SCIENTIFIC AQUATIC SERVICES

FRESHWATER ECOSYSTEM ASSESSMENT AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR THE PROPOSED SOLAR PHOTOVOLTAIC (PV) FACILITY AT THE MARULA PLATINUM MINE, NEAR BURGERSFORT, LIMPOPO PROVINCE.

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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed by SLR Consulting (Pty) Ltd to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) process for the proposed photovoltaic (PV) facility at the Marula Platinum Mine (MPM) near Burgersfort within the Greater Tubatse Local Municipality, Limpopo Province.

A field assessment was undertaken on the 13th of December 2022 during which three freshwater ecosystems – all ephemeral drainage lines - were identified in the investigation area (defined as a 500m radius around the study area). The results of the field assessment undertaken for the two drainage lines that run parallel to the development footprint eastern and western boundaries are as follows:

Freshwater ecosystem	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	REC / RMO / BAS
Western Drainage Line (Tshwenyane)	Category D	Moderately Low to Very Low	Category – Very Low	REC: D; BAS: D, RMO: D (Maintain)
Eastern Drainage Line (Unnamed trib. of the Moopetsi River)	Category C	Moderately Low to Very Low	Category Low	REC: C; BAS: C, RMO: C(Maintain)

Based on the outcome of the DWS approved Risk Assessment Matrix and provided that all mitigation measures in this report are adhered to throughout the life of the proposed development, and considering that the activities associated with the PV facility occur outside the delineated freshwater ecosystem boundaries, the activities associated with the construction and operation of the proposed PV facility pose a "Low" risk significance to the freshwater ecosystems within the investigation areas. All mitigation measures as stipulated in Section 6 and Appendix G of this report, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed by SLR Consulting (Pty) Ltd to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) process for the proposed photovoltaic (PV) facility at the Marula Platinum Mine (MPM), which is located near Burgersfort within the Greater Tubatse Local Municipality within the Sekhukhune District Municipality of the Limpopo Province.

The purpose of this report is to define the ecology of the freshwater ecosystems associated with the study and associated investigation area (defined as a 500 m radius around the various components that form part of the study area), in line with GN 509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended in terms of freshwater characteristics, including mapping of the freshwater ecosystems, defining areas of increased Ecological Importance and Sensitivity (EIS) and defining the Present Ecological State (PES) of the freshwater ecosystems associated with the study area. The report also aims to define the socio-cultural and ecological service provision of the freshwater ecosystems and additionally outlines the Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) for the freshwater ecosystems. The assessment took the following approach:

- A desktop study was conducted, in which possible freshwater ecosystems were identified for on-site investigation, and relevant national and provincial databases were consulted;
- The field assessment took place on the 13th of December 2022 during which three freshwater ecosystems (ephemeral drainage lines - EDLs) were identified within the investigation area. The two EDLs located closest to the western and eastern site boundaries have been assessed in detail as they are most at risk of being impacted by the proposed development.

The results of the field assessment are presented in Section 4 of this report, and are summarised in the table below:

Table A: Summary of results of the field assessment as discussed in Section 4.

Freshwater ecosystem	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	REC / RMO / BAS
Western Drainage Line (Tshwenyane River)	Category D (Largely Modified)	Moderately Low to Very Low	Very Low	REC: D; BAS: D, RMO: D (Maintain)
Eastern Drainage Line (Unnamed trib. of the Moopetsi River)	Category C (Moderately Modified)	Moderately Low to Very Low	Low	REC: C; BAS: C, RMO: C (Maintain)

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2016) was applied to determine the significance of impacts of the proposed PV facility on the receiving freshwater environment. The activities associated with the construction and operation of the proposed PV facility pose a “Low” risk significance to the freshwater ecosystems within the study and investigation areas, especially as the activities associated with the proposed PV facility occur outside the delineated freshwater ecosystem boundaries. The impact assessment methodology as provided by the EAP was applied to the proposed development. As the development footprint will not extend into the delineated freshwater ecosystems, no direct impacts will materialise. Thus only indirect impacts are possible and these have been assessed to be of very low significance prior to mitigation and very low significance post-mitigation.

All mitigation measures as stipulated in Section 6 and Appendix G of this report, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas. The outcome of the DWS Risk Assessment is summarised in the table below.

Table B: Summary of DWS Risk Assessment applied to the proposed development.

	Phase	Activity	Aspect	Risk Rating	Reversibility
1	Construction phase	Site clearing prior to commencement of construction activities and the set-up of contractor camps.	"•Removal of vegetation leading to exposure and associated disturbances to soil; •Increased likelihood of dust generation in adjacent freshwater ecosystems due to exposed soil; •Removal of topsoil and creation of topsoil stockpiles; •Potential creation of access roads to facilitate contractor laydown and subsequent construction activities; •Laydown of construction offices and ablution facilities.	L	Fully Reversible
2		Ground-breaking, excavation for foundations and other construction related earthworks upgradient of / within the catchment of the two drainage lines on the boundaries of the development site	•Removal of topsoil and creation of soil stockpiles upgradient of the drainage lines located to the east and west of the study area; •Potential runoff of sediment and waste material into the drainage lines located to the east and west of the study area; •The movement of construction machinery, personnel and equipment upgradient of the drainage lines located to the east and west of the study area; •Mixing and casting of concrete for construction purposes upgradient of the drainage lines located to the east and west of the study area.	L	
3	Operation phase	Operational stormwater control and design of stormwater attenuation facilities on the development site.	•Operation of stormwater infrastructure and discharge of stormwater into drainage lines on the boundaries of the development site.	L	
4		Operations and maintenance of the development (including. sewage infrastructure associated with the proposed office and control room, if applicable, and BESS).	•Potential failure of infrastructure and waste management systems (e.g. sewage infrastructure associated with the proposed office and control room, if applicable) resulting in leakages and possible contamination of surface and ground water into the downgradient drainage systems Potential leakage of hazardous materials associated with BESS technology (i.e. batteries) •Indiscriminate movement of vehicles and vegetation trampling within the immediate catchments of the drainage lines located to the east and west of the study area as part of maintenance activities.	L	

Provided all mitigation measures are implemented, it is the professional opinion of the freshwater ecologist that the proposed solar energy facility can be considered for development.

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Appendix J
2.2	Description of the preferred development site, including the following aspects-	Section 1
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 4.3
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 3.1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 3.1 and 3.2
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 4.3
2.3	Identify any alternative development footprints within the preferred development site which would be of a “low” sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	Section 6 and 7
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 6
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 4.3 and Section 6
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Section 4.3
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.). d. Assessment of the risks associated with water use/s and related activities.	Section 4.3
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system);	Section 4.3

	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 unchannelled 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); and e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).	
2.4.5	How will the development impact on the functionality of the aquatic feature including: a. 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) b. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland). c. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); d. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); e. The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc.) associated with or within the aquatic ecosystem.	Section 4.3
2.4.6	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 4.3
2.4.7	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 4.3
2.4.9	A motivation must be provided if there were development footprints identified as per paragraph 2.3 above that were identified as having a “low” biodiversity sensitivity and were not considered appropriate.	Section 7
3.	The report must contain as a minimum the following information:	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Appendix J
3.2	A signed statement of independence by the specialist;	Appendix J
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 1 and 4.3
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Appendix C
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 6 and 7
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 6
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 5
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 6
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Section 7
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 7

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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.
Baseflow	The component of river flow that is sustained from groundwater sources rather than from surface water runoff.
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 flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a freshwater ecosystem):	To determine the boundary of a freshwater ecosystem based on soil, vegetation, terrain 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".
Ephemeral	A river or watercourse that only flows at the surface periodically, especially those drainage systems that are only fed by overland flow (runoff).
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Herbaceous	A plant having little or no woody tissue and persisting usually for a single growing season
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydroperiod	The term hydroperiod describes the different variations in water input and output that form a freshwater ecosystem, characterising its ecology – i.e. the water balance of the freshwater ecosystem.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Land Type	Distinct areas defined as part of the Land Type Survey of South Africa based on a unique combination of soil pattern, macroclimate and terrain form
Mottles:	Soil with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
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 according to the International Union for Conservation of Nature (IUCN) Classification.
Reach	A longitudinal stretch of a river
Reference State / Condition	A description of the condition of riparian habitat that would exist under natural conditions, i.e. conditions prior to significant human interaction with riparian structure and function. The reference conditions form a benchmark against which to assess/estimate a deviation/change in riparian vegetation status.
Riparian Area / Zone	The physical structure and associated vegetation of the areas associated with a watercourse 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

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 50 cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50 cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
CSIR	Council of Scientific and Industrial Research
CVB	Channelled Valley Bottom
UCVB	Unchannelled Valley Bottom
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EPL	Ecosystem Protection Level
ES	Ecological Sensitivity
ESA	Ecological Support Area
ETS	Ecosystem Threat Status
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IAIA	International Association of Impact Assessors
IUCN	International Union for Conservation of Nature
mm	Millimetre
m.a.m.s.l	Metres above mean sea level
MAP	Mean Annual Precipitation
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South Africa Institute of Aquatic Biodiversity
SAIIAE	South Africa Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SASSO	South African Soil Surveyors Association
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
SuDS	Sustainable Drainage Systems
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WRC	Water Research Commission
WUA	Water Use Authorisation

1 INTRODUCTION

1.1 *Background*

Scientific Aquatic Services (SAS) was appointed by SLR Consulting (Pty) Ltd to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) process for the proposed solar energy photovoltaic (PV) facility at the Marula Platinum Mine (MPM), which is located near Burgersfort within the Limpopo Province (hereafter referred to as the 'study area'). The study area, approximately 52 hectares (ha) in extent, is located within the Greater Tubatse Local Municipality and Sekhukhune District Municipality of the Limpopo Province. The R37 runs approximately 4 km east of the MPM (Figures 1 and 2).

The site visit for the freshwater ecosystem assessment was undertaken on the 13th of December 2022. Fieldwork was undertaken to obtain accurate ground-truthed results so as to guide the planning and construction of the proposed PV facility in relation to any potential freshwater ecosystems that may be affected directly or indirectly by the activities undertaken as part of the proposed activities. To identify all possible freshwater ecosystems that may potentially be impacted, a 500 m "zone of investigation" around the footprint of the proposed PV facility, in accordance with Government Notice 509 (GN 509) of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) (as amended), was used as a guide to assess possible sensitivities of the receiving environment. This area – i.e. the 500 m zone of investigation around the footprint of the proposed PV facility- will henceforth be referred to as the "investigation area".

This study aims to provide information to guide the proposed activities associated with the proposed solar energy PV facility development in the vicinity of any freshwater ecosystems that may fall within the proposed PV facility footprint, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported, while considering the need for sustainable economic development.

This report, after consideration of the above, must guide the Environmental Assessment Practitioner (EAP) and proponent on the layout of the proposed PV facility from a freshwater management perspective and indicate any development constraints that should be considered in line with the principles of sustainable development and Integrated Environmental Management.

Figure 1: A digital satellite image depicting the location and layout of the proposed solar energy PV facility and associated investigation area in relation to the surrounding area.

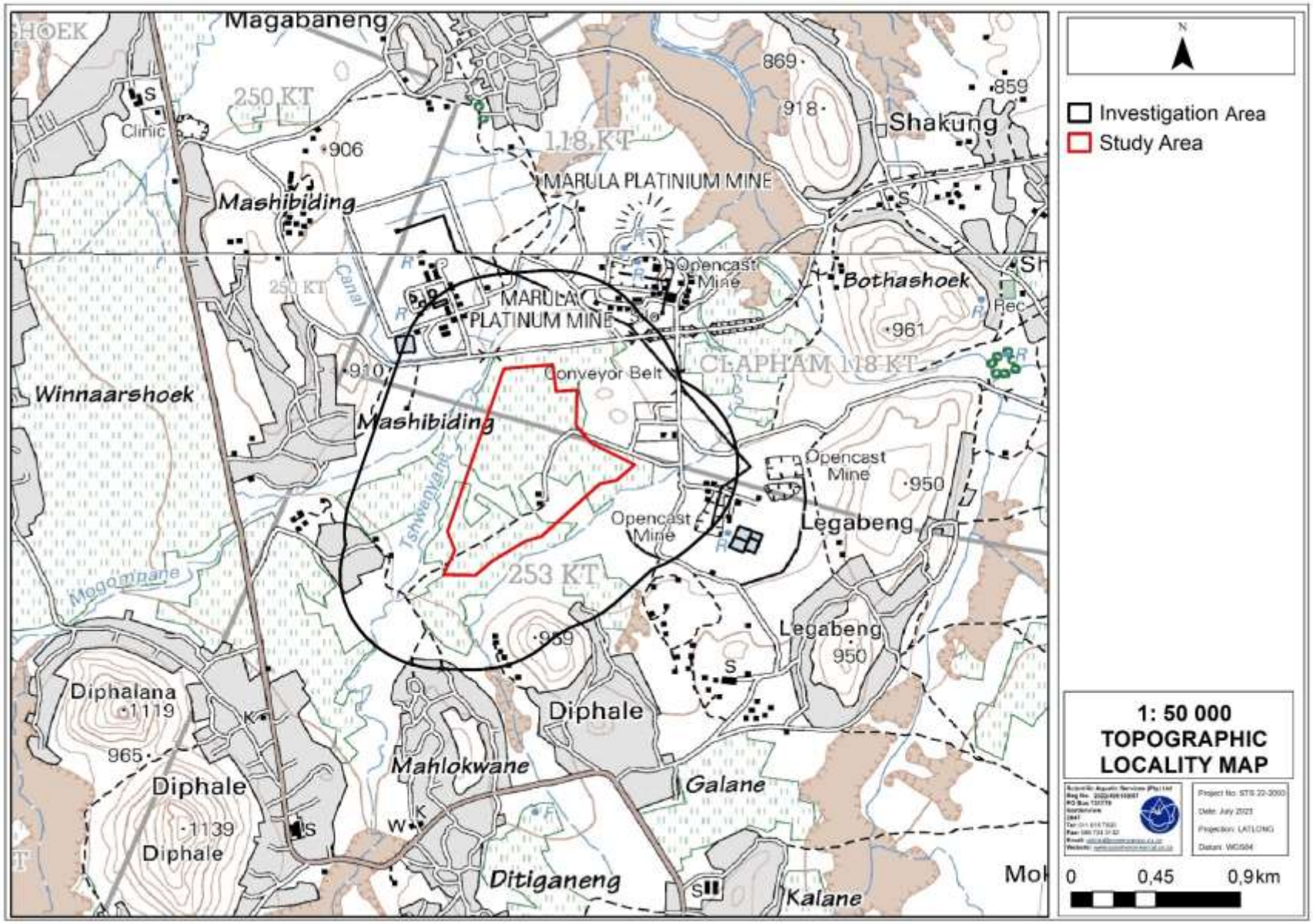

Figure 2: The proposed solar energy PV facility and investigation area depicted on a 1:50 000 topographic map in relation to the surrounding area.

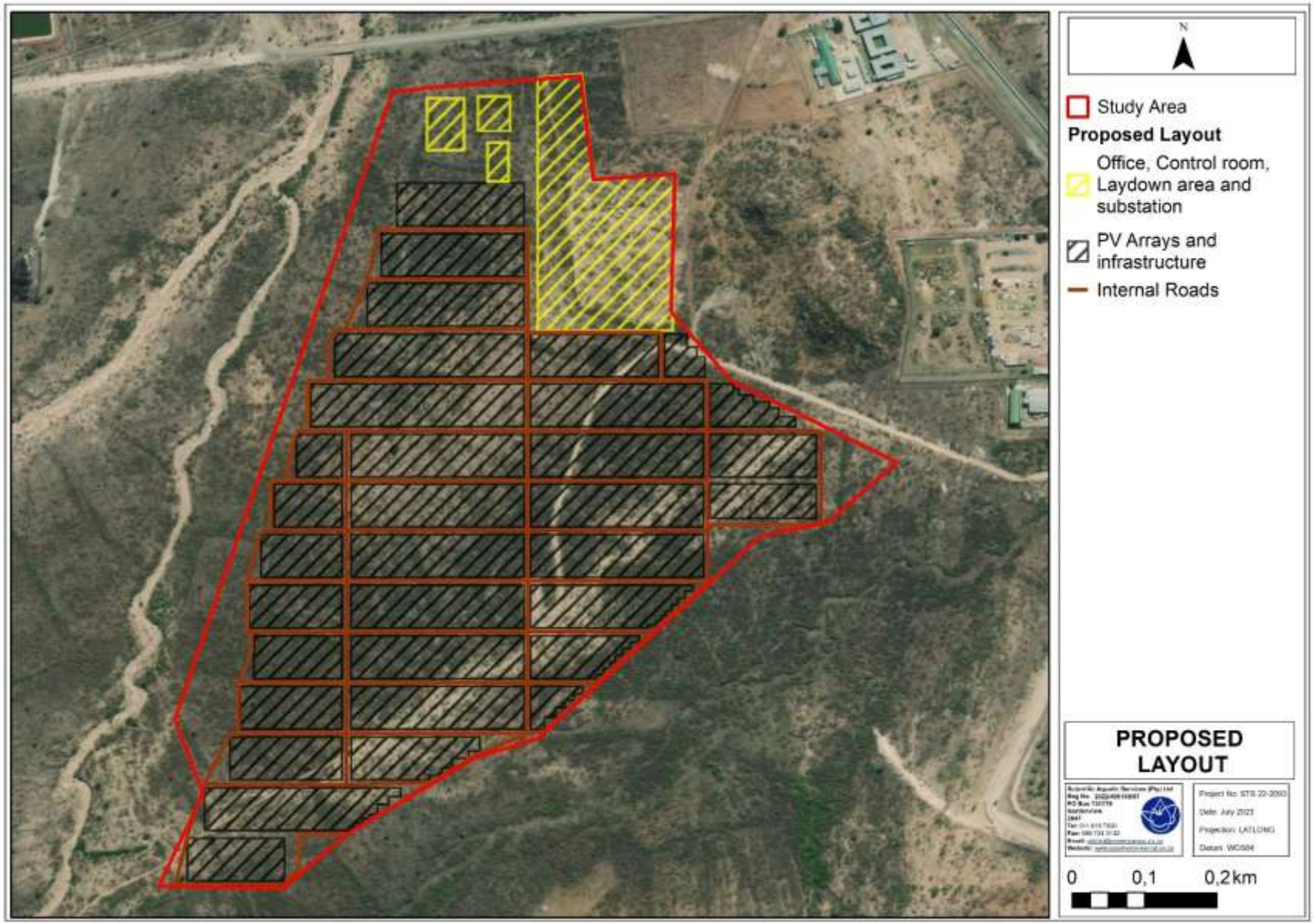

Figure 3: Layout of the proposed Solar Energy PV Facility

1.2 *Scope of Work*

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], (2014) database, National Biodiversity Assessment (NBA) (2018), and the Limpopo Conservation Plan (2013) were undertaken to aid in defining the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems;
- All freshwater ecosystems associated with the footprint of the proposed PV facility and associated investigation area were delineated using desktop methods in accordance with GN 509 of 2016 as it relates to activities as stipulated in the National Water Act, 1998 as amended (Act No. 36 of 1998) and verified according to the "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2]: A practical field procedure for identification of wetlands and riparian areas". Aspects such as soil morphological characteristics and wetness along with vegetation types were used to verify the freshwater ecosystems;
- The freshwater ecosystem classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The Present Ecological State (PES) of the freshwater ecosystems were assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.* (2008);
- The Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems were determined according to the method described by Rountree and Kotze*,* (2013);
- The Ecoservices of the freshwater ecosystems were assessed according to "A technique for rapidly assessing ecosystem services supplied by wetlands" (Kotze *et al.,* 2020);
- The freshwater ecosystem boundaries, and legislated zones of regulation were depicted for the freshwater ecosystems, where applicable;
- Allocation of a suitable Recommended Management Objective (RMO), Recommended Ecological Category (REC) and Best Attainable State (BAS) of the freshwater

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA) and subsequently 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] Even though 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.

ecosystems were assigned based on the results obtained from the PES and EIS assessments;

- The Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the freshwater ecosystems as a result of the proposed development, and to aim to quantify the significance thereof;
- The impact rating matrix provided by the EAP has been used to assessment impacts on the freshwater ecosystems in the study area and immediate surrounds for both construction and operational phases; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact of the proposed development on the receiving environment.

1.3 *Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- It has been confirmed by the client that bifacial panels will be utilised as part of the proposed solar development, however it cannot be determined at this stage whether operational vegetation clearing under the panels will be required or not (e-mail response from Luke Colvin, Energy Group, 06 July 2023). Accordingly a recommendation has been made that low vegetation be retained or allowed to become re-established under the arrays to protect the underlying soil from erosion. It is recognised that such vegetation retention in the operational phase of the development may be deemed to be technically non-feasible, in which case the operational stormwater management plan for the site must account for the presence of permanently exposed soils in the solar PV array footprint;
- The specialist has been requested to include Battery Energy Storage Systems (BESS) as part of the project components. The exact type of BESS technology proposed to be used has not been provided for assessment, thus technology-specific impacts have been unable to be included in the assessment of potential impacts;
- Both the DWS Risk Assessment Matrix (2016) and the SLR (EAP) Impact Assessment method were applied to the freshwater ecosystems. However, it is crucial to note that although these two methods may present different scores and impact significance ratings for the same activity, this is due to differences in their methodologies (refer to Appendix D and E) and not due to inconsistencies in their application;
- Freshwater ecosystems associated with the study area and its immediate surrounds, were ground-truthed, however other freshwater ecosystems units within 500 m of the study area (within the investigation area) were delineated in fulfilment of GN509 of the

NWA using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs. Desktop delineations were ground-truthed where feasible. The delineations of freshwater ecosystems outside the study area must not be utilised for any purpose, other than planning within the study area the data in this study pertains to. Any areas that may have additionally been mapped will require field-based delineation and ground-truthing as directed by applicable legislation and best practice methods;

- Various areas within the investigation area displayed transformed topography, soil profiles and runoff patterns within the landscape. As such, these disturbances have likely resulted in alterations to the hydroperiod of the identified freshwater ecosystems;
- 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 within the study area at the scale required to inform the EA process. However, this information is considered useful as background information to the study;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required, the freshwater ecosystems will need to be surveyed and pegged according to surveying principles and with surveying equipment;
- Wetland, riparian 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. It is, however, expected that the freshwater ecosystems that may be affected by the proposed activities have been accurately assessed and considered, based on the site observations undertaken in terms of freshwater ecosystem ecology.

2 ASSESSMENT APPROACH

2.1 *Freshwater Ecosystem definition*

The National Water Act, 1998 (Act No. 36 of 1998) as amended is aimed at the protection of the country's water resources, defined in the Act as "a watercourse, surface water, estuary or aquifer". According to the National Water Act, 1998 (Act No. 36 of 1998) as amended, a **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 in the *Gazette,* declare a watercourse.

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

The Act further provides definitions of wetland and riparian habitats as follows:

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 the areas associated with a watercourse which are commonly characterized 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 areas.

Thus, for the purposes of this investigation the definition of a freshwater ecosystem is considered to be synonymous with the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998) as amended.

2.2 *Freshwater Ecosystem Field verification*

Where limitations to on-site delineations were experienced, use was made of historical and current digital satellite imagery, topographic maps and available provincial and national databases to aid in the delineation of the freshwater ecosystems following the site assessment. The following were taken into consideration when utilising the above desktop methods:

- 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 watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery, these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas, where there is less soil moisture or surface water present; and
- Texture: with areas displaying various textures which are distinct from the adjacent terrestrial areas, created by varying vegetation cover and soil conditions within the freshwater ecosystems.
- The output of the relevant databases: The 1:50 000 topological maps and drainage line data (Figures 2 and 4) were used as additional indicators of wetland presence.

The site assessment was undertaken in December 2022 (mid-summer season), to delineate the freshwater ecosystems and undertake a detailed freshwater ecosystem assessment. The delineation of the freshwater ecosystems took place as far as possible, 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 soil;
- Vegetation adapted to saturated soil; and
- The presence of alluvial soil in stream systems.

In addition to the delineation process, a detailed assessment of the delineated freshwater ecosystems was undertaken. Factors affecting the integrity of the freshwater ecosystems were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater ecosystems. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 *Analyses of Relevant Databases*

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is 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 study areas actual site characteristics at the scale required to inform the EA/ WULA processes. Nevertheless, this information is considered useful as background information to the study, is important in legislative contextualisation of risk and impact, and was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance. It must, however, be noted that site assessment 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. The information contained in the dashboard report below is intended to provide background to the landscape of the study area. Actual site conditions at the time of the assessment may differ to the background information provided by various datasets. Please refer to Section 4 for details pertaining to the site investigation.

Table 1: Desktop data indicating the characteristics of the freshwater ecosystems associated with the study and investigation areas.

Aquatic ecoregion and sub-regions in which the study and investigation areas are located.	
Ecoregion	Eastern Bankenveld
Catchment	Olifants North
Quaternary Catchment	The investigation area falls within B71E.
WMA	Olifants
subWMA	Middle Olifants
Dominant characteristics of the Eastern Bankenveld Ecoregion Level II (Kleynhans *et al.*, 2007a)	
Level	Eastern Bankenveld (9.03)
Dominant primary terrain morphology	Closed hills, Mountains; moderate and high relief, low mountains
Dominant primary vegetation types	Mixed Bushveld
Altitude (m a.m.s.l)	500 to 2300
MAP (mm)	400 to 700
Coefficient of Variation (% of MAP)	20 to 34
Rainfall concentration index	55 to 64
Rainfall seasonality	Early summer
Mean annual temp. (°C)	14 to 22
Winter temperature (July)	2 to 20 °C
Summer temperature (Feb)	12 to 30 °C
Median annual simulated runoff (mm)	20 to 150
Land Type	
The study and investigation area are located within the Ea88 Land type.	
Strategic Water Source Areas for Surface Water (2017)	
The study and investigation areas do not fall within a Strategic Water Source Area.	

Detail in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The study and investigation area falls within an Upstream Management Area (FEPACODE = 4). These are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.
NFEPA Wetlands and Rivers (Figure 5)	No wetlands are indicated by the NFEPA database within the study area. Two artificial unchanneled valley bottom wetlands were indicated within the north-western and south-eastern portions of the investigation area. The Moopetsi River is located approximately 350 m east of the investigation area. This river is considered moderately modified (Class C) by the NFEPA database.
Wetland vegetation Type	The study and investigation areas fall within the Central Bushveld Group 7 Wetland Vegetation Type which is considered least threatened (LT) (Mbona *et al*, 2015).
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 6)	
According to the NBA (2018): SAIIAE there are no natural wetland features within the study or investigation area, as indicated by the NBA database. Several artificial features (reservoirs and dams) are indicated within the investigation area. The Moopetsi River (Class C Moderately Modified) is located approximately 350 m east of the investigation area. The Ecosystem Protection Level (EPL) of the Moopetsi River is **poorly protected** and the Ecosystem Threat Status (ETS) is indicated as **endangered**.	
Detail of the inundation zone in terms of the Limpopo Conservation Plan Version 2 (2013) (Figure 7)	
Ecological Support Area (ESA) 1	The majority of the study area falls within an area defined as a **Category 1 ESA**. ESA 1s are natural, near-natural and/or degraded areas that are selected to support CBAs by maintaining ecological processes
Ecological Support Area (ESA) 2	North-eastern and south-western portions of the study and investigation areas fall within a **Category 2 ESA**. ESA 2s are areas no longer intact but potentially retain significant importance from a process perspective (e.g., maintaining landscape connectivity).
National Web-based Screening Tool (2020) (Figure 9)	
The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. this assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	
For the aquatic biodiversity theme, the study area is considered to have a **low aquatic sensitivity.**	

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area

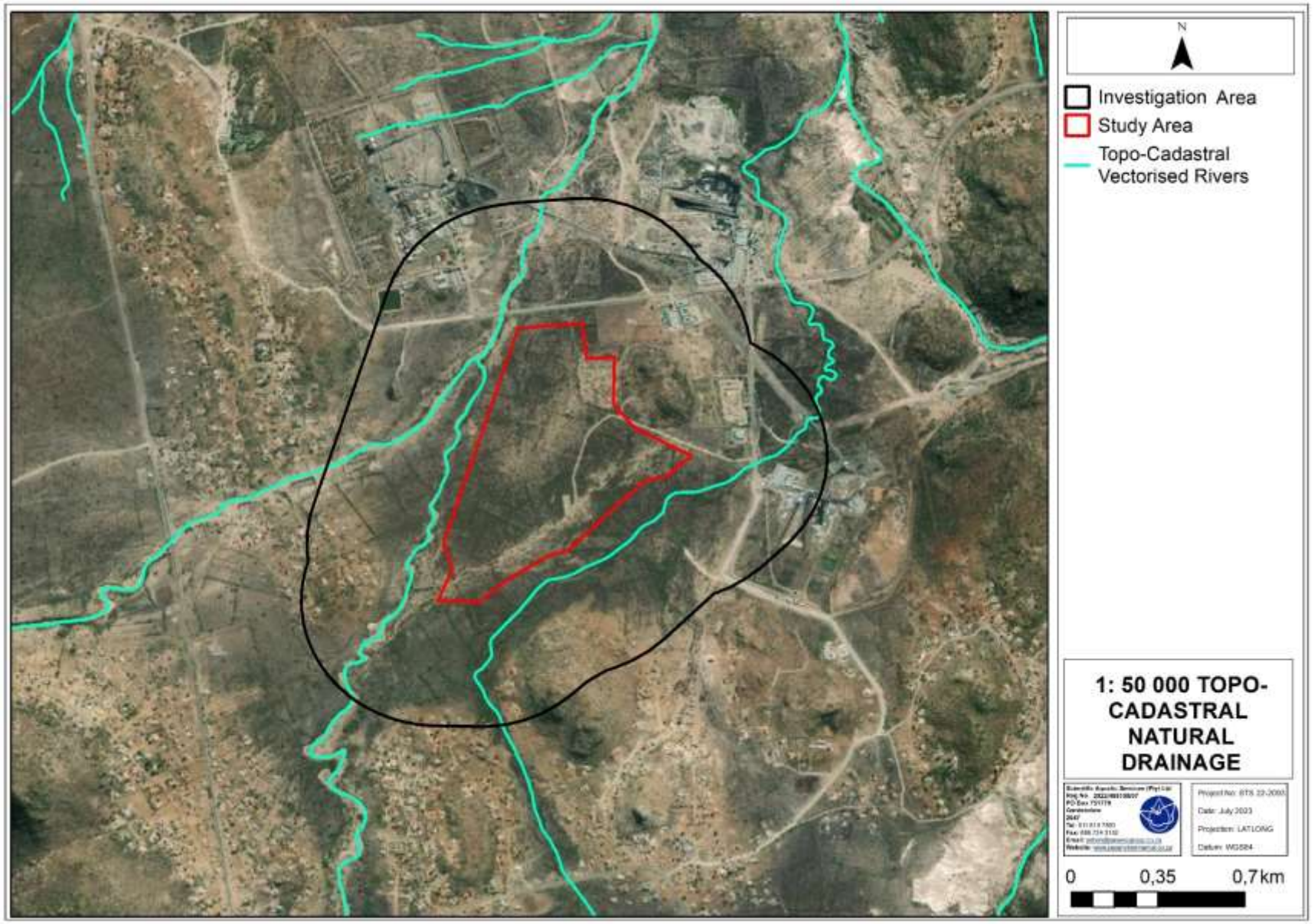

Figure 4: The 1:50 000 Topo-cadastral drainage lines associated with the study and investigation area.

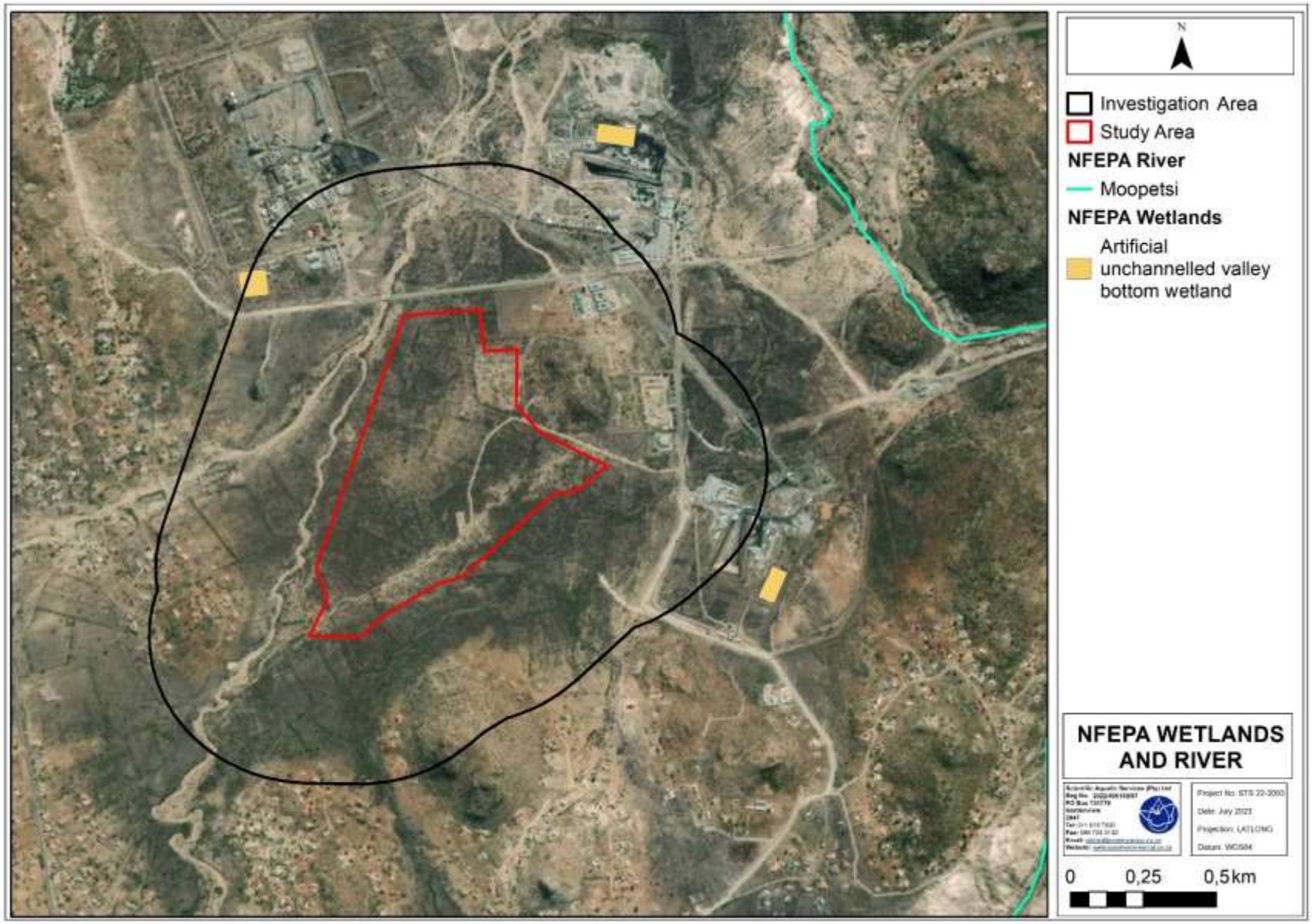

Figure 5: Wetland and river HGM classifications associated with the study and investigation areas according to the NFEPA database (2011).

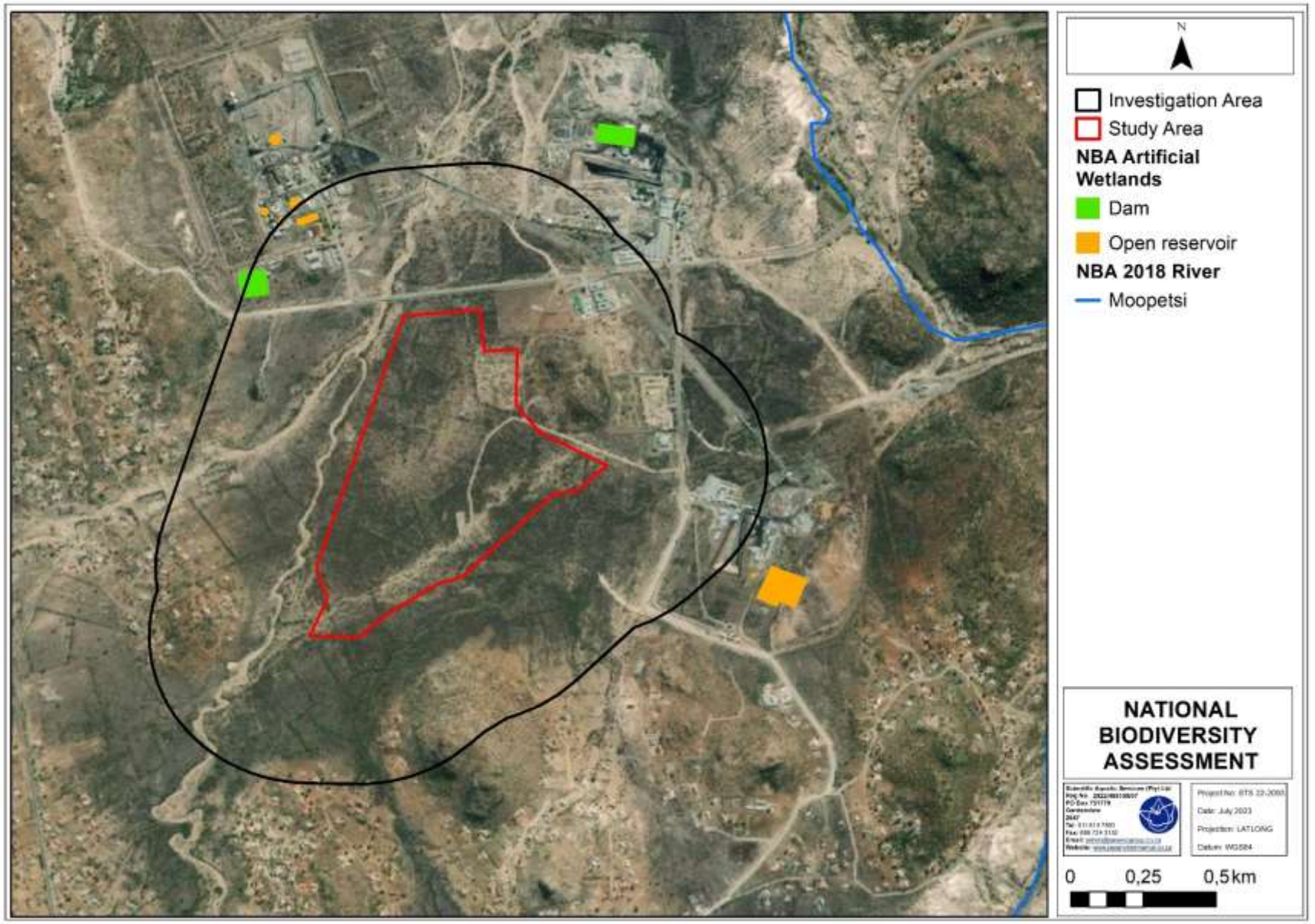

Figure 6: Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment database (2018).

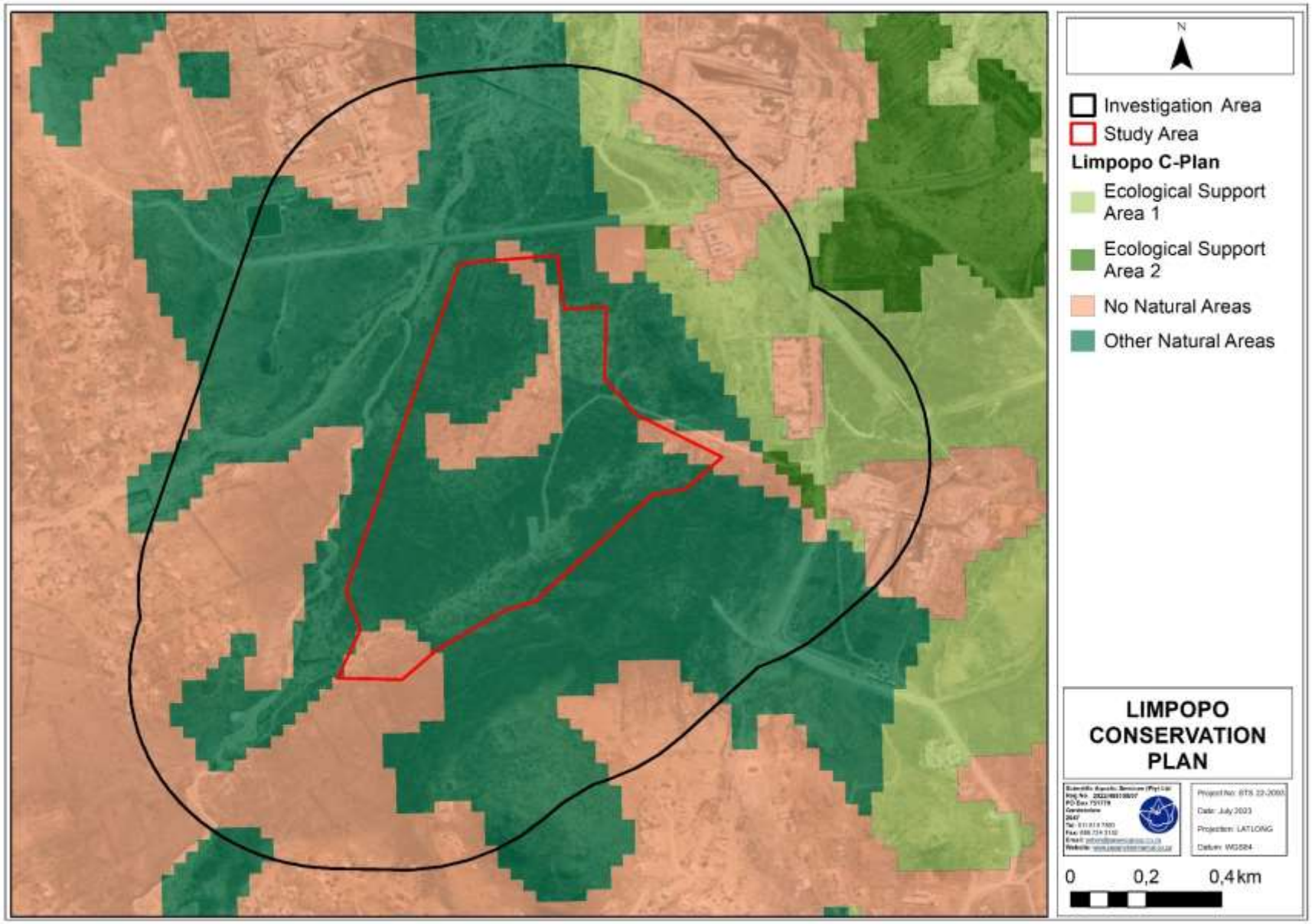

Figure 7: Ecologically important areas associated with the study and investigation areas according to the Limpopo Conservation Plan (2013).

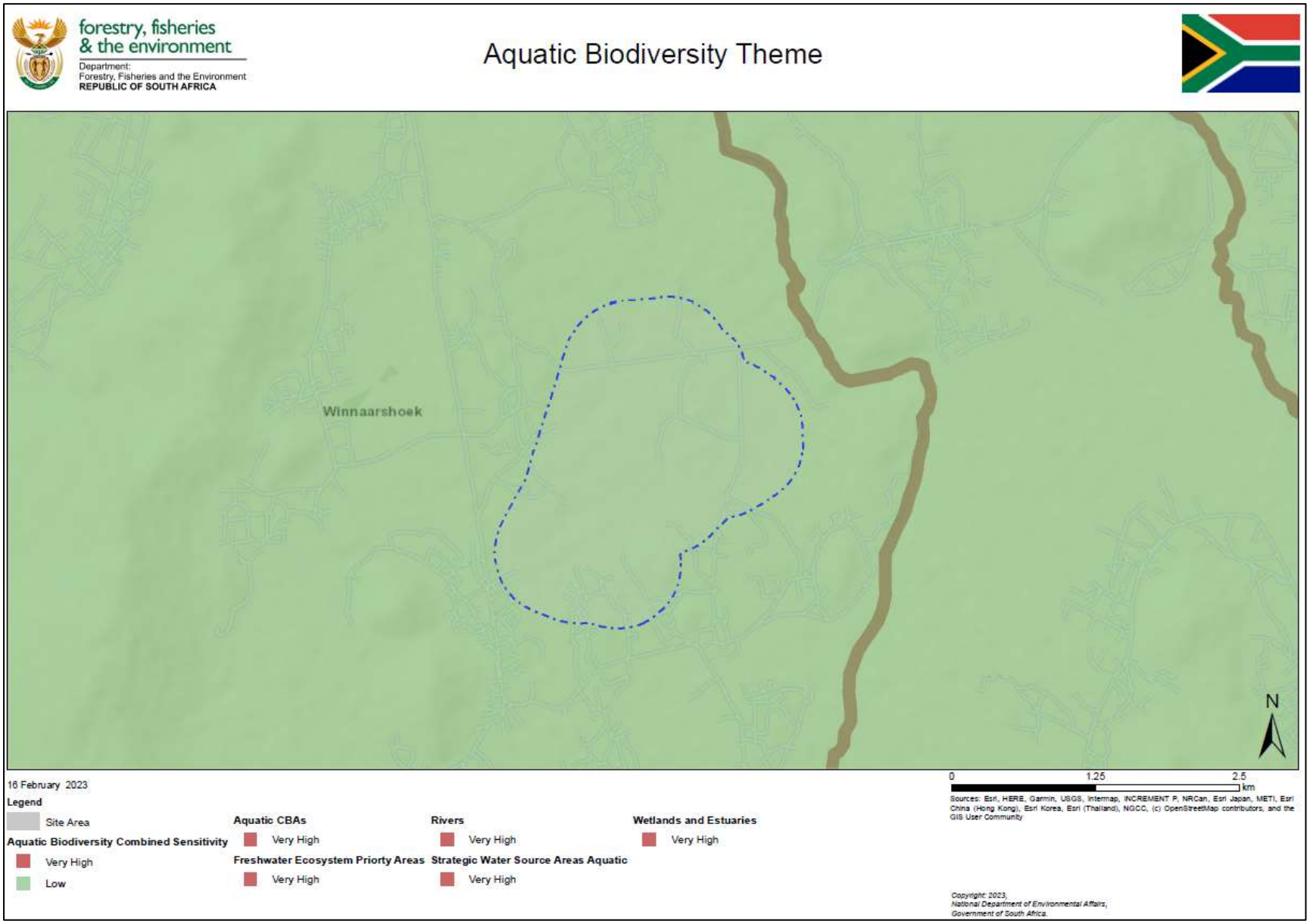

Figure 8: Map of relative aquatic biodiversity theme sensitivity for the study and investigation area according to the National Web Based Environmental Screening Tool (Accessed 2023).

3.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database*

The study area falls within the Eastern Bankenveld Ecoregion and within the B71E quaternary catchment. According to the PES/EIS database, as developed by the DWS RQIS department, the sub-quaternary catchment reach SQR B71E-00474 (Moopetsi River) is applicable. The SQR monitoring point is located approximately 350 m east of the investigation area. (Figure 8). No fish or invertebrate species have previously been recorded for B71E-00474. The ecological status of the SQR B71E-00474 is indicated in Table 2 below:

Table 2: Summary of the ecological status of the SQR B71E-00474 (Moopetsi River) according to the DWS RQS PES/EIS database.

B71E-00474 (Moopetsi River)	
Synopsis	
PES Category Median	(E) Seriously modified
Mean EI class	Low
Mean ES class	Low
Length (km)	25.11
Stream order	1
Default EC[4]	D
PES Details	
Instream habitat continuity MOD	Large
RIP/wetland zone continuity MOD	Large
Potential instream habitat MOD activities	Serious
Riparian/wetland zone MOD	Serious
Potential flow MOD activities	Serious
Potential physico-chemical MOD activities	Serious
EI details	
Fish spp/SQ	NA
Fish average confidence	NA
Fish representivity per secondary class	NA
Fish rarity per secondary class	NA
Invertebrate taxa/SQ	NA
Invertebrate average confidence	NA
Invertebrate representivity per secondary class	NA
Invertebrate rarity per secondary class	NA
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low
Habitat diversity class	High
Habitat size (length) class	Low
Instream migration link class	Moderate
Riparian-wetland zone migration link	Moderate
Riparian-wetland zone habitat integrity class	Low
Instream habitat integrity class	Low
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500 m	High
Riparian-wetland natural vegetation rating based on expert rating	Low
ES Details	

Fish physical-chemical sensitivity description	NA
Fish no-flow sensitivity	NA
Invertebrates physical-chemical sensitivity description	NA
Invertebrate velocity sensitivity	NA
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very Low
Stream size sensitivity to modified flow/water level changes description	High
Riparian-wetland vegetation intolerance to water level changes description	Low

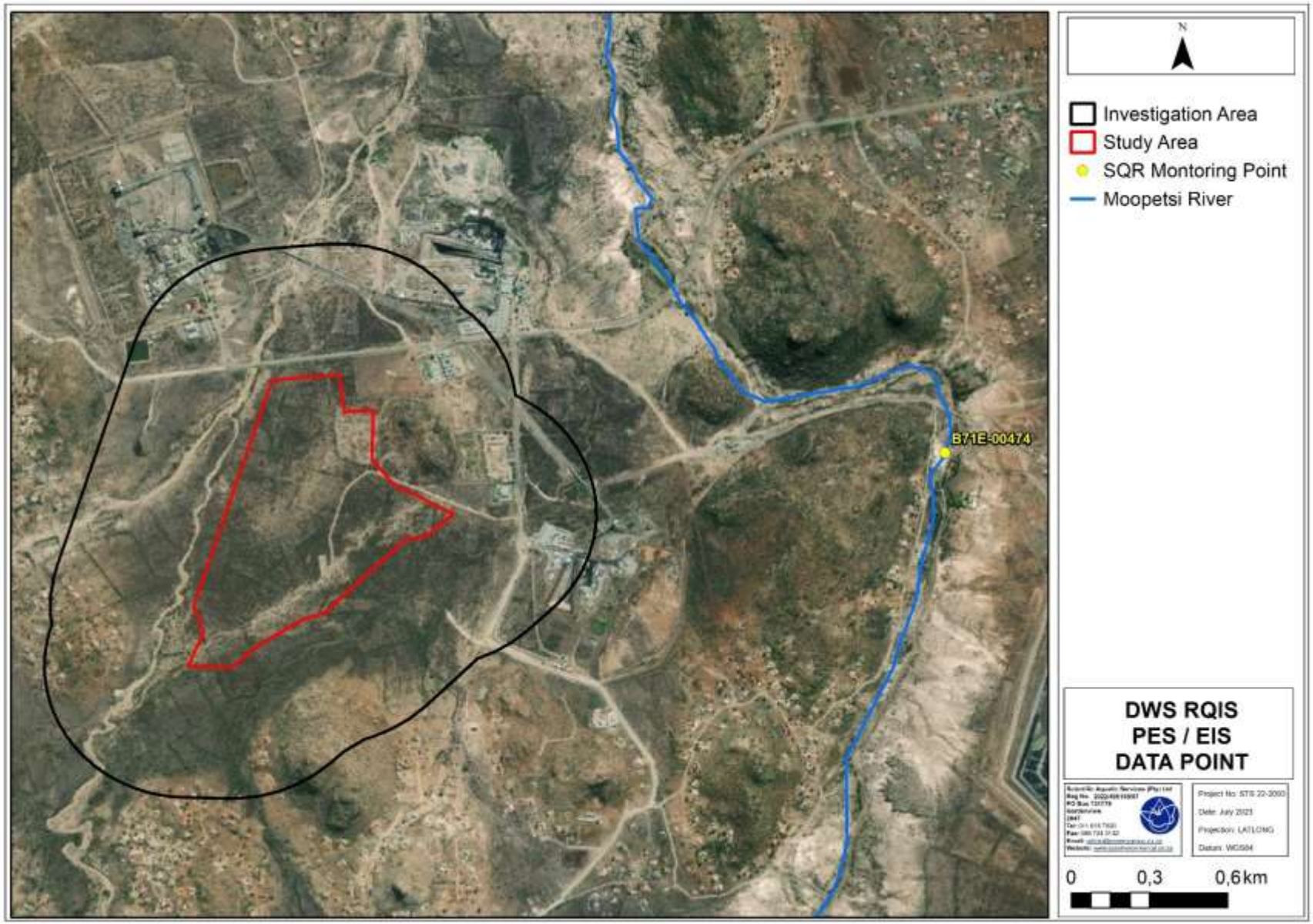

Figure 9: The DWS RQIS PES/EIS monitoring point associated with the study and investigation areas.

4 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

4.1 *Freshwater Ecosystem Characterisation*

The site assessment confirmed the presence of three (3) freshwater ecosystems within the investigation area, none of which extend into the study area. All freshwater ecosystem units fall under one Hydrogeomorphic (HGM) unit classification, namely ephemeral drainage lines.

The freshwater ecosystems identified within the study and investigation areas were classified according to the Classification System (Ollis *et al.*, 2013) as Inland Systems. The freshwater ecosystems fall within the Eastern Bankenveld Ecoregion. The study and investigation area fall within the Central Bushveld Group 7 Wetland Vegetation Type which is considered 'least threatened' (LT) according to Mbona et al. (2015). At Levels 3 (Landscape Unit) and 4 (HGM Type) of the Classification System, the systems were classified as per the summary in Table 3, below.

Table 3: Characterisation at Levels 3 and 4 of the Classification System (Ollis *et al*., 2013) of the freshwater ecosystems associated with the study and investigation areas.

Freshwater ecosystems	Level 3: Landscape unit	Level 4: HGM Type
Three (3) drainage lines fall within the investigation area, with very limited parts of their extent within the study area. The drainage lines are fluvial features and thus fall into the wider river HGM unit.	**Valley floor:** The base of a valley, situated between two distinct valley side-slopes.	**River:** A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.

The delineated freshwater ecosystems are conceptually depicted in Figure 10 below.

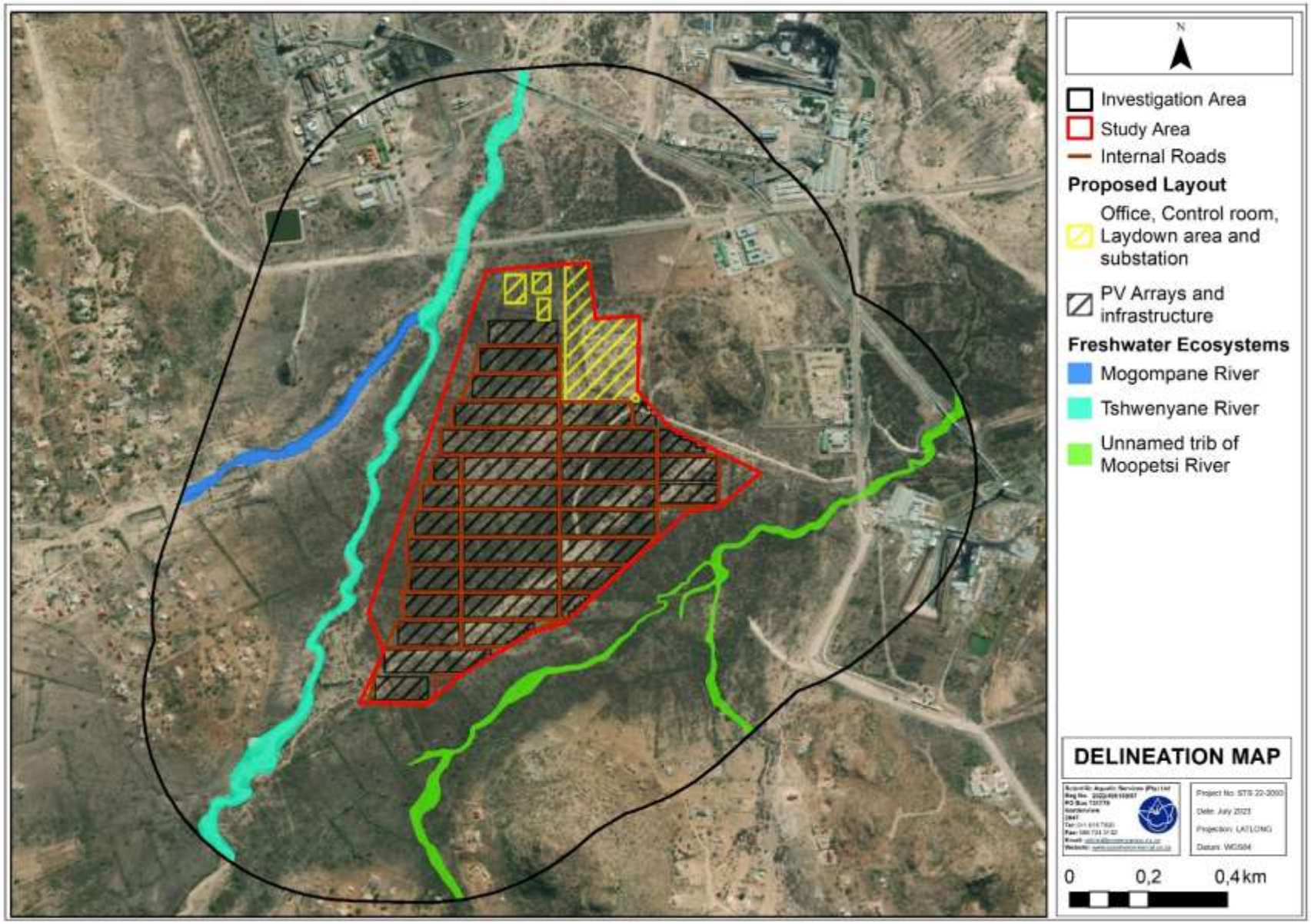

Figure 10: Location of the freshwater ecosystems associated with the proposed PV facility and associated investigation area.

4.2 *Freshwater Ecosystem Delineation*

As noted in Section 1.2, the freshwater ecosystem assessment was limited to the proposed PV facility footprint and associated investigation area as provided by the proponent. It was noted during the site assessment that historical (and in places ongoing) agricultural, mining and urban development activities have occurred within the proposed PV facility footprint, investigation area and immediate surrounds. The delineations as presented in this report are nevertheless deemed the best estimate of the freshwater ecosystem boundaries based on site conditions present at the time of the assessment and are considered adequate to allow for informed decision-making.

During the site assessment, the following indicators were used to delineate the boundaries of the freshwater ecosystems:

- Soil wetness indicator, duration and frequency of saturation in the soil profile is a diagnostic indicator since it influences the colour change in the soil. Low chroma (grey and muted colours) as well as mottles are more prominent in soil which have higher saturation frequency. Soils displaying signs of hydromorphism also indicate an increased hydroperiod and thus the potential presence of hydromorphic characteristics;
- Vegetation was utilised in conjunction with the soil indicators associated with the freshwater ecosystems, where feasible. The distinction between obligate, facultative, and terrestrial vegetation was relatively discernible;
- Soil morphological characteristics typically associated with freshwater ecosystem conditions, such as gleying or mottling were utilised in conjunction with saturation as the secondary indicator; and
- Despite transformation of the landscape associated with the investigation area, the terrain provided an indication of low-lying areas where water is likely to collect and/or move through the landscape.

4.3 *Site Verification Results*

Following the site assessment, the assessments outlined in Section 1.2 were applied. The results of the assessments are discussed in the dashboard style reports which follow and the details thereof are presented in Appendix F.

Table 4: Summary of the assessment of the Western Drainage Line (Tshwenyane River) associated with the proposed PV facility.

Ecological & socio-cultural service provision graph:

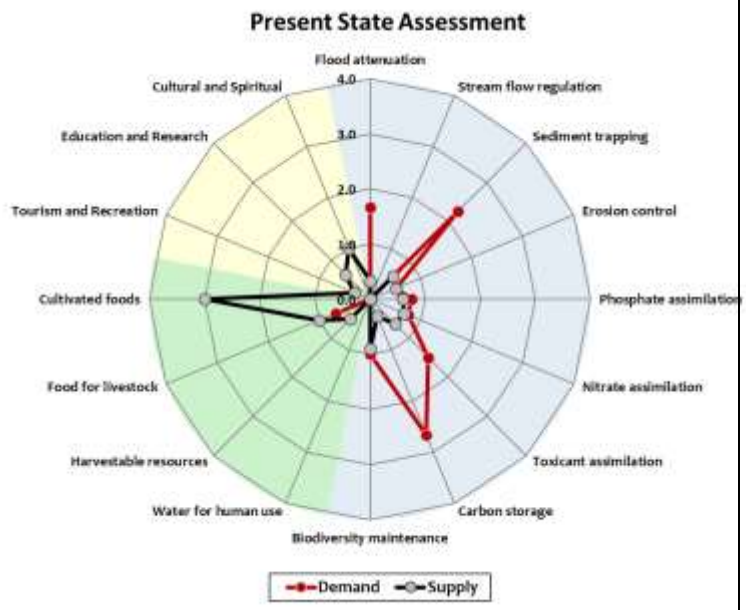

Figure 11: Representative photographs of the Western Drainage Line; top left: view downstream showing the active channel and riparian zone; top right: example of vegetation removal and significant areas of exposed, unvegetated substrate in a part of the riparian zone; bottom left: active channel and bank erosion on an outer bend of a reach of the DL; bottom right; significant erosion of the active channel banks initiated and exacerbated by livestock movement.

PES Discussion (IHI)	**Riparian IHI PES Category: D (largely modified)** Landuse factors have resulted in significant degradation of the drainage line, in particular its riparian zone. This has resulted from pressures acting on both the catchment of the reach assessed and the reach itself. Within the catchment, the urbanisation of large areas to form peri-urban settlements, along with the extensive presence of livestock and clearing of woody vegetation in a communal rural setting have denuded the catchment of much of its natural vegetation cover and have also resulted in significant gulley and sheet erosion in the catchment. Within the reach a variety of factors have caused degradation of the riparian zone. Historical cultivation resulted in vegetation transformation. Large trees that would naturally have occurred in the riparian zone have mostly been felled and the riparian zone is now dominated by *Dichrostachys cinerea* and the unpalatable succulent shrub *Euphorbia tirucalli*. Certain parts of the riparian zone have also been invaded by AIPs, especially by sisal (*Agave sisalana*). The exposure of substrate within the riparian zone twinned with gulley and sheet erosion resulted in significant loss of topsoil and subsoil in the reach. Erosion is exacerbated by livestock movement in and out of the channel and increased flood peaks from altered runoff patterns in the catchment has greatly exacerbated natural bank erosion processes.

<table>
<tr><td>EIS discussion</td><td colspan="3">EIS Category: Very Low
This reach of the drainage line was assessed to have a very low EIS, showing very little ecological sensitivity and being rarely sensitive to changes in water quality/hydrological regime. The highly degraded nature of the riparian zone depresses most biodiversity and ecological aspects of sensitivity and importance, with no significant freshwater habitat or freshwater-related biota present. The most important ecological sensitivity aspect of the reach is its function as an ecological movement corridor – which will likely be enhanced once the solar energy development becomes operational, causing further fragmentation in the landscape. The level of degradation, along with the absence of baseflow and channelised nature of the reach lowers the hydro-functional importance of the reach and the reach offers few direct human benefits.</td></tr>
<tr><td>Ecoservice provision</td><td>Cultivated Foods = Moderately Low
All other services = Very Low
The significant level of degradation of the drainage line, along with its hydraulic characteristics as an ephemeral drainage line with no baseflow significantly depresses the supply of most ecoservices. This is indicated in the demand for various ecoservices (e.g. sediment trapping, carbon storage) being much higher than the degree of ecoservices provided by the drainage line.</td><td>REC, RMO & BAS Category</td><td>REC Category: D
RMO: D (Maintain)
BAS Category: D
Based on the PES and EIS, the RMO is to maintain the ecological status of the drainage line. The drainage line is largely modified but the PES could be further degraded if existing impacts are not managed or new impacts are introduced. The solar development cannot alter the overall landuse pressures in the catchment of the reach, thereby being unlikely to improve the PES of the reach. However, the development could directly and indirectly adversely affect the reach, and therefore potential impacts associated with the proposed development must be carefully managed to ensure that it does not lower the PES of the reach in order to comply with the RMO.</td></tr>
<tr><td colspan="4">Freshwater ecosystem drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):</td></tr>
<tr><td colspan="4">The reach and its catchment are located in a relatively small catchment and without the presence of naturally-occurring springs or wetlands within the catchment, the drainage line is expected to be naturally ephemeral in terms of its hydrological characteristics. The drainage line would therefore naturally be characterised by surface flows only for relatively short periods after rainfall events of sufficient volume and intensity to generate surface runoff. The landuse practices in the catchment have however significantly altered runoff characteristics from a natural state, with the removal of vegetation through excessive livestock grazing and through erosion (loss of topsoil) being likely to significantly decrease infiltration capacity of the soils and leading to higher pulses of runoff for shorter periods, thus leading to increased flood peaks in the reach of the drainage line.
As an ephemeral drainage line the reach is naturally channelised and characterised by fluvial-related hydromorphic processes such as outer bend bank erosion. The altered hydrology of the reach has however resulted in the exacerbation of natural erosive processes and increased scour which has led to subsiding of banks. Such erosion has also been exacerbated by the movement of livestock in and out of the channel.
Under a reference state the riparian zone of the drainage line would be expected to be characterised by a woody layer with an herbaceous understorey. The woody layer would typically be characterised by larger trees than the surrounding woodland due to the increased moisture availability in the riparian zone. Due to its location in a rural communal area characterised by high levels of poverty and unemployment, dependence on natural resources is very high and most of the larger trees have been felled or significantly coppiced. The remaining woody vegetation consists almost exclusively of the indigenous invasive species Dichrostachys cinerea. The extreme grazing pressure has resulted in the large areas of exposed substrate which leads to an increased risk of the development of sheet erosion.
Water quality parameters were not taken as no surface flows in the river were observed at the time of assessment. However, it is likely that the water quality parameters would be impacted by the landuse practices in the catchment.
Due to the short hydroperiod of the drainage line combined with the high levels of degradation of the overall reach, no freshwater-dependent biota is likely to be present within the reach and a very low species diversity of both flora and fauna characterises the riparian zone.</td></tr>
<tr><td>Extent of modification anticipated.</td><td colspan="3">Low
The drainage line runs parallel to the western boundary of the study area but due to the revision of the development site and layout, it does not extend onto the development site (study area). As an important mitigation related to the proposed development in the context of freshwater resources, the delineated extent of the drainage lines that drain parallel to the site boundaries have accordingly been retained as non-developable areas, along with a suitable buffer area. Accordingly a low degree of modification is expected. (refer to Section 5 below).</td></tr>
</table>

Risk Assessment Outcome & Business Case:	
Low	The delineated extent of the drainage and a suitable buffer will fall outside of the development footprint, thereby limiting the potential for direct impacts to materialise, however, indirect impacts could still occur should mitigation measures not be implemented. Recommended mitigation measures to limit indirect impacts relate mainly to the development of formal and effective stormwater controls.

Table 5: Summary of the assessment of the Eastern Drainage Line (unnamed tributary of the Moopetsi River) associated with the proposed PV facility.

Ecological & socio-cultural service provision graph:

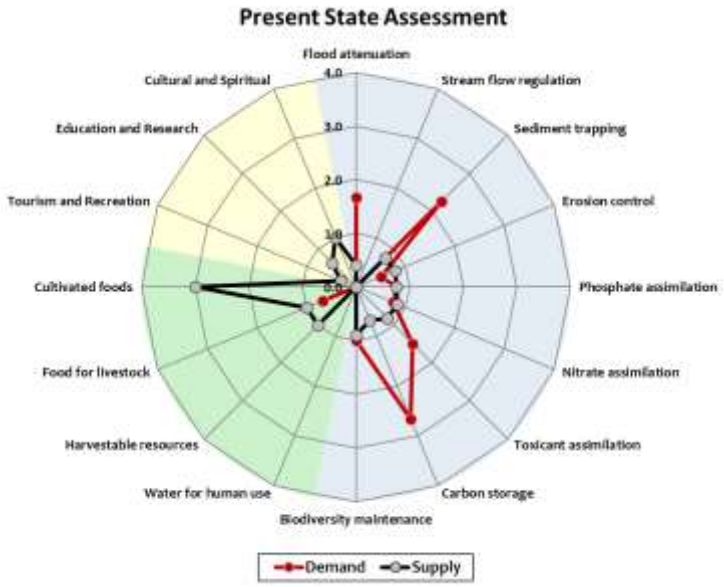

Figure 12: Representative photographs of the Eastern Drainage Line; top left: channel of the drainage line close to the north-east site boundary; top right: channel and banks in an upstream part of the reach; active channel and bank erosion in an upstream part of the reach; bottom right; water-filled depression within a part of the reach.

<table>
<tr><td>PES Discussion (IHI)</td><td colspan="3">Riparian IHI PES Category: C (moderately modified)
Landuse factors have resulted in a degree of degradation of the drainage line, in particular its riparian zone. This has resulted from pressures acting on both the catchment of the reach assessed and the reach itself. Within the catchment, the urbanisation of large areas to form peri-urban settlements, along with the extensive presence of livestock and clearing of woody vegetation in a communal rural setting have denuded the catchment of much of its natural vegetation cover and have also resulted in significant gulley and sheet erosion in the catchment. Within the reach a variety of factors impact the riparian zone, with significant volumes of sediment deposition noted in the channel of the reach assessed. Large trees that would naturally have occurred in the riparian zone have mostly been felled and the riparian zone is now dominated by Dichrostachys cinerea. Erosion was noted in certain parts of the reach, but the exposure of substrate in the riparian zone is much less prevalent than the drainage line to the west and the riparian zone is relatively well-vegetated.</td></tr>
<tr><td>EIS discussion</td><td colspan="3">EIS Category: Low
This reach of the drainage line was assessed to have a low EIS, showing very little ecological sensitivity and being rarely sensitive to changes in water quality/hydrological regime. The degraded nature of the riparian zone depresses most biodiversity and ecological aspects of sensitivity and importance, with no significant freshwater habitat or freshwater-related biota. The most important ecological sensitivity aspect of the reach is its function as an ecological movement corridor – which will likely be enhanced once the solar power development becomes operational, causing further fragmentation in the landscape. The level of degradation, along with the absence of baseflow and channelised nature of the reach lowers the hydro-functional importance of the reach and the reach offers few direct human benefits.</td></tr>
<tr><td>Ecoservice provision</td><td>Cultivated Foods = Moderately Low
All other services = Very Low
Degradation of the drainage line, along with its hydraulic characteristics as an ephemeral drainage line with no baseflow lowers the supply of most ecoservices. This is indicated in the demand for various ecoservices (e.g. sediment trapping, carbon, storage) being much higher than the degree of ecoservice provided by the drainage line.</td><td>REC, RMO & BAS Category</td><td>REC Category: C
RMO: C (Maintain)
BAS Category: C
Based on the PES and EIS, the RMO is to maintain the ecological status of the drainage line. The drainage line is moderately modified but the PES could be further degraded if existing impacts are not managed or new impacts are introduced. The solar development cannot alter the overall landuse pressures in the catchment of the reach, thereby being unlikely to improve the PES of the reach. However the development could directly and indirectly adversely affect the reach, and therefore potential impacts associated with the proposed development must be carefully managed to ensure that it does not lower the PES of the reach.</td></tr>
<tr><td colspan="4">Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):</td></tr>
<tr><td colspan="4">The reach and its catchment are located in a relatively small catchment and without the presence of naturally-occurring springs or wetlands within the catchment, the drainage line is expected to be naturally ephemeral in terms of its hydrological characteristics. The drainage line would therefore naturally be characterised by surface flows only for relatively short periods after rainfall events of sufficient volume and intensity to generate surface runoff. The landuse practices in the catchment have however significantly altered runoff characteristics from a natural state, with the removal of vegetation through excessive livestock grazing and through erosion (loss of topsoil) being likely to significantly decrease infiltration capacity of the soils and leading to higher pulses of runoff for shorter periods, thus leading to increased flood peaks in the reach of the drainage line.
The ephemeral drainage line is naturally channelised and characterised by fluvial-related hydromorphic processes, especially in the upper parts of the reach. In the lower parts of the reach adjacent to the study area, the drainage line becomes less channelised and flows slightly more diffusely, but with the retention of a shallow channel. In part of the reach a lateral depression which captures flows along the channel was noted, but this depression is isolated and most surface flows are transported into the downstream parts of the drainage line.
Under a reference state the riparian zone of the drainage line would be expected to be characterised by a woody layer with an herbaceous understorey. The woody layer would typically be characterised by larger trees than the surrounding woodland due to the increased moisture availability in the riparian zone. Due to its location in a rural communal area characterised by high levels of poverty and unemployment, dependence on natural resources is very high and most of the larger trees have been felled or significantly coppiced. The remaining woody vegetation consists almost exclusively of the indigenous invasive species Dichrostachys cinerea. Despite this grazing pressure the riparian zone was noted to be well vegetated with relatively few areas of exposed substrate. An herbaceous layer was noted to be developing in the channel and riparian zone of the drainage line following the receipt of rainfall in the area.</td></tr>
</table>

Water quality parameters were not taken as no surface flows in the river were observed at the time of assessment. However, it is likely that the water quality parameters would be impacted by the landuse practices in the catchment. Due to the short hydroperiod of the drainage line combined with the isolated presence of a single depression, no freshwater-dependent biota is likely to be present within the reach and a low species diversity of both flora and fauna characterises the riparian zone.	
Extent of modification anticipated.	**Low** The drainage line runs parallel to the eastern boundary of the study but due to the revision of the development site and layout, it does not extend onto the development site (study area). As an important mitigation related to the proposed development in the context of freshwater resources, the delineated extent of the drainage lines that drain parallel to the site boundaries have accordingly been retained as non-developable areas, along with a suitable buffer area. Accordingly a low degree of modification is expected. (refer to Section 5 below).
Risk Assessment Outcome & Business Case:	
Low	The delineated extent of the drainage and a suitable buffer will fall outside of the development footprint, thereby limiting the potential for direct impacts to materialise, however, indirect impacts could still occur should mitigation measures not be implemented. Recommended mitigation measures to limit indirect impacts relate mainly to the development of formal and effective stormwater controls.

5 LEGISLATIVE REQUIREMENTS AND APPLICATION OF BUFFER ZONES

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[3];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) (as amended);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA) (as amended); 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).

Certain articles of legislation related to the above Acts and legislation impose potential zones of regulation on freshwater ecosystems in both a national and provincial context. The Zones of Regulation (ZoR) are not necessarily development exclusion zones, rather areas in which EIA legislative tools have been introduced for the protection and sustainable use of freshwater resources by requiring that certain types of activities within a freshwater ecosystem, or within a certain distance of a freshwater ecosystem require authorisation. The definition and motivation for a regulated zone of activity for the protection of freshwater ecosystems can be summarised as follows:

[3] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 1996". 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 6: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use Authorisation Application for water uses as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (as amended).	**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) as amended** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998) as amended, a regulated area of a watercourse in terms of water uses as listed in Section 21 (c) and 21 (i) 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 in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended (2017). The activities which might trigger the required authorisations must be determined by the EAP in consultation with the relevant authorities.	**Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended in 2017)** The development of— (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs—; a) within a watercourse; b) in front of a development setback; or c) if no development setback exists, **within 32 metres of a watercourse, measured from the edge of a watercourse**.
Specific guidelines for meeting minimum requirements for CBA and ESA wetlands.	• All wetlands are protected under the National Water Act, 1998 (Act No. 36 of 1998) as amended. • In terms of the National Water Act, 1998 (Act No. 36 of 1998) as amended, freshwater ecosystems (all wetlands included) should not be allowed to degrade to an unacceptably modified condition (E or F ecological category); • Conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status. • Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetlands.

The following relevant Zone of Regulation (ZoR) are applicable (Figure 13):

- NEMA 32 m ZoR as it relates to the National Water Act, 1998 (Act No. 107 of 1998) as amended; and
- A 100 m ZoR in accordance with GN 509 in terms of the National Water Act, 1998 (Act No. 36 of 1998).

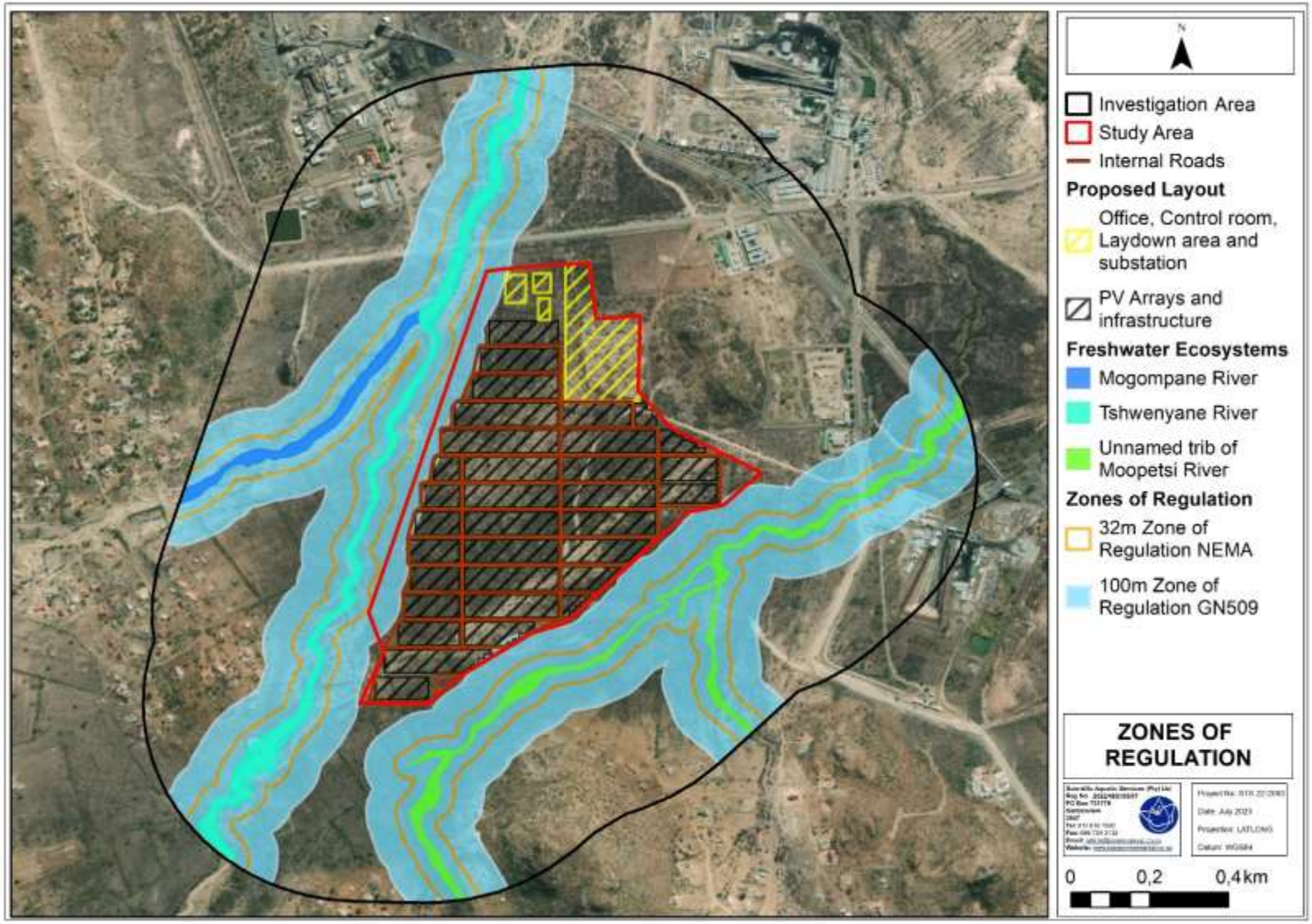

Figure 13: Conceptual representation of the zones of regulation in terms of NEMA and GN 509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended associated with the proposed PV facility and investigation area.

6 RISK ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the freshwater ecosystems. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed activities and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

6.1 *Risk assessment analysis*

6.1.1 Consideration of impacts and application of mitigation measures

Following the assessment of the freshwater ecosystems associated with the proposed PV facility, the DWS prescribed Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these freshwater ecosystems.

The points below summarise the considerations taken when applying the DWS Risk Assessment Matrix (2016):

- The DWS Risk Assessment Matrix (2016) was applied assuming that a high level of mitigation will be implemented, thus the results, provided in this report presents the perceived impact significance ***post-mitigation***;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA *et al.* (2013) (Please refer to Figure E1, Appendix E) would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required. In the context of the proposed development it has been assumed that the development would not be developed within the delineated riparian zone of the ephemeral drainage lines on the boundaries of the site (refer to Figure 3) and that no direct impacts would materialise;
- The layout of the proposed PV facility is only very marginally located within the GN509 100 m ZoR in terms of the National Water Act, 1998 (Act No. 36 of 1998) as amended of the freshwater ecosystems. As such, all legal issues pertaining to aspects and activities relating to the freshwater ecosystems were scored as “1”;
- It has been confirmed by the client that bifacial panels will be utilised as part of the proposed solar development, however it cannot be determined at this stage whether operational vegetation clearing under the panels will be required or not (e-mail response from Luke Colvin, Energy Group, 06 July 2023). Accordingly a

recommendation has been made that low vegetation be retained or allowed to become re-established under the arrays to protect the underlying soil from erosion. It is recognised that such vegetation retention in the operational phase of the development may be deemed to be technically non-feasible, in which case the operational stormwater management plan for the site must account for the presence of permanently exposed soils in the solar PV array footprint;

- While the operation of the proposed development will be a permanent activity, the construction thereof is envisioned to take no more than a few months to a year. However, the frequency of the construction impacts may be daily during this time; and
- Most impacts are considered to be easily detectable, with the exception of potential contamination of surface and groundwater which will require some effort. Assessing these potential impacts falls outside of the scope of this freshwater ecosystem study.

6.2 *Risk Assessment discussion of anticipated ecological impacts*

There are four key ecological impacts on the wetlands that are anticipated to occur namely,

- Loss of wetland habitat and ecological structure;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the freshwater ecosystems; and
- Impacts on water quality.

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, some impacts can be avoided or adequately minimised where avoidance is not feasible. The mitigation measures provided in this report have been developed with the mitigation hierarchy in mind, and the implementation and strict adherence to these measures will assist in minimising the significance of impacts on the receiving environment.

A summary of the DWS Risk Assessment Matrix applied to the proposed development activities, is provided in the table below, whilst a comprehensive outcome of the risk assessment is presented in Appendix G.

Table 7: Summary of the results of the DWS risk assessment matrix applied to the freshwater ecosystems associated with the proposed PV facility.

Phase	No	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Mitigation measures
Construction Phase	1	Site clearing prior to commencement of construction activities and the set-up of contractor camps.	"•Removal of vegetation leading to exposure and associated disturbances to soil; •Increased likelihood of dust generation in adjacent freshwater ecosystems due to exposed soil; •Removal of topsoil and creation of topsoil stockpiles; •Potential creation of access roads to facilitate contractor laydown and subsequent construction activities; •Laydown of construction offices and ablution facilities.	•Increased runoff and possible development of erosion, or exacerbation of existing erosion resulting in increased potential sedimentation and within the channel and riparian zone of the drainage lines located downgradient of the study area; •Anthropogenic and noise-pollution to surrounding biota.	1	4	9	**36**	**L**	• The construction site must be fenced prior to the start of site clearing to prevent any accidental clearing of vegetation or construction impacts from adversely impacting areas outside of the development footprint (layout). •All construction and site clearing should ideally take place during the dry season to limit potential impacts to downgradient drainage lines as a result of construction activities; •Areas which are to be cleared of vegetation including contractor laydown areas must remain as small as possible and it must be ensured as far as possible that vegetation clearing is focused to the proposed development footprint; •Areas to be cleared of vegetation must be cleared in a controlled, phased manner. •A designated contractor laydown area should be approved by the Environmental Control Officer (ECO) prior to use; •An Environmental Control Officer (ECO) must be appointed in order to ensure all water related aspects are adequately mitigated for the life of the proposed development. •All existing roads must be used for access and the development of new roads avoided.
	2	Ground-breaking, excavation for foundations and other construction related earthworks upgradient of / within the catchment of the two drainage lines on the boundaries of the development site.	•Removal of topsoil and creation of soil stockpiles upgradient of the drainage lines located to the east and west of the study area; •Potential runoff of sediment and waste material into the drainage lines located to the east and west of the study area; •The movement of construction machinery, personnel and equipment upgradient of the drainage	•Disturbances of soil leading to increased alien vegetation proliferation that if it encroached the drainage lines located to the east and west of the study area, could result in altered freshwater ecosystem habitat; •Altered runoff patterns within the landscape, leading to increased erosion and sedimentation of freshwater ecosystem habitat;	1	4	10	**40**	**L**	•The following measures are recommended to mitigate against indirect impacts with regards to excavation and soil compaction activities within the catchments of the drainage lines on the boundaries of the development site: •A construction-phase stormwater control system must be implemented as part of the development and implementation of stormwater controls across all development phases. Temporary measures must be used to control construction phase stormwater - e.g. the use of berms, silt traps / silt curtains, along with the retention of natural vegetation where possible; •During excavation activities, it must be ensured that stockpiles are not higher than 2 m in height and all exposed soil must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent

Phase	No	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Mitigation measures
			lines located to the east and west of the study area; •Mixing and casting of concrete for construction purposes upgradient of the drainage lines located to the east and west of the study area.	•Potential for deteriorated water quality, including increased likelihood of dust generation, turbidity and sedimentation within the drainage lines located to the east and west of the study area; •Noise disturbance to avifauna and aquatic biota associated with the drainage lines located to the east and west of the study area.						erosion and sedimentation of the drainage line. Furthermore, measures must be undertaken to limit the time in which soil is exposed; •Dust suppression measures must be implemented (such as spray watering on gravel roads) throughout the proposed development activities to prevent excessive dust which may adversely affect riparian vegetation within the drainage lines; With regards to concrete mixing on site: •Concrete and cement-related mortars can be toxic to aquatic life and other biota. Proper handling and disposal are considered imperative to minimise or eliminate discharge into the drainage lines. High alkalinity associated with cement can dramatically affect and contaminate both soil and ground water. The following recommendations must be adhered to: •Fresh concrete and cement mortar must not be mixed near the site boundaries (i.e. within the 100m Zone of Regulation) of the drainage lines; •Mixing of cement should only be undertaken within the construction camp and may not be mixed on bare soils; •Mixing of concrete is also to be strictly undertaken within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete; •A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing; •A washout area must be designated outside of the confines of the 100m Zone of Regulation around the drainage lines; •Cement bags must be disposed of in the demarcated hazardous waste receptacles; •Concrete spillage outside of the demarcated area must be promptly removed and taken to a suitably licenced waste disposal site.

Phase	No	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Mitigation measures
Operational phase	3	Operational stormwater control and design of stormwater attenuation facilities on the development site.	•Operation of stormwater infrastructure and discharge of stormwater into drainage lines on the boundaries of the development site.	•Potential pollutants and toxicants entering the downgradient drainage lines; •Potential changes to the water retention pattern, timing and flows within the downgradient drainage lines; •Potential exacerbation of existing erosion and development of new erosion, along with concomitant increased sedimentation within the downgradient drainage lines as a result of the increased stormwater discharge causing increased scour and velocity and due to decreased infiltration capacity of soils that may be cleared of all vegetation in the solar panel array footprint.	1	5	7	**35**	**L**	•It is recommended that herbaceous (grassy) vegetation be allowed to become re-established in the footprint of the solar arrays, thereby preventing soils under the solar panels from being permanently exposed, which would render them more vulnerable to erosion, and which render the soils less permeable and thus reducing the infiltration capacity of the soils. It is recommended that a grassy layer be allowed to grow within the array footprints, or within certain parts of the array footprint to improve infiltration of runoff and to trap surface runoff during precipitation events; •Stormwater infrastructure on the development site must be designed in line with the principles of SuDS in order to polish stormwater by trapping sediments and by removing pollutants that could pollute downgradient freshwater ecosystems, and in order to allow the gradual discharge of stormwater into the catchments of the downgradient drainage lines following rainfall events. •As such the use of 'soft' engineering features such as bioswales that are vegetated with suitable vegetation that is tolerant of both wet and dry conditions is strongly recommended. •The use of stone pitching to reduce velocity of stormwater is strongly recommended; •The proposed stormwater infrastructure must also be incorporated into a suitable and site-specific Stormwater Management Plan (SWMP).
	4	Operations and maintenance of the development (including. sewage infrastructure associated with the proposed office and control room, if applicable, and BESS).	•Potential failure of infrastructure and waste management systems (e.g. sewage infrastructure associated with the proposed office and control room, if applicable) resulting in leakages and possible contamination of surface and ground water into the	•Potential contamination and deterioration of water quality within the drainage lines in the event of a spill / damage to sewage infrastructure (associated with the proposed office and control room, if applicable) and in the event of damage to BESS infrastructure;	1	5	6	**30**	**L**	•It should be ensured that regular maintenance takes place to prevent failure of any waste / sewage infrastructure associated with the proposed development; •BESS infrastructure must be regularly inspected and must be operated in line with applicable SANS standards (e.g. SANS 56005:2022 Ed 1 and SANS 62133-2:2022 Ed 1 as issued in Schedule B1 of GN 1427 of 18 November 2022, as issued in terms of section 24(1)(a) of the Standards Act (act 8 of 2008)) •Maintenance activities must be confined to the developed footprint of the solar energy facility which must be fenced off to

Phase	No	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Mitigation measures
			downgradient drainage systems Potential leakage of hazardous materials associated with BESS technology (i.e. batteries) •Indiscriminate movement of vehicles and vegetation trampling within the immediate catchments of the drainage lines located to the east and west of the study area as part of maintenance activities.	•Damage to riparian habitat within the drainage lines and potentially decreased ecoservice provision and disturbance to biota during maintenance activities.						prevent accidental access into the adjacent freshwater ecosystems (riparian zones); •A formal waste management and disposal system must be implemented at the solar energy facility.

The activities associated with the construction and operation of all the proposed PV facility options pose a “Low” risk significance to the freshwater ecosystems within the study and investigation areas, provided that all construction and operational phase mitigation and control measures are implemented The exclusion of the solar PV and associated infrastructure from the GN 509 100m Zone of Regulation is a very effective measure (akin to a buffer) that reduces the potential for indirect impacts to materialise on the drainage lines located to the east and west of the site. However it is very important to note that the development will be located within the immediate catchment areas of the drainage lines and thus stormwater management in both construction and operational phases is highly important. The intervening area between the panels and the site boundaries can be used for the development of soft stormwater attenuation facilities (e.g. bioswales) as part of the implementation of Sustainable Drainage Systems (SuDS) for the development.

In addition, all mitigation measures as stipulated in the above table, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed solar energy facility are likely to be reduced during the construction and operational phases assuming that a high level of mitigation takes place. Additional “good practice” mitigation measures applicable to a project of this nature are provided in **Appendix H** of this report.

7 IMPACT ASSESSMENT

Tables 8 and 9 have assessed all potential impacts on the freshwater environment in the study area and investigation areas according to the method described in Appendix D (as provided by the EAP). The impact assessment methodology provided by the EAP assesses both direct impacts and indirect impacts for each phase of the proposed development. As the freshwater ecosystem habitat that is located to the east and west of the development site would be left undeveloped, no direct impacts on freshwater habitat in either the construction or operational phase would materialise, and as such no direct impacts have been assessed. Indirect impacts for the construction and operational phase have been separately assessed.

It should be noted that the tables also provide the findings of the impact assessment undertaken with reference to the perceived impacts prior to the implementation of mitigation measures and following the implementation of mitigation measures. The mitigated results of the impact assessment have been calculated on the premise that all mitigation measures as stipulated in this report are adhered to and implemented. Should such actions not be adhered to, it is highly likely that post-mitigation impact scores will increase.

Table 8: Impact on Freshwater Environment associated with the proposed development activities in the study area and immediate surrounds for the CONSTRUCTION PHASE.

Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1 to 5 years)	Very Short-term (< 1 year)
Extent	Whole site and nearby surroundings	Part of Site / Property
Consequence	Medium	Low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	**Very Low**	**Insignificant-**
Degree to which impact can be reversed	Fully Reversible: If stormwater-related or other indirect impacts such as dust-related impacts occur, these will be able to be reversed as the impacts will not be permanent.	
Degree to which impact may cause irreplaceable loss of resources	Low: The development will be very unlikely to cause irreversible loss of resources as indirect construction-related impacts will not be of a magnitude to completely transform the riparian zone or instream habitat of the downgradient drainage lines.	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High: Indirect construction impacts on the drainage lines are able to be effectively mitigated through proper design and the implementation of construction-phase environmental controls.	
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Low -	**Low -**

Table 9: Impact on Freshwater Environment associated with the proposed development activities in the study area and immediate surrounds for the OPERATIONAL PHASE.

Type of Impact	Indirect	
Nature of Impact	Negative	
Phases	Operation	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Permanent (> 20 years)	Permanent (> 20 years)
Extent	Whole site and nearby surroundings	Part of Site / Property
Consequence	Medium	Low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	**Very Low**	**Insignificant-**
Degree to which impact can be reversed	Fully Reversible: If stormwater-related or other indirect impacts occur, these will be able to be reversed as the impacts will not be permanent.	
Degree to which impact may cause irreplaceable loss of resources	Low: The development will be very unlikely to cause irreversible loss of resources as indirect (stormwater)-related impacts will not be of a magnitude to completely transform the riparian zone or instream habitat of the downgradient drainage lines.	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	High: Indirect operational impacts on the drainage lines are able to be effectively mitigated through proper design and the implementation of operational-phase environmental controls.	
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Low -	**Low -**

7.1.1 Cumulative and Residual Impacts

Freshwater ecosystems within the region are under continued threat due to urban and mining related development and expansion, alien invasive vegetation encroachment and pressures associated with landuse practices in a communal rural setting. As detailed above, no direct impacts on the nearest freshwater ecosystems will be generated as the footprint of the solar facility will be kept outside of the delineated extent of the freshwater ecosystems, with the application of a suitable development exclusion buffer. Accordingly only indirect impacts could materialise on the two drainage lines running parallel to the site boundaries.

As described in Section 4, these drainage lines are moderately to largely modified, and the western drainage line is particularly highly impacted by existing pressures. Should the development cause further impact on these drainage lines, this would constitute a cumulative impact in terms of the further overall degradation of freshwater ecosystems in the wider area, especially as downstream reaches and other components of the wider drainage system would be likely to be impacted. Such a cumulative impact associated with the proposed development would be able to be avoided if the potential indirect impacts associated with the solar development were effectively mitigated or avoided.

Residual impacts arise from activities of which the effects persist long after the activity has ceased due to the self-perpetuating nature of such impacts (e.g. erosion). Residual impacts may cease with human remediation or when the trajectory of ecosystem imbalance caused by such an impact is complete. Due to the disturbance of soil and removal of vegetation that will commence with the PV facility construction activities, there may be an increase in alien and invasive species entering the system, which may then persist long after construction activities have been completed. In addition, the possible onset of erosion associated with construction activities and extending into the operational period of the development could transpire. Such initiation of further erosion in the catchment of the drainage lines, in particular erosion associated with the clearing of vegetation and resultant, long term exposure of soils and associated altered runoff patterns may result in greater inputs of sediment into and eventual smothering of riparian vegetation over time.

It is expected that the impacts associated with the proposed PV facility on the freshwater ecosystems are unlikely to contribute to residual effects on freshwater ecosystem habitat within the local area provided that cognisant, well-planned design is implemented. The PES and ecoservice provision of the freshwater ecosystems must be maintained where feasibly possible, as per the REC and RMO.

8 CONCLUSION

Scientific Aquatic Services (SAS) was appointed by SLR Consulting (Pty) Ltd to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) process for the proposed solar energy photovoltaic (PV) facility at the Marula Platinum Mine (MPM), which is located near Burgersfort within the Limpopo Province.

The site assessment confirmed the presence of three ephemeral drainage lines within 500 m of the proposed PV facility footprint, two of which run parallel to the eastern and western site boundaries and which partly extend onto the development site. The results of the assessment are summarised in the table below:

Table 10: Summary of results of the field assessment as discussed in Section 4.

Freshwater ecosystem	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	REC / RMO / BAS
Western Drainage Line (Tshwenyane River)	Category D (Largely Modified)	Moderately Low to Very Low	Very Low	REC: D; BAS: D, RMO: D (Maintain)
Eastern Drainage Line (Unnamed trib. of the Moopetsi River)	Category C (Moderately Modified)	Moderately Low to Very Low	Low	REC: C; BAS: C, RMO: C (Maintain)

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2016) was applied to determine the significance of impacts of the proposed PV facility on the receiving freshwater environment. The activities associated with the construction and operation of the proposed PV facility pose a “Low” risk significance to the freshwater ecosystems within the study and investigation areas, provided that the construction and operational activities of the proposed PV facility remain outside the delineated boundary of the identified freshwater ecosystems and an associated 32m development exclusion buffer. All mitigation measures as stipulated in Section 6 and Appendix H of this report, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

9 REFERENCES

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APPENDIX A – Terms of Use and Indemnity

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 SAS (Pty) Ltd and its staff reserve the right, at their sole discretion, to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field or pertaining to this investigation.

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APPENDIX B – Legislation

LEGISLATIVE CONSIDERATIONS

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 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 realisation 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 (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act (NEMA) (Act 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.
National Environmental Management: Biodiversity Act (2004) (Act 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; (c) 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).
The National Water Act 1998 (Act No. 36 of 1998) (NWA) as amended	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998) as amended	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) 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; b) 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 c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix;

	iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has 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.
Specific guidelines for meeting minimum requirements for CBA and ESA wetlands (MBSP, 2014).	➢ All wetlands are protected under the National Water Act, 1998 (Act No. 36 of 1998) as amended. ➢ In terms of the National Water Act, freshwater ecosystems (all wetlands included) should not be allowed to degrade to an unacceptably modified condition (E or F ecological category). ➢ Conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status. ➢ Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetlands.

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 features present or in close proximity of the proposed study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

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

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

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present in the vicinity of or within the proposed study area.

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

The freshwater features encountered within the proposed study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure 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) Unit 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[4] (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 at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is

[4] 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.

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) group's 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 National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

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

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

Level 4: Hydrogeomorphic Units

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

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

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including

WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

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

Level of Evaluation
Two levels of assessment are provided by WET-Health:

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

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

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

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

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

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

Assessing the Anticipated Trajectory of Change

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

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

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

Overall health of the wetland

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

4. General 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 Table C5 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

5. WET-Health

The Riparian Vegetation Response Assessment Index (VEGRAI)

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 (Kleynhans *et al.*, 2007a). 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).

Riparian vegetation is described in the National Water Act (Act No. 36 of 1998) as amended as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soil, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Table C6: Descriptions of the A-F ecological categories.

Ecological category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitat and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat have occurred, but the basic ecosystem functions are still predominately 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 modified. Modifications have reached a critical level and the lotic 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

6. Watercourse Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[5] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

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

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

Table C7: Integrating scores for supply and demand to obtain and overall importance score.

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

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

[5] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

Table C8: Classes for determining the likely extent to which a benefit is being supplied.

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.

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

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

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

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

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C8) of the wetland system being assessed.

Table C9: 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

8. 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 resource (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C10: Recommended management objectives (RMO) for water resources 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
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

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

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

Table C11: Description of Recommended Ecological Category (REC) classes.

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

9. WET-Ecoservices

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[6] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

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

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.
*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

Table C9: Integrating scores for supply and demand to obtain and overall importance score.

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

[6] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a “moderate” demand scenario. The importance score is, however, adjusted by up to one class up where demand is “very high” and by up to one class down where demand is “very low”. The overall importance score can then be used to derive an importance category for reporting purposes.

Table C10: Classes for determining the likely extent to which a benefit is being supplied.

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.

APPENDIX D: Impact Assessment Methodology

Impact assessment methodology as provided by the proponent (SLR Consulting).

This assessment methodology enables the assessment of biophysical, cultural, and socio-economic impacts including cumulative impacts and impact significance through the consideration of intensity, extent, duration, and the probability of the impact occurring. Consideration is also given to the degree to which impacts may cause irreplaceable loss of resources, be avoided, reversibility of impacts and the degree to which the impacts can be mitigated.

METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF IMPACTS

Part A (Table E1) provides the definition for determining impact consequence (combining intensity, extent, and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B (Table E2) and C (Table E3). The interpretation of the impact significance is given in Part D (Table E4). This methodology is utilised to assess both the incremental and cumulative project related impacts.

Table E1: Part A – Definitions and Criteria.

PART A: DEFINITIONS AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, extent, and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance, or degradation. Associated with severe consequences. May result in severe illness, injury, or death. Targets, limits, and thresholds of concern continually exceeded. Habitats or ecosystems of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance, or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits, and thresholds of concern regularly exceeded. Habitats or ecosystems which are important for meeting national/provincial conservation targets. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance, or discomfort. Associated with real but not substantial consequences. Targets, limits, and thresholds of concern may occasionally be exceeded. Habitats or ecosystems with important functional value in maintaining biotic integrity. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance, or nuisance. Associated with minor consequences or deterioration. Targets, limits, and thresholds of concern rarely exceeded. Habitats and ecosystems which are degraded and modified. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance, or nuisance. Associated with very minor consequences or deterioration. Targets, limits, and thresholds of concern never exceeded. Species or habitats with negligible importance. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.

	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**Very Short term**	Very short, always less than a year or may be intermittent (less than 1 year). Quickly reversible.
	Short term	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	Medium term	Medium-term, 5 to 10 years.
	Long term	Long term, between 10 and 20 years. Likely to cease at the end of the operational life of the activity or because of natural processes or by human intervention.
	Very long term/ permanent	Very long, permanent, +20 years. Irreversible. Beyond closure or where recovery is not possible either by natural processes or by human intervention.
Criteria for ranking the EXTENT of impacts	**Site**	A part of the site/property. Impact is limited to the immediate footprint of the activity and within a confined area.
	Whole site	Whole site. Impact is confined to within the project area and its nearby surroundings.
	Beyond site	Beyond the site boundary, affecting immediate neighbours.
	Local	Local area, extending far beyond site boundary.
	Regional/ national	Regional/National. Impact may extend beyond district or regional boundaries with national implications.

Table E2: Part B – Determining Consequence.

PART B: DETERMINING CONSEQUENCE – APPLIES TO POSITIVE OR ADVERSE IMPACTS						
		EXTENT				
		Site	**Whole site**	**Beyond the site, affecting neighbours**	**Local area, extending far beyond site**	**Regional/ National**
INTENSITY = VL						
DURATION	**Very long term /permanent**	Low	Low	Medium	Medium	Medium
	Long term	Very Low	Low	Low	Medium	Medium
	Medium term	Very Low	Low	Low	Low	Medium
	Short term	Very low	Very Low	Low	Low	Low
	Very short term	Very low	Very Low	Very Low	Very Low	Low
INTENSITY = L						
DURATION	**Very long term /permanent**	Low	Medium	Medium	High	High
	Long term	Low	Medium	Medium	Medium	High
	Medium term	Low	Low	Medium	Medium	Medium
	Short term	Very low	Low	Low	Medium	Medium
	Very short term	Very low	Very low	Low	Low	Low
INTENSITY = M						
DURATION	**Very long term /permanent**	Medium	Medium	High	High	Very High
	Long term	Low	Medium	Medium	High	High
	Medium term	Low	Medium	Medium	Medium	High
	Short term	Low	Low	Medium	Medium	Medium
	Very short term	Very low	Low	Low	Low	Medium
INTENSITY = H						
DURATION	**Very long term /permanent**	Medium	High	High	Very High	Very High
	Long term	Medium	Medium	High	High	Very High
	Medium term	Low	Medium	Medium	High	High
	Short term	Low	Medium	Medium	Medium	High

	Very short term	Very low	Low	Low	Medium	Medium
INTENSITY = VH						
DURATION	**Very long term /permanent**	Medium	High	Very High	Very High	Very High
	Long term	Medium	High	High	Very High	Very High
	Medium term	Medium	Medium	High	High	Very High
	Short term	Low	Medium	Medium	High	High
	Very short term	Low	Low	Medium	Medium	Medium

Table E3: Part C – Determining Significance.

PART C: DETERMINING SIGNIFICANCE - APPLIES TO POSITIVE OR ADVERSE IMPACTS							
PROBABILITY (of exposure to impacts)	**Definite/ Continuous**	**VH**	Very Low	Low	Medium	High	Very High
	Probable	**H**	Very Low	Low	Medium	High	Very High
	Possible/ frequent	**M**	Very Low	Very Low	Low	Medium	High
	Conceivable	**L**	Insignificant	Very Low	Low	Medium	High
	Unlikely/ improbable	**VL**	Insignificant	Insignificant	Very Low	Low	Medium
			VL	**L**	**M**	**H**	**VH**
			CONSEQUENCE				

Table E4: Part D – Interpretation of Significance.

PART D: INTERPRETATION OF SIGNIFICANCE		
Significance		**Decision guideline**
Very High	**Very High +**	Represents a key factor in decision-making. Adverse impact would be considered a potential fatal flaw unless mitigated to lower significance.
High	**High +**	These beneficial or adverse impacts are considered to be very important considerations and must have an influence on the decision. In the case of adverse impacts, substantial mitigation will be required.
Medium	**Medium +**	These beneficial or adverse impacts may be important but are not likely to be key decision-making factors. In the case of adverse impacts, mitigation will be required.
Low	**Low +**	These beneficial or adverse impacts are unlikely to have a real influence on the decision. In the case of adverse impacts, limited mitigation is likely to be required.
Very Low	**Very Low +**	These beneficial or adverse impacts will not have an influence on the decision. In the case of adverse impacts, mitigation is not required.
Insignificant		Inconsequential, not requiring any consideration.

ADDITIONAL ASSESSMENT CRITERIA

- Additional criteria that are taken into consideration in the impact assessment process to further describe the impact and support the interpretation of significance in the impact assessment process include:
- the degree to which impacts may cause irreplaceable loss of resources;
- the degree to which impacts can be avoided;
- the degree to which impacts can be reversed;
- the degree to which the impacts can be mitigated; and
- the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects is tabulated below.

Table E5: Additional Assessment Criteria.

ADDITIONAL ASSESSMENT CRITERIA		
Criteria for DEGREE TO WHICH AN IMPACT CAN BE REVERSED	**IRREVERSIBLE**	Where the impact cannot be reversed and is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary.
	FULLY REVERSIBLE	Where the impact can be completely reversed.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE LOSS	**NONE**	Will not cause irreplaceable loss.
	LOW	Where the activity results in a marginal effect on an irreplaceable resource.

	MEDIUM	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
	HIGH	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Criteria for DEGREE TO WHICH IMPACT CAN BE AVOIDED	**NONE**	Impact cannot be avoided, and consideration should be given to compensation and offsets.
	LOW	Impact cannot be avoided but can be mitigated to acceptable levels through rehabilitation and restoration.
	MEDIUM	Impact cannot be avoided, but the significance can be reduced through mitigation measures.
	HIGH	Impact can be avoided through the implementation of preventative mitigation measures.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**NONE**	No mitigation is possible or mitigation even if applied would not change the impact.
	LOW	Some mitigation is possible but will have marginal effect in reducing the impact significance rating.
	MEDIUM	Mitigation is feasible and will may reduce the impact significance rating.
	HIGH	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the impact significance rating.
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS	**UNLIKELY**	Low likelihood of cumulative impacts arising.
	POSSIBLE	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[7] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation, or compensation.
- Desired outcomes are defined and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation.*

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

[7] Mitigation measures should address both positive and negative impacts.

APPENDIX E – Risk Assessment Methodology

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[8]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[9].

[8] The definition has been aligned with that used in the ISO 14001 Standard.
[9] Some risks/impacts that have low significance will however still require mitigation.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table D8: Rating Classes

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

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations

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

The following points were considered when undertaking the assessment:

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

Control Measure Development

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

- Mitigation and performance improvement measures and actions that address the risks and impacts[10] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and

[10] Mitigation measures should address both positive and negative impacts.

- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

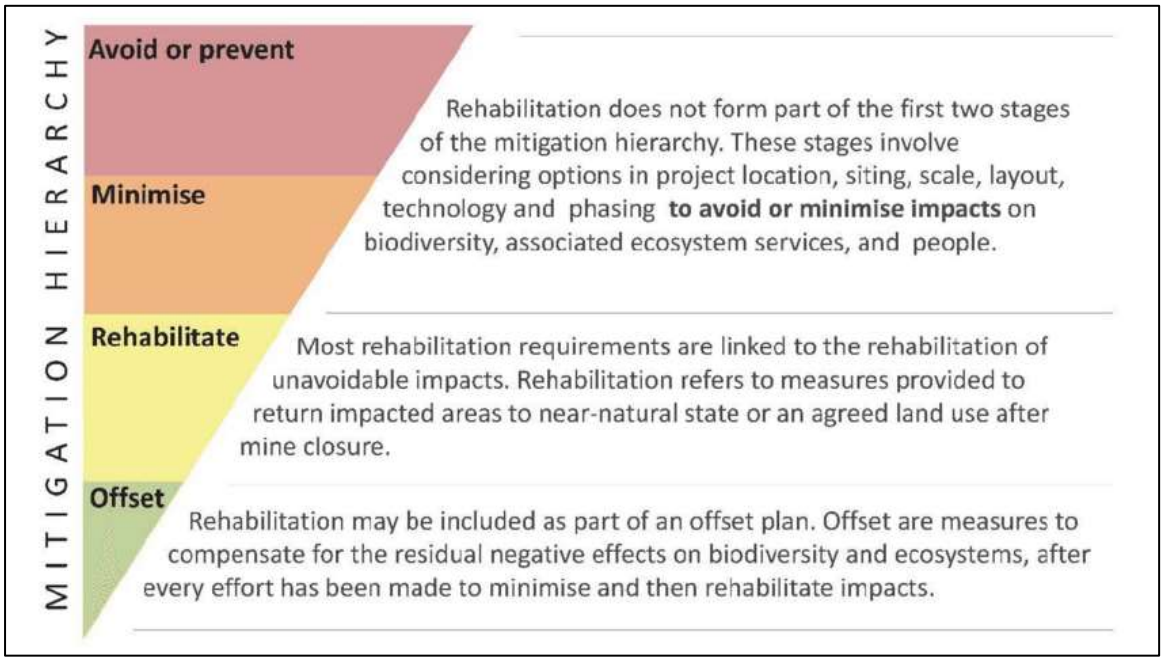

Figure D1: Impact Minimisation hierarchy as advocated by the DEA *et al.,* (2013)

Recommendations

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

Table D10: Reversibility of impacts on the watercourses

Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent)
	Partially reversible (The impact is reversible to a degree e.g. acceptable revegetation measures can be implemented but the pre-impact species composition and/or diversity may never be attained. Impacts may be partially reversible within a short (during construction), medium (during operation) or long term (following decommissioning) timeframe
	Fully reversible (The impact is fully reversible, within a short, medium or long-term timeframe)

APPENDIX F – Results of Field Investigation

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

Table F1: Presentation of the results of the PES assessment applied to the study area western drainage line (left) and eastern drainage lines (right)

RIPARIAN IHI	
Base Flows	0.0
Zero Flows	2.0
Moderate Floods	-2.5
Large Floods	0.0
HYDROLOGY RATING	**1.1**
Substrate Exposure (marginal)	1.0
Substrate Exposure (non-marginal)	3.0
Invasive Alien Vegetation (marginal)	0.0
Invasive Alien Vegetation (non-marginal)	2.0
Erosion (marginal)	4.0
Erosion (non-marginal)	4.5
Physico-Chemical (marginal)	0.0
Physico-Chemical (non-marginal)	0.0
Marginal	4.0
Non-marginal	4.5
BANK STRUCTURE RATING	**4.3**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.0**
RIPARIAN IHI %	**49.9**
RIPARIAN IHI EC	**D**
RIPARIAN CONFIDENCE	**2.0**

RIPARIAN IHI	
Base Flows	0.0
Zero Flows	2.0
Moderate Floods	-2.5
Large Floods	0.0
HYDROLOGY RATING	**1.1**
Substrate Exposure (marginal)	1.5
Substrate Exposure (non-marginal)	2.0
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	2.0
Erosion (non-marginal)	3.0
Physico-Chemical (marginal)	0.0
Physico-Chemical (non-marginal)	0.0
Marginal	2.0
Non-marginal	3.0
BANK STRUCTURE RATING	**2.7**
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	**1.0**
RIPARIAN IHI %	**64.6**
RIPARIAN IHI EC	**C**
RIPARIAN CONFIDENCE	**2.0**

Table F2: Presentation of the results of the Ecoservices assessment applied to the western drainage line.

		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.3	1.7	0.0	Very Low	0.3	1.7	0.0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	0.6	2.3	0.2	Very Low	0.6	2.3	0.2	Very Low
	Erosion control	0.5	0.5	0.0	Very Low	0.5	0.5	0.0	Very Low
	Phosphate assimilation	0.6	0.8	0.0	Very Low	0.6	0.8	0.0	Very Low
	Nitrate assimilation	0.7	0.8	0.0	Very Low	0.7	0.8	0.0	Very Low
	Toxicant assimilation	0.6	1.5	0.0	Very Low	0.6	1.5	0.0	Very Low
	Carbon storage	0.3	2.7	0.2	Very Low	0.3	2.7	0.2	Very Low
	Biodiversity maintenance	0.9	1.0	0.0	Very Low	0.9	1.0	0.0	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	0.5	0.0	0.0	Very Low	0.5	0.0	0.0	Very Low
	Food for livestock	1.0	0.7	0.0	Very Low	1.0	0.7	0.0	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	0.3	0.0	0.0	Very Low	0.3	0.0	0.0	Very Low
	Education and Research	0.6	0.0	0.0	Very Low	0.6	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 F3: Presentation of the results of the Ecoservices assessment applied to the eastern drainage line.

		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.5	1.7	0.0	Very Low	0.5	1.7	0.0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	0.8	2.3	0.4	Very Low	0.8	2.3	0.4	Very Low
	Erosion control	0.8	0.5	0.0	Very Low	0.8	0.5	0.0	Very Low
	Phosphate assimilation	0.8	0.8	0.0	Very Low	0.8	0.8	0.0	Very Low
	Nitrate assimilation	0.8	0.8	0.0	Very Low	0.8	0.8	0.0	Very Low
	Toxicant assimilation	0.8	1.5	0.1	Very Low	0.8	1.5	0.1	Very Low
	Carbon storage	0.7	2.7	0.5	Very Low	0.7	2.7	0.5	Very Low
	Biodiversity maintenance	0.9	1.0	0.0	Very Low	0.9	1.0	0.0	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	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low
	Food for livestock	1.0	0.7	0.0	Very Low	1.0	0.7	0.0	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	0.3	0.0	0.0	Very Low	0.3	0.0	0.0	Very Low
	Education and Research	0.6	0.0	0.0	Very Low	0.6	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 F5: Presentation of the results of the EIS for the Drainage Lines (DLs).

Ecological Importance and Sensitivity			Western Drainage Line	Eastern Drainage Line
			Score (0-4)	Score (0-4)
Biodiversity support			A (average)	A (average)
			0.67	0.67
Presence of Red Data species			0	0
Populations of unique species			0	0
Migration/breeding/feeding sites			2	2
Landscape scale			B (average)	B (average)
			0.6	1
Protection status of the wetland			0.5	1
Protection status of the vegetation type			1	1
Regional context of the ecological integrity			0.5	1.5
Size and rarity of the wetland type/s present			0.5	0.5
Diversity of habitat types			0.5	1
Sensitivity of the wetland			C (average)	C (average)
			0.83	1.50
Sensitivity to changes in floods			1	1
Sensitivity to changes in low flows/dry season			1.5	1.5
Sensitivity to changes in water quality			0	0
Hydro-Functional Importance			Score (0-4)	Score (0-4)
Regulating & supporting benefits	**Flood attenuation**		0	1
	Streamflow regulation		0	0
	Water Quality Enhancement	***Sediment trapping***	0.5	1.5
		Phosphate assimilations	0	0
		Nitrate assimilation	0	0
		Toxicant assimilation	0	0
		Erosion control	1	2

Ecological Importance and Sensitivity		Western Drainage Line	Eastern Drainage Line
		Score (0-4)	Score (0-4)
	Carbon storage	0.5	0.5
Direct Human Benefits		Score (0-4)	Score (0-4)
Subsistence benefits	***Water for human use***	0	0
	Harvestable resources	1.5	1.5
	Cultivated foods	0	0
Cultural benefits	***Cultural heritage***	0	0
	Tourism and recreation	0	0
	Education and research	0	0

APPENDIX G – Risk Assessment Outcome

	Phase	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph+	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction phase	Site clearing prior to commencement of construction activities and the set-up of contractor camps.	"•Removal of vegetation leading to exposure and associated disturbances to soil; •Increased likelihood of dust generation in adjacent freshwater ecosystems due to exposed soil; •Removal of topsoil and creation of topsoil stockpiles; •Potential creation of access roads to facilitate contractor laydown and subsequent construction activities; •Laydown of construction offices and ablution facilities.	•Increased runoff and possible development of erosion, or exacerbation of existing erosion resulting in increased potential sedimentation and within the channel and riparian zone of the drainage lines located downgradient of the study area; •Anthropogenic and noise-pollution to surrounding biota.	1	1	1	1	1	1	2	4	4	3	1	1	9	36	L

	Phase	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph+	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
2		Ground-breaking, excavation for foundations and other construction related earthworks upgradient of / within the catchment of the two drainage lines on the boundaries of the development site	•Removal of topsoil and creation of soil stockpiles upgradient of the drainage lines located to the east and west of the study area; •Potential runoff of sediment and waste material into the drainage lines located to the east and west of the study area; •The movement of construction machinery, personnel and equipment upgradient of the drainage lines located to the east and west of the study area; •Mixing and casting of concrete for construction purposes upgradient of the drainage lines located to the east and west of the study area.	•Disturbances of soil leading to increased alien vegetation proliferation that if it encroached the drainage lines located to the east and west of the study area, could result in altered freshwater ecosystem habitat; •Altered runoff patterns within the landscape, leading to increased erosion and sedimentation of freshwater ecosystem habitat; •Potential for deteriorated water quality, including increased likelihood of dust generation, turbidity and sedimentation within the drainage lines located to the east and west of the study area; •Noise disturbance to avifauna and aquatic biota associated with the drainage lines located to the east and west of the study area.	1	1	1	1	1	1	2	4	5	3	1	1	10	40	L

	Phase	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph+	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
3	Operational phase	Operational stormwater control and design of stormwater attenuation facilities on the development site.	•Operation of stormwater infrastructure and discharge of stormwater into drainage lines on the boundaries of the development site.	•Potential pollutants and toxicants entering the downgradient drainage lines; •Potential changes to the water retention pattern, timing and flows within the downgradient drainage lines; •Potential exacerbation of existing erosion and development of new erosion, along with concomitant increased sedimentation within the downgradient drainage lines as a result of the increased stormwater discharge causing increased scour and velocity and due to decreased infiltration capacity of soils that may be cleared of all vegetation in the solar panel array footprint.	1	1	1	1	1	1	3	5	3	2	1	1	7	35	L

	Phase	Activity	Aspect	Impact	Flow Regime	Water quality	Habitat (Geomorph+	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
4		Operations and maintenance of the development (including. sewage infrastructure associated with the proposed office and control room, if applicable, and BESS).	•Potential failure of infrastructure and waste management systems (e.g. sewage infrastructure associated with the proposed office and control room, if applicable) resulting in leakages and possible contamination of surface and ground water into the downgradient drainage systems Potential leakage of hazardous materials associated with BESS technology (i.e. batteries) •Indiscriminate movement of vehicles and vegetation trampling within the immediate catchments of the drainage lines located to the east and west of the study area as part of maintenance activities.	•Potential contamination and deterioration of water quality within the drainage lines in the event of a spill / damage to sewage infrastructure (associated with the proposed office and control room, if applicable) and in the event of damage to BESS infrastructure; •Damage to riparian habitat within the drainage lines and potentially decreased ecoservice provision and disturbance to biota during maintenance activities.	1	1	1	1	1	1	3	5	1	2	1	2	6	30	L

APPENDIX H – General "Good Housekeeping" Mitigation Measures

General construction management and good housekeeping practices

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

Development footprint

- All development footprint areas must remain as small as possible and must not encroach into the freshwater areas unless absolutely essential and part of the proposed development. It must be ensured that the freshwater habitat is off-limits to construction vehicles and non-essential personnel;
- The boundaries of footprint areas, including contractor laydown areas, must be clearly defined and all activities must remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes must 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 must be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- All hazardous storage containers and storage areas must comply with the relevant SABS standards to prevent leakage;
- No fires must 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 offsite 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 spillage must be p prevented 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. Contaminated soil must be bagged and disposed of in hazardous waste receptacles.

Vegetation

- Removal of the alien and weed species encountered within the wetlands must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 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 must be kept as small as possible when removing alien plant species; and

- No vehicles must be allowed to drive through designated sensitive watercourse areas during the eradication of alien and weed species.

Soil

- Sheet runoff from access roads and the walk ways must be slowed down by the strategic placement of berms;
- As far as possible, all construction activities must occur in the low flow season, during the drier winter months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;
- No stockpiling of topsoil must take place within close proximity to the watercourse, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the watercourse;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas must be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence must be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site;
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development must be removed. Alien vegetation control must take place for a minimum period of two growing seasons after rehabilitation is completed; and
- Side slope and embankment vegetation cover must be monitored to ensure that sufficient vegetation is present to bind these soil and prevent further erosion.

Scientific Aquatic Services
Applying science to the real world
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APPENDIX I – Site Sensitivity Verification

FRESHWATER ECOSYSTEM SITE SENSITIVITY VERIFICATION REPORT FOR THE PROPOSED MARULA PLATINUM SOLAR ENERGY PV FACILITY IN THE BURGERSFORT AREA, LIMPOPO PROVINCE.

Introduction

According to the "Protocols for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes ("the Protocols") published in Government Gazette No. 43110 on 20 March 2020 and Government Gazette No. 43855 on 30 October 2020, the Environmental Assessment Practitioner (EAP) must verify the current use of the site in question and its environmental sensitivity as identified by the Screening Tool to determine the need for specialist inputs in relation to the themes included in the Protocols. The Protocols are allowed for in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"). The Protocols must be complied with for every new application for Environmental Authorisation that is submitted after 9 May 2020.

This document serves as the Freshwater Ecosystem Site Sensitivity Verification Report for the proposed Marula Mine Solar Energy PV Facility near Burgersfort, Limpopo Province. The proposed development requires environmental authorisation in terms of the NEMA EIA Regulations (2014), as amended.

Study Area

The study area, approx. 52 hectares (ha), is located within the Greater Tubatse Local Municipality and Sekhukhune District Municipality of the Limpopo Province. The R37 runs approximately 4 km east of the Marula Platinum Mine

Figure E1: Digital satellite image depicting the location of the proposed Marula Platinum Mine Solar Energy Development and associated investigation area in relation to the surrounding area.

This Freshwater Ecosystem site sensitivity verification report relates to a Screening Tool Report (STR) completed for the site in July 2023.

Site Verification Methodology

A site visit was conducted by the specialist to inform the specialist reports required for the proposed project.

Aquatic Biodiversity Site Verification

The table below provides information regarding the outcome of the Screening Tool in terms of the aquatic biodiversity theme sensitivity associated with the proposed project as well as a brief summary of the outcome of the freshwater ecosystem specialist report in response.

Table I1: Aquatic Biodiversity Theme Sensitivity analysis for the proposed project.

Environmental Theme	Applicable Protocol	Response
Aquatic Biodiversity Sensitivity Rating: The investigation area shows **low sensitivity for aquatic biodiversity** in the study and investigation areas. Requiring an Aquatic Biodiversity Compliance Statement. **Actual Sensitivity: Three ephemeral drainage lines are located in the study area which have a very high aquatic biodiversity sensitivity; Remainder of study and investigation areas: low.**	3(b) Protocol for the assessment and reporting of environmental impacts on aquatic biodiversity (GG 45421 of 10/05/2019) _ DRAFT	A Freshwater Ecosystem Assessment was conducted by Scientific Aquatic Services (SAS, 2023). During the assessment and associated field verification it was determined that the majority of the development site (study area) is of low sensitivity and a small portion in the west and eastern part of the study area (and associated immediately adjacent parts of the study area) is of very high aquatic biodiversity (freshwater) sensitivity due to the confirmed presence of two ephemeral drainage lines. A further drainage line in the investigation area is also very high sensitivity feature. A detailed study was required to support both the authorisation process required in terms of NEMA as well as the NWA. The study and associated comprehensive report from a site visit in December 2022 provide a detailed description of the freshwater ecosystems associated with the proposed project and considered the potential impacts applicable to the freshwater ecosystems and provided suitable mitigation measures to best minimise the potential impact on the freshwater ecosystems.

APPENDIX J – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Paul da Cruz BA (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:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural 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		

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 -

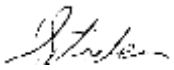
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity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

Signature of the Specialist.

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

I, Stephen van Staden, declare that -

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



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF 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
International – United Kingdom (England and Scotland); USA

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy (Wind and solar)
2. Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
3. Nature Conservation and Ecotourism Development
4. Commercial development
5. Residential development
6. Environmental and Development Planning and Strategic Assessment

7. Industrial/chemical; Non-renewable power Generation

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

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

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Assessments in support of Environmental Screening Assessments, Precinct Planning & SEA
- Wetland Construction (Compliance) Monitoring

Biodiversity Assessments

- Avifaunal Assessments
- Strategic Biodiversity Assessment

Visual Impact Assessment

- Visual Impact Assessments

GIS / Spatial Analysis

- GIS Spatial Analysis and Listing Notice 3 mapping.

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)

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 Leona
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 License 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