshwater ecosystem as used in this report.
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, 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
BESS	Battery Energy Storage System
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
EIR	Environmental Impact Report
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
FEN	Freshwater Ecologist Network
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
HV	High Voltage
IHI	Index of Habitat Integrity
IPP	Independent Power Producer
kV	Kilovolt
LV	Low Voltage
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
MTS	Main Transmission Station
MV	Medium Voltage
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
OHPL	Overhead Powerline
O&M	Operation and Maintenance
PEMC	Present Ecological Management Class
PES	Present Ecological State
PV	Photovoltaic
REC	Recommended Ecological Category
REDZ	Renewable Energy Zones
REIPPPP	Renewable Energy Independent Power Producer Procurement Program (REIPPPP)
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SARERD	South African Renewable Energy Resource Database
SEF	Solar Energy Facility
SQR	Sub-quaternary catchment reach
subWMA	Sub-Water Management Area
WMA	Water Management Areas
WULA	Water Use Licence Application
ZOR	Zone of Regulation

1 INTRODUCTION

1.1 Background

FEN Consulting (Pty) Ltd was appointed by SiVEST (Pty) Ltd to conduct a specialist freshwater ecological assessment to inform the EA processes for the proposed 240 MW Lesaka 1 SEF ~ 34 km north of Loeriesfontein, Hantam Municipality, Northern Cape (Figures 1 and 2).

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

The purpose of this freshwater assessment is to assist with informing the EA processes for the proposed SEF 1 development and associated freshwater ecosystems and has two primary objectives:

- To define the proposed SEF 1 area in terms of freshwater ecosystem coverage and characteristics, including mapping thereof, the PES, areas of increased Ecological Importance and Sensitivity (EIS) and ecological service provision; and
- To define freshwater ecosystem sensitivities, using a combination of freshwater ecosystem footprints, their associated Zones of Regulation (ZoR) and determined setback buffers as per Macfarlane et al. (2014) in conjunction with the preliminary SEF layout to inform an Impact Assessment that summarises the risk of the various SEF activities on the receiving environment. A list of development alternatives were provided during the Scoping phase of which the most appropriate layout that can be achieved was chosen and summarised in the Impact Assessment of the EIA phase (this report).

1.2 Structure of this report

This report investigates the impact significance of the proposed development, as explained in Section 2 below, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended as well as the NWA by means of the Risk Assessment Matrix, as promulgated in GN 509 of 2016 as it relates to the NWA. 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 SEF as well as a brief summary of the proposed activities associated with the proposed SEF.

Section 3: Assessment Approach

Provides the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the risk assessment approach.

Section 4: Desktop Assessment Results

Reports on the findings from the relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2011 database, the DWS RQIS PESEIS database (2014), the Northern Cape Critical Biodiversity Areas dataset (2016) and the National Biodiversity Assessment (2018) which were consulted to aid in defining the PES and EIS of the freshwater HGM types.

Section 5: Site Based Freshwater HGM type Assessment Results (Terms of Reference)

This section reports the following:

- A description and delineation of all freshwater HGM types associated with the proposed SEF according to "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2]: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones" ;
- Delineation of all freshwater HGM types (using desktop methods) within 500 m of the proposed SEF 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 freshwater HGM types according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis et al., 2013);
- The EIS of the freshwater HGM types according to the method described in DWAF (1999);
- The services provided by the freshwater HGM types associated with the proposed SEF were assessed according to the method of Kotze et al. (2020);
- The PES of the freshwater HGM types according to the resource directed measures guidelines as advocated by Kleynhans et al. (2008); and
- The Riparian Vegetation Response Assessment Index (VEGRAI) according to the resource directed measures guidelines as advocated by Kleynhans et al. (2007).

Section 6: Legislative Requirements

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

Section 7: Impact Assessment

Provides the outcomes of the Impact Assessment which highlights all potential impacts and that may affect the surrounding freshwater ecosystems. Management and mitigation measures are provided which should be implemented during the various proposed SEF development activities (planning, construction and operational phases) in order to assist in minimising the impact on the receiving environment.

Section 8: Conclusion

Summarises the key freshwater ecological findings, the outcome of the impact assessment and pertinent mitigation measures required to support the registration of the authorisation of this project.

1.3 Assumptions and Limitations

- The ground-truthing and delineation of the freshwater HGM type boundaries and the assessment thereof are confined to a single site visit undertaken between the 4th and 6th of October 2022 of the study area. All freshwater HGM types 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 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 freshwater HGM types were inaccessible. Therefore, verification points were located at points as close to the freshwater HGM type as possible, to be verified, and where necessary the conditions at the exact point required were inferred or extrapolated;

[1] 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.

[2] 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.

- Due to the majority of freshwater HGM types being episodic within the region, very few areas were encountered that displayed more than one freshwater ecosystem characteristic as defined by the DWAF (2008) method (such as containing alluvial or inundated soils, or hosts riparian vegetation adapted to saturated conditions). As a result, identification of the outer boundary of the temporary freshwater HGM type zones proved difficult in some areas, in particular where riparian zones are intermittent. Therefore delineations were augmented with the use of digital satellite imagery. Nevertheless, the freshwater HGM type delineations as presented in this report are regarded as a best estimate of the freshwater HGM type boundaries based on the site conditions present at the time of assessment and the results obtained are, however, 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;
- Freshwater ecosystems 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 freshwater ecosystem 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 freshwater HGM types 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.

1.4 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in **Appendix B**:

- Constitution of the Republic of South Africa, 1996[3];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- 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);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA); and
- The National Environmental Management: Biodiversity Act, 2014 (Alien and Invasive Species Regulations, 2014).

2 PROJECT DESCRIPTION

2.1 Introduction

Enertrag South Africa (Pty) Ltd on behalf of Lesaka 1 Solar Energy Facility (Pty) Ltd appointed SiVEST to undertake the required BA/EIA processes for the proposed construction of the Lesaka 1 SEF. In support of the EIA process (this report), a freshwater assessment must be submitted detailing the impacts of SEF construction and operation on freshwater ecosystems, which in turn saw the appointment of FEN by SiVEST.

The overall objective of the development is to generate electricity by means of renewable energy technology capturing energy to feed into the National Grid at the Helios MTS approximately 13 km north east of the study area. The project aims to supply suitable private off-taker initiatives (direct supply or wheeling agreements, as applicable), or be bid into the government coordinated Renewable Energy Independent Power Producer Programme (REIPPPP) or similar procurement programme under the Integrated Resource Plan (IRP).

2.2 Location

The proposed SEF is located on portion 0 of Kluitjeskraal farm no. 264 ~ 34 km north of Loeriesfontein town within the Hantam Local Municipality, in the Namakwa District Municipality, Northern Cape Province (Figures 1 and 2). Two access roads provide passage to the study area. The R355 district road is approximately 10 km south west of Loeriesfontein town and moves in a general north west direction, permitting access to farm roads travelling north east *en route* to the study area. Alternatively, the Grannatboskolk district road which moves in a general north easterly direction provides a comparatively more direct/shorter route to the study area.

2.3 SEF components and technical details

The proposed SEF will be administered under the respective Project Companies, and the Projects will be required to be composed of the components listed below in Table 1.

The proposed SEF involves an array of solar modules which will generate, collect and reticulate direct current (DC) in underground low voltage (LV) cables. The solar modules will step up LV to Medium Voltage (MV) via inverter transformers and the MV cabling will link the various Photovoltaic (PV) arrays to the onsite Independent Power Producer (IPP) substation. The onsite IPP substation will in turn step up the voltage from MV to High Voltage (HV) via transformers and be connected to the onsite 132 kV Switching Stations that will convert DC to Alternating Current (AC). AC via a single or double Overhead Powerline (OHPL) will feed into the national grid infrastructure at the Helios MTS.

The Lesaka 1 SEF components are discussed in more detail below in Table 1.

Table 1: Lesaka SEF 1 components and associated technical details

COMPONENT	DESCRIPTION
Site Extent	4893.94 ha (Overall Kluitjeskraal farm area – Lesaka 1 SEF is located on this farm portion)
Buildable Area	Array of solar modules into four buildable areas, covering an area of ~ 582 ha.
Installed Capacity	Up to 240 MW
Key Technological Specifications	➢ Solar Module Technology – Monocrystalline or Polycrystalline cell type. Monofacial and/or Bifacial Photovoltaic (PV) Modules. ➢ Mounting System Technology – Single-axis tracking, Dual-axis tracking or Fixed-axis tracking ➢ Overhead or underground LV and MV cabling ➢ Centralised inverter stations or string inverters ➢ Power Transformers
Solar Photo Voltaic (PV) arrays	➢ The proposed SEF will include PV fields (arrays) comprising of multiple PV modules. The PV modules are arranged in rows and columns, some of which may require levelling of the terrain and associated slope stabilisation measures. ➢ Each PV module will be approximately 2.5 m long and 1.2 m wide and mounted on supporting structures above ground. The final design details along with the structure orientation will become available during the detailed design phase of the SEF development prior to the start of construction. ➢ The foundations will most likely be either concrete or rammed piles. The final foundation design will be determined at the detailed design phase of the SEF development.
Operations and Maintenance (O&M)	Located near the onsite IPP substation and/or BESS
O&M building footprint	Septic/Conservancy tanks with portable toilets Typical provision areas include: ➢ Operations building – 20 m x 10 m = 200 m^2 ➢ Workshop building – 15 m x 10 m = 150 m^2 ➢ Stores – 15 m x 10 m = 150 m^2
Temporary laydown area and construction camp	Typical area = 300 m x 215 m = 64 500 m^2 Sewage: Septic/Conservancy tanks and portable toilets

COMPONENT	DESCRIPTION
Internal Access Roads	Access road/s to the site and internal roads between project components of up to 5 m and 6 m, this can increase to 8 m on bends. The roads to be placed with a corridor of up to 20 m width to accommodate cable trenches, stormwater channels (as required), and turning circle/bypass areas of up to 20 m in some sections. Existing roads will be upgraded wherever needed, and new roads will be constructed where necessary.
Associated Infrastructure	➢ Fencing and lighting ➢ Lightning Protection System (LPS) ➢ Telecommunication infrastructure ➢ Batching plant (if required) ➢ Security infrastructure ➢ Access and internal roads (detailed below) ➢ Stormwater infrastructure (as needed) ➢ Water pipelines (as needed)
Cables	The electrical reticulation will comprise of Low Voltage ("LV") and Medium Voltage ("MV") underground installed cables of up to 33 kV. However, where required, as per the technical assessments, OHPLs may be aboveground. The arrays will be connected by underground cabling.
Battery Energy Storage System (BESS)	The associated BESS storage capacity will be up to 120 MW / 480 MW with up to four hours of storage. It is proposed that Lithium Battery Technologies or Vanadium Redox flow technologies will be considered as the preferred battery technology. The main components of the BESS include the batteries, power conversion system, and transformer which will all be stored in various rows of containers. The approximate footprint for the BESS is up to 4 ha. Although a BESS does not require environmental authorisation in terms of the NEMA the facility is included in the description to assess the impact of the footprint on the environment in terms of vegetation removal.
Onsite IPP substation and Associated Grid Infrastructure (Switching Station and Overhead powerline)	➢ 33/132 kV onsite IPP substation utilised for collection and connection of the internal LV and MV reticulation of the SEF facility. The substation will remain the remit of the developer and forms part of the Facility EA ➢ The 132 kV Switching Station may be adjacent to the onsite IPP substation. The Switching Station will be handed over to Eskom and forms part of a separate EA ➢ The onsite IPP Substation and Switching Station combined footprint will be approximated 1 ha ➢ Standard substation infrastructure includes; office area, operation and control room, workshop, and storage area, oil dam, including standard substation electrical equipment (feeder bays, transformers, busbars, stringer strain beams, insulators, isolators, conductors, circuit breakers, lightning arrestors, relays, capacitor banks, batteries, wave/line trappers, switchyard, metering and indication instruments, equipment for carrier current, surge protection and outgoing feeders, as may be needed) ➢ The on-site and collector substation will contain transformer(s) for voltage step-up from medium voltage to high voltage. DC power from the modules will be converted into AC power in the inverters and the voltage will be stepped up to medium voltage in the inverter transformers. Medium voltage cabling will link the various PV arrays to an on-site substation. These cables will be laid underground wherever technically feasible ➢ A 132 kV OHPL is proposed to feed the electricity generated by the proposed SEF into the national grid. The associated electrical infrastructure will, however, require a separate EA and is subject to a separate BA process to be undertaken in future. ➢ MV cabling will link the proposed SEF to the grid connection infrastructure (on-site substation). Cables would be buried along access roads, where feasible, with overhead 33 kV lines grouping PV panels to crossing valleys and ridges outside of the road footprints to connect to the substation.

The buildable areas comprising the solar PV arrays, BESS and IPP substation, other support buildings and temporary laydown area and construction camp will be applied for in the EIA phase for SEF 1. A request by the DFFE during the PPP of the draft EIA was made to include the grid components, (MTS, OHPL, LILO and collectors). These grid components are discussed and illustrated in the Section 7.3.2. The components inclusive of the SEF 1 EIA phase were informed by the identified environmentally sensitive and 'No-go' areas (See Figures 19-22). All alternatives were assessed against the 'no-go' alternative (i.e. status quo). The various alternatives are described below and were considered as part of this freshwater ecological assessment.

2.4 EIA Alternatives

2.4.1 Layout Alternatives

No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development point of view.

2.4.2 Technology Alternatives

No other activity alternatives are being considered. Renewable Energy development in South Africa is highly desirable from a social, environmental and development point of view.

2.4.3 SEF Layout Alternatives

Design and layout alternatives will be considered and assessed as part of the EIA. These include alternatives for the Substation locations and also for the construction / laydown area.

2.5 BA Alternatives

Two proposed Grid Connection configuration alternatives are being considered, one for each SEF,(SEF 1 and 2) and each configuration alternative will have two layout options. These alternatives will be considered and assessed as part of a separate BA process (to be commenced) and will be amended or refined to avoid identified environmental sensitivities.

2.6 NO-GO Alternative

The ‘no-go’ alternative is the option of not undertaking the proposed SEF and / or grid connection infrastructure projects. Hence, if the ‘no-go’ option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or the surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

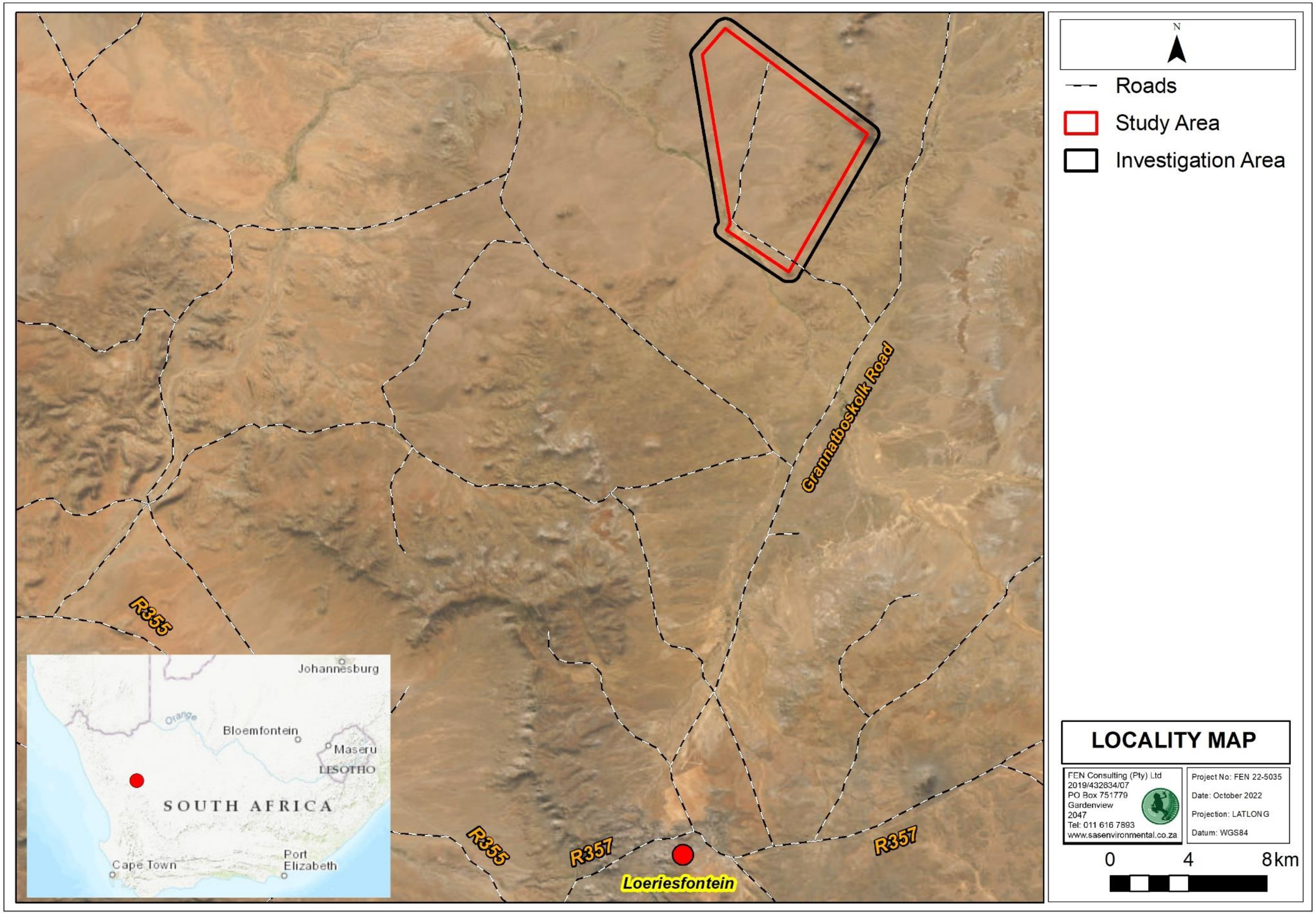

Figure 1: Digital satellite image depicting the study area and the investigation area in relation to its surroundings.

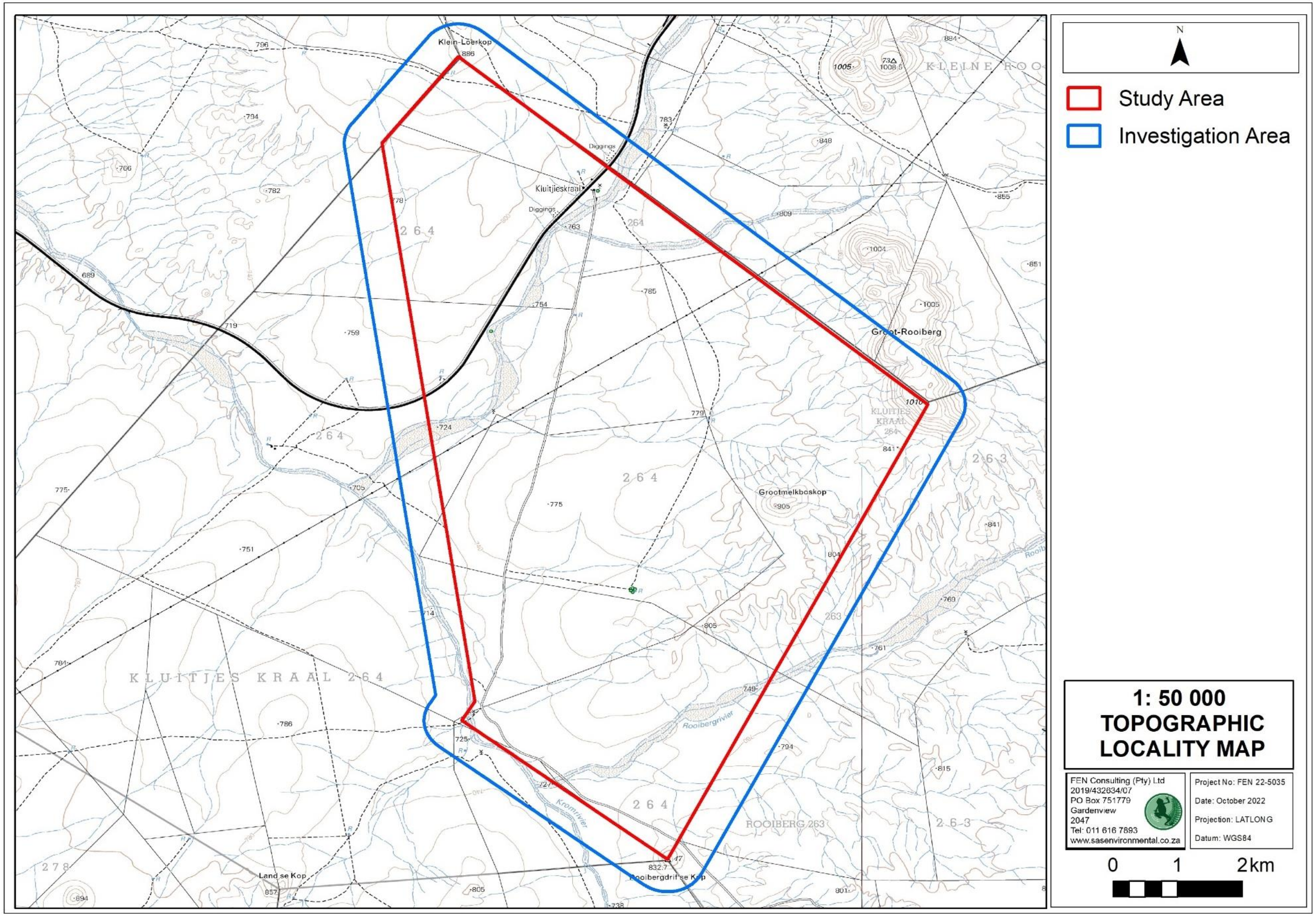

Figure 2: Location of the study area and the investigation area depicted on a 1:50 000 topographical map in relation to surrounding areas.

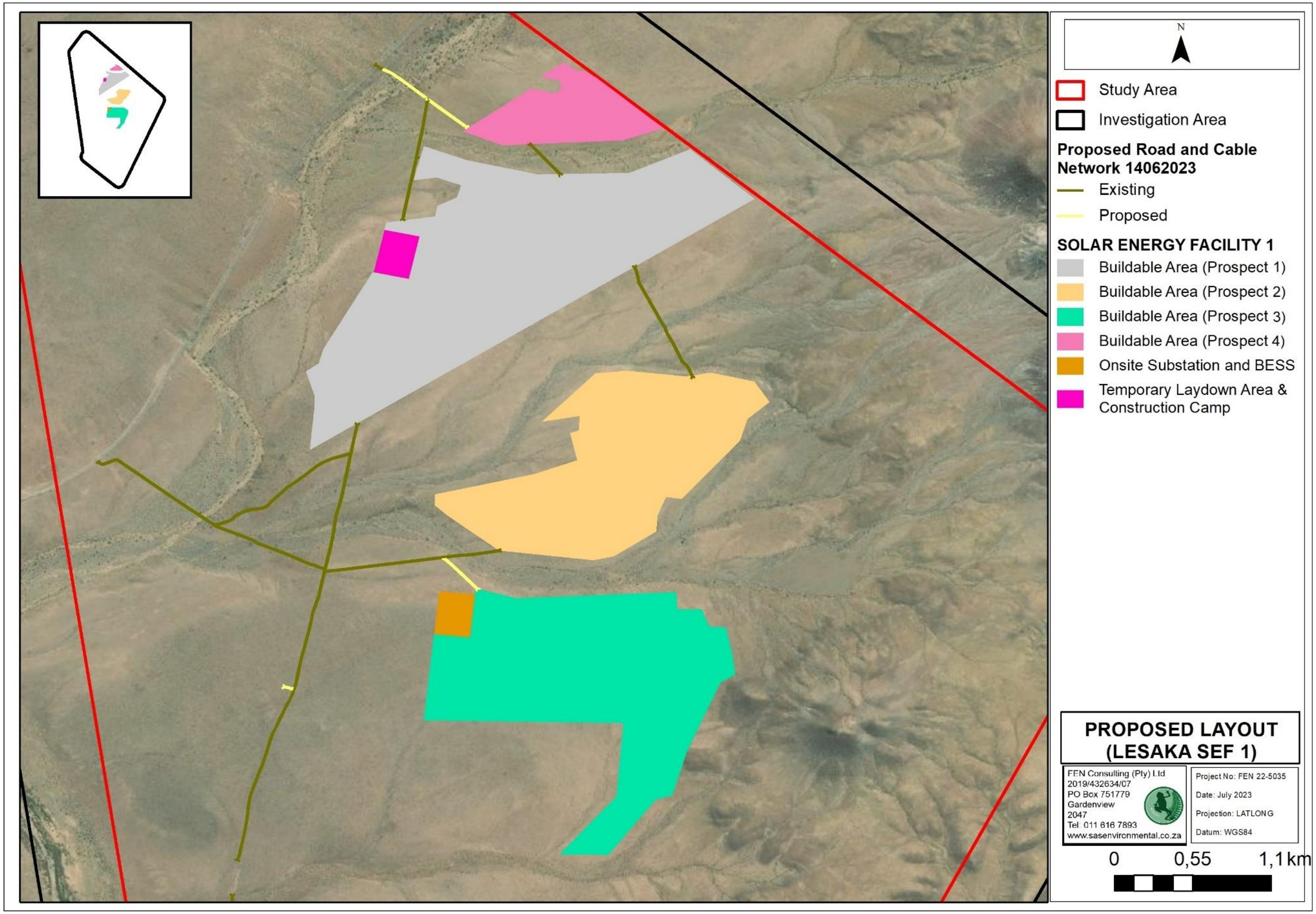

Figure 3: Final SEF 1 layout as provided by SiVEST.

3 ASSESSMENT APPROACH

3.1 Freshwater ecosystem 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.

It should be noted that in this report “freshwater ecosystem” is used and carries the same meaning as “watercourse” as defined by the NWA.

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 freshwater ecosystem which are commonly characterised by alluvial soils, 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 4^{th} to the 6^{th} October 2022 (Northern Cape dry season [4]), during which the presence of any freshwater ecosystem characteristics as defined by DWAF (2008) or a wetland and riparian habitats as defined by the National Water Act, 1998 (Act No. 36 of 1998) were noted (please refer to Section 4 and 5 of this report). The freshwater ecosystem delineations 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 freshwater ecosystems have several distinguishing factors including the following:

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

In addition to the delineation process, detailed assessment of the delineated freshwater HGM types was undertaken, at which time factors affecting the integrity of the freshwater HGM type were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater ecosystem. A detailed explanation of the methods of assessment undertaken is provided in **Appendix C** of this report.

[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 raining period to ensure optimised conditions for the identification of seasonal watercourses, which may otherwise be overlooked. The field assessments were thus undertaken during the ideal time, however, inundation due to extreme rainfall did hinder the field delineations.

3.2 Sensitivity Mapping

Freshwater HGM types falling within the investigation area were groundtruthed by navigating to predetermined points of interest based on digital satellite imagery using a GPS device. The DWAF 2008 method was used to distinguish between aquatic (i.e. freshwater ecosystem) and terrestrial areas at each point of interest and waypoints were taken at the boundaries of the groundtruthed freshwater HGM types of varying width to enable calibration of freshwater HGM type delineations, which was desk-based. The determination of freshwater HGM type footprints, their zones of regulation and determined development setback buffers (as per Macfarlane et al. 2014) were used collectively to produce a sensitivity map that is presented in Section 6 and was used to guide the design, layout and management of the proposed SEF.

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 investigation area 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 relating to the characteristics of the study area and its associated investigation area.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	Nama Karoo
Catchment	Olifants - Cape
Quaternary Catchment	E31C
WMA	Olifants/Doorn
subWMA	Knersvlakte
Dominant characteristics of the Great Karoo Ecoregion Level II (26.02) (Kleynhans et al., 2007)	
Dominant primary terrain morphology	Plains, Slightly Irregular Plains (Scattered low hills) and Pans, Extremely Irregular Plains (Almost hilly), Hills, Slightly Irregular Plains, Plains.
Dominant primary vegetation types	Orange Rive Nama Karoo, Bushmanland Nama Karoo, Upper Nama Karoo.
Altitude (m a.m.s.l)	500 – 1300
MAP (mm)	0 – 1300
The coefficient of Variation (% of MAP)	30 – >40
Rainfall concentration index	45 – 65
Rainfall seasonality	Very late summer, Winter
Mean annual temp. (°C)	5 – 20
Winter temperature (July)	-2 – 20
Summer temperature (Feb)	14 – 32
Median annual simulated runoff (mm)	<5 - 10
National Web Based Environmental Screening Tool (2020): Aquatic Biodiversity sensitivity (Figure 4)	
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.	According to the tool, more than 60% of the investigation area is designated as having a very high aquatic biodiversity sensitivity which relates to the FEPA status designations (Figure 5) and is further explained by the presence of rivers and wetlands (Krom, Klein Rooiberg and Rooiberg Rivers) (Figure 7)

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE (Figure 5)	The study area is mostly located(> 60%) in a sub-quaternary catchment classified as a Freshwater Ecosystem Priority Area (FEPATXT = "FEPA) and (FEPA CODE = "1"). The remainder of the study area is designated as an area on no freshwater ecosystem priority (FEPA CODE = "0") importance. River FEPAs achieve biodiversity targets for river ecosystems and threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.
NFEPA Wetlands	No wetlands were identified by the 2011 NFEPA database within the investigation area.
Wetland Vegetation Type	The study area falls within the Trans-Escaprment Succulent Karoo (Skt) Wetland Vegetation type which is considered to be least threatened as per Mbona et al. (2015).
NFEPA Rivers (Figure 6)	According to the NFEPA database (2011), the Klein Rooiberg, Rooiberg and Krom Rivers drain through the study area. The Klein Rooiberg River and the Rooiberg River drain in a south westerly direction and confluence with the Krom River, are considered to be in a Largely Natural ecological condition (PES Class = B) and Largely Natural to Natural Ecological condition (PES Class = A/B) according to the PES 1999 and NFEPA 2011 databases respectively. The Krom River drains in a north westerly direction and is considered to be in a Largely Natural ecological condition (PES Class = B) according to the PES 1999 and NFEPA 2011 databases.
Importance of the study area according to the Northern Cape Critical Biodiversity Areas (2016) (Figure 8)	
According to the Northern Cape Critical Biodiversity Areas (2016) the Klein Rooiberg and Rooiberg Rivers are designated as a Critical Biodiversity Area (CBA)1 while sections of the Krom River are designated as Ecological Support Areas (ESAs). The remaining majority of the study area is designated as CBA2, with the far easter and north western portions being designated as Other Natural Areas (ONAs). The Northern Cape CBA Map identifies biodiversity CBAs and ESAs which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole. The following aquatic criteria were used in the categorisation of the Northern Cape Critical Biodiversity Areas. CBA1s are National Freshwater Ecosystem Priority Area (NFEPA) 1:500 000 recognised rivers and wetlands, which are priority Phase 1 Freshwater Ecosystem Priority Areas (FEPA) with a 70% conservation target; and rivers with intact vegetation. CBA2s are prioritised FEPA wetland clusters and FEPA catchments. ESAs are NFEPA 1:500 000 recognised rivers not deemed as priority FEPA rivers but are larger rivers providing structure, ecosystem function and landscape linkage backbone for this region with a 60% conservation target; and other natural non-FEPA wetlands and ONAs refer to the significance of the Hantam Karoo and Western Bushmanland Klipveld vegetation types and large high value climate resilience areas.	
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 9)	
According to the National Biodiversity Assessment river spatial layer, the Klein Rooiberg, Rooiberg and Krom Rivers drain through the study area. These rivers are considered to be in a largely natural (PES Class – B) ecological condition. According to the Ecosystem Threat Status (ETS 2018) the Klein Rooiberg and Rooiberg Rivers are considered to be least threatened and the Krom River is considered to be endangered. According to the Ecosystem Protection Level (EPL 2018), these rivers are considered as not protected. These rivers are also displayed in the National Biodiversity Assessment wetland spatial layer.	

EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; EN = Endangered; 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; PES = Present Ecological State; WMA = Water Management Area.

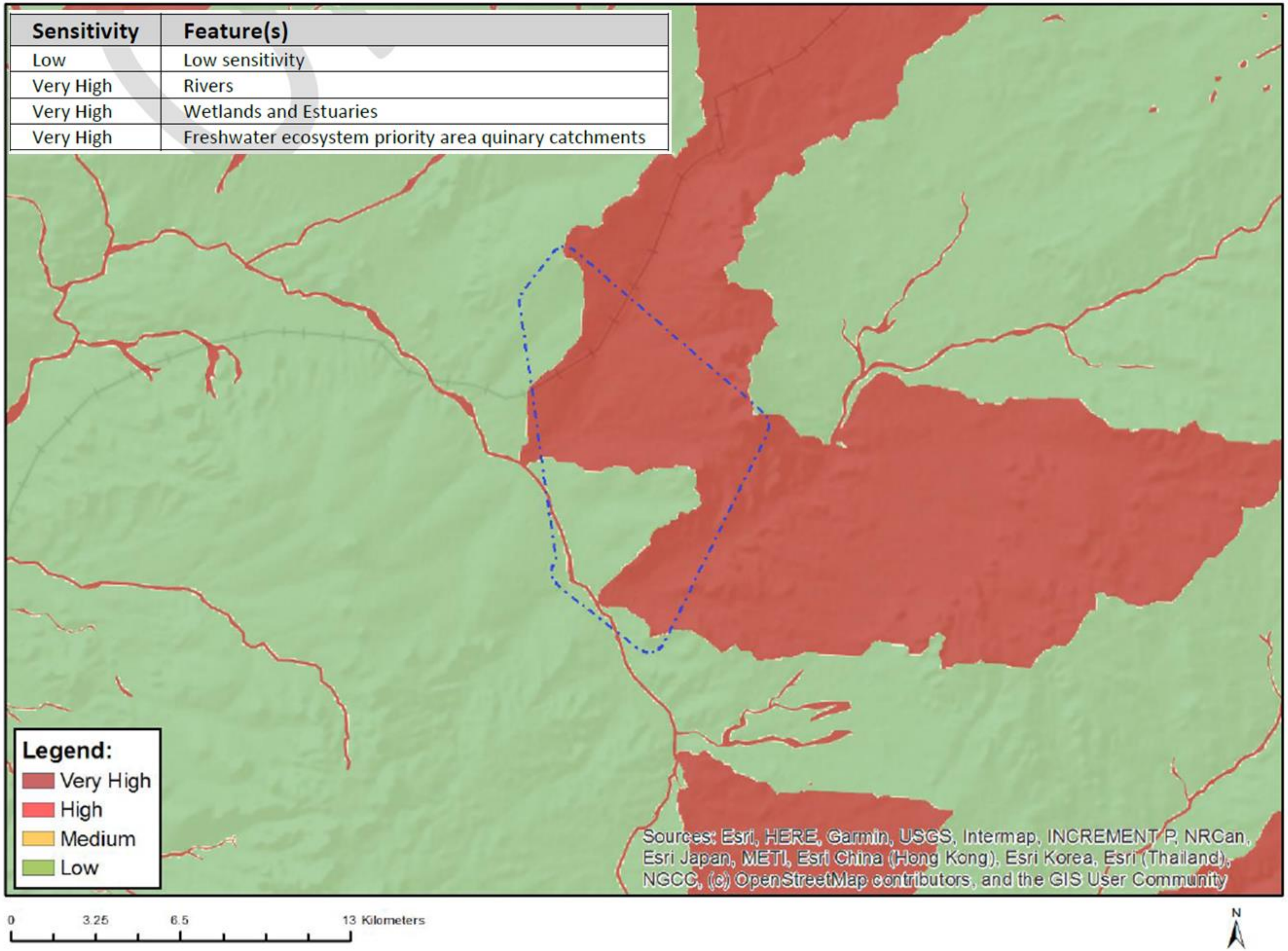

Figure 4: Aquatic biodiversity sensitivity designation as per the DFFE National Web-Based Environmental Screening Tool (2020).

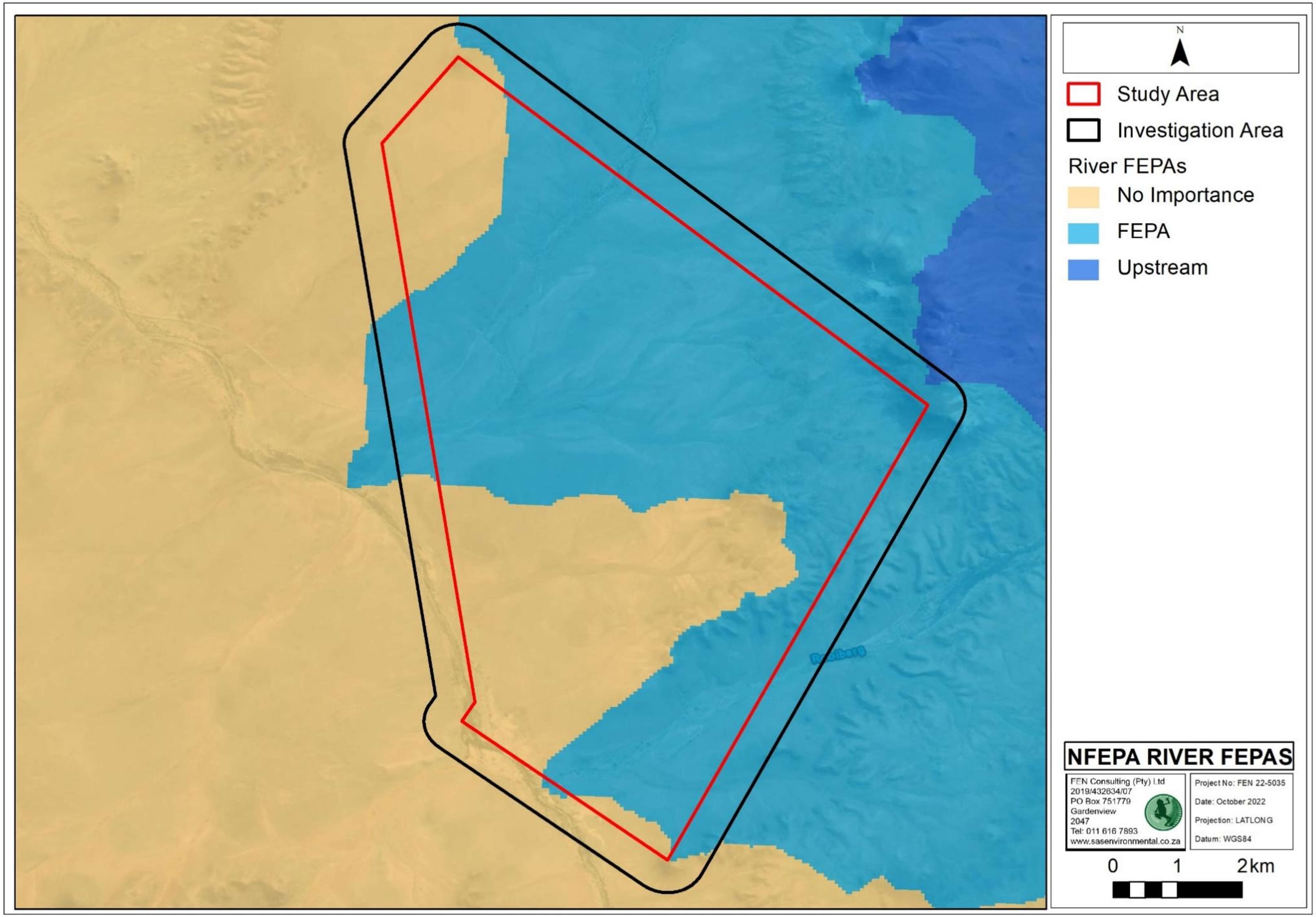

Figure 5: NFEPA River FEPA quinary catchment designations according to the 2011 NFEPA database.

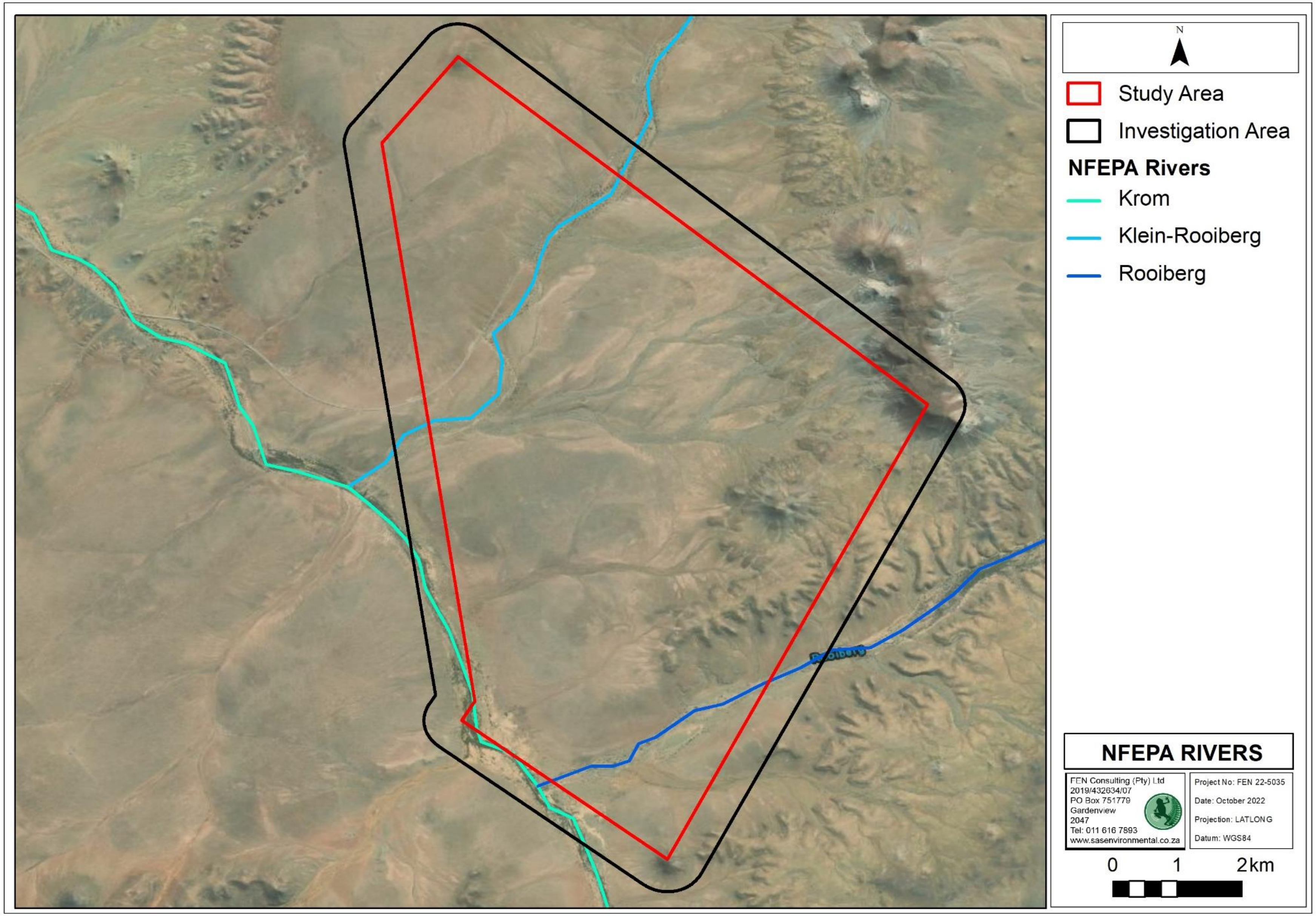

Figure 6: Rivers associated with the study and investigation area, according to the NFEPA database (2011). No wetlands were identified by the database within the investigation area.

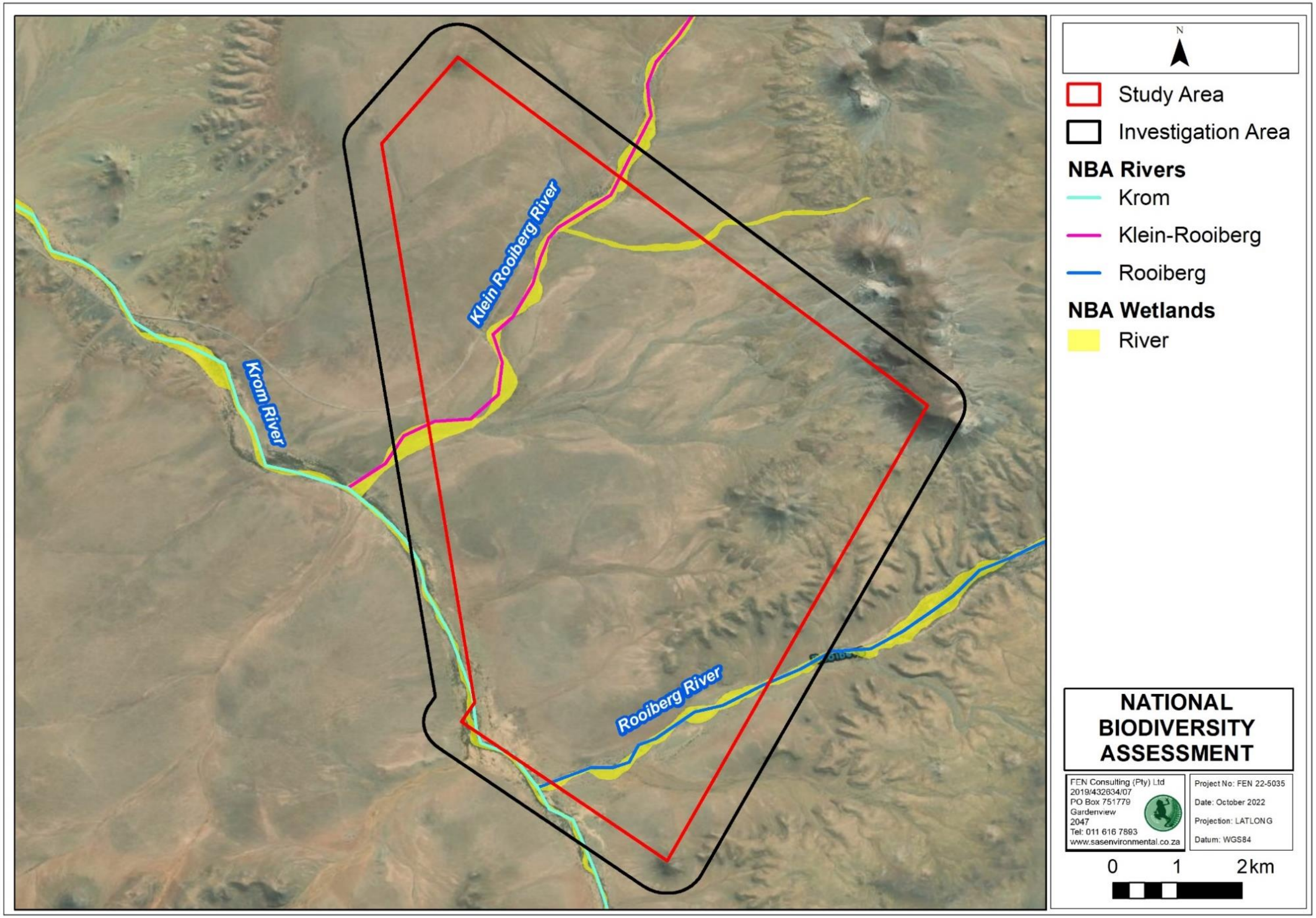

Figure 7: Rivers associated with the study and investigation area, according to the National Biodiversity Assessment (2018). No wetlands were identified by the database within the investigation area.

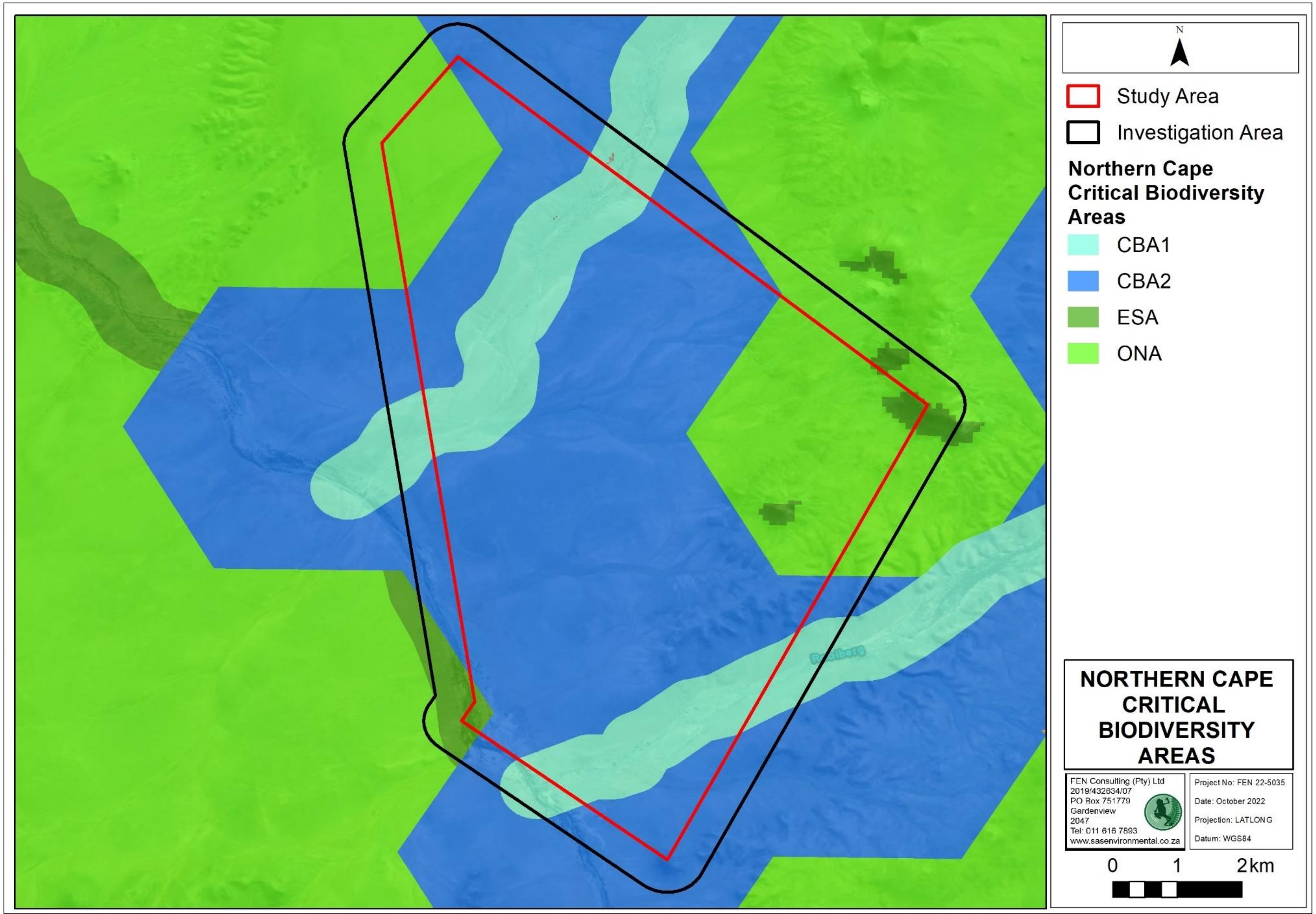

Figure 8: The areas of biodiversity importance associated with the study area, according to the Northern Cape Critical Biodiversity Areas (2016)

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 and available to consultants since mid-2014, 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 SQR E31C - 05281 (Klein Rooiberg River), SQR E31C – 05490 (Rooiberg River) and SQR E31C – 05506 (Krom 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 9 below.

Table 3: Invertebrates previously collected from or expected at the SQR monitoring point associated with the Klein Rooiberg, Rooiberg and Krom Rivers.

Aeshnidae	Culicidae	Libellulidae
Caenidae	Dysticidae	Notonectidae
Ceratopogonidae	Hydracarina	Oligochaeta
Chironomidae	Hydraenidae	Physidae
Corduliidae	Lestidae	Simulidae

Table 4: Summary of the ecological status of the sub-quaternary catchment reach associated with the Klein Rooiberg, Rooiberg and Krom Rivers based on the DWS RQS PES/EIS database.

	E31C-05281 (Klein Rooiberg River)	E31C-05490 (Rooiberg River)	E31C-05506 (Krom River)
Synopsis			
PES Category Median	B (Largely natural)	B (Largely natural)	B (Largely natural)
Mean EI class	Moderate	Moderate	Moderate
Mean ES class	High	Moderate	Moderate
Length	28.54 km	9.92 km	5.48 km
Stream order	1	2	3
Default EC[4]	B (Largely natural)	C (Moderately Modified)	C (Moderately Modified)
PES Details			
Instream habitat continuity MOD	None	None	None
RIP/wetland zone continuity MOD	Small	Small	Small
Potential instream habitat MOD activities	Small	Small	Small
Riparian/wetland zone MOD	Small	Small	Small
Potential flow MOD activities	Small	Small	Small
Potential physico-chemical MOD activities	Small	Small	Small
EI Details			
Fish spp/SQ	-	-	-
Fish average confidence	-	-	-
Fish representivity per secondary class	-	-	-
Fish rarity per secondary class	-	-	-
Invertebrate taxa/SQ	15	15	15
Invertebrate average confidence	2.73	2.73	2.73
Invertebrate representivity per secondary class	Low	Low	Low
Invertebrate rarity per secondary class	Low	Low	Low

EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low	Very Low	Very Low
	E31C-05281 (Klein Rooiberg River)	**E31C-05490 (Rooiberg River)**	**E31C-05506 (Krom River)**
Habitat diversity class	Low	Low	Very Low
Habitat size (length) class	Low	Very Low	Very Low
Instream migration link class	Very High	Very High	Very High
Riparian-wetland zone migration link	Very High	Very High	Very High
Riparian-wetland zone habitat integrity class	Very High	Very High	Very High
Instream habitat integrity class	Very High	Very High	Very High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High	Very High
Riparian-wetland natural vegetation rating based on expert rating	High	High	High
ES Details			
Fish physical-chemical sensitivity description	-	-	-
Fish no-flow sensitivity	-	-	-
Invertebrates physical-chemical sensitivity description	Moderate	Moderate	Moderate
Invertebrates velocity sensitivity	High	High	High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	High	Very Low	Very Low
Stream size sensitivity to modified flow/water level changes description	Very High	Very High	Very High
Riparian-wetland vegetation intolerance to water level changes description	Marginal and non-marginal species require seasonal flows		

[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.

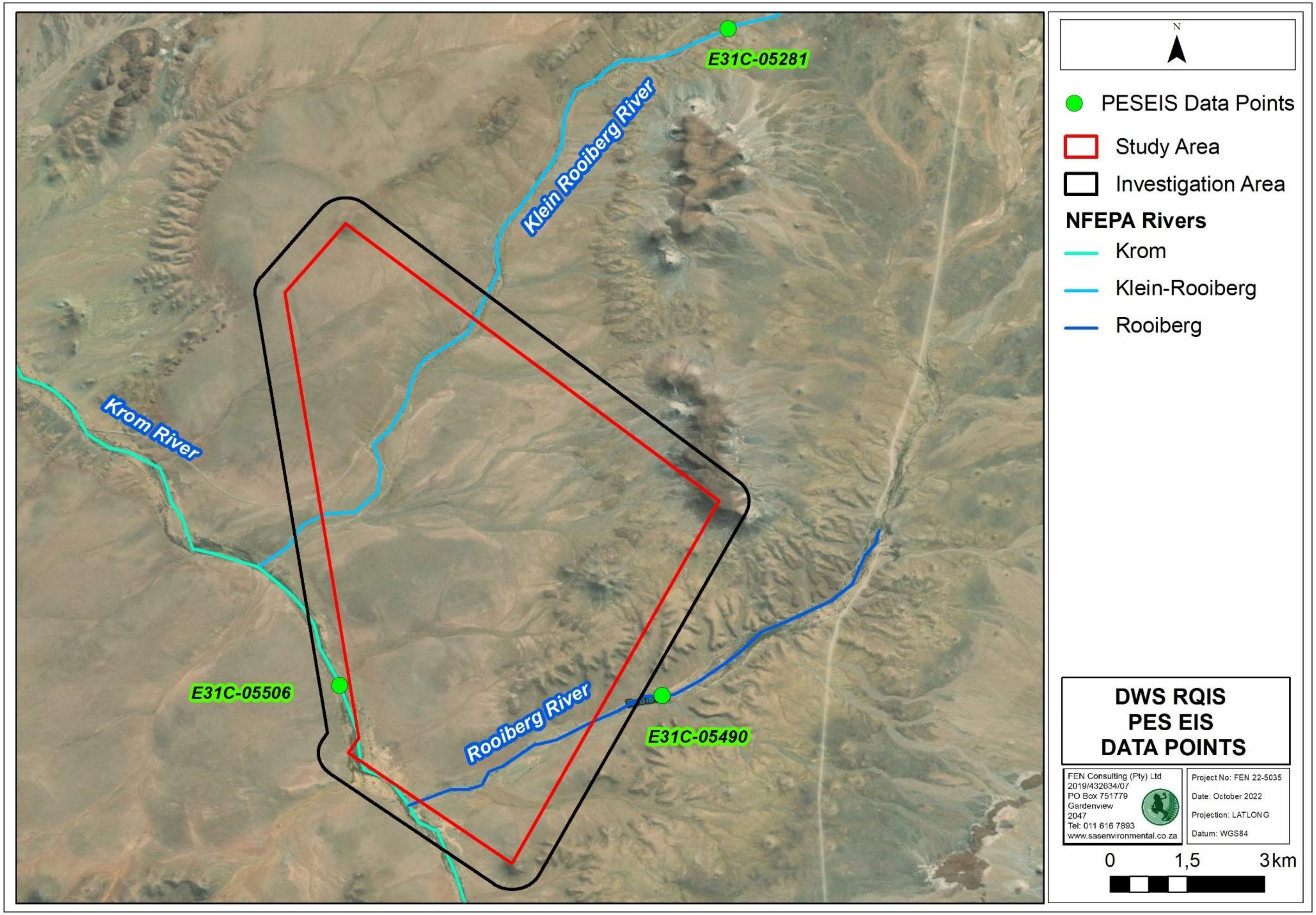

Figure 9: DWS RQIS PES/EIS sub-quaternary catchment reach (SQR) indicated relative to the study area.

5 RESULTS: FRESHWATER HGM TYPE ASSESSMENT

5.1 Field verification and delineation

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

- Linear features: since water flows/moves through the landscape, freshwater ecosystems often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with freshwater ecosystems: 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 soils displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with freshwater ecosystem 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.

Points of interest were freshwater ecosystem verified between the 4th and the 6th of October 2022 and delineated using a mixture of physical (DWAF (2008)) and desktop (digital satellite imagery), due to the large number of points of interest which made it non feasible to physically delineate every freshwater HGM type. The DWAF (2008) delineation guidelines require the following freshwater features to be considered:

Riparian drainage lines

- Terrain units in terms of topography and elevation are used to determine in which parts of the landscape a freshwater ecosystem is most likely to occur;
- Flowing surface water can be used to determine the permanent zone in perennial systems while saturated soil/alluvial soil is used to define the edge of the freshwater ecosystem permanent zone;
- Vegetation associated with riparian areas or saturated soil conditions is used to define the temporary zone;

Wetlands

- Terrain units in terms of topography and elevation are used to determine in which parts of the landscape a freshwater ecosystem is most likely to occur;
- Obligate and facultative vegetation species could be used in conjunction with terrain units as well as the point where a distinct change in the vegetation composition is observed, to determine the boundary of a freshwater ecosystem;
- Soil form indicators are used to determine the presence of soil that is associated with prolonged and frequent saturation and a fluctuating water table within 50 cm of the land surface; and
- Soil hydrogeomorphic features such as mottling, gleying and streaking can be used to identify soils which regularly experience fluctuations in the water table, are well drained or remain waterlogged for extended periods of time.

It should be noted that for an area to be identified as a freshwater ecosystem, at least two (2) of the above indicators per riparian drainage line or wetland should be present (*Pers Comm* Prof. F. Ellery).

The desktop and field-based delineations did not identify any wetlands but revealed that the study area accommodates a network of episodic[5] drainage lines which confluence into larger episodic tributaries that drain into the episodic rivers of the Klein Rooiberg, Rooiberg and Krom Rivers. The north westerly draining Krom River receives the south westerly flowing Klein Rooiberg and Rooiberg Rivers and is the largest freshwater HGM type within the study area (Figure 13). This network of episodic drainage lines will hence first be differentiated into the following freshwater HGM categories as per Table 5 below:

Table 5: Categorisation and descriptions of the freshwater features associated with the study area.

Freshwater HGM Type	Description
Preferential Flow Path (PFP)	Episodic systems in which surface water flow incises small channels or ''rills'' on the land surface in which the water supply is insufficient to support the establishment of a floral community, that relies on an increased abundance of water within the effective rooting zone. PFPs drain off of steep terrain units such as mountain slopes and form the headwaters of larger episodic systems.
Episodic Drainage Lines without Riparian Vegetation	Episodic systems in which surface water flow incises small channels that support some vegetation that relies on an increased abundance of water within the effective rooting zone, but not to the degree that a riparian vegetation margin can form. These systems typically drain moderately sloped terrain units such as mountain foot slopes and collect to form larger episodic drainage lines in the landscape.
Episodic Drainage Lines with Riparian vegetation	Episodic systems in which surface water flow incises channels with a noticeable but not necessarily consistent riparian vegetation margin. These systems drain terrain of moderate to limited gradient and collect to form episodic rivers and their main tributaries in the landscape.
Episodic Rivers with Riparian Vegetation	Episodic systems in which surface water flow incises a large channel with a dense and consistent riparian vegetation margin. These systems drain very gently sloping terrains in the valley bottom position and are the largest fluvial systems in the landscape.

Only the episodic drainage lines and rivers with riparian vegetation can, from an ecological perspective, be classified as freshwater ecosystems due to the expression of a riparian response and the presence of alluvial soil. Preferential flow paths (PFPs) are highly unlikely to have catchments which are large enough to generate a flood response and are not considered freshwater ecosystems from an ecological perspective. Episodic drainage lines without riparian vegetation may, on a system specific basis be considered freshwater ecosystems should they be subject to a 1:100 year floodline, as determined by a suitably qualified professional. Nevertheless, PFPs and drainage lines, not defined as freshwater ecosystems still function as waterways, through the episodic conveyance of water through the landscape. These systems are still considered important for the hydrological functioning of the larger episodic tributaries and rivers and must ideally be protected to manage the pattern, flow and timing of water in the landscape. Therefore, this implies that runoff from the project area must be carefully managed

These freshwater features are presented in Figures 13 - 15 below and are described in terms of the DWAF (2008) delineation guidelines for riparian freshwater ecosystems next. 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.

- **Topography/elevation** was used to determine in which parts of the landscape freshwater ecosystems are most likely to occur. Since freshwater ecosystems occur where there is a prolonged presence of water in the landscape, the most common place one could expect to find freshwater ecosystems is in the valley bottom position (DWAF, 2008). The study area is characterised by plains, slightly irregular plains (scattered low hills) and pans, extremely irregular plains (almost hilly) and hills. Larger freshwater ecosystems (episodic rivers and their main tributaries) were identified draining within low gradient valley floors between adjacent higher lying plains and hills. Smaller freshwater ecosystems (higher order tributaries such as episodic drainage lines) by contrast were identified draining through comparatively steeper

[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).

gradients as they flow off of mountains and sloping planal areas (upper and lower foothills) (Figure 10).

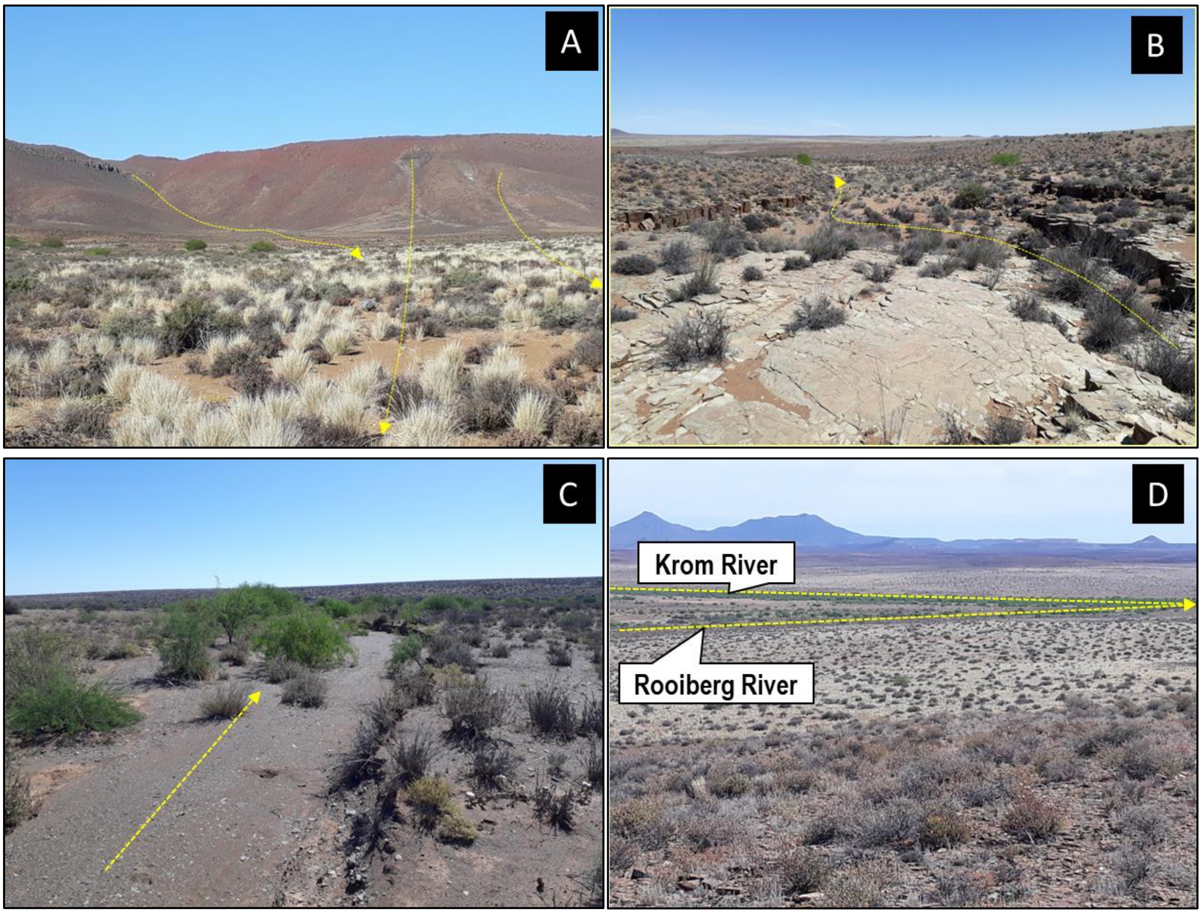

Figure 10: Terrain settings illustrating A) the first order head waters of episodic drainage lines (yellow arrows) forming off of mountains whereafter they drain through the B) upper and C) lower foothills en route to the D) valley floor where large fluvial systems such as the Klein Rooiberg, Rooiberg and Krom Rivers form.

- **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.

Larger episodic drainage lines such as rivers and their main contributing tributaries were inhabited by a dense riparian belt of *Prosopis* spp. which are considered to be Category 1b invaders according to the National Environmental Management Biodiversity Act (Act no 10 of 2004). The smaller episodic drainage lines with riparian vegetation consist of sporadic clusters of *Prosopis* spp, but primarily *Stipagrostis namaquensis*, which is an important grass that binds river sediments. Episodic drainage lines without riparian vegetation consisted of densified clusters of *Stipagrostis ciliata* (Tall Bushmans grass) and *Stipagrostis obtusa* (Short Bushmans grass) (Figure 11).

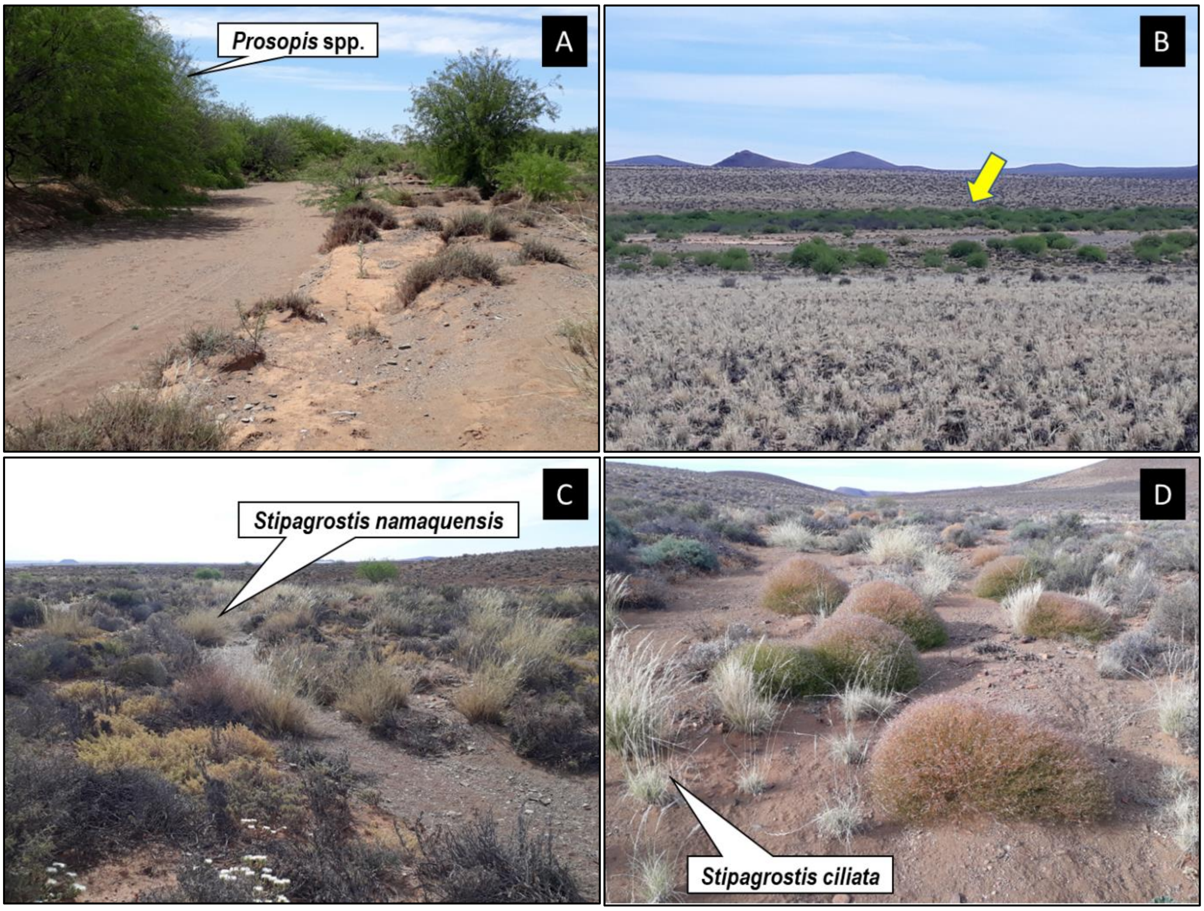

Figure 11: Vegetation associated with episodic drainage lines illustrating A-B) the riparian fringe of episodic rivers and their main tributaries that is densely inhabited by *Prosopis* spp., C) *Stipagrostis namaquensis* that is typically found in larger episodic drainage lines and D) *Stipagrostis ciliata* that densifies in smaller episodic drainage lines.

- ***The presence of alluvial soils:*** The presence of alluvial soils 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 freshwater ecosystem (such as that of the identified episodic drainage lines). Alluvial soils are soils derived from material deposited by flowing water, especially in the valley bottom position. Riparian areas often, but not always, have alluvial soils (Figure 12). While the presence of alluvial soils cannot always be used as a primary indicator to delineate riparian freshwater ecosystems accurately, it can be used to confirm 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 freshwater ecosystems are mainly driven by flow, originating from their local catchment which flows through the freshwater ecosystem and does not reside in the riparian freshwater ecosystem as with wetlands. This is especially true for episodic systems that experience flash flooding in response to rainfall events once over several years.

The substrates of the episodic drainage lines and the larger episodic rivers into which they collect are indicative of rapid laminar sheet flow through the landscape and consist of fine sands that have been transported from the upstream catchment, that have subsequently been deposited due to falling out of suspension (Figure 12).

Figure 12: Sandy sediments indicative of episodic laminar sheet flow.

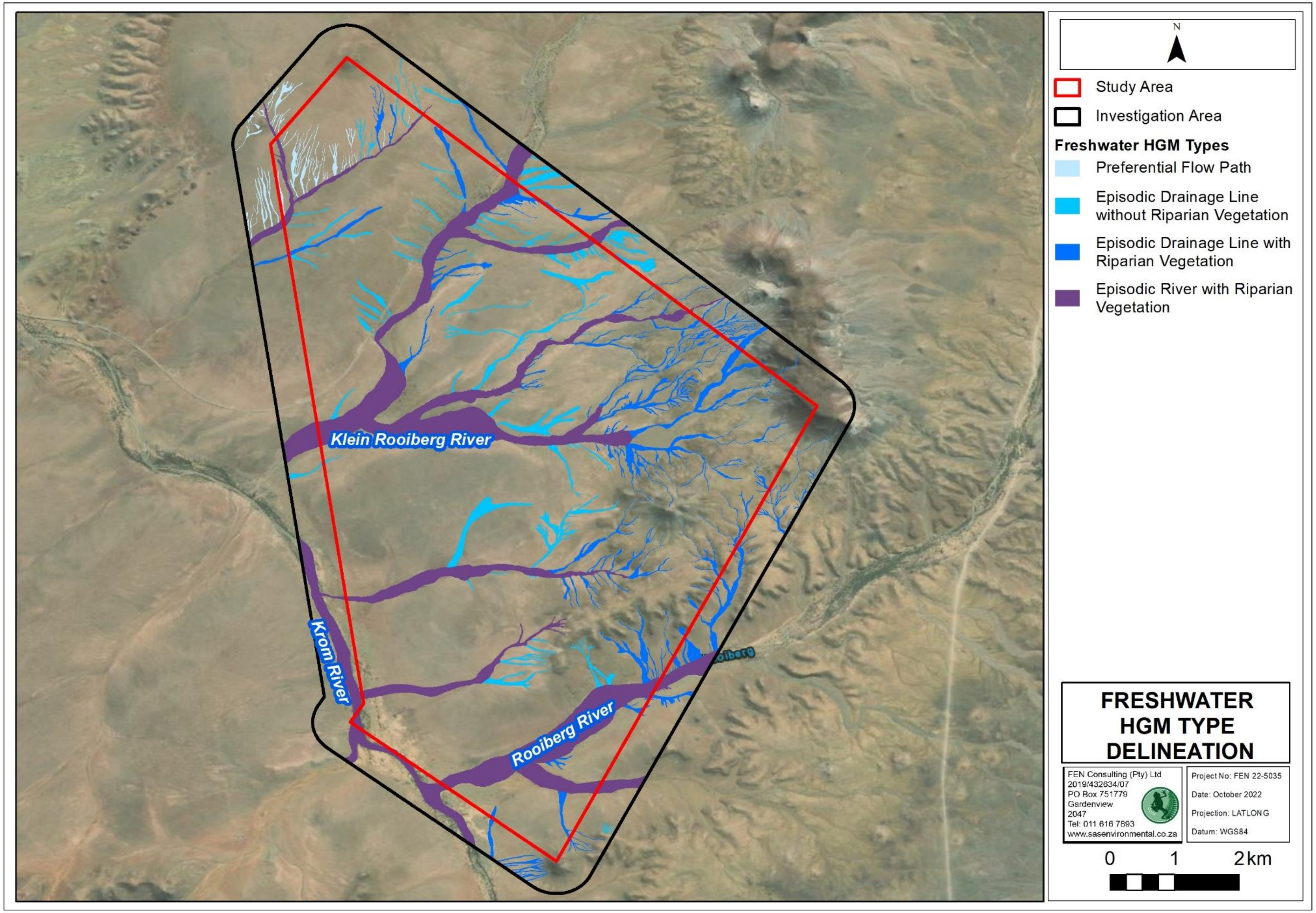

Figure 13: Overall delineated extent of the freshwater HGM types associated with the proposed SEF relative to the study and investigation area.

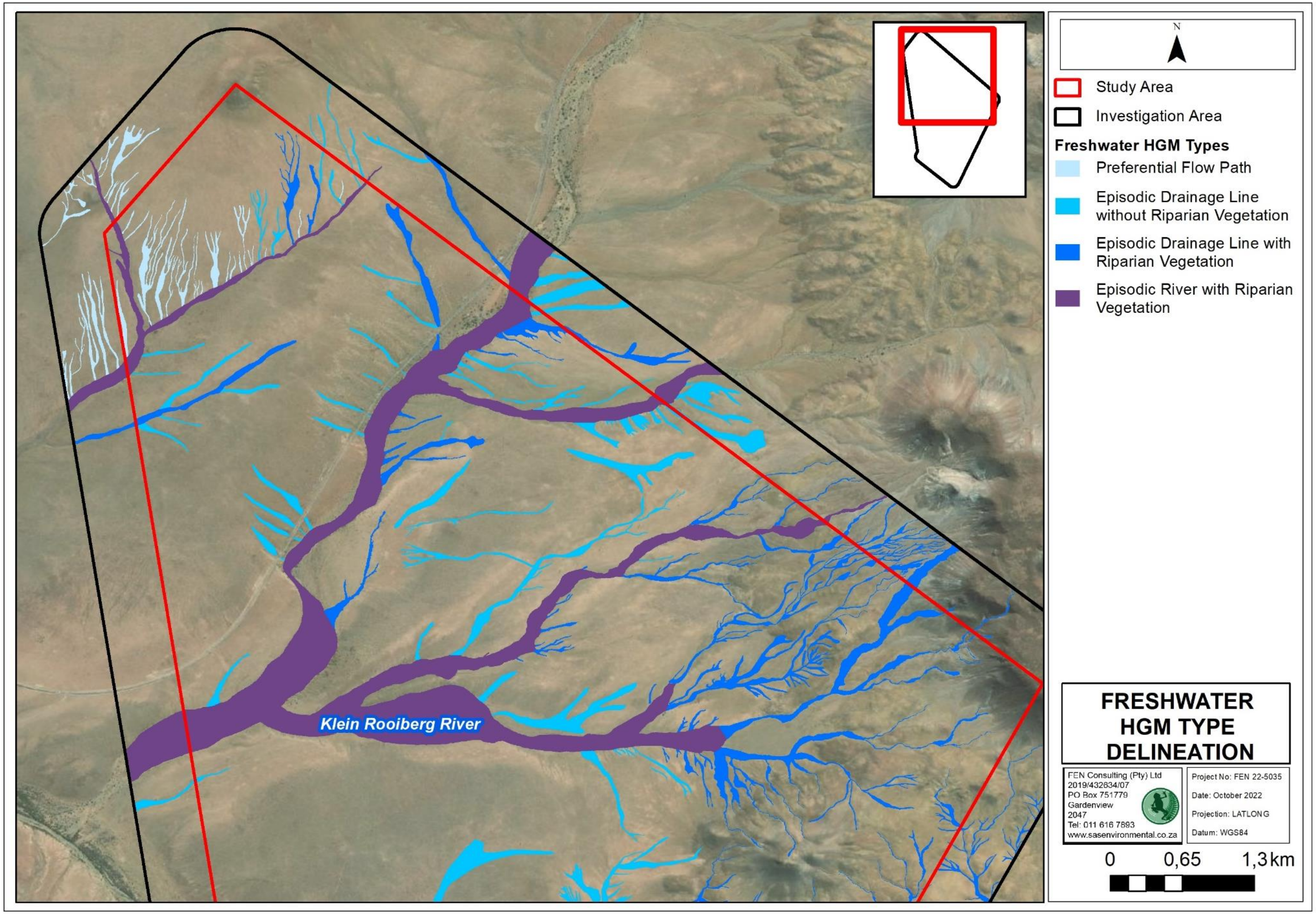

Figure 14: Northern delineated extent of the freshwater HGM types associated with the proposed SEF relative to the study and investigation area.

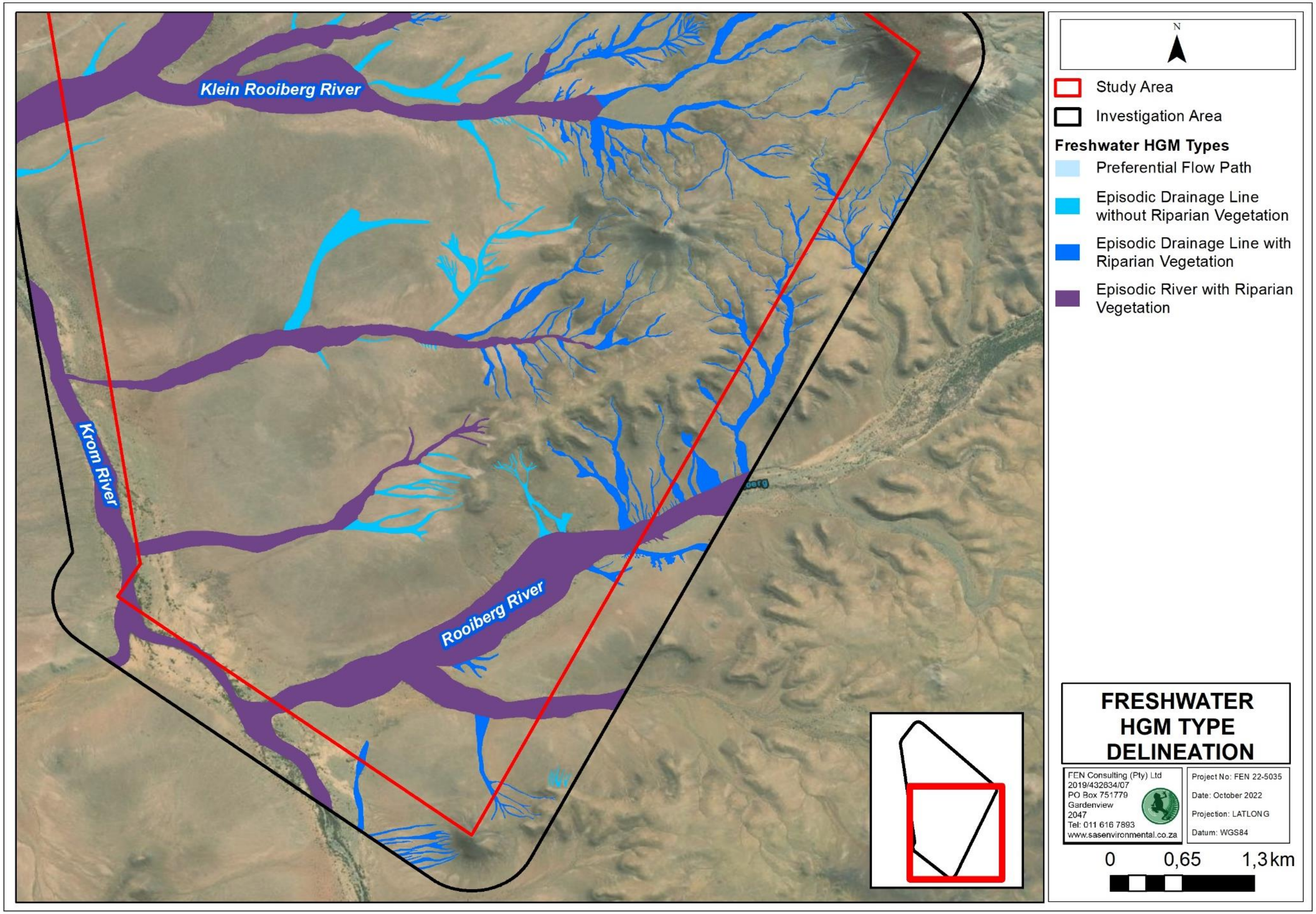

Figure 15: Southern delineated extent of the freshwater HGM types associated with the proposed SEF relative to the study and investigation area

5.2 Freshwater ecosystem classification and assessment

The freshwater HGM types listed in Table 5 above were classified according to the Classification System outlined in **Appendix C** of this report as Inland Systems, located within the Nama Karoo Ecoregion. Table 6 below presents the classification from level 3 to 4 of the Wetland and other Aquatic Ecosystem Classification System (Ollis et al*.* 2013).

Table 6: Classification of the freshwater HGM types associated with the proposed SEF.

Freshwater HGM Type	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Preferential flow paths, episodic drainage lines without and with riparian vegetation	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.	A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Episodic rivers and their main 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.	

Tables 7 -10 provide a summary of the field verification findings in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the freshwater HGM types. Each episodic drainage line category (as per Table 5) was assessed as a group considering that the nature and intensity of anthropogenic pressure was reasonably category specific. The details pertaining to the methodology used to assess these freshwater HGM types are contained in **Appendix C**.

Table 7: Ecological assessment summary of the episodic rivers with riparian vegetation associated with the study area.

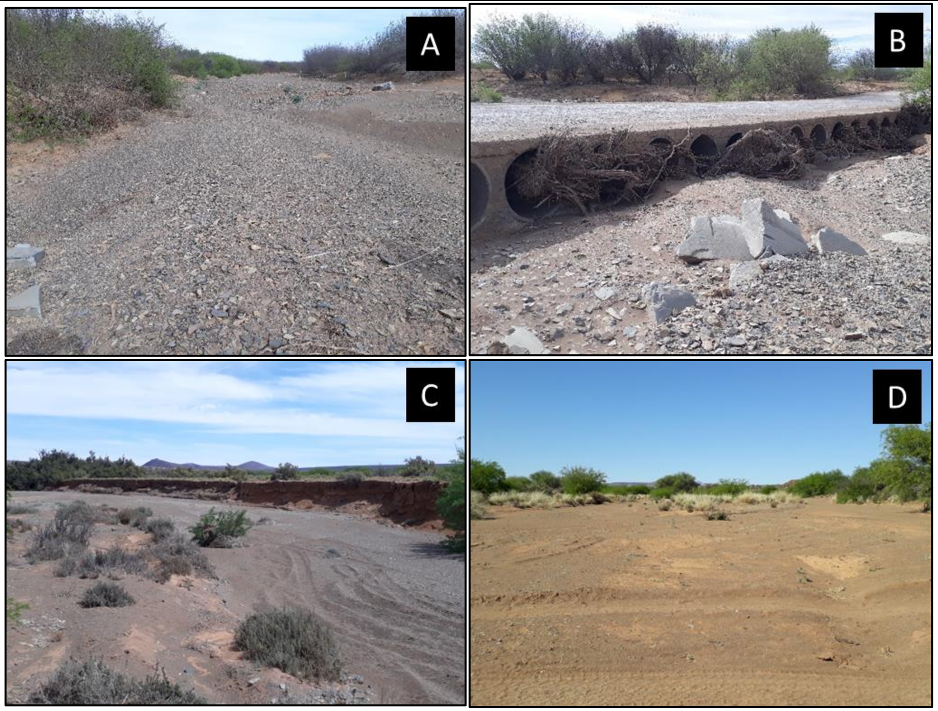

Figure 16: Episodic rivers with riparian vegetation illustrating A) deposited alluvium (shale shards), B) blocked culverts posing threats to future flows and infrastructure, C) bank erosion and D) riparian zones being infested with *Prosopis* spp.

Index of Habitat Integrity Summary

Instream IHI	Riparian Zone IHI
IHI: 70.4 % and Ecological Category (C) (Moderately Modified)	IHI: 34.2 % and Ecological Category (E) (Seriously Modified)

Aspect	Severity Rating
Hydrology	Moderate
Physico-chemistry	Small
Bed modification	Small
Bank modification	Serious
Connectivity	Moderate

Aspect	Severity Rating
Hydrology	Moderate
Bank Structure	Serious
Connectivity	Serious

Freshwater ecosystem Characteristics

Hydrological regime

The hydrological regime of the episodic rivers within the study area such as the Klein Rooiberg, Rooiberg and Krom Rivers and their main tributaries was determined to be in a near natural functional state. Minimal anthropogenic pressure on these rivers stems from flows being unpredictable, infrequent and extremely flashy.

Water provision infrastructure (e.g. weirs and impoundments) is therefore almost entirely absent with only a few sporadic off channel reservoirs noticed for historic sheep farming.

The additional water use by opportunistic *Prosopis* shrubs from shallow groundwater in the subterranean alluvium is considered to moderately decrease the hydrological budget of these rivers.

Geomorphology and sediment balance

These systems are characterised by shallow layers of loose alluvial soil over shale bedrock which are expected to transport naturally large quantities of sediment when in flow. The sediment balance is however expected to be minimally disturbed due to informal road crossings where some erosion has occurred and historic grazing practice which would destabilise soil and increase sediment loading into these systems.

Habitat and biota

The entire riparian belt of this rivers has been infested with *Prosopis* spp. which are level 1B invaders that have a high invasive potential and require compulsory control (remove and destroy) in an alien invasive species control programme. Due to the episodic nature of these systems, they do not retain water long enough to provide breeding and foraging habitat for aquatic macro-invertebrates or avifaunal species. However, they do provide migratory connectivity as well as sheltered nesting habitat for terrestrial avifaunal species.

Water Quality

No water quality measurements could be taken due to conducting the fieldwork outside of flow conditions. Nevertheless, due to the relatively remote locality of these systems and the low degree of catchment transformation, it can be concluded that surface water, when present, is likely to be of relatively natural quality, with limited impacts from pollutants.

Ecological Importance and Sensitivity Discussion

EIS Category: Moderate

The EIS was determined to be moderate for the biotic and moderate for the habitat assessment components respectively. The moderate biotic score stems from large areas of the study area being designated as FEPA and ESA areas with the Klein Rooiberg and Rooiberg episodic rivers being designated as CBA1 areas that must be protected against biodiversity loss. While no fish are associated with any of the rivers within the study area, the 2014 RWQO database indicates that aquatic invertebrate taxa are highly sensitivity to flow changes. The primary importance of these episodic rivers is to maintain freshwater flows through the landscape and provide a temporary aquatic ecological corridor.

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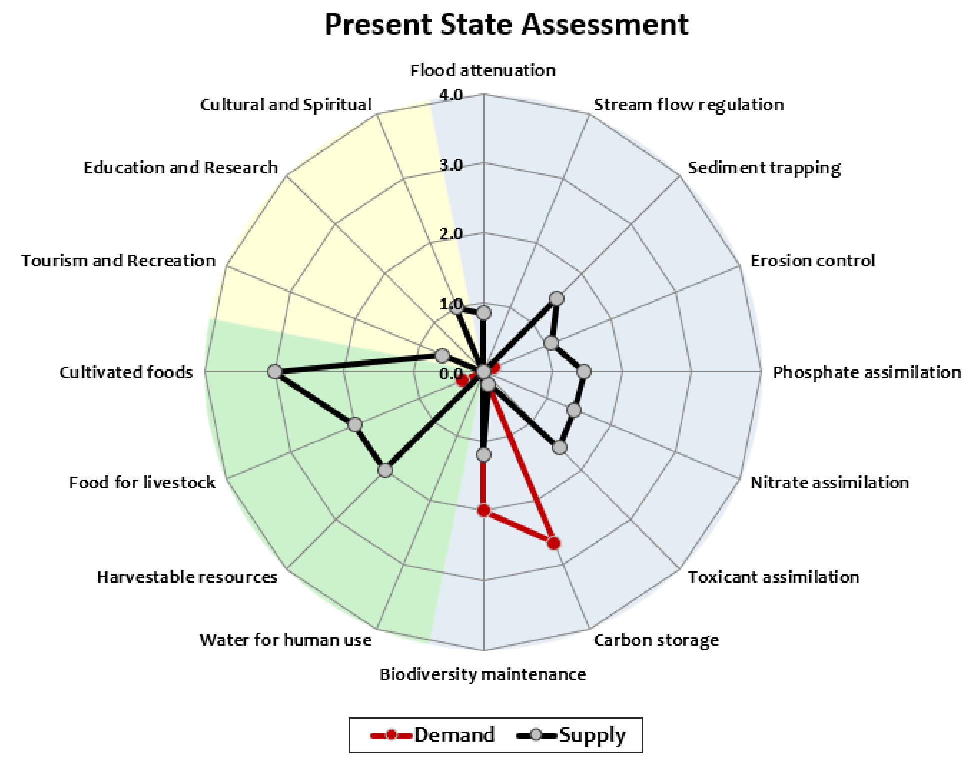

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WET - Ecoservices

Ecoservice Provisioning: (indicator dependent)

The WET-Ecoservices model determined an overall very low ecoservice importance of the Klein Rooiberg, Rooiberg and Krom Rivers when comparing the supply of ecoservices to their demands. This is due to these rivers only functioning as aquatic freshwater ecosystems for a number of hours or days every several years when aquatic ecoservices can be rendered.

Supplied ecoservices of moderate importance include 1) sediment trapping, 2) erosion control, 3) harvestable resources and 4) food for livestock and high importance for suitable conditions to cultivate foods. The proliferation of *Prosopis* spp in the riparian zones of these systems provides a rich supply of wood and the seed pods and veld vegetation are suitable for sheep farming. Sediment trapping and erosion control are of moderate importance due to the dense riparian belt in which sediments are managed. Biodiversity is also of moderate importance,

In terms of anthropogenic demand, biodiversity maintenance is moderately important and the provision of stored carbon is highly important. The very low importance in the demand for phosphate, nitrate and toxicant assimilation is due to very low traces of these compounds occurring in this largely natural catchment. The moderate importance of biodiversity maintenance stems from these freshwater ecosystems being recognised in national and regional conservation plans such as the Northern Cape Critical Biodiversity Areas layer (2016) and the 2011 NFEPA database.

Integration of the supply and demand scores computed that the single most important ecoservices in the study area is the ability of the episodic rivers to provide conditions suited for food cultivation. However, the current land use is not dedicated to this and it is the opinion of the freshwater specialist that the maintenance of hydraulic connectivity through the landscape is the most important ecoservice, overall.

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REC, BAS and RMO Categories

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REC: Category B
BAS: Category C – Moderately Modified
RMO: Maintain in Category B/C
The outcome of the RMO indicates that the episodic river ecological condition must be maintained in a category PES Class B/C (largely natural/moderately modified). The default PES Class C (moderately modified) ecological category provided by the 2014 database has thus already been achieved with no remediation works required by the proponent. The BAS is considered to be a PES Class C and would require the removal of *Prosopis* spp. from the episodic rivers which is neither feasible, nor within the scope of the proponents responsibility. Additionally, it must be ensured that no edge effects (such as sediment laden stormwater runoff) from surface infrastructure proposed as part of the proposed SEF enters these episodic drainage lines.

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Table 8: Ecological assessment summary of the episodic drainage lines with riparian vegetation associated with the study area.

Figure 17: Episodic drainage lines (yellow arrow) illustrating a smooth channel surface that is bordered by a riparian zone consisting of some Prosopis, indigenous shrubs and grasses.

Index of Habitat Integrity Summary

Instream IHI

IHI: 79.9 % and Ecological Category (B/C) (Largely Natural to Moderately Modified)

Aspect	Severity Rating
Hydrology	Small
Physico-chemistry	Small
Bed modification	Small
Bank modification	Large
Connectivity	Small

Riparian Zone IHI

IHI: 50.9 % and Ecological Category (D) (Largely Modified)

Aspect	Severity Rating
Hydrology	None – Small
Bank Structure	Serious
Connectivity	Moderate

Freshwater ecosystem Characteristics

Hydrological regime

The hydrological regime of the episodic drainage lines within the study area was determined to be in a near natural functional state. Minimal anthropogenic pressure on these rivers stems from flows being unpredictable, infrequent and extremely flashy

Water provision infrastructure (e.g. weirs and impoundments) is therefore almost entirely absent with only a few sporadic off channel reservoirs noticed for historic sheep farming.

The additional water use by opportunistic *Prosopis* shrubs from shallow groundwater in the subterranean alluvium is considered to moderately decrease the hydrological budget of these rivers on a moderate scale.

Geomorphology and sediment balance

These systems are characterised by shallow layers of loose alluvial soil over shale bedrock which are expected to transport naturally large quantities of sediment when in flow. The sediment balance is however expected to be minimally disturbed due to informal road crossings where some erosion has occurred and historic grazing practice which would destabilise soil and increase sediment loading into these systems. The sediments of these systems are however more stabilised compared to the episodic rivers due to being more densely vegetated

Habitat and biota

Small segments of the riparian belt have been infested with *Prosopis* spp. The indigenous grass *Stipagrostis namaquensis* was also a key riparian zone inhabitant. Due to the episodic nature of these systems, they do not retain water long enough to provide breeding and foraging habitat for aquatic macro-invertebrates or avifaunal species. However, they do provide migratory connectivity as well as sheltered nesting habitat for terrestrial avifaunal species.

Water Quality

No water quality measurements could be taken due to conducting the fieldwork outside of flow conditions. Nevertheless, due to the relatively remote locality of these systems and the low degree of catchment transformation, it can be concluded that surface water, when present, is likely to be largely natural, with limited impacts from pollutants.

Ecological Importance and Sensitivity Discussion

EIS Category: Moderate

The EIS was determined to be moderate for the biotic and moderate for the habitat assessment components respectively. The moderate biotic score stems from large areas of the study area being designated as FEPA, CBA1 and ESA areas and while no fish are associated with any of the rivers within the study area, the 2014 RWQO database indicates that aquatic invertebrate taxa are highly sensitivity to flow changes. The primary importance of these episodic rivers is to maintain freshwater flows through the landscape and provide a temporary aquatic ecological corridor. Notably, these freshwater features are considered to support higher levels of biodiversity compared to episodic rivers due to being more densely covered by indigenous vegetation.

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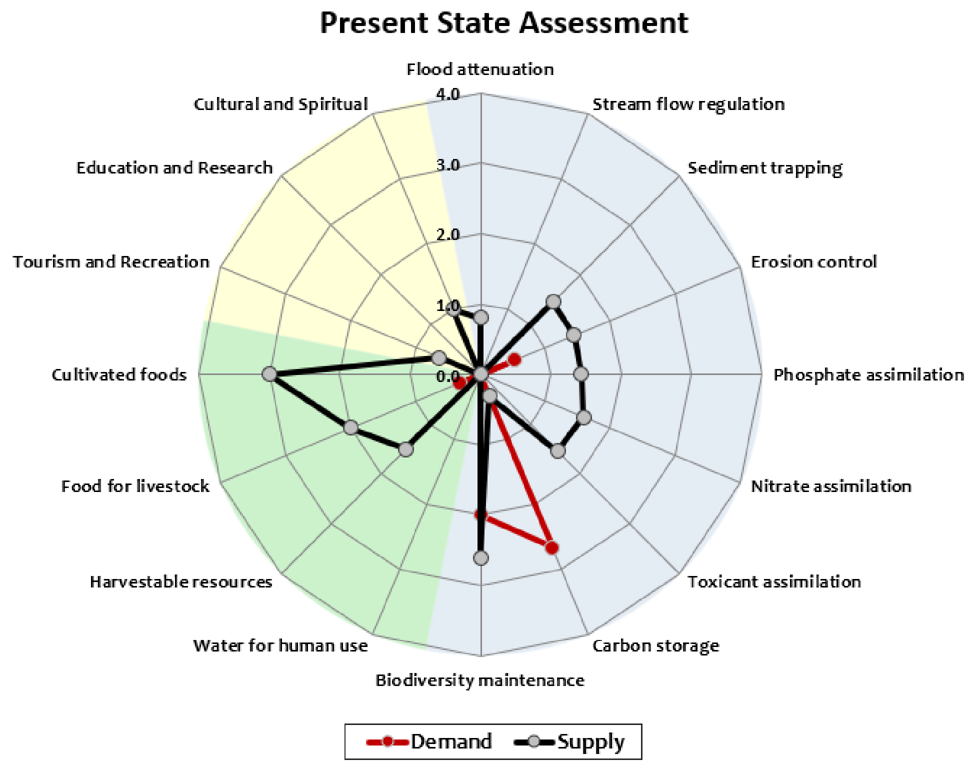

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<td>
WET – Ecoservices

Ecoservice Provisioning: (indicator dependent)
The WET-Ecoservices model determined an overall low to moderately low ecoservice importance when comparing the supply of ecoservices to their demands. This is due to these rivers only functioning as aquatic freshwater ecosystems for a number of hours or days every several years when aquatic ecoservices can be rendered.

Supplied ecoservices of moderate importance include 1) sediment trapping, 2) erosion control, 3) phosphate, nitrate and toxicant assimilation, 4) harvestable resources and 5) food for livestock and high importance for biodiversity maintenance and suitable conditions to cultivate foods. The moderate importance of phosphate, nitrate and toxicant assimilation stems from the reasonably low longitudinal gradient of the drainage line and low lateral gradient of the adjacent riparian zone. This topography is ideal in that flows are encouraged to be diffuse, with increased residence times which promote uniformity of flows through the riparian zone which ultimately maximises the polishing of water quality. Assimilation in these episodic drainage lines is expected to the most effective compared to other episodic features in the study area due these systems being the most densely vegetated with short indigenous shrubs and grasses. The proliferation of Prosopis spp in the riparian zones of these systems (albeit not as much compared to episodic rivers) provides a supply of wood and the seed pods and veld vegetation are suitable for sheep farming. Sediment trapping and erosion control are of moderate importance due to the dense vegetation in which sediments are managed.

In terms of anthropogenic demand, biodiversity maintenance is moderately important and the provision of stored carbon is highly important. The very low importance in the demand for phosphate, nitrate and toxicant assimilation is due to very low traces of these compounds occurring in this largely natural catchment. The moderate importance of biodiversity maintenance stems from these freshwater ecosystems being recognised in national and regional conservation plans such as the Northern Cape Critical Biodiversity Areas layer (2016) and the 2011 NFEPA database.

Integration of the supply and demand scores computed that the single most important ecoservices in the study area is for biodiversity maintenance (moderate).
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<td>REC, BAS and RMO Categories</td>
<td colspan="2">
REC: Category B
BAS: Category A/B – Largely Natural to Pristine
RMO: Maintain in Category B
The outcome of the RMO indicates that these episodic drainage lines must be maintained in a category PES Class B/C (largely natural/moderately modified) ecological condition. The BAS is considered to be a PES Class C=A/B (Largely Natural to Pristine) and would require the removal of sporadic stands of Prosopis spp. Along certain section of these systems. Additionally, it must be ensured that no edge effects (such as sediment laden stormwater runoff) from surface infrastructure proposed as part of the proposed SEF enters these episodic drainage lines.
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Table 9: Ecological assessment summary of the episodic drainage lines without riparian vegetation associated with the study area.

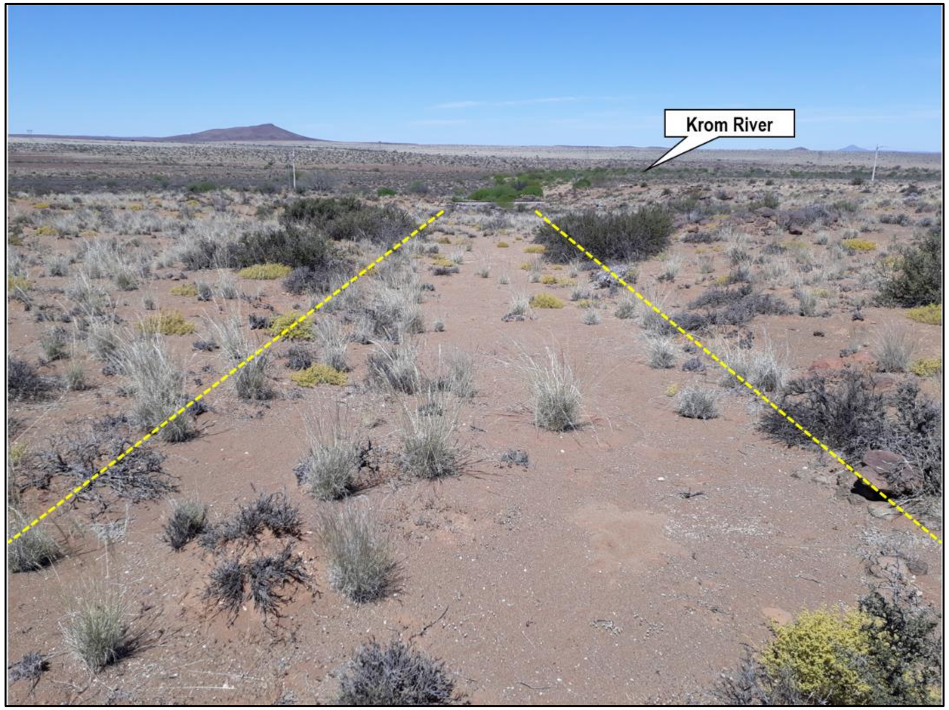


Figure 18: An episodic drainage line without riparian vegetation that confluences with the Krom River.

Freshwater ecosystem Characteristics

Hydrological regime

The hydrological regime of the episodic drainage lines was determined to be in a near natural functional state. Minimal anthropogenic pressure on these rivers stems from flows being unpredictable, infrequent and extremely flashy.

Water provision infrastructure (e.g. weirs and impoundments) is therefore almost entirely absent with only a few sporadic off channel reservoirs noticed for sheep farming.

In addition to water use by opportunistic *Prosopis* shrubs, many of these systems are forced through culverts underneath train tracks which may cause temporary impedance of flows.

Geomorphology and sediment balance

These systems are characterised by shallow layers of loose alluvial soil over shale bedrock which are expected to transport naturally large quantities of sediment when in flow. The sediment balance is however expected to be minimally disturbed due to informal road crossings where some erosion has occurred and historic grazing practice which would destabilise soil and increase sediment loading into these systems. The sediments of these systems are however more stabilised compared to the episodic rivers due to being more densely vegetated.

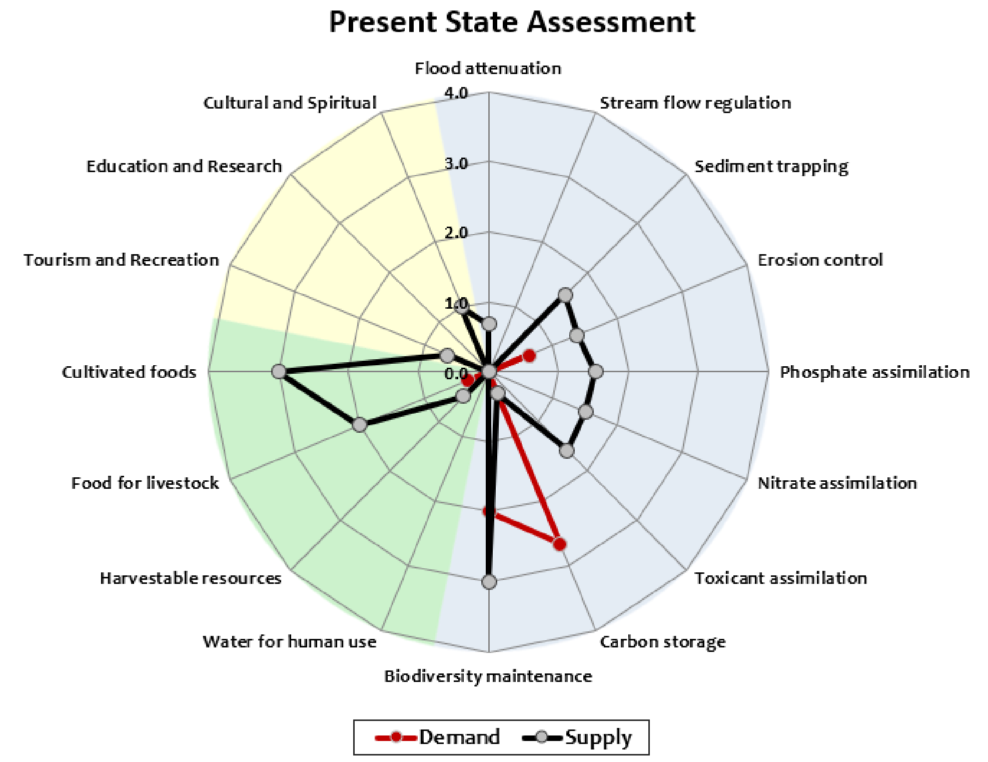
Habitat and biota

The vegetation occurring within these systems consists mostly of *Stipagrostis ciliata* (Small Bushmans grass) and *Stipagrostis ciliata* (Tall Bushmans grass) with an almost entire absence of *Prososis* spp. Due to the episodic nature of these systems, they do not retain water long enough to provide breeding and foraging habitat for aquatic macro-invertebrates or avifaunal species. The lack of large shrubs also limits these areas being used as refugia by avifauna.

Water Quality

No water quality measurements could be taken due to conducting the fieldwork outside of flow conditions. Nevertheless, due to the relatively remote locality of these systems and the low degree of catchment transformation, it can be concluded that surface water, when present, is likely to be largely natural, with limited impacts from pollutants.

REC, BAS and RMO Categories	**REC: Category B** **BAS: Category B – Largely Modified** **RMO: Maintain in Category B** The outcome of the RMO indicates that the episodic river ecological condition must be maintained in a category PES Class B (largely natural). The BAS is considered to be a PES Class B which requires no further remediation. Additionally, it must be ensured that no edge effects (such as sediment laden stormwater runoff) from surface infrastructure proposed as part of the proposed SEF enters these episodic drainage lines.	**Ecological Importance and Sensitivity Discussion** **EIS Category: Moderate** The EIS was determined to be moderate for the biotic and low for the habitat assessment components respectively. The moderate biotic score stems from large areas of the study area being designated as FEPA, CBA1 and ESA areas and no fish are associated with any of the rivers within the study area. The primary importance of these episodic rivers is to maintain hydraulic connectivity through the landscape and provide a temporary aquatic ecological corridor for aquatic biota.



WET – Ecoservices

Ecoservice Provisioning: (indicator dependent)

The WET-Health model determined a very low ecoservice importance when comparing the supply of ecoservices to their demands. This is due to these rivers only functioning as aquatic freshwater ecosystems for a number of hours or days every several years when aquatic ecoservices can be rendered.

Supplied ecoservices of moderate importance include 1) sediment trapping, 2) erosion control, 3) phosphate, nitrate and toxicant assimilation and 4) food for livestock and high importance for biodiversity maintenance and suitable conditions to cultivate foods. The moderate importance of phosphate, nitrate and toxicant assimilation stems from the low longitudinal gradient of the drainage line with a low gradient of the adjacent higher lying areas. This topography is ideal in that flows are encouraged to be diffuse, with increased residence times which promote uniformity of flows through the drainage line which maximises the polishing of water quality. Sediment trapping and erosion control are of moderate importance due to increased vegetation cover in the drainage line in which sediments are managed. Biodiversity maintenance is considered a highly important ecoservice due to the largely natural condition of these episodic drainage lines , that assumes increases biodiversity support.

In terms of anthropogenic demand, biodiversity maintenance is moderately important and the provision of stored carbon is highly important. The very low importance in the demand for phosphate, nitrate and toxicant assimilation is due to very low traces of these compounds occurring in this largely natural catchment. The moderate importance of biodiversity maintenance stems from these freshwater ecosystems being recognised in national and regional conservation plans such as the Northern Cape Critical Biodiversity Areas layer (2016) and the 2011 NFEPA database.

Integration of the supply and demand scores computed that the single most important ecoservices in the study area is for biodiversity maintenance (moderately high).

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) as amended (NEMA);
- The National Water Act, 1998 as amended (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).

It is important to note that in terms of the definition of a watercourse as per the NWA (See **Appendix B**), the episodic rivers and drainage lines with riparian vegetation, including those episodic drainage lines subjected to a 1:100 year floodline (not yet determined) within the study area will be regulated by Section 21(c) and (i) of the NWA as well as the applicable zones of regulation. All the natural watercourses will thus require further authorisation from the DFFE and the DWS. This section thus aims to inform the proponent on the authorisation processes required, based on the provided layout.

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 as follows:

Table 10: 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.

[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.

<table>
<tr><th>Regulatory authorisation required</th><th>Zone of applicability</th></tr>
<tr><td>Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended in 2017.
Department of Forestry, Fisheries and the Environment (DFFE)</td><td>
<u>Activities of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)</u>

Activity 12:
The development of:
(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 100 square meters; or
(ii) infrastructure or structures with a physical footprint of 100 square meters or more;
Where such development occurs—
a) Within a watercourse;
b) In front of a development setback; or
c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse.
Activity 19:
The infilling or depositing of any material of more than 10 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 from –
(a) a watercourse

<u>Activities of Listing Notice 3 (GN 324) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)</u>

Activity 10:
The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.
Northern Cape
i. In an estuary;
ii. Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland;
iii. Outside urban areas:
(aa) A protected area identified in terms of NEMPAA, excluding conservancies;
(bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
(dd) Sites or areas identified in terms of an international convention;
(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
(ff) Core areas in biosphere reserves;
(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve;
(hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; or
(ii) Within 500 metres of an estuary; or
iv. Inside urban areas:
(aa) Areas zoned for use as public open space;
(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; or
(cc) Within 500 metres of an estuary.
Activity 14:
The development of –
(x) Buildings exceeding 10 square meters in size; or
(ii) infrastructure or structures with a physical footprint of 10 square metres or more;
Where such development occurs-
a) Within a watercourse;
</td></tr>
</table>

Regulatory authorisation required	Zone of applicability
	b) In front of a development setback; or *c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse* ***Northern Cape*** *(i)* In an estuary; *(ii)* Outside urban areas, in: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) World Heritage Sites; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (ee) Site of areas identified in terms of an International Convention; (ff) Critical biodiversity areas or ecosystems service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (gg) Core areas in biosphere reserves; (hh) Areas within 10 kilometres from national parks or world heritage sites of 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (ii) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; or *(iii)* In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose; or (cc) Areas seawards of the development setback line.

The episodic rivers with riparian vegetation and their main tributaries, including their smaller contributing episodic drainage lines with riparian vegetation were assigned the following Zones of Regulation (ZoR), and development setbacks, as determined using Macfarlane *et. al.* (2015):

- A 32 m (ZoR) in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA);
- In the absence of defined 1 in 100 year flood lines, a 100 m ZoR in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA;
- A 15 m setback (no go area) using the Macfarlane et al. (2014) buffer tool for the episodic drainage lines with riparian vegetation, with appropriate mitigation for all non-linear infrastructure, except the solar arrays (see bullet 5);
- A 25 m setback (no go area) using the Macfarlane et al. (2014) buffer tool for the episodic rivers and their larger tributaries with riparian vegetation, which are considered more sensitive for all non-linear infrastructure, including the solar arrays;
- For the solar arrays near episodic drainage lines, a 25 m setback to be allowed to ensure sufficient space for erosion and sediment control and dissipation near these episodic features, as these areas are subjected to greater amounts of runoff compared to non-developed areas during high rainfall events; and
- All linear infrastructure should avoid drainage lines as far as possible and cross them at acute, rather than obtuse angles to minimise the extent of disturbance within these systems.

These above ZoR and development setbacks are illustrated below in Figures 19-22.

Areas of sensitivity were developed following the on-site delineation of the freshwater HGM types, and after determining their applicable regulated areas and development setback areas. Based on these delineations and the assignment of ZoRs and development setbacks, the following was concluded:

- **No-go Area:** includes the extent of the delineated boundaries of the episodic rivers and drainage lines with riparian vegetation, and development setback buffers (as determined by the buffer tool) of 15 m for the episodic drainage lines with riparian vegetation (for all non-linear infrastructure) and 25 m for episodic rivers with riparian vegetation (for all infrastructure). Roads and associated river crossings should only be planned within these areas if it is absolutely unavoidable to circumnavigate these freshwater ecosystems;
- **High Sensitivity Area:** within the 32 m regulated area of a freshwater ecosystem as stipulated by NEMA applicable to the freshwater ecosystems. No surface SEF infrastructure components (solar PV arrays, BESS, construction camp) and onsite IPP substation and associated surface grid infrastructure) should be placed in these areas;
- **Moderate Sensitivity Area:** includes the 100 m GN 509 regulated area of the freshwater ecosystems. Development within these areas could take place but should be avoided, if possible, to avoid triggering Section 21 (c) and (i) water uses as it relates to the NWA; and
- **Low Sensitivity Area:** all other areas remaining in the study area, comprising terrestrial areas, PFPs and episodic drainage lines without riparian vegetation that are not subjected to a 1:100 year floodline. These areas are considered the least sensitive from a freshwater ecosystem conservation and water resource management point of view.

As per Figure 3 and Figures 19-22, only the proposed access roads pose direct impacts to freshwater ecosystems, but the layout was proposed in a manner to, as far as possible, avoid and minimise crossings. All other infrastructure fall outside of the 32 m NEMA ZoR.

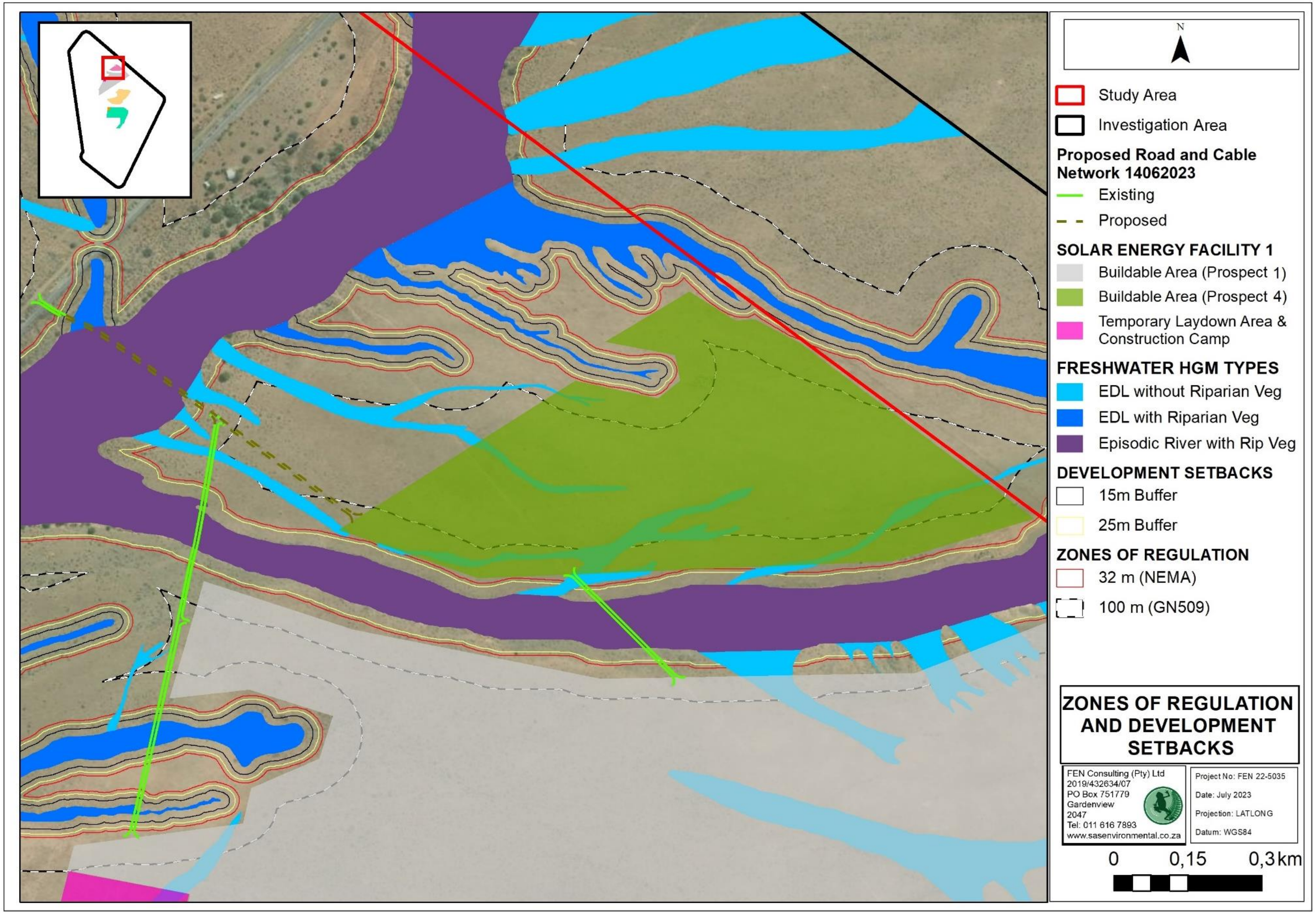


Figure 19: Zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA and development setbacks in relation to the delineated freshwater HGM types in the northern portion of the study area.

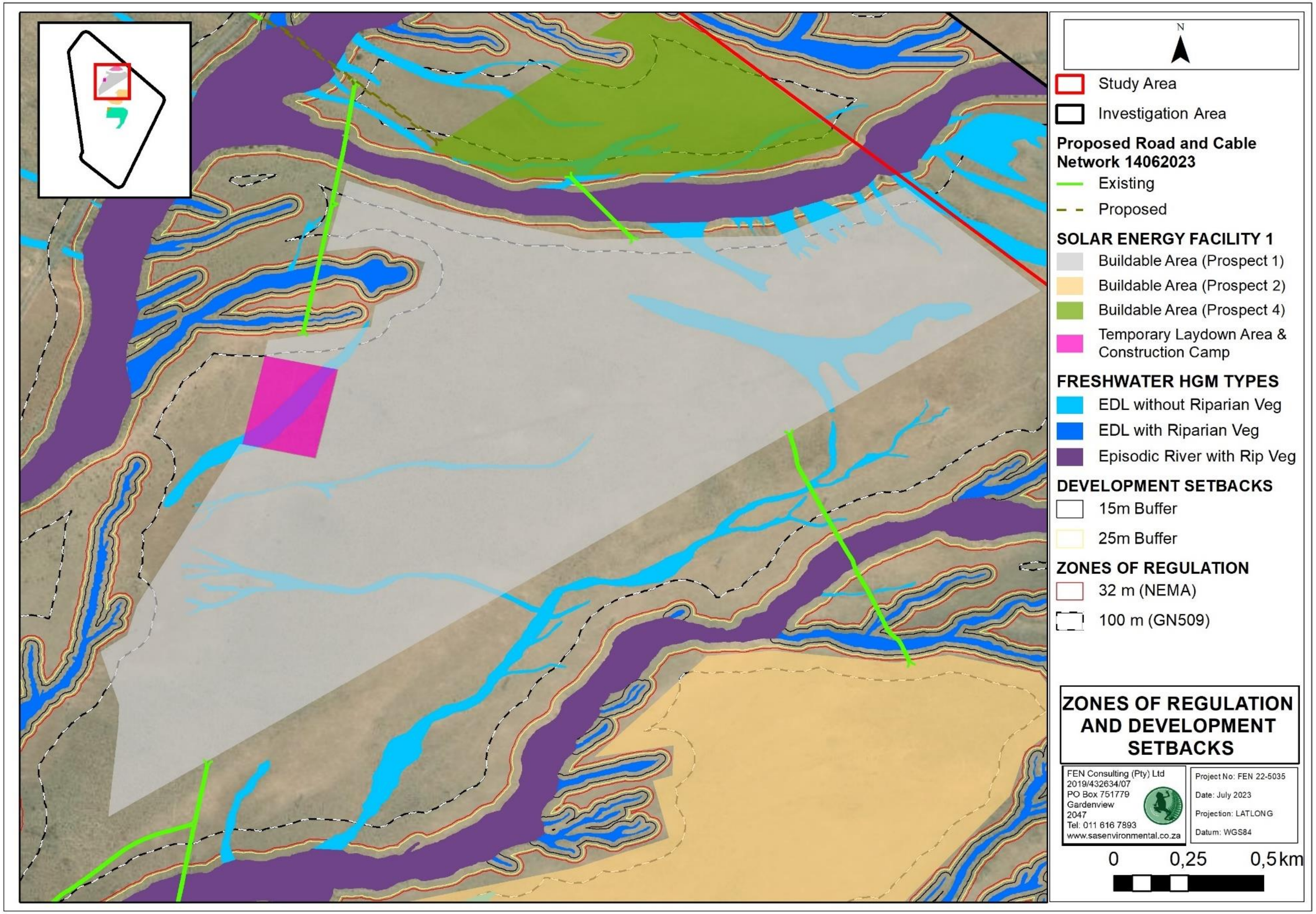


Figure 20: Zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA and development setbacks in relation to the delineated freshwater HGM types in the northern portion of the study area.

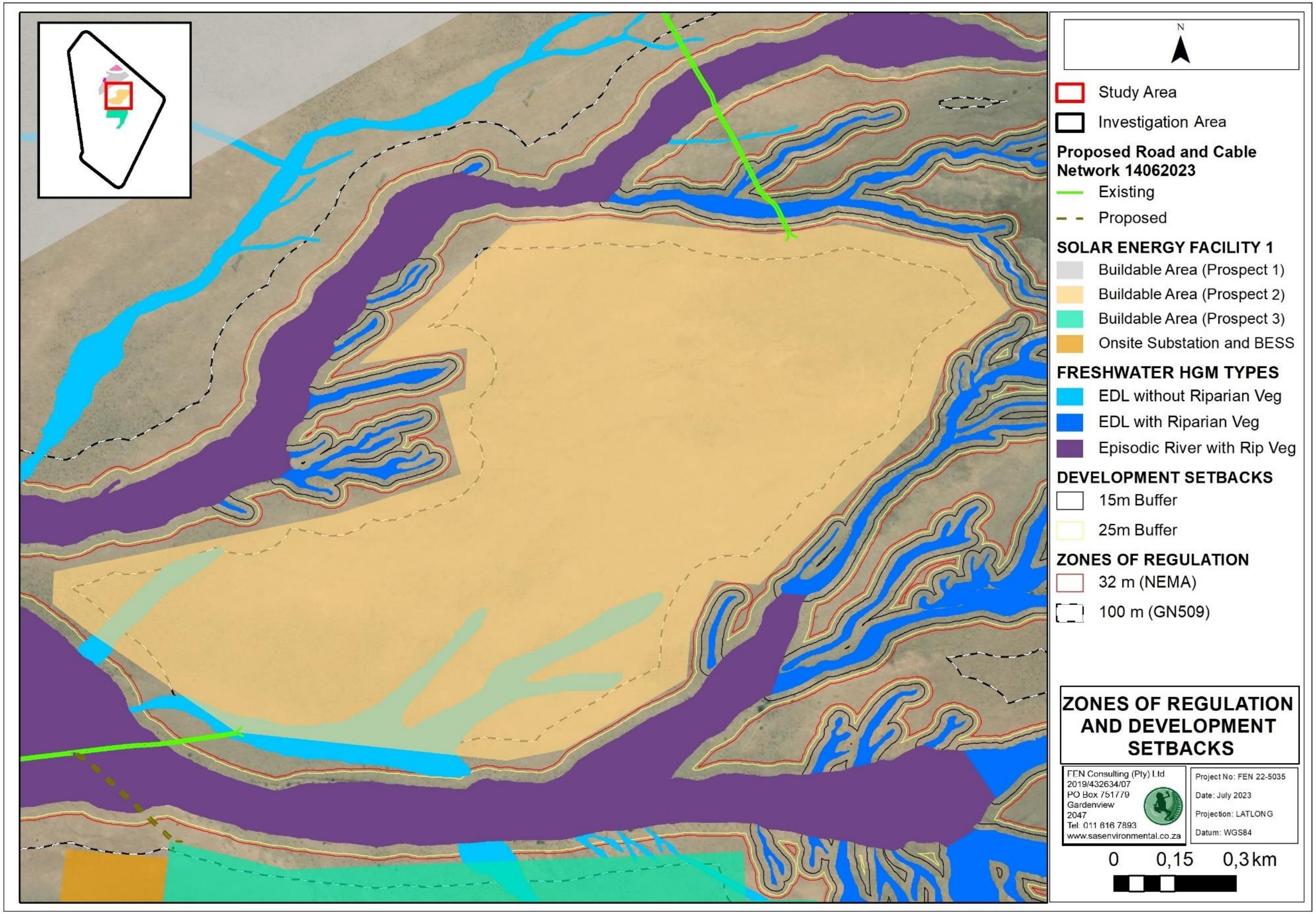


Figure 21: Zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA and development setbacks in relation to the delineated freshwater HGM types in the middle central portion of the study area.

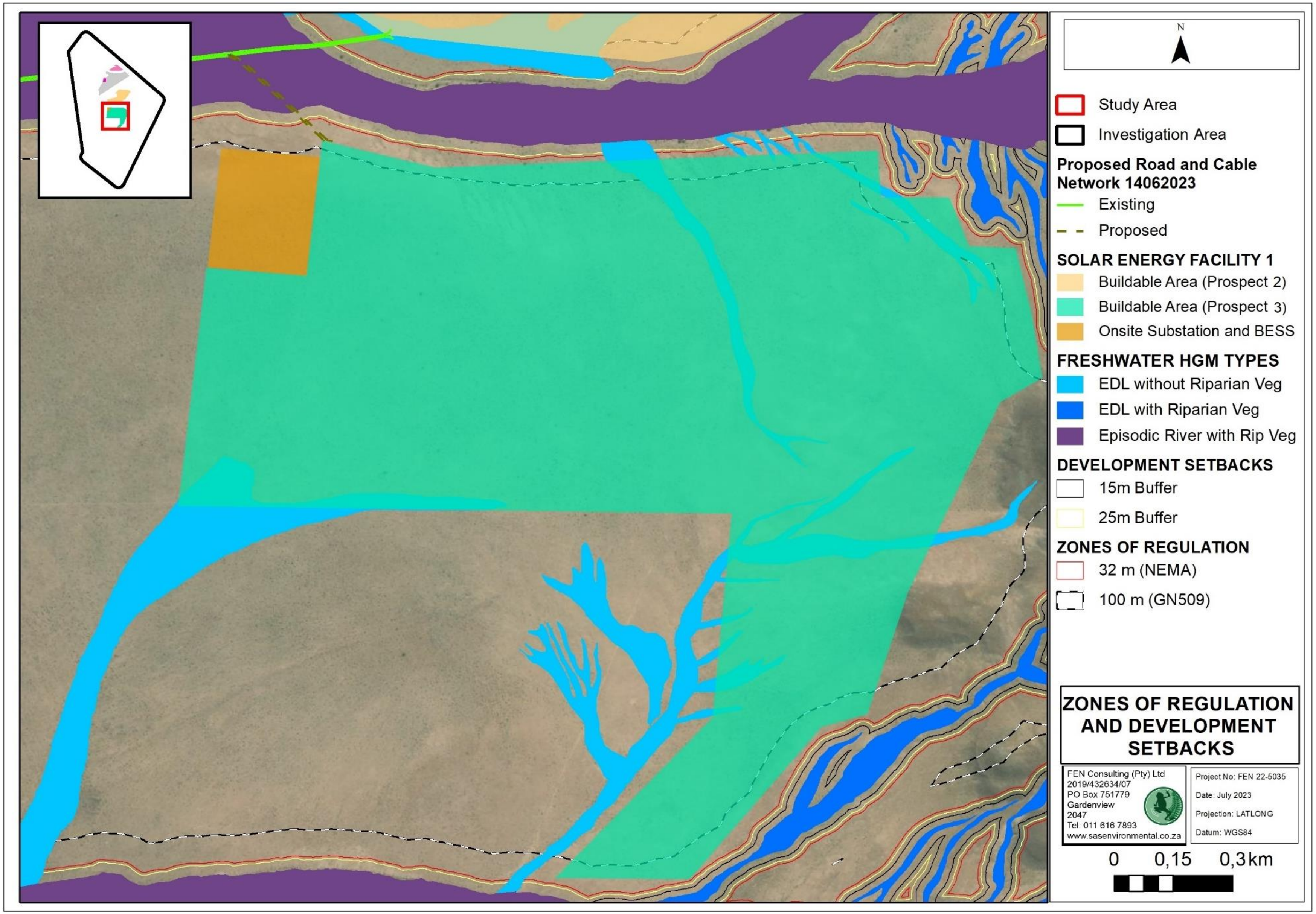


Figure 22: Zones of regulation in terms of GN509 of 2016 as it relates to the NWA and NEMA and development setbacks in relation to the delineated freshwater HGM types in the southern portion of the study area.

7 IMPACT ASSESSMENT

7.1 Introduction

The Environmental Impact Assessment (EIA) Methodology evaluates the overall effect (impact significance class) of a proposed activity on the following parameters of the receiving freshwater ecosystem environment for the construction, operation and decommissioning phases:

- Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area;
- Geomorphology (including sediment balance and erosion control) of the freshwater ecosystems identified in the study area; and
- Hydrological functioning and surface water quality (if present) of the freshwater ecosystems identified in the study area.

The impact significance classes comprise of "LOW, MEDIUM, HIGH and VERY HIGH" which indicates the level of mitigation required to minimise the proposed development activity impacts and thus summarises the significance of impacts before and after mitigation (Table 10). See the detailed methodology in Appendix D.

7.2 *SiVEST Impact Assessment*

Following the assessment of the freshwater ecosystems associated with the proposed SEF 1 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 freshwater ecosystems located in the vicinity of the proposed Lesaka 1 layout (Figures 19-22) and is based on the proximities between the proposed layout components and the freshwater ecosystems (Table 11).

The points below summarise the considerations made when applying the Impact Assessment:

- The existing access road options that will be utilised to access the proposed SEF development traverse several of the delineated freshwater ecosystems in the study area (No-Go areas), and
- New access roads are proposed to be developed as part of the proposed SEF development within the study area, and as illustrated in Figures 19-22 will traverse two sections of the Klein Rooiberg River system. It is not considered feasible to avoid the crossing of freshwater ecosystems, but it must be noted that the proposal of new access roads was done in a manner to, as far as possible, avoid and minimise crossings, with existing access roads being commissioned for this development. Potential new road crossings are presumed to be low water crossings (i.e. clearing of the area and compacting the residual material), as per the existing gravel road crossings in the study area, not utilising formal low level crossing structures such as culverts which may result in concentrated flow.

Table 11: Summary of the locations of the proposed surface infrastructure components in relation to the freshwater ecosystems, development setbacks and zones of regulation.

SEF	Proposed surface infrastructure component	Within Freshwater ecosystem	Within Setback	Within NEMA 32m ZoR	Within GN509 100m ZoR	Outside GN509 100m ZoR
	Sensitivity:	No- Go Area		High	Moderate	Low
LESAKA 1	Access Road Option	√				
	Onsite Substation and BESS					√
	Solar Array Buildable Area 1				√	
	Solar Array Buildable Area 2				√	
	Solar Array Buildable Area 3				√	
	Solar Array Buildable Area 4				√	
	Temporary Laydown Area and construction camp					√
	MTS Proposed footprint					√
	Lesaka 1 OHPL					√
	LILO			√		

Table 12 below provides a summary of the outcome of the impact 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 12: Summary of the outcome of the impact assessment considering the proposed SEF development.

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance
CONSTRUCTION PHASE								
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by **construction** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem – No-Go area ○ Access Roads ○ Cable laying alongside access roads These direct impacts may result in: • Trampling by construction personnel and equipment is likely to impact on the riparian and instream vegetation, leading to habitat degradation; • Net loss of habitat and ecological structure provided by the freshwater ecosystems; and • Source of sedimentation and smothering of freshwater ecosystem habitat.	45	NEGATIVE	NEGATIVE HIGH IMPACT	**GENERAL MITIGATION MEASURES:** • All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential; • Retain as much indigenous freshwater vegetation as possible; • All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) must be stockpiled in designated areas (outside the 32 m NEMA ZoR) or disposed of at a registered waste disposal facility; and • Regular spraying of water alone or in conjunction with chemical dust suppressants must be implemented where possible to reduce dust and to ensure that no smothering of vegetation within the freshwater ecosystems occurs from excessive dust settling during construction activities associated with surface infrastructure – within close proximity to a freshwater ecosystem (required at road crossings and for infrastructure located within the 32 m NEMA ZoR). **MITIGATION MEASURES PERTAINING TO THE NEW ROAD AND CABLE CROSSINGS AND THE UPGRADING OF EXISTING ROADS:** Due to the nature of this proposed development, it is acknowledged that the road freshwater ecosystem crossings cannot be avoided, thus a direct negative impact is expected to occur on the freshwater ecosystems. Nevertheless, the following mitigation measures are applicable for the construction of new freshwater ecosystem crossings and the upgrading of existing freshwater ecosystem crossings: • The design of the new road crossings should ensure that no concentration of flow occurs thus reducing the risk of erosion and incision,. As such, vegetation must be established in the construction footprint immediately after the construction of the road/ installation of cables is complete and as directed by the ECO; • New road crossings must, as far as possible, intersect the freshwater ecosystem at a right angle (perpendicular) to minimise disturbance to the freshwater ecosystem; • During the construction of roads, upgrading of internal roads and associated cable installation that may potentially traverse freshwater ecosystems, a construction corridor	18	NEGATIVE	NEGATIVE LOW IMPACT

<table>
<tr><th rowspan="2">ENVIRONMENTAL PARAMETER</th><th rowspan="2">ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE</th><th colspan="3">ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION</th><th rowspan="2">RECOMMENDED MITIGATION MEASURES</th><th colspan="3">ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION</th></tr>
<tr><th>TOTAL</th><th>STATUS (+ OR -)</th><th>Significance</th><th>TOTAL</th><th>STATUS (+ OR -)</th><th>Significance</th></tr>
<tr><td>Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.</td><td>Potential direct impacts caused by construction upgrades of the following proposed infrastructure components that directly traverse freshwater ecosystems:
• Within delineated freshwater ecosystem – No-Go area
○ Upgrading of existing sections of Access Roads in the study area which traverses several freshwater ecosystems.
<u>These direct impacts may result in:</u>
• Trampling by construction personnel and equipment is likely to impact on the riparian and instream vegetation, leading to habitat degradation;
• Potential additional loss of habitat and ecological structure provided by the freshwater ecosystems; and
• Potential changes to ecological and socio-cultural service provision.</td><td>42</td><td>NEGATIVE</td><td>NEGATIVE MEDIUM IMPACT</td><td>of no more than 5 m on either side of the proposed road reserve through the freshwater ecosystems may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area;
• Soil excavated from the cable trench must be stockpiled immediately upgradient of the trench. Once the cable is installed the trench must be backfilled with the removed material and suitably compacted to avoid any erosion and preferential flow paths from forming; and
• Any remaining soil following the completion of backfilling of the trenches are to be spread out thinly in an area within the freshwater ecosystems to aid in the natural reclamation process.</td><td>18</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
</table>

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **indirect impacts** caused by **construction** of the following proposed infrastructure components not directly traversing freshwater ecosystems: • Within 32m ZoR (NEMA) – high sensitivity area o LILO support towers • Within 100m (GN509) – medium sensitivity area o Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509) – low sensitivity area o Onsite substation and BESS o Temporary laydown area and construction camp o MTS proposed footprint o Lesaka 1 OHPL These indirect impacts may result in: • Disturbance to the buffer zone surrounding the freshwater ecosystem, making the freshwater ecosystems vulnerable to the invasion of alien and invasive vegetation species; and • Source of sedimentation and smothering of freshwater ecosystem habitat	18	NEGATIVE	NEGATIVE LOW IMPACT	• It should be feasible to utilise existing roads to gain access to the proposed construction area. Use must be made of existing and newly authorised freshwater ecosystem crossings and no indiscriminate crossing of the freshwater ecosystems outside of the existing crossing points or driving indiscriminately in the veld within the buffer zones of the freshwater ecosystems may be permitted. This will avoid any disturbance to the terrestrial vegetation; • No other terrestrial vegetation areas may be disturbed by the proposed construction activities for the surface infrastructure, other than the approved proposed footprint areas; • During excavation activities, the topsoil and vegetation that is removed should be stockpiled separately from other material outside of the 32 m NEMA ZoR; • Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up, so as to not impact on any vegetation (freshwater ecosystem or terrestrial). The mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later use as backfill material after construction has commenced; • All exposed soils must be protected for the duration of the construction phase to prevent potential erosion, sedimentation and smothering (through dust and potential run-off) of the vegetation in the surrounding area; and • After construction of the surface infrastructure, the area surrounding the surface infrastructure must be revegetated with suitable indigenous vegetation (terrestrial vegetation) to prevent the establishment of alien vegetation species and their potential spread into the freshwater ecosystems.	5	NEGATIVE	NEGATIVE LOW IMPACT

<table>
<tr><th rowspan="2">ENVIRONMENTAL PARAMETER</th><th rowspan="2">ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE</th><th colspan="3">ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION</th><th rowspan="2">RECOMMENDED MITIGATION MEASURES</th><th colspan="3">ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION</th></tr>
<tr><th>TOTAL</th><th>STATUS (+ OR -)</th><th>Significance</th><th>TOTAL</th><th>STATUS (+ OR -)</th><th>Significance</th></tr>
<tr><td>Geomorphological processes (including sediment balance and erosion control) of the freshwater ecosystems identified in the study area.</td><td>Potential direct impacts caused by construction of the following proposed infrastructure components directly traversing freshwater ecosystems:
• Within delineated freshwater ecosystem – No – Go area
o Access Roads
o Cable laying alongside access roads
<u>These direct impacts may result in:</u>
• Excavation and trenching leading to stockpiling of soil within close proximity to the active channel of the freshwater ecosystems;
• Movement of construction equipment and personnel within the freshwater ecosystem leading to increased turbidity;
• Disturbances of soils leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and
• Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems and disturbance of geomorphological processes.</td><td>45</td><td>NEGATIVE</td><td>NEGATIVE HIGH IMPACT</td><td>GENERAL MITIGATION MEASURES:
• The duration of impacts within the freshwater ecosystem (specifically associated with the construction of new road crossings and upgrading of existing crossings) should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised. Therefore, the construction period should be kept as short as possible; and
• Construction activities in the freshwater ecosystems (where applicable) will potentially result in bank destabilisation, and cause bank incision and sedimentation of the freshwater ecosystem, therefore, sediment control devices should be installed downgradient of the construction site in the freshwater ecosystem and all excess sediment is to be removed once construction activities have been completed.

MITIGATION MEASURES PERTAINING TO THE NEW ROAD AND CABLE CROSSINGS AND THE UPGRADING OF EXISTING ROADS:
Due to the nature of this proposed development, it is acknowledged that the road freshwater ecosystem crossings cannot be avoided, thus a direct negative impact is expected to occur on the freshwater ecosystems. Nevertheless, the following mitigation measures are applicable for the construction of new freshwater ecosystem crossings and the upgrading of existing freshwater ecosystem crossings:</td><td>18</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
</table>

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance
Geomorphological processes (including sediment balance and erosion control) of the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by **construction upgrades** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem – No-Go area ○ Upgrading of existing sections of Access Roads in the study area which traverses several freshwater ecosystems. These direct impacts may result in: • Excavation and trenching leading to stockpiling of soil within close proximity to the active channel of the freshwater ecosystems; • Movement of construction equipment and personnel within the freshwater ecosystem leading to increased turbidity; • Disturbances of soils leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and • Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems and disturbance of geomorphological processes.	42	NEGATIVE	NEGATIVE MEDIUM IMPACT	• The design of the new road crossings should ensure that no concentration of flow occurs thus reducing the risk of erosion and incision,. As such, vegetation must be established in the construction footprint immediately after the construction of the road/ installation of cables is complete and as directed by the ECO; • New road crossings must, as far as possible, intersect the freshwater ecosystem at a right angle (perpendicular) to minimise disturbance to the freshwater ecosystem; • During the construction of roads, upgrading of internal roads and associated cable installation that may potentially traverse freshwater ecosystems, a construction corridor of no more than 5 m on either side of the proposed road reserve through the freshwater ecosystems may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; • Soil excavated from the cable trench must be stockpiled immediately upgradient of the trench. Once the cable is installed the trench must be backfilled with the removed material and suitably compacted to avoid any erosion and preferential flow paths from forming; • Any remaining soil following the completion of backfilling of the trenches are to be spread out thinly in an area within the freshwater ecosystems to aid in the natural reclamation process; and • Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the freshwater ecosystems which may result in the reduction of surface roughness. This can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction area enters the freshwater ecosystems.	18	NEGATIVE	NEGATIVE LOW IMPACT

<table>
<tr><th rowspan="2">ENVIRONMENTAL PARAMETER</th><th rowspan="2">ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE</th><th colspan="3">ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION</th><th rowspan="2">RECOMMENDED MITIGATION MEASURES</th><th colspan="3">ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION</th></tr>
<tr><th>TOTAL</th><th>STATUS (+ OR -)</th><th>Significance</th><th>TOTAL</th><th>STATUS (+ OR -)</th><th>Significance</th></tr>
<tr><td>Geomorphological processes (including sediment balance and erosion control) of the freshwater ecosystems identified in the study area.</td><td>Potential indirect impacts caused by construction of the following proposed infrastructure components not directly traversing freshwater ecosystems:
• Within 32m ZoR (NEMA) – high sensitivity area
○ LILO support towers
• Within 100m (GN509) – medium sensitivity area
○ Solar array buildable areas 1– 4
• Outside 100m ZoR (GN509) – low sensitivity area
○ Onsite substation and BESS
○ Temporary laydown area and construction camp
○ MTS proposed footprint
○ Lesaka 1 OHPL

<u>These indirect impacts may result in:</u>
• Reduction in the surface roughness surrounding the freshwater ecosystems leading to altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems and disturbance of geomorphological processes.</td><td>18</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td><td>• It should be feasible to utilise existing roads to gain access to the proposed construction area. Use must be made of existing and newly authorised freshwater ecosystem crossings and no indiscriminate crossing of the freshwater ecosystems outside of the existing crossing points or driving in unmarked areas through the buffer zones of the freshwater ecosystems may be permitted. This will avoid any disturbance to the terrestrial vegetation. This will avoid any disturbance to the soils surrounding the freshwater ecosystems and any sediment laden runoff;
• Concentrated flow from the construction footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction area enters the freshwater ecosystems; and
• The LILO support towers must have rip rap or be rock-packed (or similar erosion protection) installed around their vertices to ensure that any potential preferential flow paths continue to drain to their intended downstream reaches (considering that the support towers will be within 32 m of the Klein Rooiberg River), and to protect the downstream freshwater ecosystems from any potential erosion generated around these vertices.</td><td>5</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
</table>

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance
Hydrological functioning and surface water quality (if present) within the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by **construction** of the following proposed infrastructure components directly traversing freshwater ecosystems: • Within delineated freshwater ecosystem (No-Go area) ○ Access Roads ○ Cable laying alongside access roads These direct impacts may result in: • Construction in the freshwater ecosystems may result in potential changes to the pattern, flow and timing of water entering the downstream portion of the freshwater ecosystem when surface water is present (during rainfall season); • Potential alterations to the runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystem; and • Constriction of flow leading to turbulent erosive flow of increased velocity or possible loss of recharge to downstream areas, impacting on downstream biota.	45	NEGATIVE	NEGATIVE HIGH IMPACT	• It is considered imperative that all works be undertaken during the dry period to limit surface water contamination and the need for any surface water diversion during the construction works (diverting the flow of water through a pipe or an excavated channel was not included as part of this risk assessment). In so doing, the severity of impact to the hydrological functioning will be significantly reduced as would the frequency of an impact; • The design of the road and cable crossings should ensure adequate flow connectivity between the upstream and downstream portions of the freshwater ecosystems. Thus, the gravel road and cable trenches must be level with the freshwater ecosystem bed to allow water to flow over the road surface (avoid constriction of flow and alteration of flow pattern) and no drop may form downgradient of the road crossing which may result in concentrated flow and subsequent erosion; • Road crossings must be broad enough to allow for surface water (when present) connectivity over the entire width of the active channel of the freshwater ecosystem. This can be achieved by ensuring that the embankments of the freshwater ecosystem are adequately sloped (3:1 ratio recommended) to allow free flowing of surface water; and • All excavated trenches must be compacted to natural soil compaction levels to prevent the formation of preferential surface flow paths and subsequent erosion/incision.	18	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance
Hydrological functioning and surface water quality (if present) within the freshwater ecosystems identified in the study area	Potential **direct impacts** caused by **construction upgrades** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem (No-Go area) o Upgrading of existing sections of Access Roads which traverse several freshwater ecosystems. These direct impacts may result in: • Construction in the freshwater ecosystems may result in potential changes to the pattern, flow and timing of water entering the downstream portion of the freshwater ecosystem when surface water is present (during rainfall season); • Potential alterations to the runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystem; and • Constriction of flow leading to turbulent erosive flow of increased velocity or possible loss of recharge to downstream areas, impacting on downstream biota.	42	NEGATIVE	NEGATIVE MEDIUM IMPACT	• Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the freshwater ecosystems which may result in the reduction of surface roughness and cause concentrated surface runoff into the freshwater ecosystems.	18	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance

Hydrological functioning and surface water quality (if present) within the freshwater ecosystems identified in the study area.	Potential **indirect impacts** caused by **construction** of the following proposed infrastructure components not directly traversing freshwater ecosystems:
	• Within 32m ZoR (NEMA) – high sensitivity area
	  ○ LILO support towers
	• Within 100m (GN509) – medium sensitivity area
	  ○ Solar array buildable areas 1– 4
	• Outside 100m ZoR (GN509) – low sensitivity area
	  ○ Onsite substation and BESS
	  ○ Temporary laydown area and construction camp
	  ○ MTS proposed footprint
	  ○ Lesaka 1 OHPL
	These indirect impacts may result in:
	• Potential alteration to the surface water flow patterns leading to concentrated surface flow into the freshwater ecosystems;
	• Higher flood peaks into the freshwater ecosystems due to reduced surface roughness (sinuosity) of the areas surrounding the infrastructure.
		18	NEGATIVE	NEGATIVE LOW IMPACT	• It should be feasible to utilise existing roads to gain access to the proposed construction area. Use must be made of existing and newly authorised freshwater ecosystem crossings and no indiscriminate crossing of the freshwater ecosystems outside of the existing crossing points or driving in unmarked areas through the buffer zones of the freshwater ecosystems may be permitted. This will avoid/minimise any additional disturbance to the hydrological regime of the freshwater ecosystems.
					• High flood peaks from the construction footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction area enters the freshwater ecosystems. The velocity of surface water flow from these areas must be reduced by ensuring that the vegetation in the buffer area surrounding the freshwater ecosystems are intact or by the strategic placement of silt traps consisting of haybales as a means to obstruct flow but still allow flow to percolate at a reduced velocity and encourages a diffuse flow pattern.
					• Concrete may be utilised as part of the surface infrastructure activities. The following mitigation measures are applicable to prevent any impacts to the hydrological functioning of the freshwater ecosystems:
					  ○ No mixed concrete may be deposited outside of the designated construction footprint;
					  ○ As far as possible, concrete mixing should be restricted to the contractor laydown area. Additionally, batter / dagga board mixing trays and impermeable sumps should be provided, onto which any mixed concrete can be deposited while it awaits placing;
					  ○ Concrete spilled outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site; and
					• The LILO support towers must have rip rap or rock-packed (or similar erosion protection) installed around their vertices to ensure that any potential preferential flow paths continue to drain to their intended downstream reaches (considering that the support towers will be within 32 m of the Klein Rooiberg River), and to protect the downstream freshwater ecosystems from any potential erosion generated around these vertices.
						5	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR -)	Significance

CONSTRUCTION PHASE SUMMARY

	Direct Impacts – new infrastructure		Direct impacts – road upgrades		Indirect impacts – within 100m ZoR (GN509)	
Impact Significance as per suggested Mitigation	Before	After	Before	After	Before	After
Habitat and biota	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
Geomorphological processes	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
Hydrological functioning & surface water quality	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR-)	Significance
OPERATIONAL PHASE								
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by the **operation** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Access roads These direct impacts may result in: • Continued use of road may result in the disturbance of vegetation and biota of the freshwater ecosystems; and • Proliferation of opportunistic alien and invasive species due to ongoing disturbances	36	NEGATIVE	NEGATIVE MEDIUM IMPACT	• No indiscriminate driving through the freshwater ecosystems may be permitted. Use must be made of the existing freshwater ecosystem crossings only; • Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided; • Vehicles used in the development site must be regularly washed (within a non-permeable area or off-site) to avoid the dispersal of seeds on any alien or invasive species into the freshwater ecosystems; • Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to manage the establishment of indigenous vegetation and reduce the presence of any alien or invasive plant species; and • Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the road crossings and surface infrastructure areas. 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.	18	NEGATIVE	NEGATIVE LOW IMPACT
	Potential **indirect impacts** caused by **the operation** of the following proposed infrastructure components not directly traversing freshwater ecosystems: • Within 32m (NEMA) ZoR – high sensitivity area o LILO support towers • Within 100m (GN509) – medium sensitivity area o Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509 – low sensitivity area o Onsite substation and BESS o MTS proposed footprint o Lesaka 1 OHPL These indirect impacts may result in: • Disturbance to the buffer zone surrounding the freshwater ecosystem, making the freshwater ecosystems vulnerable to the invasion of alien and invasive vegetation species; and	14	NEGATIVE	NEGATIVE LOW IMPACT	• No indiscriminate movement of construction equipment in the buffer zones surrounding the freshwater ecosystems may be permitted. Use must be made of the existing roads only; • Vehicles used in the development site must be regularly washed (within a non-permeable area or off-site) to avoid the dispersal of seeds on any alien or invasive species into the surrounding terrestrial environment and the subsequent dispersal thereof into the freshwater ecosystems and • Ensure that routine inspections and monitoring of surface infrastructure are undertaken to manage the establishment of indigenous vegetation and the presence of any alien or invasive plant species, so as to reduce the spread of such species into the freshwater ecosystems.	5	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR-)	Significance
	• Reduction in the surface roughness surrounding the freshwater ecosystems.							
Geomorphological processes, hydrological functioning and surface water quality (if present) within the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by the **operation** of the proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem – No-Go area ○ Access roads These direct impacts may result in: • Concentrated runoff from the road/surface infrastructure leading to erosion and subsequent sedimentation of the freshwater ecosystems (increase in the sediment load) and turbulent flows when surface water is present; and • Higher flood peaks into the freshwater ecosystems due to reduced surface roughness in the freshwater ecosystems and immediate vicinity of the surface infrastructure.	39	NEGATIVE	NEGATIVE MEDIUM IMPACT	• 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 that no erosion of the freshwater ecosystems occurs. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the freshwater ecosystem (through vegetation and rocky areas); • Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the freshwater ecosystems may be permitted; • During periodic maintenance activities of the roads/surface infrastructure, 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.	18	NEGATIVE	NEGATIVE LOW IMPACT
Geomorphological processes, hydrological functioning and surface water quality (if present) within the freshwater ecosystems identified in the study area.	Potential **indirect impacts** caused by the operation of the following proposed infrastructure components that do not directly traverse freshwater ecosystems: • Within 32m (NEMA) ZoR – high sensitivity area • LILO support towers • Within 100m (GN509) – medium sensitivity area ○ Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509 – low sensitivity area ○ Onsite substation and BESS ○ MTS proposed footprint ○ Lesaka 1 OHPL These indirect impacts may result in:	14	NEGATIVE	NEGATIVE LOW IMPACT	• No water used as part of the SEF cleaning activities may enter the freshwater ecosystems. It should be ensured that the water is collected in stormwater management systems within the development area. This must be included in the Stormwater Management Plan for the proposed SEF development; • No concentrated surface water flow from the surface infrastructure areas may enter the freshwater ecosystems. Flow must be spread in a diffuse manner over the landscape to eventually enter the freshwater ecosystems. This can be achieved by ensuring a high surface roughness of the buffer area surrounding the freshwater ecosystems and by the strategic placement of either permanent or temporary energy dissipation structures; and • The LILO support towers must be monitored to ensure that the erosion protection structure has remained intact and that no erosion around the support structure has taken place. The structure must be repacked in the event that it has failed.	5	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	Significance		TOTAL	STATUS (+ OR-)	Significance
	• Concentrated surface water entering the freshwater ecosystems leading to erosion and adding to the sediment load of the freshwater ecosystems; and • Contaminated surface water (from cleaning activities) may enter the freshwater ecosystems.							

OPERATION PHASE SUMMARY

	Direct Impacts		Indirect impacts	
Impact Significance as per suggested Mitigation	**Before**	**After**	**Before**	**After**
Habitat and biota	**(-) M**	**(-) L**	**(-) L**	**(-) L**
Geomorphological processes, hydrological functioning and surface water quality	**(-) M**	**(-) L**	**(-) L**	**(-) L**

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	SIGNIFICANCE		TOTAL	STATUS (+ OR -)	SIGNIFICANCE
DECOMMISSIONING PHASE								
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **direct and indirect** impacts that may potentially result due to the decommissioning activities: • Clearing of habitat that has established in previous phases, resulting in a disturbed ecological structure; • Compaction and disturbance of soils due to decommissioning activities, making the impacted areas unfavourable for the establishment of vegetation and may allow for opportunistic alien and invasive species to establish in the freshwater ecosystems; • Movement of construction vehicles within the freshwater ecosystems, disturbing established biota in the freshwater ecosystems.	39	NEGATIVE	NEGATIVE MEDIUM IMPACT	• No indiscriminate movement of construction equipment in the freshwater ecosystems and buffer zones surrounding the freshwater ecosystems may be permitted. Use must be made of the existing roads during the decommissioning phase; • All surface infrastructure within the freshwater ecosystems and that within its 100 m ZoR must be decommissioned. All materials must be removed from the freshwater ecosystems (where appliable) and may temporarily be stockpiled outside the 32 m NEMA ZoR, where after is must be removed from site and disposed of at a registered disposal facility; • Should road crossings be decommissioned, road footprint areas within the freshwater ecosystem 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; • Freshwater ecosystem embankments must be suitably rehabilitated (shaped and revegetated) to prevent any erosion from occurring; • All bare areas in the study area, specifically where vegetation was initially cleared for surface infrastructure components) must be ripped and be revegetated within suitable indigenous vegetation species; • All areas revegetated must be monitored until suitable basal cover has been re-established. Follow up revegetation should take place in areas where initial revegetation is not successful; • It is recommended that a Freshwater ecosystem Rehabilitation and Management Plan be compiled and implemented once the layout plan has been finalised. Implementation must be overseen by a suitably qualified Environmental Control Officer (ECO) and must sign off the rehabilitation before the relevant contractors leave site; and • Post-closure monitoring of the freshwater ecosystems (for a period of 3 years), with specific mention of the invasion of alien vegetation species) is recommended.	18	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	SIGNIFICANCE		TOTAL	STATUS (+ OR -)	SIGNIFICANCE
Geomorphological processes, hydrological functioning and surface water quality (if present) within the freshwater ecosystems identified in the study area.	Potential **direct and indirect** impacts that may potentially result due to the decommissioning activities: • Site disturbance and trampling of vegetation resulting in increased runoff which leads to erosion and alteration of the geomorphology of the freshwater ecosystems; • Disturbance to the erodible soils, that may potentially result an increased risk of bank incision, sheet erosion and gully formation in the freshwater ecosystems and their surrounding area; • Increased movement of construction vehicles within the freshwater ecosystems (utilising freshwater ecosystem road crossings) resulting in soil compaction; • Potential runoff from stockpiles, earthwork activities and disposal of hazardous materials contributing to the freshwater ecosystem sediment load; and • Latent impacts from landscape scarring after decommission which creates a loss of ground cover that may potentially lead to erosion and sedimentation of freshwater ecosystems.	16	NEGATIVE	NEGATIVE LOW IMPACT	• No indiscriminate movement of construction equipment through the freshwater ecosystems outside of the existing crossing point or driving in unmarked areas through the buffer zones of the freshwater ecosystems may be permitted. This will avoid any disturbance to the freshwater ecosystem. • 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 freshwater ecosystems. The velocity of surface water flow from these areas must be reduced by ensuring that the vegetation in the buffer area surrounding the freshwater ecosystems are 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; • Areas where surface infrastructure have been decommissioned and removed must be suitably compacted and revegetated to ensure that no erosion occurs which may contribute to the sediment load of the freshwater ecosystems; and • 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.	5	NEGATIVE	NEGATIVE LOW IMPACT
CUMULATIVE IMPACT								
Drainage system habitat integrity and hydrological functioning.	• Loss of freshwater ecosystem vegetation and subsequent habitat, due to freshwater ecosystem road crossings and potential infrastructure located in the freshwater ecosystems; and • Changes to flow, pattern and timing of surface water in the drainage system due to land use changes in the catchment, potentially resulting in changes to the hydrological regime of the larger downstream freshwater ecosystems.	39	NEGATIVE	NEGATIVE MEDIUM IMPACT	• The mitigation measures pertaining to the construction of new road infrastructure must be adhered to, specifically to avoid erosion and only allow new road crossings where authorised; • Continuous and more frequent use of the roads and movement within the freshwater ecosystems and surrounding buffer areas during the life of the proposed SEF development may compromise the integrity of the freshwater ecosystems. As such it is highly recommended that a Freshwater ecosystem Maintenance and Management Plan (WMMP) be implemented, to avoid any unnecessary impacts and to ensure adequate mitigation of activities that may directly impact on the freshwater ecosystems, in order to avoid extensive cumulative impacts from occurring. This WMMP must detail: o Alien and invasive plant species control; o Sediment and erosion control; and o Hydrological connectivity.	20	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION			RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION		
		TOTAL	STATUS (+ OR -)	SIGNIFICANCE		TOTAL	STATUS (+ OR -)	SIGNIFICANCE
NO GO ALTERNATIVE								
No-Go Alternative (the option of not fulfilling the proposed project)	• This alternative would result in no environmental impacts and thus no impacts to the freshwater ecosystems in the study area from the proposed project on the site or surrounding local area. Implementing the no-go option would entail no development.	5	POSITIVE	POSITIVE LOW IMPACT	Since no activities will be constructed or operated, no mitigation measures can be applied.	5	POSITIVE	POSITIVE LOW IMPACT

7.3 Impact Assessment Discussion

The following results from the Impact Assessment are discussed below:

- Direct impacts relating to the **construction** of new access roads and SEF grid infrastructure determined a Negative High Impact significance before mitigation and a Negative Low Impact significance after mitigation on all of the above listed assessed drivers and receptors of watercourses in the landscape;
- Direct impacts relating to **construction** of existing access roads determined a Negative Medium Impact before mitigation and a Negative Low Impact significance after mitigation on all of the above listed environmental parameters;
- Indirect impacts relating to **construction** of SEF grid infrastructure determined a Negative Low Impact before mitigation and a Negative Low Impact after mitigation on all of the above listed environmental parameters;
- Direct impacts relating to the **operation** of new access roads determined a Negative Medium Impact significance before mitigation and a Negative Low Impact significance after mitigation on all of the above listed environmental parameters;
- Indirect impacts relating to the **operation** of SEF infrastructure determined a Negative Low Impact before mitigation and a Negative Low Impact after mitigation on all of the above listed environmental parameters;
- Cumulative impacts determined a Negative Medium Impact before mitigation and Negative Low Impact after mitigation on the drainage system habitat integrity and hydrological functioning;
- The impact of the No-Go Alternative would present a positive low impact before and after mitigation.

Pertinent mitigation to ensure that Low Negative Impacts can be achieved during the various project phases are listed below as follows: (Refer to comprehensive mitigation measures list in Table 12)

- General
  - All construction works for the freshwater ecosystem road crossings must be supervised by a freshwater ecologist that must ensure that weather conditions are sufficiently dry enough such that no diversion of flow is necessary to proceed with construction – this is imperative to maintain a low impact significance;
  - Construction activities in the freshwater ecosystem will potentially result in bank destabilisation, and cause bank incision and sedimentation of the freshwater ecosystem, therefore, sediment control devices should be installed downgradient of the construction site in the freshwater ecosystem and all excess sediment is to be removed once construction activities have been completed;
  - For the solar arrays near episodic drainage lines, a 25 m setback to be allowed to ensure sufficient space for erosion and sediment control and dissipation near these episodic features, as these areas are subjected to greater amounts of runoff compared to non-developed areas during high rainfall events; and
  - Existing roads and newly authorised freshwater ecosystem crossings should be utilised to gain access to the proposed construction area. No indiscriminate crossing of the freshwater ecosystems outside of the existing crossing points or driving in unmarked areas through the buffer zones of the freshwater ecosystems may be permitted;
  - Development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential;
  - New road crossings must intersect the freshwater ecosystem at a right angle (perpendicular) as far as possible to minimise disturbance to the freshwater ecosystem;
  - Soils excavated as part of trenching must be stockpiled immediately upstream of the trench and backfilled as soon as possible with the removed material and suitably compacted to avoid any erosion and preferential flow paths from forming;
  - During excavation activities, the topsoil and vegetation that is removed should be stockpiled separately from other material outside of the 32 m NEMA ZoR; and
  - After construction of the surface infrastructure, the area surrounding the surface infrastructure must be revegetated with suitable indigenous vegetation (terrestrial

vegetation) to prevent the establishment of alien vegetation species and their potential spread into the freshwater ecosystems.

- Specific to the proposed Lesaka 1 development:
  - New road crossings must intersect the freshwater ecosystem at a right angle (perpendicular) as far as possible to minimise disturbance to the freshwater ecosystem. The proposal of new access roads was done in a manner to, as far as possible, avoid and minimise crossings; and
  - The LILO support towers must have rip rap or be rock-packed (or similar erosion protection) installed around their vertices to ensure that any potential preferential flow paths continue to drain to their intended downstream reaches (considering that the support towers will be within 32 m of the Klein Rooiberg River), and to protect the downstream freshwater ecosystems from any potential erosion generated around these vertices. The support tower must be monitored for any associated erosion, and the erosion protection structure repacked in the event of a structure fail.

Provided that the above mitigation measures, including those listed in Table 12 are followed, a Negative Low significance of impact can be achieved for the activities associated with the proposed SEF development.

Sections 7.3.1 – 7.3.3 below discuss the potential impacts on the surface water features (freshwater HGM types) in terms of the SEF buildable areas, linear infrastructure and other forms of construction related impacts.

7.3.1 Potential impact on surface water features in the footprint of the SEF

The location (footprint) of the components of the solar power plant would have an important bearing on whether surface water features on the development site would be impacted or not. Under a worst case scenario, the footprint of the SEF could intercept one or more of the surface water drainage features on the site (the expected footprint of the solar array modules is approximately 582 ha. Under this scenario entire freshwater ecosystems, or certain reaches of freshwater ecosystems could be transformed, with resultant loss of riparian habitat. This could exert a localised, but important cumulative impact on surface water features on the site, and hydrological and ecological functionality (ecosystem goods and services) associated with the affected freshwater ecosystem would be lost or severely impaired.

The potential for this type of impact occurring is believed to be low and can be fully mitigated through appropriate cogent layout planning. Most importantly, large parts of the development site have been identified to have no surface water drainage (Figures 13-15), thus the SEF components could be easily developed on parts of the site in which no surface water features (freshwater ecosystems) are present, thus resulting in far less risk form a freshwater ecological perspective.

7.3.2 Impacts Associated With The Proposed Grid Infrastructure

The area in which the MTS footprint is proposed does not comprise of any freshwater ecosystems and the MTS footprint, together with the Lesaka 1 OHPL are outside of the 100 m zone of regulation as defined in GN509 of 2016. The proposed LILO connection between the onsite substation and the existing 400 kV OHPL that feeds to the Helios MTS would be required to span the Klein Rooiberg River for an approximate distance of 250 m. The proposed support towers would however be placed outside of the 25 m development setback (ecological protection buffer) of this river, and provided that the mitigation measures, as listed in Table 12 above are followed, no significant cumulative impacts to the environment due to the above proposed grid infrastructure are envisaged.

The proposed grid infrastructure is illustrated in Figures 23 below.

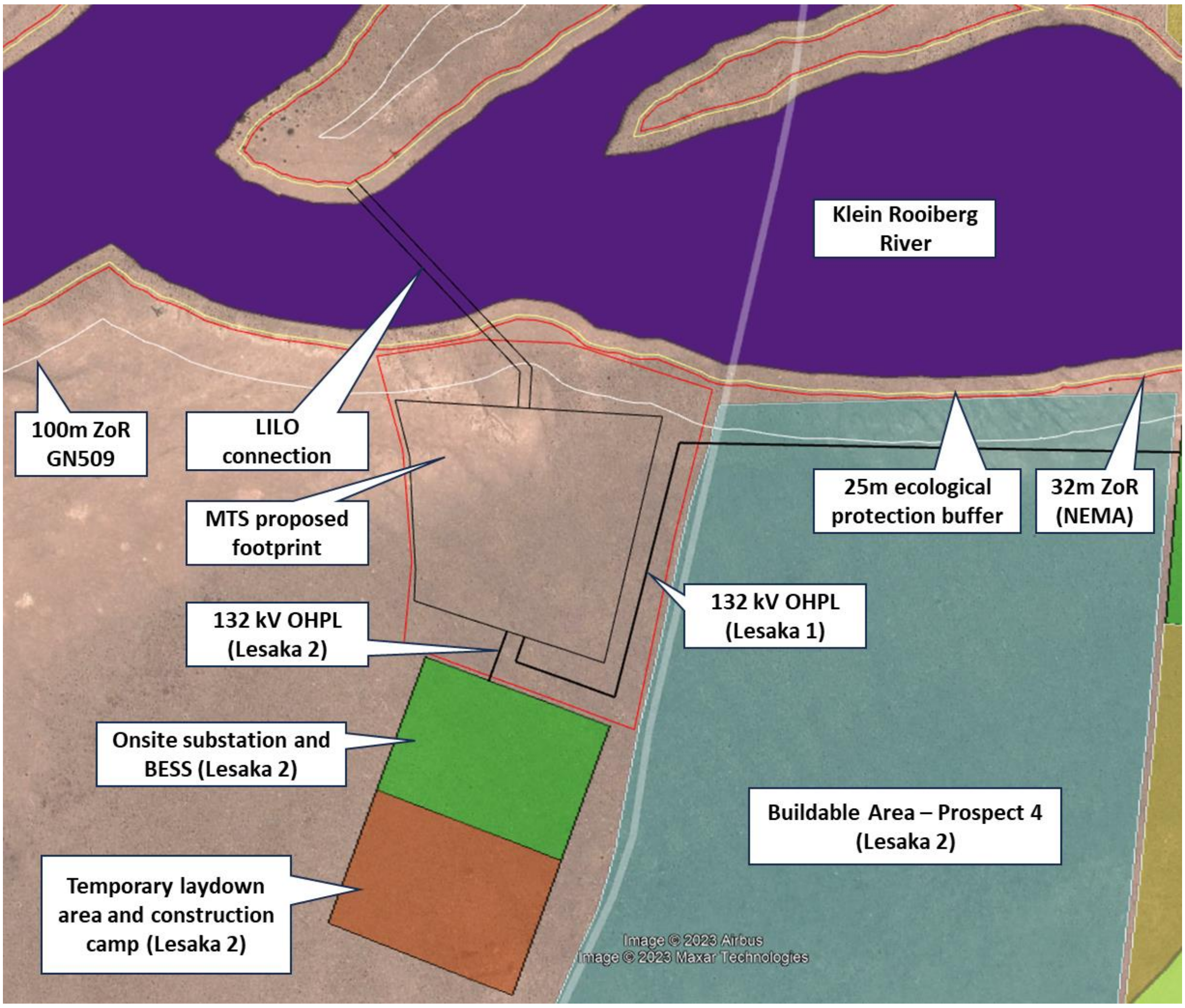


Figure 23: Location of the proposed grid infrastructure with respect to other SEF infrastructure, freshwater ecosystems, Zones of Regulation and development setbacks.

7.3.2.1 Impacts related to access roads

Access roads, could potentially also exert an impact on surface water features, as they would have a physical footprint within the surface water feature crossed. The primary potential impacts related to access roads is the physical disturbance of substrate and vegetation, and the creation of a physical barrier across a drainage feature that could potentially affect the hydrological and ecological functionality of the surface water feature.

Roads can have the potential to have significant impact on surface water features, as depending on the design of the road crossing the surface water feature may be physically affected as the footprint of the road will affect the hydrology and habitat of the surface water feature to varying degrees. The degree of impact depends to a large degree on the type of the road crossing.

The two most important types of impacts that would relate to new roads constructed into and across surface water features relates to the destruction of surface water habitat and vegetation and the alteration of the hydrological regime. Depending on the nature of the design roads constructed into a surface water feature could involve the placing of imported substrate into the bed of the freshwater ecosystem. This would cause a certain area of vegetation on the banks and in the channel to be lost. The presence of a raised road crossing structure and its substrate typically acts as hydraulic barrier within the system. This leads to upstream ponding effects downstream, flow concentration and desiccation effects. The impounding effect can also have an important effect on the morphology of the freshwater ecosystem as sediment that is transported down the freshwater ecosystem during flow periods would be trapped behind the structure. This can alter the natural sediment balance of the downstream freshwater ecosystem, and by depriving the downstream stretches of sediment, can induce erosion in these stretches as the natural sediment balance is re-established. It is not considered feasible to avoid the crossing of freshwater ecosystems, but it must be noted that the proposal of new access roads was done in a manner to, as far as possible, avoid and minimise crossings, with existing access roads being commissioned for this development as far as possible.

Where a bridge structure is not constructed, culverts are typically used as bridge structures. The number and size of the culverts is an important factor in determining the degree and nature of the impact on the hydromorphological regime of the feature; too few culverts can exacerbate the upstream ponding effects of the road, also concentrating flow downstream of the crossing which can result in channelisation of the downstream portion of the surface water feature, exerting an impact on riparian vegetation.

It should be noted that the episodic nature of flows along the freshwater ecosystems on the site entails that such hydrological impacts would only be experienced transiently during isolated periods of surface flow. Nonetheless it is important that these flows be allowed to traverse road crossing structures, as these flows are likely to be important for the maintenance of riparian vegetation along the downstream reaches of the freshwater ecosystem.

Roads can also form hard barriers which can hamper the movement of terrestrial biota along the riparian corridor, and even other flying invertebrates such as butterflies. This must be considered in the final design of the crossing structures.

Roads can also be associated with stormwater inputs into surface water features, especially if the road has an impermeable surface. Stormwater input can be associated with a number of impacts; firstly it can artificially increase the flow within the surface water feature during rainfall events, resulting in potential knock-on effects on the downstream portions of the freshwater ecosystem such as scour and erosion. Stormwater may also pick up pollutants that are spilt onto the road surface, especially fuel, oil and other hydrocarbons that could pollute the downstream surface water feature. Lastly, but just as importantly, stormwater may also contribute silt from the catchment or road surface itself into a freshwater ecosystem, thus altering the habitat integrity of the feature.

7.3.3 Other Potential Construction Related Impacts

The process of constructing the linear infrastructure through freshwater ecosystems could potentially impact these features in other ways through a series of construction-related impacts. The following impacts on surface water features can result from construction activities along the servitude:

- The uncontrolled interaction of construction workers with freshwater ecosystems that could lead to the pollution of these freshwater ecosystems, e.g. dumping of construction material into the drainage system, washing of equipment etc.
- The lack of provision of adequate sanitary facilities and ablutions on the servitude may lead to direct or indirect faecal pollution of surface water resources.
- Leakage of hazardous materials, including chemicals and hydrocarbons such as fuel, and oil, which could potentially enter nearby surface water resources through stormwater flows, or directly into the sandy soils within freshwater ecosystems. This may arise from their incorrect use or incorrect storage. This is not only associated with a risk of pollution of surface water, but with a risk of the pollution of shallow groundwater within the riparian zone due to the presence of typically highly permeable alluvial substratum.
- The potential incorrect mixing (batching) of cement could lead to siltation and contamination of freshwater ecosystems, as described above.
- Potential inadequate stormwater management and soil stabilisation measures in cleared areas could lead to erosion that could cause the loss of riparian vegetation and which would lead to siltation of nearby freshwater ecosystems.

7.3.4 Recommendations to be included in the EMPr

Table 13 below provides a list of monitoring actions to ensure the continued success of the mitigation measures discussed in Section 7.3.

Table 13: Monitoring actions to be implemented with the activities associated with the proposed development.

Aspect	Phase	Monitoring Location	Frequency	Performance Indicator (Methodology)	Reporting Requirement
Erosion and sedimentation	Construction	• Freshwater ecosystem road crossings • Surrounding the solar arrays (buildable areas 1- 4)	Visual inspections must take place after rainfall events.	To monitor the extent of erosion and sedimentation of the freshwater ecosystems. Provide a report addressing the following: 1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed; 3. Photographs and GPS point locations taken of existing erosion prior to and post rehabilitation activities must be incorporated into the report; 4. Any erosion observed must be discussed in detail; 5. Map indicating where erosion is present; and 6. Recommended mitigation and remediation actions should be presented and dates when remediation actions were undertaken.	
	Operation		Visual inspections must take place monthly during the winter rainy season for three years after the completion of construction to monitor and remove debris, sediment deposits and erosion along the freshwater ecosystem crossings.		
Alien Invasive Species Plant Control.	All phases	• Freshwater ecosystem road crossings • Surrounding the solar arrays (buildable areas 1- 4), BESS and substation	Monitoring must be undertaken as per an Alien and Invasive plant species plan. This must include: • Visual inspection of construction footprint areas once a month during the construction phase; • Visual inspections must take place monthly during the winter rainy season for three years after the completion of construction to monitor the establishment of alien or invasive plant species, specifically at the freshwater ecosystems in the vicinity of the buildable areas (1-4), but also surrounding the BESS and substation.	To monitor the germination of AIPs at freshwater ecosystem road crossings and surrounding the buildable areas. BESS and substation: The report needs to address the following: 1. A list of species identified within the focus areas; 2. Discuss the density of species; 4. Fixed point photo (Taking photo at specific point within focus area where AIPs was identified); and 5. Focus areas requiring AIP control and proposed AIP control measures.	Reporting to be included as part of the annual ECO monitoring report and submitted to the competent authority.
Revegetation	All phases	• Freshwater ecosystem road crossings (those that will not be retained as maintenance roads) • Surrounding the solar arrays (buildable areas 1- 4), BESS and substation	A vegetation assessment to be undertaken one year post rehabilitation (during the growing season) to ensure plant survival and to ensure that no AIPs are outcompeting indigenous species.	To monitor the reinstatement of vegetation. The report needs to address the following: 1. A list of species occurring within the focus areas; 2. Discuss the density of species; 4. Fixed point photo (Taking photo at specific point within focus area to identify the success of revegetation; and 5. Focus areas requiring remedial action and proposed corrective actions.	

8 CONCLUSION

FEN Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment to inform the EA processes as part of the EIA phase for the proposed SEF 1 development.

A field assessment took place between the 4th and 6th of October 2022 which confirmed a vast drainage network of episodic drainage lines that were categorised as follows:

- Preferential Flow Paths
- Episodic Drainage Lines without Riparian Vegetation
- Episodic Drainage Lines with Riparian Vegetation
- Episodic Rivers with Riparian Vegetation

Only the episodic drainage lines and rivers with riparian vegetation can, from an ecological perspective, be classified as freshwater ecosystems due to the expression of a riparian response and the presence of alluvial soil. PFPs are highly unlikely to have catchments which are large enough to generate a flood response and are not considered freshwater ecosystems from an ecological perspective. Episodic drainage lines without riparian vegetation may, on a system specific basis be considered freshwater ecosystems should they be subject to a 1:100 year floodline, as determined by a suitably qualified professional. Nevertheless, PFPs and drainage lines, not defined as freshwater ecosystems still function as waterways, through the episodic conveyance of water through the landscape. These systems are still considered important for the hydrological functioning of the larger episodic tributaries and rivers and must ideally be protected to manage the pattern, flow and timing of water in the landscape. Therefore, this implies that runoff from the project area must be carefully managed

The ecological assessment results of the freshwater HGM types are tabulated below in Table 13.

Table 14: Summary of results of the field assessment as discussed in Section 5.

Freshwater HGM Type	Present Ecological State (PES)		Ecoservices (supply importance)	Ecological Importance and Sensitivity (EIS)
Episodic drainage lines without riparian vegetation	Considered to be in a largely natural condition (PEC Class B) based on field observations of the ecological drivers (hydrology, geomorphology, biota and water quality.)		➢ Sediment trapping ➢ Erosion control ➢ Biodiversity maintenance	Moderate
Episodic drainage lines with riparian vegetation	**Instream IHI** B/C (Largely natural to moderately modified)	**Riparian IHI** D (Largely Modified)	➢ Sediment trapping ➢ Erosion control ➢ Biodiversity maintenance	Moderate
Episodic rivers with riparian vegetation	**Instream IHI** C (Moderately modified)	**Riparian IHI** E (Seriously Modified)	➢ Sediment trapping ➢ Erosion control ➢ Harvestable resources	Moderate

Anthropogenic impacts within this remote landscape include those associated with sheep farming, informal and formal gravel road freshwater ecosystem crossings, the Transnet railway line freshwater ecosystem crossings and most notably, infestation by Prosopis alien invasive shrubs. These impacts pressurise the lower lying episodic drainage lines and rivers most, particularly in terms of the generation of increased sediment inputs from destabilised soil.

Mitigation measures associated with the proposed SEF development will therefore be heavily focused on maintaining sediment balance and freshwater flows in the landscape.

Notwithstanding these impacts, and the episodic nature of these freshwater HGM types, the hydrological importance together with the provision of temporary aquatic freshwater corridors and the likelihood that these systems provide important refuge and migratory corridors for smaller mammals and avifauna must be acknowledged. Furthermore, the ecological conservation importance of the study area is recognised nationally in the 2011 NFEPA and 2018 National Biodiversity Assessment databases, and provincially in the 2016 Northern Cape Critical Biodiversity Areas assessment.

The DFFE National Web-Based Environmental Screening Tool designated the majority of the investigation area as having a very high aquatic biodiversity sensitivity due to the presence of FEPA catchments, rivers, wetlands and estuaries. No wetlands and estuaries occur within the investigation area but the presence of FEPA catchments and rivers retain the very high aquatic biodiversity sensitivity within of the investigation area. However, the DWAF (1999) EIS tool for riparian watercourses determined an overall moderate EIS for the various freshwater HGM types, with the EDLs in the upland areas being more sensitive than the ephemeral rivers to alien invasive vegetation invasion. The proponent has however made suitable provision for the protection of no -go areas and areas of high and moderate sensitivity in accordance with the derived PES of these freshwater HGM types.

The NEMA Impact Assessment was applied to the proposed SEF layout in the determination to apply for EA, which was informed by the footprints of the freshwater HGM types, their ZoR and determined development setback buffers as per Macfarlane et al. (2014), ultimately for the classification of environmental sensitivities against which the Impact Assessment can be rated.

The Impact Assessment identified that the Negative High and Medium Impacts in the construction, operation and decommissioning phases after mitigation can be lowered to a Negative Low Impact, on condition of strict adherence to general and project-specific suggested mitigation measures.

Only the proposed access roads pose direct impacts to freshwater ecosystems, but the layout was proposed in a manner to, as far as possible, avoid and minimise crossings. All other infrastructure falls outside of the 32 m NEMA ZoR, except the proposed LILO support towers which will fall within the 32 m NEMA ZoR, but outside of the 25 m development setback.

The results of the Impact Assessment are shown below in Table 14.

Table 15: Summary of the impact significance for the various project phases before and after mitigation for the proposed SEF 1 development.

Phase	Environmental Parameter	Direct Impacts – new infrastructure		Direct impacts – road upgrades		Indirect impacts – within 100m ZoR (GN509)	
CONSTRUCTION	Impact Significance as per suggested Mitigation	Before	After	Before	After	Before	After
	Habitat and biota	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
	Geomorphological processes	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
	Hydrological functioning & surface water quality	(-) H	(-) L	(-) M	(-) L	(-) L	(-) L
OPERATION	Environmental Parameter	Direct Impacts				Indirect Impacts	
	Impact Significance as per suggested Mitigation	Before		After		After	
	Habitat and biota	(-) M		(-) L		(-) L	
	Geomorphological processes, hydrological functioning and surface water quality	(-) M		(-) L		(-) L	
DECOMMISSION	**Environmental Parameter**	Direct and Indirect Impacts					
	Impact Significance as per suggested Mitigation	Before				After	
	Habitat and biota	(-) M				(-) L	
	Geomorphological processes, hydrological functioning and surface water quality	(-) L				(-) L	

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place (and the implementation of general construction management and good housekeeping practices, as per Appendix F), the significance of impacts arising from the proposed SEF development can be adequately managed and the project considered for EA.

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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 Consulting (Pty) Ltd and its staff reserve the right to, at their sole discretion, 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 Environmental Management: Biodiversity Act, 2004(Act No.10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. (b) An MEC for environmental affairs in a province may, by notice in the Gazette, publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): (a) critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; (b) endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; I vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and (d) protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs (a), (b) or (c).
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 freshwater ecosystem 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 freshwater ecosystem 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 freshwater ecosystems and drainage line features present in close proximity of the SEF development are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.2 *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 SEF development.

1.3 *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 freshwater ecosystem traversed by the proposed linear development.

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

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

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

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

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

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

Level 1: Inland systems

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

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

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

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

[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.

- **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).

1. Wet-Ecoservices (2020)

The WET-Ecoservices (v2) method by Kotze et al. (2020) provides an overall importance score to each of the ecoservices listed below (Table C4). The overall importance score of each ecoservice is calculated by integrating its respective supply and demand scores (Table C3). Each ecoservice supply and demand score in turn is calculated using an algorithm that has been designed to reflect the relative importance and interactions of the attributes represented by indicators that characterise that ecoservice.

The supply of an ecoservice is related to the innate ability of the wetland to provide a particular service, tying to its PES, while the demand on an ecoservice is founded on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency.

The WET-Health (v2) summary thus enables the reader to gauge both the relative importance of the individual ecoservice supply and demand scores and combined (overall) ecoservice importance.

➢ Flood attenuation	➢ Biodiversity maintenance
➢ Stream flow regulation	➢ Provision of water for human use
➢ Sediment trapping	➢ Provision of harvestable resources
➢ Phosphate assimilation	➢ Food for livestock
➢ Nitrate assimilation	➢ Provision of cultivated foods
➢ Toxicant assimilation	➢ Cultural and spiritual experience
➢ Erosion control	➢ Tourism and recreation
➢ Carbon storage	➢ Education and research

Table C3: Integration of ecoservice supply and demand scores to derive overall importance

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0.0	0.0	0.5	1.5	2.5
Low	1	0.0	0.0	1.0	2.0	3.0
Moderate	2	0.0	0.5	1.5	2.5	3.5
High	3	0.0	1.0	2.0	3.0	4.0
Very High	4	0.5	1.5	2.5	3.5	4.0

Table C4: Ecoservice importance categories and descriptions based on integration of supply and demand scores.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

2. 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 C5: 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

3. Riparian Vegetation Response Assessment Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a freshwater ecosystem which are commonly characterised by alluvial soils, 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.

The Riparian Vegetation Response Assessment Index (VEGRAI) is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results[9]. Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

[9] Kleynhans et al, 2007

4. 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 freshwater ecosystem 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 C6: 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

5. 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 freshwater ecosystem (sections above), with the objective of either maintaining, or improving the ecological integrity of the freshwater ecosystem in order to ensure continued ecological functionality.

Table C7: Recommended management objectives (RMO) for freshwater ecosystems based on PES & EIS scores.

			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
PES	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
PES	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
PES	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
PES	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
PES	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 freshwater ecosystem fall into one of these PES categories, a REC class D is allocated by default, as the minimum acceptable PES category.**

A freshwater ecosystem may receive the same class for the REC as the PES if the freshwater ecosystem 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 freshwater ecosystem.

Table C8: Description of Recommended Ecological Category (REC) classes.

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

6. Freshwater ecosystem 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 soils 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 soils 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: Impact Assessment Methodology

SIVEST IMPACT ASSESSMENT

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 3.

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

Impact Rating System

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

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used to Classify Impacts

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

Table D1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT I		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY I		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).

3	Long term	The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		

Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered “fatal flaws”.
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Impact Summary

The impacts will then be summarized, and a comparison made between pre and post mitigation phases as shown in the table below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity will be averaged. A comparison will then be made to determine the effectiveness of the proposed mitigation measures. The comparison will identify critical issues related to the environmental parameters.

Table D2: Comparison of 84ummarized impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Surface water	Erosion	43		16	
	Oil spills	22		22	
	Alteration of aquatic biota	16		3	
			- 27		**-13.67**
			Low Negative Impact		Low Negative Impact

Comparative assessment of proposed project alternatives

Table D3: Key for the preference classes to the proposed project alternatives

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

APPENDIX E: Results of Field Investigation

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

Table D1: Summary of the results of the IHI assessment applied to the episodic rivers with riparian vegetation.

	MRU
INSTREAM IHI	
Base Flows	-3.0
Zero Flows	0.0
Floods	-1.0
HYDROLOGY RATING	**1.5**
pH	0.5
Salts	0.5
Nutrients	0.5
Water Temperature	1.0
Water clarity	-0.5
Oxygen	-1.0
Toxics	
PC RATING	**0.5**
Sediment	1.0
Benthic Growth	
BED RATING	**1.0**
Marginal	4.0
Non-marginal	4.0
BANK RATING	**4.0**
Longitudinal Connectivity	-1.5
Lateral Connectivity	-2.0
CONNECTIVITY RATING	**1.7**
INSTREAM IHI %	**70.4**
INSTREAM IHI EC	**C**
INSTREAM CONFIDENCE	**3.8**

	MRU
RIPARIAN IHI	
Base Flows	-3.0
Zero Flows	0.0
Moderate Floods	-1.5
Large Floods	-1.0
HYDROLOGY RATING	**1.5**
Substrate Exposure (marginal)	1.0
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	5.0
Invasive Alien Vegetation (non-marginal)	4.0
Erosion (marginal)	1.0
Erosion (non-marginal)	1.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	5.0
Non-marginal	4.0
BANK STRUCTURE RATING	**4.3**
Longitudinal Connectivity	4.0
Lateral Connectivity	4.0
CONNECTIVITY RATING	**4.0**
RIPARIAN IHI %	**34.2**
RIPARIAN IHI EC	**E**
RIPARIAN CONFIDENCE	**4.0**

Table D2: Summary of the results of the IHI assessment applied to the episodic drainage lines with riparian vegetation.

	MRU
INSTREAM IHI	
Base Flows	-1.5
Zero Flows	0.0
Floods	-1.0
HYDROLOGY RATING	**0.9**
pH	0.5
Salts	0.5
Nutrients	0.5
Water Temperature	1.0
Water clarity	-0.5
Oxygen	-1.0
Toxics	
PC RATING	**0.5**
Sediment	1.0
Benthic Growth	
BED RATING	**1.0**
Marginal	3.0
Non-marginal	2.0
BANK RATING	**2.6**
Longitudinal Connectivity	-0.5
Lateral Connectivity	-1.5
CONNECTIVITY RATING	**0.7**
INSTREAM IHI %	**79.9**
INSTREAM IHI EC	**B/C**
INSTREAM CONFIDENCE	**3.8**

	MRU
RIPARIAN IHI	
Base Flows	-1.5
Zero Flows	0.0
Moderate Floods	1.5
Large Floods	-1.0
HYDROLOGY RATING	**1.1**
Substrate Exposure (marginal)	1.0
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	3.0
Invasive Alien Vegetation (non-marginal)	4.0
Erosion (marginal)	1.0
Erosion (non-marginal)	1.0
Physico-Chemical (marginal)	0.5
Physico-Chemical (non-marginal)	0.5
Marginal	3.0
Non-marginal	4.0
BANK STRUCTURE RATING	**3.6**
Longitudinal Connectivity	2.0
Lateral Connectivity	2.5
CONNECTIVITY RATING	**2.2**
RIPARIAN IHI %	**50.9**
RIPARIAN IHI EC	**D**
RIPARIAN CONFIDENCE	**4.0**

Table D3: Summary of the results of the EIS assessment applied to the episodic rivers with riparian vegetation.

ECOLOGICAL IMPORTANCE & SENSITIVITY - Episodic rivers with riparian veg		
CRITERIA	**EIS Scores**	**Confidence**
BIOTIC		
Rare & endangered biota	1	High
Unique biota	2	Medium
Intolerant (i.e. sensitive) biota	1	High
Species/taxon richness	2	High
Median score (Biotic criteria)	**1.5**	**Medium**
	(Moderate EIS)	
HABITAT		
Diversity of aquatic habitat types	1	Medium
Refuge value of habitat types	2	Medium
Sensitivity of habitat to flow changes	0	Medium
Sensitivity of habitat to WQ changes	0	Medium
Migration route/corridor	4	High
Protected/natural areas	4	High
Median score (Habitat criteria)	**1.5**	**Medium**
	Moderate EIS)	
Overall median score	**1.5**	**Medium**
	(Moderate EIS)	

Table D4: Summary of the results of the EIS assessment applied to the episodic drainage lines with riparian vegetation.

ECOLOGICAL IMPORTANCE & SENSITIVITY - Episodic Drainage Lines with riparian veg		
CRITERIA	**EIS Scores**	**Confidence**
BIOTIC		
Rare & endangered biota	1	High
Unique biota	2	Medium
Intolerant (i.e. sensitive) biota	1	High
Species/taxon richness	2	High
Median score (Biotic criteria)	**1.5**	**Medium**
	(Moderate EIS)	
HABITAT		
Diversity of aquatic habitat types	1	Medium
Refuge value of habitat types	2	Medium
Sensitivity of habitat to flow changes	0	Medium
Sensitivity of habitat to WQ changes	0	Medium
Migration route/corridor	3	High
Protected/natural areas	4	High
Median score (Habitat criteria)	**1.5**	**Medium**
	(Moderate EIS)	
Overall median score	**1.5**	**Medium**
	(Moderate EIS)	

Table D5: Summary of the results of the EIS assessment applied to the episodic drainage lines without riparian vegetation.

ECOLOGICAL IMPORTANCE & SENSITIVITY - Episodic Drainage Lines without riparian veg		
CRITERIA	**EIS Scores**	**Confidence**
BIOTIC		
Rare & endangered biota	1	High
Unique biota	2	Medium
Intolerant (i.e. sensitive) biota	1	High
Species/taxon richness	2	High
Median score (Biotic criteria)	**1.5** (Moderate EIS)	**Medium**
HABITAT		
Diversity of aquatic habitat types	1	Medium
Refuge value of habitat types	0	Medium
Sensitivity of habitat to flow changes	0	Medium
Sensitivity of habitat to WQ changes	0	Medium
Migration route/corridor	2	High
Protected/natural areas	2	High
Median score (Habitat criteria)	**0.5** Low EIS)	**Medium**
Overall median score	**1.0** (Moderate EIS)	**Medium**

Table D6: Presentation of the results of the Ecoservices applied to the episodic rivers with riparian vegetation.

		Present State				Future State			
	ECOSYSTEM SERVICE	Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.8	0.0	0.0	Very Low	0.8	0.0	0.0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Erosion control	1.1	0.2	0.0	Very Low	1.1	0.2	0.0	Very Low
	Phosphate assimilation	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Nitrate assimilation	1.4	0.0	0.0	Very Low	1.4	0.0	0.0	Very Low
	Toxicant assimilation	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Carbon storage	0.2	2.7	0.0	Very Low	0.2	2.7	0.0	Very Low
	Biodiversity maintenance	1.2	2.0	0.7	Very Low	1.2	2.0	0.7	Very Low
PROVISIONING SERVICES	Water for human use	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Harvestable resources	2.0	0.0	0.5	Very Low	2.0	0.0	0.5	Very Low
	Food for livestock	2.0	0.3	0.7	Very Low	2.0	0.3	0.7	Very Low
	Cultivated foods	3.0	0.0	1.5	Moderately Low	3.0	0.0	1.5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0.6	0.0	0.0	Very Low	0.6	0.0	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low

Table D7: Presentation of the results of the Ecoservices applied to the episodic drainage lines with riparian vegetation.

		Present State				Future State			
	ECOSYSTEM SERVICE	Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.8	0.0	0.0	Very Low	0.8	0.0	0.0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Erosion control	1.4	0.5	0.2	Very Low	1.4	0.5	0.2	Very Low
	Phosphate assimilation	1.4	0.0	0.0	Very Low	1.4	0.0	0.0	Very Low
	Nitrate assimilation	1.6	0.0	0.1	Very Low	1.6	0.0	0.1	Very Low
	Toxicant assimilation	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Carbon storage	0.3	2.7	0.2	Very Low	0.3	2.7	0.2	Very Low
	Biodiversity maintenance	2.6	2.0	2.1	Moderate	2.6	2.0	2.1	Moderate
PROVISIONING SERVICES	Water for human use	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Harvestable resources	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Food for livestock	2.0	0.3	0.7	Very Low	2.0	0.3	0.7	Very Low
	Cultivated foods	3.0	0.0	1.5	Moderately Low	3.0	0.0	1.5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0.6	0.0	0.0	Very Low	0.6	0.0	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low

Table D8: Presentation of the results of the Ecoservices applied to the episodic drainage lines without riparian vegetation.

		Present State				Future State			
	ECOSYSTEM SERVICE	Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.7	0.0	0.0	Very Low	0.7	0.0	0.0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Erosion control	1.4	0.6	0.2	Very Low	1.4	0.6	0.2	Very Low
	Phosphate assimilation	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Nitrate assimilation	1.5	0.0	0.0	Very Low	1.5	0.0	0.0	Very Low
	Toxicant assimilation	1.6	0.0	0.1	Very Low	1.6	0.0	0.1	Very Low
	Carbon storage	0.3	2.7	0.2	Very Low	0.3	2.7	0.2	Very Low
	Biodiversity maintenance	3.0	2.0	2.5	Moderately High	3.0	2.0	2.5	Moderately High
PROVISIONING SERVICES	Water for human use	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Harvestable resources	0.5	0.0	0.0	Very Low	0.5	0.0	0.0	Very Low
	Food for livestock	2.0	0.3	0.7	Very Low	2.0	0.3	0.7	Very Low
	Cultivated foods	3.0	0.0	1.5	Moderately Low	3.0	0.0	1.5	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	0.6	0.0	0.0	Very Low	0.6	0.0	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low

APPENDIX F: Impact Assessment Analysis and Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the freshwater ecosystem 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 freshwater ecosystem identified in this report:

Development footprint

- All development footprint areas should remain as small as possible and should not encroach into freshwater ecosystems unless absolutely essential and where project activities are located in the freshwater ecosystems. It must be ensured that the freshwater ecosystem 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 freshwater ecosystems 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.

Soils

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

- No stockpiling of topsoil is to take place within the recommended buffer zone around the freshwater ecosystems (unless specified otherwise), and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the freshwater ecosystems;
- All soils 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 SEF 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 freshwater ecosystem ecology of the study 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: Impact Assessment outcomes for the proposed SEF.

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S	E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
CONSTRUCTION PHASE																			
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by **construction** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem – No-Go area o Access Roads o Cable laying alongside access roads These direct impacts may result in: • Trampling by construction personnel and equipment is likely to impact on the riparian and instream vegetation, leading to habitat degradation; • Net loss of habitat and ecological structure provided by the freshwater ecosystems; and • Source of sedimentation and smothering of freshwater ecosystem habitat.	2	4	3	3	3	3	45	NEGATIVE	NEGATIVE HIGH IMPACT	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT
	Potential **direct impacts** caused by **construction upgrades** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem – No-Go area o Upgrading of existing sections of Access Roads in the study area which traverses several freshwater ecosystems. These direct impacts may result in: • Trampling by construction personnel and equipment is likely to impact on the riparian and instream vegetation, leading to habitat degradation; • Potential additional loss of habitat and ecological structure provided by the freshwater ecosystems; and • Potential changes to ecological and socio-cultural service provision.	2	4	3	2	3	3	42	NEGATIVE	NEGATIVE MEDIUM IMPACT	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S	E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
	Potential **indirect impacts** caused by **construction** of the following proposed infrastructure components not directly traversing freshwater ecosystems: • Within 32m ZoR (NEMA) – high sensitivity area ○ LILO support towers • Within 100m (GN509) – medium sensitivity area ○ Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509) – low sensitivity area ○ Onsite substation and BESS ○ Temporary laydown area and construction camp ○ MTS proposed footprint ○ Lesaka 1 OHPL These indirect impacts may result in: • Disturbance to the buffer zone surrounding the freshwater ecosystem, making the freshwater ecosystems vulnerable to the invasion of alien and invasive vegetation species; and • Source of sedimentation and smothering of freshwater ecosystem habitat	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT	1	1	1	1	1	1	5	NEGATIVE	NEGATIVE LOW IMPACT
Geomorphology (including sediment balance and erosion control) of the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by **construction** of the following proposed infrastructure components directly traversing freshwater ecosystems: • Within delineated freshwater ecosystem – No – Go area ○ Access Roads ○ Cable laying alongside access roads These direct impacts may result in: • Excavation and trenching leading to stockpiling of soil within close proximity to the active channel of the freshwater ecosystems; • Movement of construction equipment and personnel within the freshwater ecosystem leading to increased turbidity; • Disturbances of soils leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems and disturbance of geomorphological processes.	2	4	3	3	3	3	45	NEGATIVE	NEGATIVE HIGH IMPACT	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S	E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
	Potential **direct impacts** caused by **construction upgrades** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Within delineated freshwater ecosystem – No-Go area ○ Upgrading of existing sections of Access Roads in the study area which traverses several freshwater ecosystems. <u>These direct impacts may result in:</u> • Excavation and trenching leading to stockpiling of soil within close proximity to the active channel of the freshwater ecosystems; • Movement of construction equipment and personnel within the freshwater ecosystem leading to increased turbidity; • Disturbances of soils leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and • Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems and disturbance of geomorphological processes.	2	4	3	2	3	3	42	NEGATIVE	NEGATIVE MEDIUM IMPACT	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT
	Potential **indirect impacts** caused by **construction** of the following proposed infrastructure components not directly traversing freshwater ecosystems: • Within 32m ZoR (NEMA) – high sensitivity area ○ LILO support towers • Within 100m (GN509) – medium sensitivity area ○ Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509) – low sensitivity area ○ Onsite substation and BESS ○ Temporary laydown area and construction camp ○ MTS proposed footprint ○ Lesaka 1 OHPL <u>These indirect impacts may result in:</u> • Reduction in the surface roughness surrounding the freshwater ecosystems leading to altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems and disturbance of geomorphological processes.	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT	1	1	1	1	1	1	5	NEGATIVE	NEGATIVE LOW IMPACT

<table>
<tr><th rowspan="2">ENVIRONMENTAL PARAMETER</th><th rowspan="2">ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE</th><th colspan="9">ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION</th><th colspan="9">ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION</th></tr>
<tr><th>E</th><th>P</th><th>R</th><th>L</th><th>D</th><th>I / M</th><th>TOTAL</th><th>STATUS (+ OR -)</th><th>S</th><th>E</th><th>P</th><th>R</th><th>L</th><th>D</th><th>I / M</th><th>TOTAL</th><th>STATUS (+ OR -)</th><th>S</th></tr>
<tr><td rowspan="2">Hydrological functioning and surface water quality (if present) of the freshwater ecosystems identified in the study area.</td><td>Potential direct impacts caused by construction of the following proposed infrastructure components directly traversing freshwater ecosystems:
• Within delineated freshwater ecosystem (No-Go area)
o Access Roads
o Cable laying alongside access roads
These direct impacts may result in:
• Construction in the freshwater ecosystems may result in potential changes to the pattern, flow and timing of water entering the downstream portion of the freshwater ecosystem when surface water is present (during rainfall season);
• Potential alterations to the runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystem; and
• Constriction of flow leading to turbulent erosive flow of increased velocity or possible loss of recharge to downstream areas, impacting on downstream biota.</td><td>2</td><td>4</td><td>3</td><td>3</td><td>3</td><td>3</td><td>45</td><td>NEGATIVE</td><td>NEGATIVE HIGH IMPACT</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>18</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
<tr><td>Potential direct impacts caused by construction upgrades of the following proposed infrastructure components that directly traverse freshwater ecosystems:
• Within delineated freshwater ecosystem (No-Go area)
o Upgrading of existing sections of Access Roads in the study area which traverses several freshwater ecosystems.
These direct impacts may result in:
• Construction in the freshwater ecosystems may result in potential changes to the pattern, flow and timing of water entering the downstream portion of the freshwater ecosystem when surface water is present (during rainfall season);
• Potential alterations to the runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystem; and
• Constriction of flow leading to turbulent erosive flow of increased velocity or possible loss of recharge to downstream areas, impacting on downstream biota.</td><td>2</td><td>4</td><td>3</td><td>2</td><td>3</td><td>3</td><td>42</td><td>NEGATIVE</td><td>NEGATIVE MEDIUM IMPACT</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>18</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
</table>

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S	E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
	Potential **indirect impacts** caused by **construction** of the following proposed infrastructure components not directly traversing freshwater ecosystems: • Within 32m ZoR (NEMA) – high sensitivity area o LILO support towers • Within 100m (GN509) – medium sensitivity area o Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509) – low sensitivity area o Onsite substation and BESS o Temporary laydown area and construction camp o MTS proposed footprint o Lesaka 1 OHPL These indirect impacts may result in: • Potential alteration to the surface water flow patterns leading to concentrated surface flow into the freshwater ecosystems; • Higher flood peaks into the freshwater ecosystems due to reduced surface roughness (sinuosity) of the areas surrounding the infrastructure.	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT	1	1	1	1	1	1	5	NEGATIVE	NEGATIVE LOW IMPACT

OPERATIONAL PHASE																			
ENVIRONMENTAL PARAMETER	**ISSUE/ IMPACT/ ENVIRONMENTAL EFFECT/ NATURE**	**ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION**									**ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION**								
		E	**P**	**R**	**L**	**D**	**I/M**	**TOTAL**	**STATUS (+ or -)**	**S**	**E**	**P**	**R**	**L**	**D**	**I/M**	**TOTAL**	**STATUS (+ or -)**	**S**
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **direct impacts** caused by the **operation** of the following proposed infrastructure components that directly traverse freshwater ecosystems: • Upgrading and new road crossings through the freshwater ecosystems These direct impacts may result in: • Continued use of road may result in the disturbance of vegetation and biota of the freshwater ecosystems; and • Proliferation of opportunistic alien and invasive species due to ongoing disturbances	1	3	2	2	4	3	36	NEGATIVE	NEGATIVE MEDIUM IMPACT	1	2	2	1	3	2	18	NEGATIVE	NEGATIVE LOW IMPACT
	Potential **indirect impacts** caused by **the operation** of the following proposed infrastructure components not directly traversing freshwater ecosystems: • Within 32m (NEMA) ZoR – high sensitivity area o LILO support towers • Within 100m (GN509) – medium sensitivity area o Solar array buildable areas 1– 4 • Outside 100m ZoR (GN509 – low sensitivity area o Onsite substation and BESS o MTS proposed footprint o Lesaka 1 OHPL These indirect impacts may result in: • Disturbance to the buffer zone surrounding the freshwater ecosystem, making the freshwater ecosystems vulnerable to the invasion of alien and invasive vegetation species; and • Reduction in the surface roughness surrounding the freshwater ecosystems.	1	1	2	1	2	2	14	NEGATIVE	NEGATIVE LOW IMPACT	1	1	1	1	1	1	5	NEGATIVE	NEGATIVE LOW IMPACT

<table>
<tr><th rowspan="2">ENVIRONMENTAL PARAMETER</th><th rowspan="2">ISSUE/ IMPACT/ ENVIRONMENTAL EFFECT/ NATURE</th><th colspan="9">ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION</th><th colspan="9">ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION</th></tr>
<tr><th>E</th><th>P</th><th>R</th><th>L</th><th>D</th><th>I/M</th><th>TOTAL</th><th>STATUS (+ or -)</th><th>S</th><th>E</th><th>P</th><th>R</th><th>L</th><th>D</th><th>I/M</th><th>TOTAL</th><th>STATUS (+ or -)</th><th>S</th></tr>
<tr><td rowspan="2">Geomorphology, hydrological functioning and surface water quality (if present) of the freshwater ecosystems identified in the study area.</td><td>Potential direct impacts caused by the operation of the proposed infrastructure components that directly traverse freshwater ecosystems:
• Upgrading and new road crossings through the freshwater ecosystems
<u>These direct impacts may result in:</u>
• Concentrated runoff from the road/surface infrastructure leading to erosion and subsequent sedimentation of the freshwater ecosystems (increase in the sediment load) and turbulent flows when surface water is present; and
• Higher flood peaks into the freshwater ecosystems due to reduced surface roughness in the freshwater ecosystems and immediate vicinity of the surface infrastructure.</td><td>1</td><td>4</td><td>2</td><td>2</td><td>4</td><td>3</td><td>39</td><td>NEGATIVE</td><td>NEGATIVE MEDIUM IMPACT</td><td>1</td><td>2</td><td>2</td><td>1</td><td>3</td><td>2</td><td>18</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
<tr><td>Potential indirect impacts caused by the operation of the following proposed infrastructure components that do not directly traverse freshwater ecosystems:
• Within 32m (NEMA) ZoR – high sensitivity area
• LILO support towers
• Within 100m (GN509) – medium sensitivity area
○ Solar array buildable areas 1– 4
• Outside 100m ZoR (GN509 – low sensitivity area
○ Onsite substation and BESS
○ MTS proposed footprint
○ Lesaka 1 OHPL
<u>These indirect impacts may result in:</u>
• Concentrated surface water entering the freshwater ecosystems leading to erosion and adding to the sediment load of the freshwater ecosystems; and
• Contaminated surface water (from cleaning activities) may enter the freshwater ecosystems.</td><td>1</td><td>1</td><td>2</td><td>1</td><td>2</td><td>2</td><td>14</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>5</td><td>NEGATIVE</td><td>NEGATIVE LOW IMPACT</td></tr>
</table>

DECOMMISSIONING PHASE																				
ENVIRONMENTAL PARAMETER	ISSUE/ IMPACT/ ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION									
		E	P	R	L	D	I/M	TOTAL	STATUS (+ or -)	S	E	P	R	L	D	I/M	TOTAL	STATUS (+ or -)	S
Habitat and biota (inclusive of the vegetation component) and ecological structure of the freshwater ecosystems identified in the study area.	Potential **direct and indirect** impacts that may potentially result due to the decommissioning activities: • Clearing of habitat that has established in previous phases, resulting in a disturbed ecological structure; • Compaction and disturbance of soils due to decommissioning activities, making the impacted areas unfavourable for the establishment of vegetation and may allow for opportunistic alien and invasive species to establish in the freshwater ecosystems; • Movement of construction vehicles within the freshwater ecosystems, disturbing established biota in the freshwater ecosystems.	2	4	3	2	2	3	39	NEGATIVE	NEGATIVE MEDIUM IMPACT	1	2	2	2	2	2	18	NEGATIVE	NEGATIVE LOW IMPACT
Geomorphology, hydrological functioning and surface water quality (if present) of the freshwater ecosystems identified in the study area.	Potential **direct and indirect** impacts that may potentially result due to the decommissioning activities: • Site disturbance and trampling of vegetation resulting in increased runoff which leads to erosion and alteration of the geomorphology of the freshwater ecosystems; • Disturbance to the erodible soils, that may potentially result an increased risk of bank incision, sheet erosion and gully formation in the freshwater ecosystems and their surrounding area; • Increased movement of construction vehicles within the freshwater ecosystems (utilising freshwater ecosystem road crossings) resulting in soil compaction; • Potential runoff from stockpiles, earthwork activities and disposal of hazardous materials contributing to the freshwater ecosystem sediment load.	1	2	2	1	2	2	16	NEGATIVE	NEGATIVE LOW IMPACT	1	1	1	1	1	1	5	NEGATIVE	NEGATIVE LOW IMPACT
CUMULATIVE IMPACT																				
Drainage system habitat integrity and hydrological functioning	• Loss of freshwater ecosystem vegetation and subsequent habitat, due to freshwater ecosystem road crossings and potential infrastructure located in the freshwater ecosystems; and • Changes to flow, pattern and timing of surface water in the drainage system due to land use changes in the catchment, potentially resulting in changes to the hydrological regime of the larger downstream freshwater ecosystems.	2	3	3	2	3	3	39	NEGATIVE	NEGATIVE MEDIUM IMPACT	2	2	2	2	2	2	20	NEGATIVE	NEGATIVE LOW IMPACT
NO-GO ALTERNATIVE																				
No-Go Alternative (the option of not fulfilling the proposed project)	This alternative would result in no environmental impacts and thus no impacts to the freshwater ecosystems in the study area from the proposed project on the site or surrounding local area. Implementing the no-go option would entail no development.	1	1	1	1	1	1	5	POSITIVE	POSITIVE LOW IMPACT	1	1	1	1	1	1	5	POSITIVE	POSITIVE LOW IMPACT

APPENDIX G: Details, Expertise and Curriculum Vitae of Specialists

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

Cole Grainger	MSc Conservation Ecology (Stellenbosch University)
Paul Da Cruz	BSc (Hons) Geography and Environmental Studies (University of the Witwatersrand)
Stephen van Staden	MSc Environmental Management (University of Johannesburg)

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

Company of Specialist:	SAS Environmental Group of Companies		
Name / Contact person:	Cole Grainger		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	084 397 6753
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	cole@sasenvgroup.co.za		
Qualifications	MSc Conservation Ecology (Stellenbosch University)		
Registration / Associations	Registered Candidate 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, Cole Grainger, 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, Paul 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

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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

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SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF COLE GRAINGER

PERSONAL DETAILS

Position in Company	Freshwater Specialist
Joined SAS Environmental Group of Companies	2022
Years of work experience	6

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate member of the South African Council for Natural Scientific Professions (SACNASP) (SACNASP – Reg No. 119870)

EDUCATION

Qualifications

MSc Conservation Ecology (Stellenbosch University)	2017
BSc Conservation Ecology (Stellenbosch University)	2010
BSc Environmental and Biological Sciences (North West University)	2011

Short Courses

Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	2020
SASS5 National Aquatic Ecosystem Health Monitoring Programme	2018

AREAS OF WORK EXPERIENCE

South Africa – Western Cape, Eastern Cape and Northern Cape

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination

Aquatic Ecological Assessments and Water Quality Studies

- Habitat Assessment Indices (IHAS, IHI)
- Aquatic Macro-Invertebrate Community Integrity Assessments (SASS5 & MIRAI)
- Riparian Vegetation Integrity Assessments (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Sediment Chemical Analysis
- Benthic Algal Monitoring
- Wetland Monitoring

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)

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

- Renewable energy (Wind and solar)
- Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
- Nature Conservation and Ecotourism Development
- Commercial development
- Residential development
- Environmental and Development Planning and Strategic Assessment
- 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

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)
Years of work experience	20

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

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leone
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

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