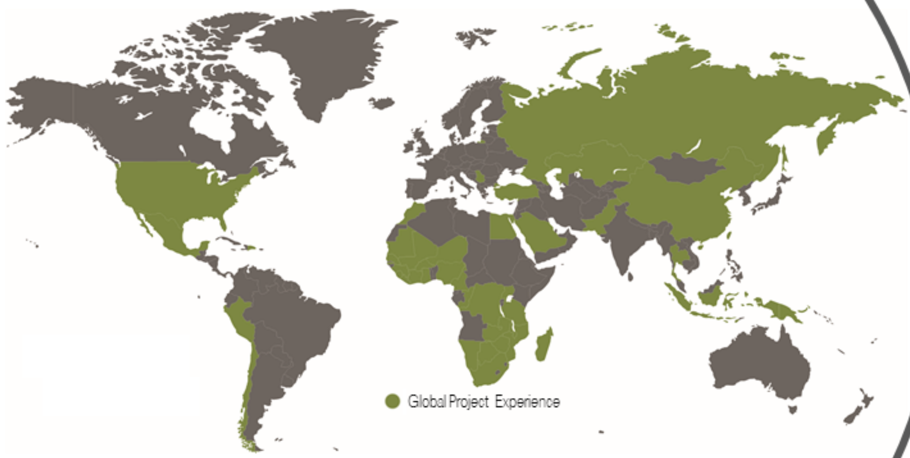

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Environmental Authorisation Process for the Expansion of the Copper Sunset Mining Right Area

Wetland Environmental Impact Assessment

Prepared for:	**Project Number:**
Copper Sunset Sands (Pty) Ltd	COP6679
	May 2021

Digby Wells and Associates (South Africa) (Pty) Ltd
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This document has been prepared by Digby Wells Environmental.

Report Type:	Wetland Environmental Impact Assessment
Project Name:	Environmental Authorisation Process for the Expansion of the Copper Sunset Mining Right Area
Project Code:	COP6679

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Kathryn Terblanche	Report Writer and Technical Review		February 2021
Danie Otto	Technical Review		February 2021

DETAILS AND DECLARATION OF THE SPECIALIST

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Title/ Position:	Soil Scientist and Wetland Specialist
Qualification(s):	B.Sc. Honours Soil Science
Experience (years):	5
Registration(s):	SACNASP: 117870

I, Willnerie Janse van Rensburg, 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.

February 2021

Signature of the Specialist *Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Digby Wells Environmental (Digby Wells) has been appointed by Copper Sunset (Pty) Ltd (Copper Sunset) as the independent Environmental Assessment Practitioner (EAP) to conduct the required environmental authorisation process to expand their existing and approved Mining Right (MR) for the mining of sand over the proposed areas.

The wetlands cover **1638.733 hectare (ha)** which amounts to **58.62 %** of the total **2795.7 ha** Mining Right Extension Area (MREA). The wetlands associated with the MREA was desktop delineated and confirmed during a rapid site survey. The wetlands associated with the MREA were categorised into six (6) Hydrogeomorphic (HGM) units namely:

- Channelled Valley Bottom (CVB) and hillslope seep wetland (east);
- CVB (west);
- Floodplain (east);
- Floodplain and associated Valley Bottoms (VBs) (west);
- Seep (east); and
- Valley head seep and CVB (west).

The HGM units were considered to have an ecological state ranging between **'Moderately Modified'** (Present Ecological State (PES) **C**) and **'Highly Modified' (**PES **E).** The land use of the area directly impacts the PES of each HGM unit. The dominant land use of the area is mining and agropastoral activities, including large areas of cultivation and natural grassland for grazing. The wetlands have been altered from their natural state as the area has been largely transformed.

The CVB (west) and Floodplain and associated VBs (west) has been determined to be of **High** ecological importance, whereas the rest of the HGM units measured as **Moderate High Importance**. The **moderately high important** ecological services identified for the CVB and seep (east), Floodplain (east), Seep (east), Valley head seep and CVB (west) pertain largely to water quality enhancement services, such as sediment and phosphate trapping, streamflow regulation, nitrate removal and carbon storage as well as water supply for human use and natural resources. This is to be expected owing to the diffuse nature of flow in such wetland units.

The Floodplain and associated VBs (west) were measured as **Very High** due to its Ecological Importance & Sensitivity, whereas the Floodplain (east), Valley head seep and CVB (west) and CVB (west) are of **High** importance. The CVB and seep (east) and Seep (east) were of **Moderate** importance given the impacts to the HGM units as well as the low hydrological functioning thereof.

The land uses within and surrounding the MREA have contributed to losses of wetland areas and continued impacts on the remaining areas. Land uses such as the alteration of vegetation due to cultivation and cattle grazing, overgrazing, contamination of water resources as a result of industrial process and increased surface inflows, have all contributed to the physical impacts on the wetlands and freshwater systems.

The mining activities within the catchment have led to losses in wetland areas that may have facilitated increased water flow and also have increased the number of pollutants flowing into the water resources. The alteration of vegetation and surface flow has led to the onset of erosion in the wetland areas, and this may be perpetuated further by mining and related activities within the MREA.

Mining and associated activities impacting the wetlands include changes to the hydrological, geomorphological, and natural vegetation of the wetlands. Impacts include:

- Direct loss of wetland areas;
- Loss of biodiversity;
- Erosions and sedimentation of wetland areas;
- Fragmentation of wetland areas;
- Accidental spills causing soil and water contamination;
- Habitat loss as a result of poor water quality;
- Siltation of wetlands due to erosion; and
- Change in habitat and potential change in species composition.

The loss of wetlands in the proposed excavation areas that cannot be mitigated or reduced, has been recommended to implement a Wetland Offset strategy. A ‘no-go’ zone is recommended for the rehabilitated wetlands and mined out areas to aid in the re-establishment of wetland functions and vegetation and also to make provision for rehabilitation results.

The overall impacts of the project were determined to be significant and may potentially lead to irreversible damage to wetland areas. The loss of wetland areas leads to altered ecosystem functioning and the loss of biodiversity. The recommended mitigation measures will not restore wetland areas that are lost as a result of the Project; however, will be to rehabilitate and preserve un-impacted wetlands and improve their functioning. A Wetland Offset Calculator should be applied to determine the total wetland loss and to compensate for significant residual adverse impacts.

It is advised that one wetland is targeted for wetland offsetting and protected against any mining activities that will be used to compensate for other wetlands that will be mined. It is recommended to target a section of the Floodplain and associated VBs (west) for wetland offsetting. However, it is highly advised to first calculate the wetland hectare equivalent to determine the area to be offset.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degree Celsius
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
CVB	Channelled Valley Bottom
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation, previously Department of Water Affairs and Forestry (DWAF)
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EMPr	Environmental Management Program
EP	Environmental Practitioner
ESA	Ecological Support Area
FEPA	Freshwater Ecological Priority Area
h	Hectare
HGM	Hydro-geomorphic
I&APs	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
km	Kilometre
L	Litre
LoM	Life of Mine

m	Metre
m.a.m.s.l.	Metres above mean sea level
MAP	Mean Annual Precipitation
mm	Millimetre
MM	Mine Manager
MR	Mining Right
MRA	Mining Right Area
MREA	Mining Right Extension Area
NBA	National Biodiversity Assessment
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
PES	Present Ecological State
PPP	Public Participation Process
RE	Remaining Extent
S&EIR	Scoping and Environmental Impact Reporting
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SEP	Stakeholder Engagement Process
SFI	Soil Form Indicator
STP	Sewage Treatment Plant
SWI	Soil Wetness Indicator
SWMP	Storm Water Management Plan
TUI	Terrain Unit Indicator
UCVB	Un-channelled Valley Bottom
WET-EcoServices	Wetland Ecological Services

WET-Health	Wetland Ecological Health Assessment
WMA	Water Management Areas
WRC	Water Research Commission
WUL	Water Use License
WWF	Worldwide Fund for Nature

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section ii and iii Section ii and iii
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section iii
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
cA	And indication of the quality and age of the base data used for the specialist report;	Section 5
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 5 and 16
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	Section 7
(g)	an identification of any areas to be avoided, including buffers;	Section 9
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 7.2
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
(k)	any mitigation measures for inclusion in the Environmental Management Programme (EMPr);	Section 9
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 12
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 10
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 13

Legal Requirement		Section in Report
	whether the proposed activity, activities or portions thereof should be authorised; and	Section 13
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 12 and 13
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 11
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 11
(q)	any other information requested by the competent authority.	None

1. Introduction

Copper Sunset (Pty) Ltd (Copper Sunset) has an approved Mining Right (MR) (DMRE Ref. No. FS30/5/1/1/2/164 MR) and Environmental Management Programme (EMPr), in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), for the mining of sand on several properties in Viljoensdrift in the Free State Province. The Mining Right was approved in 2008 and amended in 2011, 2016 and 2017 to incorporate additional areas into the Mining Right Area (MRA).

Copper Sunset now intends to expand its MRA to incorporate adjacent properties to extend the Life of Mine (LoM). The intent is to expand the current mining operations to include additional portions of the Remaining Extent (RE) of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Zandfontein No. 259. The proposed extension of the MRA amounts to approximately 1642 ha (Bankfontein) and 1153.6 ha (Zandfontein), for the mining of sand. The MREA triggers activities incorporated in Listing Notice 1 and Listing Notice 2 of the Environmental Impact Assessment (EIA) Regulations, 2014 (Government Notice Regulations GN R R982 of 04 December 2014 as amended), promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

Copper Sunset appointed Digby Wells Environmental (Digby Wells) as the independent Environmental Assessment Practitioner (EAP) to conduct the required environmental authorisation process to expand their existing and approved MR for the mining of sand over the proposed areas.

The EIA process includes a specialist Wetland Impact Assessment in compliance with Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996). This document comprises the specialist Wetland Impact Assessment report in support of the EIA and Integrated Water Use Licence (IWUL) process.

1.1. Terms of Reference

Copper Sunset appointed Digby Wells as the Independent (EAP) to complete the following processes in support of the Project:

- A Section 102 amendment application process as per the MPRDA to amend the MR boundary;
- A Scoping and EIA Process to authorise the new Listed Activities as per the NEMA;
- An Integrated Water Use Licence Application (IWULA) process in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) to mine the wetland areas found within the expansion area; and
- A Regulation 31 amendment process to consolidate the Environmental Authorisations (EAs) and EMPrs into one consolidated report as per the NEMA.

1.2. Scope of Work

The Scope of Work for the Wetland Impact Assessment comprised:

- **Desktop Assessment:** Review of historical reports, catchment data, regional background information and identifying additional freshwater resources within the Project Area. A desktop wetland delineation was carried out prior to the field assessment;
- **Wetland Delineation Verification:** Identification and characterisation of wetlands and buffer zones within the Project Area during a site visit;
- **Wetland Health Assessment:** Assess the Present Ecological State (PES), wetland service provision (ES), and Ecological Importance and Sensitivity (EIS) of the identified wetlands within the Project Area;
- **Sensitivity Mapping:** Provide recommendations on buffer zones according to the guidelines set out in the 'Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries' (Macfarlane, et al., 2014);
- **Impact Assessment:** Assess the proposed activities and impacts thereof on the wetlands based on the findings of the desktop and field assessments; and
- **Mitigation and Management Plan:** Provide recommendations to develop a wetland rehabilitation and management plan for the LoM.

1.3. 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 and Technical Services at Digby Wells. He holds a Master of Science (MSc) in Environmental Management with Bachelor of Science Honours (B.Sc. Hons) in 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 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.
- **Kathryn Terblanche** is the Rehabilitation and Soils Manager at Digby Wells. She received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She also has received her MSc in Restoration Ecology through the University of KwaZulu-Natal.

Kathryn is an ecologist with fields of interest in wetlands, flora, restoration and rehabilitation. In her 7-year career she has undertaken various wetland delineations and assessments, flora assessments, rehabilitation assessments and audits, as well as project management of various implementation projects. Kathryn is also involved with both wetland and rehabilitation monitoring programmes. She has also worked extensively with alien invasive species removal programmes, ecological restoration projects and sustainable development programmes within the Government Sector.

She has published a variety of environmental documents/articles and presented at various South African and international conferences.

- **Willnerie Janse van Rensburg** is a Soil Scientist and Wetland Specialist in the Rehabilitation, Closure and Soils department at Digby Wells. 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 five years' 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, Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.
- **Aamirah Dramat** is an Assistant 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.

2. Project Description and Background

Copper Sunset currently holds the following EAs and EMPrs, which are applicable to the MR boundary:

- The original EMPr associated with the application for a MR on the Farm Bankfontein No. 1849, approved in 2008 (DMRE Ref. No. FS30/5/1/1/2/164 MR dated 28/04/2009);
- The 2011 EA and EMPr associated with the construction of a washing plant, a Return Water Dam (RWD), a settling dam and brick building (DMRE Ref. No. FS30/5/1/2/3/2/1 (164) EM dated 19/09/2011);

- The 2015 and 2016 EA and EMPr associated with the incorporation of additional areas into the MRA (DMRE Ref. No. FS30/5/1/2/3/2/1 (164) EM dated 08/03/2016 and 20/12/2016); and
- The 2017 EMPr associated with incorporation of additional areas into the MR (DMRE Ref. No. FS30/5/1/2/2 (164) MR dated 30/05/2018).

Copper Sunset began sand mining in 2009. The present LoM is approximately nine months. Copper Sunset intends therefore to extend the MRA to include additional portions of the RE of Portion 9 of the Farm Bankfontein No. 1849 (1 642 ha) and a portion of the RE of the farm Zandfontein No. 259 (1153.6 ha ha). The deposit extends over an area of 2795.7 hectares (ha). The deposit is known to have an average thickness of 1.2 m. Copper Sunset intends to supply a number of clients with building and plaster sand for use mainly in the construction industry.

The current mining rate for Copper Sunset is about 2 000 m^3 per day for all sand products. This is expected to continue, and at this rate the proposed extension area will extend the LoM for Copper Sunset by approximately 20 years.

2.1. Project Location

The Project Area is located within Viljoensdrift, approximately 8 kilometres (km) south of Vereeniging, 10 km south-east from Vanderbijlpark and 13 km north-east from Sasolburg. The project area is located in the Metsimaholo Local Municipality within the Fezile Dabi District Municipality of the Free State Province Refer to Table 2-1, Figure 2-1 and Figure 2-2 for detailed location information.

Table 2-1: Summary of the Copper Sunset Project Location Details

Province	Free State
District Municipality	Fezile Dabi District Municipality
Local Municipality	Metsimaholo Local Municipality
Nearest Town	Vereeniging (8 km), Vanderbijlpark (10 km), Sasolburg (13 km).
Property Name and Number	Bankfontein No. 1849; RE of Zandfontein No. 259; A portion of the RE of Bankfontein No. 9; and A portion of the RE of Rietfontein No. 152.

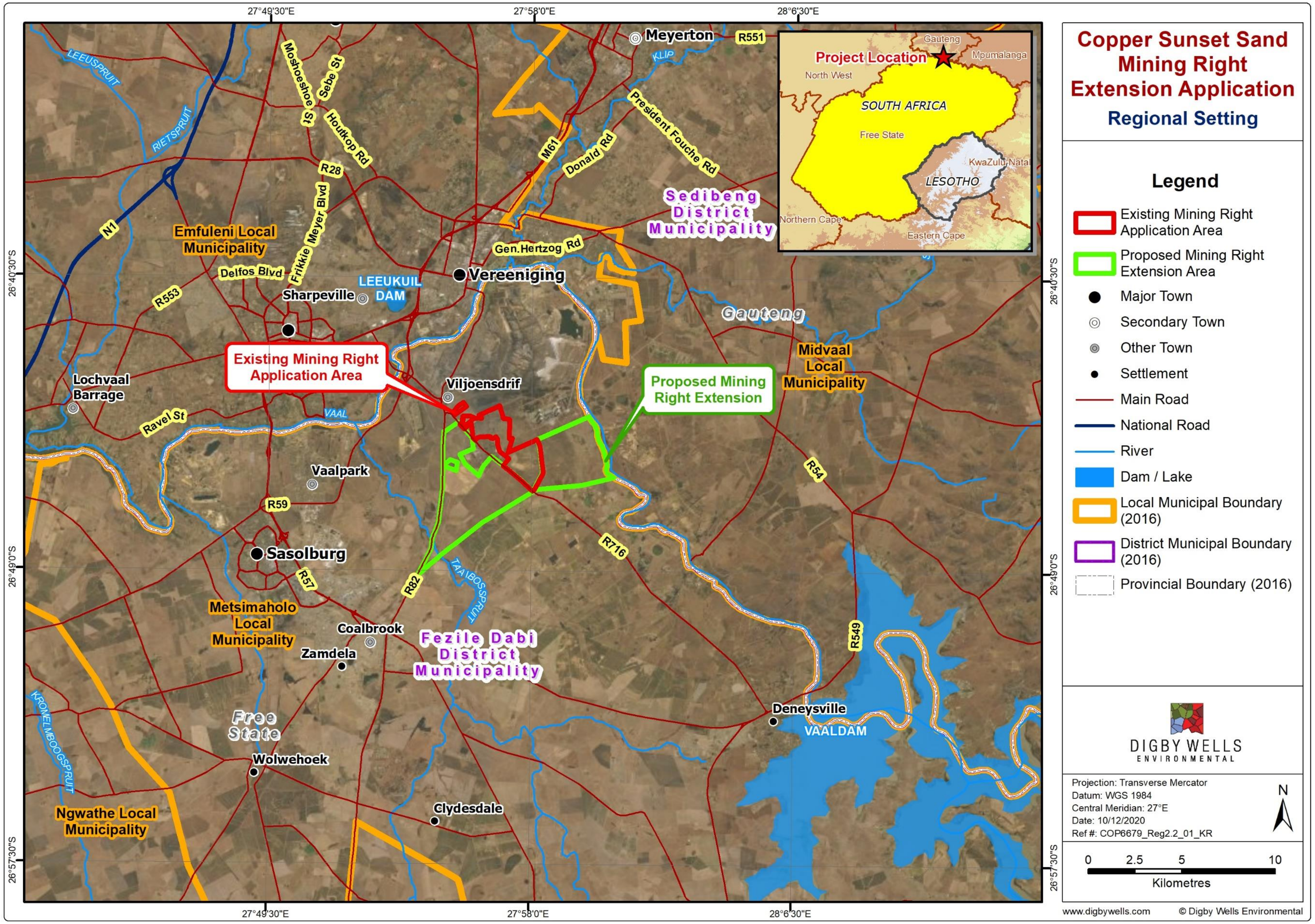


Figure 2-1: Regional Setting

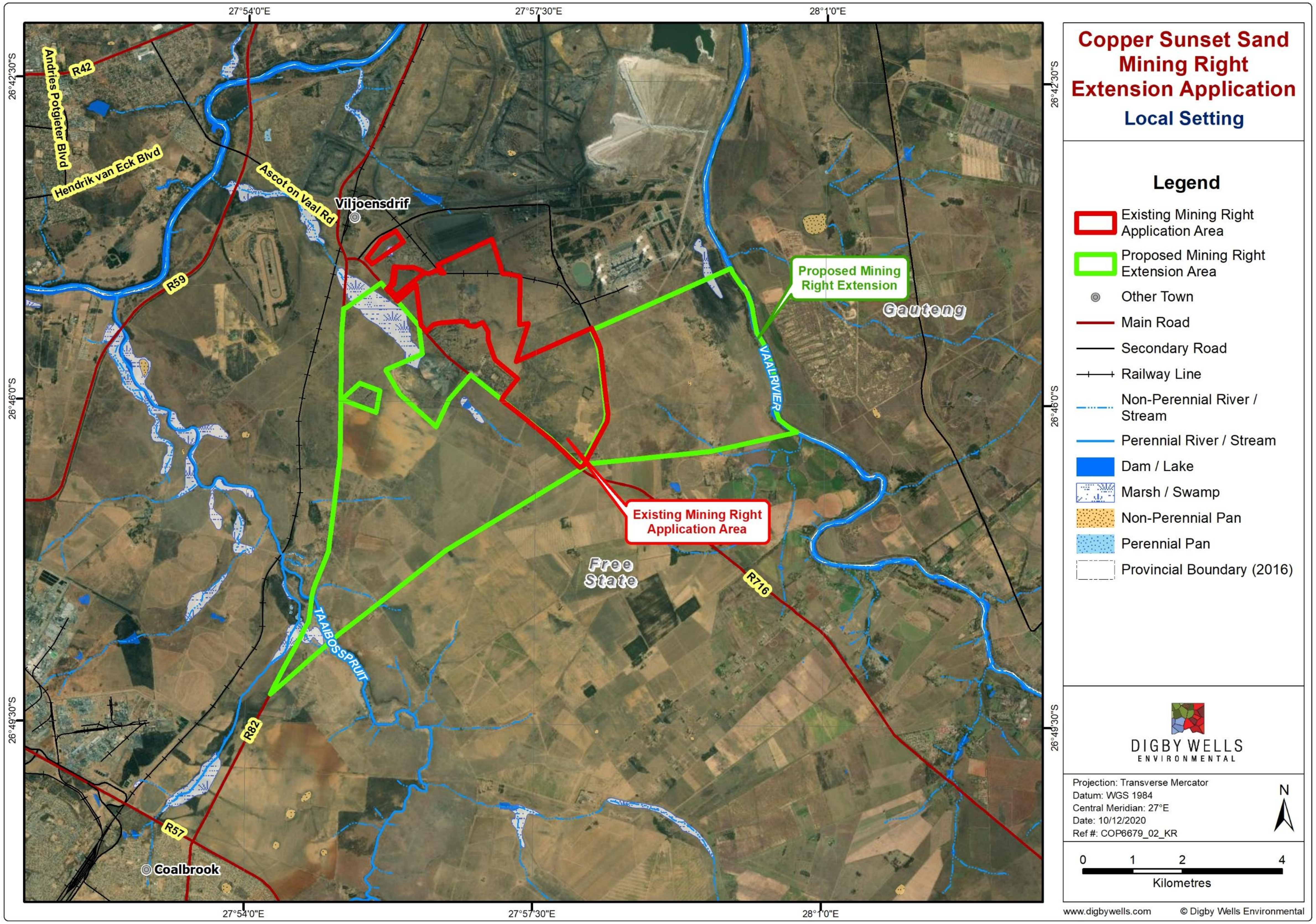


Figure 2-2: Local Setting

2.2. Proposed Infrastructure and Activities

Copper Sunset will utilise the existing mining infrastructure for the proposed expansion areas, with the exception of establishing mobile offices at the entrance to the new mining areas. A total of two new mobile offices, each approximately 1 ha, will be established at the entrance to each mining area. No permanent infrastructure will be constructed for the Project and all machinery will be mobile. In addition to the mobile office infrastructure, these areas will comprise:

- Hydrocarbon storage tank (14,000 litres (ℓ)) with associated bund for refuelling of machinery;
- Waste storage area;
- Parking area for the storage of mobile infrastructure; and
- A generator and solar panels to provide electricity to the offices.

The operation will mine general sand and plaster sand which comprises 90% plaster sand and 10% building sand. Clay will also be mined. The sand deposit lies between 0.4 – 1.5 metres (m) below the surface. The mining method to be applied includes:

- Stripping and stockpiling of topsoil. Strip mining will be utilised to recover the resource, with the sand mined in strips of 30 – 35 m in width and 0.4 – 2 m in depth. The length of the strips is dependent on the area to be mined but approximate lengths are in the region of 180 – 600 m;
- Construction of a temporary haul road (20 m wide and length approximately 6 km). The haul road will move as mining progresses through life of mine;
- Mining of the sand resource including screening;
- Backfilling of the mined excavations with stockpiled topsoil; and
- Concurrent rehabilitation.

Figure 2-1 provides an indication of the area where the offices will be placed as well as the mining area. Table 2-2 presents a summary of the Project-related activities expected within each phase of the Project lifecycle.

Table 2-2: Project Phases and Associated Activities

Project Phase	Project Activities
Establishment Phase	Site Clearance: removal of vegetation and topsoil using a bulldozer and stockpiling topsoil along the mined-out strip.
	Construction of a haul road to gain access to the sand mining area. It is important to note that the haul road will move as mining progresses through life of mine.
	Establishment of the mobile office, which will include portable toilets, a portable diesel bowser, a water bowser, and mobile screening plants. Space will be made available to park mobile equipment when not in use.
	Establishment of the hydrocarbon storage tank and refuelling area.
Operational Phase	Operation of a fleet of tipper trucks, front-end loaders, excavators, water trucks, tractors and bulldozers to recover the resource.
	Operation of two mobile screening plants within the areas disturbed through the mining process. These mobile screens will be used when required, should sand become contaminated with unusable material. The sand will be separated out into separate stockpiles, depending on particle sizes.
	Customer trucks (100 – 200 trucks per day) entering the MRA through the haul road to collect mined-out sand directly from extraction.
Decommissioning Phase	Concurrent rehabilitation: mined-out areas will be backfilled with stockpiled topsoil and waste material from the screening plant.
	Backfilled material will be levelled and contoured to avoid ponding of water.
	The area will be allowed to naturally re-vegetate. Where vegetation is not establishing well, an indigenous seed mix will be utilised to improve vegetation establishment.

The existing infrastructure area at the Bankfontein Farm will continue to be utilised. The refuelling of equipment will take place at the mobile office areas within the expanded mining area. Water will be abstracted from an authorised borehole, located at the existing Copper Sunset MRA. This borehole is authorised by the Department of Water and Sanitation (DWS) under Water Use Licence (WUL) No. 08/C22F/AG/2315 granted 18 September 2013. It is anticipated that water will only be required for potable water and dust suppression on the expansion area. The amount of water used will remain within the limits of the existing license. No mining will take place within a 100 m buffer from the edge of the Vaal River.

2.3. Alternatives Considered

Alternatives to consider ensuring minimal impacts to the wetlands include:

- Minimize the surface infrastructure to be located outside of wetlands and associated 100 m buffer zones and 500 m zones of regulation as described in Section 3;
- Restrict access to remaining wetlands. Avoid establishment and movement in remaining wetlands and the associated zone of regulation;
- Where establishment in wetlands cannot be avoided (e.g., roads), take precautions to prevent soil and water contamination as well as erosion and sedimentation, such as modifying and stabilizing slopes with vegetation;
- Vegetate stockpiles to prevent erosion and sedimentation into the wetlands;
- Minimize the infrastructure footprint and quantity of water utilised for operations; and
- Implement wetland monitoring.

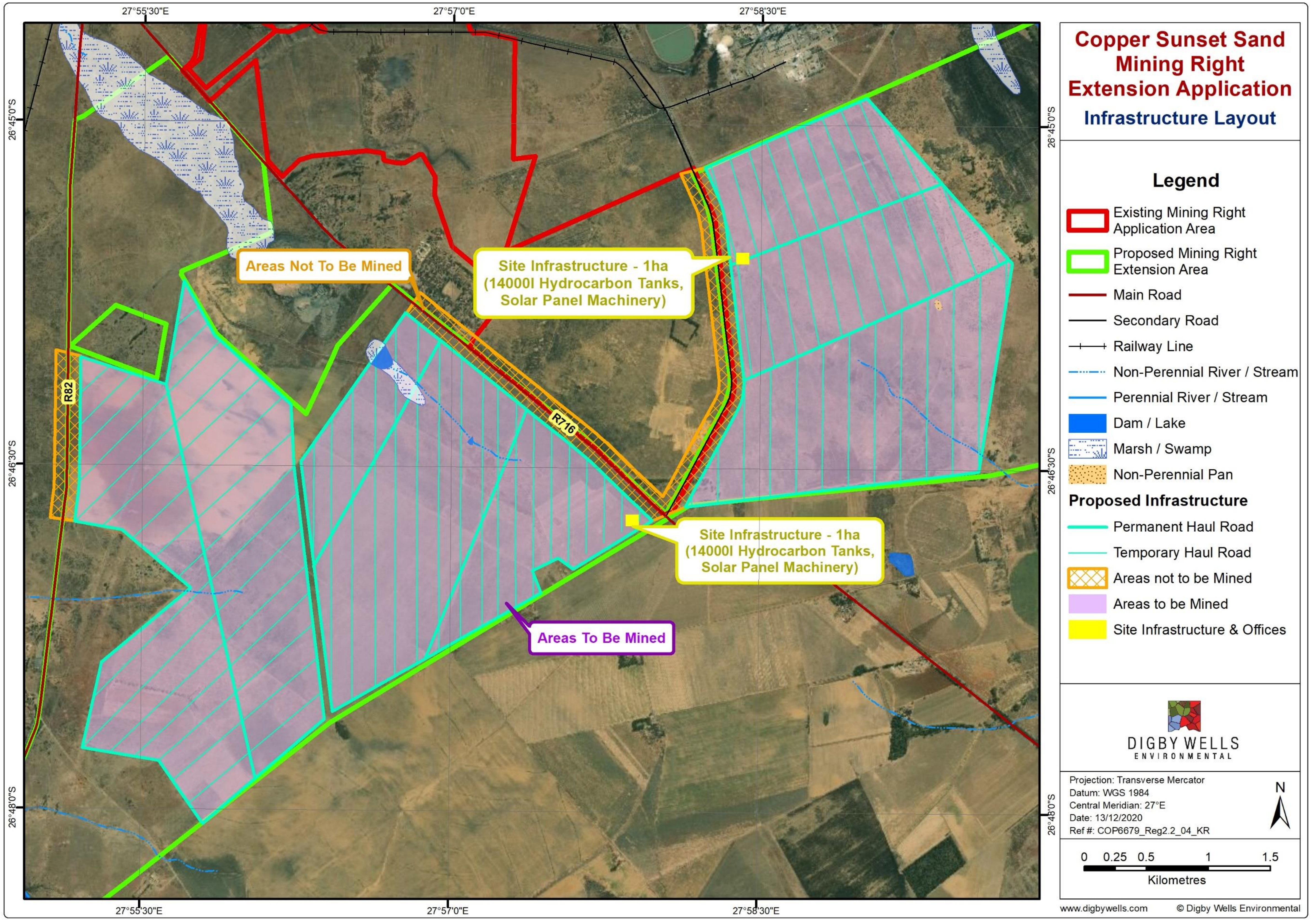


Figure 2-1: Proposed Mine Layout

3. 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 Impact Assessment are detailed in Table 3-1.

Table 3-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996) 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 focus on: • The prevention of pollution and ecological degradation; • Promote conservation and secure ecological sustainability; and • Promote justifiable economic and social development using natural resources.	• Environmental Management Plan (EMP) and Monitoring Program is included in the report; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
The National Water Act, 1998 (Act No. 36 of 1998) (NWA) • Section 19 of the NWA, 1998 (Act 36 of 1998) that include the prevention and remediation of the effects of pollution; and • Section 21 (c), (g) and (i) of the Act 36 of 1998 that include the use of water.	• The application process was undertaken in accordance with the principles of the NWA; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). 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 (1)(a) and (b) of NEMA state 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.	• Activities that will influence the Wetlands of the proposed Project Area are listed in Section 2 and have been identified as Listed Activities and therefore require environmental authorisation before being undertaken.
Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005) To delineate any wetland the following criteria are used as 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 centimetres (cm) of the soil; and • The presence, at least occasionally, of water-loving (hydrophilic) plants (i.e. hydrophytes).	• This guideline was used as a tool for wetland mapping, delineations, health assessment, recognising, digitising, classifying wetlands and identifying human impacts on wetlands.
GN R. 982: Environmental Impact Assessment Regulations, 2014 (as amended) These three listing notices set out a list of identified activities which may not commence without an Environmental Authorisation from the relevant Competent Authority through one of the following processes: • Regulation GN R. 983 (as amended) - Listing Notice 1: This listing notice provides a list of various activities which require environmental authorisation and which must follow a basic assessment process. • Regulation GN R. 984 (as amended) – Listing Notice 2: This listing notice provides a list of various activities which require environmental authorisation and which must follow an environmental impact assessment process. Regulation GN R. 985 (as amended)) – Listing Notice 3: This notice provides a list of various environmental activities which have been identified by provincial governmental bodies which if undertaken within the stipulated provincial boundaries will require environmental authorisation. The basic assessment process will need to be followed.	Refer to the EIA report for a full description of the Listed Activities triggered by the proposed Project. • To comply with the regulations, an EIA process must be completed in support of the EA application. This Wetland Impact Assessment was completed to inform the EIA process to comply with Section 24 of the NEMA.

Legislation, Regulation, Guideline or By-Law	Applicability
Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996) 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 focus on: • The prevention of pollution and ecological degradation; • Promote conservation and secure ecological sustainability; and • Promote justifiable economic and social development using natural resources.	• Environmental Management Plan (EMP) and Monitoring Program is included in the report; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
Wetland Management Series (published by Water Research Commission (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. 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.	• This guideline was used as a tool for wetland health assessment, classifying wetlands and identifying human impacts on wetlands. This tool helped to provide background information about wetlands and natural resource management.
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 a 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'.	• The maps and data provide information regarding protected areas as well as was used as a tool to guide our choices for the strategic development of water resources and to support sustainable development.
General Authorisation in Terms of Section 39 of the National, Water Act, 1998 (Act No. 36 Of 1998). The GA defines a 'regulated area of a water course' for, Section 21(C) Or Section 21(I) of the Act water uses in terms of this notice as: • The outer edge of the 1 in 100-year flood line and /or delineated riparian habitat whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • In the absence of a determined 1 in 100 year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or • A 500 m radius from the delineated boundary (extent) of any wetland or pan. Wetlands are delineations and sensitivity maps include a 500 m "regulated area of a water course', also known as a 500 m 'zone of regulation'	• Wetlands are delineations and sensitivity maps include a 500 m 'regulated area of a water course', also known as a 500 m 'zone of regulation'

4. Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations (Table 4-1).

Table 4-1: Limitations and Assumptions with Resultant Consequences of this Report

Assumptions and Limitations	Consequences
Wetlands situated within the 500 m zone of regulation were assessed mostly on a desktop level with very limited ground-truthing.	Some discrepancies within the zone may occur. However, these systems were scrutinised at a desktop level using aerial imagery and contours and have been demarcated as such for transparency.
The area surveyed was based on the layout presented by Copper Sunset in December 2020.	The study does not include any other information other than Farm Bankfontein No. 1849, the Remaining Extent (RE) of the Farm Zandfontein No. 259, a portion of the RE of the Farm Bankfontein No. 9 and a portion of the RE of the Farm Rietfontein No. 152. The Project Area was focused on the proposed mining areas.
This wetland study forms part of a larger EIA and should be read in conjunction with the EIA and other related specialist studies.	This report does not include any other specialist studies other than the wetland assessment. The wetland report cannot be used as a stand-alone report in the application for an IWUL or EMPr.

5. Methodology

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

The field assessment was carried out on the 21st and 22nd September 2020 and 13th and 15th January 2021.

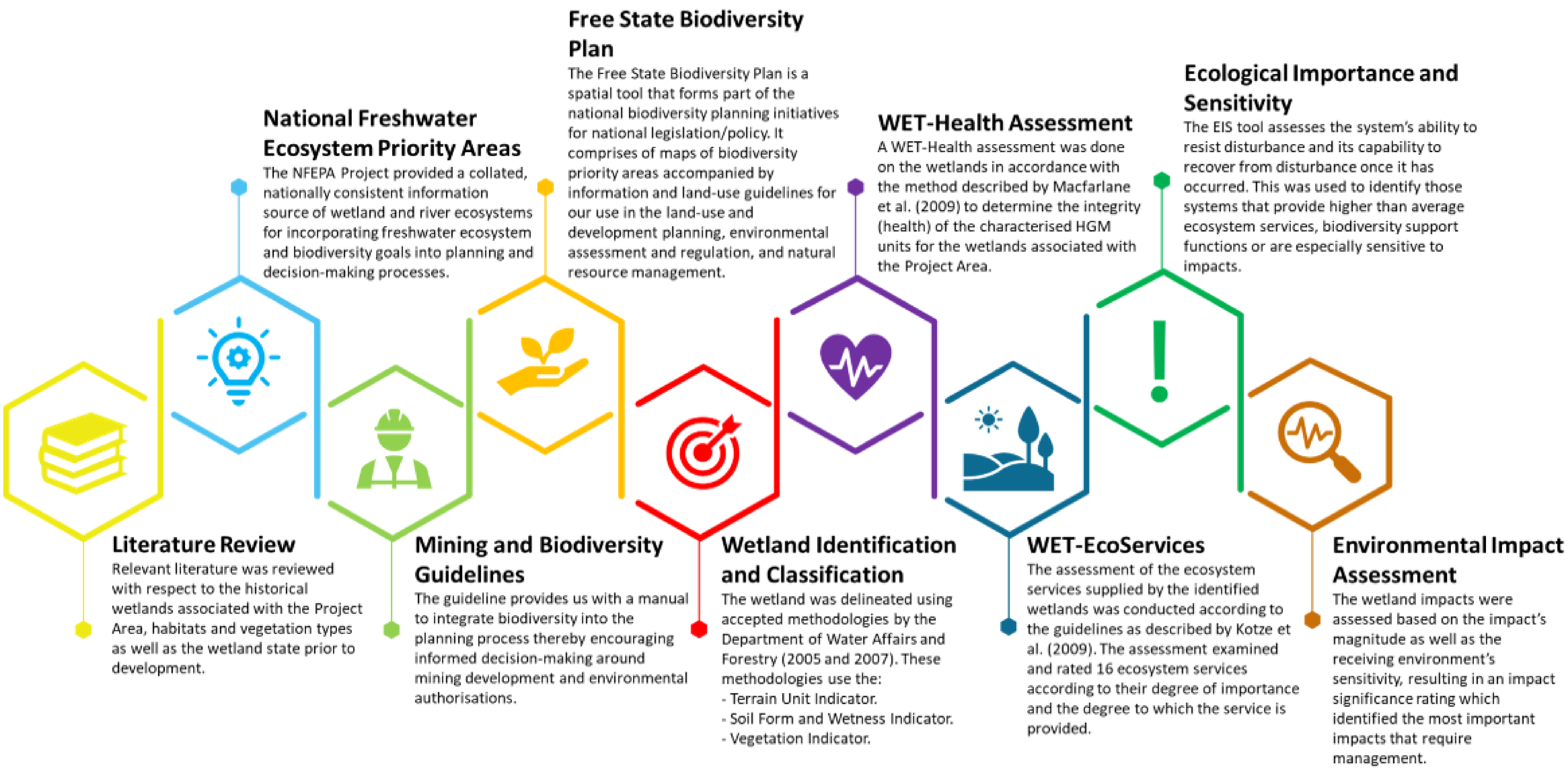


Figure 5-1: Wetland Assessment Methodology

6. Baseline Environment

The baseline environment of the Copper Sunset MREA is described in Table 6-1 below, supported by the subsequent maps.

Table 6-1: Baseline Environment of the Copper Sunset Project Area

Bioregional Context (Darwell W. , Smith, Tweddle, & Skelton, 2009)		**Characteristics of the Highveld Ecoregion** (Kleynhans, Thirion, & Moolman, 2005)		**Plant Species Characteristic of the Central Free State Grasslands** (Mucina & Rutherford, 2012) **(Figure 6-1)**		**Plant Species Characteristic of the Andesite Mountain Bushveld** (Mucina & Rutherford, 2012) **(Figure 6-1)**	
Political Region	Free State	**Terrain Morphology**	Plains; Low Relief; Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief.	**Graminoid Species**	*Agrostis lachnantha, Andropogon appendiculatus, Aristida bipartita, A. canescens, A. adscensionis, A. congesta, Cynodon dactylon, C. transvaalensis, Cymbopogon pospischilii, Digitaria argyrograpta, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. lehmanniana, E. micrantha, E. obtusa, E. plana, E. racemosa, E. trichophora, Heteropogon contortus, Microchloa caffra, Panicum coloratum, Setaria incrassata, S. sphacelata, Sporobolus discosporus, Themeda triandra, Tragus koelerioides.*	**Graminoid Species**	*Cymbopogon pospischilii, Digitaria eriantha subsp. eriantha, Elionurus muticus, Eragrostis racemosa, E. curvula, E. superba, Hyparrhenia hirta, Panicum maximum, Setaria sphacelata, Themeda triandra.*
Level 1 Ecoregion	Highveld	**Vegetation Types**	Mixed Bushveld (limited); Rocky Highveld Grassland; Dry Sandy Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).	**Herb Species**	*Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Crabbea acaulis, Geigeria aspera var. aspera, Hermannia depressa, Hibiscus pusillus, Nidorella pinnata, Pseudognaphalium luteo-album, Salvia stenophylla, Selago densiflora, Sonchus dregeanus.*	**Herb Species**	*Commelina africana, Hilliardiella galpinii, H. oligocephala.* Succulent Herb: *Aloe greatheadii var. davyana.*
Freshwater Ecoregion	Southern Temperate Highveld	**Altitude (m.a.m.s.l.) (modifying)**	1 100-2 100, 2 100-2 300 (very limited)	**Geophytic Herb Species**	*Oxalis depressa, Raphionacme dyeri.*	**Woody Climber Species**	*Rhoicissus tridentata.*
Geomorphic Province	Free State	**Mean Annual Precipitation (MAP) (mm) (Secondary)**	400 to 1 000	**Succulent Herb Species**	*Tripteris aghillana var. integrifolia.*	**Small Tree Species**	*Celtis africana, Protea caffra, Senegalia caffra, S. karroo, Zanthoxylum capense, Ziziphus mucronate.*
Vegetation Type	Free State Grassland and Andesite Mountain Bushveld	**Coefficient of Variation (% MAP)**	<20 to 35	**Low Shrub Species**	*Anthospermum rigidum subsp. pumilum, Felicia muricata, Helichrysum dregeanum, Melolobium candicans, Pentzia globosa.*	**Tall, Low and Soft Shrub Species**	Tall Shrubs: *Asparagus laricinus, Diospyros lycioides subsp. lycioides, Euclea crispa subsp. crispa, Gymnosporia polyacantha, Lippia javanica, Rhamnus prinoides, Searsia pyroides var. pyroides,* Low Shrubs: *Asparagus suaveolens, Searsia rigida var. margaretae, Teucrium trifidum.* Soft Shrubs: *Isoglossa grantii.*

<table>
<tr><td>WMA</td><td>Vaal Major</td><td>Rainfall Seasonality</td><td>Early to late summer</td><td>Status</td><td>Vulnerable.</td><td>Status</td><td>Least Threatened</td></tr>
<tr><td>Sub-WMA</td><td>Upper Vaal</td><td>Mean Annual Temp. (°C)</td><td>12 to 20</td><td colspan="4">Free State Biodiversity Plan (Figure 6-3)</td></tr>
<tr><td>Secondary Catchment</td><td>Vaal</td><td>Mean Daily Summer Temp. (°C): February</td><td>10 to 32</td><td colspan="4" rowspan="2">The western section of the proposed MREA is classified as Degraded Land, ESA1 and ESA2. The eastern section of the MREA is predominantly classified as ESA2, with smaller areas classified as ESA1.</td></tr>
<tr><td>Quaternary Catchment (Figure 6-2)</td><td>C22F, C22G and C22K</td><td>Mean Daily Winter Temp. (°C): July</td><td>-2 to 22</td></tr>
<tr><td>Watercourse</td><td>Vaal River, Klip River, Taaibosspruit, Vaal Dam and Vaal Barrage</td><td>Median Annual Simulated Runoff (mm)</td><td>5 to >250</td><td colspan="4">NFEPA Wetland Classification (Nel, et al., 2011) (Figure 6-5)</td></tr>
<tr><td colspan="4">Mining and Biodiversity Guideline Category, DEA (2013) (Figure 6-4)</td><td>NFEPA Wetlands</td><td colspan="3">The following NFEAP wetlands were identified within the MREA:
• Valley floor, CVB, Rank 5 – Downstream of the MREA;
• Bench, Depression, Rank 6 – Within the western MREA;
• Slope, Seep, Rank 6 – Associated with both the Vaal river and Taaibosspruit;
• Valley floor, CVB, Rank 4 – Associated with the CVB within the western MREA;
• Valley floor, CVB, Rank 6 – Associated with the Vaal river; and
• Valley floor, Floodplain, Rank 6 - Associated with both the Vaal river and Taaibosspruit</td></tr>
<tr><td colspan="4">No areas within the proposed MREA were classified according to the guideline. However, in proximity downstream of the MREA, along the Vaal River and Viljoensdrif,, areas were classified as a Class C - High Biodiversity Importance – High Risk for Mining and Moderate Biodiversity Importance – Moderate Risk for Mining. As well as adjacent of the Vaal River the area is classified as D – moderate biodiversity importance with a moderate risk for mining.</td><td>River FEPA</td><td colspan="3">The entire MREA was defined as a Sub-Quaternary Catchment and did not contain any FEPA river systems.</td></tr>
</table>

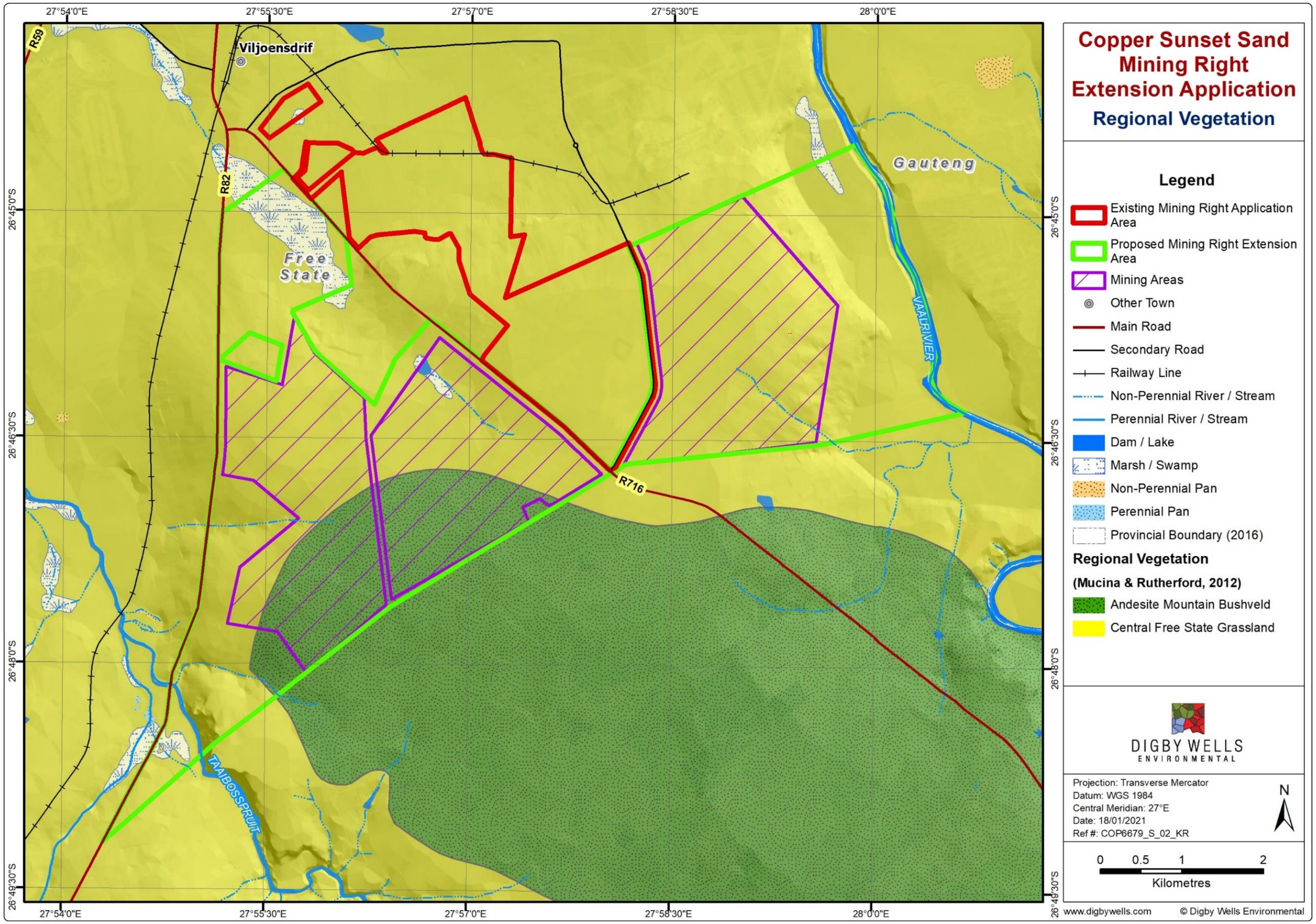


Figure 6-1: Regional Vegetation of the Copper Sunset MREA

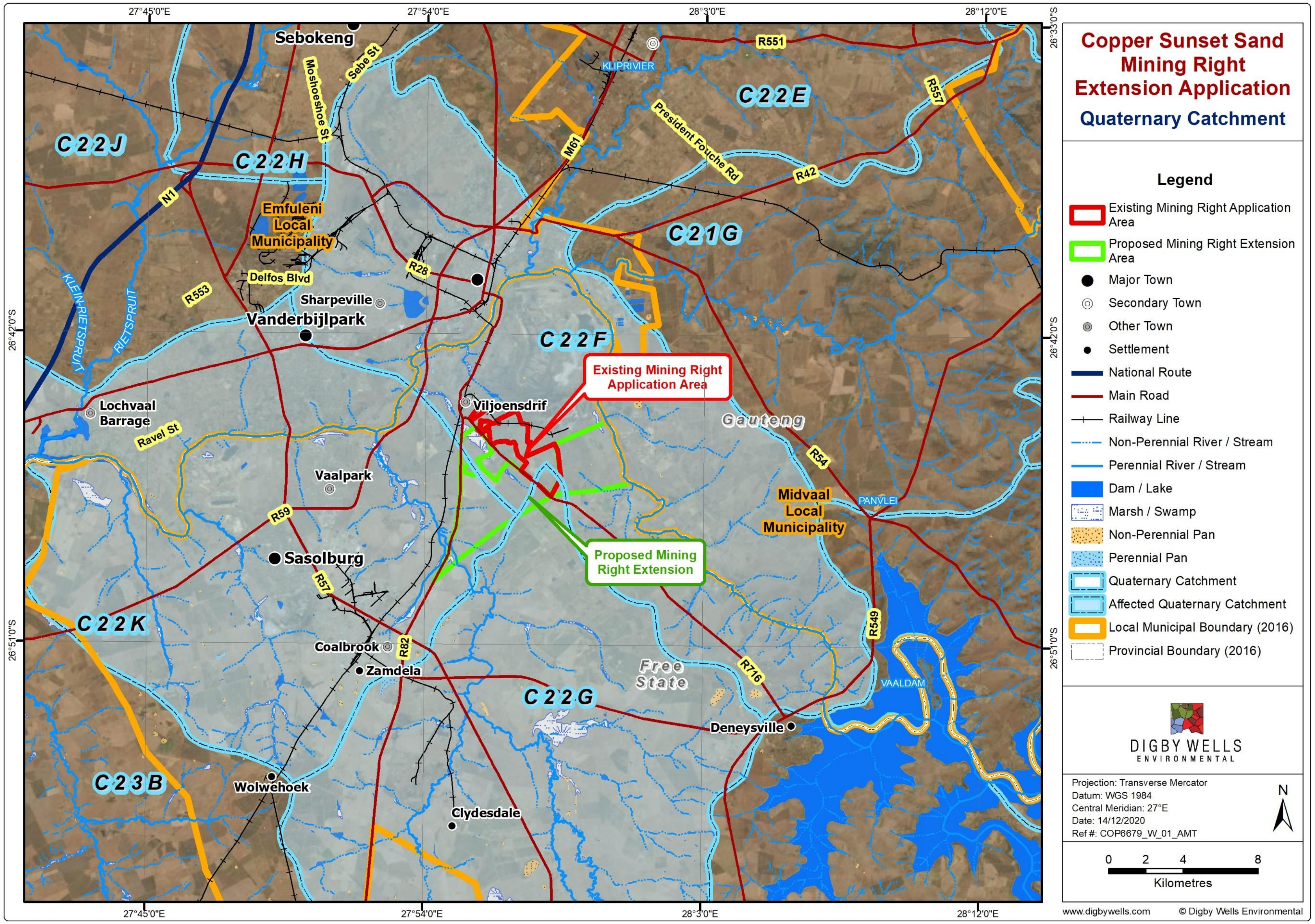


Figure 6-2: Quaternary Catchment of the Copper Sunset MREA

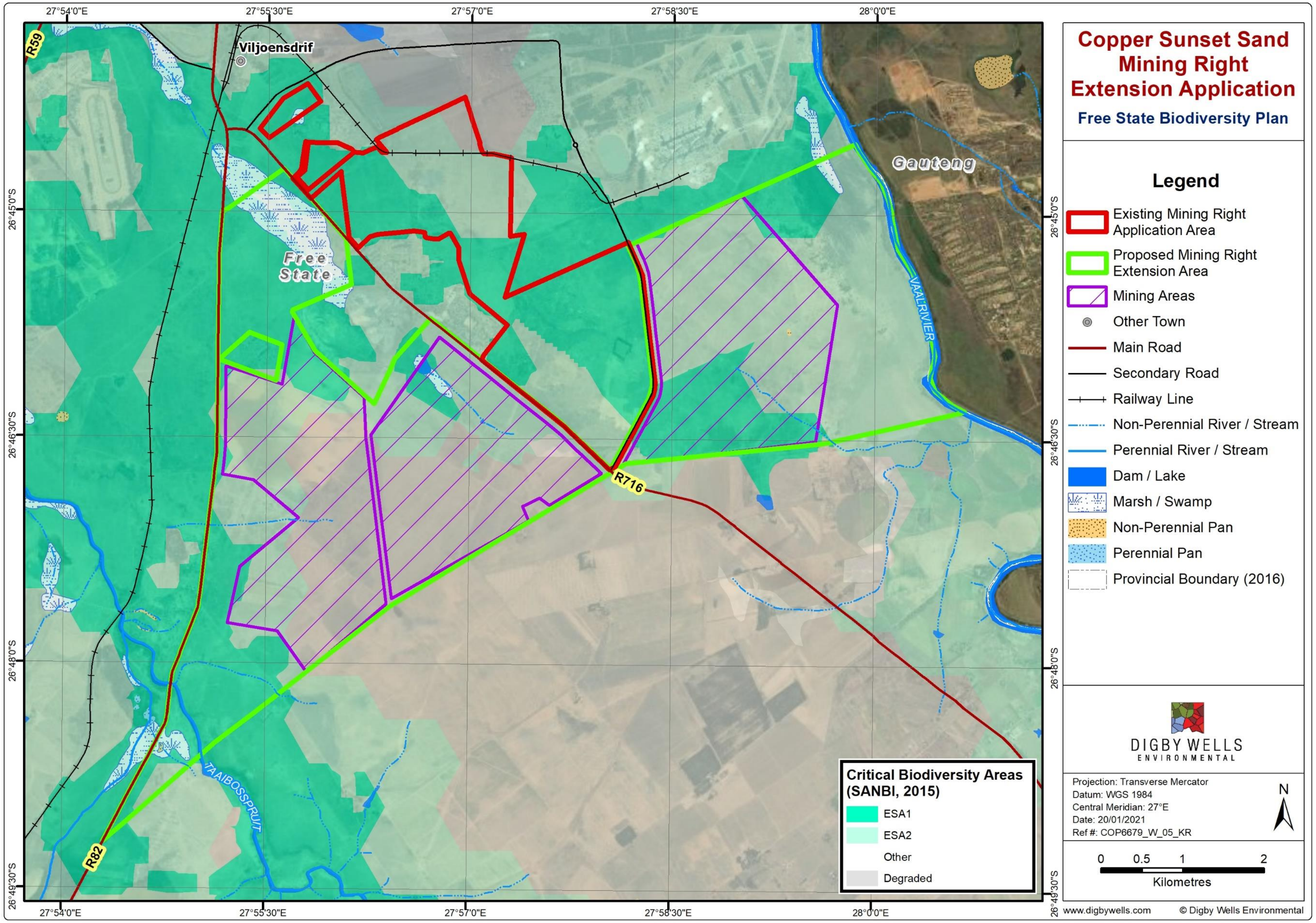


Figure 6-3: Free State Biodiversity Plan of the Copper Sunset MREA

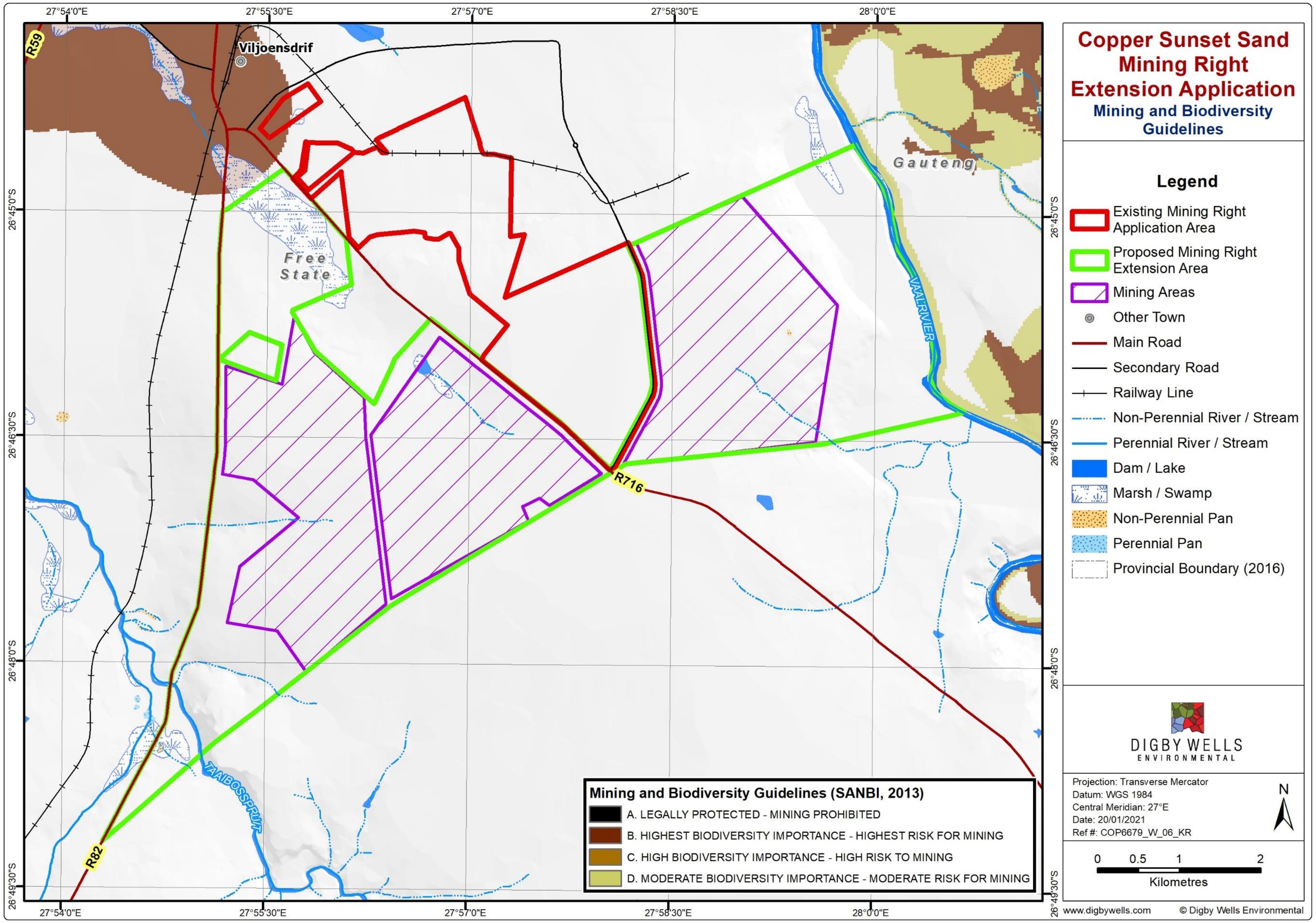


Figure 6-4: Mining and Biodiversity Guidelines of the Copper Sunset MREA

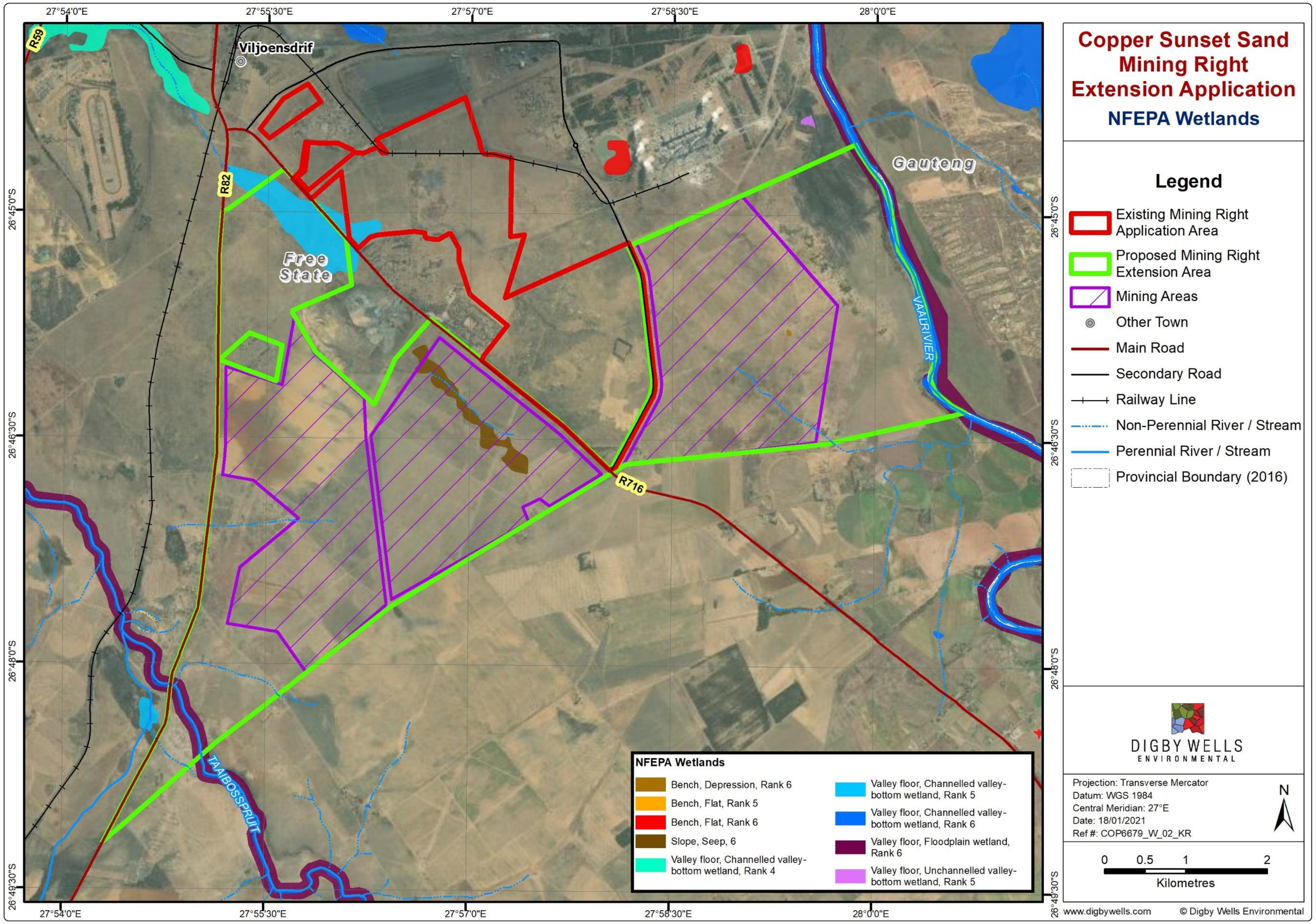


Figure 6-5: NFEPA Wetlands of the Copper Sunset MREA

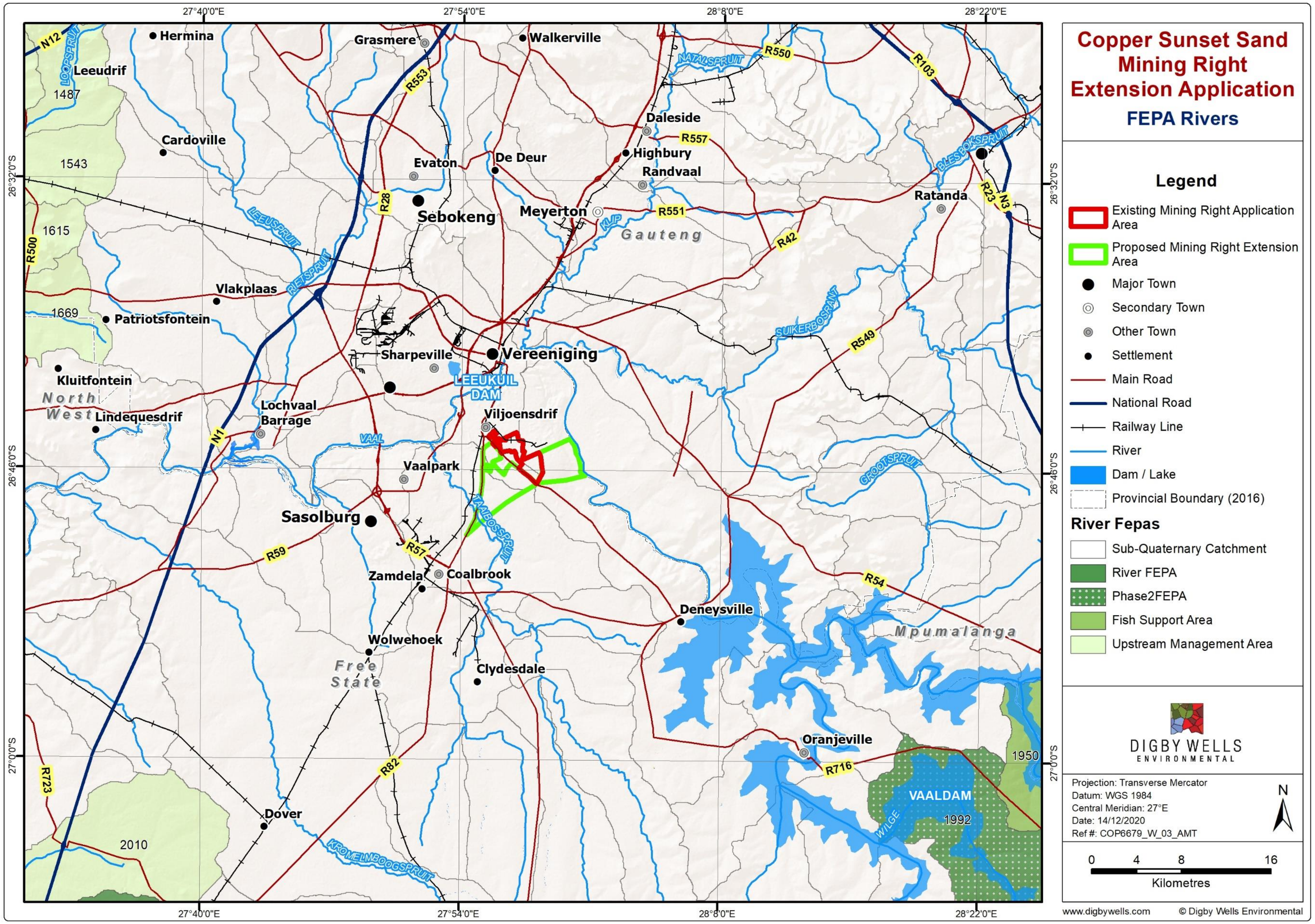


Figure 6-6: River FEPAs of the Copper Sunset MREA

7. Findings and Discussion

The assessor completed a desktop delineation of the wetlands associated with the MREA and confirmed the delineation during a rapid site survey. The site survey was conducted in September 2020 and January 2021 to refine the wetland delineation and determine the PES, ES and EIS values. The wetlands were categorised into six HGM types (Figure 7-4), namely:

- CVB and seep (east);
- CVB (west);
- Floodplain (east);
- Floodplain and associated VBs (west);
- Seep (east);
- Valley head seep and CVB (west)

The PES, ES and EIS were calculated accordingly. This report includes a consolidation of the aforementioned assessments, along with the potential impacts the Project will have on the wetland systems of the area.

7.1. Wetland Indicators

The accepted methodology from the now DWS (Department of Water Affairs and Forestry, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (Department of Water Affairs and Forestry, 2008) states the four wetland indicators as Soil Wetness Indicators (SWI), Soil Form Indicators (SFI), Vegetation and Terrain.

The wetland indicators used to delineate the wetlands are described in the subsections below.

7.1.1. Terrain Unit Indicators

Terrain indicators help to identify areas in the landscape where wetlands are more likely to occur. The topography is typically the physical characteristics of an area with a variation of soils against the slope, each with its own characteristics because of its relative position in the landscape and terrain.

The topography of the MREA is of the Highveld Lower Ecoregion with gentle, rolling grassland slopes and many valley systems (Figure 7-1). Detailed imagery and contours, coupled with field verifications, allows the geomorphic setting of the wetland and catchments to be understood and the HGM to be determined. Terrain indicators are important for understanding the specific functionality of the wetland and determining the potential risks from anthropological activities on the wetland.

Large areas of the MREA have previously been cultivated and affected by adjacent mining activities. The natural topographies have therefore been impacted in areas and not natural.

The topography of the MREA consists of steep slopes towards the Vaal River and the Taaibosspruit, with ridges associated with these systems in proximity of the rivers. The catchment divider consequently divides the eastern and western MREA into the Vaal River and Taaibosspruit systems. The topography is typically that of the Plinthic Catena, with deep, sandy, interflow soils at the top of the catchment and clayey soil, associated with wetlands towards the valley floor systems.

	
Gentle, rolling grassland slopes with many valley systems, depressions, and seeps	*Low-lying areas identified as valley bottom systems within cultivated fields*

Figure 7-1 Topography Indicators

7.1.2. Soil Indicators

Soil indicators, including soil forms and soil wetness, such as mottling and gleying, were used extensively throughout the MREA to identify and confirm wetland delineations.

The low-lying areas of the MREA showed increased clay content and soil wetness. These soils were identified as wetland soils (hydromorphic soils) and are saturated for long periods with a fluctuating water table, altering the morphology of the soils. These soils are somewhat limited for cultivation and highly mobile (high erosion probability). Clovelly, Avalon, Katspruit, Arcadia and Pinedene soils were typical soils identified within the wetland systems (Figure 7-2). The land uses in these areas were generally observed to be cultivation, cattle grazing and perennial grasslands.

Hydromorphic soils are significant to the overall site sensitivity analysis. The low angled topographic slopes and resulting wide expansive drainage lines coupled with the presence of restrictive sedimentary layers (sandstone predominantly) have resulted in proportionately much larger areas of transition zones, moist grasslands and wet based soils that meet the wetland classification both pedologically as well as ecologically.

	
Hydromorphic soil with high clay content, leached soil matrix and manganese (Mg) mottling	Hydromorphic, recharge soil with clear mottling of iron (Fe) within a leached soil matrix

Figure 7-2: Soil Indicators

7.1.3. Vegetation Indicators

Vegetation communities of the various wetlands and their respective HGM units were relatively variable. Large portions of the natural vegetation communities had been historically altered due to the predominant surrounding land use activities such as cultivation and cattle grazing.

Wetland plant species used in the identification and delineation of the various HGM units included, but was not limited to, those tabulated in Table 7-1. Some wetland species identified on site are shown in Figure 7-3. Please refer to the Fauna and Flora Impact Assessment Report (Digby Wells, 2021) for a detailed plant species list.

Table 7-1: Vegetation Indicators Species List (Water Research Commission, 2014)

Class	Abbreviation	Example
Obligate Wetland Species	OWS	*Agrostis lachnantha*, *Leersia hexandra, Phragmites australis, Paspalum distichum*
Facultative Wetland Species	FWS	*Andropogon eucomis, Hemarrthria altissima, Hyparrhenia tamba, Paspalum urvillei*
Seasonal Wetland Species	SWS	*Setaria sphacelata; Aristida junciformis, Themeda triandra, Eragrostis gummiflua*
Temporary Wetland Species	TWS	*Imperata cylindrica; Paspalum dilatatum*
Mostly Wetland Dependant Species	MWS	*Typha capensis, Juncus* sp., *Cyperus* sp., *Persicaria* sp.

Imperata cylindrica within the seepage wetlands

Imperata cylindrica and Agrostis lachnantha within the UVB wetlands

Figure 7-3 Vegetation Indicators

7.2. Wetland Delineation and HGM Unit Identification

Figure 7-4 illustrates the wetland delineations for the MREA. Due to the location of the Project Area on the watershed, wetlands are draining in a multitude of different directions. The HGM units associated with the eastern MREA are marked as **east**, draining into the Vaal River, whereas the wetlands within the western MREA are marked as **west**, and drain into the Taaibosspruit River.

The wetlands cover **1638.733 ha** which amounts to **58.62 %** of the total **2795.7 ha** MREA. The breakdown of the wetland HGM units areas are detailed in Table 7-2.

Table 7-2: Wetland HGM Units of the Copper Sunset MREA

HGM Unit	Associated river system	Area (ha)
CVB and seep (east)	Vaal River	125.53
Floodplain (east)	Vaal River	268.52
Seep (east)	Vaal River	158.408
CVB (west)	Taaibosspruit River	508.9
Floodplain and associated VBs (west)	Taaibosspruit River	549.25
Valley head seep and CVB (west)	Taaibosspruit River	28.125
Total wetland coverage of the MREA		**1638.733**

Field verification focused on the wetlands located within the proposed MREA, especially near the Vaal River and Taaibosspruit where impacts are expected to be greatest. Wetlands that will be impacted to a lesser extent, such as wetlands located within the 500 m zone of regulation were only verified at a desktop level.

Each HGM unit type is described in the subsections below together with the dominant impacts, land use and functionality.

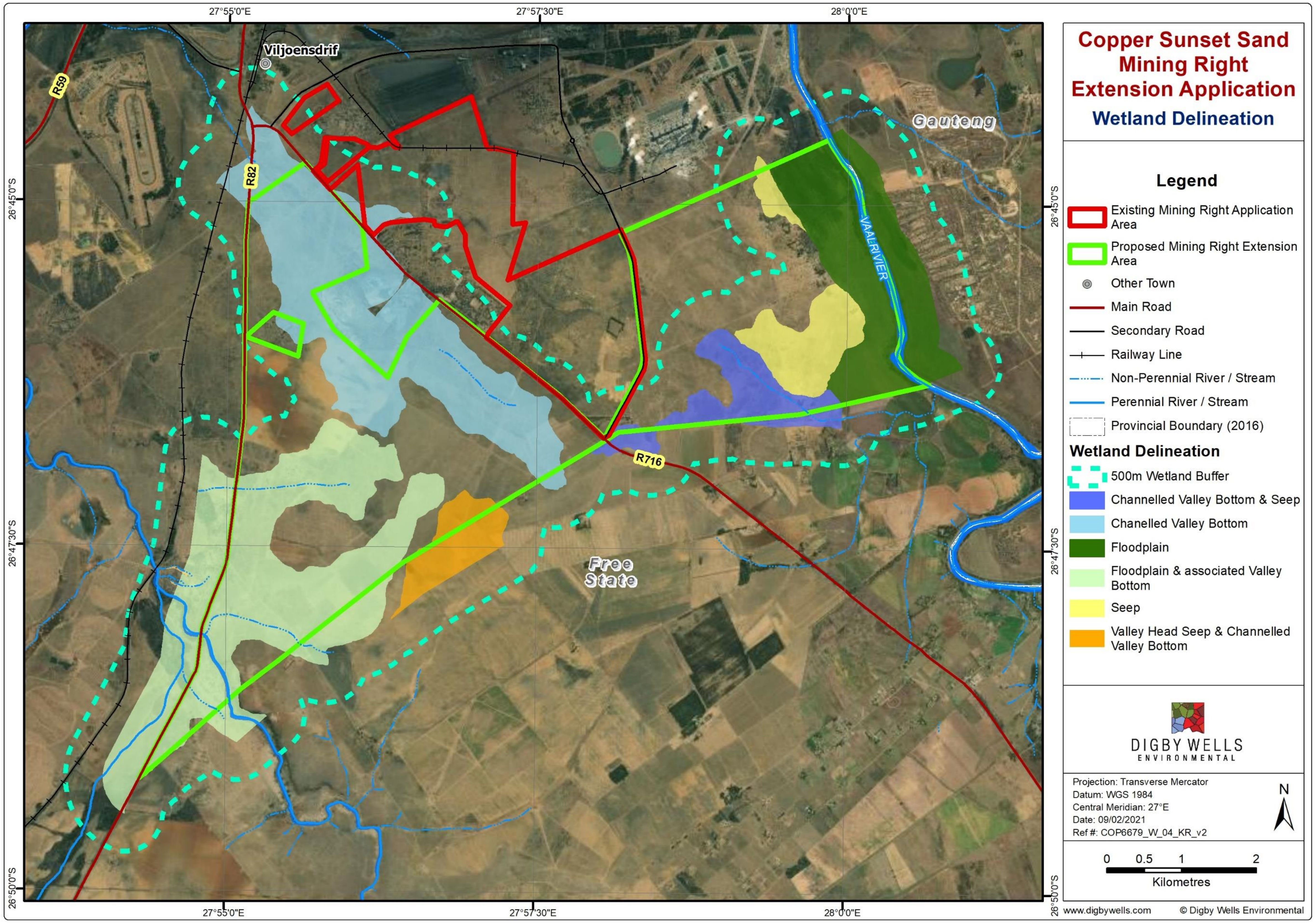


Figure 7-4 Wetland Delineation

7.2.1. CVB and seep (East)

According to Kotze *et al.* (2007), CVBs are characterised by less active deposition of sediment and an absence of oxbows and other floodplain features such as levees and meander scrolls. These wetland types tend to be narrower and have somewhat steeper gradients and the contribution from lateral groundwater input relative to the mainstream channel is generally greater (Kotze *et al.,* 2007).

Figure 7-5 CVB and Seep (East)

The CVB and associated seep within the eastern area are high in clays, leached and wet throughout the year. The dominant land use is historical cultivation, cattle grazing and housing (small settlement). The water from the CVB is used for drinking for both humans and animals. The area is heavily impacted with encroachment of Alien Invasive Plants (AIPs), excavations, stockpiling, dumping and ponding of water (Figure 7-5).

7.2.2. Floodplain (East)

The floodplain wetland, associated with the Vaal River system consists of an oxbow, sediment deposits and heavy clay soils. The floodplain receives water from the occasional flooding from the Vaal River as well as contributions of upstream wetlands within the catchment (CVB and seep (east) and Seep (east)). The floodplain therefore contributes to sediment trapping, flood attenuation, habitat and other services to the ecosystem and local community.

Figure 7-6 Floodplain (East)

The heavy clayey soils associated with the floodplain restrict intensive cultivation, however, is used for cattle grazing. The vegetation cover is low due to excessive cattle grazing and other agropastoral activities such as access roads, feedlots, and camp sites (Figure 7-6).

7.2.3. Seep (East)

The characteristic soil forms of the hillslope seepage wetlands which occur in MREA are sandy with increased clay with soil depth. It is common for these soils to remain saturated for periods during the summer months (wet season) and dry out during the dry season (winter months), thus clear mottling observed within the soils. The seep wetland is considered seasonal and contributes to water supply to downstream wetlands and the Vaal River.

The hillslope seep wetlands within the eastern parts of the MREA are significantly impacted by historical mining and agropastoral activities. The natural geomorphology, vegetation and hydrology have been impacted. However, these systems contribute flow to the downstream watercourses, even if only seasonally. Figure 7-7 indicates the heavily impacted vegetation due to overgrazing and historical mining activities (left), and *Hypoxis sp.* (right)

	
Historical mining activities and overgrazing	Hypoxis sp. within the seepage wetlands

Figure 7-7 Seep (East)

7.2.4. Floodplain and associated VBs (West)

The floodplain and associated VBs within the western MREA are associated with the Taaibosspruit catchment. The HGM unit has the same characteristics as the Floodplain (east), however covers a much larger area and includes a CVB and UVB which contributing to the hydrological functionality.

The dominant land use for this area is cattle grazing. The area is well vegetated, however, consists of areas of erosion, historical infrastructure such as housing, buildings and borrow pits, AIPs and agropastoral related infrastructure and impacts. Figure 7-8 shows the vegetation cover within the wetlands as well vegetated, however contains various AIPs and linear infrastructure. The two photos at the bottom are of a *Gladiolus sp.* and *Eucomis autumnalis (*pineapple lily*)*, of which the pineapple Lillie is a Provincially protected species.

	
Well vegetated hillslope seep area, with powerlines	Well vegetated hillslope seep area, with large stands of AIPs (Eucalyptus sp.)
	
Gladiolus sp. within the seepage wetlands	*Eucomis autumnalis (*pineapple lilies) Provincially protected species

Figure 7-8 Floodplain and associated VBs (West)

7.2.5. CVB (West)

The CVB and associated seep within western area are high in clays, leached and wet throughout the year. The HGM unit contributes to the ecological functioning of the Vaal River. The dominant land use is mining, cultivation, cattle grazing and historical infrastructure. The water from the CVB is used for drinking water for both humans and animals. The area is heavily impacted with an encroachment of AIPs, damming of the channel, cultivated fields, excavations, stockpiling and dumping of material (Figure 7-9).

This HGM unit drains directly into the Vaal River system.

	
Hillslope seepage wetland with scares vegetation cover and signs of overgrazing	Profileration of AIPs
	
Some areas are well vegetated, however increased AIPs and cattle grazing	*Boophone disticha* within the wetlands (Mpumalanga protected species)

Figure 7-9 CVB (West)

7.2.6. Valley head seep and CVB (West)

The Seep and CBV within the western MREA are completely cultivated (Figure 7-10). The area consists of deep, sandy recharge soils with clear SWI, such as mottling, leaching and gleying. The natural topography is altered because of agropastoral activities, changing the natural geomorphology, hydrological functioning which has completely removed the natural vegetation cover. Even though the system has been impacted by the anthropological activities, historically and currently, the HGM unit contributes significantly to the flow of the Taaibosspruit and wetland functionality.

	
Maize cultivation and stand of AIPs in the valley head seep and CVB	Well vegetated sections of the seepage wetland

Figure 7-10 Valley Head Seep and CVB (West)

7.3. Present Ecological Health Assessment

The wetland PES scores were assessed according to their hydrology, geomorphology and vegetation functionality.

The land use of the area directly impacts the PES of each HGM unit. The dominant land use of the area is mining and agropastoral activities, including large areas of cultivation and natural grassland for grazing. The wetlands have been altered from their natural state as the area has been largely transformed. Examples of these impacts recorded on site are shown and described in Figure 7-11 below.

Land Use and Description	
	**Commercial cultivation** – Cultivation involves removing the natural vegetation, ripping and ploughing the soils and planting of crops. Cultivation changes the natural hydrology, geomorphology, and vegetation. Farmers tend to cultivate in seepage wetlands as the water table is shallow enough optimal water and thus increased yield production. Cultivation contributes to erosion, contamination (pesticides, herbicides and fertilisers), sedimentation and loss of natural vegetation and habitat.
Cattle farming - Resulting in overgrazing in many areas, trampling, and erosion and has resulted in impaired water quality of the wetlands associated with the site. These activities cause increased sedimentation of the systems due to exposed substrate. Sedimentation alters the natural hydrological and geomorphological functioning of the wetlands and may have an impact on aquatic life. The impaired water quality may also result from additional loading of phosphates and nitrates.	
	**Infrastructure** - Dams within wetland systems impacting the natural functionality of the wetland. Infrastructure, such as dams, roads, fence lines and buildings can result in fragmentation of wetlands, erosion, increased runoff, increased AIPs. Infrastructure that is not managed and maintained could lead to large erosion gullies, increased AIPs, decreased water flow in the system, water ponding and wetland fragmentation.

AIPs - The establishment of AIPs, particularly *Populus x canescens* (Grey Poplar), *Eucalyptus camaldulensis* (Red River Gum) in the wetter areas and *Tagetes minuta* (Khaki Bush) and *Bidens pilosa* (Blackjack), further limiting the ability of the hydromorphic grasslands to function. AIPs tends to use more water than natural vegetation, which therefore restrict the natural vegetation to function optimally. Decreased natural vegetation has various other impacts, such as changes to the natural habitat, fauna composition and in effect the functionality and health of a wetland.	
	**Mining -** The presence of mining in the area and industrial infrastructure (such as powerlines and roads) affect the ecological integrity of the wetlands and avifaunal populations. Mining directly impacts the hydrological quality, quantity and functionality, geomorphology and change the natural occurring vegetation. The adjacent mine to the MREA created a river diversion, mining through the CVB downstream of the MREA. Mining activities also created large changes to the wetlands through possible contamination, changes to the natural flow of the wetlands, large excavations and borrow pits.

Figure 7-11 Land Use and Description

The HGM units were considered to have an ecological state ranging between **'Moderately Modified'** (**PES Category C**) and **'Highly Modified' (PES Category E)** (Table 7-3). According to the integrity (health) method described by Kotze *et al.* (2009) a **Category C** wetland has undergone a moderate change in ecosystem processes including loss of natural habitats, however the natural habitat remains predominantly intact. A **Category D** wetland has undergone large modifications to the natural ecosystem processes and loss of natural habitat and biota. Finally, a **Category E** wetland is described as the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.

Table 7-3: Wetland Ecological Importance and Sensitivity Scores

HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final PES	PES Category
CVB and seep (east)	19.5	2.4	16.1	5.429	D
Floodplain (east)	27	2.75	15.5	6.464	E
Seep (east)	24	1.95	16	5.993	D
CVB (west)	22.5	2.2	16.8	5.929	D
Floodplain and associated VBs (west)	22.5	1.35	17.3	5.879	D
Valley head seep and CVB (west)	12	1.9	13.4	3.900	C

The wetlands are important ecosystems within the MREA and include most of the wetland habitat types (HGM units). The ecological functioning of these ecosystems is directly linked to their position in the landscape as well as their ecological condition. Wetlands of the Grassland biome represent important ecosystems providing many services and goods to people and the biodiversity however, this does lead often to over exploitation of these systems which compromises their ecological integrity.

7.4. Wetland Ecological Services (WET-EcoServices)

The general features of the wetlands were assessed in terms of functioning and the overall importance of each HGM unit was then determined at a landscape level. Figure 7-12 represents radial plots showing the relative importance of each ecosystem service and Table 7-4 lists the summary of the scores obtained.

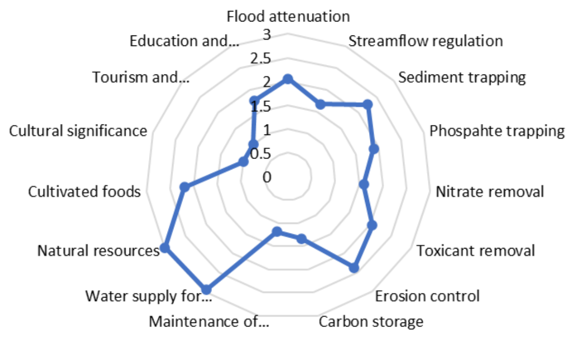
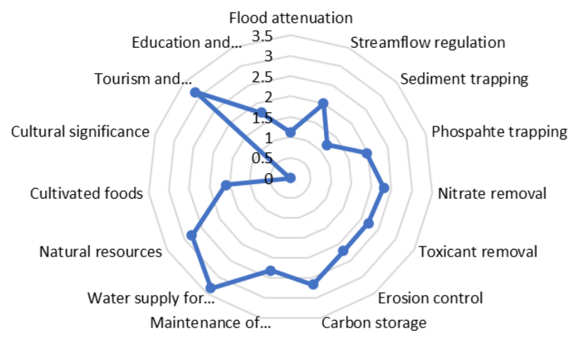
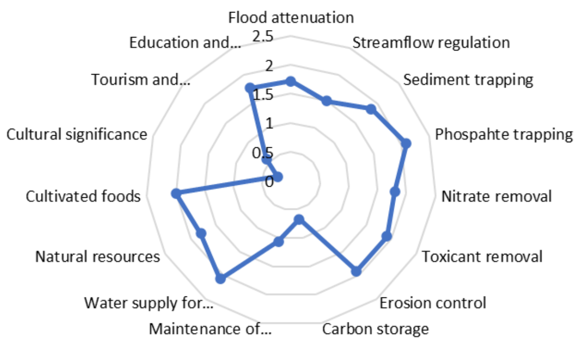
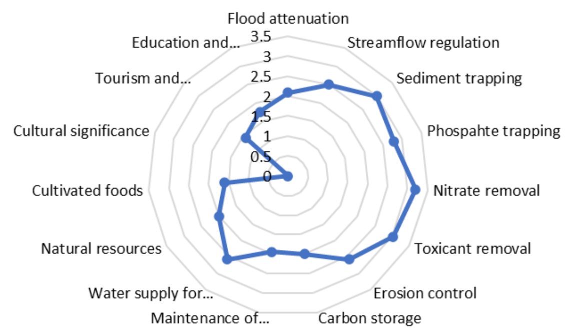
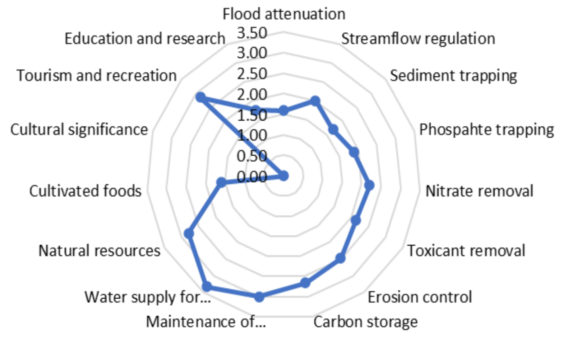
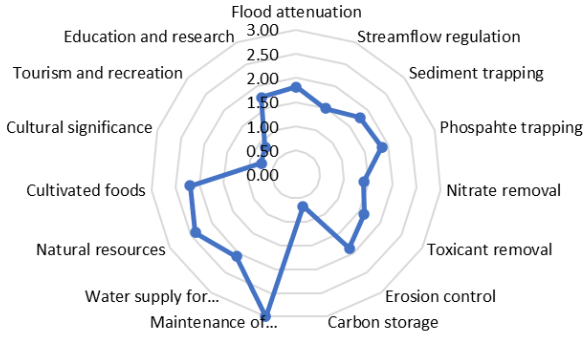
CVB and seep (east)	Floodplain (east)
	
Seep (east)	**CVB (west)**
	
Floodplain and associated VBs (west)	**Valley head seep and CVB (west)**
	

Figure 7-12: Wetland Ecological Services

The CVB (west) and the Floodplain and associated VBs (west) has been determined to be of **High** ecological importance, whereas the remainder of the HGM units measured as **Moderately High Importance** (Table 7-4**)**.

Overall, all six systems provide services of varying importance which should not be considered in isolation, nor can these units be considered individually. The removal or degradation of a unit will inadvertently impose increased stresses on the remaining units.

Some services include:

- Water for human and animal consumption. Multiple farm dams are present in channelled valley bottoms, for livestock watering and for abstraction;
- CVB and floodplains aid in streamflow regulation, nutrient assimilation, and sediment trapping;
- UVB also provide the aforementioned services, with the addition of flood attenuation. These functions are strongly linked to the absence of a channel as water is spread throughout the wetland unit.
- Seeps sustain streamflow during the dry season as they are slowly fed with sub-surface flow that moves laterally into the valley floor and river systems. Due to the diffuse nature of water movement through seep systems, sediment trapping and nutrient assimilation is an important water quality enhancement benefit.
- Wetlands provide habitat for a variety of aquatic and terrestrial fauna and flora species. The gentle, grassland slopes of the seeps could possibly provide habitat for important species of the area, however none was observed during the site visit. Floodplain and channelled valley bottoms provide habitat for aquatic species as well as birds and mammals that feed off aquatic species. Depressions provide unique habitat in the landscape for species. Provincially protected plant species (Eucomis autumnalis (pineapple lilies) and Boophone disticha) were noted within the wetlands which increases the biodiversity maintenance function; and
- Most of the wetlands are cultivated and/or used for grazing and therefore are providing high service provision in this regard. Additionally, the use of pesticides and fertilisers within these areas will likely increase the assimilation function of the wetlands to remove phosphates, nitrates and toxicants.

Table 7-4: Wetland Ecological Services

Ecosystem Service	**CVB and seep (East)**	**Floodplain (East)**	**Seep (East)**	**CVB (West)**	**Floodplain and associated VBs (West)**	**Valley head seep and CVB (West)**
Flood Attenuation	2.06	1.13	1.71	2.09	1.59	1.81
Streamflow Regulation	1.67	2.00	1.50	2.50	2.00	1.50
Sediment Trapping	2.26	1.21	1.86	2.98	1.69	1.77
Phosphate Assimilation	1.90	1.97	2.09	2.79	1.88	1.86
Nitrate Assimilation	1.60	2.30	1.80	3.20	2.20	1.40
Toxicant Assimilation	2.05	2.21	1.90	3.03	2.14	1.62
Erosion Control	2.38	2.21	1.92	2.58	2.47	1.88
Carbon Storage	1.33	2.67	0.67	2.00	2.67	0.67
Biodiversity Maintenance	1.19	2.31	1.06	1.94	3.00	3.00
Water Supply	2.94	3.33	2.08	2.58	3.33	2.08
Harvestable Resources	3.00	2.80	1.80	2.00	2.80	2.40
Cultivated Foods	2.20	1.60	2.00	1.60	1.60	2.20
Cultural Value	1.00	0.00	0.25	0.00	0.00	0.75
Tourism and Recreation	1.00	3.14	0.57	1.43	2.86	0.86
Education and Research	1.75	1.75	1.75	1.75	1.75	1.75
SUM	**28.33**	**30.64**	**22.97**	**32.46**	**31.98**	25.55
Average Score	**3.54**	**3.83**	**2.87**	**4.06**	**4.00**	3.19
Category	Moderately High	Moderately High	Moderately High	High	High	Moderately High

7.5. Ecological Importance and Sensitivity (EIS)

The EIS of a wetland is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. On the other hand, ecological sensitivity refers to the wetland's ability to resist disturbance and is capability to recover from disturbance that has occurred (Department of Water Affairs and Forestry, 1999).

The EIS scores are indicated in Table 7-5 below. The Floodplain and associated VBs (west) were measured as **Very High** due to the Ecological Importance & Sensitivity, whereas the Floodplain (east), Valley head seep and CVB (west) and CVB (west) are of **High** importance. The CVB and seep (east) and Seep (east) were of **Moderate** importance given the impacts to the HGM units as well as the low hydrological functioning thereof.

Table 7-5: Wetland Ecological Importance and Sensitivity Scores

HGM Unit	Ecological Importance & Sensitivity	Hydrological / Functional Importance	Direct Human Benefits	Final EIS	EIS Category
CVB and seep (east)	**1.3**	**1.9**	**2.0**	**2.0**	Moderate
Floodplain (east)	**2.7**	**2.0**	**2.1**	**2.7**	High
Seep (east)	**1.0**	**1.7**	**1.4**	**1.7**	Moderate
CVB (west)	**2.0**	**2.4**	**1.6**	**2.4**	High
Floodplain and associated VBs (west)	**3.7**	**2.1**	**2.1**	**3.7**	Very high
Valley head seep and CVB (west)	**2.3**	**1.6**	**1.6**	**2.3**	High

8. Wetland Impact Assessment

This section rates the significance of the potential impacts pre-mitigation and post-mitigation. The impacts below are a result of both the environment in which the activity takes place, as well as the activity itself. The impacts associated with the proposed project include the NEMA EIA Regulations, 2014 (as amended) Listed Activities, as well as the mining and associated activities to take place at the Project Area. The methodology utilised to assess the significance of the potential impacts is described in Appendix A. The following activities will be assessed as discussed in Table 8-1.

Table 8-1: Summary of Project Activities

Activity No.	Activity
Establishment Phase	• Vegetation and topsoil will be removed with a bulldozer and stockpiled along the mined-out strip; and • Construction of a temporary haul road (20 m width) to gain access to the sand mining area. Haul road will move as mining progresses.
Operational Phase	• Mining of sand resources including screening (if required) to approximately 0.4 – 2 m and stockpiling; • Transportation of material on haul roads; and • Refuelling of machinery within the mining area or at the mobile offices.
Closure and Rehabilitation Phase	• Concurrent rehabilitation (topsoil cover, ripping and vegetation establishment) and monitoring of vegetation establishment; • Backfilling of the mined excavations with topsoil and waste from the screening plants; and • Post-closure monitoring.

The wetland impacts were assessed for the three phases of the Project life, including the Establishment, Operational and Decommissioning Phases. The impacts were assessed based on the impact's magnitude as well as the receiver's sensitivity, concluding in an impact significance rating which identifies the most important impacts that require management. The wetland delineations together with the proposed infrastructure are illustrated in Figure 8-1.

The impacts identified in this section are a result of both the environment in which the proposed Project activities will take place, as well as the actual activities.

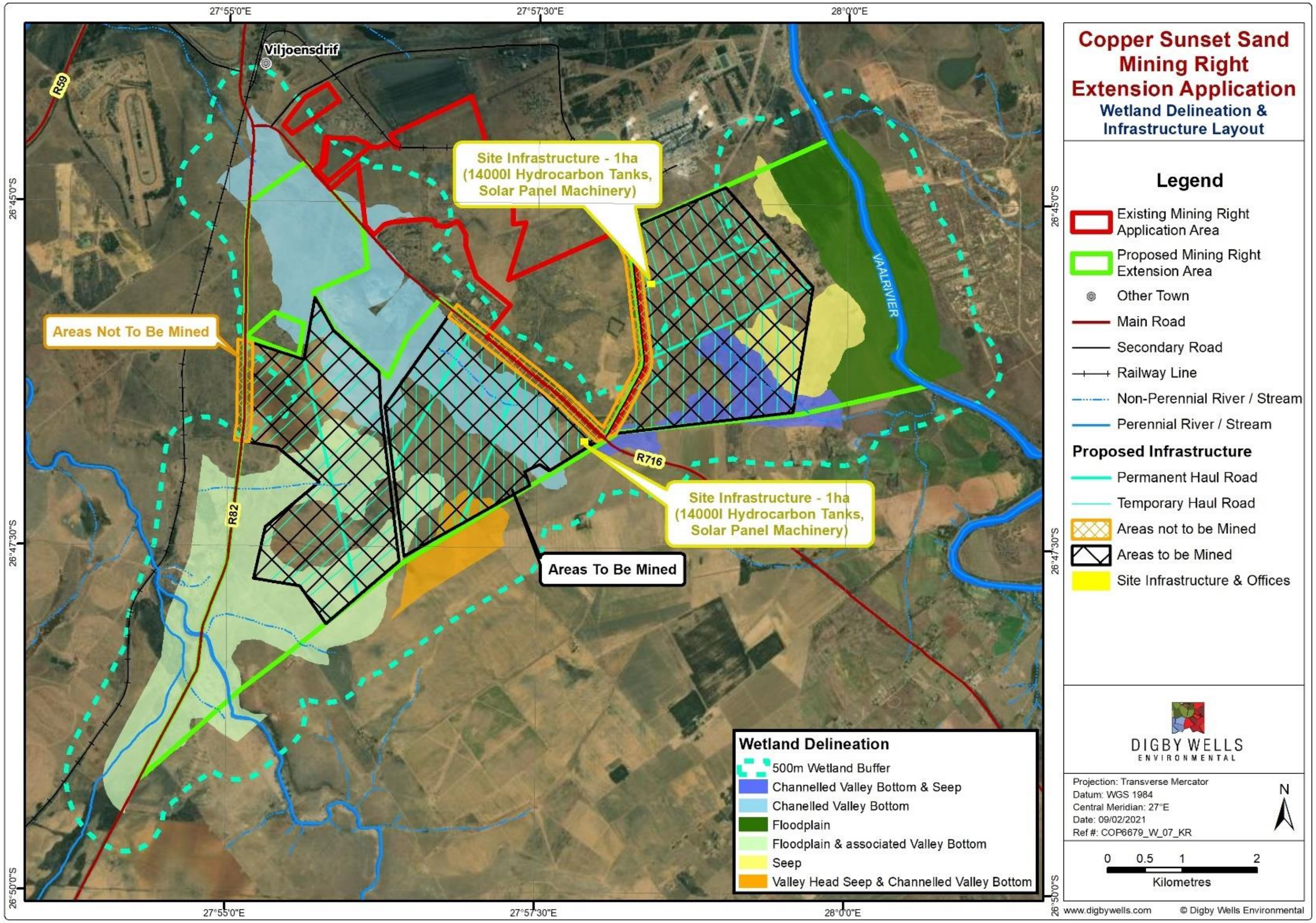


Figure 8-1 Wetland Delineations with Proposed Infrastructure

8.1. Establishment Phase

Activities during the Establishment Phase that may have potential impacts on wetlands are described in Table 8-2 below.

Table 8-2: Interactions and Impacts of the Activity

Interaction 1	**Impact**
Site clearance and vegetation removal.	• Direct loss of wetland areas; • Habitat loss; • Loss of biodiversity; and • Erosion and sedimentation of wetland areas.
Description	
The removal of vegetation and topsoil will result in the direct loss of wetland areas. This will alter the hydrological regime and flow of water which may contribute to further loss of wetland areas. The altered water flows may increase the erosion risk of wetland areas and the eroded material may result in sedimentation of downstream water resources.	
Interaction 2	**Impact**
Construction of a temporary haul road (20 m width) to gain access to the sand mining area.	• Fragmentation of wetland areas; • Habitat loss; • Loss of biodiversity; and • Erosion and sedimentation of wetland areas.
Description	
The construction of the haul road may cause fragmentation of wetlands. Linear infrastructure often results in erosion and sedimentation within the wetlands resulting in habitat loss and vegetation loss.	

8.1.1. Management Objectives

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 Establishment Phase, the next step is to minimize 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 aim during the Establishment Phase is to:

- Minimize the impact footprint on the wetlands as it is not possible to avoid the impacts;
- Keep the impact size to a minimal with as little changes to the natural state of the Project Area as far as possible; and
- Prevent the spillage, seepage and runoff of hydrocarbons and other hazardous materials to the wetland areas.

8.1.2. Impact Ratings

Table 8-3 present the impact ratings associated the Establishment Phase of the Project.

Table 8-3: Establishment Phase Interactions and Impacts of Activity Rating

1. Activity and Interaction: Site Clearance: Vegetation and topsoil will be removed with a bulldozer and stockpiled along the mined-out strip.			
Impact Description: • Direct loss of wetland areas; • Habitat loss; • Loss of biodiversity; and • Erosion and sedimentation of wetland areas.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	Complete and/or partial removal of wetlands	Major (negative) - 119
Extent	Municipal (4)	The loss of wetland areas may lead to a reduction of water to a regional area.	
Intensity	Irreplaceable loss (6)	Permanent loss of wetlands	
Probability	Definite (7)	Loss of wetland areas will definitely occur due to the proposed mining within delineated wetlands	
Nature	Negative		
Mitigation Measures			
• Avoid infrastructure within wetlands as far as possible, especially wetlands with a high PES, EIS and ES rating; • Establishment of a 100 m buffer zone to protect wetland areas from infrastructure within the study area. This would require that development occur further than 100 m from a delineated wetland area; • Place sediment trapping berms on the boundary of the 100 m buffer or end of development; • Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands; and • Ensure concurrent rehabilitation with special attention to reshaping the areas and re-vegetating.			

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (6)	Complete and/or partial removal of wetlands	Moderate (negative) - 84
Extent	Local (3)	The loss of wetland areas may lead to a reduction in water supply to the local area if wetland rehabilitation and offsetting is implemented.	
Intensity	Serious loss (5)	The impact of mining of wetlands is great, however offsetting can be undertaken and rehabilitation with correct sloping and vegetation management may assist in reducing this impact.	
Probability	Almost certain (6)	Loss of wetlands will occur if mined, however, if they are rehabilitated the impact will be less	
Nature	Negative		

2. **Activity and Interaction:** Construction of a temporary haul roads (20 m width) to gain access to the sand mining area. It is important to note that the haul road will move as mining progresses through life of mine.

Impact Description:

- Fragmentation of wetland areas;
- Habitat loss;
- Loss of biodiversity; and
- Erosion and sedimentation of wetland areas.

Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project Life (6)	Construction of haul road could lead to impacts beyond the LOM.	Moderate (negative) -78
Extent	Local Area (3)	Loss of wetlands due to the construction of haul roads may lead to impacts within the local area	
Intensity	Serious loss (4)	The loss of wetland is serious	
Probability	Almost Certain (6)	Haul road will almost certainly have a negative effect on wetlands due to habitat fragmentation.	
Nature	Negative		

Mitigation Measures			
• If erosion has occurred, topsoil should be sourced, replaced, vegetated and shaped to reduce the recurrence of erosion in wetlands; • Only the designated access routes are to be used to reduce any unnecessary compaction of surfaces and therefore increased flow into the wetlands; • Place sediment trapping berms where erosion has occurred; • Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands; and • When the temporary haul roads are deconstructed, the area should be ripped and re-vegetated to prevent impacts to the environment.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	When mitigation measures are followed, the impacts should only last during the LoM	Minor negative (-55)
Extent	Local (3)	Loss of wetlands due to the construction of haul roads may only be to the extent of the impact if mitigation and rehabilitation measures are implemented efficiently	
Intensity	Moderate loss (3)	If mitigation measures are followed, the loss should only be moderate	
Probability	Likely (5)	Impacts to the wetlands are likely to occur even though mitigation measures are followed	
Nature	Negative		

8.2. Operational Phase

Activities during the Operational Phase that may have potential impacts on the soil, land use and land capability are described in Table 8-4 below.

Table 8-4: Interactions and Impacts of Activity

Interaction 1	**Impact**
Mining of sand resources including screening (if required) to approximately 0.4 – 2 m and stockpiled in a separate area	• Direct loss of wetlands; • Water quality contamination and deterioration; • Habitat loss as a result of poor water quality; • Loss of biodiversity; and • Erosion and sedimentation within the wetlands.
Description	
During the operation of the mine, sand mining is proposed within delineated wetlands which will have a direct loss of wetlands. Other proposed mining outside delineated wetlands, but within a buffer of the wetlands will impact the wetlands through sedimentation and contamination, decreased flow into the wetlands, change to the natural habitat and vegetation and changes to the natural geomorphology. Some of the wetlands will be completely removed therefore reducing water inputs to the downstream wetlands and freshwater bodies. These impacts will result in habitat and biodiversity deterioration and loss. Accidental spills of oil, lubricants and hydrocarbons will lead to water contamination, impacting the wetland health and functionality.	
Interaction 2	**Impact**
Transportation of material on haul roads	• Erosion of wetland crossings associated with the haul road; • Accidental spills causing soil and water contamination; • Habitat loss as a result of poor water quality; • Loss of biodiversity; • Siltation of wetlands due to erosion; and • Change in habitat and potential change in species composition.
Description	
The use of access roads will result in exposed soil surfaces for prolonged periods and the generation of loose soil which may be washed to wetland areas and cause sedimentation. The exposed soil surfaces will have the ability to increase water flow and as such may cause an elevated water flow to the wetland areas which may prompt the onset of erosion in wetland areas and erosion of the roads which could lead to sedimentation of wetlands. Accidental oil, lubricant and hydrocarbon spills from trucks could lead to soil and water contamination within the wetlands and therefore loss of wetland health. Linear infrastructure causes fragmentation of wetland habitat and changes to the health thereof.	

Interaction 3	Impact
Refuelling of machinery within the mining area or at the mobile offices	• Water quality contamination and deterioration; • Potential spills may lead to loss of vegetation, causing sedimentation of wetlands, contamination, habitat loss and potential change in species composition; • Habitat loss as a result of poor water quality; and • Loss of biodiversity.
Description	
Accidental spills may occur which could lead to wetland contamination, habitat and biodiversity loss. Sedimentation causes changes to the natural flow of a wetland, reduced vegetation and could lead to proliferation of AIPs.	

8.2.1. Management Objectives

The aim during the Operational Phase is to:

- Implement measures to prevent desiccation of the surrounding wetland areas and rivers due to the loss of upstream wetland habitat;
- Limit activities to the operational area;
- Implement corrective actions as soon as erosion occurs to limit and reduce the impact;
- Assess bare areas for compaction or contamination and rip, ameliorate and reseed if required; and
- Clean and rehabilitate areas impacted by contamination.

8.2.2. Impact Ratings

The Operational Phase impacts are rated in Table 8-5 below.

Table 8-5: Operational Phase Interactions and Impacts of Activity Rating

1. **Activity and Interaction:** Mining of sand resources including screening (if required) to approximately 0.4 – 2 m and stockpiling
Impacts: • Direct loss of wetlands; • Water quality contamination and deterioration; • Habitat loss as a result of poor water quality; • Loss of biodiversity; and • Erosion and sedimentation within the wetlands

Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project life (6)	Complete and/or partial removal of wetlands	Major (negative) - 105
Extent	Local (3)	The loss of wetland areas may lead to reduced water in the catchment.	
Intensity	Irreplaceable loss (6)	Permanent loss of some wetlands	
Probability	Definite (7)	Loss of wetland areas will definitely occur due to the proposed mining areas being within delineated wetlands	
Nature	Negative		
Mitigation Measures			
• Avoid infrastructure as far as possible within wetlands, especially wetlands with a high PES, EIS and ES rating; • Establish a 100 m buffer zone to protect wetland areas from the proposed infrastructure within the study area. This would require that development occur further than 100 m from a delineated wetland area; • Place sediment trapping berms on the boundary of the end of development; • Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands; • Ensure concurrent rehabilitation with special attention to reshaping the areas and re-vegetating; • Develop and implement a Wetland Offset Strategy and Rehabilitation plan for the wetlands in the Project area. • Maintain and monitor wetland functionality; • Monitor the roads monthly to identify and rectify any areas that have begun to erode and where water may be flowing towards wetland areas.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project life (5)	Complete and/or partial removal of wetlands	Moderate negative (-72)
Extent	Limited (2)	The loss of wetland areas may lead to reduced water within the municipal area if wetland rehabilitation and offsetting is implemented.	

Intensity	Serious loss (5)	The impact of mining of wetlands is serious. However, offsetting can be undertaken and rehabilitation with correct sloping and vegetation management may assist in reducing this impact.	
Probability	Almost certain (6)	Loss of wetlands will occur if mined, however, if they are mitigated, wetland functionality can be saved/gained	
Nature	Negative		
2. Activity and Interaction: Transportation of material on haul roads.			
Impacts: • Erosion of wetland crossings associated with the haul road; • Accidental spills casing soil and water contamination; • Habitat loss as a result of poor water quality; • Loss of biodiversity; • Siltation of wetlands due to erosion; and • Change in habitat and potential change in species composition.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	Transportation of sand will occur during the LOM	Moderate negative -72
Extent	Local (3)	The impact will occur in the project infrastructure area only	
Intensity	Serious loss (4)	Impacts to the wetlands may be serious and have serious consequences to the impacted area and beyond	
Probability	Almost certain (6)	Vehicles will most certainly move in wetlands or lose to wetland	
Nature	Negative		
Mitigation Measures			
• Restrict vehicle movement in delineated wetlands; • Only the designated access routes are to be used to reduce any unnecessary compaction leading to erosion, increased runoff and fragmentation of wetlands; • Rip rehabilitated areas to reduce compaction and reseed to increase vegetation cover; and • Clean up spills immediately to prevent migration of contaminants into the wetlands.			

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Medium term (3)	Transportation of sand will occur during the LOM, thereafter mitigation will assure no further impacts to the wetlands	Negligible Negative (-32)
Extent	Limited (2)	The impact will occur in the project area only if mitigation is followed	
Intensity	Moderate Loss (3)	Impacts to the wetlands may be minimal if managed and have low consequences.	
Probability	Probable (4)	Even with the stipulated mitigation measures, there is a possibility that vehicles may still have an impact on wetlands.	
Nature	Negative		

3. **Activity and Interaction:** Refuelling of machinery within the mining area or at the mobile offices.

Impacts:

- Water quality contamination;
- Potential spills may lead to loss of vegetation, causing sedimentation of wetlands, contamination, habitat loss and potential change in species composition;
- Habitat loss as a result of poor water quality; and
- Loss of biodiversity.

Prior to Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	Wetlands may be contaminated for a long-term if spills occur	Minor negative (-48)
Extent	Local (3)	The contamination may extend to the local area	
Intensity	Serious Loss (5)	Pollution and deterioration of water quality may be serious	
Probability	Probable (4)	Spills will probably occur during refuelling	
Nature	Negative		

Mitigation Measures			
• Conduct pollution monitoring along the low-lying areas (wetlands) to detect any high levels of pollutants if spills has occurred; • Create a designated refuelling area; • Prevent contaminated water entering the remaining freshwater systems (wetlands); and • Any spillages should be cleaned up immediately, and the contaminated material should be disposed of at licenced disposal sites.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Medium Term (3)	Only occur during the spillage period if mitigated/managed immediately	Negligible Negative (-24)
Extent	Limited (2)	The impact will only be at the point source within the project area.	
Intensity	Serious Loss (4)	The wetlands may be contaminated and therefore impact the biodiversity	
Probability	Unlikely (3)	Spills will unlikely occur if mitigation is followed	
Nature	Negative		

8.3. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts on the wetlands are described in Table 8-6 below.

Table 8-6: Decommissioning Phase Interactions and Implications of Activity

Interaction 1	**Impact**
Concurrent rehabilitation (topsoil cover, ripping and vegetation establishment) and monitoring of vegetation establishment	• Erosion due to rehabilitated areas being exposed to wind and surface water runoff; • Siltation of watercourses leading to deteriorated water quality and altered geomorphology; and ; • Change in habitat and potential change in species composition;
Description	
The activities that will be performed during the final rehabilitation will entail the movement of material and shaping of the topography and will include the establishment of vegetation on exposed soil surfaces. The movement of material and large areas of exposed soil surfaces could result in erosion that may cause sedimentation of wetland areas.	

Interaction 2	Impact
Backfilling of the mined excavations with topsoil and unusable soil (pebbles, rocks, gravel etc.) from the screening plants	• Water quality contamination and deterioration due to an increase in sedimentation and waste material; • Habitat and biodiversity loss as a result of poor water quality; • Water ponding and preferential flow paths; • Siltation of wetlands leading to deteriorated water quality and quantity; and • Change in habitat and potential change in species composition.
Description	
Backfilling of the mined areas with unusable soil (pebbles, rocks, gravel etc.) and topsoil may lead to erosion and sedimentation of the wetlands. Erosion and sedimentation can lead to loss of habitat, changes in vegetation growth and water contamination.	
Interaction 3	**Impact**
Post-closure monitoring	• Soil compaction, leading to increased runoff and changes to the wetland functionality (e.g., erosion); • AIPs proliferation due to changes to the natural landscape, soils and wetlands; • Changes to the habitat, wetland functionality and biodiversity.
Description	
Monitoring will have little impacts to the wetland. However, movement in the area, potentially in wetland areas may lead to increased AIPs, erosion and sedimentation. Vehicle movement in the wetlands and adjacent access roads may lead to increased runoff, erosion and channel forming.	

8.3.1. Management Objectives

The aim during the Decommissioning Phase is to rehabilitate the affected areas to near-natural conditions without resulting in additional impacts to the wetland ecology throughout the process.

Impacts to the Project Area that cannot be rectified and reduced will lead to additional areas to be offset. Avoidance of impacts is not possible during the Decommissioning Phase; however the Decommissioning Phase will include the mitigation and monitoring of impacts which will in return have a positive consequence to the impact assessment.

8.3.2. Impact Ratings

The impact rating associated with activities related to the removal of surface infrastructure and rehabilitation of potentially affected areas have been predicted in Table 8-7 below.

Table 8-7: Decommissioning Phase Interactions and Impacts of Activity Rating

1. Activity and Interaction: Concurrent rehabilitation (topsoil cover, ripping and vegetation establishment) and monitoring of vegetation establishment			
Impacts: • Erosion due to exposed areas to wind and surface water runoff; • Siltation of surface water resources leading to deteriorated water quality and quantity of the wetlands; • Siltation of wetlands due to erosion; • Change in habitat and potential change in species composition;			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	As concurrent rehabilitation will take place, the impacts will occur through the life of the project. Wetlands may be impacted during rehabilitation	Minor Negative (-50)
Extent	Limited (2)	The impact will only occur within the specific mined out areas	
Intensity	Moderate loss (3)	Loss of wetlands, biodiversity and increased AIPs	
Probability	Likely (5)	Impacts will likely occur due to compaction, AIPs proliferation	
Nature	Negative		
Mitigation Measures			
• Continue with Concurrent Rehabilitation, and implement wetland rehabilitation measures; • Address areas of AIPs proliferation by utilizing a AIPs Program; • Ensure proper stormwater management designs are in place to ensure no excessive run-off or pooling occurs; • Only designated access routes are to be used to reduce any unnecessary impacts to the wetlands; and • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.			

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Medium term (3)	As concurrent rehabilitation will take place, the impacts will occur through the life of the project. If mitigation measures are followed, the duration should only be during rehabilitation phase or until closure is achieved.	Negligible negative (-28)
Extent	Very Limited (1)	The impact will only occur within the specific mined out areas	
Intensity	Minor loss (3)	Loss of wetlands and the biodiversity will be minimal if mitigation and remediation measures are followed as well as following a offset strategy	
Probability	Probable (4)	There is still a probability that impacts may occur	
Nature	Negative		
2. **Activity and Interaction:** Backfilling of the mined excavations with topsoil unusable soil (pebbles, rocks, gravel etc.) from the screening plants.			
Impacts: • Water quality deterioration due to an increase in sedimentation and unusable soil (pebbles, rocks, gravel etc.) material; • Habitat and biodiversity loss as a result of poor water quality; • Water ponding and preferential flow paths; • Siltation of wetlands leading to deteriorated water quality and quantity; and • Change in habitat and potential change in species composition.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	Wetlands may be impacted if backfilling, reshaping and unusable soil (pebbles, rocks, gravel etc.) is not done correctly.	Minor negative (50)
Extent	Limited (2)	Impacts to the wetlands will be limited to the impact area	
Intensity	Moderate loss (3)	Impacts may have moderate to the wetlands	
Probability	Likely (5)	Backfilling will likely have an impact on the wetlands through siltation, sedimentation and erosion	

Nature			

Mitigation Measures

- The unusable soil (pebbles, rocks, gravel etc.) must be placed below the topsoil and compacted to prevent increased infiltration;
- The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions;
- If erosion has occurred, topsoil should be sourced, replaced, vegetated and shaped to reduce the recurrence of erosion in wetlands;
- Only the designated access routes, outside of wetlands, are to be used to reduce any unnecessary compaction of surfaces and therefore increased flow into the wetlands;
- Place sediment trapping berms where erosion has occurred; and
- Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Medium term (3)	Wetlands may be impacted if backfilling, reshaping and unusable soil (pebbles, rocks, gravel etc.) is not done correctly.	Negligible (negative) – 28
Extent	Limited (2)	Impacts to the wetlands will be limited to the impact area	
Intensity	Minor loss (2)	Impacts may have moderate to the wetlands	
Probability	Probable (4)	Backfilling will likely have an impact on the wetlands through siltation, sedimentation and erosion	
Nature			

3. Activity and Interaction: Post-closure monitoring

Impacts:

- Soil compaction, leading to increased runoff and changes to the wetland functionality (e.g., erosion);
- AIPs proliferation due to changes to the natural landscape, soils and wetlands;
- Changes to the habitat, wetland functionality and biodiversity.

Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	Impacts may remain for some time after the project life	Negligible (negative) – 27
Extent	Limited (2)	The impact will only occur within the immediate area.	
Intensity	Minor loss (2)	Monitoring will only have minor impacts to the wetlands	
Probability	Unlikely (3)	Impacts are unlikely during monitoring	
Nature	Negative		
Mitigation Measures			
• Only use designated roads; • Use vehicles as little as possible in the wetlands, monitoring should preferable be done on foot; and • Wetland monitoring during the wet season for three years post-closure and report with rehabilitation recommendations if necessary.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	Impacts may remain for some time after the project life	Negligible (negative) - 27
Extent	Limited (2)	The impact will only occur within the immediate area.	
Intensity	Minor loss (2)	Monitoring will only have minor impacts to the wetlands	
Probability	Unlikely (3)	Impacts are unlikely during monitoring	
Nature			

8.4. Cumulative Impacts

The mining activities within the catchment have led to losses in wetland areas that may have facilitated increased water flow and also have increased the number of pollutants flowing into the water resources. The alteration of vegetation and surface flow has led to the onset of erosion in the wetland areas, and this may be perpetuated further by mining and related activities within the MREA.

The mining activities within the catchment have led to losses in wetland areas that may have facilitated increased water flow and also have increased the number of pollutants flowing into the water resources. The alteration of vegetation and surface flow has led to the onset of erosion in the wetland areas, and this may be perpetuated further by mining and related activities within the MREA. Mining may disturb the hydrological patterns further which could in turn lead to large scale desiccation of wetland areas and the direct loss of some of the wetland areas because of water flow being cut off.

8.5. Unplanned and Low Risk Events

This section considers the potential risks to the wetlands, as well as the potential risks that could arise for Copper Sunset in terms of implementation of the Project.

There is a risk that wetland areas associated with the mining operations and associated 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 culverts, may result in impacts to the habitat and water quality.

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

Table 8-8: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
• Chemical and (or) contaminant spills from mining operation, infrastructure and associated activities.	• Ensure correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g. sealed containers for hydrocarbons); • Ensure staff involved at the proposed Project have been trained to correctly work with chemicals at the sites; and • Ensure spill kits (e.g. Drizit) are readily available at areas where chemicals are known to be used. Staff must also receive appropriate training in the event of a spill, especially near wetlands, watercourses and/or drainage lines.
• Erosion, sedimentation, loss of vegetation and deterioration of wetland health due to flash floods	• Implement concurrent rehabilitation; • Re-seed and re-vegetate the area directly after topsoil has been replaced and landscaped; and • Make use of sediment traps to prevent sediment entering watercourses.

9. Environmental Management Plan

The EMP is described in Table 9-1 below.

Table 9-1: Environmental Management Plan

Phase	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period for Implementation
Establishment	• Site clearance and vegetation removal.	• Direct loss of wetland areas; • Habitat loss; • Loss of biodiversity; and • Erosion and sedimentation of wetland areas.	• Avoid infrastructure within wetlands as far as possible, especially wetlands with a high PES, EIS and ES rating; • Establishment of a 100 m buffer zone to protect wetland areas from infrastructure within the study area. This would require that development occur further than 100 m from a delineated wetland area; • Place sediment trapping berms on the boundary of the 100 m buffer or end of development; • Ensure concurrent rehabilitation with special attention to reshaping the areas and re-vegetating. • If erosion has occurred, topsoil should be sourced, replaced, vegetated and shaped to reduce the recurrence of erosion in wetlands; • Only the designated access routes are to be used to reduce any unnecessary compaction of surfaces and therefore increased flow into the wetlands; • Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands; and • When the temporary haul roads are deconstructed, the area should be ripped and re-vegetated to prevent impacts to the environment.	Concurrent rehabilitation through the life of mine	Life of Establishment Phase
	• Construction of a temporary haul road (20 m width) to gain access to the sand mining area.	• Fragmentation of wetland areas; • Habitat loss; • Loss of biodiversity; and • Erosion and sedimentation of wetland areas.			
Operational	• Mining of sand resources including screening (if required) to approximately 0.4 – 2 m and stockpiled in a separate area	• Direct loss of wetlands; • Water quality contamination and deterioration; • Habitat loss as a result of poor water quality; • Loss of biodiversity; and • Erosion and sedimentation within the wetlands.	• Avoid infrastructure as far as possible within wetlands, especially wetlands with a high PES, EIS and ES rating; • Establish a 100 m buffer zone to protect wetland areas from the proposed infrastructure within the study area. This would require that development occur further than 100 m from a delineated wetland area; • Place sediment trapping berms on the boundary of the end of development; • Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands;	Concurrent rehabilitation through the life of mine	Life of Operational Phase

	• Transportation of material on haul roads	• Erosion of wetland crossings associated with the haul road; • Accidental spills causing soil and water contamination; • Habitat loss as a result of poor water quality; • Loss of biodiversity; • Siltation of wetlands due to erosion; and • Change in habitat and potential change in species composition.	• Ensure concurrent rehabilitation with special attention to reshaping the areas and re-vegetating; • Develop and implement a Wetland Offset Strategy and Rehabilitation plan for the wetlands in the Project area. • Maintain and monitor wetland functionality; • Monitor the roads monthly to identify and rectify any areas that have begun to erode and where water may be flowing towards wetland areas. • Restrict vehicle movement in delineated wetlands; • Only the designated access routes are to be used to reduce any unnecessary compaction leading to erosion, increased runoff and fragmentation of wetlands; • Rip rehabilitated areas to reduce compaction and reseed to increase vegetation cover; and • Clean up spills immediately to prevent migration of contaminants into the wetlands. • Conduct pollution monitoring along the low-lying areas (wetlands) to detect any high levels of pollutants if spills has occurred; • Create a designated refuelling area; • Prevent contaminated water entering the remaining freshwater systems (wetlands); and • Any spillages should be cleaned up immediately, and the contaminated material should be disposed of at licenced disposal sites.		
	• Refuelling of machinery within the mining area or at the mobile offices	• Water quality contamination and deterioration; • Potential spills may lead to loss of vegetation, causing sedimentation of wetlands, contamination, habitat loss and potential change in species composition; • Habitat loss as a result of poor water quality; and • Loss of biodiversity.			
Decommissioning	• Concurrent rehabilitation (topsoil cover, ripping and vegetation establishment) and monitoring of vegetation establishment	• Erosion due to rehabilitated areas being exposed to wind and surface water runoff; • Siltation of watercourses leading to deteriorated water quality and altered geomorphology; and ; • Change in habitat and potential change in species composition.	• Continue with Concurrent Rehabilitation, and implement wetland rehabilitation measures; • Address areas of AIPs proliferation by utilizing a AIPs Program; • Ensure proper stormwater management designs are in place to ensure no excessive run-off or pooling occurs; • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions. • The unusable soil (pebbles, rocks, gravel etc.) must be placed below the topsoil and compacted to prevent increased infiltration; • If erosion has occurred, topsoil should be sourced, replaced, vegetated and shaped to reduce the recurrence of erosion in wetlands; • Only the designated access routes, outside of wetlands, are to be used to reduce any unnecessary compaction of surfaces and therefore increased flow into the wetlands;	Concurrent rehabilitation through the life of mine	Life of Decommissioning and beyond
	• Backfilling of the mined excavations with topsoil and unusable soil (pebbles, rocks, gravel etc.) from the screening plants	• Water quality contamination and deterioration due to an increase in sedimentation and waste material; • Habitat and biodiversity loss as a result of poor water quality; • Water ponding and preferential flow paths; • Siltation of wetlands leading to deteriorated water quality and quantity; and • Change in habitat and potential change in species composition.			

	• Post-closure monitoring	• Soil compaction, leading to increased runoff and changes to the wetland functionality (e.g., erosion); • AIPs proliferation due to changes to the natural landscape, soils and wetlands; • Changes to the habitat, wetland functionality and biodiversity.	• Place sediment trapping berms where erosion has occurred; and • Minimise the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands. • Use vehicles as little as possible in the wetlands, monitoring should preferable be done on foot; and • Wetland monitoring during the wet season for three years post-closure and report with rehabilitation recommendations if necessary.		

10. Monitoring Programme

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

The monitoring programme are based on the following points:

- External monitoring should commence from prior to the Establishment Phase to ensure baseline information regarding soils and vegetation and to monitor any changes thereof;
- Throughout the Establishment Phase, external monitoring should be done annually for wetlands and vegetation, preferable right after the rainy season (March to May);
- Throughout the Operational and Decommissioning Phases, bi-annual (twice a year) external monitoring of wetlands, preferable one survey after the rainy season (March to May) and one after the dry season (July to September);
- Monitoring should be done in terms of:
  - Appendix 6 of the NEMA EIA Regulations, 2014, (as amended);
  - NEMA, 1998 (Act No. 107 of 1998) (NEMA);
  - NEM:WA, 2008 (Act No. 59 of 2008); and
  - CARA, 1983 (Act No. 43 of 1983) (CARA).
- The Mine Manager (MM) and the Environmental Practitioner (EP) are responsible to report on results of the monitoring program; 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.

As the proposed MREA is comprised largely of wetland habitat, it is recommended that the WET-Health and WET-Ecoservices tools should be used to re-evaluate PES and eco-services on a bi-annual (twice a year) basis by a suitably qualified wetland specialist for the duration of the Establishment Phase, and annually for the duration of the Operational Phase. Upon closure and decommissioning, annual monitoring should take place for another three years to ensure no emerging impacts are identified, which may need to be addressed.

Table 10-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Responsibility
Wetland area size	Implementation of intervention measures.	Wetland update report and recommendations for impact mitigation, if any.	Once every year.	Environmental Officer.
Wetland health (PES, EIS and ES)	Implementation of intervention measures.	Wetland update report and recommendations for impact mitigation, if any.	Once every year.	Environmental Officer.
Wetland physical attributes	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take photos of wetland areas and record any impacts seen.	Every three months and after storm events.	Mine Environmental Manager.

11. Stakeholder Engagement Comments Received

The consultation process affords Interested and Affected Parties (I&APs) opportunities to engage in the EIA process. The objectives of the Stakeholder Engagement Process (SEP) include the following:

- To ensure that I&APs are informed about the Project;
- To provide I&APs with an opportunity to engage and provide comment on the Project;
- To draw on local knowledge by identifying environmental and social concerns associated with the Project;
- To involve I&APs in identifying methods in which concerns can be addressed;
- To verify that stakeholder comments have been accurately recorded; and
- To comply with the legal requirements.

The Public Participation Process (PPP) has been completed in part, as a process separate to the EIA. No formal consultation was undertaken as part of this assessment. Should any I&AP comments be submitted in relevance to soil resources during the SEP, these will be considered in the final EIA report.

12. Recommendations

The following actions are recommended to reduce adverse effects on the wetland resources of the Project Area (Table 12-1):

Table 12-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations	Person Responsible
Loss of wetlands	Identify the most important wetland system (high PES, ES and or EIS score) on site and use for wetland offsetting. Compensate the loss of other wetlands that will be mined with one wetland that will be rehabilitated and offset.	Wetland ecologist and Botanist.
Soil disturbance, and decreasing biodiversity resulting in increased sedimentation and increased erosion.	Improve vegetation cover and establish hydrophytic plants and facultative hydrophytes that are native to the area. Reduce risk of erosion and sedimentation. This should be done as soon as possible to avoid long standing bare areas.	Wetland ecologist, Botanist and Soil Scientist.
Linear infrastructures resulting in fragmentation of wetlands, the creation of preferential flow paths, and the onset of erosion.	Reduce risk of erosion, compaction, and the creation of preferential flow paths. Maintain linear infrastructure and ensure proper stormwater management	Wetland ecologist.
Erosion/Sedimentation.	Reduce risk of erosion and sedimentation of downstream wetland areas by re-vegetation, sediment traps and monitoring.	Wetland ecologist.
Increased inputs of pesticides and fertilisers due to a reduced buffer capacity of wetlands and increased surface runoff.	Employment of a protective vegetated buffer strip around the wetlands and creating 'no-go' areas after rehabilitation to ensure establishment of vegetation.	Wetland ecologist and Botanist.

13. Reasoned Opinion Whether Project Should Proceed

Based on the aforementioned information and impact ratings, it is the opinion of the specialist that this project will have major impacts on the wetlands. However, when Wetland Offsetting and the proposed mitigation measures and recommendations are incorporated, the impacts will be reduced. It is highly recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise potential impacts.

It is advised that one wetland is targeted for wetland offsetting and protected against any mining activities that will be used to compensate for other wetlands that will be mined. It is recommended to target a section of the Floodplain and associated VBs (west) for wetland offsetting. However, it is highly advised to first calculate the wetland hectare equivalent to determine the area to be offset.

A Rehabilitation Audit Program is recommended to ensure successful rehabilitation and to achieve successful rehabilitation and functioning of wetlands after mining.

Wetland management measures and monitoring requirements as set out in 8.1.1 should form part of the conditions for environmental authorisation.

It is recommended to do a Wetland Offset Assessment to calculate the total wetland loss and determine the number of wetlands to be offset. The complete removal of wetlands in the headwaters of the catchment may cause loss of water inputs to the lower catchment and therefore have a major effect of the downstream biodiversity, aquatic systems, fauna and flora.

14. Conclusion

The wetlands associated with the MREA were categorised into six HGM types namely:

- CVB and seep (east);
- CVB (west);
- Floodplain (east);
- Floodplain and associated VBs (west);
- Seep (east);
- Valley head seep and CVB (west).

The wetlands cover **1638.733 ha** which amounts to **58.62 %** of the total **2795.7 ha** MREA. The loss of wetlands in the proposed excavation areas that cannot be mitigated or reduced, has been recommended to implement a Wetland Offset strategy. A ‘no-go’ zone is recommended for the rehabilitated wetlands and mined out areas to aid in the re-establishment of wetland functions and vegetation and also to make provision for rehabilitation results.

The MREA are currently heavily impacted by agropastoral activities as well as historical and current mining activities. The wetland health, functionality and ecological state of most of the wetlands are low and not natural.

The overall impacts of the project were determined to be significant and may potentially lead to an irreversible damage to the remaining wetland in the MREA. The loss of wetland areas leads to altered ecosystem functioning and the loss of biodiversity. The recommended mitigation measures will not restore wetland areas that are lost because of the Project; however, will be to rehabilitate and preserve un-impacted wetlands and improve their functioning. A Wetland Offset Calculator should be applied to determine the total wetland loss and to compensate for significant residual adverse impacts.

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Appendix A: Methodology

16. Methodology

16.1. 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.

For the purpose of this assessment, wetland areas were identified, and preliminary wetland boundaries were delineated at the desktop level using detailed aerial imagery and wetland signatures, along with 5 m contours. Baseline and background information were researched and used to understand the area on a desktop level prior to fieldwork confirmation. This included but was not limited to:

- A practical field procedure for the identification and delineation of wetlands and riparian areas (Department of Water Affairs and Forestry, 2005);
- WET-RoadMap: A Guide to the Wetland Management Series (WRC, 2007);
- NFEPA (Driver, et al., 2011; Nel, et al., 2011);
- Mining and Biodiversity Guidelines, DEA et al. (2013);
- Free State Biodiversity Plan (Collins, 2016); and
- Wetland Offsets: A Best Practice Guideline for South Africa (SANBI and DWS, 2016);

Relevant and available historical studies conducted within, or surrounding the Project Area, the South African National Biodiversity Institute (SANBI), Water Management Areas (WMA) and Quaternary Catchments, the National Spatial Biodiversity Assessment, Vegetation types of South Africa (Mucina & Rutherford, The Vegetation of South Africa, Lesotho and Swaziland., 2012), and Fauna distribution and identification books of South Africa (Friedman & Daly, 2004; Skinner & Chimimba, 2005) were some of the platforms used to identify and create a background study of the area.

16.1.1. 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) sub-national 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 were ranked in terms of their biodiversity importance and as such, Wetland FEPAs were identified in an effort to achieve biodiversity targets (Driver, et al., 2011). Table 16-1 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 16-1: 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 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

16.1.2. 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, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013) (Table 16-2).

Table 16-2: 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.

16.1.3. Free State Biodiversity Plan

The Free State Biodiversity Plan (Collins, 2016) is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for in national legislation and policy. The Free State Biodiversity Plan was published in 2016, and like those of the other provinces, identifies and maps terrestrial categories with associated land-use and management guidelines. The categories are divided into Protected Area (PA), Critical Biodiversity Area (CBA), Ecological Support Area (ESA), Other Area and Degraded Area (Table 16-3).

The main objective is the sustainable use of resources to unlock meaningful and lasting benefits for both the people of the Free State Province (e.g. enhancing human well-being) and the environment (e.g. enhancing the integrity of the environment). This means that any resource use must, on balance, 'improve the state of' the conditions or circumstances prevalent in the area to be affected by the resource use (Collins, 2016).

Table 16-3: Free State Biodiversity 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	CBA Irreplaceable A site that is irreplaceable or near-irreplaceable for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with the site. Such sites are therefore critical and they need to be maintained to ensure that features targets are achieved and that such features persist. CBA Optimal A site that has been selected based on its complementarity for meeting biodiversity targets. CBA Optimal sites are therefore important but their maintenance is not critical to ensure that features targets are achieved and that such features persist.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESAs	Area which plays important roles in supporting the ecological functioning of a PA or CBA, or in delivering ecosystem services. In most cases ESAs are currently in at least fair ecological condition, and should remain in at least fair functioning condition. ESA1: sites with minimal degradation. ESA2: sites with degradation, i.e. they can be totally degraded, but not totally transformed.	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
Other	Areas of natural habitat not required to meet biodiversity targets for ecosystem types, species or ecological processes, i.e. natural areas not selected as CBA or ESA.	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.
Degraded	Areas of degraded or transformed habitat that has not been selected as an ESA, i.e. all remaining areas.	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.

16.2. Wetland Identification, Delineation and Classification

The Copper Sunset MREA encompasses of large wetland areas. Due to the size of the MREA, a detailed desktop delineation was done prior the field assessment for budget and time purposes. The site survey was therefore done for ground truthing purposes to verify the desktop delineations as well as compiling data and information to assess the wetland health, ecological state and importance and sensitivity.

The wetland delineations were verified according to the accepted methodology from the Department of Water and Sanitation ‘A practical field procedure for identification and delineation of wetlands and riparian areas’ (Department of Water Affairs and Forestry, 2005) as well as the “Updated manual for identification and delineation of wetlands and riparian areas” (Department of Water Affairs and Forestry, 2008). These methodologies use the:

- **Terrain Unit Indicator**: Identifies those parts of the landscape where wetlands are more likely to occur;
- **Soil Form Indicator**: Identifies the soil forms, which are associated with prolonged and frequent saturation;

- **Soil Wetness Indicator**: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- **Vegetation Indicator**: Identifies hydrophilic vegetation associated with frequently saturated soils.

16.2.1. Terrain Unit Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, contour data, aerial photographs and engineering and town planning diagrams (Department of Water Affairs and Forestry, 2005). In accordance with the guidelines provided by the DWS (Department of Water Affairs and Forestry, 2005) wetlands are identified and classified into various HGM units based on their individual characteristics and setting within the landscape. The HGM unit classification system focuses on the hydro-geomorphic setting/position of wetlands in a landscape which incorporates geomorphology; water movement into, through and out of the wetland. The HGM unit is dependent on various aspects, including whether the drainage is open or close, water is dominating the system or is sub-surface water, how the water flows from and into the wetlands and how water is contained within the wetland. Once wetlands have been identified, they are categorised into HGM units.

Wetlands in the crest were typically characterized as pans and isolated seep wetlands, whereas wetlands in the scarp, middle slope and foot slope terrain typically identified as valley head seeps, seep wetlands and valley bottom wetlands. Floodplains, un-channelled and channelled valley bottoms were typically identified within the valley bottom terrain (Figure 16-1 and Table 16-4).

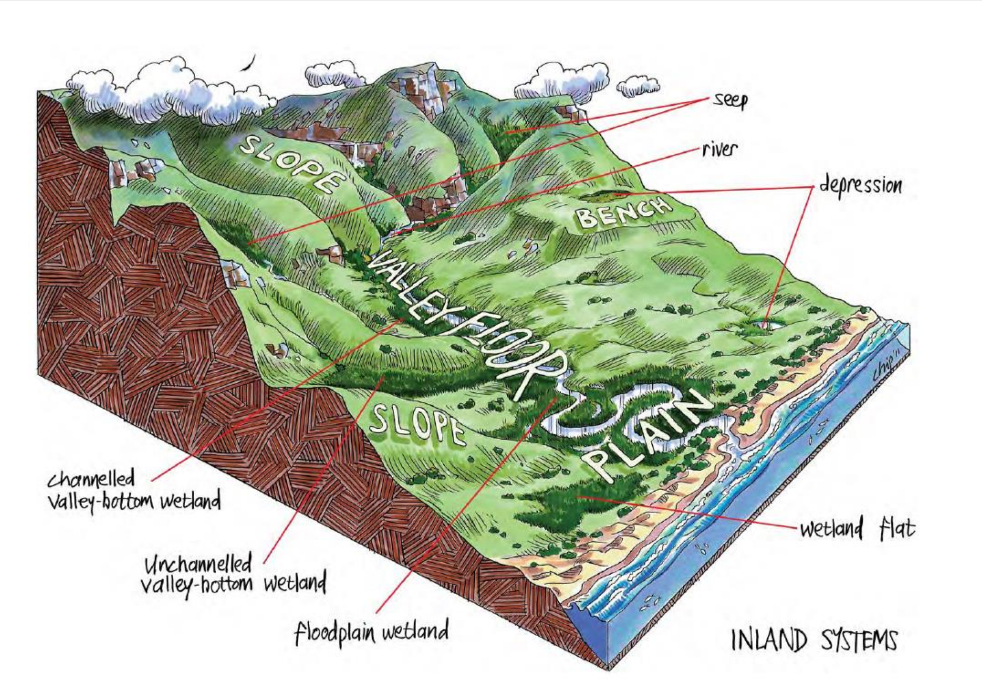
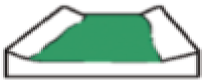


Figure 16-1: Terrain Morphological Units (Ollis, Snaddon, Job, & Mbona, 2013)

Table 16-4: Description of the Various HGM Units for Wetland Classification

Hydromorphic Wetland Type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

16.2.2. Soil Indicators

16.2.2.1. Soil Form Indicators

Hydromorphic soils are characterized as soils that has undergone redox reactions because of the fluctuation of water and oxygen within the soil profile, creating segregations of iron (Fe) and manganese (Mn) particles. This fluctuation of water and oxygen in the soils can be attributed to the fluctuating ground water table, creating seasonal, temporary and permanent wet zones. Hydromorphic soils are thus Soil Form Indicators (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (Department of Water Affairs and Forestry, 2005). The permanent, as well as occasional saturation of soil results in anaerobic conditions of the soils causing a chemical, physical and biological change to the soil.

Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (Department of Water Affairs and Forestry, 2005). A feature of hydromorphic soils are coloured mottles (iron and manganese accumulation) which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils and are less abundant in temporarily saturated soils (Department of Water Affairs and Forestry, 2005). The hydromorphic soils must display signs of wetness within 50 cm of the soil surface, as this is necessary to support hydrophytic vegetation.

Soils that are commonly associated with wetlands are: Champagne, Rensburg, Arcadia, Katspruit, Kroonstad, Longlands, Fernwood and Westley soil forms. These soil forms are associated with high clay content and accumulation of clay, promoting water logging and creating low drainage, thus water logging conditions. These soils are commonly associated with low-laying landscapes such as valley bottoms, foot-slopes and mid-slopes.

16.2.2.2. Soil Wetness Indicators

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (Department of Water Affairs and Forestry, 2005). Iron and manganese accumulation in a soil profile, termed mottles, are some of the recognized ‘wet-indicators’. These two elements are insoluble under aerobic (unsaturated) conditions and become soluble when the soil becomes anaerobic (saturated). The fluctuating water table creates these conditions by increasing and reducing the oxygen levels in the soil profile by increased and reduced water levels. Iron is one of the most abundant elements in soils and is responsible for the red and brown chroma of many soils.

During anaerobic (saturated) conditions, the iron and manganese in the soils are mobile and thus begin to leach out of the soil profile. Where oxidation takes place around for example roots, aggregate surfaces and pores, relatively insoluble ferric oxides is deposited leading to formation of red/green mottles and concretions. These soil profiles are commonly known as leached soils, gleysol, E-horizons or Albic horizons. Resulting from the prolonged anaerobic conditions, the soil matrix is left a grey, greenish or bluish colour, and is said to be “gleyed”.

Recurrence of the cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has mottles within the first 0.5 m of the surface are indicating a zone that is seasonally or temporarily saturated, interpreted and classified as a wetland (Department of Water Affairs and Forestry, 2005).

16.2.3. Vegetation Indicator

Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze & Marneweck, Guidelnes for delineating the wetland boundary and zones within a wetland under the South African Water Act, 1999; Department of Water Affairs and Forestry, 2005). This is summarised in Table 16-5 below.

When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (Department of Water Affairs and Forestry, 2005). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 16-5 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (Department of Water Affairs and Forestry, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineate wetland areas.

Table 16-5: Classification of Plant Species According to Occurrence in Wetlands

Type	Description
Obligate Wetland Species (OW)	Almost always grow in wetlands: > 99% of occurrences.
Facultative Wetland Species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67-99% of occurrences.
Facultative Species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34-66% of occurrences.
Facultative Dry-land Species (FD)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1-34% of occurrences.

(Source: (Department of Water Affairs and Forestry, 2005))

16.3. Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane et al. (2009), 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 1 WET-Health assessment was done on the wetlands in accordance with the method described by Macfarlane et al., (2009) to determine the integrity (health) of the characterised HGM units for the wetlands associated with the Copper Sunset 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 is calculated using Equation 1, which provides a score ranging from 0 (pristine) to 10 (critically impacted in all respects).

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 16-6 (Macfarlane, Kotze, & Ellery, 2009).

$$Wetland\ Health = \frac{3(Hydology) + 2(Geomorphology) + 2(Vegetation)}{7}$$

Equation 1: Overall Wetland Ecological Health Score

Table 16-6: 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 16-7) (Macfarlane, Kotze, & Ellery, 2009).

Table 16-7: 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 and vegetation components provide a summary of impacts, PES, Trajectory of Change and Health for individual HGM units and for the entire wetland.

16.4. 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 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 16-8).

Table 16-8: 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

16.5. 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, Ellery, Macfarlane, & Jewitt, 2012; Rountree, Malan, & Weston, 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 16-9.

Table 16-9: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very High Systems that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4
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

16.6. 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:

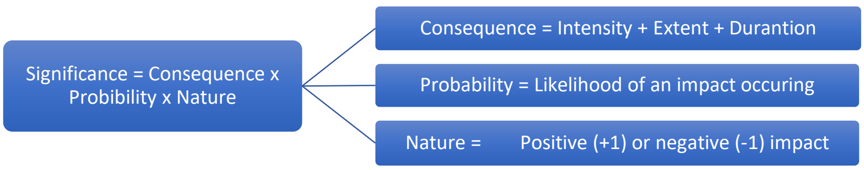
- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability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

16.6.1. 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:



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 16-12. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

16.6.2. 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 16-11, which is extracted from Table 16-12. The description of the significance ratings is discussed in Table 16-10.

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.

16.6.3. 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, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity

Institute, 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 16-10.

Table 16-10: 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 16-11: 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 16-12: 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 16-13: 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) (-)