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Wetland Offset Strategy and Rehabilitation Plan for Eskom Kusile Ash Disposal Facility

Wetland Environmental Impact Assessment and Offset Strategy Update

Prepared for:
Eco Elementum (Pty) Ltd

Project Number:
ECE7774

July 2022

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I, Ivan Baker, 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

July 2022

Signature of the Specialist *Date*

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EXECUTIVE SUMMARY

Eskom Kusile Power Station (KPS) in Mpumalanga, South Africa was awarded an Integrated Water use Licence (IWULA) for the proposed 60-year Ash Dump Facility (ADF).

In 2015, the KPS Wetland Offset Strategy (the Strategy) was developed (Prime Africa Consultants, 2015). The purpose of the Strategy was to quantify the size of the wetland offset required as a result of the loss of 227 ha wetlands directly related to the construction of the 60 Year ADF. Furthermore, the Strategy identified possible wetland areas on both Eskom and privately-owned land which could be utilised as a possible receiving area to achieve offset targets. The Strategy was in accordance with the Wetland Offset Guidelines and calculator developed by SANBI and the Department of Water and Sanitation (DWS) in 2014.

The layout of the ADF has since changed, a result of a detailed engineering review of the approved design. The footprint of the ADF was shifted approximately 500m south, thus avoiding some wetlands and a river diversion. This change in layout reduced the extent of wetland area that required to be offset. The, now, additional (or unimpacted) wetland areas further provide more wetland rehabilitation intervention areas for the Wetland Rehabilitation Plan which could further help Eskom reach their wetland offset targets.

Following the update of the Strategy, a consolidated Wetland Offset Plan for the KPS 60-year ADF was undertaken. The purpose of the plan was to determine the design of wetland rehabilitation interventions within the identified receiving areas (now unimpacted wetlands) as well as the subsequent application for the Environmental Authorisations (EA) for the implementation of the rehabilitation interventions.

For the implementation of the wetland rehabilitation interventions, a General Authorisation (GA) in terms of Section 21 (c) and (i) of the National Water Act (NWA) was required. A GA was submitted to the DWS in 2018 and is now in the final stages of review with the DWS.

Eco Elementum (Pty) Ltd (Eco Elementum) in collaboration with Engineering, Procurement and Construction Management (EPCM) has been appointed on Task Order 3 to gather and compile the requested information for submission to the DWS. Digby Wells Environmental (Digby Wells) has subsequently been requested by Eco Elementum to update the Wetland Environmental Impact Assessment and Offset Strategy for the updated ADF layout.

Wetland Functionality

Wetland Consulting Services (Pty) Ltd (Wetland Consulting) completed the wetland delineations and impact assessment of the Project Area. These delineations were used for this assessment and further divided into seven Hydro-geomorphic (HGM) units, which all include Channelled Valley Bottom (CVB) wetlands and hillslope seeps.

The findings from the most recent site visit conducted in 2022 indicate slightly higher modification scores to the wetlands. The CVB wetlands were determined to have higher modification scores than the hillslope seeps. This can be attributed to existing crossings and impeding structures affecting the natural hydrological functioning of the wetlands. The hillslope seeps are characterised by higher vegetation modifications, due to the ingress of Alien Invasive Pants (AIPs).

The ecosystem services (EcoServices) associated with delineated wetlands in previous assessments, although limited in detail, are similar to those conditions identified during the 2022 assessment. The EcoServices for the CVB wetlands were determined to be similar in type and significance of each functional aspect. The assimilation ability of the hillslope seeps was determined to be slightly higher than that of the CVB wetlands, predominantly due to the diffuse nature of flows.

The CVB wetlands scored slightly higher (moderate vs low) Ecological Importance and Sensitivity (EIS) scores. The main reason for the difference in EIS scores can be explained by the fact that the hillslope seeps are not nationally protected as part of the NFEPA or NBA wetland data set series. Additionally, the vegetation type is characterised as being endangered, which contributes to the calculated scores.

The Recommended Ecological Class (REC) for HGM 3A has been determined to be a class D due to the current Present Ecological State (PES) and the EIS which have been calculated to be “E” and “B” respectively. Improving the health of the wetland past D is considered to be impractical considering the extent of dams within the system. As for HGM 6, it is considered impractical to improve this system past a “C” condition, predominantly due to the unlikely control of AIPs within this system. The improvement of HGM 7 too will be unfeasible, considering the existing impedance of infrastructure in these wetland systems.

Hectare Equivalents

The most recent calculations considering the revised ADF layout indicate that the required offsets are at least 126.3 ha and 915.4 ha of wetland and ecosystem conservation targets, respectively. The prescribed rehabilitation interventions located within EMU A, B, F and G will ensure a net-gain in wetland functional targets worth 53 ha, whilst achieving a net-gain in ecosystem conservation targets worth 484,9 ha. *Therefore, more offset areas will be required upon the completion of the proposed rehabilitation intervention activities described by* (Digby Wells, 2022) *outside of the already assessed EMU A, B, F and G*.

Various rehabilitation interventions for HGM 3 and 6 inside the ADF Project Area were subsequently recommended, to determine the net-gains achieved within the ADF Project Area. Following the proposed rehabilitation interventions, HGM 3 is expected to improve from E to D (7.5 to 5.5) and HGM 6 is expected to remain moderately modified (C) yet will improve from a score of 3.2 to 2.1. The post-rehabilitation PES ratings correlate perfectly with the REC. *Subsequently, the ecosystem conservation targets are expected to be met upon the completion of recommended interventions, while the functional offset net-gains (ha) will only account for 12,2 hectare equivalents*.

Therefore, there is a shortfall in functional offset targets of 61.1 ha equivalents. It is recommended that additional areas be investigated for potential offsetting. Prime Africa Consultants (2015) mentioned various other offset areas within proximity to the affected Klipfonteinspruit. It is recommended that these suggestions be investigated to determine whether access to private property can be gained to ultimately assess potential intervention sites and ultimately implement such interventions.

Specialist Opinion

The impact assessment indicates major impacts on the wetlands during the construction phase as the wetlands within the ADF area will be completely lost. Even though mitigation and rehabilitation are vital with respect to the conservation of wetland areas, these strategies are deemed to be insufficient as the wetlands will be lost. Therefore, wetland offsets will be required to compensate for the direct and, to a lesser extent, the indirect loss of wetlands. Wetland offset net-gains calculated in previous assessments, as well as those considered for HGM 3 and 6 in this assessment still indicate a shortfall of 61,1 ha of functional offset targets. It is therefore recommended that the proposed activities only proceed once alternative offset areas are investigated and deemed to be sufficient in achieving the excess net-gains of 61,1 ha of functional offset targets.

It is the specialist's opinion that if all the recommendations made within this report, including the investigation of alternative offset areas, be met, the proposed activities should proceed as planned.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degree Celsius
ADF	Ash Dump Facility
AIP	Alien Invasive Plant
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CBA	Critical Biodiversity Area
cm	Centimetre
CMA	Catchment Management Agencies
CSIR	Council for Scientific and Industrial Research
CWD	Clean Water Dam
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
Eco Elementum	Eco Elementum (Pty) Ltd
EcoServices	Ecological Services
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EMPr	Environmental Management Program
EMU	Ecological Management Units
EP	Environmental Practitioner
EPCM	Engineering, Procurement and Construction Management
ESA	Ecological Support Area
FEPA	Freshwater Ecological Priority Area
GA	General Authorisation
ha	Hectare
HGM	Hydro-geomorphic
IWULA	Integrated Water use Licence
IUCN	International Union for Conservation of Nature

km	Kilometre
KPS	Kusile Power Station
m	Metre
m.a.m.s.l.	Metres above mean sea level
MAP	Mean Annual Precipitation
mm	Millimetre
NBA	National Biodiversity Assessment
NBF	National Biodiversity Framework
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecological Priority Area
NWA	National Water Act, 1998 (Act No. 36 of 1998)
ONA	Other Natural Area
PA	Protected Area
PCD	Pollution Control Dam
PES	Present Ecological State
REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SWMP	Storm Water Management Plan
WCS	Wetland Consulting Services (Pty) Ltd
WET-EcoServices	Wetland Ecological Services
WET-Health	Wetland Ecological Health Assessment
Wetland Consulting	Wetland Consulting Services (Pty) Ltd
WMA	Water Management Areas

GN320 Requirements (National Environmental Management Act, 2020)		**Section in Report**
2.3	A specialist report prepared in terms of these Regulations must contain-	
2.3.1	A description of the aquatic biodiversity and ecosystems on site, including;	N/A
(a)	Aquatic ecosystem types	N/A
(b)	Presence of aquatic species and composition of aquatic species communities, habitat distribution and movement patterns;	
2.3.2	Threat status of ecosystem and species identified by the screening tool	Section 7.1
2.3.3	National and provincial priority status of aquatic ecosystems	Section 6
2.3.4	A description of the ecological importance and sensitivity of aquatic ecosystems	Section 7.3
(a)	Description of ecosystem processes that operate in relation to aquatic ecosystems	Section 7.2
(b)	Historic ecological conditions as well as the present ecological state of watercourses	Section 7.1
2.4	Alternative development footprints within the preferred site	Section 1
2.5	Detailed impact assessment, including;	Section 8.4
(a)	Impacts on hydrological functioning	
(b)	Changes in sediment regime	
(c)	Changes in hydrogeomorphic typing of aquatic resources	
(d)	Changes in quality of water	
(e)	Fragmentation and loss of ecological connectivity	
(f)	The loss or degradation of all or part of unique or important features	
2.5.5	How will the proposed activities have an impact on ecosystem services	Section 8.6
2.5.6	How will the proposed activities have an impact on community composition	Section 8.6
2.6	Impacts on estuaries	N/A
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2.7.1	Details of specialist	Section 4
2.7.2	A signed statement of independence	Page iii

GN320 Requirements (National Environmental Management Act, 2020)		**Section in Report**
2.7.3	Duration, date and season of site inspection	Section 1
2.7.4	Methodology and approach for site assessment	Section 5
2.7.5	Assumptions and limitations	Section 3
2.7.6	Location of areas not suitable for development	Section 11
2.7.7	Additional environmental impacts expected	Section 8.7
2.7.8	Direct, indirect and cumulative impacts	Section 8.6
2.7.9	The degree to which impacts can be mitigated	Section 9
2.7.10	The degree to which impacts can be reversed	Section 9
2.7.11	The degree to which irreplaceable loss can be caused	Section 8.7
2.7.12	Suitable buffers for aquatic resources	Section 7.5
2.7.13	Inclusions into EMPr	Section 9
2.7.14	Justification for “low” sensitivity water resources	Section 8.5
2.7.15	Acceptability of proposed activities	Section 12
2.7.16	Any conditions to which this statement is subjected	N/A
2.8	Mitigation and monitoring objectives	Section 9 and 10

1. Introduction

Eskom Kusile Power Station (KPS) in Mpumalanga, South Africa was awarded an Integrated Water use Licence (IWULA) for the proposed 60-year Ash Dump Facility (ADF).

In 2015, the KPS Wetland Offset Strategy (the Strategy) was developed. The purpose of the Strategy was to quantify the size of the wetland offset required as a result of the loss of 227 ha wetlands directly related to the construction of the 60 Year ADF. Furthermore, the Strategy identified possible wetland areas on both Eskom and privately-owned land which could be utilised as a possible receiving area to achieve offset targets. The Strategy was in accordance with the Wetland Offset Guidelines and calculator developed by SANBI and the Department of Water and Sanitation (DWS) in 2014.

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1.1. Project Locality

The KPS falls under the Victor Khanye Local Municipality which is located in the Nkangala District Municipality, Mpumalanga Province (Table 1-1, Figure 1-1 and Figure 1-2). It is located between the towns of Ogies, Witbank and Kendal.

Table 1-1: Summary of the Project Location Details

Province	Mpumalanga
District Municipality	Nkangala District Municipality
Local Municipality	Victor Khanye Local Municipality
GPS Co-ordinates (the relative centre point of Project Area)	25°55'07.0"S
	28°55'01.9"E

1.2. Proposed Infrastructure and Activities

The proposed activities of the Project per phase are provided in Table 1-2 below.

Table 1-2: Project Phases and Associated Activities

Project Phase	Associated Activities
Construction Phase	Site/vegetation clearance within wetlands
	Site/vegetation clearance within wetland buffers
	Establishment of ancillary infrastructure (i.e. offices, security rooms and changing houses).
	Construction linear components (pipelines and roads)
	Construction of Pollution Control Dam (PCD), Clean Water Dam (CWD)
	Construction of topsoil stockpile footprint area
	Construction and clearance of Ash Dam Facility (ADF) footprint area, including continuous expansion over the life of the operation
	Construction of conveyor crossing
	Construction of attenuation dam D10 (only attenuation pond outside of ADF offset footprint)
Operation Phase	Continuous monitoring and maintenance
	Operation of ancillary infrastructure (i.e. offices, security offices and changing houses).
	Operation of linear components (pipelines and roads), including potential leaks and increased traffic
	Operation of PCD and CWD
	Operation of topsoil stockpile
	Operation of ADF footprint area
	Operation of conveyor crossing
	Operation of attenuation dams

Project Phase	Associated Activities
Decommissioning/ Rehabilitation Phase	Demolition and removal of infrastructure
	Post-closure monitoring and rehabilitation
	Reclamation of ADF

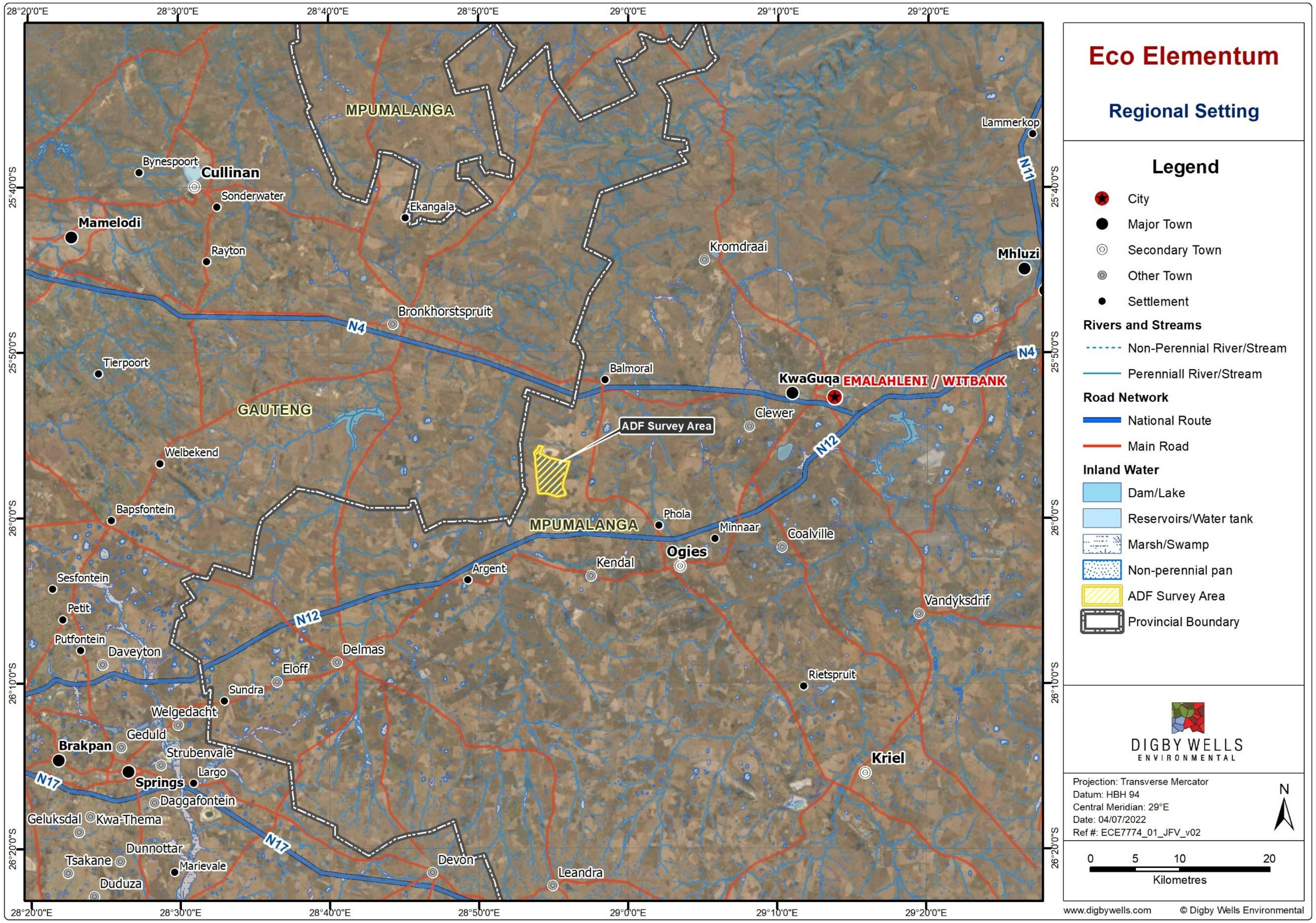

Figure 1-1: Regional Setting of the Project Area

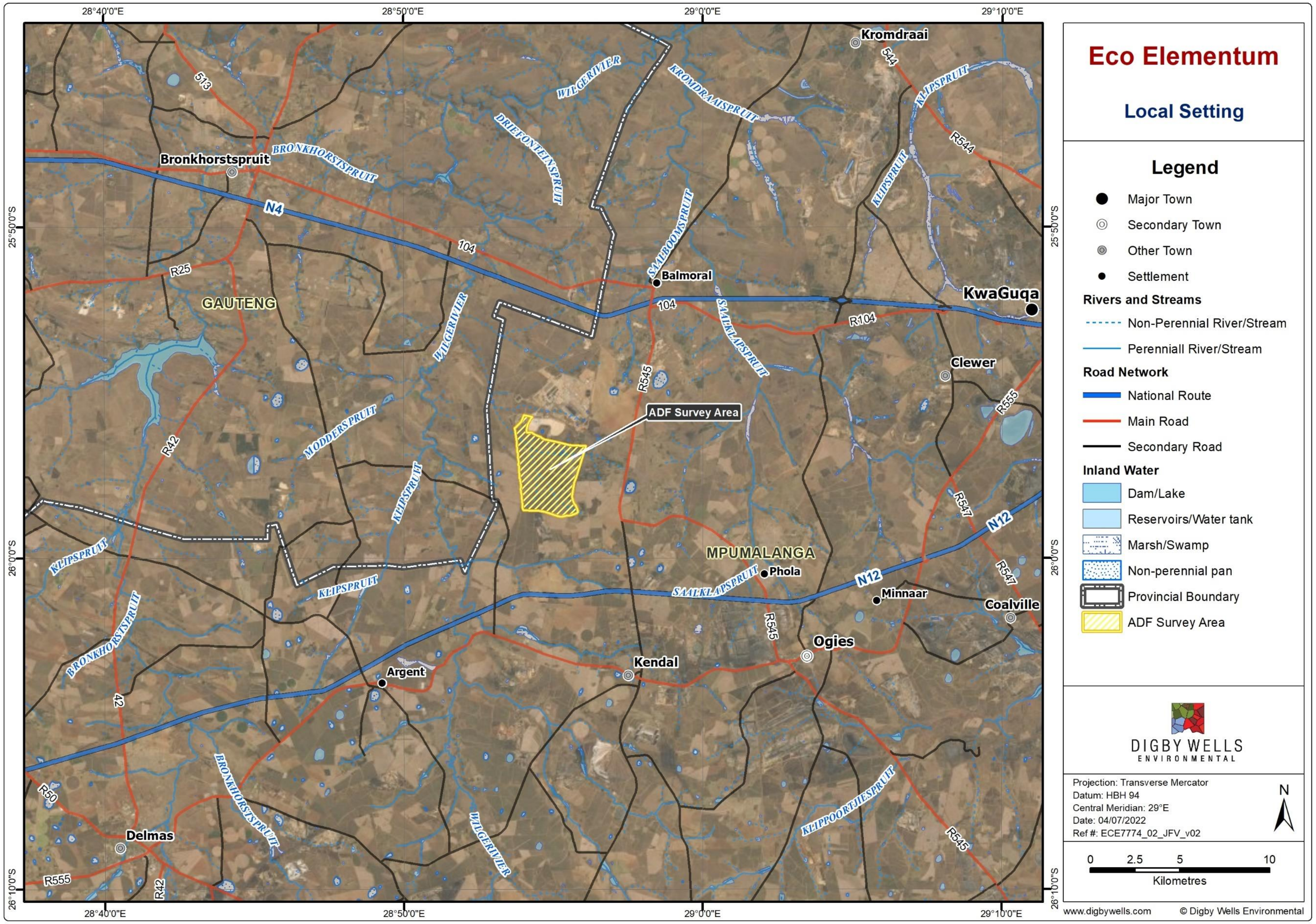

Figure 1-2: Local Setting of the Project Area

2. Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the National legislations, regulations, guidelines and by-laws. The guidelines directing the Wetland Environmental Impact and Offset Strategy Assessment are detailed in Table 2-1.

Table 2-1: Applicable Legislation, Regulations, Guidelines and By-Laws

<table>
<tr><th>Legislation, Regulation, Guideline or By-Law</th></tr>
<tr><td><u>National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA)</u>
The NEM:BA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and also takes into account the management of alien and invasive species. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance:
Alien and Invasive Species Lists, 2020 (terms of GNR 1003 in GG 43726 dated 18 September 2020 – effective from 18 October 2020);
Threatened and Protected Species Regulations; and
National list of Ecosystems Threatened and in need of protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GNR 1002, 9 December 2011).</td></tr>
<tr><td><u>Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996)</u>
Wetlands are protected under the Act that states that everyone has the right to an environment that is not harmful to their health or wellbeing. It also states that the environment must be protected for the benefit of present and future generations through responsible legislative measures. The Act:
Prevents pollution and ecological degradation;
Promote conservation and secure ecological sustainability; and
Promote justifiable economic and social development using natural resources.</td></tr>
<tr><td><u>The National Water Act, 1998 (Act No. 36 of 1998) (NWA)</u>
Section 19 of the National Water Act (NWA), 1998 (Act 36 of 1998) includes the prevention and remediation of the effects of pollution; and
Section 21 of the NWA (Act 36 of 1998) includes Water Uses.</td></tr>
<tr><td><u>National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).</u>
NEMA (as amended) was set in place under Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment.
Section 24 of NEMA states that:
The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment must be considered, investigated and assessed before their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.
The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.</td></tr>
<tr><td><u>Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands </u>(2005)
To delineate any wetland the following criteria are used in line with the Department of Water Affairs and Forestry (DWAF): A practical field procedure for identification and delineation of wetlands and riparian areas (2005). These criteria are:
Topographical location of the wetland in the landscape;
Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation (such as grey horizons, mottling streaks, hardpans, organic matter depositions, iron and manganese concretion resulting from prolonged saturation);
A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 centimeter (cm) of the soil; and
The presence, at least occasionally, of water-loving (hydrophilic) plants (i.e. hydrophytes).</td></tr>
<tr><td><u>Wetland Management Series (published by Water Research Commission </u>(WRC, 2007)
The WET-Management Series is a set of integrated tools that can be used to guide well-informed and effective wetland management and rehabilitation.</td></tr>
</table>

Legislation, Regulation, Guideline or By-Law
The WET-Management tools are designed to be used at different spatial and institutional levels as needed, from national and provincial to the level of specific wetland sites involving individual landowners, to meet a range of wetland management and rehabilitation needs.
National Freshwater Ecosystems Priority Areas (NFEPA, (Nel, et al., 2011)**)** The NFEPA project was a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water and Sanitation (DWS) formerly known as the Department of Water Affairs and Forestry (DWAF)), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute for Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The NFEPA project aimed to: • Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and • Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers. The NFEPA study responded to the high levels of threat prevalent in the river, wetland, and estuary ecosystems of South Africa. It provides strategic spatial priorities for conserving the country's freshwater ecosystems and supporting the sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or 'FEPAs'.
SANBI, in collaboration with the DWS report on "Wetland offsets: a Best-Practice Guideline for South Africa" (SANBI and DWS, 2016) This guideline serves as a practical tool to aid in the consistent application of wetland offsets in South Africa. The guideline is primarily aimed at wetland offsets required as part of water use authorisation processes (e.g. in an application for a Water Use Licence under the National Water Act) where compensatory actions are required to achieve water resources management and biodiversity conservation objectives. The guideline is equally relevant for use in EIA processes (e.g. as part of the environmental authorisation process in terms of the NEMA or an application for a mining license or development of an Environmental Management Programme under the Mineral and Petroleum Resources Development Act). Wetland offsets are enduring measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse impacts on wetlands. They are implemented to address any anticipated significant residual impacts arising from development projects after appropriate avoidance, minimisation, and rehabilitation measures have been considered. The goals of wetland offsets are to achieve 'No Net Loss' and preferably a net gain concerning the full spectrum of functions and values provided by wetlands. These include: • Water resource and ecosystem service value, especially concerning regulating and supporting functions pertinent to water resource management and disaster risk reduction, such as flood control and water quality enhancement, but also including direct services such as food and water provisioning and cultural services such as spiritual, recreational, and cultural benefits that sustain communities; • Ecosystem conservation, especially in terms of meeting national, provincial and local objectives for habitat protection and avoiding a deterioration in ecosystem threat status; and • Species of conservation concern, to ensure that the status of threatened, rare or keystone wetland dependent species is maintained or improved.

3. Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations in Table 3-1.

Table 3-1: Limitations and Assumptions with Resultant Consequences

Assumptions and Limitations	Consequences
This report constitutes an update of the previously conducted Wetland Assessment compiled by Wetland Consulting Services (Pty) Ltd (WCS) (Wetland Consulting Services (Pty) Ltd, 2014). Relevant Project information, such as reports, wetland delineations, GIS data etc., were provided by Eco Elementum and are assumed to be correct.	Wetland delineations were not confirmed during this assessment. The delineations are assumed to be correct.
To ensure consistency across the wetland assessments, the previous WET-Health and WET-EcoServices tools were used (Macfarlane, et al., 2009; Kotze, et al., 2009).	The new WET-Health and WET-EcoServices released in 2020 tools were not utilised to prevent inconsistencies across assessments. The new method makes use of landcover categories, disturbance units and an additional water quality component for the WET-Health Assessment, while the WET-EcoServices Assessment has additional questions and redefined graph outputs. While the old tool can be seen as outdated, it still provides accurate results and therefore no consequences are expected.
A large pipeline will systematically be installed underneath each of the ADF phases to ensure the total streamflow of HGM 1 is received by HGM 4. It is assumed that this pipeline is already authorised.	The potential impacts and failures of this pipeline are assumed to already have been considered by the previous wetland assessment, which has subsequently been authorised. This has not been assessed in this report.

4. Details of the Specialist

The following is a list of Digby Wells' staff who were involved in the Wetland Environmental Impact Assessment:

- **Danie Otto** manages the South African Operations at Digby Wells. He holds an M.Sc. in Environmental Management with B.Sc. Hons (Limnology & Geomorphology, and GIS & Environmental Management) and B.Sc. (Botany and Geography & Environmental Management). He is a biogeomorphologist that specialises in ecology of wetlands and rehabilitation. He has been a registered Professional Natural Scientist since 2002. Danie has over 25 years of experience in the mining industry in environmental and specialist assessments, management plans, audits, rehabilitation, and research. He has experience in 8 countries and his experience is in the environmental sector of coal, gold, platinum (PGMs), diamonds, asbestos, rock, clay & sand quarries, copper, phosphate, andalusite, base metals, heavy minerals (titanium), uranium, pyrophyllite, chrome, nickel etc. He has wetland and geomorphology working experience across Africa including specialist environmental input into various water resource related studies. These vary from studies of the wetlands of the Kruger National Park to swamp forests in central Africa to alpine systems in Lesotho.

- **Willnerie Janse van Rensburg** is the Soils and Wetlands Manager within the Closure and Rehabilitation Department at Digby Wells Environmental. She received her Bachelor of Science in Environmental Geography as well as her Honours degree in Soil Science from the University of the Free State. She has seven years of experience in the fields of Soil Science and Environmental Science. She has experience in proposal compilation, completing soil and wetland baseline and impact assessments, soil and wetland delineations, biodiversity plans, wetland offsetting, soil and wetland rehabilitation, land use and capability assessments, irrigation scheduling and provides recommendations on soil amelioration. She has undertaken work in Mali, Sierra Leonne, Tanzania, Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.
- **Ivan Baker** is a senior wetland specialist in the Rehabilitation, Closure and Soils Division at Digby Wells Environmental. Ivan is Pr. Sci Nat registered (119315) in environmental science with Cand. Sci. Nat recognition in geological science. Ivan is a wetland and soil specialist with vast experience in wetlands, pedology, hydropedology and land contamination and has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydropedology at the North-West University of Potchefstroom. Ivan is also affiliated with the Fertiliser Society of South Africa after the acquiring a certificate of competence following the completion of the FERTASA training course.
- **Aamirah Dramat** is a Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. She received her Bachelor of Science Degree in Applied Biology and Environmental and Geographical Science (EGS) as well as her Honours Degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020 as a Rehabilitation Intern and has since gained experience in the environmental services sector with specialised focus in Soils, Wetlands and Rehabilitation, both locally and internationally. She has been involved in the report compilation and undertaking of Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy

and Implementation Plans (RSIPs), Alien Invasive Plant (AIP) Assessments, Re-vegetation Trial Studies and Monitoring Assessments. Aamirah is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.

5. Methodology

This section provides the methodology used in the compilation of the Wetland Impact Assessment and Offset Strategy. A detailed methodology is described in Appendix A and is summarized in Figure 5-1 below.

Figure 5-1: Wetland Assessment Methodology

5.1. Scientific Buffers

Scientific buffers were calculated by means of the "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane, et al., 2014) methodology.

5.2. Recommended Ecological Category

The Recommended Ecological Category (REC) has been determined using the Roundtree et al., (2012) methodology. According to this methodology, the first step in determining the REC is to calculate the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) for the relevant wetland.

Three scenarios exist in determining the REC, namely;

1. The wetland is characterised by a PES of E or F;
    - The REC should be set at least a PES D. The ecological categories of E or F are considered to be unsustainable.
2. The wetland is characterised by a PES of between A and D as well as the EIS has been scored low or moderate or the EIS has been scored high or very high, but improving the PES/REC is deemed impractical;
    - The REC should remain the same as the current PES.
3. The wetland is characterised by a PES of between A and D and the EIS has been scored high or very high, and improving the PES/REC is deemed practical;
    - The REC is set at least one Ecological Category higher than the current PES.

5.3. Offset Strategy

SANBI, in collaboration with the DWS, has developed a Wetland Offset: Best Practice Guideline for South Africa (SANBI and DWS, 2016). The guideline was produced to provide guidance on wetland offsetting, with particular reference to the loss of wetlands due to mining-related activities. The guideline for wetland offsets in South Africa defines 'biodiversity offsets' as "measurable conservation outcomes resulting from actions to compensate for residual negative impacts on biodiversity". The following list outlines the goals proposed in SANBI's guideline:

- The formal protection of wetland systems that are in good ecological condition; to meet national conservation targets for the representation and persistence of wetlands and wetland vegetation types;
- A 'no-net-loss' approach in the overall wetland functional area by ensuring that there is a gain in wetland area and/or condition equal to or greater ('like for like') than the losses due to residual impacts;
- Providing appropriate and adequate compensation for residual impacts on key ecosystem services by:
    - Directing offset activities that will improve key regulating and supporting services towards those wetlands where these specific services can best be enhanced;

- Providing substitute services for the communities affected by the residual impacts of development; such that these communities are at least as well-off after development as they were prior to development taking place; and
- Adequately compensating for residual impacts on threatened or otherwise important (e.g. wetland-dependent) biota through appropriate offset activities that support and improve the survival and persistence of these species.

5.3.1. Offset Calculations

Wetland offset targets will be calculated by means of the best-practice guidelines for South African wetland offsets (Macfarlane, et al., 2014). The same parameters were used in calculating offset ratio multipliers to that of Prime Africa Consultants (2015) to ensure consistency.

5.3.2. Wetland Offset Strategy and Impacts

In this report, the state of the wetlands inside the ADF Project Area was considered. Consideration as to the potential improvements and rehabilitation of wetland systems to be conserved within the Project Area was regarded as valuable inclusions within the proposed offset strategy, not only from the perspective of improvements to the present ecological state of the systems as a whole, but also in terms of improvements to ecological importance and service provision within the greater catchment.

Thus, while the principle of “like-for-like” discussed above, was considered as far as possible, the value of including the proposed rehabilitation measures within the offset strategy serve as grounds for the consideration of an “out-of-kind” offset (to some extent) that involves “trading up” and improving the biodiversity, restoring stream connectivity and improving the functioning of each of the systems as a whole. In addition to this, is the added benefit that Kusile is already in possession of the surface rights to the proposed rehabilitation areas and thus, may be more likely to follow through on these commitments in the long term.

This report provides information pertaining to the framework of the strategy and the required measures to achieve the set objectives. Soft engineering interventions will be recommended within this report to determine the net-gain in wetland offset targets.

5.3.3. Hectare Equivalents

To allow for the quantification of wetland losses due to development and the gains due to wetland offsets and rehabilitation, as well as the comparison between the two, a unit of measure is required to use as a common currency for evaluating impacts and assessing the adequacy of offset proposals. This is achieved through use of the ‘hectare equivalent’.

A hectare equivalent is a quantitative expression of the ecological integrity of a wetland hydrogeomorphic (HGM) unit under given land use. It represents the common currency that enables the wetland functional area restored to the landscape by restoration, rehabilitation and artificial creation to be compared to that removed from the landscape by a development.

Most environmental authorities advocate a no-net-loss of resources approach, be it to biodiversity or wetland functioning, and the hectare equivalent provides the conceptual means of judging whether these rehabilitation objectives have been satisfied.

'Hectare equivalent' is a measure of wetland functional area obtained through a conversion of the wetland health (PES) rating and the wetland aerial extent (hectares). This is completed by converting the overall health (PES) score to an intactness score and then multiplying by the wetland area (in hectares) to obtain a measure of functional area:

((10-PES score)/10) X wetland area = hectare equivalent

As an example, a 10 ha wetland with a PES score of 3 (category C – moderately modified) would be equal to:

((10-3)/10) X 10 = 7-hectare equivalents

In essence, this reflects that a wetland which is moderately modified (PES category C) is only expected to be performing 70 % of the function that the wetland could have performed under pristine conditions.

6. Regional Baseline Environment and Desktop Review

Relevant literature was reviewed prior to the field assessment concerning the historical wetlands associated with the Project Area. This includes the habitats and vegetation types as well as the wetland states. Baseline and background information was researched and used to understand the Project Area prior to undertaking the fieldwork component and is described in Table 6-1 below.

Table 6-1: Baseline Environment of the Project Area

Bioregional Context (Kleynhans, et al., 2005; Darwall, et al., 2009; Climate-data.org, n.d.)		**Plant Species Characteristic of the Eastern Highveld Grassland** (Mucina & Rutherford, 2012) **(Figure 6-1)**	
Ecoregion	Highveld	Graminoids	*Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata subsp. eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris, Urelytrum agropyroides.*
Köppen-Geiger Climate Classification (Köppen & Geiger, 1936)	*Cwb* (Subtropical highland climate)	Herbs	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides subsp. latifolia, Selago densiflora, Senecio coronatus, Hilliardiella oligocephala, Wahlenbergia undulata.*
Mean Annual Precipitation (mm) and Seasonality	787; Early to late summer	Geophytic Herbs	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula var. pilosissima, Ledebouria ovatifolia.*
Mean Annual Temp. (°C)	16.3	Succulent Herbs	*Aloe ecklonis.*
Water Management Area (WMA)	Olifants	Low Shrubs	*Anthospermum rigidum subsp. pumilum, Seriphium plumosum.*
Quaternary Catchment (Figure 6-2)	B20F	Status	Endangered

Mining and Biodiversity Guideline Category, DEA (2013) **(Figure 6-3)**	**Mpumalanga Biodiversity Sector Plan** (MTPA, 2014) **(Figure 6-4)**
The Project Area is predominantly classified as **Highest Biodiversity Importance – Highest Risk for Mining** with minor areas classified as **Moderate Biodiversity Importance – Moderate Risk for Mining.**	The Project Area predominantly consists of land classified as **Heavily Modified**, with the remaining area classified as **Other Natural Areas** and **Moderately Modified – Old Lands.**

National Biodiversity Assessment (NBA) (SANBI, 2018) **(Figure 6-5)**	**National Freshwater Ecological Priority Area (NFEPA) Wetland Classification** (Nel, et al., 2011) **(Figure 6-6 and Figure 6-7)**	
The majority of the wetlands within the Project Area have a **Wetland Ecosystem Threat Status of Critically Endangered** and are **Not Protected at a Wetland Ecosystem Protection Level.** The wetland located near the R686 and a small section of the wetland located in the south-east of the Project Area has a **Wetland Ecosystem Threat Status of Critically Endangered** and is **Poorly Protected at a Wetland Ecosystem Protection Level.**	NFEPA Wetlands	**Channelled Valley Bottoms (Rank 4, 5 and 6)** are located within the Project Area. It should be noted that dams are sometimes incorrectly classified as NFEPA Wetlands, as in the case of the dam situated in HGM 3.
	River FEPA	The Project Area does not fall within any FEPA river catchments

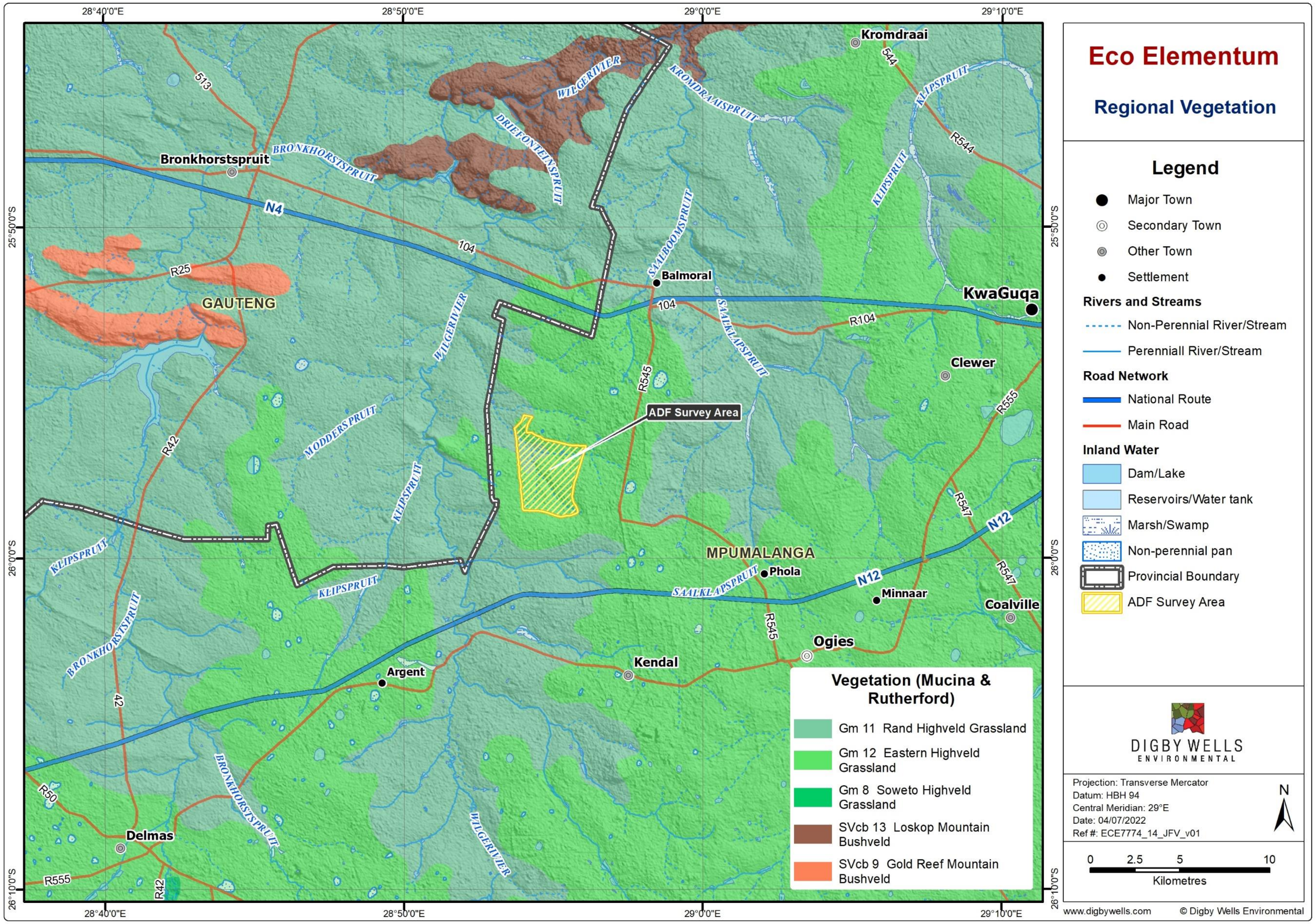

Figure 6-1: Regional Vegetation of the Project Area

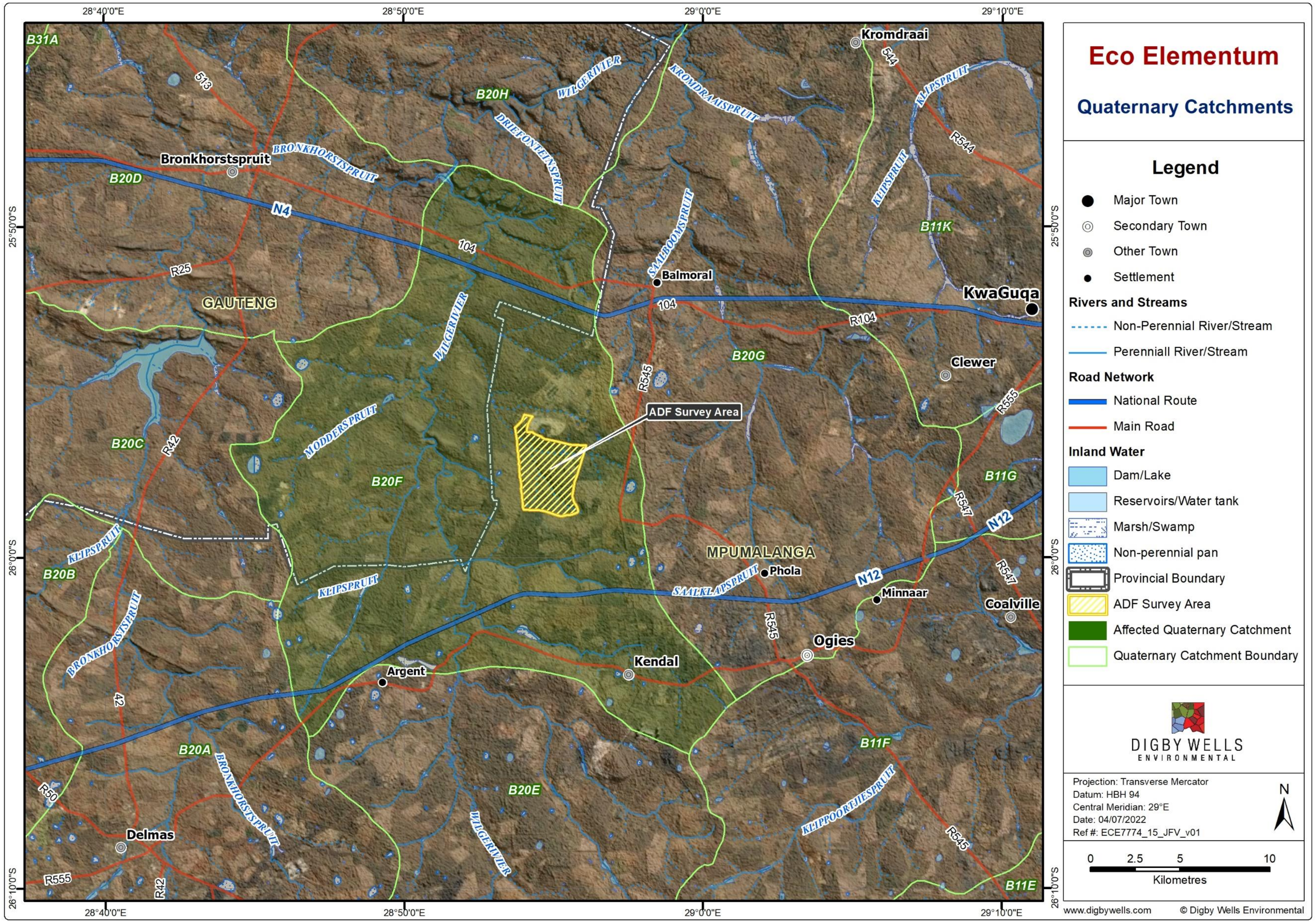

Figure 6-2: Quaternary Catchment of the Project Area

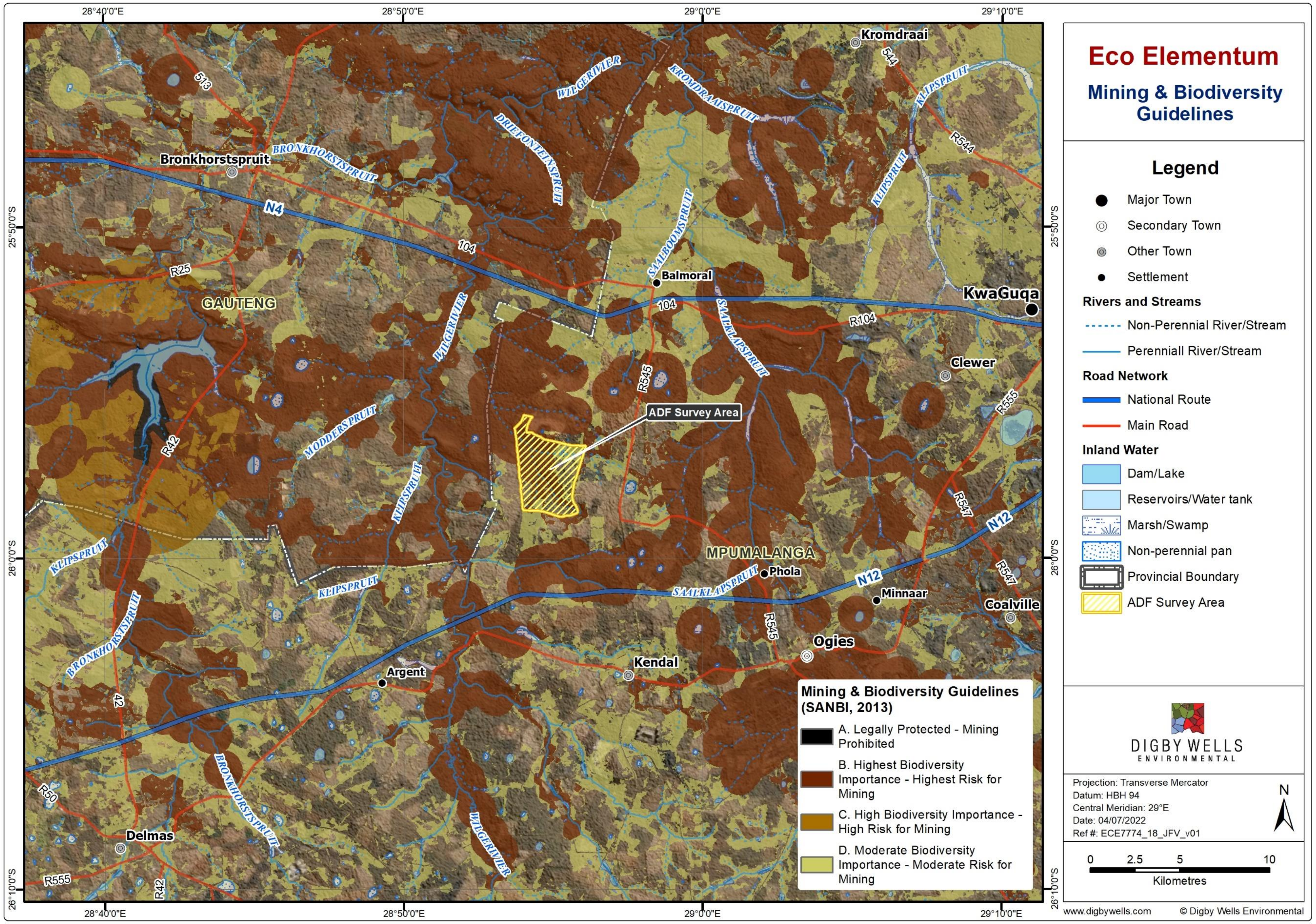

Figure 6-3: Mining and Biodiversity Guideline of the Project Area

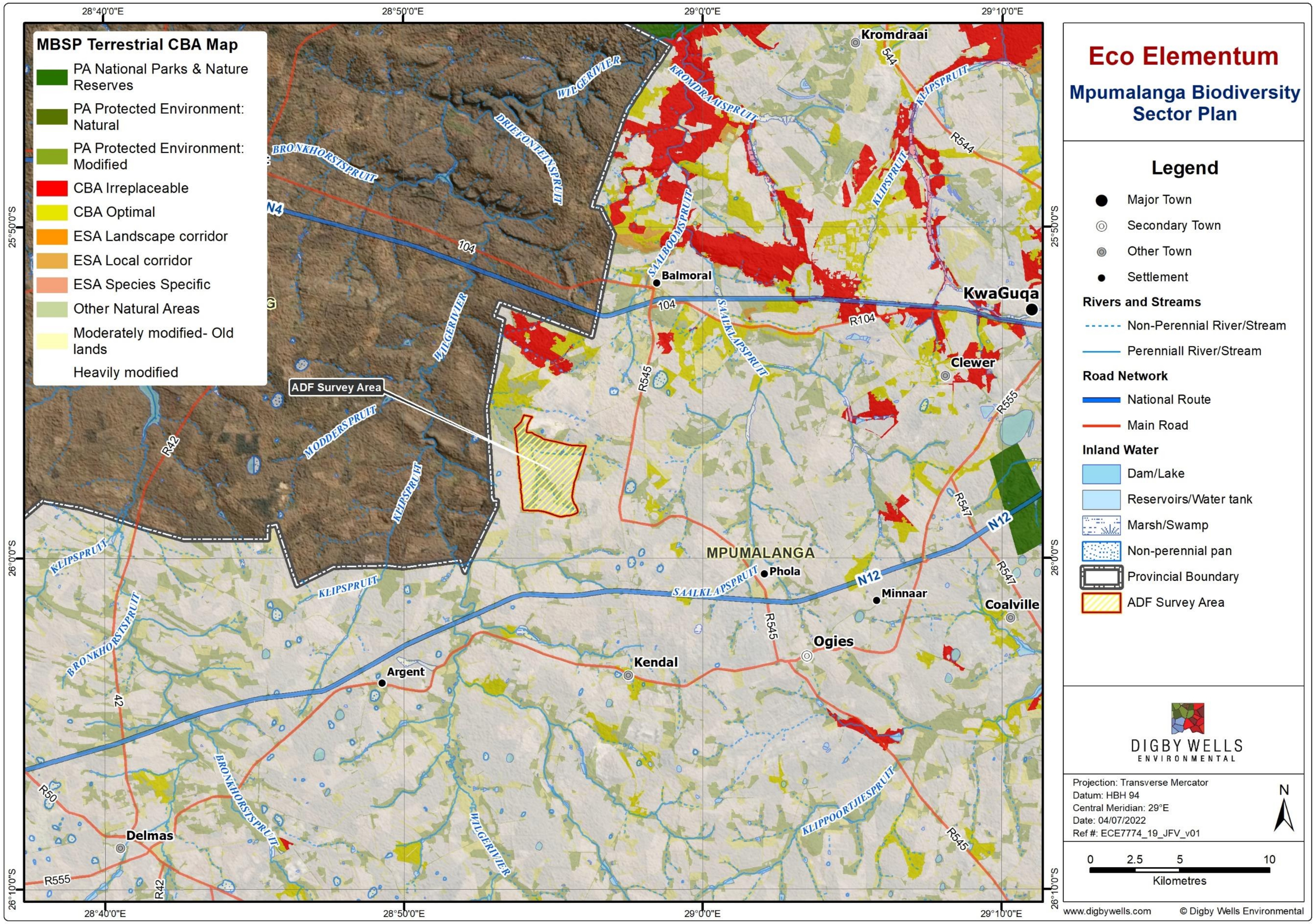

Figure 6-4: Mpumalanga Biodiversity Sector Plan of the Project Area

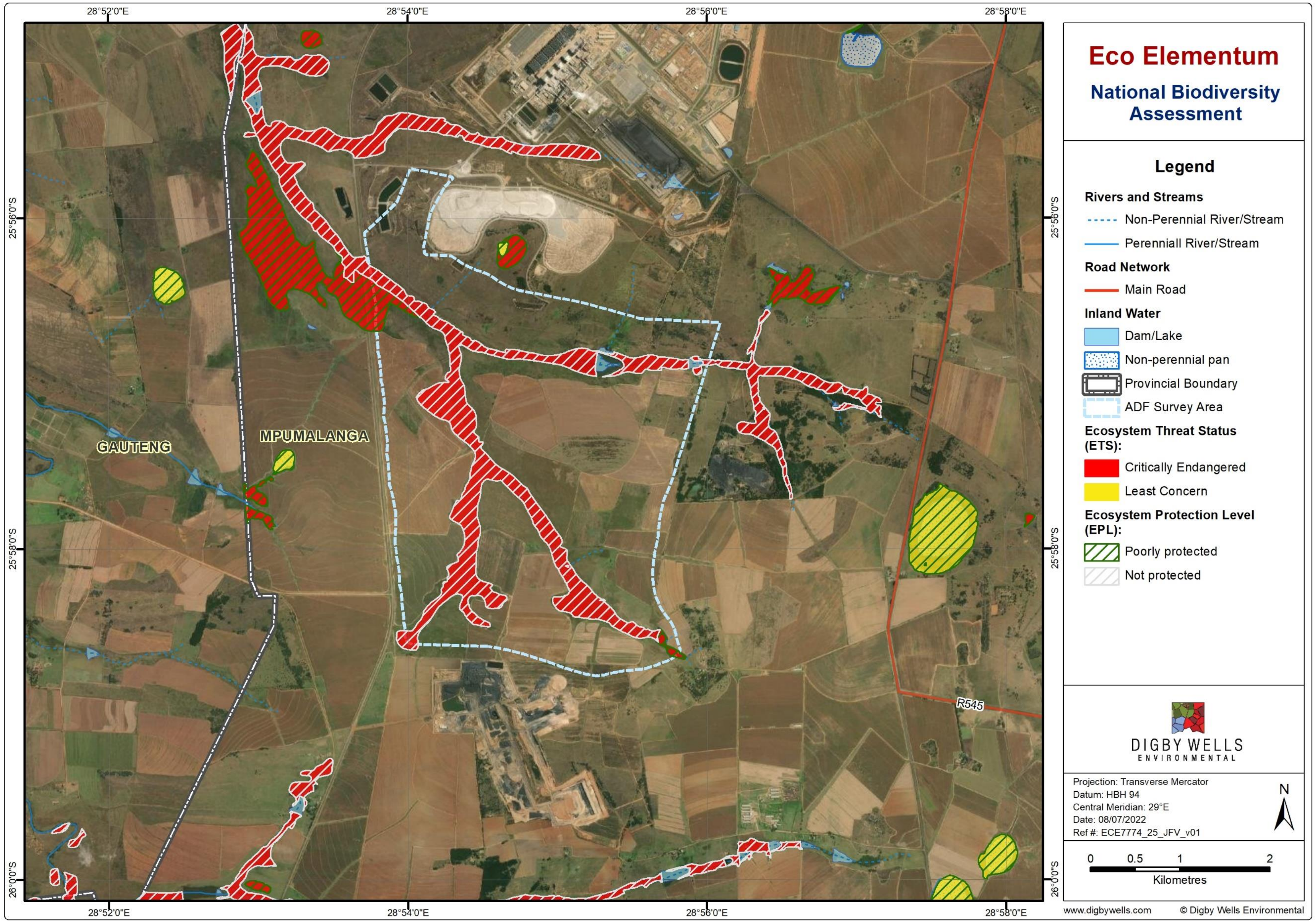

Figure 6-5: National Biodiversity Assessment of the Project Area

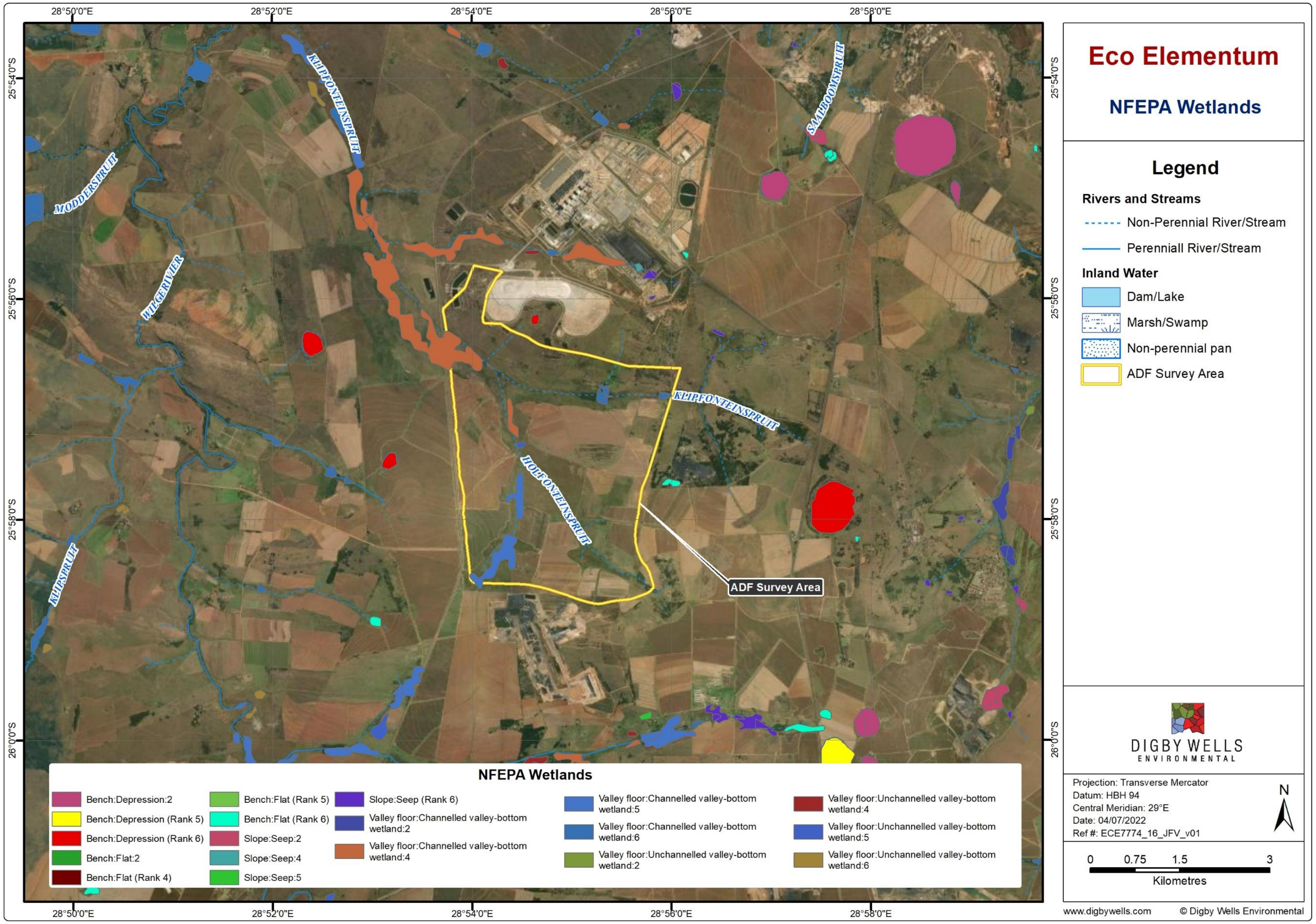

Figure 6-6: NFEPA Wetlands of the Project Area

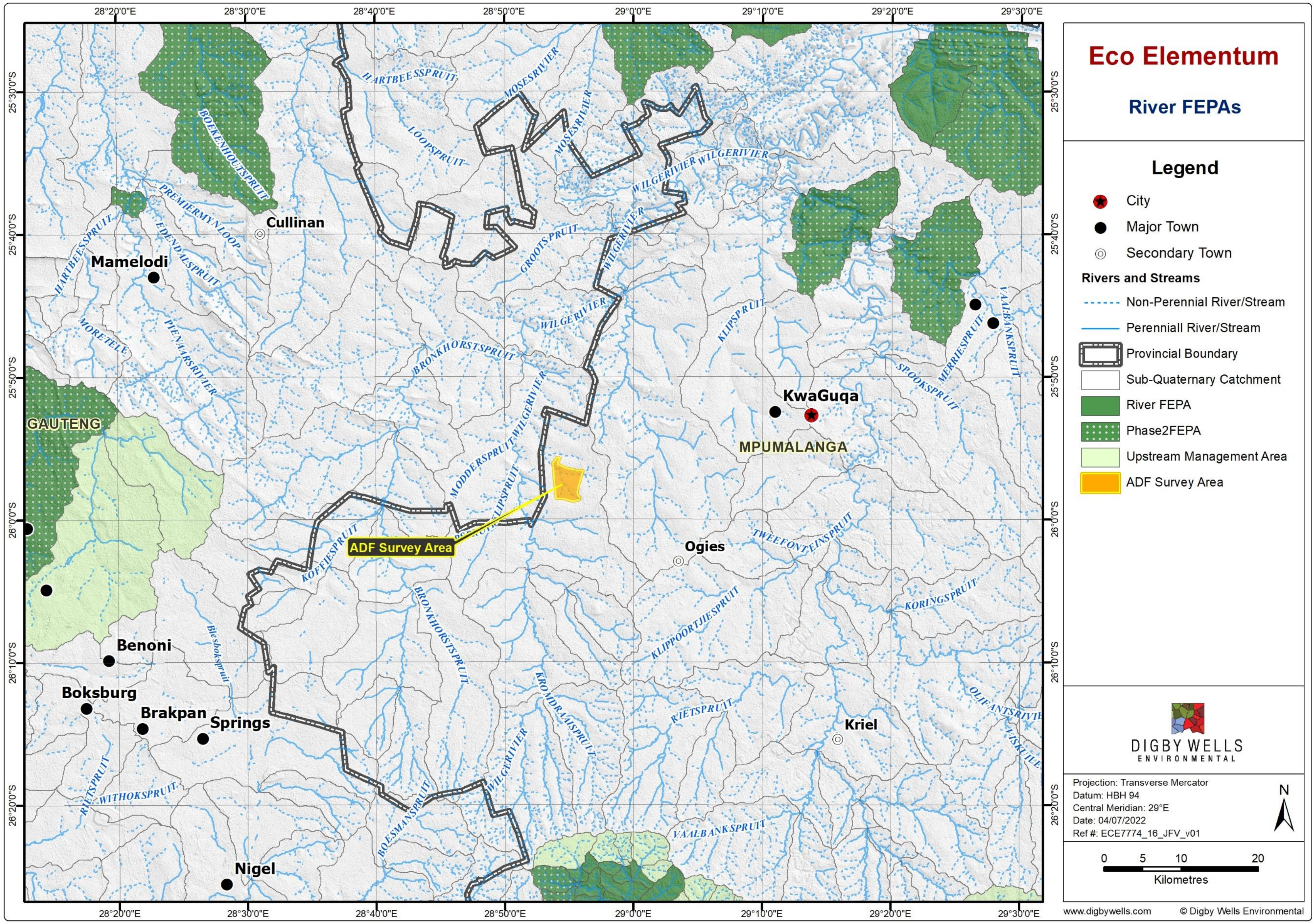

Figure 6-7: River FEPA of the Project Area

7. Wetland Functionality Assessment

Wetland Consulting completed a Wetland Delineation and Impact Assessment of the Project Area in 2014 (Wetland Consulting Services (Pty) Ltd, 2014). The wetlands were categorised into the following Hydro-geomorphic (HGM) units in the ADF Project Area (Wetland Consulting Services (Pty) Ltd, 2014) (Figure 7-1):

- Channelled Valley Bottom (CVB); and
- Hillslope Seep (Seep).

The Present Ecological State (PES), Ecosystem Services (EcoServices) and Ecological Importance and Sensitivity (EIS) scores were calculated accordingly (Wetland Consulting Services (Pty) Ltd, 2014). Digby Wells undertook a site visit in June 2022 to re-assess these scores to determine whether any changes occurred since the previous assessment. The results are detailed in the sections below.

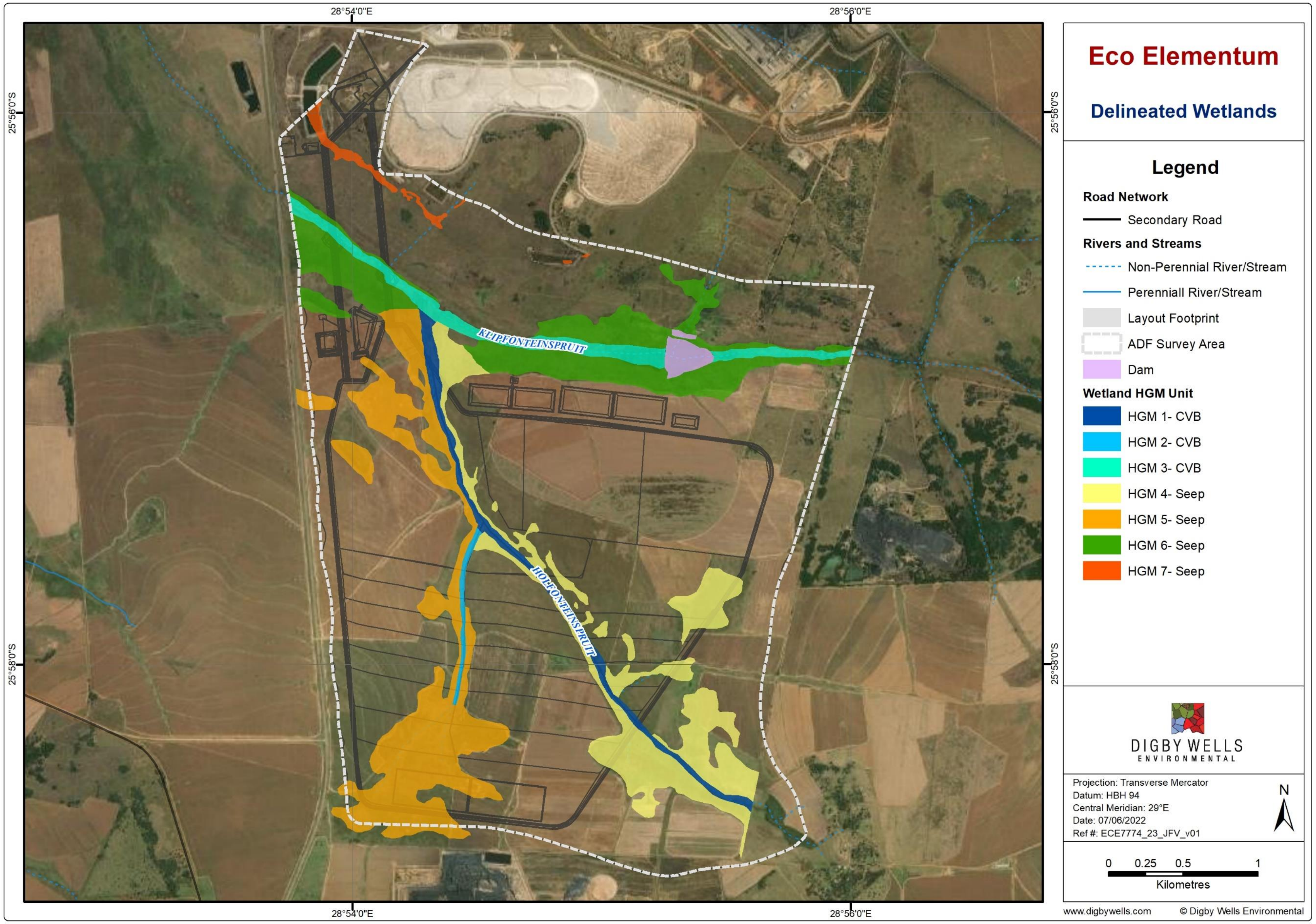

Figure 7-1: Wetland Delineation of the Project Area

7.1. Wetland Ecological Health Assessment (WET-Health)

The PES of the wetlands within the ADF as detailed in the original wetland assessment report (Wetland Consulting Services (Pty) Ltd, 2014) are provided in Table 7-1 below.

Table 7-1: Wetland Ecological Health Assessment Scores (Wetland Consulting Services (Pty) Ltd, 2014)

HGM Unit	A	A/B	B	C	D	Total
CVB	-	-	-	20.31	16.30	36.61
Hillslope Seep	1.68	9.85	6.37	153	17.04	187.94
Total	**1.68**	**9.85**	**6.37**	**173.31**	**33.34**	**224.55**

The findings from the most recent site visit conducted in 2022 indicate slightly higher modification scores. The CVB wetlands were determined to have higher modification scores than that the hillslope seeps. This is attributed to existing crossings and impeding structures which affect the natural hydrology of the wetlands. The hillslope seeps are characterised by higher vegetation modifications, due to the ingress of Alien Invasive Plants (AIP). Other impacts include (see Figure 7-2);

- Informal wetland crossings and culvert structures;
- Dams;
- Alien invasive trees;
- Bare cultivated lands encroaching on the wetlands;
- Drainage gullies; and
- Erosion.

Table 7-2: Wetland Ecological Health Assessment Scores (2022)

HGM Unit	Hydrological Health	Geomorphological Health	Vegetation Health	Final PES	PES Category
HGM 1 - CVB	6.5	3.6	5.8	5.5	D
HGM 2 - CVB	5	2.8	5.7	4.5	D
HGM 3 - CVB	9	5.4	7.4	7.5	E
HGM 4 - Seep	3	1.3	4.6	2.9	C
HGM 5 - Seep	3	1.6	7.8	3.9	C
HGM 6 - Seep	3	1.6	7.1	3.8	C
HGM 7 - Seep	7.5	3.3	4.6	5.3	D

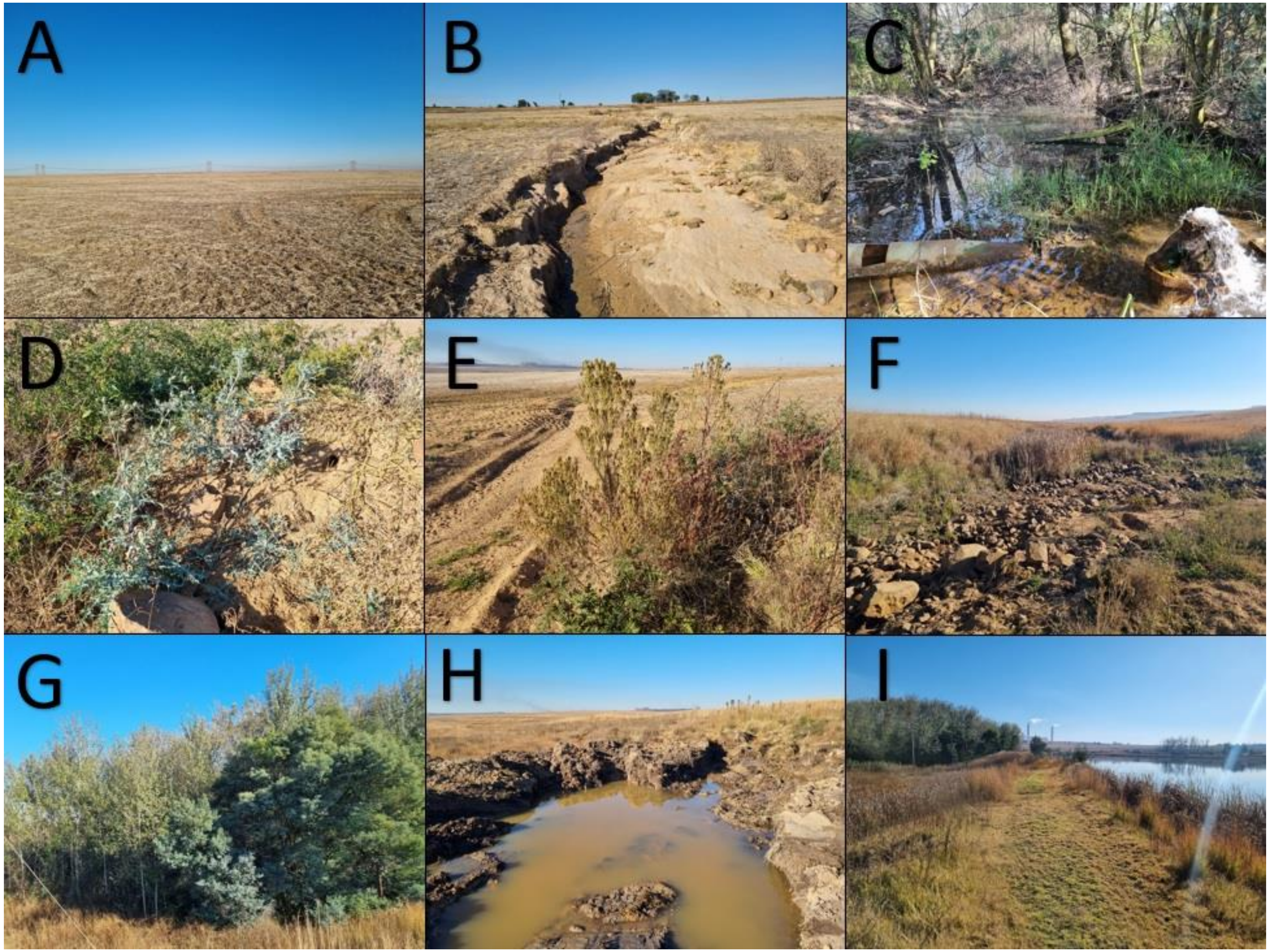

Figure 7-2: Examples of Impacts Identified On-site

(A: Bare crop fields surrounding wetlands; B: Drainage gullies; C: Outlet within HGM 3 concentrating flows; D: *Argemone Mexicana* (AIP); E: *Tagetes minuta* (AIP); F: Informal wetland crossing (gravel and rock used as culvert system); G: *Acacia mearnsii* and *Populus alba* (alien invasive trees); H: Excavations within the CVB; I: Dam and relevant crossing within HGM 3)

7.2. Wetland Ecological Services (WET-EcoServices)

WCS determined the EcoServices provision per wetland type for the larger Project Area (Wetland Consulting Services (Pty) Ltd, 2014). The radial plots showing the results of their WET-EcoServices assessments are provided in Figure 7-3 below.

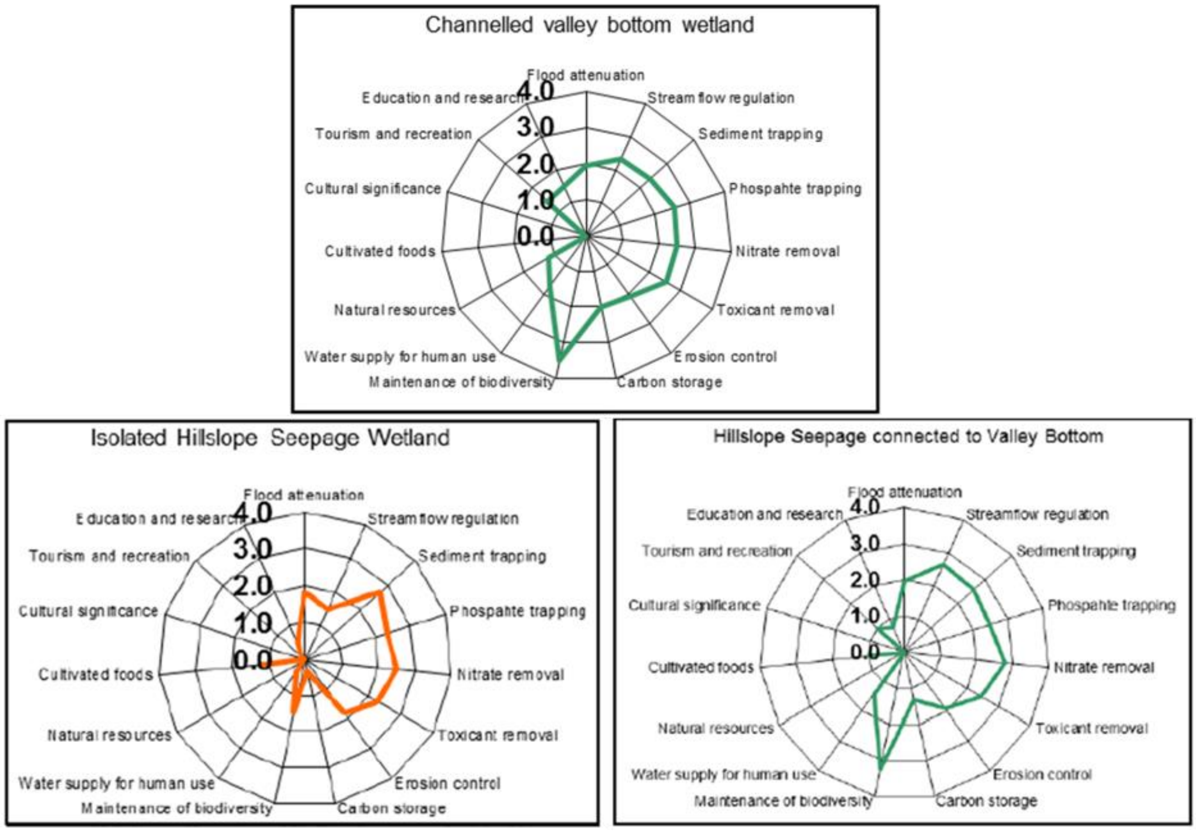

Figure 7-3: Radial Plots Showing the WET-EcoServices Assessment Results (Wetland Consulting Services (Pty) Ltd, 2014)

The high-level descriptions of EcoServices associated with delineated wetlands in previous assessments, although limited in detail, are similar to those conditions identified during the 2022 assessment. The EcoServices for the CVB wetlands were determined to be similar in the type and significance of each functional aspect. The assimilation ability of the hillslope seeps was determined to be slightly higher than that of the CVB wetlands, predominantly due to the diffuse nature of flows.

Some notable EcoServices contributing to scores include:

- Flood attenuation;
- Streamflow regulation;
- Sediment trapping;
- Phosphate, nitrate and toxicant assimilation;

- Erosion control; and
- Biodiversity maintenance.

Table 7-3 illustrates some of the main parameters contributing to the above-mentioned services.

Table 7-3: Parameters Contributing to EcoServices Scores

Ecosystem Service	Parameter	Typically Associated With
Flood Attenuation	• Frequency with which stormflows spread across the system; • Surface roughness of wetland; and • Size of the wetland relevant to the catchment.	Larger wetlands are characterised by dense vegetation growth.
Streamflow Regulation	• Linkage to stream network; • Reduction in evapotranspiration through frosting back; and • Presence of important aquatic resources down-stream.	Systems directly linked to important aquatic resources down-stream, i.e. Wilge River.
Sediment Trapping	• Direct evidence of sediment deposition; • Extent of sediment sources delivering sediments; and • Presence of important aquatic resources down-stream.	Well-vegetated systems where sediments are prone to wash down-stream, with evidence of sediments accumulating.
Assimilation of Phosphates, Nitrates and Toxicants	• Sediment trapping ability; • Diffuse nature of flows; • Application of fertilisers and pesticides in the catchment (including historic); and • Presence of important aquatic resources down-stream.	Well-vegetated systems where sediments are prone to wash down-stream, with evidence of sediments accumulating. Current and historic crops within a specific wetland's catchment.
Erosion Control	• Extent of vegetation cover; • Erodibility of soil (i.e. presence of highly erodible Pedocutanic soils; and • Direct signs of wetlands.	Well-vegetated areas with little signs of erosion, especially where highly erodible Pedocutanic soils are present.
Biodiversity Maintenance	• Potential for red data species occurring, or suitable habitat; • Connectivity of wetlands in the landscape; and • Variety of intact habitats	Differentiating between different habitats within a wetland (that are still intact) contributes to the potential for rare species to occur.

CVB wetlands tend to contribute less to sediment trapping and flood attenuation than other systems. CVB wetlands are well known to improve the assimilation of toxicants, nitrates and sulphates, especially in cases where sub-surface flows contribute to the system's water source (Ollis, et al., 2013).

The CVBs on site are permanently inundated, which has resulted in permanently saturated soils. Permanently saturated soils assimilate toxicants and contaminants more so than temporary and seasonally saturated soils. These soils are also more likely to promote high density hydrophytic vegetation, which in turn contributes to sediment trapping and flood attenuation.

Hillslope seeps are well documented by Kotze *et al.* (2009) to be associated with sub-surface ground water flows. These systems tend to contribute to flood attenuation given their diffuse nature. This attenuation only occurs while the soil within the wetland is not yet fully saturated. The accumulation of organic material and sediment contributes to prolonged levels of saturation due to this deposition slowing down the sub-surface movement of water. Water typically accumulates in the upper slope (above the seep). The accumulation of organic matter additionally is essential in the denitrification process involved with nitrate assimilation. Seeps generally also improve the quality of water by removing excess nutrient and inorganic pollutants originating from agriculture, industrial or mine activities. The diffuse nature of flows ensures the assimilation of nitrates, toxicants and phosphates with erosion control being one of the EcoServices provided very little by the wetland given the nature of a typical seep's position on slopes.

The hillslope seeps on site, even though characterised by some AIP infestation, are characterised by dense hydrophytic vegetation growth (albeit facultative in some areas). The high-density vegetation growth stabilises soils, which is increasingly important on hillslopes. The seeps identified on-site are characterised by extremely diffuse sub-surface flows, which improve the assimilation ability. A moderate biodiversity maintenance score has been allocated to the hillslope seeps considering the presence of marsh owls on-site.

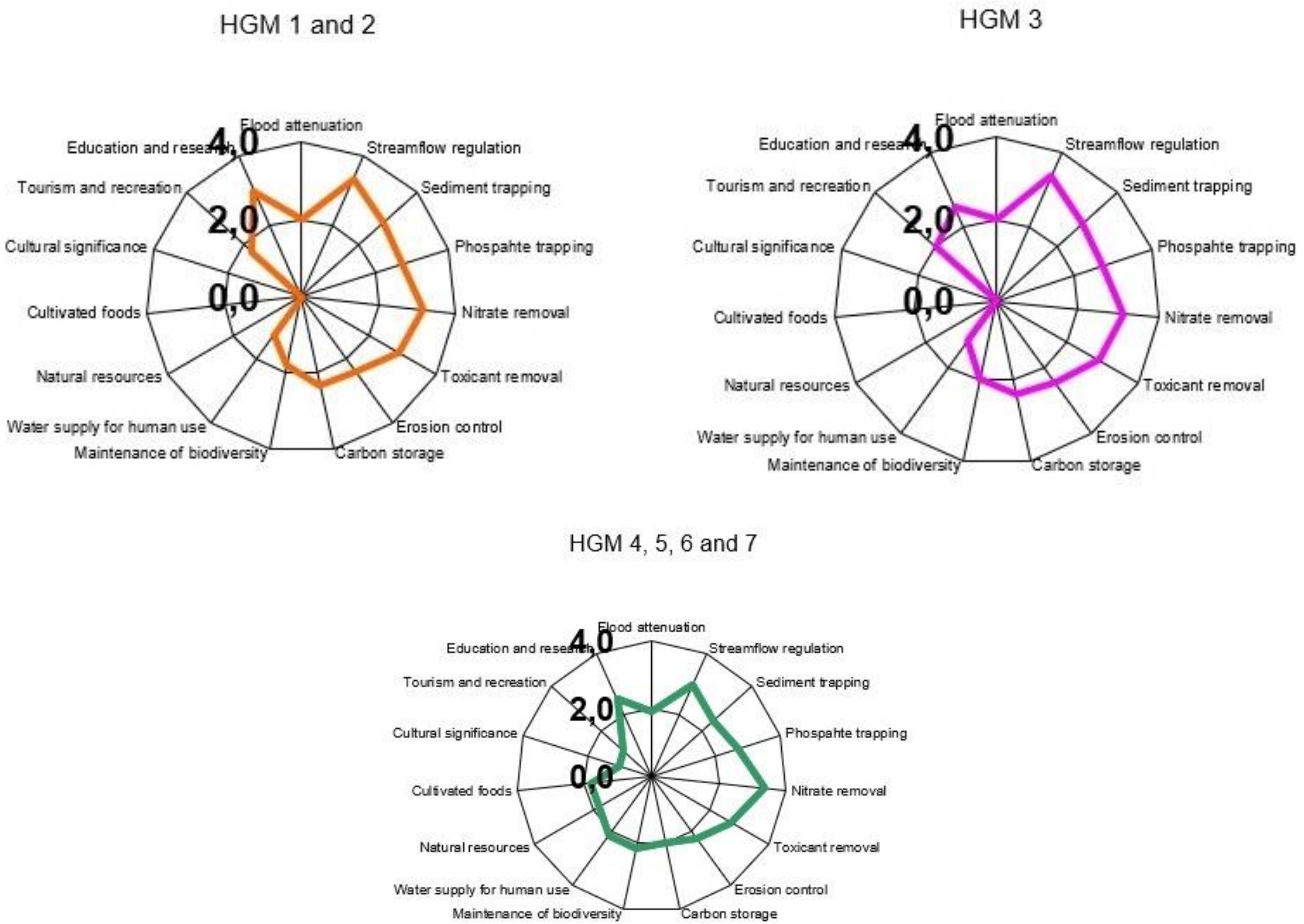

Figure 7-4: Radial Plots Illustrating the WET-EcoServices Assessment Results (2022)

7.3. Ecological Importance and Sensitivity (EIS)

The EIS categories ranged from Low to High across the Hillslope Seep wetlands and were Moderate for the CVB wetlands within the Project Area (Wetland Consulting Services (Pty) Ltd, 2014). The EIS categories for the wetlands within the ADF Project Area are provided in Table 7-4 below.

Table 7-4: Wetland Ecological Importance and Sensitivity Categories (Wetland Consulting Services (Pty) Ltd, 2014)

HGM Unit	EIS Category
CVB	C (Moderate)
Hillslope Seep	B (High), C (Moderate) and D (Low)

The CVB wetlands are scored slightly higher than the hillslope seeps i.e., moderate vs low EIS scores. The main reason for the difference in EIS scores can be explained by the fact that the hillslope seeps aren't nationally protected as part of the NFEPA or NBA wetland data set series. Additionally, the vegetation type is characterised as being endangered, which contributes to the calculated scores.

Table 7-5: Some of the Parameters Considered for the EIS Calculations

Wetland	ETS	EPL	Vegetation Type Surrounding Wetland	Sensitivity of Vegetation Type
CVB Systems	Critically Endangered	Not Protected	Eastern Highveld Grassland	Endangered
Hillslope Seeps	N/A	N/A	Eastern Highveld Grassland	Endangered

Table 7-6: Wetland Ecological Importance and Sensitivity Categories (2022)

HGM Unit	EIS Category
CVBs	Moderate
Hillslope Seeps	Low

7.4. Recommended Ecological Category

The following REC ratings were determined for each of the wetlands to be conserved within the Project Area based on the current PES and the current EIS ratings. The methodology used to calculate the REC is depicted in Section 5.2- “Recommended Ecological Category”.

The Recommended Ecological Class (REC) for HGM 3A, has been determined to be a class D due to the current PES and the EIS which have been calculated to be “E” and “B” respectively. Improving the health of the wetland past D is considered impractical considering the extent of impacts within the system. As for HGM 6, it is considered impractical to improve this system past a “C” condition, predominantly due to the unlikely control of AIPs within this system. The improvement of HGM 7 too will be unfeasible, considering the existing impedance of infrastructure in these wetland systems.

Table 7-7: REC Calculated from Current PES and EIS

	HGM 3 - CVB	HGM 6 - Seep	HGM 7 - Seep
PES	E	C	D
EIS	B	B	C
Practical to Improve PES Rating? (Y/N)	N/A	N	N
REC	**D**	**C**	**D**

7.5. Scientific Buffers

Scientific buffers were calculated for the relevant wetlands considering various parameters as part of the (Macfarlane, et al., 2014) methodology. The proposed activities were used to determine suitable buffer sizes for those wetlands expected to be conserved. These activities were grouped into three different categories, namely “waste impoundments”, “ancillary infrastructure” (buildings and dams) and linear activities (roads, pipelines and powerlines) (Table 7-8 and Figure 7-5). These buffer zones must be adhered to during the construction, operation and decommissioning phases of relevant activities. No laydown yards, stockpiling and other operational activities should be allowed within the “infrastructure” buffers.

Table 7-8: Scientific Buffers

Activity	Wetland Buffer Size (Pre-Mitigation)	Wetland Buffer Size (Post-Mitigation)
Waste Impoundments	50	29
Ancillary Infrastructure	29	20
Linear Activities	29	15

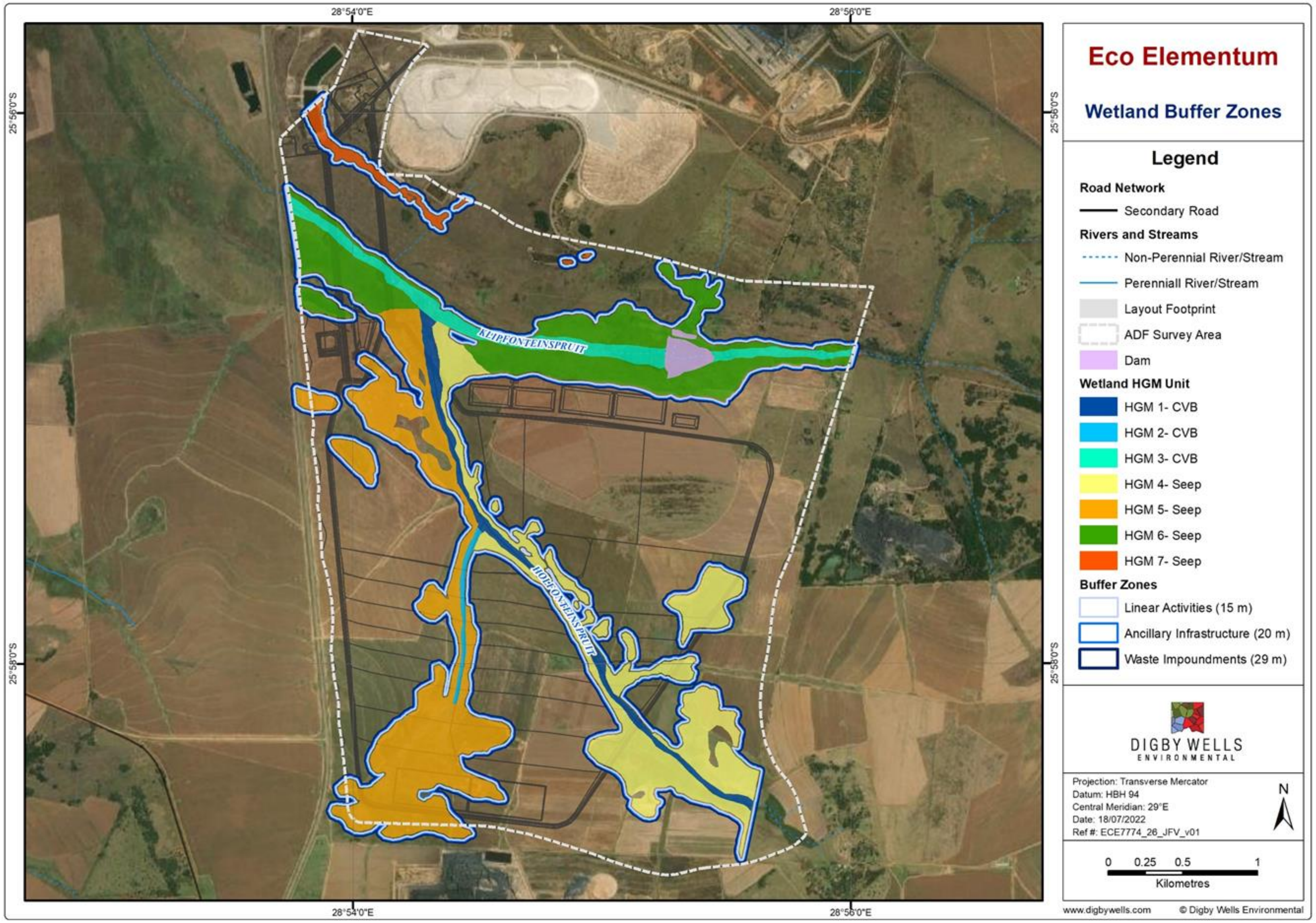

Figure 7-5: Recommended buffer zones

8. Wetland Offset Strategy Update

8.1. Additional Rehabilitation Interventions

As part of the Kusile Wetland Offset Strategy and Rehabilitation Plan (Digby Wells Environmental, 2022), proposed engineering interventions located along the various wetlands within their respective EMUs were assessed with additional engineering interventions to rehabilitate the wetlands also being recommended.

Due to the ADF layout changes following the previous assessment (Wetland Consulting Services (Pty) Ltd, 2014), some wetlands will no longer fall within the updated ADF footprint and therefore more wetlands were made available to rehabilitate and include in the offset calculations. Additional rehabilitation interventions were thus proposed for those wetlands (HGM 3 and HGM 6) outside of the updated ADF layout. These rehabilitation interventions are detailed in Table 8-1 with their locations illustrated in Figure 8-1.

It is not recommended to remove the large dam in the Klipfontein Spruit as the current proposed interventions downstream of the dam are focused on slowing down the water velocities. Even though the dam has resulted in modifications to the natural system, the dam has created habitat, is well functioning and assist with flood attenuation. The impacts that will result from the removal of the dam will outweigh the net gains and is therefore recommended not to be removed.

The following are the main rehabilitation objectives identified:

- Remove AIPs;
- Ameliorate erosion and investigate water inputs that are promoting erosion activity; and
- Installation of culverts to promote diffuse water flow.

Table 8-1: ADF Rehabilitation Interventions

Point ID	Co-ordinates	Rehab Measure Outcome	Comments
ADF - 01	25°56'52.00"S; 28°55'52.08"E	Remove AIPs	Dense AIP trees.
ADF - 02	25°56'54.85"S; 28°55'50.31"E	Remove AIPs	High AIP presence along a farm road.
ADF - 03	25°56'54.68"S; 28°55'41.19"E	Remove AIPs	High AIP presence along a farm road.
ADF - 04	25°56'46.60"S; 28°55'38.46"E	Remove AIPs	Dense AIP trees.
ADF - 05	25°56'56.33"S; 28°55'36.25"E	Remove AIPs	High AIP presence along a farm road.

Point ID	Co-ordinates	Rehab Measure Outcome	Comments
ADF - 06	25°56'52.91"S; 28°55'30.41"E	Remove AIPs	Dense AIP trees (Black Wattle)
ADF - 07	25°56'59.28"S; 28°55'28.59"E	Ameliorate Erosion and Manage Surface Flow	Backfill and reshape the entire drainage gully and revegetate and manage the surface flow by the road to avoid erosion taking place.
ADF - 08	25°57'0.51"S; 28°55'26.68"E	Remove AIPs, Ameliorate Erosion, Manage Surface Flow	Remove AIPs along the farm road, fix erosion and manage surface flow.
ADF - 09	25°56'48.82"S; 28°55'15.58"E	Ameliorate Erosion	Install gabions to minimise erosion and reshape downstream portion of the spillway.
ADF - 10	25°56'54.99"S; 28°55'14.95"E	Install More Outlets	Promote diffuse flows rather than concentrated flow (i.e. drop spillways slightly to promote ecological flows from the sides as well as the center of the channel)
ADF - 11	25°56'53.17"S; 28°55'11.01"E	Remove AIPs	Dense AIP trees.
ADF - 12	25°56'57.29"S; 28°54'40.46"E	Remove AIPs	High AIP presence along a farm road.
ADF - 13	25°56'50.45"S; 28°54'38.99"E	Remove AIPs	Dense AIP trees (Black Wattle).

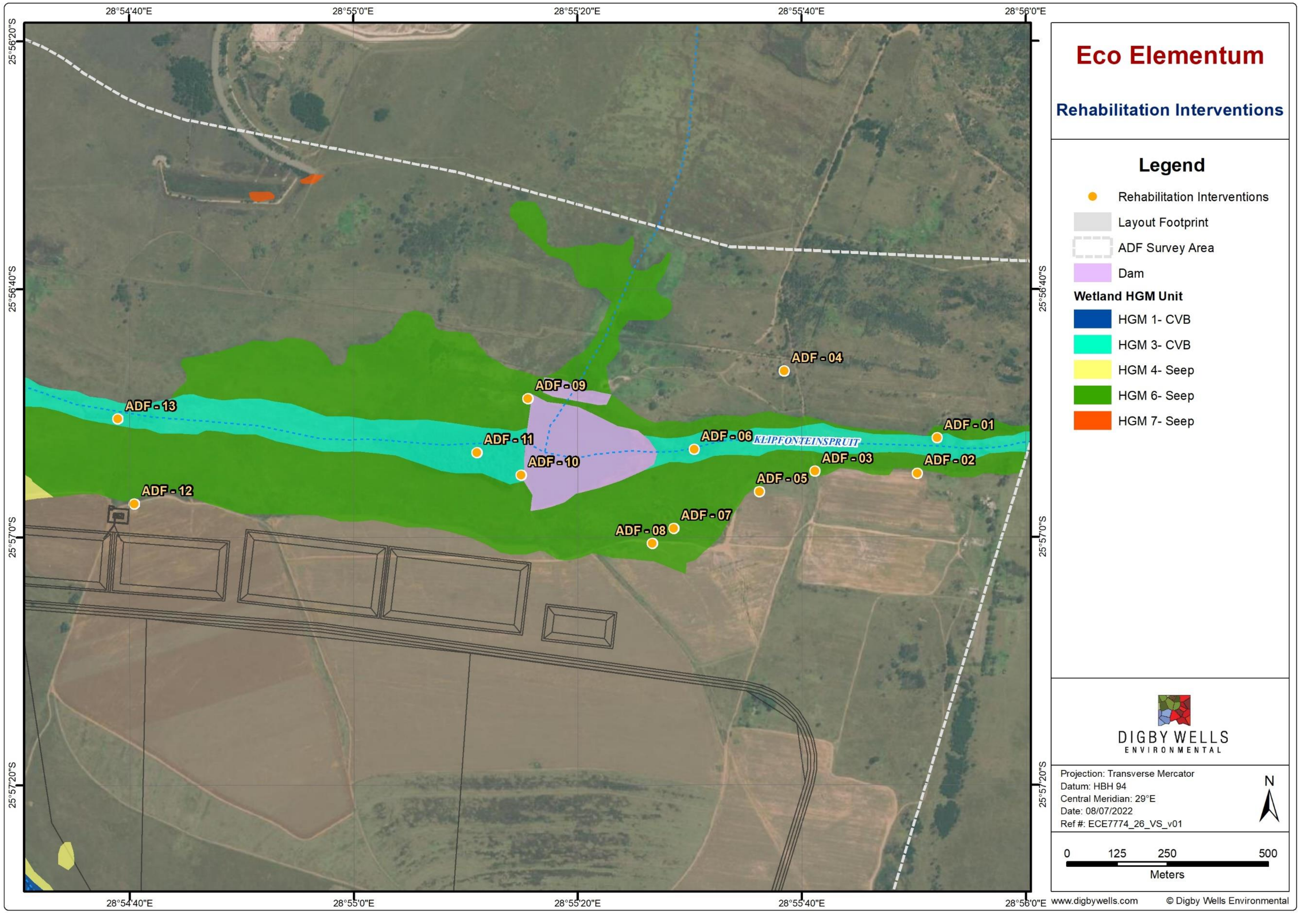

Figure 8-1: ADF Rehabilitation Interventions Locations

8.2. Hectare Equivalents

The hectare equivalents were initially calculated by Prime Africa Consultants (2015), which concluded that the proposed ADF will result in a loss of wetland habitat, which constitutes wetland offset targets of 343 ha (water resource and ecosystem service targets) and ecosystem conservation offset target of 2 342 ha.

This assessment focuses on updating the wetland offset calculations by considering the latest amended ADF layout. The latest layout is characterised by a significantly smaller surface area, which has resulted in less direct wetland loss throughout in comparison to the layout considered by Prime Africa Consultants (2015).

Figure 8-2 illustrates the wetland areas expected to be directly lost as well as those expected to be indirectly lost. The majority of the wetlands outside of these categories will be affected by the proposed activities yet will not require offsetting. Table 8-2 illustrates the wetland offset calculations associated with those systems expected to be directly and indirectly lost during the proposed activities.

The wetland offset rehab plan conducted by Digby Wells (2022) indicates that the prescribed rehabilitation interventions located within EMU A, B, F and G will ensure a net-gain in wetland functional targets worth 53 ha, whilst achieving a net-gain in ecosystem conservation targets worth 864.4 ha. As illustrated in Table 8-2, at least 126.3 ha and 484,9 ha of wetland and ecosystem conservation targets are required respectively. Therefore, more offset areas will be required upon the completion of the proposed rehabilitation intervention activities described by Digby Wells (2022) outside of the already assessed EMU A, B, F and G. These calculations are summarised in Table 8-3.

Table 8-2: Offset Target Calculations for the Updated ADF Layout

HGM	Wetland Type	Directly/Indirectly Lost	Size of the Wetland (ha)	Functional Value (%)	Functional Hectare Equivalents Lost	Functional Importance Ratio	Functional Offset Targets (ha)	Development Impact (ha)	Ecosystem Conservation Ratio	Ecosystem Conservation Target (ha)
1	CVB	Direct and Indirect	14.9	45	6.7	1.5	10.1	6.7	10.9	68,1
2	CVB	Direct	3.4	55	1.9		2.8	1.9		15,9
4	Seep	Direct	33.8	71	24		36	24		198,5
5	Seep	Direct and Indirect	84.6	61	51.6		77.4	51.6		202,4
Total					84.2		**126.3**	84.2		**484,9**

Table 8-3: Summarised Offset Calculations

	Functional Offset Targets	Ecosystem Conservation Target
Offset Targets Required	126.3	484,9
Net-Gains Achieved by Rehabilitation Interventions in EMU A, B, F and G	53	864.4
Shortcoming	**73.3**	**N/A (Achieved)**

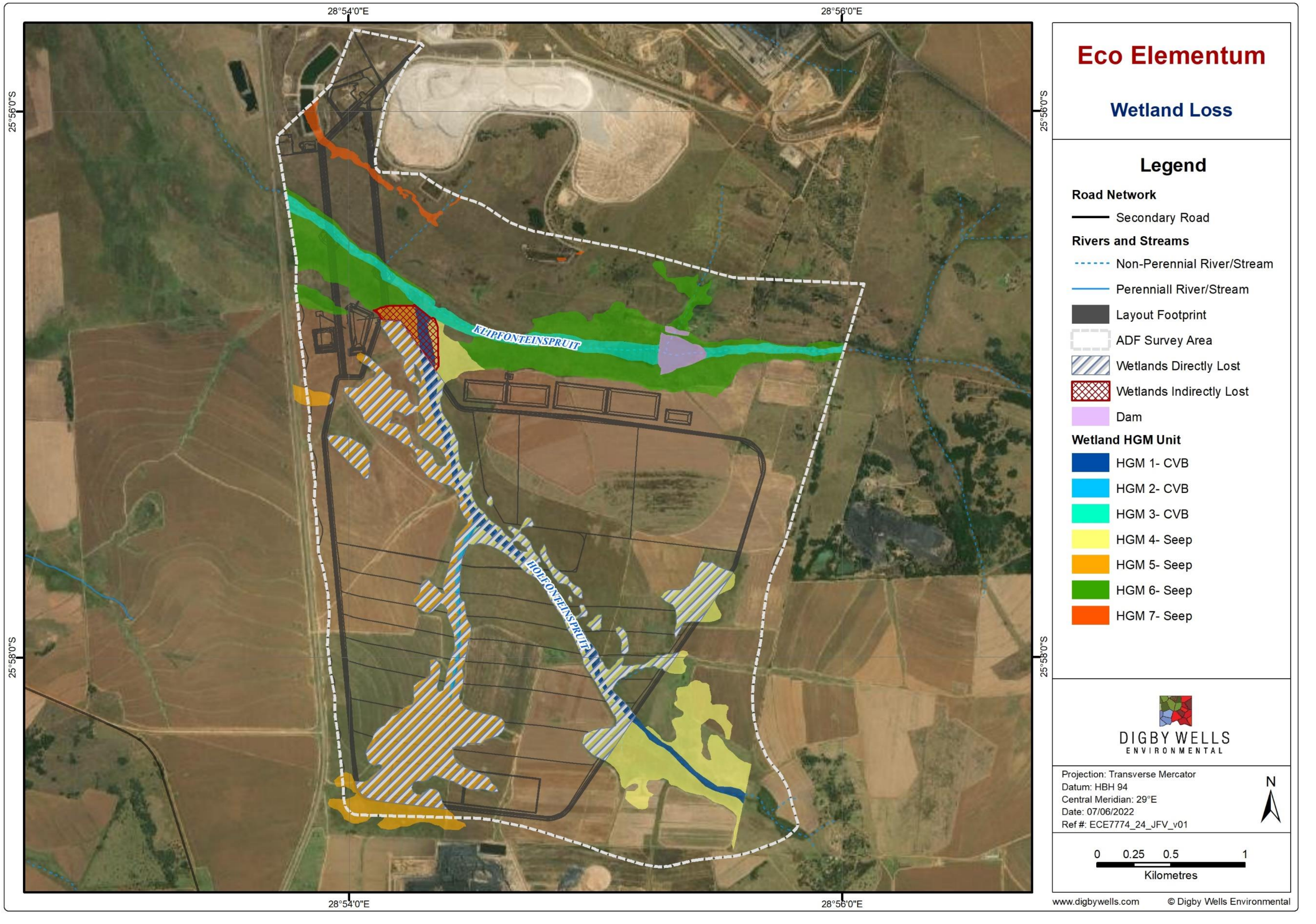

Figure 8-2: Wetlands directly and indirectly lost during the construction and operation of the proposed ADF

8.3. Net-Gain for HGM 3 and 6

Various soft engineering interventions are described in Section 8.1. These interventions have been assessed to determine the net-gain achieved in functional offset targets and ecosystem conservation targets. These interventions are aimed at improving the wetland health of HGM 3 and 6.

The following calculations depict the hectare equivalents currently available within the extent of HGM 3 and 6 as well as the net-gain expected regarding hectare equivalents and ecosystem conservation targets after the implementation of relevant intervention strategies.

The following calculations are associated with HGM 3 and 6, which will be conserved during the life of the ADF operation. Following the proposed rehabilitation interventions, HGM 3 is expected to be improved from E to D (7.5 to 5.5) and HGM 6 is expected to remain moderately modified (C) yet will improve from a score of 3.2 to 2.1. The post-rehabilitation PES ratings correlate perfectly with the REC.

Table 8-4: Parameters Associated with Offset Contribution Calculations (EMU A)

System	Functional Value Prior to Interventions	Functional Value After Interventions	Functional Offset Net-Gains (ha)	Ecosystem Conservation Net-Gains (ha)
HGM 3 - CVB	25	45	3.3	33.8
HGM 6 - Seep	62	79	8.9	187.2
Total			**12.2**	**221**
Required Targets			**73.3**	**0**
Deficit (Offset Targets Still Required)			**61.1**	**N/A (Achieved)**

The above-mentioned calculations indicate that there will be a shortfall in functional offset targets, whilst the ecosystem conservation targets are already met upon the implementation of the recommended interventions in the four EMUs. It is recommended that other areas be investigated for potential offsetting. Prime Africa Consultants (2015) mentions various other offset areas within proximity to the affected Klipfonteinspruit. It is recommended that these suggestions be investigated to determine whether access to private property can be gained to ultimately assess potential intervention sites and ultimately implement such interventions.

8.4. Wetland Impact Assessment Update

Guidance Note:

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are a result of both the environment in which the proposed project activities take place, as well as the actual activities. The potential impacts are discussed per aspect and per each phase of the Project, i.e., the Construction Phase, Operational and Rehabilitation/Closure Phases where applicable.

Mitigation measures in this section are ultimately provided to avoid, minimise and rehabilitate wetlands within the Project Area.

The mitigation hierarchy includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented.

The Impact Assessment aims to strive to avoid damage to, or loss of, ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for the loss of habitat are regarded as a last resort after all efforts have been made to avoid, reduce and mitigate.

Even though avoidance is the first option, it is not always possible to avoid or prevent impacts and therefore, minimisation of impacts and future rehabilitation should be considered. If this is not possible or feasible, wetland offsetting should be implemented where rehabilitation may be included as part of the Offset Plan. The mitigation hierarchy for the wetlands within the Project Area is described in Table 8-5 below.

Table 8-5: Mitigation Hierarchy

Mitigation Step	Actions
Avoid or prevent	*Consider options to avoid impacts on biodiversity and ecosystem services (e.g., project location, siting, scale, layout, technology and project phase). This is the best option, however not always possible.*
	• Avoid any activities within delineated wetlands and their associated buffers.
Minimize	*Consider alternatives to minimise impacts on biodiversity and ecosystem services (e.g., project location, scale, technology and layout). In areas where the environmental constraints are not too high, minimising should still be taking place.*
	• Implement all prescribed mitigation measures to minimise impacts

Mitigation Step	Actions
Rehabilitate	*Where minimising impacts isn't feasible (i.e. where the post-mitigation significance rating is scored moderate to high), rehabilitation should take place to restore sensitive receptors of functionality.*
	• Rehabilitate selected wetlands within the Project Area (impacted upon by the proposed activities); and • Implement monitoring to ensure the conservation of wetlands.
Offset	*Compensating for remaining and residual (unavoidable) negative impacts on the biodiversity. Offset should be implemented when every effort has been made to minimise and rehabilitate remaining impacts to a degree of 'no net loss' of biodiversity against biodiversity targets.*
	• Implement the Wetland Offset Strategy and Rehabilitation Plan for the wetlands that will directly be lost due to the proposed activities.

Activities during the Construction, Operational and Decommissioning/Rehabilitation Phases that may have potential impacts on the wetlands are described below.

As for the updated layout of the proposed ADF, fewer wetlands are expected to be directly lost. Offsetting was therefore completed to determine the hectare equivalent lost ("like-for-like").

The main impacts regarding the proposed ADF footprint include the clearance of the area during the construction phase. Even though this will take place throughout the life of the project, and not immediately, these impacts were scored in their entirety. Therefore, the duration is immediate and the significance of impacts high. Any other activities located within the ADF footprint were regarded as low, considering that these wetlands will be offset due to the loss expected from the ADF itself. As per the example, the only attenuation dam assessed is that of "D10" seeing that this is the only attenuation dam located outside of the ADF footprint. The remainder of the attenuation dams will have impacts on wetlands, however, considering that these wetlands will be offset, and that impacts were already determined to be significant for the ADF clearance, these dams were not included. Similarly, the proposed stockpiles are located within the ADF footprint and will have negligible impacts on wetlands due to the fact that these wetlands are already considered to be lost (and then to be remedied by wetland offsets).

The following are discussed below:

- Table 8-6: Interactions and Impacts of Activity;
- Table 8-7: Impact Ratings;
- Table 8-8: Mitigation Measures.

Table 8-6: Interactions and Impacts of Activity

Project Phase	Project Activity	Impact	Description
Construction Phase	• Site/vegetation clearance within wetlands • Site/vegetation clearance within wetland buffers • Establishment of ancillary infrastructure (i.e. offices, security rooms and changing houses). • Construction of linear components (pipelines and roads) • Construction of PCD and CWD; • Construction of topsoil stockpile footprint area • Construction and clearance of ADF footprint area, including continuous expansion over the life of the operation • Construction of conveyor crossing • Construction of attenuation dam D10 (only attenuation dam outside of ADF footprint)	• Loss of wetland habitat, vegetation and biodiversity; • Disturbance, fragmentation and degradation of freshwater ecosystems; • Degradation of the wetlands natural geomorphology and hydrology, including adjacent wetlands; • Loss of water supply and catchment yield; • Increased runoff and creation of preferential flow paths; • Increased erosion; • Sedimentation and increased sediment loads into freshwater ecosystems; • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems; • AIP infestation due to disturbance; • Soil compaction from moving machinery leads to decreased soil depth for root/water penetration and increased runoff from hardened surfaces; • Deterioration of wetland health and functionality;	• The site clearance, removal of vegetation, soil stripping and stockpiling will result in the complete loss of wetlands within the vicinity of the proposed infrastructure. This will alter the hydrological regime and flow of water to adjacent and downstream wetlands and watercourses. This could contribute to further loss of wetlands adjacent and downstream of the infrastructure area, referred to as indirect loss. • Exposed surfaces may result in dust, erosion and sedimentation into the low-lying areas and wetlands. • Construction of infrastructure will result in complete and or partial loss of wetlands within the proposed infrastructure area. Construction may lead to soil compaction, increased surface runoff and increased risk of erosion, contamination and sedimentation of the wetlands. • Among the impacts associated with the proposed Project are potential impacts on soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the construction activities. The contamination of water resources will result in the deterioration of water quality which will result in impacts on the aquatic faunal species, terrestrial faunal species and vegetation. • Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the construction areas and resulting in impacts further downstream. • With unregulated use of dirt roads across wetlands and indiscriminate driving and movement of heavy machinery across wetland areas, vegetation establishment will be hindered, and erosion will be promoted. These impacts have the potential to increase sediment loads being deposited, which in turn may result in the establishment and further spread of invasive hydrophytic plants and loss of stream flow and natural refuge areas in the aquatic systems further downstream. • Removal of vegetation and disturbance of soils in the vicinity of the construction footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and AIP species, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the decommissioning footprint. • Increased flow velocity from hardened surfaces and concentrated flow may increase the erosion risk and sedimentation of water resources. • The potential for chemical pollution and soil contamination exists during site preparation and construction when hydrocarbon spills or leaks (e.g., fuels, oils and lubricants) from construction vehicles or machinery occur. Fluids used for vehicles and machinery may spill during filling or direct leakage.

Project Phase	Project Activity	Impact	Description
Operational Phase	• Continuous monitoring and maintenance • Operation of ancillary infrastructure (i.e. offices, security offices and changing houses). • Operation of linear components (pipelines and roads), including potential leaks and increased traffic • Operation of PCD and CWD • Operation of topsoil stockpile • Operation of ADF footprint area • Operation of conveyor crossing • Operation of attenuation dam D10 (only attenuation dam outside of ADF footprint)	• Impacts on downstream and adjacent wetlands and watercourses; • Loss of wetland habitat, vegetation and biodiversity; • Erosion and sedimentation; • Water and soil quality contamination and deterioration; • Increased runoff and flow from hardened surfaces; • Decreased water supply; • Dewatering of wetland adjacent and downstream to the Project Area; • Change in habitat and potential change in species composition; • Vehicle movement in the area, leading to soil compaction and increased runoff and erosion potential; and • Increased AIPs.	• Impacts include loss of vegetation, compaction, and loss of topsoil through erosion due to exposed areas, soil and water contamination by hydrocarbon waste, reduced infiltration, increased runoff and increased AIPs. • The soils could potentially become compacted, leading to the onset of erosion, loss of effective rooting depth and decreased water and root penetration, water holding capacity and soil fertility. • The vehicle movement within the wetland could lead to soil compaction, which reduces the vegetation's ability to grow and as a result erosion and loss of soil organic material. • Ash from the ADF will contain several pollutants. Contaminated surface water runoff from the ADF or water seeping out of the ADF or the Pollution Control Dams (PCDs) will result in water quality deterioration in receiving water resources. Overflow of PCDs could also occur and impact water quality within receiving systems. The Klipfonteinspruit drains into the Wilge River and therefore any water quality impacts on the Klipfonteinspruit will likely also affect the Wilge River. • Water quality could also be affected by dust deposition in wetlands. Ash dust is likely to be blown from the ADF as well as from the required conveyor transporting ash from the power station to the ADF. Direct deposition of this dust into wetlands could result in contamination of surface waters with a resultant loss in fauna and flora. • The ADF will be lined and treated as a dirty water area. No surface runoff from the ADF or seepage should thus enter adjacent wetlands. This will reduce the water inputs to adjacent wetlands and could lead to partial desiccation and terrestrialisation of the wetlands, specifically hillslope seepage wetlands, immediately adjacent to the ADF.
Decommissioning Phase	• Demolition and removal of infrastructure • Post-closure monitoring and rehabilitation • Reclamation of ADF	**Negative Impacts:** • Water and soil quality contamination and deterioration; • Erosion and sedimentation; • Vehicle movement in the area, leading to soil compaction and increased runoff and erosion potential; and • Increased AIPs. **Positive Impacts:** • Increased natural flow pathways; • Increase vegetation cover; • Remediation of potentially contaminated wetlands; • Reducing the risk of erosion, sedimentation and loss of the soil resource; and	• Upon rehabilitation, all surface infrastructure will be demolished and removed. The areas will be landscaped and rehabilitated. Impacts are therefore somewhat positive as rehabilitation will be implemented after deconstruction. • Rehabilitation of the ADF will include the placement of topsoil on the side slopes and crest and the establishment of vegetation on the ADF. Surface runoff on the steep side slopes of the ADF is likely to erode the placed topsoil, especially in the initial stages prior to the establishment of sufficient vegetation cover. • If deconstruction is not properly controlled and managed, the activities could lead to impacts on the wetlands and freshwater systems. Impacts include loss of vegetation, compaction, and loss of topsoil through erosion due to exposed areas, soil and water contamination by hydrocarbon waste, reduced infiltration, increased runoff and increased AIPs. • The soils could potentially become compacted, leading to the onset of erosion, loss of effective rooting depth and decreased water and root penetration, water holding capacity and soil fertility. • The movement of heavy machinery within the wetland could lead to soil compaction, which reduces the vegetation's ability to grow and as a result erosion and loss of soil organic material. • Rehabilitation should include ripping, spreading of overburden and topsoil and establishment of vegetation. • Demolishing the infrastructure could potentially lead to soil, water and wetland contamination, resulting in decreased soil fertility, increased AIPs, decreased biological activity and land capabilities. However, when rehabilitation of these areas commences and is implemented correctly, the land capability status should increase, being a positive impact. It would be optimal to rehabilitate the Project Area to at least cattle grazing and wildlife or the desired land use of the local communities after stakeholder engagements throughout the Project Life.

Project Phase	Project Activity	Impact	Description
		• Improved wetland health and functionality.	• Removal/demolishing of infrastructure may lead to erosion, compaction and hydrocarbon spills.

8.5. Impact Ratings

Table 8-7 presents the impact ratings associated with the Project for all the phases prior to and post-mitigation, whereas Table 8-8 presents the mitigation measures to be implemented to avoid, reduce, and rehabilitate impacts.

Table 8-7: Impact Ratings

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Pre-Mitigation Significance	Post-Mitigation Significance
Construction Phase	Site/vegetation clearance within wetlands	• Loss of wetland habitat, vegetation and biodiversity; • Disturbance, fragmentation and degradation of freshwater ecosystems; • Degradation of the wetlands natural geomorphology and hydrology, including adjacent wetlands; • Loss of water supply and catchment yield; • Increased runoff and creation of preferential flow paths; • Increased erosion; • Sedimentation and increased sediment loads into freshwater ecosystems; • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems; • AIP infestation due to disturbance; • Soil compaction from moving machinery leads to decreased soil depth for root/water penetration and increased runoff from hardened surfaces; and • Deterioration of wetland PES and EcoServices.	Permanent (7)	Local (3)	Very high – negative (7)	Highly probable (<80%) (6)	Negative	Moderate – negative (-102)	Moderate – negative (-90)
	Site/vegetation clearance within wetland buffers		Beyond project life (6)	Local (3)	Moderately high – negative (4)	Probable (<50%) (4)	Negative	Minor – negative (-52)	Minor – negative (-48)
	Establishment of ancillary infrastructure (i.e. offices, security rooms and changing houses).		Short Term (2)	Limited (2)	High – negative (-5)	Likely (<65%) (5)	Negative	Minor – negative (-45)	Minor – negative (-36)
	Construction linear components (pipelines and roads)		Short Term (2)	Limited (2)	Moderately high – negative (4)	Probable (<50%) (4)	Negative	Negligible – negative (-32)	Negligible – negative (-15)
	Construction of PCD and CWD		Permanent (7)	Limited (2)	Very high – negative (6)	Likely (<65%) (5)	Negative	Moderate – negative (-75)	Minor – negative (-56)
	Construction of topsoil stockpile footprint area		Project Life (5)	Local (3)	Very low – negative (1)	Highly unlikely (<1%) (1)	Negative	Negligible – negative (-9)	Negligible – negative (-5)
	Construction and clearance of ADF footprint area, including continuous expansion over the life of the operation		Permanent (7)	Local (3)	Extremely high – negative (7)	Definite (>80%) (7)	Negative	Major – negative (-119)	Major – negative (-112)
	Construction of conveyor crossing		Short Term (2)	Limited (2)	Very high – negative (-6)	Highly probable (<80%) (6)	Negative	Minor – negative (-60	Minor – negative (-50)

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Pre-Mitigation Significance	Post-Mitigation Significance
	Construction of attenuation pond D10 (only attenuation pond outside of ADF offset footprint)		Permanent (7)	Limited (2)	Very high – negative (6)	Highly probable (<80%) (6)	Negative	Moderate – negative (-90)	Minor – negative (-84)
Operational Phase	Continuous monitoring and maintenance	• Impacts on downstream and adjacent wetlands and watercourses: • Loss of wetland habitat, vegetation and biodiversity; • Erosion and sedimentation; • Water and soil quality contamination and deterioration; • Increased runoff and flow from hardened surfaces; and • Decreased water supply; • Dewatering of wetland adjacent and downstream to the Project Area; • Change in habitat and potential change in species composition; • Vehicle movement in the area, leading to soil compaction and increased runoff and erosion potential; and • Increased AIPs.	Long term (6-15 yrs) (4)	Local (3)	Very low – negative (1)	Highly unlikely (<1%) (1)	Negative	Negligible – positive (+8)	Negligible – positive (+8)
	Operation of ancillary infrastructure (i.e. offices, security offices and changing houses).		Project Life (>15 yrs) (5)	Limited (2)	Moderately high – negative (4)	Probable (<50%) (4)	Negative	Minor – negative (-44)	Negligible – negative (-33)
	Operation of linear components (pipelines and roads), including potential leaks and increased traffic		Project Life (>15 yrs) (5)	Limited (2)	Moderate – negative (5)	Unlikely (<25%) (3)	Negative	Negligible – negative (-30)	Negligible – negative (-30)
	Operation of PCD and CWD		Beyond project life (6)	Limited (2)	Moderate – negative (5)	Highly probable (<80%) (6)	Negative	Moderate – negative (-78)	Minor – negative (-70)
	Operation of topsoil stockpile		Project Life (>15 yrs) (5)	Limited (2)	Very low – negative (1)	Highly unlikely (<1%) (1)	Negative	Negligible – negative (-8)	Negligible – negative (-5)
	Operation of ADF footprint area		Permanent (7)	Local (3)	Very high – negative (6)	Highly probable (<80%) (6)	Negative	Moderate – negative (-96)	Moderate – negative (-90)
	Operation of conveyor crossing		Project Life (>15 yrs) (5)	Limited (2)	Moderate – negative (5)	Highly probable (<80%) (6)	Negative	Minor – negative (-72)	Minor – negative (-65)
	Operation of attenuation pond D10 (only attenuation pond outside of ADF offset footprint)		Beyond project life (6)	Limited (2)	Moderately high – negative (4)	Probable (<50%) (4)	Negative	Minor – negative (-52)	Minor – negative (-48)
Decommissioning and Rehabilitation Phase	Demolition and removal of infrastructure	**Negative Impacts:** • Water and soil quality contamination and deterioration; • Erosion and sedimentation; • Vehicle movement in the area, leading to soil compaction and increased runoff and erosion potential; and • Increased AIPs.	Project Life (>15 yrs) (5)	Limited (2)	High – negative (5)	Likely (<65%) (5)	Negative	Minor – negative(-60)	Negligible – negative (-40)
	Post-closure monitoring and rehabilitation		Long term (6-15 yrs) (4)	Local (3)	Very low – negative (1)	Highly unlikely (<1%) (1)	Positive	Negligible – positive (+8)	Negligible – positive (+8)

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Pre-Mitigation Significance	Post-Mitigation Significance
	Reclamation of ADF	**Positive Impacts:** • Increased natural flow pathways; • Increase vegetation cover; • Remediation of potentially contaminated wetlands; • Reducing the risk of erosion, sedimentation and loss of the soil resource; and • Increased wetland health and EcoService delivery.	Beyond project life (6)	Local (3)	Very low – negative (-1)	Rare/improbable (<10%) (2)	Negative	Negligible – negative (-20)	Negligible – negative (-18)

Table 8-8: Mitigation Measures

Project Phase	
Construction Phase	• Environmental Practitioner to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area. • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. • Where vegetation has been removed or damaged, the areas should be revegetated as soon as possible with a suitable mix of indigenous plant species as determined by a qualified botanist. • No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas. All vehicles must remain on demarcated roads and within the rehabilitation footprint and access roads. • At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and at a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing. • Install sediment barriers and/or low berms along the downslope edge of cleared areas to trap sediments on site. • Ensure a soil management programme is implemented and maintained to minimize erosion and sedimentation. • Stripped topsoil stockpiles and bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • All recommended buffer zones should be designated as "No-Go" areas and be off-limits to all unauthorised vehicles and personnel. Only authorised activities should be permitted within wetland and their associated buffer areas. • Implement a Storm Water Management Plan (SWMP). • Implement concurrent rehabilitation to prevent and minimise impacts on the freshwater systems. • Implement the Wetland Offset Strategy. • Identify other potential offset areas to achieve the total required offset targets determined within this report. • A suitable AIP control programme must be put in place to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones.
Operational Phase	• Ensure that sound environmental management is in place during the proposed operational phase. • Ensure that as far as possible all operational activities take place outside of wetland areas and their prescribed buffer zones. Only authorised activities should be permitted within wetland and their associated buffer areas. • Limit the footprint area of the operational activities to what is essential to minimise impacts as a result of vegetation clearing and compaction of soils. • Ensure that no incision and canalisation of the wetland features present take place as a result of the proposed operational activities. • All erosion noted within and in the vicinity of the area footprint should be remedied immediately and included as part of the ongoing rehabilitation plan. • All soils compacted as a result of operational activities should be ripped and profiled. • A suitable AIP control programme must be put in place to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones. • Permit only essential personnel within the calculated buffer zones. • No crossing of the wetland features or impedance within the relevant associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained. • No material may be dumped or stockpiled within any wetland areas in the vicinity of the proposed decommissioning footprint. • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zone of regulation. All vehicles must remain on demarcated roads and within the Project area footprint. • All vehicles must be regularly inspected for leaks and re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil. • All spills should be immediately cleaned up and treated accordingly. • Isolate the ADF from the surrounding catchment through the installation of a liner (as per waste classification guidelines and best practice standards) and seepage collection infrastructure, as well as separation of clean and dirty water (SWMP).

Project Phase	
	• Water quality with special mention of pH, dissolved salts and specific metals needs to be managed and monitored to ensure that reasonable water quality occurs downstream of the development areas to allow for the on-going survival of wetland and aquatic communities of some diversity and reasonable sensitivity. • Dust pollution monitoring must take place throughout the life of the operation phase. • Monitoring of conserved wetlands must be taken place bi-annually during the life of the operational phase. • Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate waste facility. • During the operational phase, erosion berms should be installed on roadways and in the vicinity of disturbed soils and cleared vegetation soils as well as in areas where contaminated soils are reclaimed or removed to prevent gully formation and siltation of the wetland areas.
Decommissioning Phase	• Limit the footprint area of the decommissioning activities to what is essential to minimise impacts as a result of vegetation clearing and compaction of soils. • Wetland monitoring must be carried out during both the decommissioning and rehabilitation phases to ensure no unnecessary impact on wetlands takes place and also to report on the success of rehabilitation. Monitoring should take place on an annual basis during the summer/wet season and be carried out by an independent consultant for the duration of the decommissioning phase. Monitoring should continue to take place every two years upon the completion of the decommissioning phase until the systems are considered stable. • Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season to identify any emerging issues, trends or improvements in the receiving environment. • Wetlands and their associated buffer zones must be demarcated and avoided as far as possible. Only authorised activities should be permitted within wetland and their associated buffer areas. • An AIP management plan to be implemented and managed for the life of the proposed rehabilitation phase of the Project. • As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils and vegetation, clearance should be kept to a minimum as the biomass in the area is not very high and so therefore plants will not grow quickly. • Re-vegetate the side slopes of the ADF as soon as possible following capping with topsoil. • All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses. • Preventative measures such as hessian sheeting should be used in steep re-seeded areas where high erosion potentials exist. • The use of indigenous phyto-remediation specific grass, forb and tree species is encouraged. • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint. • Compacted soils should be ripped, re-profiled and re-seeded. • All vehicles must be regularly inspected for leaks and re-fueling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil. • All existing litter, debris should be removed from the wetland areas and littering should be prohibited on an ongoing basis. • All spills should be immediately cleaned up and treated accordingly. • Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities and all waste must be removed to an appropriate waste facility.

8.6. Cumulative Impacts

The land uses within the Project Area have contributed to losses of wetlands and continued impacts on the remaining catchment. Historical and current agricultural impacts (i.e., intensive cultivation, cattle grazing, infrastructure, dams and boreholes) and power generation, infrastructure (i.e., roads, dams, powerlines and pipelines) have led to various geomorphological, vegetation and hydrological changes (e.g., vegetation loss, overgrazing and contamination of water resources and increased surface inflows) contributing to the physical impacts on the wetlands, reducing the PES, EIS and ES.

The historical and current agricultural activities and mining within the catchment have led to losses in wetlands and alteration to the hydrological regime that may have facilitated increased water flow and also have increased the number of pollutants flowing into the water resources and created large erosion gullies. The alteration of vegetation and surface flow has led to the onset of erosion in the wetlands and adjacent areas, and this is likely to further be impacted using the proposed activities.

8.7. Unplanned and Low Risk Events

There is a risk that wetland areas associated with the ADF operations/infrastructure throughout the life of the proposed Project might be affected by the entry of hazardous substances, such as hydrocarbons, in the event of a spillage or unseen seepage from storage facilities. Accidents or deterioration of structures along the roadways and river/wetland crossings, including pipelines, may result in impacts on the habitat and water quality.

Table 8-9 outlines mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the proposed Project.

Table 8-9: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
• Chemical and (or) contaminant/ash spills from ADF operation, infrastructure and associated activities.	• Ensure the correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g. sealed containers for hydrocarbons); • Ensure staff involved in the proposed Project have been trained to correctly work with chemicals at the sites; and • Ensure spill kits (e.g. Drizit) are readily available in areas where chemicals are known to be used. Staff must also receive the appropriate training in the event of a spill, especially near wetlands, watercourses and/or drainage lines.
• Unplanned structural deterioration or accidents along the roadways and	• Install safety valves and emergency switches that can be used to seal off leakages from pipelines when noticed or triggered;

Unplanned Risk	Mitigation Measures
pipelines in the vicinity of wetlands.	• Ensure that emergency equipment like TLB's etc and spill kits and trained staff capable of using the kits are available on site in case of accidental spillages; and • Maintenance of roadways, river crossings and pipelines should be considered an ongoing process where leakages or issues with the pipe should be reported to the acting Environmental Control Officer (ECO) of the Project immediately after notice.

9. Environmental Management Plan

The EMP is described in Table 9-1 below.

Table 9-1: Environmental Management Plan

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Construction Phase	• Site/vegetation clearance within wetlands • Site/vegetation clearance within wetland buffers • Establishment of ancillary infrastructure (i.e. offices, security rooms and changing houses). • Construction lianear components (pipelines and roads) • Construction of PCD and CWD • Construction of topsoil stockpile footprint area • Construction and clearance of ADF footprint area, including continuous expansion over the life of operation • Construction of conveyor crossing • Construction of attenuation dam D10 (only attenuation dam outside of ADF footprint)	• Loss of wetland habitat, vegetation and biodiversity; • Disturbance, fragmentation and degradation of freshwater ecosystems; • Degradation of the wetlands natural geomorphology and hydrology, including adjacent wetlands; • Loss of water supply and catchment yield; • Increased runoff and creation of preferential flow paths; • Increased erosion; • Sedimentation and increased sediment loads into freshwater ecosystems; • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems; • AIP infestation due to disturbance; • Soil compaction from moving machinery leads to decreased soil depth for root/water penetration and increased runoff from hardened surfaces; and • Deterioration of wetland PES and EcoServices.	• Control. All wetland areas which do not require offsets should be rehabilitated concurrently throughout the life of construction, operation and decommissioning phases. This should be supplemented by the relevant monitoring programmes; • Control. In areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing; • Control. Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; • Control and Remedy. Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction with an indigenous seed mix. • Control and Remedy. Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • Control and Remedy. If spills have occurred, it should be reported to authorities and cleaned up immediately; and • Control and Remedy. Stockpiles must be located outside wetlands and the relevant calculated buffer zones	Concurrent rehabilitation	Life of Construction Phase

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Operational Phase	• Continuous monitoring and maintenance • Operation of ancillary infrastructure (i.e. offices, security offices and changing houses). • Operation of linear components (pipelines and roads), including potential leaks and increased traffic • Operation of PCD and CWD • Operation of topsoil stockpile • Operation of ADF footprint area • Operation of conveyor crossing • Operation of attenuation dam D10 (only attenuation dam outside of ADF footprint)	• Impacts on downstream and adjacent wetlands and watercourses: • Loss of wetland habitat, vegetation and biodiversity; • Erosion and sedimentation; • Water and soil quality contamination and deterioration; • Increased runoff and flow from hardened surfaces; and • Decreased water supply; • Dewatering of wetland adjacent and downstream to the Project Area; • Change in habitat and potential change in species composition; • Vehicle movement in the area, leading to soil compaction and increased runoff and erosion potential; and • Increased AIPs.	• Control and Remedy. Water resources must be continuously monitored throughout the construction, operational, decommissioning and rehabilitation phases. These objectives should advise the ECO as to problem areas and potential solutions to remedy impacts on water resources. • Remedy. A rehabilitation strategy (linked to the rehabilitation plan of the ADF) will be required for components located within the relevant buffer zones, whilst no activities are permitted inside of delineated wetlands except for the ADF (which will be subject to wetland offsets); • Control. All vehicle maintenance must occur within designated areas; • Control. All vehicles must be regularly inspected for leaks; • Control and Remedy. All spills must be reported to authorities and cleaned up immediately to prevent contaminants to enter the wetlands; • Control. Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • Control and Stop. All areas of increased ecological sensitivity adjacent to the Project Area should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel. Only authorised activities should be permitted within wetland and their associated buffer areas; • Control and Stop. No material is to be dumped or stockpiled within any rivers, tributaries, drainage lines or relevant buffer zones; • Control and Remedy. Culverts, roads and river crossings must be maintained, cleared and monitored; • Control and Stop. No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint; • Control and Remedy. Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems. This is also applicable to the proposed ADF; • Control and Remedy. A Storm Water Management Plan (SWMP) should already be implemented. This should consider all wetlands and other watercourses adjacent to and downstream of the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Control and Remedy. Care must be taken to ensure that contamination of the receiving environment as a result of the proposed activities is minimised as far as possible; and • Control and Stop. Chemicals, such as hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical’s specific storage descriptions.	Concurrent rehabilitation	Life of Operational Phase

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Decommissioning Phase	• Demolition and removal of infrastructure • Post-closure monitoring and rehabilitation • Reclamation of ADF	**Negative Impacts:** • Water and soil quality contamination and deterioration; • Erosion and sedimentation; • Vehicle movement in the area, leading to soil compaction and increased runoff and erosion potential; and • Increased AIPs. **Positive Impacts:** • Increased natural flow pathways; • Increase vegetation cover; • Remediation of potentially contaminated wetlands; • Reducing the risk of erosion, sedimentation and loss of the soil resource; and • Increased wetland health and EcoServices delivery.	• Control and Stop. Rehabilitation should occur at the end of the dry season or early spring to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Control and Remedy. Stormwater must be diverted from or equally spread over newly rehabilitated areas; • Control and Stop. Stored mine-affected water should be treated before being reintroduced into the environment; • Modify, Control and Remedy. Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas; • Modify, Control and Remedy. Implement and maintain a Wetland and AIPs Plan for the duration of the rehabilitation phase and into closure; • Control and Stop. No material should be dumped/stockpiled within any watercourses or their associated buffer zones; • Control and Stop. No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; • Modify, Control and Remedy. Rehabilitation must be done as soon as any impacts are observed; • Control and Remedy. Ongoing dust control must be undertaken; • Modify, Control and Remedy. Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion; and • Modify, Control and Remedy. Implement the Wetland Offset Strategy to compensate for the wetlands lost.	Concurrent rehabilitation	Life of Rehabilitation Phase

10. Monitoring Programme

Guidance Note:

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place.

Monitoring should be done in terms of:

- EIA Regulations, 2014 promulgated under the NEMA;
- NEMA;
- NEM: WA; and
- The CARA.

The Mine Manager and the Environmental Practitioner are responsible to report on results of the monitoring program. Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 10-1 describes the monitoring plan which should be followed from the onset of the Construction Phase through to the Rehabilitation and Monitoring phase. The table below includes each aspect of monitoring together with the frequency of monitoring and person responsible thereof.

The monitoring programme is based on the following points:

- Undertake monitoring on the adjacent and downstream wetlands to detect and rectify any secondary impacts caused by the Project and submit to Environmental Monitoring Committee (EMC) and authorities on a seasonal basis;
- Commence with monitoring prior to the Construction Phase to collect baseline information regarding adjacent and downstream wetlands, soils and vegetation and to monitor any changes due to the proposed activities;
- Undertake bi-annual (twice a year) monitoring throughout the Construction Phase, for wetlands, soils and vegetation, preferably one survey after the rainy season (January to March) and one after the dry season (July to September);
- Undertake annual wetland monitoring throughout the Operational and Rehabilitation Phases, preferably one survey after the rainy season (January to March);
- Upon closure and rehabilitation, undertake annual monitoring and wetland auditing for another three years to ensure there are no emerging impacts identified, which may need to be addressed;
- Update the monitoring programme once a wetland offset plan has been developed and offsetting has been implemented; and

- Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 10-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Phase	Responsibility	Duration
Wetland extent of adjacent wetlands (HGM 1, 3, 6 and 7)	Implementation of intervention measures.	Update wetland report and recommendations for impact mitigation, if any.	Once every year	Construction	Environmental Officer	Up to Rehabilitation
				Operational		
				Rehabilitation		
Wetland health of HGM 1, 3, 6 and 7 (PES, EcoServices, EIS)	Implementation of intervention measures.	Update wetland report and recommendations for impact mitigation, if any.	Quarterly	Construction	Environmental Officer	3 years after Rehabilitation
			Once every year	Operational		
				Rehabilitation		
Wetland physical attributes of HGM 1, 3, 6 and 7 (vegetation, erosion, habitat, open water extent)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take photos of adjacent and downstream wetland areas and record any impacts seen. Continue wetland and aquatic bio-monitoring. Transects in representative wetlands to monitor vegetation changes, sediment changes (ash detection).	Quarterly and after storm events.	Construction	Environmental Manager.	Up to Rehabilitation
				Operational		
			Once every year	Rehabilitation		
Surface water and soil contamination assessment of HGM 1, 3, 6 and 7	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take water and soil samples for laboratory analysis, measuring heavy metals and potentially harmful elements	Only after a spill has occurred	Construction	Environmental Officer	3 months thereafter (monthly) the spill has occurred
				Operational		
				Rehabilitation		
Wetland functionality of HGM 1, 3, 6 and 7	Monitor the functionality of remaining wetlands throughout the life of the operation	Annual wetland functionality assessments to determine the success of interventions, identify impacts and make recommendations	annually during the wet season	Construction	Wetland Specialist	Life of operation
				Operational		
				Rehabilitation		
All interventions recommended within the ADF footprint associated with HGM 1, 3, 6 and 7	Monitor the success of interventions	The progress and success of all interventions to be assessed, further recommendations to be made if necessary	annually during the wet season	Construction	Wetland Specialist	Life of operation
				Operational		
				Rehabilitation		

11. Recommendations

The following recommendations have been made;

- All prescribed mitigations must be adhered to at all times;
- More offset areas should be investigated to achieve the relevant net-gains required;
- No activities should proceed before other suitable, and practical, offset areas are identified;
- The offset calculations will require updating once engineering designs have been finalised with respect to redirecting flows south-east of the ADF. This engineering strategy is vital to the conservation of wetlands in the local area; and
- Authorisation should include all the above-mentioned recommendations as conditions to proceed with the proposed activities; and
- The portion of HGM located south-east of the ADF must be reconnected to HGM 4 (north of the ADF) to conserve total streamflow.

12. Conclusion

Eskom Kusile Power Station (KPS) in Mpumalanga, South Africa was awarded an Integrated Water use Licence (IWULA) for the proposed 60-year Ash Dump Facility (ADF).

Wetland Functionality

Wetland Consulting completed the wetland delineations and impact assessment of the Project Area in 2014 (Wetland Consulting Services (Pty) Ltd, 2014). These delineations were used for this assessment and further divided into seven HGM units, which all include CVB wetlands and hillslope seeps.

The findings from the most recent site visit conducted in 2022 indicate slightly higher modification scores to the wetlands. The CVB wetlands were determined to have higher modification scores than that the hillslope seeps. This can be attributed to existing crossings and impeding structures affecting the natural hydrological functioning of the wetlands. The hillslope seeps are characterised by higher vegetation modifications, due to ingress of AIPs.

The ecosystem services associated with delineated wetlands in previous assessments, although limited in detail, are similar to those conditions identified during the 2022 assessment. The ecosystem services for the CVB wetlands were determined to be similar in type and significance of each functional aspect. The assimilation ability of the hillslope seeps was determined to be slightly higher than that of the CVB wetlands, predominantly due to the diffuse nature of flows.

The CVB wetlands scored slightly higher (moderate vs low) EIS scores. The main reason for the difference in EIS scores can be explained by the fact that the hillslope seeps aren't nationally protected as part of the NFEPA or NBA wetland data set series. Additionally, the vegetation type is characterised as being endangered, which contributes to the calculated scores.

The REC for HGM 3 A, has been determined to be a class D due to the current PES and the EIS which have been calculated to be "E" and "B" respectively. Improving the health of the wetland past D is considered to be impractical considering the extent of dams within the system. As for HGM 6, it is considered impractical to improve this system past a "C" condition, predominantly due to the unlikelihood of sustainably controlling AIPs within this system. The improvement of HGM 7 too will be unfeasible, considering the existing impedance of infrastructure in these wetland systems.

Hectare Equivalents

The most recent calculations considering the revised ADF layout indicate that the required offsets is at least 126.3 ha and 915.4 ha of wetland and ecosystem conservation targets. The prescribed rehabilitation interventions located within EMU A, B, F and G will ensure a net-gain in wetland functional targets worth 53 ha, whilst achieving a net-gain in ecosystem conservation targets worth 484,9 ha. **Therefore, more offset areas will be required upon the completion of the proposed rehabilitation intervention activities described by** (Digby Wells, 2022) **outside of the already assessed EMU A, B, F and G.**

Various rehabilitation interventions for HGM 3 and 6 inside the ADF Project Area were subsequently recommended, to determine the net-gains achieved within the ADF Project Area. Following the proposed rehabilitation interventions, HGM 3 is expected to improve from E to D (7.5 to 5.5) and HGM 6 is expected to remain moderately modified (C) yet will improve from a score of 3.2 to 2.1. The post-rehabilitation PES ratings correlate perfectly with the REC. **Subsequently, the ecosystem conservation targets are expected to be met upon the completion of recommended interventions, while the functional offset net-gains (ha) will only account for 12,2 hectare equivalents**.

Therefore, there is a shortfall in functional offset targets of 61.1 ha equivalents. It is recommended that additional areas be investigated for potential offsetting. Prime Africa Consultants (2015) mentions various other offset areas within proximity to the affected Klipfonteinspruit. It is recommended that these suggestions be investigated to determine whether access to private property can be gained to ultimately assess potential intervention sites and ultimately implement such interventions.

Specialist Opinion

The impact assessment indicates major impacts on the wetlands during the construction phase due to the complete removal of the wetlands. Even though mitigation and rehabilitation are vital with respect to the conservation of wetland areas, these strategies are deemed to be insufficient as the wetlands will completely be lost. Therefore, wetland offsets will be required to compensate for the direct and, to a lesser extent, the indirect loss of wetlands. Wetland offset net-gains calculated in previous assessments, as well as those considered for HGM 3 and 6 in this assessment still indicate a short fall of 61,1 ha of functional offset targets. It is therefore recommended that the proposed activities only proceed once alternative offset areas are investigated and deemed to be sufficient in achieving the excess net-gains of 61,1 ha of functional offset targets.

It is the specialist's opinion that if all the recommendations made within this report, including the investigation of alternative offset areas, be met, the proposed activities should proceed as planned.

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Appendix A: Methodology

Literature Review and Desktop Assessment

Relevant literature was reviewed with respect to the historical wetlands associated with the Project Area, habitats and vegetation types as well as the wetland state prior to development. This was completed to obtain relevant information on the wetland ecology of the Project Area and its vicinity to acquire enough information to compile a Wetland Environmental Impact Assessment Report.

Baseline and background information was researched and used to understand the area on a desktop level. This included but was not limited to:

- WET-RoadMap: A Guide to the Wetland Management Series (WRC, 2007);
- Wetland Delineation and Impacts Assessment Report (Wetland Consulting Services (Pty) Ltd, 2014);
- Mpumalanga Biodiversity Sector Plan (MTPA, 2014);
- Wetland Offset Strategy (Prime Africa Consultants, 2015);
- Wetland Management and Rehabilitation Plan (Wetland Consulting Services (Pty) Ltd, 2015);
- Wetland Offsets: A Best Practice Guideline for South Africa (SANBI and DWS, 2016);
- Kusile Wetland Offset Planning Report (Prime Africa Consultants, 2017);
- Kusile Wetland Offset Rehabilitation Design Report (Prime Africa Consultants, 2017a); and
- Environmental Management Programme: Rehabilitation of Wetlands Identified in the Kusile Wetland Offset Plan (Prime Africa Consultants, 2018).

National Freshwater Ecosystem Priority Areas

The NFEPA Project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel, et al., 2011). The spatial layers (FEPAs) include the nationally delineated wetland areas that are classified into Hydro-geomorphic (HGM) units and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetlands.

The NFEPA Project represents a multi-partner Project between the CSIR, SANBI, WRC, DWS, DEA, WWF, SAIAB and SANParks. The NFEPA Project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel, et al., 2011).

More specifically, the NFEPA Project aims to:

1. Identify FEPAs to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity within the context of equitable social and economic development. The second aim is comprised of two separate components: the (i) national component aimed to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems, while the (ii) subnational component is aimed to use three case studies to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes. The Project further aimed to maximize synergies and alignment with other national level initiatives, including the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation (Driver, et al., 2011).

Based on a desktop-based modelled wetland condition and a combination of special features, including expert knowledge (e.g. intact peat wetlands, presence of rare plants and animals, etc.) and available spatial data on the occurrence of threatened frogs and wetland-dependent birds, each of the wetlands within the inventory was ranked in terms of their biodiversity importance and as such, Wetland FEPAs were identified to achieve biodiversity targets (Driver, et al., 2011). Table 1 below indicates the criteria that were considered for the ranking of each of these wetland areas. Whilst being a valuable tool, it is important to note that the FEPAs were delineated and studied at a desktop and relatively low-resolution level. Thus, the wetlands delineated via the desktop delineations and ground-truthing work done through this study may differ from the NFEPA data layers. The NFEPA assessment does, however, hold significance from a national perspective.

Table 1: NFEPA Wetland Classification Ranking Criteria (Nel et al., 2011)

Criteria	Rank
Wetlands that intersect with a Ramsar site.	1
• Wetlands within 500 m of an International Union for Conservation of Nature (IUCN) threatened frog point locality; • Wetlands within 500 m of a threatened water-bird point locality; • Wetlands (excluding dams) with most of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; • Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and • Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment were identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by SANBI, the DEA, the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum (2013). The purpose of the guideline was to provide the mining sector with a manual to integrate biodiversity into the planning process thereby encouraging informed decision-making around mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning process. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining Project. The country has been mapped into biodiversity priority areas including the four categories each with associated risks and implications (Department of Environmental Affairs, et al., 2013) (Table 2).

Table 2: Mining and Biodiversity Guideline Categories (DEA et al., 2013)

Category	Risk and Implications for Mining
Legally Protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: the EIA process must confirm significance of the biodiversity features that may be a fatal flaw to the proposed Project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision-making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

Mpumalanga Biodiversity Sector Plan (MBSP)

The MBSP is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for national legislation and policy. The MBSP was published in 2014 by the Mpumalanga Tourism and Parks Agency (MTPA) and comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines for use in land-use and development planning, environmental assessment and regulation, and natural resource management (MTPA, 2014). Strategically the MBSP enables the province to:

- Implement the NEM:BA, 2004 provincially, and comply with requirements of the National Biodiversity Framework, 2009 (NBF) and certain international conventions;

- Identify those areas of highest biodiversity that need to be considered in provincial planning initiatives; and
- Address threat of climate change (ecosystem-based adaptation).

The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) or Other Natural Areas (ONAs) (Table 3).

Wetlands in Mpumalanga Province have been extensively degraded and, in many cases, irreversibly modified and lost through a combination of inappropriate land-use practices, development, agriculture and mining. Wetlands represent ecosystems of high value for delivering, managing and storing good water quality for anthropological and animal use yet they are vulnerable to undesirable impacts. It is therefore in the interest of national water security that all wetlands are protected by law.

Table 3: Mpumalanga Biodiversity Sector Plan Categories

Map Category	Definition	Desired Management Objectives
PA	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazette protected environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes. CBA Wetlands are those that have been identified as FEPA wetlands that are important for meeting biodiversity targets for freshwater ecosystems.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESAs	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services. ESAs Wetlands are those that are non-FEPA and ESA Wetland Clusters are clusters of wetlands embedded within a largely natural landscape that function as a unit and allow for the migration of species such as frogs and insects between individual wetlands.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorization process that ensures the underlying biodiversity objectives are not compromised.

Map Category	Definition	Desired Management Objectives
ONAs	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritized for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritized for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximize ecological functionality and authorization is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilized and restored where possible, especially for soil carbon and water-related functionality.

National Biodiversity Assessment (NBA)

The National Biodiversity Assessment (NBA) presents the best available science on South Africa's biodiversity (SANBI, 2018). It aims to inform policy, planning and decision making in a range of sectors for the conservation and sustainable use of biodiversity. The NBA 2018 builds on the National Spatial Biodiversity Assessment 2004 and 2011 thus providing a comprehensive picture of South Africa's biodiversity threat status and protection level over time (SANBI, 2018).

The NBA has four indicators, providing information on the threat status and protection level of ecosystems and species. The threat status indicators use the established IUCN Red List of Species and Red List of Ecosystems assessment frameworks. The risk of extinction (species) or collapse (ecosystems) is evaluated across all realms and for taxonomic groups for which sufficient data exists. The protection level indicators reflect how well our species and ecosystem types are represented in the protected area network (SANBI, 2018).

Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane et al. (2009; 2020), the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A Level 1b WET-Health assessment was done on the wetlands in accordance with the method described by Macfarlane et al., (Macfarlane, et al., 2009) to determine the integrity (health) of the characterised HGM units for the wetlands associated with the Project Area. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the associated wetlands. The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions. The overall health score of the wetland was then calculated.

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 above.

The overall approach is to quantify the impacts on wetland health and then to convert the impact scores to a PES 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 PES categories are provided in Table 4 (Macfarlane, et al., 2009; Macfarlane, et al., 2020).

Table 4: Impact Scores and Present Ecological State Categories (WET-Health; Macfarlane et al., 2009)

Impact Category	Description	Combined Impact Score	PES 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 has 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 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 recognizable.	6-7.9	E
Critical	Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

As is the case with the PES, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit, 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 5) (Macfarlane, et al., 2009).

Table 5: 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	↓↓

Once all HGM units have been assessed, a summary of health for the wetland 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, vegetation and water quality components provide a summary of impacts, PES, Trajectory of Change and Health for individual HGM units and for the entire wetland.

Wetland Ecological Services (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 (Department of Water Affairs and Forestry, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze et al. (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

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

The characteristics were used to quantitatively determine the value and, by extension, sensitivity of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland (Table 6).

Table 6: Classes for Determining the Likely Extent to Which a Benefit is Being Supplied

Score	Rating of the Likely Extent to Which the Benefit is Being Supplied
<0.5	Low
0.6-1.2	Moderately Low
1.3-2	Intermediate
2.1-3	Moderately High
>3	High

Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. 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. The methodology outlined by DWAF (1999) and updated in Kotze and Rountree (Kotze, et al., 2012; Rountree, et al., 2013), was used for this study.

In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity:** incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance:** which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- **Importance in Terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland system, as defined in Table 7.

Table 7: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median
<u>Very High</u> Systems that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is	>3 and <=4

usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	
High Systems that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate Systems that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/Marginal Systems that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

Wetland Offset Strategy

Wetland Offset Calculator

The SANBI, in collaboration with the DWS, Wetland Offset: Best Practice Guideline for South Africa Calculator was used to determine the value of required wetlands to be offset by calculating the total hectare equivalent of wetlands lost and impacted upon due to the Project activities (SANBI and DWS, 2016). The guideline was produced to provide guidance on wetland offsetting, with particular reference to loss of wetlands due to the Project-related activities. The guideline for wetland offsets in South Africa defines 'biodiversity offsets' as "measurable conservation outcomes resulting from actions to compensate for residual negative impacts on biodiversity". The calculator consists of three target components, namely: wetland functionality target, ecosystem conservation target and species conservation target. The following list outlines the goals proposed in SANBI's guideline:

- The formal protection of wetland systems that are in good ecological condition; to meet national conservation targets for the representation and persistence of wetlands and wetland vegetation types;
- A no-net-loss approach in the overall wetland functional area by ensuring that there is a gain in wetland area and/or condition equal to or greater than the losses due to residual impacts;
- Providing appropriate and adequate compensation for residual impacts on key ecosystem services by:
  - Directing offset activities that will improve key regulating and supporting services towards those wetlands where these specific services can best be enhanced;

- Providing substitute services for the communities affected by the residual impacts of development; such that these communities are at least as well-off after development as they were prior to development taking place; and
- Adequately compensating for residual impacts on threatened or otherwise important (e.g. wetland-dependent) biota through appropriate offset activities that support and improve the survival and persistence of these species.

Hectare Equivalents

To allow for the quantification of a suitable offset, it is important to establish a common unit or currency that will allow residual losses (due to the proposed impacts) and gains (due to the proposed offset) to be consistently measured and compared. This is central to the concept of offsets, and the 'no-net-loss' approach. In the past, the area of wetland residually affected (as measured in hectares, for example) was a commonly used currency and is still used in many instances. The wetland hectare equivalent concept, however, uses a more refined currency that better incorporates a measure of ecological function, quality and/or integrity. The basic hectare equivalents of intact wetlands are a combination of extent of the wetland impacted, and the change in condition or functionality. They are used as a surrogate for measuring residual loss and have been adopted here as the primary currency for evaluating impacts of proposed development on wetland ecosystems (Crowden & Kotze, 2009).

Wetland hectare equivalents are determined using three wetland calculators as represented in Figure 1. For this study, the hectare equivalents for the wetland functionality and ecosystem conservation targets were calculated; with focus on restoring functionality. Since no Red Data species were recorded for the impacted wetland, the species conservation targets calculated was not deemed as necessary. The impacted wetland was largely transformed prior to development due to cultivation/agriculture of almost all of the area.

Figure 2 represents a schematic illustration of a hypothetical scenario. Each circle represents a wetland area of the same size in hectares (e.g. 5 ha). The size of each circle is indicative of the hectare equivalent for each wetland. Wetland 1 and 2 for instance, may cover equal areas in hectares but their hectare equivalents differ due to a difference in ecological condition, sensitivity and importance.

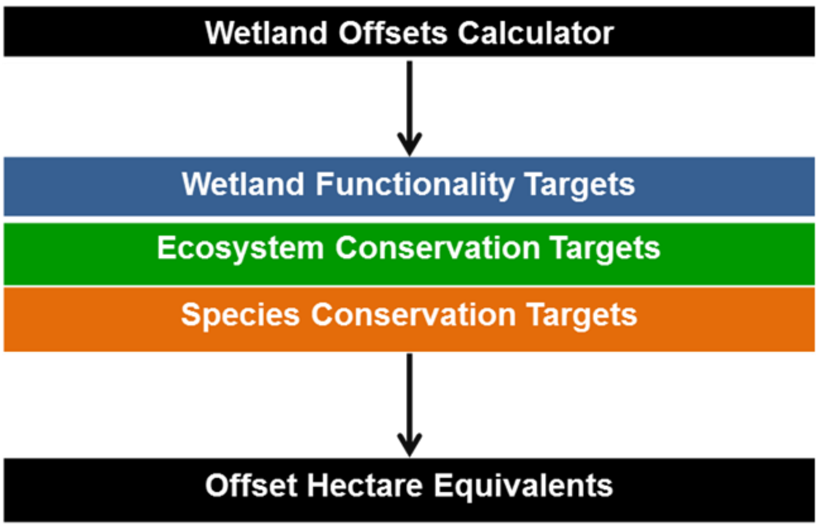

Figure 1: Wetland Calculator Components

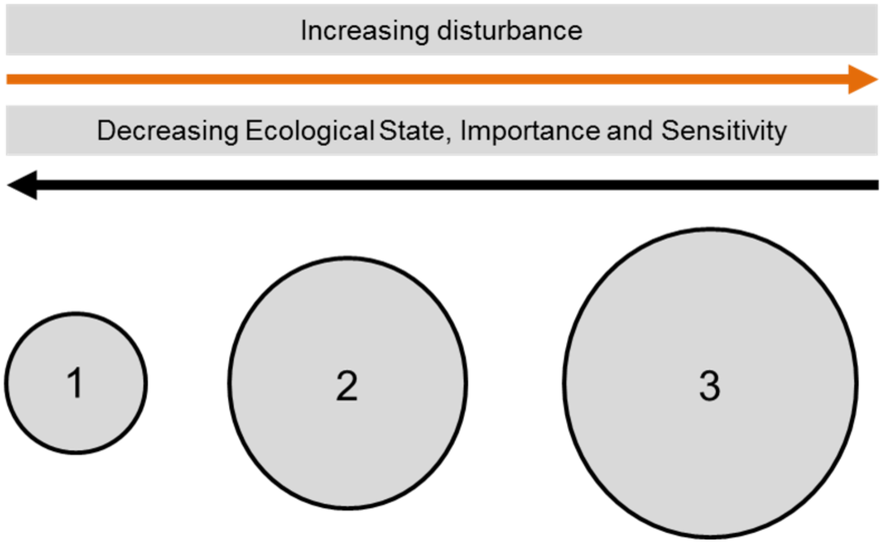

Figure 2: Schematic Illustration of Hectare Equivalents

Impact Assessment

The wetland impacts were assessed based on the impact's magnitude as well as the receiving environment's sensitivity, resulting in an impact significance rating which identified the most important impacts that require management. Based on international guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to wetlands:

- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

Significance Rating

Impacts and risks have been identified based on the description of the activities to be undertaken. Once the impacts were identified, a numerical environmental significance rating process was undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a specific environmental impact.

The severity of an impact was determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact was then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures were incorporated into the EMP. Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below. The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probibility x Nature

- Consequence = Intensity + Extent + Durantion
- Probability = Likelihood of an impact occuring
- Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts.

The matrix calculated the rating out of 147, whereby intensity, extent, duration and probability were each rated out of seven as indicated in Table 10. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

Parameter Rating

Impacts are rated prior to mitigation and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined and categorised into one of seven categories, as indicated in Table 9, which is extracted from Table 10. The description of the significance ratings is discussed in Table 11.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Mitigation Hierarchy

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, et al., 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is represented in Table 8.

Table 8: Mitigation Hierarchy

	Avoid or Prevent	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the other steps in the mitigation.
	Minimize	Refers to considering alternatives in the Project location, sitting, scale, layout, technology and phasing that would minimize impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimize impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable, and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Rehabilitation can, however, fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimize and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 9: Impact Assessment Parameter Ratings

Rating	Intensity/Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	**Irreplaceable loss** or damage to biological or physical resources or **highly sensitive** environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the Project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	**Irreplaceable loss** or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond Project Life: The impact will remain for some time after the life of the Project and is potentially irreversible even with management.	Almost Certain/Highly Probable: It is most likely that the impact will occur. > 65 but < 80% probability.
5	**Serious loss** and/or damage to physical or biological resources or **highly sensitive** environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/Region Will affect the entire province or region.	Project Life (> 15 years): The impact will cease after the operational life span of the Project and can be reversed with sufficient management.	Likely: The impact may occur. < 65% probability.
4	**Serious loss** and/or damage to physical or biological resources or **moderately sensitive** environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long Term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. < 50% probability.
3	**Moderate loss** and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediate surrounding area.	Medium Term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur. < 25% probability.
2	**Minor loss and/or effects** to biological or physical resources or **low sensitive** environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short Term: Less than 1 year and is reversible.	Rare/Improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. < 10% probability.
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and/or social benefits felt by a very small percentage of the baseline.	Very Limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly Unlikely/None: Expected never to happen. < 1% probability.

Table 10: Probability/Consequence Matrix

Probability	Significance																																				
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Consequence																																				

Table 11: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and/or social environment.	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and/or social environment.	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and/or social environment.	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and/or social environment.	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the Project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)