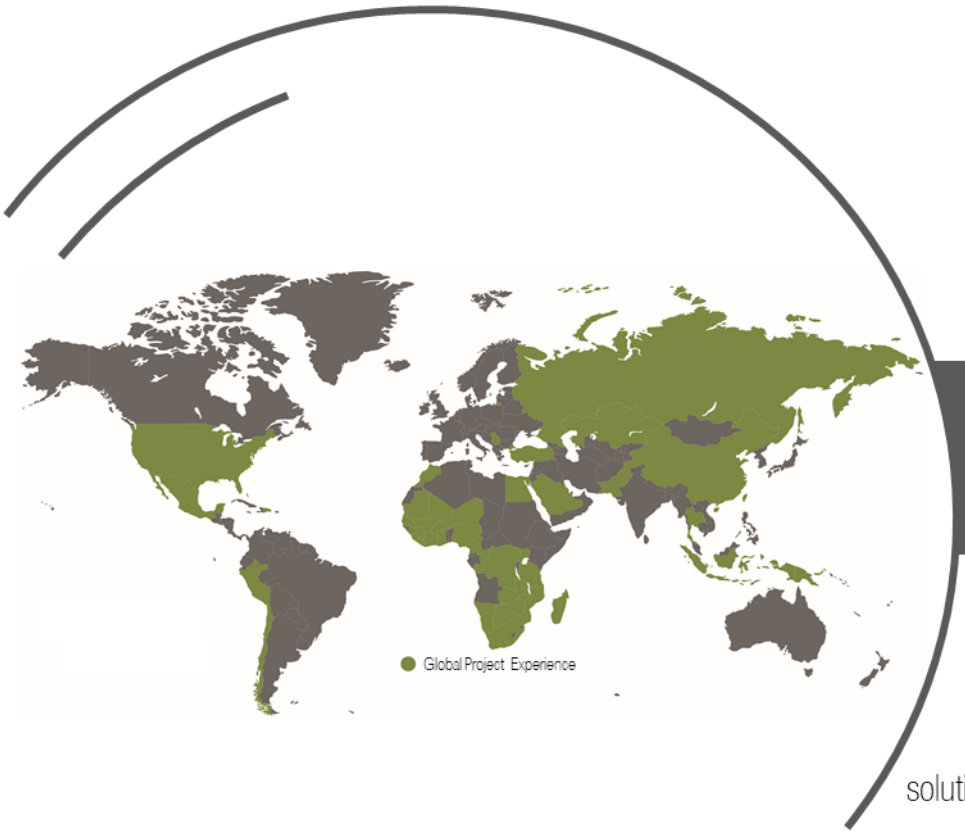

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Basic Assessment Process for the Closure of the Cooke Underground Operations

Wetland Impact Assessment

Prepared for:
Sibanye Gold Limited

Project Number:
SIB6297

October 2020

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This document has been prepared by Digby Wells Environmental.

Report Type:	Wetland Impact Assessment
Project Name:	Basic Assessment Process for the Closure of the Cooke Underground Operations
Project Code:	SIB6297

Name	Responsibility	Signature	Date
Brett Coutts	Report Compiler		October 2020
Danie Otto	Report Reviewer		October 2020
Mia Smith	Project Manager		October 2020

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DETAILS AND DECLARATION OF THE SPECIALIST

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Qualification(s):	BSc Animal, Plants and Environmental Science
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I, Brett Coutts, 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.

Signature of the Specialist *Date 06/10/2020*

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 [DWE] (hereinafter Digby Wells) was appointed by Sibanye Gold Limited, a subsidiary of Sibanye-Stillwater Ltd. (hereinafter Sibanye), Rand Uranium Operations to conduct a wetland impact assessment for the decommissioning activities associated with the Cooke Underground Closure Project. The project entails decommissioning of the Cooke 1, 2 and 3 shafts and associated infrastructure, rewatering of the underground workings, cessation of pumping and discharge of extraneous groundwater and rehabilitation activities associated with the proposed closure.

Twenty five hydro-geomorphic (HGM) wetland units were identified within the Cooke Mining and Surface Right Areas. The area had unchannelled valley bottom wetlands, ephemeral drainage lines, hillslope seeps, channelled valley bottom wetlands, depressions/pans and artificial wetlands.

The wetland HGM units identified exhibit a variety of PES values, ranging from *Seriously Modified*, to *Moderately Modified.* Some of the impacts associated with the area are a result of both historic and current mining activities, illegal mining activities, impacts from urban development and discharging of water both from current water management activities associated with the Cooke Underground Mining Right Area and sewage treatment plants. In addition to this other activities such as cattle grazing and other agricultural activities have impacted and are currently impacting upon wetland resources within the area.

The Ecological importance and Sensitivity (EIS) is *Low* to *High* as most of the wetland HGM Units are sensitive to changes but still provide habitat for various species. Thus, despite the altered wetland integrity from their natural states, the wetland HGM units identified do still provide hydrological important services such as streamflow regulation, sediment trapping and assimilation of toxicants, phosphates and nitrates. In general, the EIS for 'Direct Human Benefits' is considered lower as there is limited human use of water, natural resources and cropping and limited cultural benefit of some of the wetlands.

Biodiversity maintenance is varied for the different wetlands. This is partly due to the fact that cumulative loss/degradation of wetland in the area is moderate too high, Alien Invasive Plant Species (AIP's) are proliferating and indigenous vegetation being encroached upon making the remaining wetlands even more important for meeting these functions.

The proposed decommissioning activities may have direct impacts to the wetlands adjacent to the shaft areas that are being permanently decommissioned. If the appropriate mitigation measures are adopted, these impacts should be minimal as the activities to be undertaken are not directly within wetland areas, but within the 500m buffer zone of the wetlands.

The rehabilitation of the impacted wetland areas needs to be undertaken to both improve the functionality of these systems, but also negate the negative changes to the receiving watercourses and downstream water users.

With the removal of the shafts and associated infrastructure the overall benefit to the receiving environment would be positive as areas are rehabilitated and natural drainage paths

reinstated. In addition to this, the removal of contamination sources would have a beneficial positive impact.

Decant is not expected from the shafts and eventual rewatering of the partially dewatered dolomitic aquifers leading to the overflow from the eyes in the Wonderfonteinspruit is expected to be of good quality, and should not impact on wetlands that are related to the proposed decommissioning activities.

In saying this it is still recommended that monitoring and updating of the groundwater numerical models is still done as information becomes available to ensure that if additional mitigation measures are required they can be implemented in a timeously to avoid further degradation to the environment occurring, as recommended in the Geohydrological Assessment submitted in support of the proposed activities.

The overall rehabilitation of Magazine Pan and other wetlands within the area would improve the functionality of the associated systems. In addition to this it would be anticipated that there would be an overall improvement of ecological services provided for by these systems.

Even though the wetlands assessed and discussed have been impacted upon as a result of several different activities within the region these systems still play a major role major role in controlling the hydrology of the West Rand, which is of national importance as the Vaal and Crocodile River systems are downstream. They are also important as they support a range of ecological processes and biodiversity in the region. It is thus finally recommended that any activities that are undertaken within the region take into account potential ways in improving the functionality of these systems in the long term.

Based on the impact assessment, mitigation measures and recommendations that have been proposed, it is the opinion of the specialist that the project should proceed. It is anticipated that the potential positive impacts would outweigh the negative impacts in the long term and thus the associated closure activities would ultimately be beneficial for the receiving environment. As closure activities are undertaken there is the potential that areas within the catchment could return back to pre-mining conditions overtime as the closure progression of mines takes place. To do this all roleplayers within the catchment need to work together (integrated catchment approach) , this will allow for better decision making towards closure. This will require the support of both national and regional regulators and other water users.

It is anticipated that overtime certain wetlands areas could return to pre-mining conditions as a result of the progression of closure related activities within the catchment as mines close in the area. All role players within the catchment will need to work together, which will allow for better decision making, which will ultimately lead to progressive rehabilitation objectives being achieved. Ultimately an integrated catchment approach to closure needs to be established with support from national and regional regulators and other water users.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

AIP	Alien Invasive Management Plan
BRP	Bioregional Plan
CMA	Catchment Management Agencies
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
DWAF	Department of Water and Forestry
DWE	Digby Wells Environmental
DWS	Department of Water and Sanitation
EC	Ecological Class
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMO	Environmental Management Officer
F	Facultative species
FD	Facultative dry-land species
FW	Facultative wetland species
GDARD	Gauteng Department of Agriculture and Rural Development
GIS	Geographical Information System
Ha	Hectares
HGM	Hydrogeomorphic
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Area
MTIS	Mineable tonnes in-situ
NEM:BA	National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystems Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OW	Obligate wetland species
PCD	Pollution Control Dam
PES	Present Ecological State

REC	Recommended Ecological Category
RQIS	Resource Quality Information Services
SANBI	South African National Biodiversity Institute
SFI	Soil Form Indicator
SWI	Soil Wetness Indictor
TUI	Terrain Unit Indicator
WMA	Water Management Areas
WRC	Water Research Commission
WRDM	West Rand District Municipality
WUL	Water Use Licence

LEGAL REQUIREMENTS

This report has been compiled in accordance with Appendix 6 of the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) promulgated National Environmental Management Act, 1997 (Act No. 107 of 1997) (NEMA) which specifies the legal requirements for a Specialist Report.

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 5
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Pg. ii & iii
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section
cA	And indication of the quality and age of the base data used for the specialist report;	Section 6.1
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 8

Legal Requirement		Section in Report
(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 6
(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 8
(g)	an identification of any areas to be avoided, including buffers;	Section 8
(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 8
(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 9
(k)	any mitigation measures for inclusion in the EMPr;	Section 10
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 13
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
(n)	a reasoned opinion (Environmental Impact Statement) -	Section14
	whether the proposed activity, activities or portions thereof should be authorised; and	Section 14
	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;	N/A
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q)	any other information requested by the competent authority.	N/A

1 Introduction

Digby Wells Environmental (hereafter Digby Wells) was appointed by Sibanye Gold Ltd (a subsidiary of Sibanye-Stillwater Ltd., hereinafter Sibanye), owners of Rand Uranium (Pty) Ltd (hereafter Rand Uranium), to undertake the closure and rehabilitation studies in support of the environmental regulatory process to authorise the decommissioning, rehabilitation and ultimate closure of the Cooke 3, 2 and 1 Shafts. Underground mining activities associated with these shafts are authorised under Mining Right (GP) 30/5/1/2/2 (07) MR (hereinafter referred to as the Cooke Underground Operations).

A Basic Assessment Process has been undertaken in terms of the EIA Regulations, 2014 (GN R326 of 7 April 2017), as amended, promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). It is noted that the environmental regulatory process also includes an application for a Water Use Licence (WUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

This report constitutes the Wetlands Specialist Impact Assessment Report to identify and quantify positive- and negative impacts on the wetlands as a result of decommissioning and rehabilitation activities to be undertaken at the Cooke 3, 2 and 1 Shafts, as well as the ultimate closure state of the shafts and associated infrastructure.

2 Project Description

Rand Uranium is the holder of a converted Mining Right for the Cooke Underground Operations which are located within the West Rand District Municipality, approximately 10 kilometres (km) south-east of the town Randfontein (Figure 2-1 and Figure 2-2).

The operations comprise three underground mine shaft complexes, namely: Cooke No. 1, No. 2 and No. 3 Shafts. The underground workings are accessible through vertical shafts at each of these complexes. Infrastructure in the underground workings includes water pumping and treatment systems including clarifiers, attenuation and settling dams as well as storage areas, underground walkways and conveyors. Ancillary surface infrastructure including administrative and workshop buildings water management structures (e.g. water storage infrastructure, trenches, berms etc.) are also in place at each of the complexes.

Underground mining at all three shafts ceased in May 2018. Sibanye has maintained an extensive groundwater pumping and treatment scheme to keep the underground workings dry in case of the recommencement of mining in future. Following extensive investigations, no sustainable mining plans were found to be feasible and as such, a permanent closure solution is now being sought out.

The scope of final decommissioning, rehabilitation and closure activities being applied for by Rand Uranium are described below.

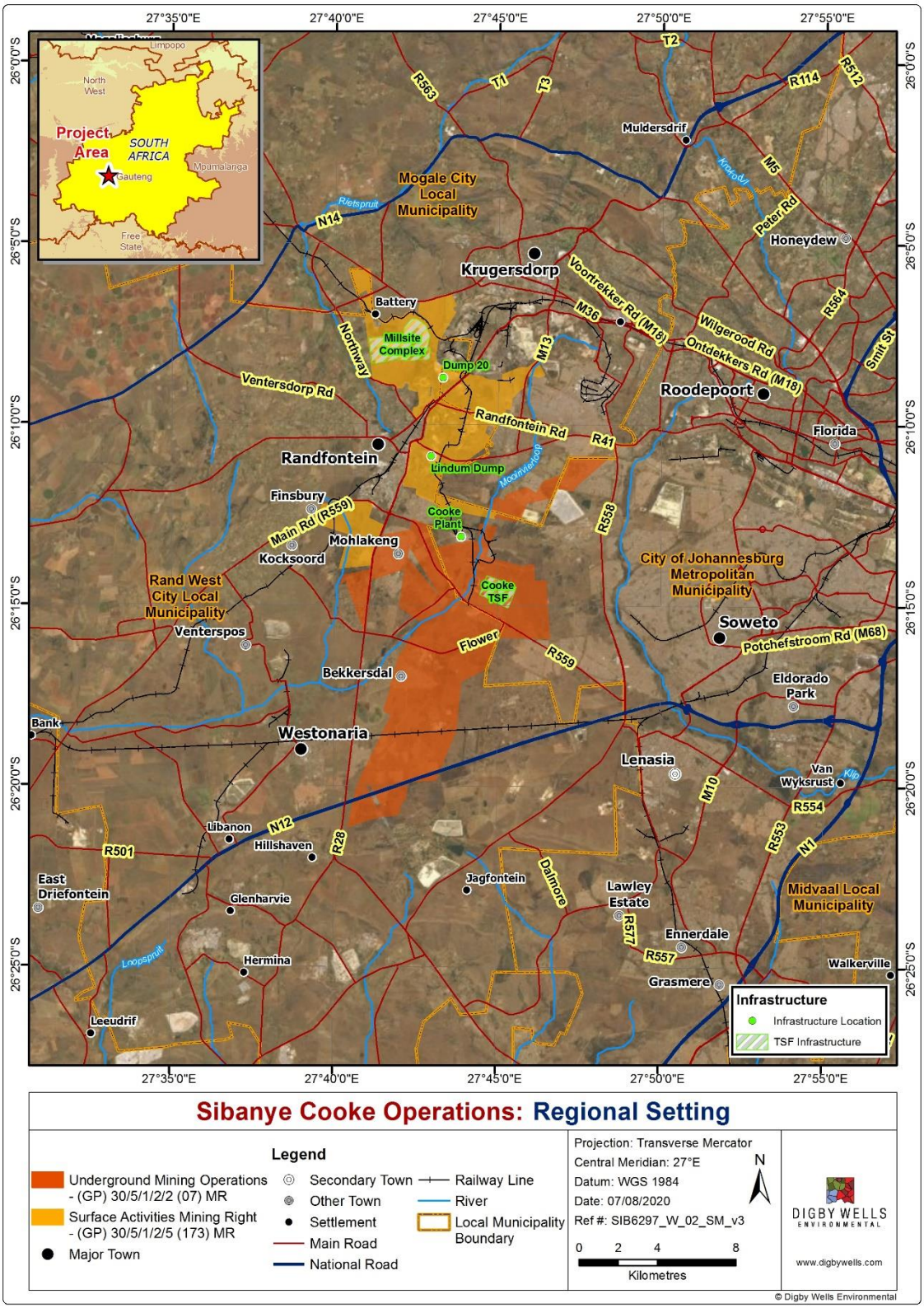


Figure 2-1: Regional Setting

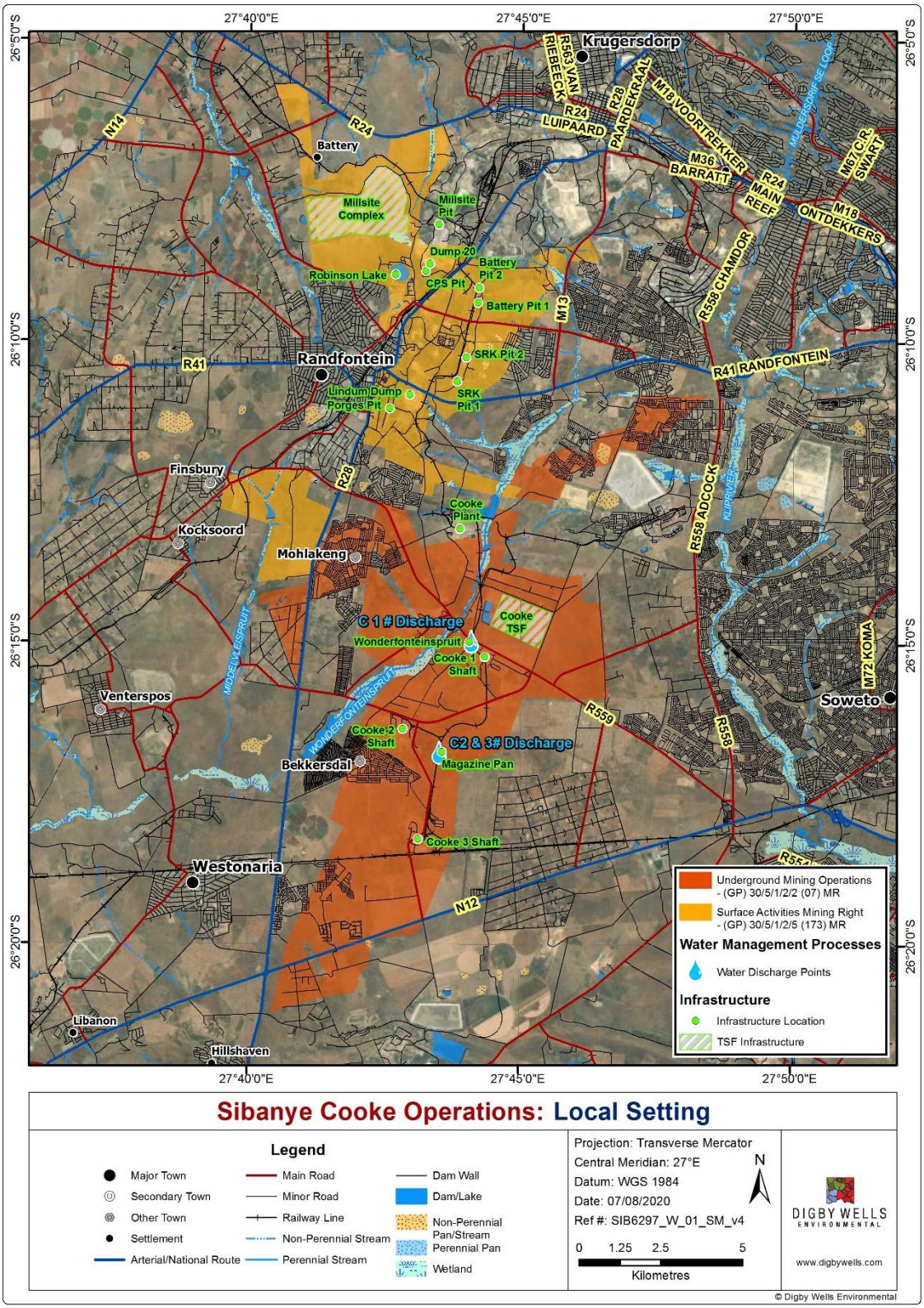


Figure 2-2: Local Setting

2.1 Cessation of Underground Water Pumping- and Discharge Remine

During this time, Rand Uranium maintained an extensive groundwater pumping and treatment scheme to continue access to the underground mine workings through the prevention of the flooding of mining areas due to groundwater ingress. Extraneous water collected from underground is treated in a series of settlers after which it is transported to surface for further settlement, evaporation and discharge to the environment.

An overview of the process is described in Table 2-1 and depicted in Figure 2-3 below.

Table 2-1: Water Management Process at Cooke 3, 2 and 1 Shafts

Process step	Cooke 1 Shaft	Cooke 2 and 3 Shafts
Collection and treatment of extraneous underground water	• Underground water from Cooke 1 Shaft is pumped to and treated through a series of settlers and stored in underground dams located at Cooke 1 Shaft.	• Underground water from Cooke 3 Shaft is pumped and gravitated to Cooke 2 Shaft. • The underground water is treated through a series of settlers and stored in underground dams located at Cooke 2 Shaft.
Surface treatment	• From the underground dams, water is pumped to surface for settling of suspended solids as well as for attenuation purposes.	• From the underground dams, water is pumped to surface for settling of suspended solids as well as for attenuation purposes.
Transport and end-destination	• Water is discharged by means of a concrete canal into the Wonderfonteinspruit the discharge point is located below Cooke 1 Shaft.	• Water is discharged through a short pipeline and a concrete channel into the Magazine Pan, a depression wetland where evaporation and recharge to underground aquifers.
Sediment disposal	• The settled solids are disposed of in paddocks on surface at the shaft.	• The settled solids are disposed of in paddocks on surface at the shaft.

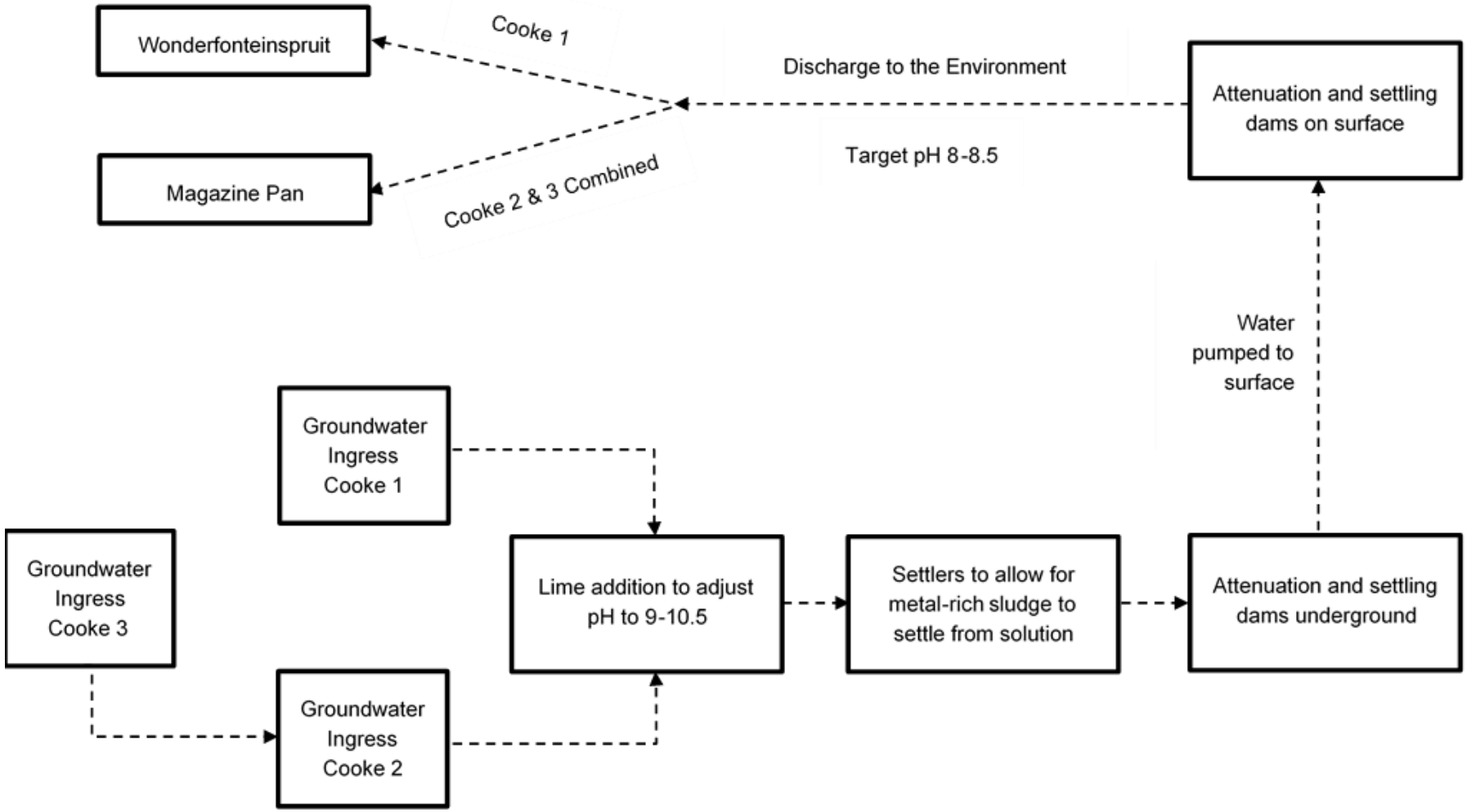


Figure 2-3: Water Management Process

The scope of decommissioning, rehabilitation and closure activities to be undertaken as a result of the cessation of underground water pumping- and discharge regime include:

- Removal and decontamination of underground infrastructure containing hydrocarbons and other contaminants from the Cooke 3, 2 and 1 underground workings;
- Refurbishment of plugs between Cooke 3 and Cooke 4 Shafts, as well as between Cooke 1 and Doornkop Mine;
- Rewatering of underground workings;
- Potential capping of the shaft barrel below the dolomitic aquifer, dependent on specialist studies regarding the groundwater quality;
- Decommissioning of surface dams and rehabilitation of dam footprints;
- Removal of settled solids from surface paddocks and mud ponds for processing through the Plant and/or disposal into the Pits;
- Rehabilitation of surface paddocks and mud ponds;
- Decommissioning and rehabilitation of concrete channels; and
- Rehabilitation of Magazine Pan, a pan used for water management.

2.2 Removal of Shaft Infrastructure

The scope of decommissioning, rehabilitation and closure activities for shaft infrastructure at Cooke 3, 2 and 1 Shafts include:

- Decommissioning of shaft headgear and surface infrastructure;
- Capping of shafts;
- Sale of salvageable items;
- Disposal of waste; and
- Rehabilitation of infrastructure footprints.

It is proposed to remove all surface infrastructure to reduce the risk of vandalization and theft by illegal activities prevalent in the area. The shafts will be capped, and potentially backfilled (tailings, rock and/or rubble, to make the area safe and prevent access to underground workings, which will be rewatered at closure.

2.3 Additional Rehabilitation Activities

In addition to the activities proposed for the permanent closure of the Cooke Underground Operation, Sibanye also intends to undertake closure planning rehabilitation activities of wetlands located at its Cooke Surface Operations, under (GP) 30/5/1/2/5 (173) MR), which have been affected by current and historic legal and illegal mining activities, these activities were not necessarily associated with the Sibanye-Stillwater activities.

The wetlands include:

- Three contaminated wetlands near Lindum Dump;
- Contaminated wetland near Millsite TSF;
- Robinson Lake; and
- Tiger Mills wetland area.

2.4 Alternatives Considered

As indicated above, Rand Uranium has maintained an extensive groundwater pumping, treating and discharge regime at the Cooke Underground Operations while investigating alternatives for the continuation of the operation. No sustainable mining plans, including sale to other parties, were found to be feasible and as such, a permanent closure solution is now being sought. The decommissioning, rehabilitation and closure activities discussed above are the only way to achieve sustainable closure.

3 Relevant Legislation, Standards and Guidelines

The following international, national and regional legislative and policy documents form part of the legislative and policy framework of the Wetland Impact Assessment. The objective is to ensure that the assessments meet all stipulated requirements to ensure legal compliance and successful integration into the regional planning context.

3.1 International Conventions

3.2 The Ramsar Convention

The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is "*the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world*". As of January 2016, 169 nations have joined the Convention as Contracting Parties and more than 2 220 wetlands around the world, covering over 214 million hectares, have been designated for inclusion in the Ramsar List of Wetlands of International Importance.

The original emphasis of the Ramsar Convention was upon the conservation and wise use of wetlands primarily as habitat for water birds. Over the years, however, the Convention has broadened its scope of implementation to cover all aspects of wetland conservation and wise use. Wetlands are now recognised as ecosystems that are vital for biodiversity conservation, as well as for sustainable development.

The inclusion of a wetland site in the Ramsar List confers upon it the prestige of international recognition and embodies the government's commitment to take all steps necessary to ensure the maintenance of the ecological character of the site.

None of the wetlands associated with the Rand Uranium operations have been declared a Ramsar wetland.

3.2.1 Other requirements

Sibanye subscribes to the following international standards for environmental and risk management and therefore aim to comply with the requirements of the following:

- The ISO14001:2015 standard for Environmental Management Systems (EMS);
- The Global Reporting Initiative (GRI) reporting requirements for Environment, Social and Governance (ESG);
- The CDP (formerly known as the Carbon Disclosure Project);
- The Biological Diversity Protocol;
- The International Cyanide Management Code (ICMI) for the manufacture, transport and use of cyanide in the production of gold; and
- Reporting obligations associated with membership to the International Council on Mining and Metals.

3.3 National legislation and policy

The wetlands assessment aims to support the following regulations, regulatory procedures and guidelines:

- Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA);
- Section 5 of the NEMA;
- Department of Water Affairs and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005);
- Mining and Biodiversity Guideline (Department of Environmental Affairs (DEA) *et al*., 2013);
- Gauteng Conservation Plan (Gauteng Department of Agriculture and Rural Development (GDARD), 2011);
- Wetland Management Series (published by Water Research Commission, 2007);
- DWAF Government Notice No. 704 (GN704 of 1999) Guideline Document for the Implementation of Regulations on use of Water for Mining and Related Activities aimed at the Protection of Water Resources.

- National Freshwater Ecosystems Priority Areas (NFEPA) (Nel *et al.,* 2011); and
- South African National Biodiversity Institute (SANBI), in collaboration with the Department of Water and Sanitation (DWS) report on "Wetland offsets: a Best-Practice Guideline for South Africa" (Macfarlane, *et al.,* 2014).

3.3.1 National Freshwater Ecosystem Priority Areas

The NFEPA project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), SANBI, Water Research Commission (WRC), DWS, DEA, Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims 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 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 maximise 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., 2011a).

Wetland clusters are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts (Driver et al., 2011b).

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 FEPA's were identified in an effort to achieve biodiversity targets (Driver et al., 2011b). Table 3-1 below indicates the criteria that were considered for the ranking of each of these wetland areas.

Table 3-1: NFEPA wetland classification ranking criteria

NFEPA Wetland Criteria	NFEPA Rank
• Wetlands that intersect with a RAMSAR site.	1
• Wetlands within 500 m of an IUCN threatened frog point locality; • Wetlands within 500 m of a threatened water bird point locality; • Wetlands (excluding dams) with the majority 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

3.3.2 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 in 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 listed in Table 3-2 below, each with associated risks and implications.

Table 3-2: Mining and Biodiversity Guideline Categories (SANBI, 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 seen as 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.

3.3.3 Gauteng Conservation Plan Background

Gauteng Nature Conservation, a component of GDARD, produced the Gauteng Conservation Plan Version 3 (C-Plan 3) in December 2010. The latest version is C-Plan 3.3 which became available in October 2011 and was revised in December 2013. C-Plan 3.3 is a valuable tool to ensure adequate, timely and fair service delivery to clients of GDARD and will be critical in ensuring adequate protection of biodiversity and the environment in Gauteng Province.

The main purposes of the C-Plan 3.3 are:

- To serve as the primary decision support tool for the biodiversity component of the EIA process;
- To inform protected area expansion and biodiversity stewardship programmes in the province; and
- To serve as a basis for development of Bioregional Plans in municipalities within the province.

3.4 West Rand District Municipality Conservation Tools

The West Rand District Municipality (WRDM), according to the WRDM Environmental Management Framework (EMF) (2013), is experiencing extreme pressure between mining, agriculture and tourism in terms of biodiversity, heritage, air quality, water availability and quality, and geological constraints. According to the NEMA EMF Regulations, an EMF is

defined as "*a study of the biophysical and socio-cultural systems of a geographically defined area to reveal where specific land uses may best be practiced and to offer performance standards for maintaining appropriate use of such land.*" These frameworks are designed to facilitate ease of access to up-to-date environmental information so as to enable decision making related to environmental management principles.

The EMF will serve as a management and decision-support tool that provides authorities with information about the status quo of the environment and the associated planning parameters. It will identify and spatially represent areas of potential conflict between sensitive environments and development proposals.

The aim of the EMF is to:

- Promote sustainability;
- Secure environmental protection; and
- Promote cooperative environmental governance.

Bioregional Plans (BRP) are one of a range of tools provided for in NEM:BA that can be used to facilitate the management and conservation of biodiversity priority areas outside the protected area network.

Similarly to the EMF, the purpose of a BRP is to inform land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity. This is done by providing a map of biodiversity priority areas with accompanying land-use planning and decision-making guidelines. The WRDM BRP was published in November 2011 and revised in March 2014; making it the most recent municipal biodiversity and conservation document. The plan was developed in parallel with and is deliberately designed to be compatible with, the WRDM EMF.

4 Assumptions, Limitations and Exclusions

The following assumptions, limitations and exclusions formed part of this assessment:

- This wetland assessment report is based on previous assessments that have been undertaken for the Cooke Underground Operation Mining Right Area (GP) 30/5/1/2/5 (07) MR and Cooke Surface Operation Mining Right Area (GP) 30/5/1/2/5 (173) MR. During the site assessment these areas were visited and verified to identify if any changes to these systems had occurred.
- The wetland delineation for areas that could not be accessed was based on a desktop assessment and would need to be verified in future;
- The focus of the assessment was to confirm changes to existing wetlands that had been delineated based on the desktop review, identification of any potential new wetlands areas that may have been omitted from previous assessments or not identified; and

- A large portion within the Cooke Mining Right Areas could not be visited as a result of security and safety reasons, thus the previous wetland specialist reports and other existing spatial information was utilised for these areas; and
- Township areas were excluded from this assessment.

5 Detail of Specialists

Mr. Brett Coutts is an Ecologist with a BSc Honours in Ecology, Environment and Conservation. Brett gained practical hands on experience as a project manager on environmental rehabilitation projects at Hydromulch and his roles and responsibilities include the compilation of Basic Assessment (BA) reports, Scoping & Environmental Impact Reports, compilation of Environmental Management Plans (EMP), GIS mapping and Biodiversity Action Plans linking to rehabilitation. Brett is a Principal Consultant within the Closure and Rehabilitation Division and was previously the Divisional Manager of Ecology. Brett is in the process of acquiring is SACNASP Registration as a Professional Natural Scientist.

Prior to his appointment, he gained experience as a junior project manager on environmental rehabilitation projects at Hydromulch and then was appointed by Terra Pacis as an Environmental Consultant where his roles and responsibilities included the compilation of Basic Assessment (BA) reports, Scoping &Environmental Impact Reports, compilation of Environmental Management Plans (EMP), GIS mapping and Biophysical Studies.

Brett has gained working experience with respect wetland assessments during his career at Digby Wells and prior to being at the company. He has completed several assessments within Mpumalanga and Gauteng respectively. In addition to this he has gained experience associated with the compilation of wetland offset assessments and undertaking of wetland offset projects. In addition to this he has been involved with constructed wetlands projects within South Africa and West Africa.

Danie Otto manages the Southern African Operations at Digby Wells. He holds an M.Sc. in Environmental Management with B.Sc. Hons (Limnology & Geomorphology, and GIS & Environmental Management) and B.Sc. (Botany and Geography & Environmental Management). He is a biogeomorphologist that specialises in ecology of wetlands and rehabilitation. He has been a registered Professional Natural Scientist since 2002.

Danie has 24 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.

6 Methodology

6.1 Desktop Review

A desktop review was undertaken of all previous wetland assessment that have been conducted for the area. This was undertake to determine what the areas have been assessed and what has not been assessed within the Cooke Mining Right Area. The following specialist reports were reviewed:

- Sibanye-Stillwater (2018). Sibanye-Stillwater: Klein Wes Rietspruit Wetland Investigation. Environmental Management Department, Sibanye-Stillwater, Gauteng, South Africa;
- Sibanye-Stillwater. 2018. Sibanye-Stillwater: Rand Uranium & Tiger Mills Wetland Assessment and Interim Rehabilitation Plan. Environmental Management Department, Sibanye-Stillwater, Gauteng, South Africa.
- Digby Wells and Associates (Pty) Ltd (2017). Freshwater Resource Assessment in the Vicinity of the Proposed Lindum Railway Decommissioning for Sibanye Still Water;
- Digby Wells and Associates (Pty) Ltd (2017). Freshwater Resource Assessment in the vicinity of the Proposed Millstie TSF Reclamation for Sibanye Still Water; and
- Digby Wells and Associates (Pty) Ltd (2015). Wetland Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project. Soils, Land Capability and Land Use Impact Assessment, Sibanye Gold Limited.

6.2 Study Area

The defined study areas for the Wetland Assessment are associated with the activities associated with the decommissioning of the shaft infrastructure and related activities. In addition to this during the site visit additional areas within the Cooke Mining Right Areas were visited to verify previous specialist wetlands assessment that had been conducted and to identify any other potential wetlands that may be located within the Mining Right Areas. A verification site visit was conducted on the 4th and 5th of June 2020. Refer to Figure 6-1 for areas assessed during the site visits undertaken.

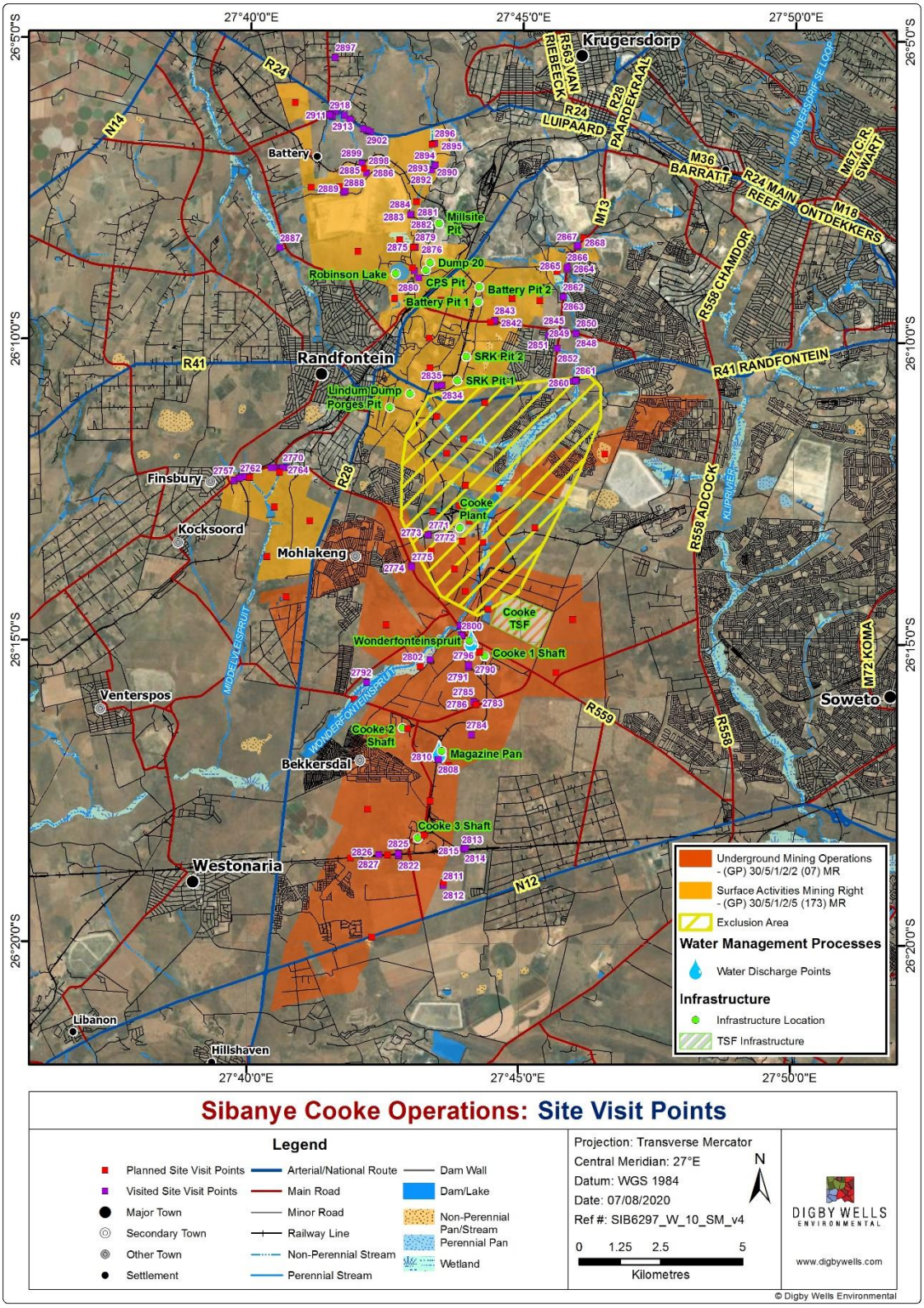


Figure 6-1: Site Visit Locations

6.2.1 Wetland Identification, Delineation and Classification

The wetlands in the Cooke Mining Right Areas were delineated according to the accepted methodology from DWS 'A practical field procedure for identification and delineation of wetlands and riparian areas' (DWAF, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008). These methodologies use the following four indicators of wetland conditions:

- Terrain Unit Indicator (TUI) – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator (SFI) – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator (SWI) – 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.

6.2.1.1 Terrain Unit Indicator (TUI)

TUI areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, aerial photographs, and engineering and town planning diagrams ((South African Dept. Water Affairs and Forestry, 2005)). The Hydro-geomorphic (HGM) unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape or topographic setting. Once wetlands have been identified, they are categorised into HGM units as shown in Table 6-1.

Table 6-1: Description of the various HGM units for wetland classification

Hydromorphic wetland type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined 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.

Hydromorphic wetland type	Diagram	Description
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.

6.2.1.2 Soil Form Indicator

Hydromorphic soils are taken into account for the SFI, which will display unique characteristics resulting from prolonged and repeated water saturation (South African Dept. Water Affairs and Forestry, 2005). The continued saturation of the soils results in the soils becoming anaerobic and thus resulting in a change of the chemical characteristics of the soil. Iron and manganese are two soil components which are insoluble under aerobic conditions and become soluble when the soil becomes anaerobic and thus begin to leach out into the soil profile. Iron is one of the most abundant elements in soils and is responsible for the red and brown colours of many soils.

Resulting from the prolonged anaerobic conditions, iron is dissolved out of the soil, and the soil matrix is left a greying, greenish or bluish colour, and is said to be 'gleyed'. Common in wetlands which are seasonally or temporarily saturated is a fluctuating water table, these result in alternation between aerobic and anaerobic conditions in the soil (South African Dept. Water Affairs and Forestry, 2005). Iron will return to an insoluble state in aerobic conditions which will result in deposits in the form of patches or mottles within the soil. Recurrence of this cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is 'gleyed' and has many mottles may be interpreted as indicating a zone that is seasonally or temporarily saturated (South African Dept. Water Affairs and Forestry, 2005).

6.2.1.3 Soil Wetness Indicator

In practice, the SWI is used as the primary indicator (South African Dept. Water Affairs and Forestry, 2005). 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 (South African Dept. Water Affairs and Forestry, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils, are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (South African Dept. 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.

6.2.1.4 Vegetation Indicator

As one moves along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas plant communities undergo distinct changes in species composition. 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 et al., 1999); South African Dept. Water Affairs and Forestry, 2005). This is summarised in Table 6-2 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 (South African Dept. 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 6-2 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (South African Dept. Water Affairs and Forestry, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineate wetland areas.

Table 6-2: Classification of plant species according to occurrence in wetlands (South African Dept. Water Affairs and Forestry, 2005).

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.

6.2.2 Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane, Kotze, & Ellery (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 Kotze *et al.* (2007) to determine the integrity (health) of the wetland. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the wetland. 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.

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 6-3.

Table 6-3: Impact scores and PES categories (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

Impact Category	Description	Combined Impact Score	PES Category
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 recognisable.	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 6-4).

Table 6-4: Trajectory of change classes and scores used to evaluate likely future changes to the PES 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 as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, PES, trajectory of change, and health for individual HGM units and for the entire wetland.

6.2.3 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'. The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze et al. (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

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

The characteristics were used to quantitatively determine the value and, by extension, sensitivity of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland (Table 6-5).

Table 6-5: 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

6.2.4 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 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 6-6.

Table 6-6: 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

7 Baseline Environment

7.1 Catchments, Rivers and Drainage

The Rand Uranium operations span across with A21D and C23D quaternary catchments of the Limpopo Water Management Area (WMA) (previously known as Crocodile West and Marico) and the Upper Vaal WMA respectively. The main or perennial river within A21D quaternary catchment is the Bloubankspruit River which flows from the south towards the north eastern side where the catchment outlet is situated. The Bloubankspruit is approximately 800 m from the Millsite Complex (associated with the Cooke Surface Operations). There are also a few non-perennial drainages/streams that exist within this catchment and it is a tributary of the Crocodile River which the feeds into Hartebeespoort Dam.

The Wonderfonteinspruit is the main river within the C23D quaternary catchment (Refer to Figure 7-1) (associated with the Cooke Underground Operations and portions of the Cooke Surface Operations). Runoff emanating from this quaternary catchment drains in a south westerly direction into the Wonderfonteinspruit. The C23D quaternary catchment is a contributing catchment to C23E, and therefore all runoff from C23D eventually drains into Mooirivierloop of the C23E quaternary catchment and eventually into the C23G catchment of the Mooi River and finally the Vaal River. With the Boskop Dam in the Mooi River being the drinking water source for Potchefstroom.

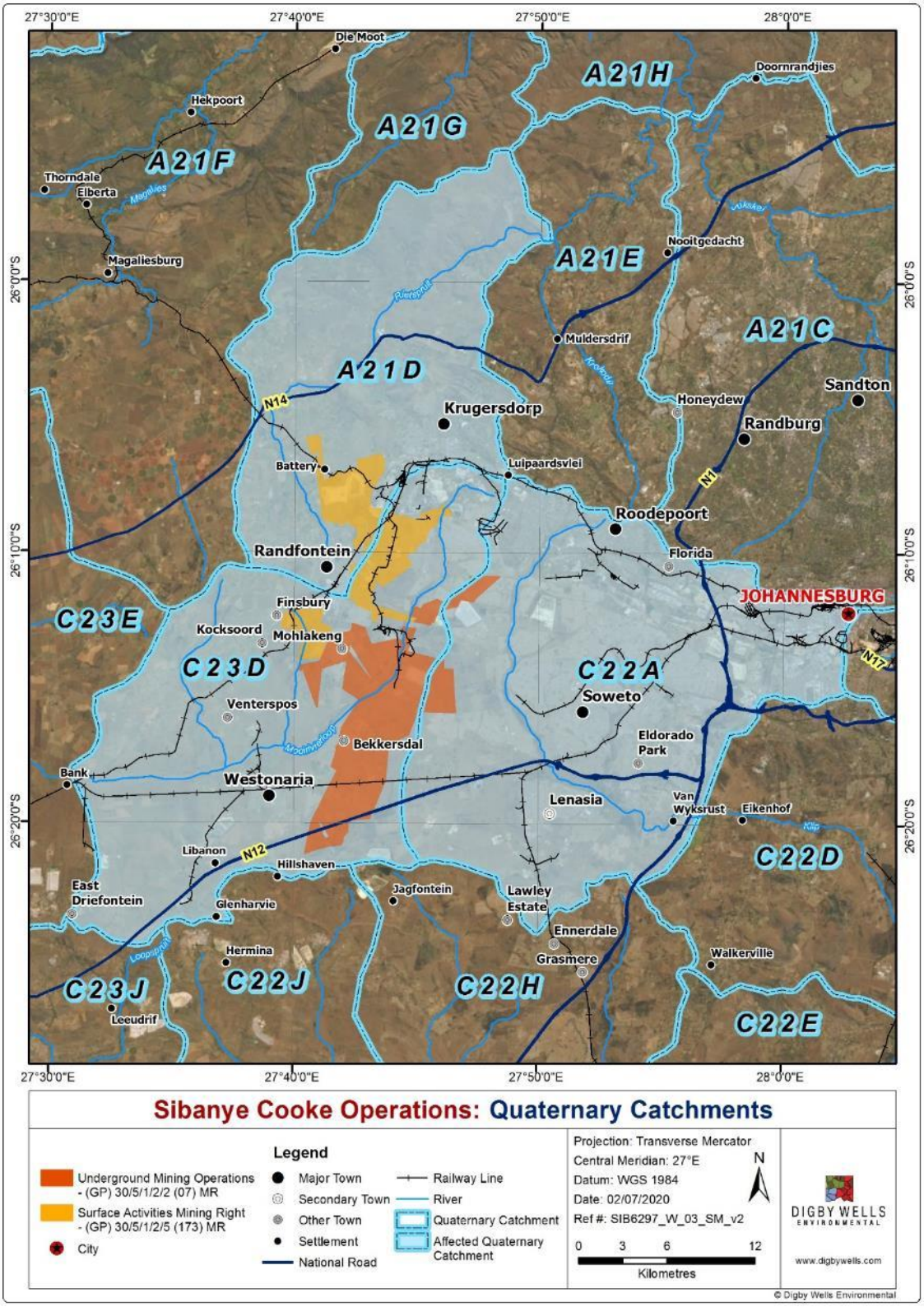


Figure 7-1: Quaternary Catchments

7.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The NFEPA project provides information of wetland and river ecosystems for integrating into freshwater ecosystem and biodiversity planning and decision-making processes. The assessor considered the strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources contained therein to evaluate the importance of the wetland areas located within the Cooke Mining Right (Nel *et al.* 2011). Figure 7-2 demonstrates the distribution of NFEPA wetlands within the Project area. The wetland types that dominate the landscape are flats and seeps although some of these have been incorrectly categorised as NFEPA wetlands, whilst in reality they are artificial, i.e. pollution control dams, return water dams and other man-made dirty water features. Large channelled valley bottom wetlands running through the centre of the site can also be seen from the NFEPA data.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. The wetlands are ranked 3, 4, 5 and 6 within the Cooke Mining Right Area.

Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA layers. The NFEPA assessment does, however, hold significance from a national perspective

7.3 Mining and Biodiversity Guidelines

The Mining and Biodiversity Guideline (2013) can be seen as a cumulative finding of all available biodiversity and ecological related information with a final mapped area. The assessment looks at NFEPA and regional biodiversity plans such as the Gauteng Conservation Plan. This is shown in Figure 7-3 below. The area ranges from moderate to highest biodiversity importance.

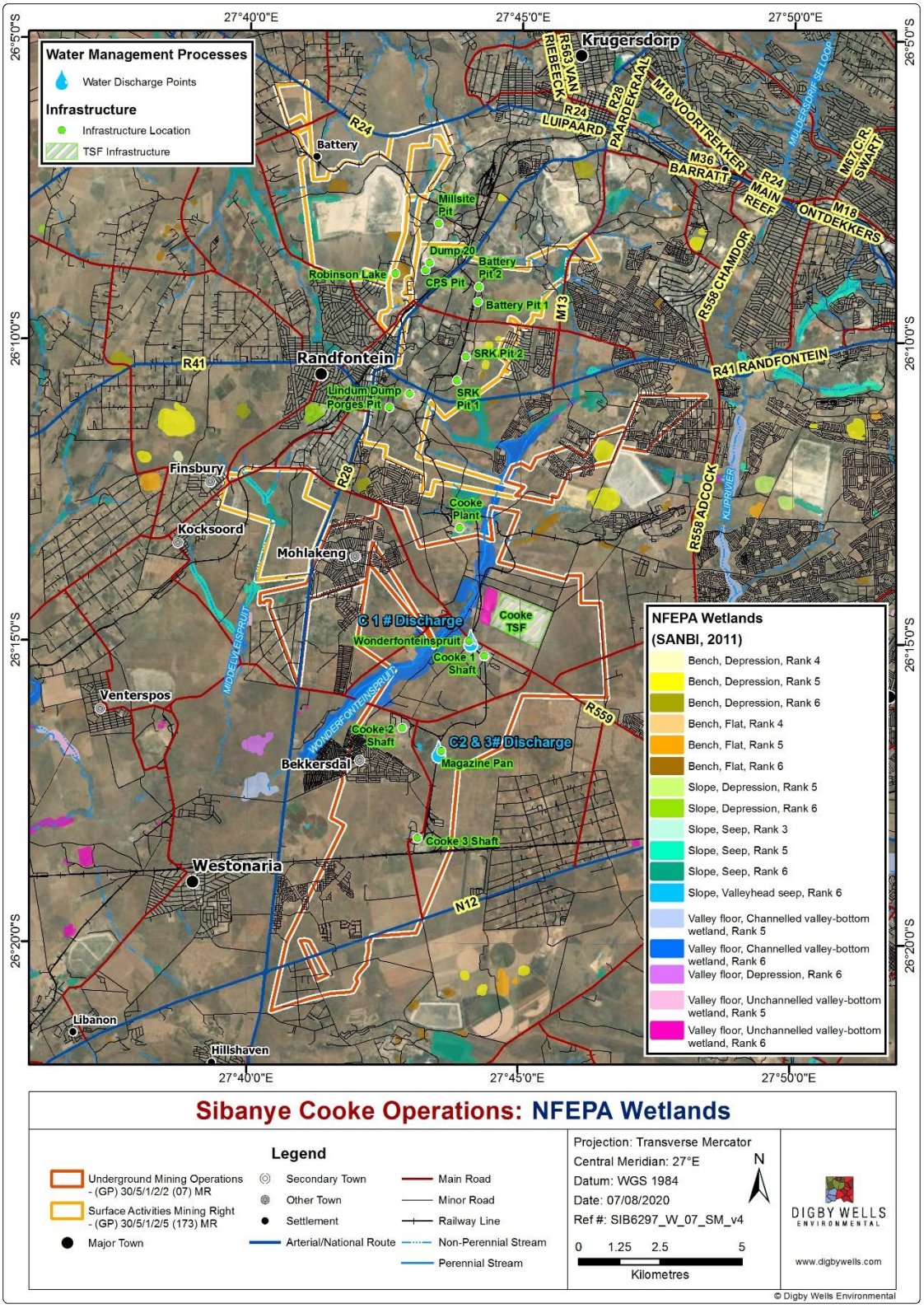


Figure 7-2: NFEPA Wetlands

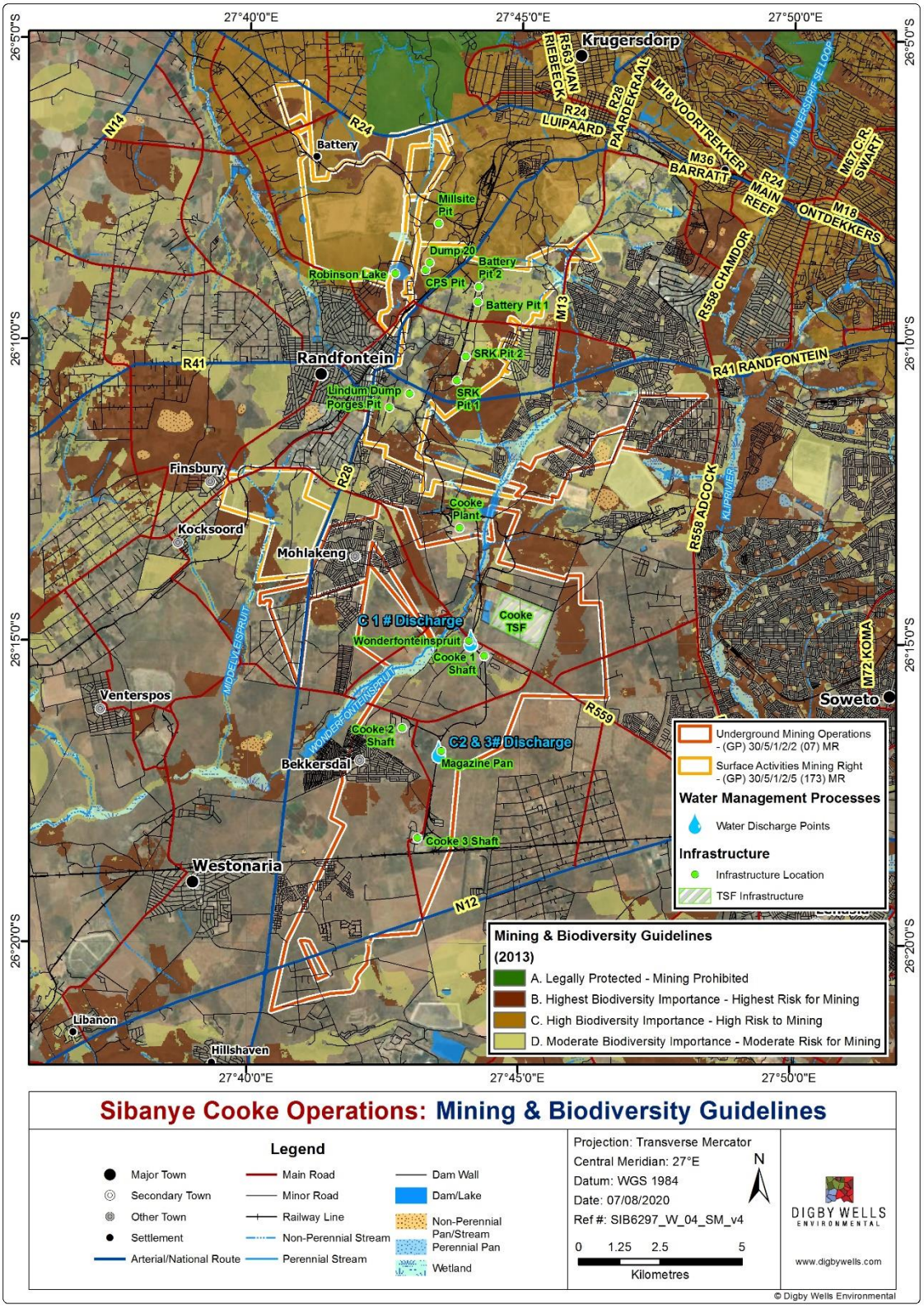


Figure 7-3: Mining and Biodiversity Guideline

7.4 Gauteng C-Plan

According to the C-Plan (Figure 7-4), the Cooke Mining Right Areas are mainly made up of ecological important areas, with the Krugersdorp Nature Reserve as a protected area to the North.

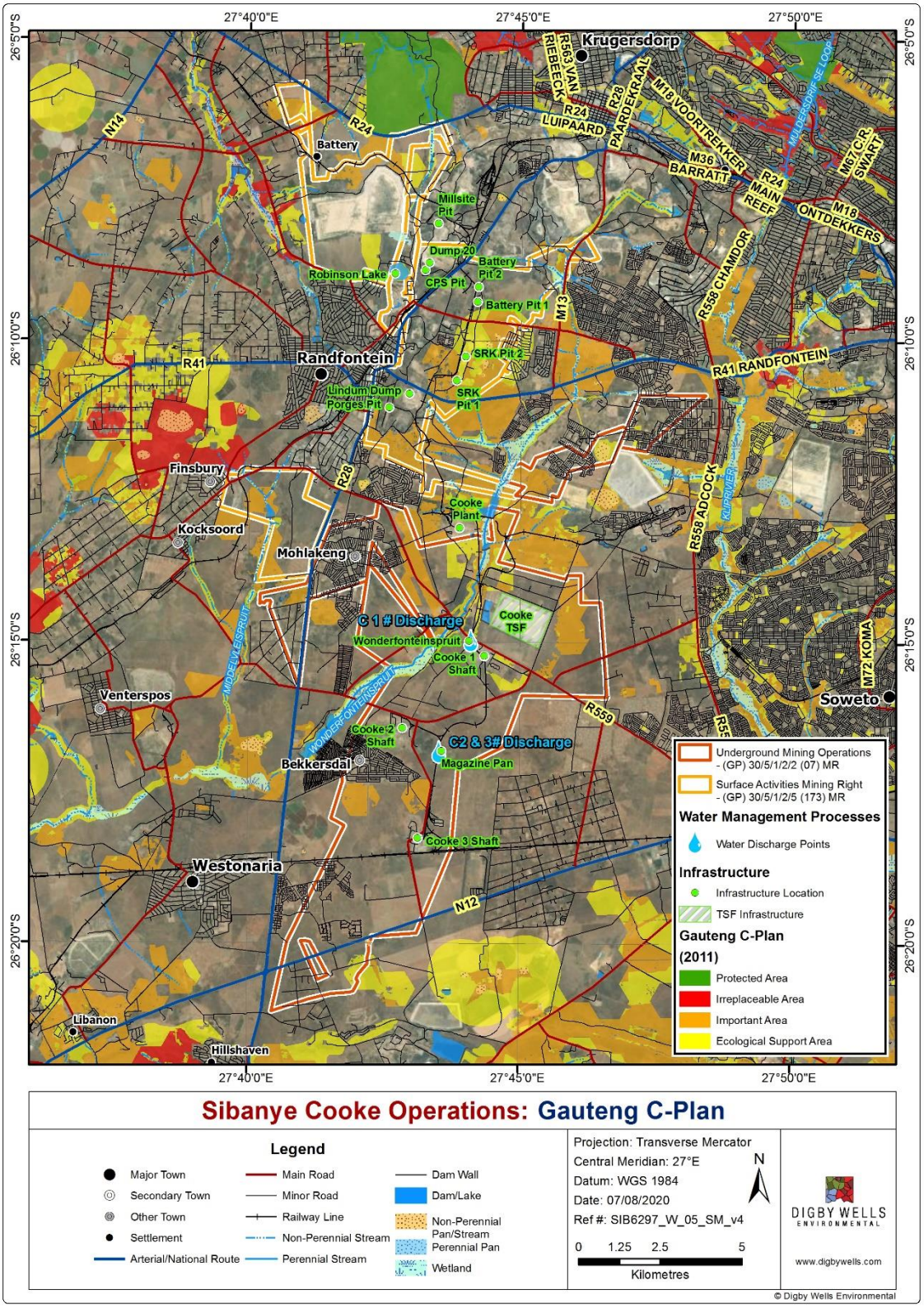


Figure 7-4: Gauteng C-Plan

7.4.1 WRDM EMF and BRP Wetlands

The WRDM contains a high diversity of river and wetland ecosystems (WRDM BRP, 2014); incorporating a total of 1 032.35 ha of Eastern Temperate Freshwater Wetlands, of which none are conserved. However, there are 3 960 ha of important wetlands in the WRDM according to the Gauteng C Plan of which only 2.7% are under formal conservation.

Wetlands, watercourses, and pan wetlands are delineated in the WRDM, as shown in Figure 7-5. The pan wetland systems are highlighted as circular cluster areas; the waterbodies are associated with dams and other non-natural wetland conditions; and the wetlands are associated with valley bottom systems.

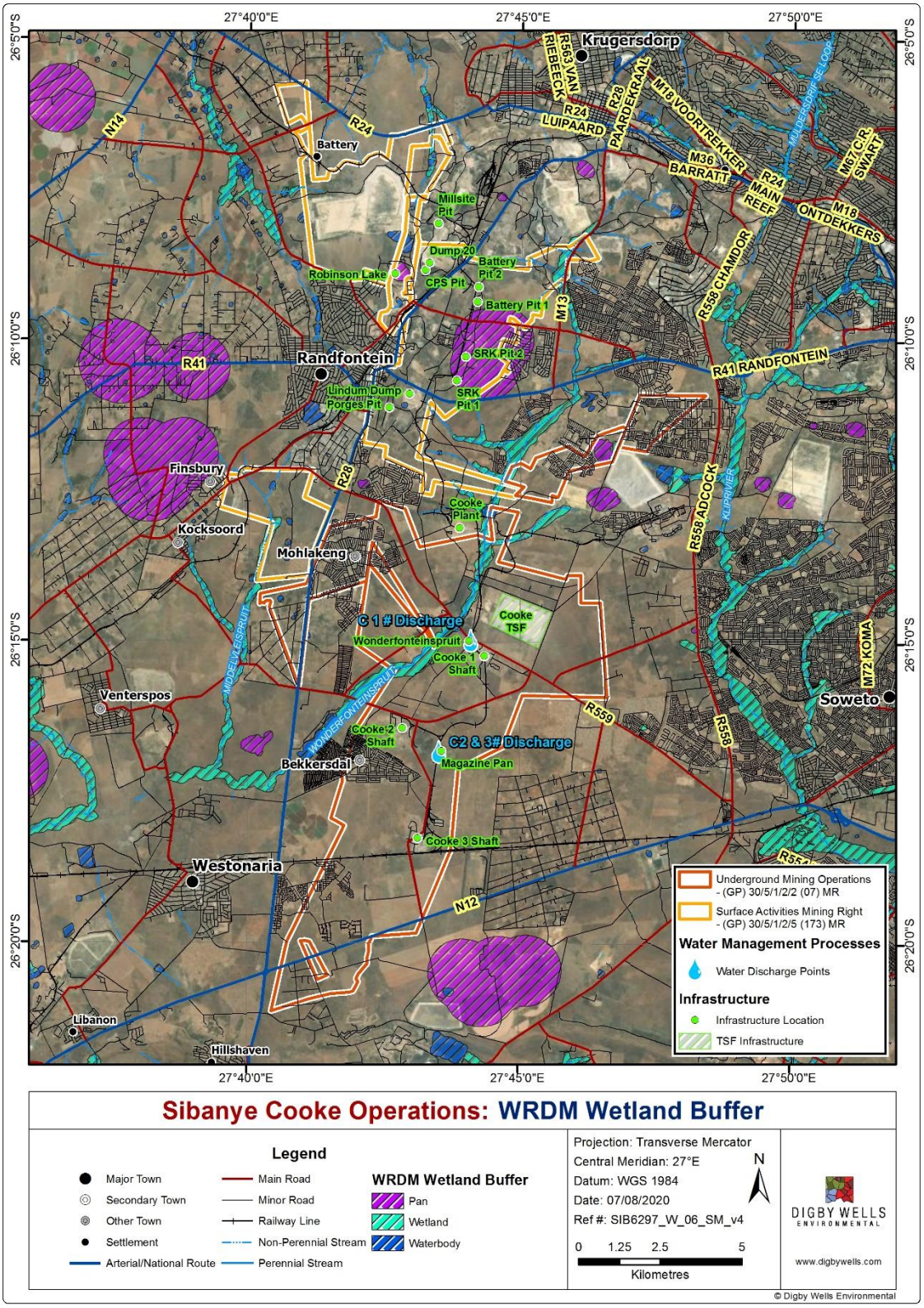


Figure 7-5: WRDM and BRP Wetlands

7.5 Regional Vegetation

The Cooke Mining Right Areas span across the Soweto Highveld Grassland and Carletonville Dolomite Grassland further North with the Eastern Temperate Freshwater Wetlands mainly running through the site in a South to North direction as described by Mucina and Rutherford (2006) (refer to Figure 7-6). Common and characteristic plant species of the Soweto Highveld Grassland, Carletonville Dolomite Grassland and Eastern Temperate Freshwater Wetlands are listed in Table 7-1, Table 7-2 and Table 7-3 respectively.

The regional vegetation for the area gives an indication of which species occur naturally in the area and inform the selection of species suitable for rehabilitation.

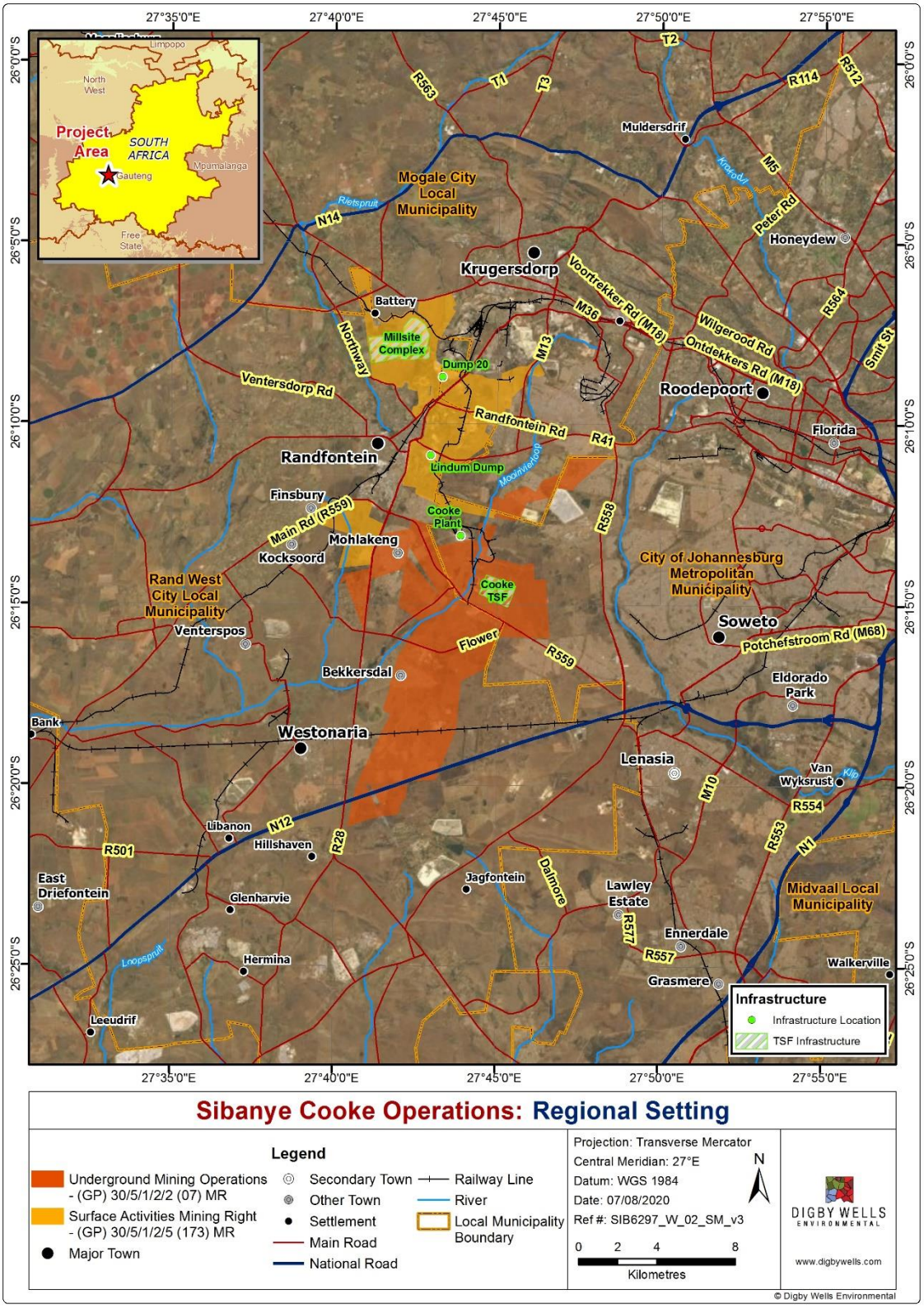


Figure 7-6: Regional Vegetation

Table 7-1: Common and Characteristic Plant Species of the Soweto Highveld Grassland

Plant Form	Species
Graminoids (grasses and sedges)	*Andropogon appendiculatus, Andropogon schirensis, Aristida adscensionis, Aristida bipartita, Aristida congesta, Aristida junciformis subsp. Galpinii, Brachiaria serrata, Cymbopogon caesius, Cymbopogon pospischilii, Cynodon dactylon, Digitaria diagonalis, Diheteropogon amplectens, Elionurus muticus, Eragrostis capensis, Eragrostis chloromelas, Eragrostis curvula, Eragrostis micrantha, Eragrostis plana, Eragrostis planiculmis, Eragrostis racemosa, Eragrostis superba, Harpochloa falx, Heteropogon contortus, Hyparrhenia hirta, Microchloa caffra, Paspalum dilatatum, Setaria nigrirostris, Setaria sphacelata, Themeda triandra, Tristachya leucothrix*
Herbs	*Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera var. aspera, Haplocarpha scaposa, Helichrysum miconiifolium, Helichrysum nudifolium var. nudifolium, Helichrysum rugulosum, Schistostephium crataegifolium, Senecio coronatus, Vernonia (renamed Hilliardiella) oligocephala Wahlenbergia undulata, Rhynchosia totta, Rhynchosia effuse, Hermannia depressa, Hibiscus pusillus, Graderia subintegra*
Geophytic herbs	*Haemanthus humilis subsp. hirsutus, Haemanthus montanus*

Table 7-2: Plant Species Characteristic of the Carletonville Dolomite Grassland

Plant Form	Species
Graminoids	*Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Alloteropsis semialata subsp. eckloniana, Andropogon schirensis, Aristida canescens, A. diffusa, Bewsia biflora, Bulbostylis burchellii, Cymbopogon caesius, C. pospischilii, Elionurus muticus, Eragrostis curvula, E. gummiflua, E. plana, Eustachys paspaloides, Hyparrhenia hirta, Melinis nerviglumis, M. repens subsp. repens, Monocymbium ceresiiforme, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides,Tristachya leucothrix, T. rehmanii*

Plant Form	Species
Herbs	*Acalypha angustata, Barleria macrostegia, Chamaecrista mimosoides, Chamaesyce inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. miconiifolium, H. nudifolium var. nudifolium, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Kohautia amatynbica, Ophrestia oblongifolia, Pollichia campestris, Senecio coronatus, Hilliardiella oligocephala*
Geophytic Herbs	*Boophone disticha, Habenaria mossii*
Low Shrubs	*Anthospermum rigidum subsp. pumilum, Indigofera comosa, Pygmaeothamnus zeyheri var. rogersii, Searsia magalismontana, Tylosema esculentum, Ziziphus zeyheriana*
Geoxylic Suffrutex	*Elephantorrhiza elephantina, Parinari capensis subsp. Capensis*

Table 7-3: Plant Species Characteristic of the Eastern Temperate Freshwater Wetlands

Type	Plant Form	Species
Marshes	Megagraminoid	*Cyperus congestus* (d)
	Graminoids	*Agrostis lachnantha* (d), *Carex acutiformis* (d), *Eleocharis palustris* (d), *Eragrostis plana* (d), *E. planiculmis* (d), *Fuirena pubescens* (d), *Helictotrichon turgidulum* (d), *Hemarthria altissima* (d), *Imperata cylindrica* (d), *Leersia hexandra* (d), *Paspalum dilatatum* (d), *P. urvillei* (d), *Pennisetum thunbergii* (d), *Schoenoplectus decipiens* (d), *Scleria dieterlenii* (d), *Setaria sphacelata* (d), *Andropogon appendiculatus*, *A. eucomus*, *Aristida aequiglumis*, *Ascolepis capensis, Carex austro-africana*, *C. schlechteri*, *Cyperus cyperoides*, *C. distans*, *C. longus*, *C. marginatus*, *Echinochloa holubii*, *Eragrostis micrantha*, *Ficinia acuminata*, *Fimbristylis complanata*, *F. ferruginea*, *Hyparrhenia dregeana*, *H. quarrei, Ischaemum fasciculatum*, *Kyllinga erecta*, *Panicum schinzii*, *Pennisetum sphacelatum*, *Pycreus macranthus*, *P. nitidus*, *Setaria pallide-fusca*, *Xyris gerrardii*.

Type	Plant Form	Species
	Herbs	*Centella asiatica* (d), *Ranunculus multifidus* (d), *Berkheya radula*, *B. speciosa*, *Berula erecta* subsp. *thunbergii*, *Centella coriacea*, *Chironia palustris*, *Equisetum ramosissimum*, *Falckia oblonga, Haplocarpha lyrata, Helichrysum difficile*, *H. dregeanum*, *H. mundtii*, *Hydrocotyle sibthorpioides, H. verticillata*, *Lindernia conferta*, *Lobelia angolensis, L. flaccida*, *Mentha aquatica*, *Monopsis decipiens*, *Pulicaria scabra*, *Pycnostachys reticulata*, *Rorippa fluviatilis* var. *fluviatilis*, *Rumex lanceolatus*, *Senecio inornatus*, *S. microglossus*, *Sium repandum*, *Thelypteris confluens*, *Wahlenbergia banksiana*.
	Geophytic Herbs	*Cordylogyne globosa*, *Crinum bulbispermum*, *Gladiolus papilio*, *Kniphofia ensifolia*, *K. fluviatilis*, *K. linearifolia*, *Neobolusia tysonii, Satyrium hallackii* subsp. *hallackii*.
Reed & sedge beds	Megagraminoids	*Phragmites australis* (d), *Schoenoplectus corymbosus* (d), *Typha capensis* (d), *Cyperus immensus*.
	Graminoid	*Carex cernua*.
Water bodies	Aquatic Herbs	*Aponogeton junceus*, *Ceratophyllum demersum*, *Lagarosiphon major*, *L. muscoides*, *Marsilea capensis*, *Myriophyllum spicatum, Nymphaea lotus*, *N. nouchali* var. *caerulea*, *Nymphoides thunbergiana*, *Potamogeton thunbergii*.
	Carnivorous Herb	*Utricularia inflexa*.
	Herb	*Marsilea farinosa subsp. farinosa.*

8 Findings and Discussion

This section presents the findings of the previous specialist assessments undertaken (and findings from the site visits conducted). The Cooke Mining Right Areas have been divided up into three different sections, namely the North, Central and South zones and the results of the assessment are presented for each zone.

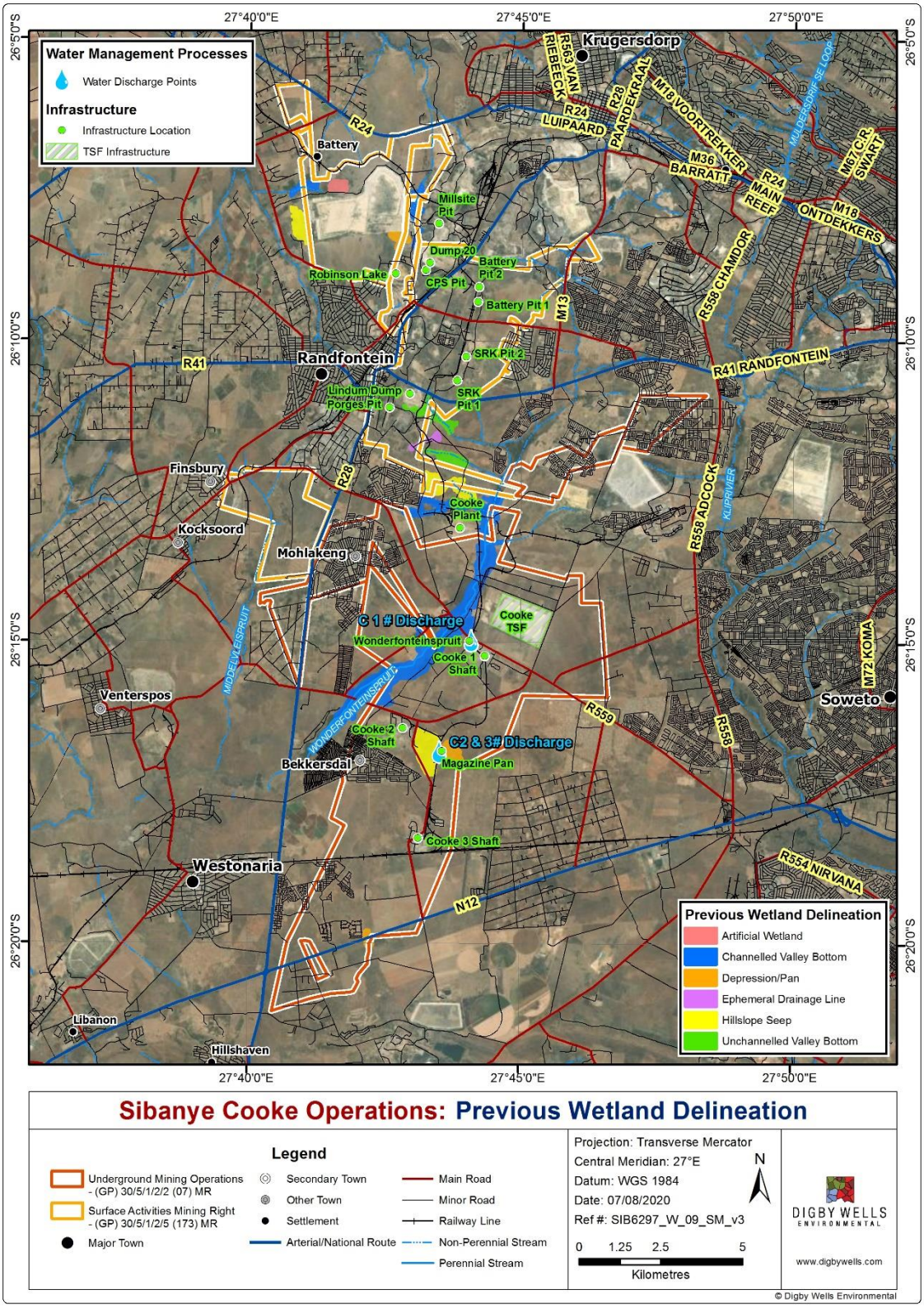


Figure 8-1:Previous Wetland Delineations within the Cooke Area

8.1.1 North Zone

The North Zone covers the areas from Lindum Dump and SRK Pits moving North towards Robinson Lake and Millsite TSF. Historical delineations have been done with in the area associated with the Millsite reclamation project undertaken project undertaken by Digby Wells in 2017 as part of the ongoing Cooke Surface Operations.

8.1.2 Central Zone

The Central Zone is located between the Lindum Dump (ongoing Cooke Surface Operations), moving South, including the Cooke TSF and Plant and Cooke 1 and Cooke 2 shafts ending above Magazine Pan (Cooke Underground Operations). The Central Zone includes a large portion of the Wonderfonteinspruit and associated tributaries.

8.1.3 South Zone

The South Zone focuses on the areas from Magazine Pan, moving south to the Cooke 3 Shaft (Cooke Underground Operations) and just over the N12.

8.2 Wetland Delineation and Classification

The project area was surveyed and 25 different wetland units were delineated that interact with the project infrastructure. Due to the undulating terrain, valley bottoms characterised the area, both channelled and unchannelled. In the flatter areas there are pans present. Each of the wetlands is briefly described in the summary section in Table 8-1.

8.3 Ecological Health and Sensitivity

The wetlands identified are impacted as a result of the surrounding land-uses which is dominated by mining, agriculture, road infrastructure housing and sewage treatment plants. These impacts are typical of the West Rand, as described in Section 8.5. Many wetlands are impacted upon as a result of the activities that are undertaken within the catchment. This has led to serious impacts to the quality of these systems and has contributed to direct loss of wetland habitat. In saying this the increased discharge has also lead to increased wetland extent and therefore habitat being created. The dams that have been constructed within the catchment have also contributed to a significant alteration of the wetland extent and function within the catchment.

The road infrastructure is extensive in the area and has led to significant impacts to wetland connectivity and hydrology. The WET-Health assessment led to overall PES values for each wetland and similarly the EIS assessment led to final scores and status per wetland; these results are given the Summary section in Table 8-1.

8.4 Ecological Services

The general features of each wetland HGM unit were assessed in terms of functioning and the overall importance of the HGM unit was then determined at a landscape level. The results

from the Wet Eco-services tool for the respective wetland units are presented the Summary section in Table 8-1. The eco-services that received a rating of ≥2.8 are characterised to be high. The major ecoservices provided by the wetland in the project area are Streamflow regulation, Toxicant and Phosphate Removal, Sediment trapping and, with the more intact wetlands, Maintenance of biodiversity was scored high.

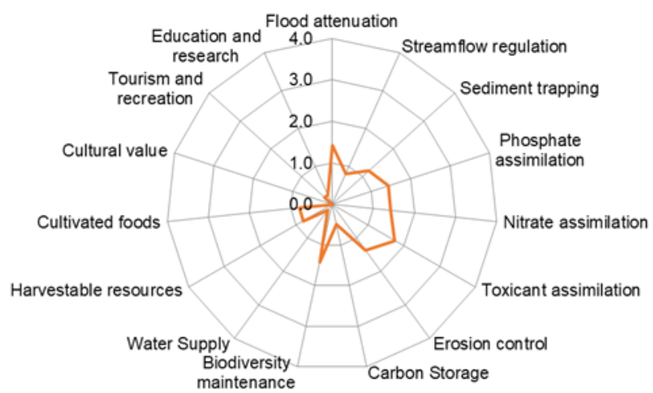
As aforementioned, wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, carbon storage, streamflow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity.

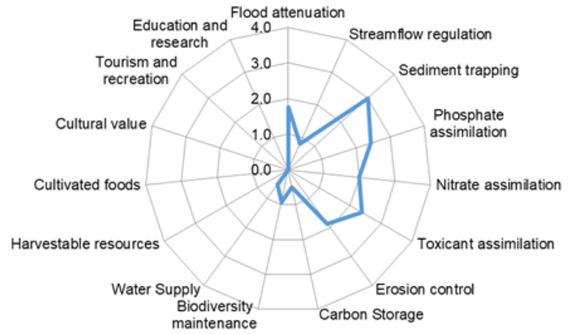
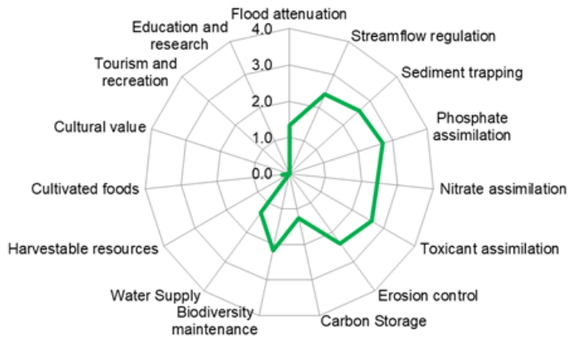
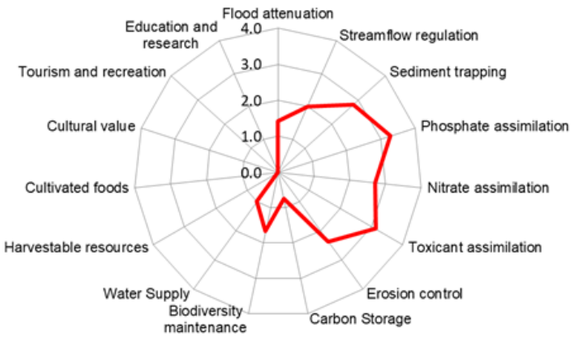
Wetlands are highly susceptible to the degradation of quality and a change in quantity as a result of anthropogenic resource use activities, (Diederichs and Ellery, 2001), land-surface-development (Gibbs, 2000) and landscape-management (Kotze and Breen, 1994; Whitlow, 1992) practices that alter their hydrological regime impacting these systems (Winter and Llamas, 1993). The results of the EcoServices assessment are given the Summary section in Table 8-1.

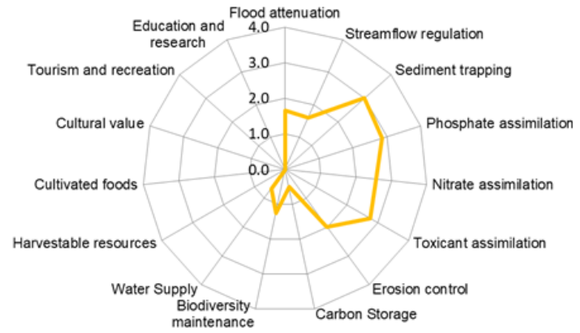
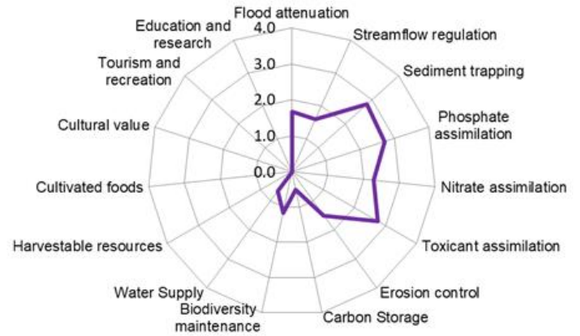
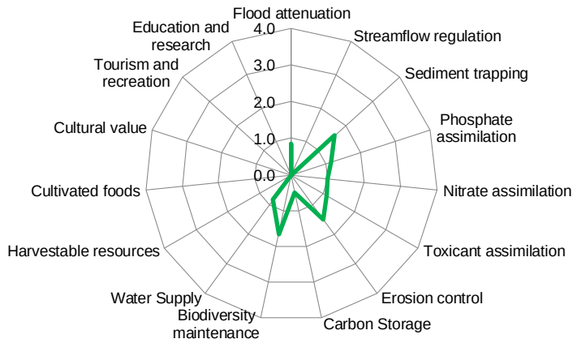
8.5 Wetland Findings Summary

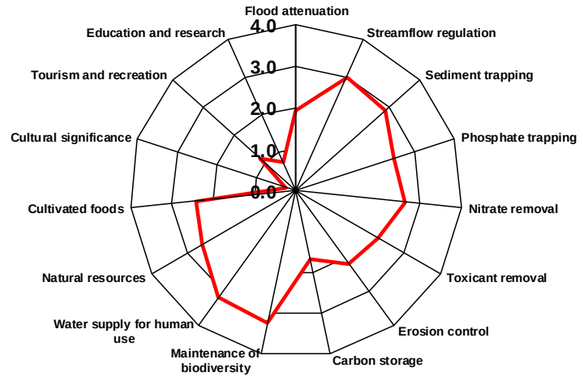
Table 8-1 below and on the following pages serves as a comprehensive summary of the wetlands found and assessed in the study area. Also refer to Figure 8-2, Figure 8-3 and Figure 8-4 for the mapping of these wetlands and Table 8-2 for the photographs taken during the site assessment of some of the HGM Units.

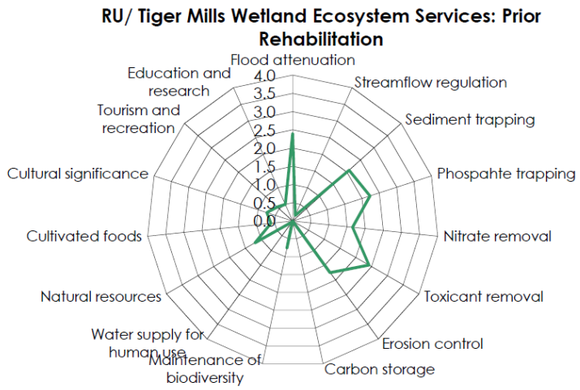
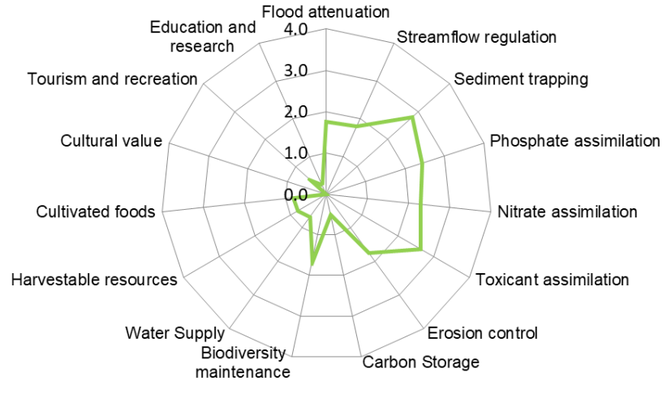
Table 8-1: Wetlands Findings

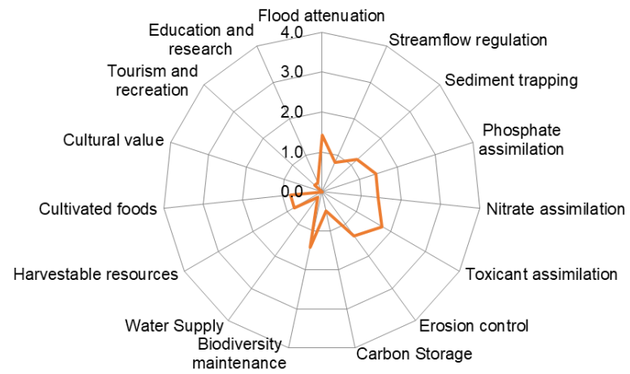
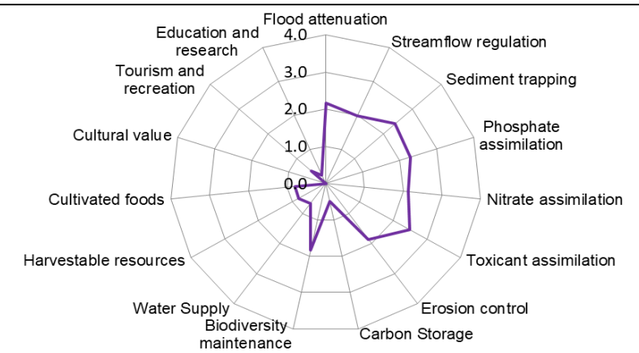
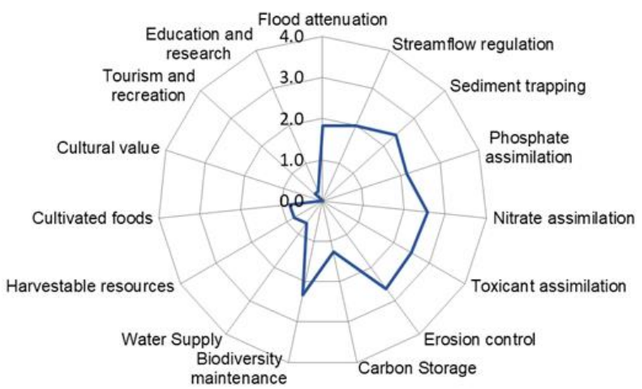
Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
North	Artificial Depression/Pan	1	0.725	Further North of the Millsite TSF there was a hillslope seep identified, which feeds into a depression/pan. There has been evidence of disturbance within the area, such as cattle grazing and roads. It is suspected that the depression/pan, has been artificially created as a result of housing development and the road within the proximity to these HGM Units. There are some Alien Invasive Plant (AIP) species located within these HGM units. There are agricultural activities that are taking place further up in the catchment, which may have resulted in some impacts from run off from these areas.	N/A – Falls outside of the project area thus PES, EIS and EcoServices have not been assessed.		
North	Hillslope Seep	2	10.47				
North	Ephemeral Drainage Line	3	1.33	HGM Unit 3 and 4 are located to the North of the Millsite TSF. These two HGM units are two new units that have not previously been identified and would require further investigation. Wetlands soils indicators where present further up the slope (within HGM Unit 4 in one location), however disappeared once the drainage line moved towards the railway line. There is a culvert that has been constructed under the railway and a channel has also been constructed. This has resulted in a preferential flow path along this drainage line, which has resulted in a channel developing in the higher reaches of the channel. The channel then disappeared further down the hill. It was difficult to determine the full extent of the wetland within this area and how this ephemeral drainage line connects further down. Based on the PES (C) and the EIS (C) both the drainage line and Hillslope Seep have been classified as moderately modified. There are features that have impacted upon this system, such as cattle grazing, culverts under the railway line channelization of the drainage line and creation of access tracks within the area and some colonisation of AIP species. It is recommended that this system be further investigated to determine the full extent of this wetland area, specifically once the TSF has been removed and the natural topography and drainage patterns can be better	C	C	
North	Hillslope Seep	4	1.07				

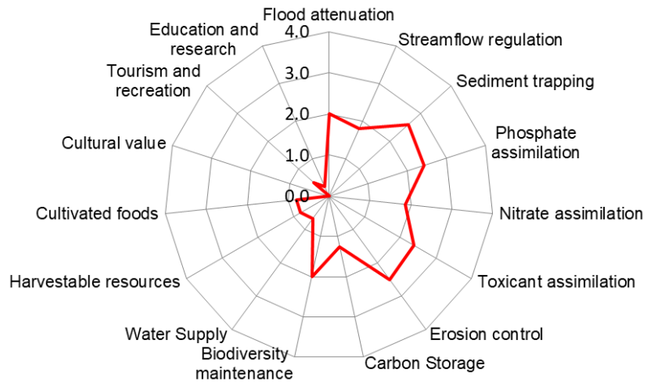
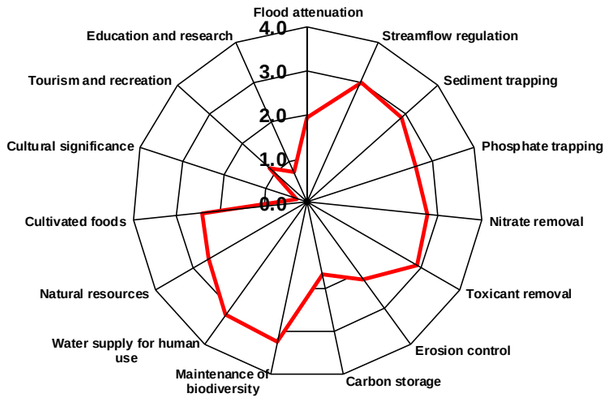
Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
				informed to address rehabilitation requirements. Historical imagery potentially indicates that this was a drainage line fed by seepage from the TSF			
North	Artificial Wetland	5	16.78	From the previous Digby Wells (2017) assessment conducted five HGM units were identified within 500 m of the Millsite TSF, which cover approximately 105.1 ha. These comprised of a Hillslope Seep (HGM Unit 7), which is currently heavily impacted on by a neighbouring sewage works facility, two Channelled Valley Bottom wetlands (HGM Units 6, where only limited impacts were observed, and HGM 9, where serious impacts in terms of altered stream channels, disturbance of soils, altered hydrology and impacts from Alien Invasive Species [AIPs] were observed), an artificial wetland (historical cascade dams) and a Depression (HGM Unit 10, which is seriously impacted on in terms of toxicants and sedimentation). The wetlands that surround the Millsite TSF exhibit a variety of PES values/conditions, ranging from *Seriously Modified* (Category E), to *Moderately Modified* (Category C). HGM Unit 9 may be considered as *Seriously Modified* (Category E), which is largely due to the alteration of the channel, various gullies, and channelization. The presence of tailings material adjacent to HGM Unit 9 has also impacted the PES score through deposition in the wetland. HGM 8 and 9 receive impacts not only from Sibanye's activities, but also those associated with adjacent mines and derelict and abandoned mines now managed by the Government. HGM Units 7 and 10 are both *Largely Modified* (Category D). HGM Unit 7 is impacted on heavily by the presence of a sewage trench that is discharging untreated sewage into the wetland, while HGM Unit 10 has been negatively impacted on by the deposition of tailings, large areas of unvegetated land and the proliferation of AIPs. HGM Unit 6 is *Moderately Modified* (Category C) with some erosion noted at this point. It should be noted that this HGM unit has been historically impacted upon by historical tailings deposition. Furthermore to this, upon	N/A for artificial wetland	D	
North	Channelled Valley Bottom	6	14.78		C	C	
North	Hillslope Seep	7	36.19		D	C	

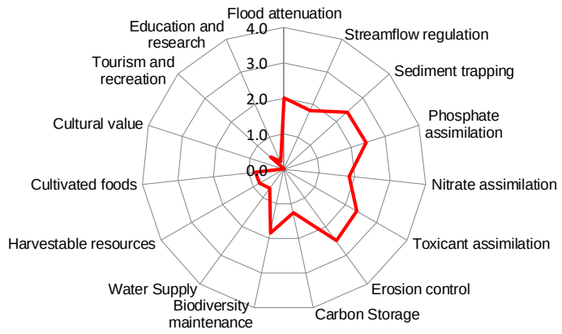
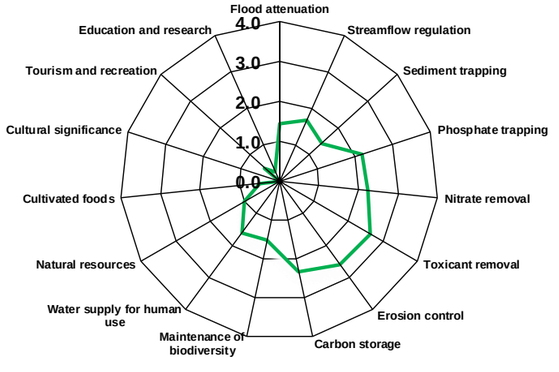
Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
North	Channelled Valley Bottom	9	33.48	removal of the upstream sources (artificial cascade dams and Millsite TSF complex) rehabilitation of this wetland section must be investigated and implemented. HGM Unit 5 is an artificial wetland and therefore PES scores are not applicable. The Ecological importance and Sensitivity is *Low* to *Moderate* for all the HGM units, as these wetlands are sensitive to changes but still provide habitat for various species. Although the wetlands are modified, they do still provide *Low* to *Moderate* hydrological importance services, such as sediment trapping and assimilation of toxicants, phosphates and nitrates.	E	C	
North	Depression/Pan	10	16.42		D	D	
North	Artificial	8	3.54	This HGM unit consist of 3 artificial wetlands that are located to the East of the Tweelopiespruit. Two of the artificial wetlands have been created as a result of water decanting from the Winzes. The third artificial wetland has formed as a result of historic construction of a paddock. It is uncertain what the paddock was historically utilised for but it is assumed that the impacts within this areas are a result of mining related activities. The area has been highly modified as a result of mining activities that have been undertaken within this area. These systems offer very little ecological services to the area and water emanating from these sources is captured. No PES rating has been given as the wetland is artificial. The EIS rating is a D and these areas have a marginal ecological importance.	N/A for artificial wetland	D	

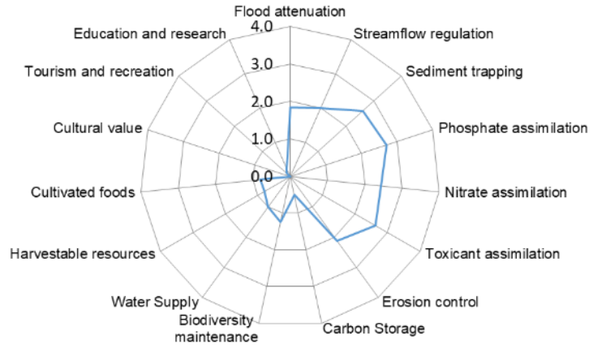
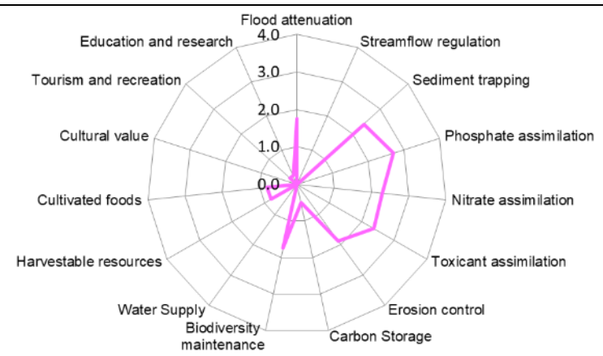
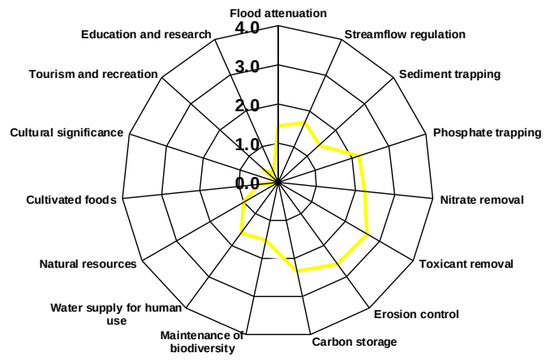
Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
North	Depression/Pan	11	22.61	The NFEPA data classifies Robinson Lake as natural pan/depression and has a ranking of 6. Robinson Lake is situated in the northernmost section of the Cooke Mining Right and just south of the Millsite TSF. To the south of Robinson Lake is the Randfontein Golf Course and the residential area of Robinson. This lake has been heavily impacted upon as a result of historic mining activities within the area and discard of water into this system. Robinson Lake was previously a pan system, which has been heavily altered. Consideration to how Robinson Lake will be rehabilitated will need to be investigated and stormwater management will be a key aspect to consider in the rehabilitation.	F	D	No EcoServices done for Robinson Lake as the system has been severely modified and thus it was assessed that this feature does not add offer any goods or services to the environment or the surrounding community.
North	Channelled Valley Bottom Wetland	12	35.68	HGM 12 is a channelled valley bottom wetland that is also located along the Wonderfonteinspruit system. This unit is located further North of HGM 15 and has been impacted upon in a similar manner when compared to HGM 15. The PES, EIS and Ecoservices for HGM Unit 12 is the same as HGM 15. HGM 12 has been impacted by adjacent mines, such as upstream and instream impacts from Mintails and other various smaller mining processing and operations, and not activities associated with the Rand Uranium Operations.	E	D	
North	Depression/Pan	13	8.69	The NFEPA database was utilised at a desktop level to identify these potential pans that are located in the vicinity of the SRK Pits. These depressions are associated with the Lindum Crusher. Historical imagery indicated that there could have been historic tailings deposition within this area. During the site assessment to the area, this location was not visited as access to these areas was difficult. Thus based on this it is recommended that further assessments be conducted to confirm the existence of these pans within these areas. The area has been highly modified as a result of the close proximity of mining activities (historic open pit mining and illegal mining activities) and it is assumed that these systems have become degraded overtime. The PES, and EIS was based on desktop information. Further investigation will be required with respect to rehabilitation interventions once	E	D	No EcoServices done as the system has been severely modified and is currently assumed that these systems do not offer any current goods and services to the environment and surrounding community.

Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
				the Lindum Crusher has been removed and the associated pits rehabilitated.			
North	Temporary Wetland	Temporary Wetland	3.91	Sibanye undertook a Wetland Assessment, for an area located adjacent to the Tiger Mills operation, based on a Directive received. The assessment expanded upon previous work undertaken by Digby Wells for the Lindum Railway Decommissioning Project, undertaken in 2017. The areas has been historically impacted upon. Located on site is a historic rock, dump, historic tailings material, the Tiger Brands Mill operations, historic mine buildings and infrastructure such as commercial and industrial businesses and roads. The wetland identified within this areas was considered to be a temporary unchannelled valley bottom wetland. The areas has been highly impacted upon. It is recommended that rehabilitation of the area be undertaken. If rehabilitation is undertaken this could potentially improve the overall functionality of the system and improve the ecology. The wetland can be considered critically modified. Majority of the impacts are attributed to historical mining activities and placement of infrastructure. The current Ecoservices that are provided are related to sediment, nutrient and toxicant trapping. These services are rated low to medium and it is anticipated that these services could improve if rehabilitation is undertaken as proposed within the specialist assessment.	F	D	 **Note:** Information extracted from the Sibanye-Still Water; Rand Uranium and Tiger Mills Wetland Assessment and Interim Rehabilitation Plan.
Central	Unchannelled Valley Bottom	14	85.43	Three seriously modified wetlands are present within this area. HGM Unit 14, has the worst PES (E) along with HGM Units 16 (E) and 18 (E). The high scores are largely due to the impact of illegal mining within the wetland. Extensive excavations are present resulting in altered hydrology, erosion and sedimentation. The presence of tailings material upstream of HGM Unit 14 has impacted the PES score, while the proliferation of Alien Invasive Species (AIPs) in the case of HGM Units 16 and 18 is a contributing factor to the seriously modified status of those wetlands. HGM Unit 17 has the best PES score (C) as it is only *Moderately Modified*. The hydrology and geomorphology	E	C	

Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
Central	Ephemeral Drainage Line	25	8.63	has not been largely modified and there is extensive vegetation cover and low levels of infestation by AIPs. HGM Unit 25 has been scored a PES D because it has extensive road crossings, erosion in the channel and widespread AIP proliferation.	D	B	
Central	Unchannelled Valley Bottom	16	38.22		E	C	
Central	Hillslope Seep	17	61.59		C	B	

Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
Central	Channelled Valley Bottom	18	45.66		E	B	
Central	Channelled Valley Bottom	15	588.93	This is the Wonderfonteinspruit River and wetland, which is delineated from Cooke 2 and 3 to the Cooke Dump; however it extends further than this as this is a river system. This is designated as a NFEPA wetland. The wetland is highly impacted and the Common Bulrush (*Typha capensis*) is a main wetland indicator and it has become dominant in long stretches of the river. The river and wetland has been dammed in multiple places and significant negative land uses characterise the Wonderfonteinspruit catchment and upper reaches; these include urbanisation, agriculture industrial and mining activities. Downstream of the delineation, the Wonderfonteinspruit has been piped for a significant distance, over 30 km. The PES of this wetland was determined to be an E due to the significance of the local and catchment scale impacts. This is in agreement with the 2013 Department of Water Affairs (DWA) data which states the upper, middle and lower Wonderfonteinspruit to be in a seriously modified state (class E). The EIS was therefore determined to be low. The wetland does play a role in providing ecological services as it is the main river draining the catchment. Despite being highly impacted, the wetland and river are important features for maintenance of biodiversity, streamflow regulation as well as removal of pollutants and toxicant removal. All of these can be improved if the health status of the wetland is improved. The pipeline from Cooke dump containing tailings as well as the water pipeline to Cooke Dump is proposed to be within 500m of this wetland, however these are no longer	E	D	

Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
				in use and will not be used upon closure of the underground mining activities, these pipelines though may be reinstated for future reclamation and rehabilitation activities of the Cooke TSF.			
Central	Channelled/Unchanneled Valley Bottom	19	56.35	This HGM Unit is located to the East of Mohlakeng community and is characterised as an initial channelled valley bottom wetland becoming a unchanneled valley bottom wetland further down the catchment, and eventually disappears into a dolomitic area. Impacts to this system have resulted from some urban encroachment in the north section to mining impacts moving south. The system has been moderately modified (PES D) with and EIS of a B. Sibanye-Stillwater has no active mining operations in this area, but is rehabilitating the Middelvlei Pits within 500m of the delineated wetland.	D	B	
Central	Dam/Artificial Impoundment	20	0.65	This was identified as a desktop level as artificial impoundment, located to the North of the Randfontein South Agricultural Holdings. The fill extent of this HGM unit was not assessed during the in-field assessment and would require further investigation. This area was not assessed in detail as this area will not be impacted as a result of the proposed activities and is located on the edge of the mining right.	Not assessed	Not assessed	Not assessed.
South	Depression/Pan	23	9.21	This system is located to the West of Cooke 3 Shaft and is bisected by a railway line running East to West. HGM 22 is in a similar state to HGM 24 and has a similar PES and EIS. As HGM 24 the ecological services provided by this pan are limited; mostly playing a role an intermediate role in the removal of pollutants. The pan does offer some biological services, however is limited.	D	D	

Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
South	Hillslope Seep	22	77.80	HGM unit 22 has been impacted as a result of treated sewage discharge passed the Cooke 2 Shaft to the Wonderfonteinspurit as well as discharge from the Cooke 2 to the Magazine Pan. Historically the area has been irrigated with water from the sewage treatment plant. It is anticipated that the seep in this area has been created as a result of the discharge and that cessation of this activity would result in this system disappearing. HGM Unit 21 is mainly impacted by the runoff and discharge from the Cooke 2 shaft. There is speculation that this pan is also artificial or a certain increased extent of the pan is artificial as a result of the discharge. Rehabilitation options for Magazine Pan are in the process of being considered	D	B	
South	Depression/Pan	21	40.75		D	C	
South	Depression/Pan	24	8.93	This is a pan wetland that has been bisected by the N12 and therefore now two separate pan systems are present (although referred to as one). It is an ephemeral pan that is significantly impacted by the surrounding historical land-use. Almost no natural vegetation was present at the time of assessment due to grazing, burning and general poor condition. The wetland will be of greater significance during wet periods, where birds would be supported by the wetland. Is it is assumed that intense cattle grazing at one time and lack of hydrological drivers for sediment deposition, as well as likely the dense plant growth in the deepest section due to a lack of flow, has resulted in the pan sediments being severely disturbed. The wetland has a PES of D due to the significance of the impacts to the wetland as well as the catchment. Similarly, the EIS of this wetland was found to be low. The ecological services provided by this pan are limited; mostly playing a role an intermediate role in the removal of	D	D	

Section	Wetland and HGM unit	(HGM Unit No.)	Area (ha)	Description and Associated infrastructure	PES	EIS	EcoServices Radial Plot
				pollutants. The pan plays a very small role in the maintenance of biodiversity; however this could be enhanced. There is a culvert that runs under the N12 found on the eastern edge of this wetland that is to be used for the tailings pipeline from Cook Dump southwards for the WRTRP.			

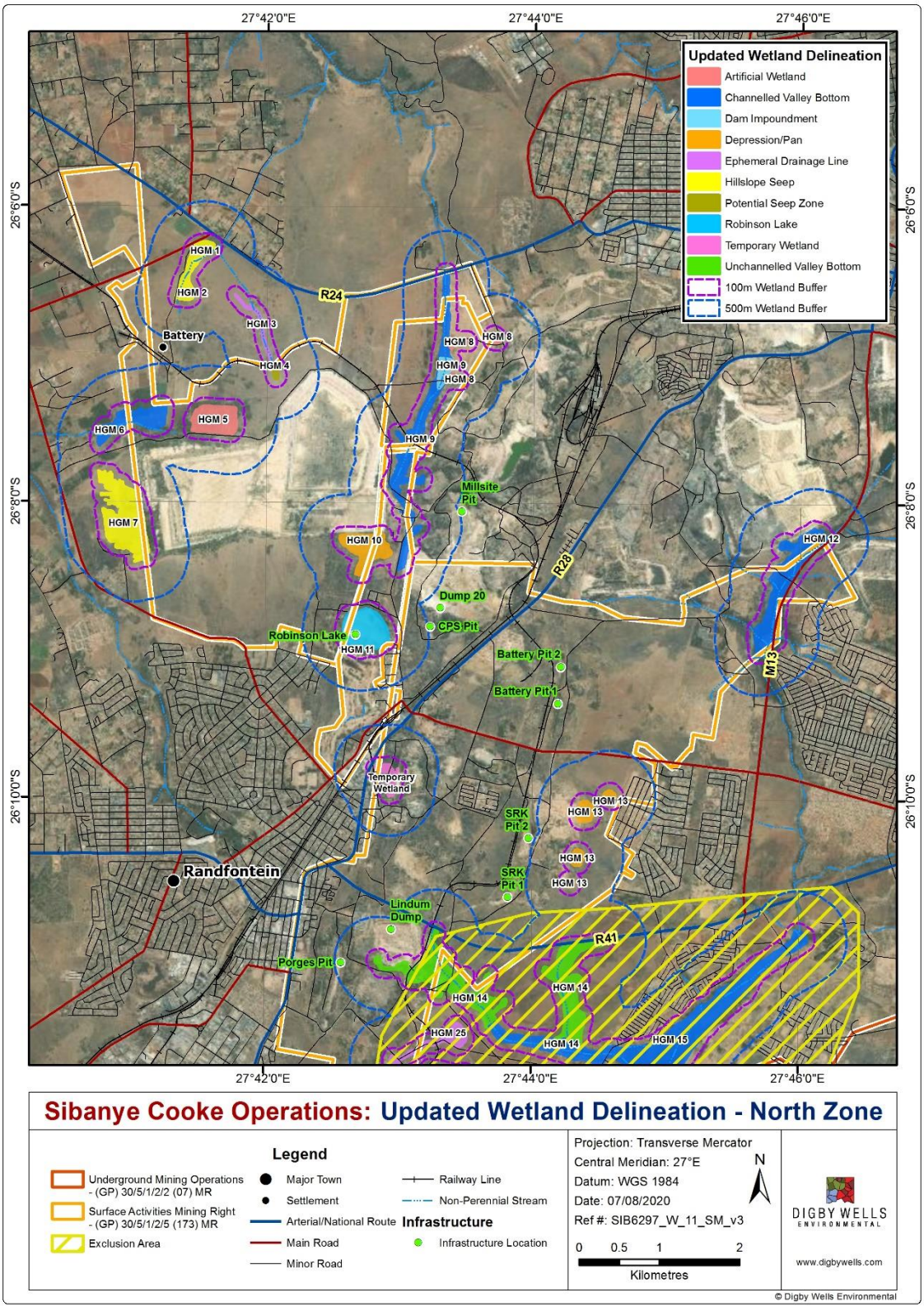


Figure 8-2: North Zone Delineation and Buffers

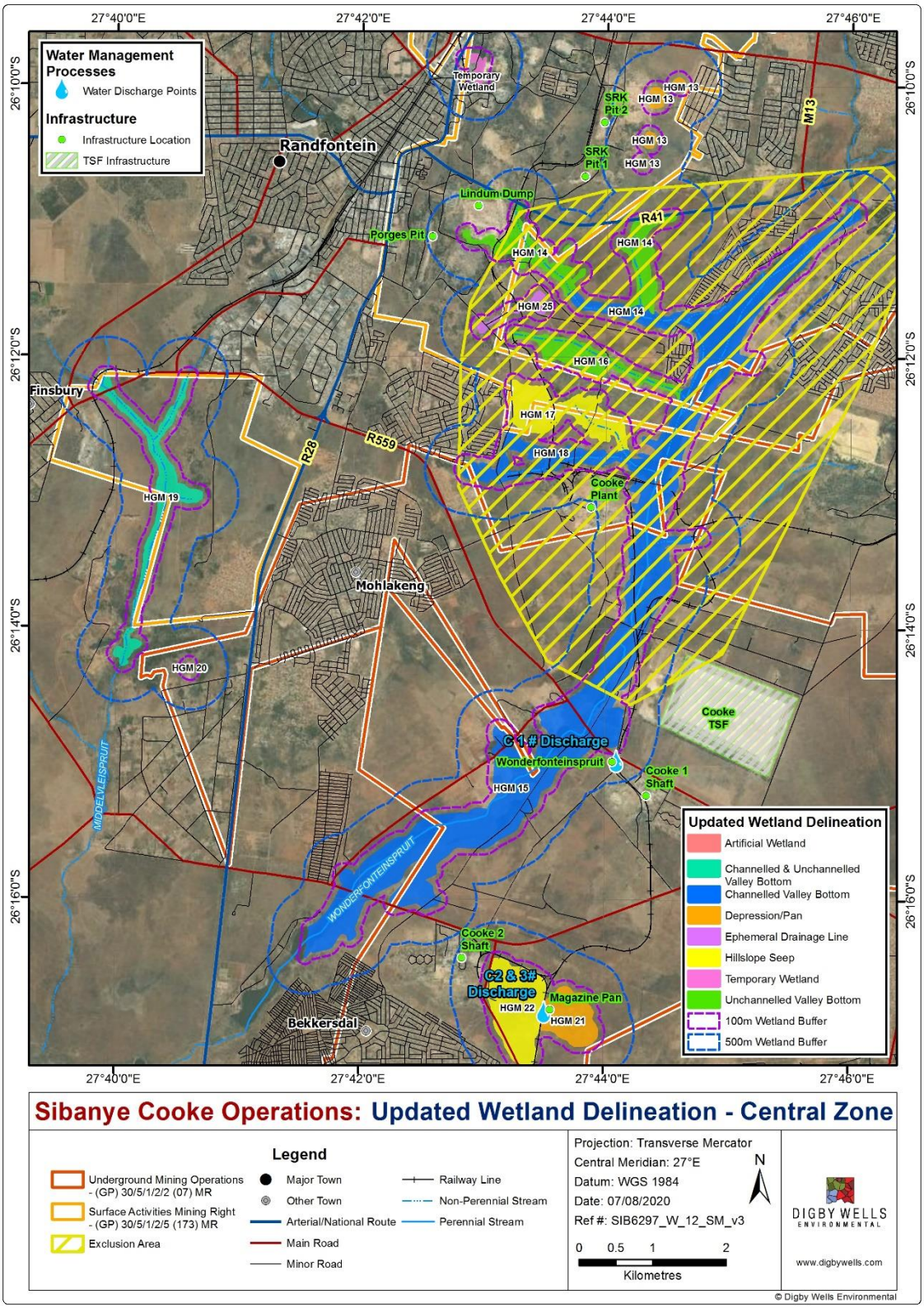


Figure 8-3: Central Zone Delineation and Buffers

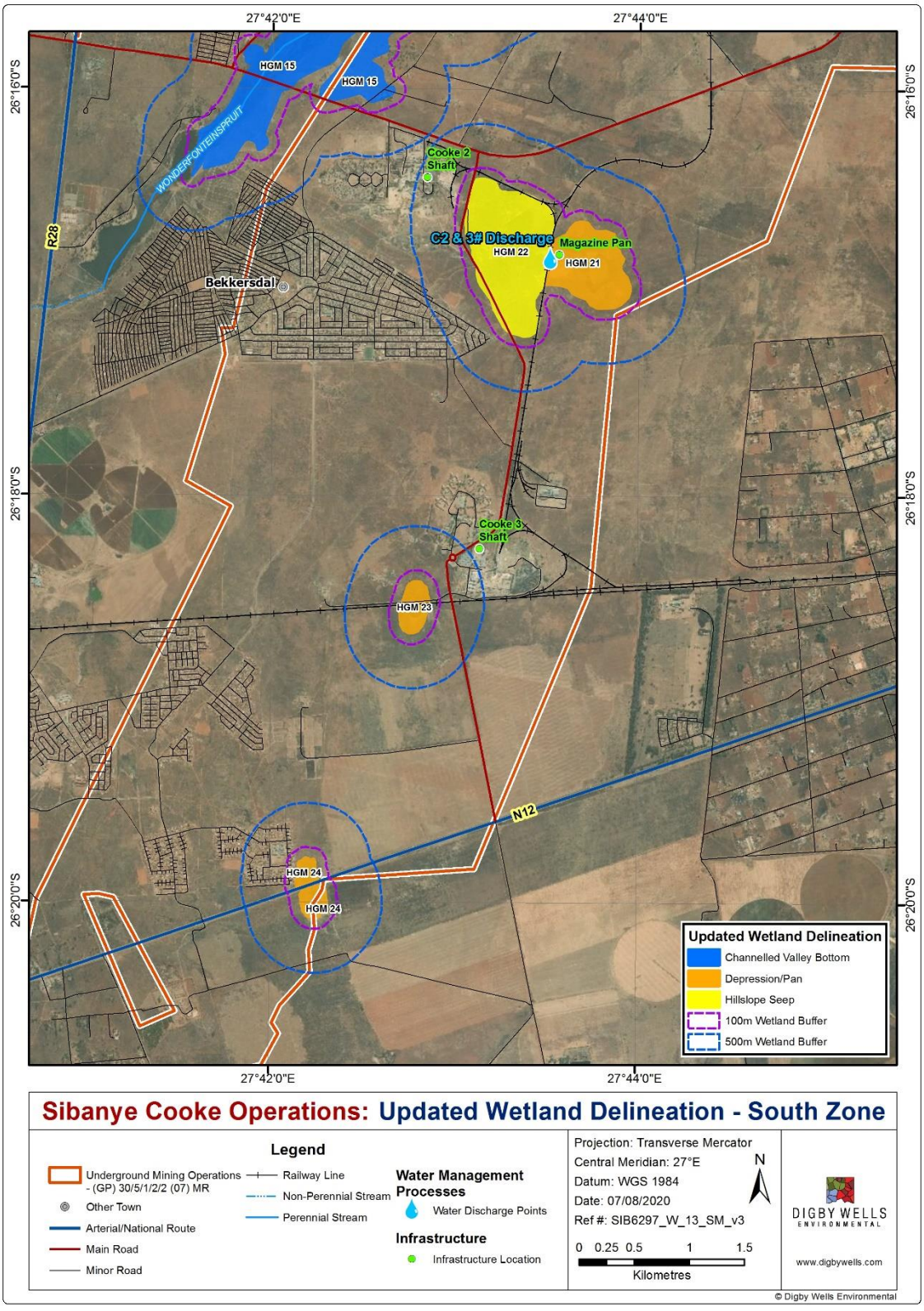


Figure 8-4: South Zone Delineation and Buffers

8.5.1 Site Photographs

This section provides the site photographs taken during the field assessment.

Table 8-2: Site Photographs

HGM Unit/Area	Photography	Notes
HGM 15		Located along the Wonderfonteinspruit, downstream of Donaldson Lake indicating raised pipeline crossing of spruit.

HGM Unit/Area	Photography	Notes
HGM Unit 15		Pipeline plinths located within the channel of the Wonderfonteinspruit. Water is still present within the system with some channelization that has occurred.
HGM 19		Focusing downstream of HGM 15 of channelled/unchanneled valley bottom wetland. There is a weir located downstream of this point that has impacted of streamflow within the system.

HGM Unit/Area	Photography	Notes
HGM 19		Focusing downstream of HGM 19, indicating overutilization of surrounding grassland and small channel running through the centre of the wetland.
HGM 19		Looking upstream of wetland unit. Urban development has encroached upon this wetland area.

HGM Unit/Area	Photography	Notes
HGM 15		Taken towards Main Road of the Wonderfonteinspruit indicated highly disturbed natural of the system and road that crosses over the spruit. Section of wetland had recently been burnt.
HGM 15		Small poplar grove located within the Wonderfonteinspruit section, indicating colonization of AIP species within this zone.

HGM Unit/Area	Photography	Notes
HGM 21		Magazine Pan with standing water still located within the peripheral of the site. Other impacts found on site was illegal mining activities taking place within the area and footprint of the system.
HGM 23		Identified depression within close proximity to the Cooke 3 Shaft Area.

HGM Unit/Area	Photography	Notes
HGM 23		There is a railway line that bisects with wetland area and other tracks within the wetland.
HGM 23		Wetland soils identified within HGM 23.

HGM Unit/Area	Photography	Notes
HGM 15		Taken of a the R41 further upstream along the Wonderfonteinspruit
HGM 12		Recently burnt section further upstream of the Wonderfonteinspruit.

HGM Unit/Area	Photography	Notes
HGM 11		Robinson Lake that has become heavily impacted upon by mining activities and colonisation of AIP's surrounding the lake.
HGM 4		Potential hillslope seep located North of the Millsite TSF. Signs of mottling found within the soil. Further investigation required.

HGM Unit/Area	Photography	Notes
HGM 5		Artificial wetland created from paddocks.
HGM 9		Section of the Tweelopiespruit prior to the stream entering the Krugersdorp Nature Reserve. Highly impacted system.

HGM Unit/Area	Photography	Notes
HGM 1 and 2		Hillslope seep and pan South of the Millsite TSF.

9 Impact Assessment

The activities assessed for the wetlands impact assessment are listed in Table 9-1 and Table 9-4 and final rehabilitation and closure phase of the project. This section includes an impact assessment for activities associated with the proposed decommissioning activities associated with the Rand Uranium Operations. The Cooke Mining Right has several wetland systems located within the Mining Right Areas. Only activities that will either have a positive or negative impact associated with the decommissioning and closure phases have been assessed, thus other mining related impacts have not been included.

It is the opinion of the ecologist that the proposed decommissioning activities, in the long term, is likely to have a positive impact on the ecological integrity of the area in general, should the relevant mitigation and management measures outlined in this report be adhered to.

9.1 Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts…

Table 9-1: Interactions and Impacts of Activity

Interaction Number	Interaction Description	Impact
1	Removal and decontamination of underground infrastructure containing hydrocarbons and other contaminants from the Cooke 3, 2 and 1 underground workings	Potential impact to wetland areas as a result of hydrocarbon spillages.
2		Potential dumping of decommissioned infrastructure in wetland/riparian areas.
3	Refurbishment of plugs between Cooke 3 and Cooke 4 Shafts, as well as between Cooke 1 and Doornkop Mine.	None anticipated at this stage.
4	Potential capping of the shaft barrel below the dolomitic aquifer, dependent on specialist studies regarding the groundwater quality.	None anticipated at this stage.

Interaction Number	Interaction Description	Impact
5	Decommissioning of surface dams and rehabilitation of dam footprints.	There is a risk to potential wetland resources as decommissioning activities associated with the removal of the surface dams and other associated water management features could impact negatively as there is a change in drainage patterns that could occur and potential contaminates that could migrate towards wetland systems. In saying this the opposite is also true, there would be a positive impacts as a result of removal of these contaminates, thus removing the source of contamination (Refer to Interaction Number 7).
6	Removal of settled solids from surface paddocks and mud ponds for processing through the Plant and/or disposal into the Pits.	Potential positive impact if the landscape is returned to a state that resembles an earlier landscape and potential reinstatement of wetlands that would have been impacted upon as a result of mining related activities.
7	Decommissioning and rehabilitation of concrete channels.	Potential negative impacts to wetland resources as a result to changes in drainage patterns and potential release of accumulated solids during decommissioning activities, but ultimately will be a positive impact for wetlands in the long term.
8	Decommissioning of shaft headgear and surface infrastructure.	Potential negative impacts to wetland resources as a result to changes in drainage patterns and potential release of accumulated solids during decommissioning activities, but ultimately will be a positive impact for wetlands in the long term.
9	Capping of shafts.	No anticipated impact
10	Sale of salvageable items.	No anticipated impact

Interaction Number	Interaction Description	Impact
11	Disposal of waste.	Potential negative impacts to wetland resources caused by hydrocarbon waste and other contaminants, if not appropriately managed with respect to removal and disposal. However ultimate removal removes future risk of contamination.
12	Rehabilitation of wetlands in the vicinity of the Cooke Surface and underground Operations, including, but not limited to: • Magazine Pan; • Three contaminated wetlands near Lindum Dump; • Millsite footprint; • Dump 20, Lindum crusher and TSF, Middelveli; • All associated pits; • Cooke Plant, Cooke TSF RWDs, Cooke Plant Surge Ponds; • Cooke 1 Shaft silt trap dams and discharge canal to the Wonderfonteinspruit; • Cooke 2/3 discharge canal to the Magazine Pan; • Contaminated wetland near Millsite TSF; • Robinson Lake; • Tiger Mills temporary wetland area; and • Millsite footprint, pits, SRK 2/3 pits Cooke 2 & 3 Shaft infrastructure. (removal of gold bearing material, decommissioning, rehabilitation, potential soil removal and amelioration including vegetation removal to achieve soil remediation, alien and invasive species control, revegetation, landscaping and maintenance & monitoring activities).	Potential negative impacts to wetland resources as a result to changes in drainage patterns during rehabilitation activities, but ultimately will be a positive impact for wetlands in the long term. It should be noted that detailed rehabilitation studies will be conducted once upstream pollution sources have been removed, these will further inform the way forward, with the goal to aim for non-intrusive rehabilitation solutions. All infrastructure within the 500m buffer will be removed and the area rehabilitated.

9.1.1 Impact Description – Interaction 1, 2, 7 and 8

Among the impacts associated with the proposed decommissioning activities associated with the shafts and other associated areas there could be minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities.

HGM 15 is within 500m of the Cooke 1 and 2 Areas and Cooke RWD's. To the East of Cooke 2 Shaft HGM Unit 22 is also located in close proximity. There is also a small depression/pan (HGM Unit 23) is located to the West of the Cooke 3 Shaft. There is a risk that if decommissioning activities move beyond the boundary of the footprint areas, which could result in disturbance occurring within the prescribed buffer zones. In addition to this there is a risk that potential hydrocarbons and/or other chemicals are spilled within this area that could result in runoff of contaminated water into these HGM unit.

Other impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.

There is a risk that removal of additional vegetation may occur, which could give rise to the increased risk of erosion and spread of alien invasive species within the wetland buffer zones and potentially within the wetlands indicated above.

9.1.1.1 Management Objectives

The objectives for management measures for the decommissioning phase are to preserve wetland functionality and integrity for the duration and into the rehabilitation and closure phases of the proposed decommissioning activities and that activities do not expand into the wetland buffer zone and associated wetlands to avoid further degradation of these systems.

9.1.1.2 Management Actions

The following mitigation and management measures have been prescribed for the decommissioning phase:

- Ensure that sound environmental management is in place during the proposed decommissioning phase;
- Ensure that as far as possible all decommissioned infrastructures are placed outside of wetland/riparian areas and their associated buffer zones (recommended buffer zone of 100m) where possible;
- Limit the footprint area of the decommissioning activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas);
- If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated. It is advised that the

mitigation hierarchy needs to be followed from avoidance to offset in consultation with a wetland specialist, with offset considered as an absolute last resort;

- All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation maintenance plan;
- All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled;
- A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- All areas of increased ecological sensitivity (C class and above) should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;
- Existing crossing to be utilised to gain access to areas associated with decommissioning and rehabilitation activities;
- Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the wetlands and the aquatic resources further downstream, should activities occur during the wetter months then appropriate stormwater control measure must be implemented with the aim to adhere to GNR 704 and ensure dirty water features are kept to a minimum dimension for storage only for a limited period of time;
- No material may be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed decommissioning footprint, stockpiling areas should be located in areas to prevent the contamination of downstream water resources. Where stockpiling occurs for the purposes of rehabilitation and maintenance of water systems (dams and impacted wetland areas requiring rehabilitation), as material will be required to dry-out before disposal, the area must be upstream of the impacted water systems such that any run-off feeds back into the impacted water system and not a clean environment;
- The creation of new dirty areas for stockpiling must be discouraged;
- The disturbance of sediment within flowing systems must not occur as this will result in further downstream pollution, should sediment removal be deemed a requirement, suitable diversion structure must be implemented;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated buffer zones. All vehicles must remain on demarcated roads and within the decommissioning area footprint;
- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;

- Appropriate sanitary facilities must be provided for the duration of the decommissioning activities and all waste must be removed to an appropriate waste facility;
- Monitor all systems for erosion and incision; and
- Ongoing wetland monitoring and rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint areas and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.

9.1.1.3 Impact Ratings

The majority of wetlands that are at risk of negative impacts during the decommissioning phase have been identified as largely modified to seriously modified and further impacts related to sedimentation and habitat degradation may result in a further drop in ecological state of the wetland features present. Table 9-2 represents the impact ratings for the decommissioning phase.

Table 9-2: Potential Impacts of the Decommissioning Phase for Interaction 1, 2, 7 and 8

Dimension	Rating	Motivation	Significance
Activity and Interactions: Decommissioning of shaft areas and associated infrastructure.			
Prior to Mitigation/Management			
Duration	Medium term 1 – 5 years (3)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Minor (negative) – 36
Extent	Local (3)	The impact should be limited to the areas that are going to be decommissioned, but if no mitigation is adopted there is a risk that impacts to wetland buffer areas and the wetlands themselves could occur.	
Intensity x type of impact	Moderate (3)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in medium term impacts.	

Dimension	Rating	Motivation	Significance
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative		
Post-Mitigation			
Duration	Medium term 1 – 5 years (3)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Negligible (negative) - 21
Extent	Limited (2)	Impacts will be limited only to the project footprint area.	
Intensity x type of impact	Minor (2)	Due to the impacted nature of the systems present, should the decommissioning and rehabilitation project proceed, and the appropriate precautions and management or mitigation measures the potential to impact on wetlands would be significantly reduced.	
Probability	Unlikely (3)	Should the proposed decommissioning and rehabilitation project proceed it is anticipated that the impacts would be unlikely to occur.	
Nature	Positive		

9.1.2 Impact Description Interaction 5, 7, 6, 11 and 12

Activities associated with the decommissioning of the surface dams, paddocks and removal of sediment built up within these facilities could pose a risk to the surrounding wetlands in close proximity to these structures. In addition to this the potential rehabilitation of some of the wetlands associated with the Cooke Surface Operations could also result in negative impacts in the short term.

There are surface settling dams and slimes paddocks located at the Cooke 1 and 2 Shaft Area. There are several HGM units within close proximity to these facilities (250 – 600m).

As these structures are removed and rehabilitated there is a risk that surface drainage patterns may change and result in water flowing from these facilities towards the respective wetlands, which could pose a risk if the footprint of these facilities have not been cleaned up/rehabilitated properly. This would result in contaminates entering into these systems, which could have

further impacts to the functionality. This would also be the same for wetlands that are rehabilitated. If contaminated material is required to be removed from these systems it must be done with care as not to result in additional discharge of contaminants into the respective systems. If material is removed from wetland areas, it must not be stored within wetland areas or within the required buffer zones. Ultimately once this material is removed, it should be taken away from the project site in order to remove the contamination source.

There is also a risk that when rehabilitation of the respective wetlands is undertaken that further impacts could manifest as a result of working within these systems, such as an increased risk of erosion and sedimentation of wetland systems located adjacent to areas being rehabilitated. Special attention must be undertaken for areas where wetland rehabilitation is going to take place. These areas must be targeted and focused and it is imperative that rehabilitation activities (initial disturbance activities) do not expand beyond the targeted zone of rehabilitation.

In addition, if surface reprofiling is not done correctly, including revegetation, there is an increased risk of having exposed surfaces, which could result in increased risk of erosion and sediment loads reporting to the associated wetlands. Removal of sediment within these facilities and where this sediment is also stored on surface poses a risk of contamination to water resources. It is imperative that the sediment that is removed is not stockpiled within the prescribed buffer zones.

In addition to the above there could potentially be an overall positive impact as a result of the removal of the sludge from the dams, which would be beneficial for the overall rehabilitation of the associated dams and could improve the overall functionality of some of the HGM units as the source of contamination is removed.

Furthermore to this, decommissioning and rehabilitation over the larger extent of the Cooke Mining Right and surface rights also need to be considered, such as the reclamation activities either currently being undertaken or are proposed to be undertaken at location like Dump 20 and Millsite, removal and decommissioning of infrastructure and backfilling of voids.

Potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with heavy moving machinery could occur. Larger impacts could include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation resulting in impacts further downstream.

These impacts have the potential to increase sediment loads being deposited on river bends and levees, which in turn may result in the establishment and further spread of invasive hydrophytic plants and loss of stream flow and natural refuge areas in the aquatic systems further downstream.

Alterations to the natural hydrology and geohydrology of the area should tailings or contaminated soils not be adequately removed may also result in a loss of the wetland integrity of these systems. Any potential dumping of tailings or contaminated soils in wetland areas has the potential to impact water quality of the wetlands as well as the aquatic resources further downstream of the site.

In addition, any temporary stockpiling or dumping of tailings or contaminated soils within wetland areas has the potential to result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.

Removal of vegetation and disturbance of soils in the vicinity decommissioning/reclamation activities could likely give rise to an increased potential for encroachment by robust pioneer species and alien invasive vegetation species, further altering the natural vegetation profiles of the wetlands encountered within the larger extent of the mining right and surface right.

Transport of tailings and contaminated soils has the potential to result in further contamination and sedimentation of the freshwater resources present through spills. Furthermore, disturbance of historical tailings and contaminated soils has the potential to result in increased oxidation of pollutants such as pyrites, which has the potential to increase impacts to water quality of the freshwater resources. In addition, disturbance and reclamation of tailings and contaminated soils has the potential to result in increased erosion and sedimentation of the freshwater resources present.

9.1.2.1 Management Objectives

The management objective while decommissioning these dams is to avoid the movement of sediments and increased salt loads from these footprints into the surrounding wetland areas. In addition to the above risk of material that is removed from these facilities must not be allowed to enter into the receiving environment.

9.1.2.2 Management Actions

The following mitigation and management measures have been prescribed for the decommissioning phase:

- Ensure that sound environmental management is in place during the proposed decommissioning phase;
- Ensure that as far as possible all decommissioned infrastructures are placed outside of wetland/riparian areas and their associated buffer zones (recommended buffer zone of 100m) where possible;
- Limit the footprint area of the decommissioning activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas);
- Ensure that sediment that is removed from these footprints is not stored within the buffer zones and that it is removed offsite and disposed of at an appropriate authorised facility;
- If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated. It is advised that the

mitigation hierarchy needs to be followed from avoidance to offset in consultation with a wetland specialist ,with offset considered as an absolute last resort;

- All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation maintenance plan;
- All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled;
- A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- All areas of increased ecological sensitivity (C class and above) should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;
- Existing crossing to be utilised to gain access to areas associated with decommissioning and rehabilitation activities;
- Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the wetlands and the aquatic resources further downstream, should activities occur during the wetter months then appropriate stormwater control measure must be implemented with the aim to adhere to GNR 704 and ensure dirty water features are kept to a minimum dimension for storage only for a limited period of time;
- No material may be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed decommissioning footprint, stockpiling areas should be located in areas to prevent the contamination of downstream water resources. Where stockpiling occurs for the purposes of rehabilitation and maintenance of water systems (dams and impacted wetland areas requiring rehabilitation), as material will be required to dry-out before disposal, the area must be upstream of the impacted water systems such that any run-off feeds back into the impacted water system and not a clean environment;
- The creation of new dirty areas for stockpiling must be discouraged;
- The disturbance of sediment within flowing systems must not occur as this will result in further downstream pollution, should sediment removal be deemed a requirement, suitable diversion structure must be implemented;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated buffer zones. All vehicles must remain on demarcated roads and within the decommissioning area footprint;
- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;

- Appropriate sanitary facilities must be provided for the duration of the decommissioning activities and all waste must be removed to an appropriate waste facility;
- Ensure correct profiling and vegetation of these disturbed footprints is undertaken;
- Monitor all systems for erosion and incision; and
- Ongoing monitoring of the Wonderfonteinspruit system, its water quality, wetlands (Wet-Health) and aquatic biota to detect changes that would occur as a result of the cessation of pumping activities. Sibanye will address impacts only directly associated with its activities and not other water users activities;
- The paddocks should be maintained, i.e the same impacted footprints should be used, until the discharge and associated treatment has ceased, thereafter they may be removed, so as to prevent the creation of additional dirty areas and the further alteration of the catchment.

9.1.2.3 Impact Ratings

The wetlands are at risk as a result of potential contamination from the dams entering into water resources and risk of increased sediment and salts loads from these facilities as a result of poor rehabilitation.Table 9-2 represents the impact ratings for the decommissioning phase.

Table 9-3: Potential Impacts of the Decommissioning Phase for Interaction 5, 6, 7, 11 and 12

Dimension	Rating	Motivation	Significance
Activity and Interactions: Decommissioning of dams and disposal of sludge			
Prior to Mitigation/Management			
Duration	Medium term 1 – 5 years (3)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Minor (negative) – 40
Extent	Municipal (4)	This impact could extend further downstream if no mitigation measures are adopted resulting in impacts to downstream users.	
Intensity x type of impact	Moderate (3)	This impact would be moderate to severe in nature if it had to occur.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative		

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	Medium term 1 – 5 years (3)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Negligible (negative) - 21
Extent	Limited (2)	Impacts will be limited only to the project footprint area.	
Intensity x type of impact	Minor (2)	Due to the impacted nature of the systems present, should the decommissioning and rehabilitation project proceed, and the appropriate precautions and management or mitigation measures the potential to impact on wetlands would be significantly reduced.	
Probability	Unlikely (3)	Should the proposed decommissioning and rehabilitation project proceed it is anticipated that the impacts would be unlikely to occur.	
Nature	Positive		
Post-Mitigation			
Duration	Medium term 1 – 5 years (3)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Minor (positive) + 45
Extent	Local (3)	Removal of sludge should have a benefit as the contamination source will be removed, so the positive impact would be for the local surrounds.	
Intensity x type of impact	Moderate (3)	It is anticipated that there would be an overall slight positive impact as a result of the re-movement of the sediment and contamination source.	
Probability	Likely (5)	It is likely that by removing the sediment will occur.	
Nature	Positive		

9.2 Final Rehabilitation and Closure Phase

Activities during the final rehabilitation and closure phase that may have potential impacts are listed in Table 9-4 below.

Table 9-4: Interactions and Impacts of Activity

Interaction No.	Interaction Description	Impact
1	Rewatering of underground workings.	Rewatering may alter discharge patterns and could have an impact on surface water flow and wetlands that will need to be monitored to determine the level of impact that could occur based on quality and quantity of water.
2	Rehabilitation of surface paddocks and mud ponds. Also consideration for the larger extent of rehabilitation of impacted areas such as Dump 20, Millsite and pits etc.	Potential positive impact on the landscape as sources of potential contamination to be removed. Options to reinstate wetlands that were impacted upon could be considered.
3	Rehabilitation of Magazine Pan, a pan used for water management and other associated wetlands within the mining right and surface right area.	Potential positive impact the landscape as sources of potential contamination to be removed. Options to reinstate wetlands that were impacted upon could be considered. The best fit for purpose approach will be adopted for rehabilitation and the solutions that will be implemented. The intent would be to ensure that the environmental impacts are reduced. The land may not be rehabilitated back to a pre-mining environment, but fit for purpose approached adopted. Option to retain the pan system and improve overall habitat structure. If the pan is not retained could result in a negative impact to wetland species (fauna and flora) that utilise the area as habitat.
4	Rehabilitation of infrastructure footprints.	Potential positive impact the landscape as sources of potential contamination to be removed. Options to reinstate wetlands that were impacted upon could be considered. The best fit for purpose approach will be adopted for rehabilitation and the solutions that will be implemented. The intent would be to ensure that the environmental impacts are reduced. The land may not be rehabilitated back to a pre-mining environment, but fit for purpose approached adopted.

9.2.1 Impact Description – Interaction 1 and 3

Rewatering of the underground workings will change surface water flow patterns as it is anticipated that water will not be discharge to the receiving environment as per the current scenario that has been undertaken.

Reduction in flow patterns will ultimately result in a reduction in the quantity of water being discharge to the environment. As a result of this there is the potential that wetland sections along the Wonderfonteinspruit and Magazine Pan could be impacted upon. The reduction in water reporting to these two systems would result in a possible shrinking of the associated wetlands as they dry up, with particular emphasis placed on Magazine Pan as this is an artificial system currently. With a reduction in water quantity as a result in cessation of pumping activities, it is anticipated that wetland areas would shrink in size and return back to potential pre-mining conditions. It is debatable that if the reduction in water quantity discharge and shrinking of wetland areas would be considered as a negative impact as wetland extents would potentially return back to pre-mining conditions as noted above. In saying this as wetlands shrink, wetland habitat that would have been created would disappear, which could be considered as a negative impact.

With re-watering activities of the underground workings and cessation of pumping activities within the Wonderfonteinspruit, it is anticipated that water qualities will change within this system. This will initially result in a reduction in dilution of municipal, upstream and processing activities and it is anticipated that there could be a potential deterioration in water quality within the Wonderfonteinspruit for a period of five years. As recharge occurs overtime and groundwater levels re-establish, re-watering from the “eyes – such as the Gemsbokfontein Eye” will occur. It is expected that this will occur within year five and gradually increase over a 15 year period, resulting in an increased flow of water back into the Wonderfonteinspruit. It is anticipated that the water quality would then generally improve over time.

It is noted that Sibanye cannot be held accountable as a result of the decline in water quality in the short term. It is evident that the dilution (current discharge) does improve the overall water quality. It is key to note that it would be the Governments responsibility to ensure that the upstream impacts and other water uses in the catchment are managed to cater for the change in water quality. As noted Sibanye will address impacts that are directly associated with its activities and that other mining companies and water uses within the catchment also need to implement appropriate management measures.

One minor positive impacts as a result water not being discharge could be the potential reduction in salt load into the system.

In addition to the above positive and negative impacts, decant water from the underground workings needs to be considered, capping of the underground workings would potentially minimise the risk of mine water and potentially mine water decanting out of the shafts and other areas as recharge occurs. Based on the findings of the geohydrological assessment, undertaken by M van Biljon dated May 2020, the risk of decant from the shafts was considered unlikely and the quality of water will should be within the SANS 241 guideline limits.

9.2.1.1 Management Objectives

The objectives for management measures for the final closure phase would be to ultimately improve the functionality of the wetlands within the greater area of impact, though rehabilitation measures adopted.

9.2.1.2 Management Actions

The following mitigation and management measures have been prescribed for the decommissioning phase:

- Consideration to the rehabilitation options that should be considered for Magazine Pan even though this is an artificial system that has been created, there is an opportunity to maintain this system as a wetland and improve the functionality of the system and overall the biodiversity despite reduced inflows;
- Design capping of the shafts to minimise the potential risk of decant from these areas, as informed by the requirements of the Hydrogeological assessment report;
- Ongoing groundwater monitoring and modelling to determine if there is the potential that additional decant points would occur overtime to ensure that the appropriate mitigation measures are implemented to protect water resources in the event that decant does occur;
- Investigate and determine prefeasibility treatment options for integration into the larger closure strategy for the region;
- Ongoing monitoring of the Wonderfonteinspruit system, its water quality, wetlands (Wet-Health) and aquatic biota to detect changes that would occur as a result of the cessation of pumping activities. Sibanye will address impacts only directly associated with its activities and not other water users activities;
- and adopt remedial action if required if there is an overall reduction in ecological functionality of the system were possible;
- Monitor geomorphology of all systems for subsidence, erosion and incision; and
- Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint areas and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.

9.2.1.3 Impact Ratings

There are both negative and positive risks associated with the rewatering of the underground workings. Reduction in the quantity of water could result in systems drying out for a period of time, until groundwater recharge levels re-establish. In addition to this there could be positive and negative impacts associated with changes in water quality, which is discussed in further detail above and is further discussed within the Groundwater Assessment Report. In the short

term there would be a potential reduction in salt loads, but without the dilution the water quality within the Wonderfonteinspruit could deteriorate further, until recharge has occurred and rewatering from the eyes starts. This would lead to additional flow of water to the Wonderfonteinspruit and in the long term, potentially improve the water quality.

It must be noted that in the long term there would be an overall improvement of water quality within the Wonderfonteinspruit as the baseflow from the unimpacted groundwater would be of better quality then the current discharge quality. There would be a limited time period while recharge occurs that dilution will be reduced, which in the short term could lead to a slight deterioration in water quality, until recharge occurs.

Table 9-5 represents the impact ratings for reduction in quantity of water, Table 9-6 represents the changes in water quality associated with water not being discharged and recharge occurring overtime and Table 9-7 represents potential positive impacts as a result of dirty footprints (contamination sources) being removed.

Table 9-5: Potential Impacts of Final Closure Phase – Quantity of Water Discharge

Dimension	Rating	Motivation	Significance
Activity and Interactions: Potential Impacts of Final Closure Phase Quantity of Water Discharge			
Prior to Mitigation/Management			
Duration	Permanent (7)	It is anticipated that no water would be discharge back into the Wonderfonteinspruit and Magazine Pan	Moderate (negative) – 98
Extent	Municipal Area (4)	The impact would extend beyond the project boundary associated with the Wonderfonteinspruit but limited for Magazine Pan.	
Intensity x type of impact	Moderate (3)	Potential moderate reduction in wetland areas overtime.	
Probability	Definite (7)	The impact will occur as a result of not discharging water.	
Nature	Negative		
Post-Mitigation – No mitigation for change in flow regime for Wonderfonteinspruit, however potential positive impact associated with the rehabilitation of Magazine Pan and other associated systems and wetlands.			
Duration	Permanent (7)	Once rehabilitation of Magazine Pan is done and the system becomes self-sufficient this would remain forever.	Minor (Positive) + 65

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	Limited to Magazine Pan footprint.	
Intensity x type of impact	Moderate (4)	Moderate improvement overtime and improvement of biodiversity.	
Probability	Likely (5)	Potential that Magazine Pan could be rehabilitated.	
Nature	Positive		

Table 9-6: Potential Impacts of Final Closure Phase – Quality of Water Discharge and Recharge

Dimension	Rating	Motivation	Significance
Activity and Interactions: Potential Impacts of Final Closure Phase – Quality of Water Discharge			
Mitigation – Reinstatement of current treatment			
Duration	Medium Term (3)	Potential deterioration of water quality as a result of not discharging, resulting in no dilution of water which could impact on the functionality of wetlands along the Wonderfonteinspruit. The duration of this impacts is expected to be only medium term (short term) in nature until recharge from the eyes starts.	Minor (Negative) - 70
Extent	Municipal Area (4)	The impact would extend beyond the project boundary associated with the Wonderfonteinspruit.	
Intensity x type of impact	Moderate (3)	Potential moderate negative impact.	
Probability	Definite (7)	The impact will occur as a result of not discharging water, however will be for a short term in nature.	
Nature	Negative		
Activity and Interactions: Potential Impacts of Final Closure Phase – Recharge and rewatering from the "eyes" into the Wonderfonteinspruit			
Duration	Permanent (7)	Potential improvement of water quality into the Wonderfonteinspruit once recharge has occurred.	Moderate (Positive) + 75

Dimension	Rating	Motivation	Significance
Extent	Municipal Area (4)	The impact would extend beyond the project boundary associated with the Wonderfonteinspruit.	
Intensity x type of impact	Moderate (4)	Potential moderate positive impact.	
Probability	Likely (5)	The impact will occur as a result of recharge.	
Nature	Positive		

Table 9-7: Potential Impacts of Final Closure Phase – Quality of Water Discharge emanating from previous Dirty Footprints (such as tailings facilities, dams and paddocks)

Dimension	Rating	Motivation	Significance
Activity and Interactions: Potential Impacts of Final Closure Phase – Quality of Water Discharge			
Mitigation measures to be adopted as discussed in Section 9.1.			
Duration	Permanent (7)	Removal of dirty footprints would ultimately improve water quality within the catchment as dirty water will not be emanating from these areas, thus resulting in better quality water reporting into the catchment from previous contaminated areas.	Moderate (Positive) + 98
Extent	Municipal Area (4)	The impact would extend beyond the project boundary associated with the Wonderfonteinspruit.	
Intensity x type of impact	Moderate (3)	Potential moderate positive impact.	
Probability	Definite (7)	The impact will occur as a result of not discharging water.	
Nature	Positive		

9.2.2 Impact Description – Interaction 2, 3 and 4

With the removal of the surface infrastructure, dams and paddocks, there would be an overall positive impact in the long term, as contamination sources have been removed, the areas rehabilitated and natural drainage paths reinstated, thus resulting in an overall benefit to the environment. The same would be true for the overall rehabilitation of Magazine Pan and other

associated wetlands. Removal of contaminates from these wetlands would be beneficial and improve the water quality and overall functionality of these systems overtime. In addition it would be anticipated that ecological services that these systems would provide would improve as a result of rehabilitation related activities.

9.2.2.1 Management Objectives

To ensure that rehabilitation is undertaken in the long term and that areas rehabilitated are self-sustaining

9.2.2.2 Management Actions

The following mitigation and management measures have been prescribed for the decommissioning phase:

- Ensure rehabilitation is done according to a plan and monitoring of these areas is undertaken for a period of 3-5 years;
- Development of specific rehabilitation plans for Magazine Pan and other wetland areas that are going to be rehabilitated;
- Monitoring of wetland rehabilitation activities that are undertaken both during the rehabilitation phase and post closure; and
- If monitoring determines that additional rehabilitation actions are required, ensure that these are implemented as soon as possible to stop further degradation occurring.

9.2.2.3 Impact Ratings

Table 9-8: Potential Impacts of Final Closure Phase – Removal of Surface Infrastructure, Dams and Paddocks

Post-Mitigation			
Duration	Permanent (7)	Once rehabilitation is done and the system becomes self-sufficient this would remain forever.	Moderate (Positive) + 78
Extent	Limited (2)	Limited to footprint. of rehabilitated areas.	
Intensity x type of impact	Moderate (4)	Moderate improvement overtime and improvement of biodiversity.	
Probability	Almost Certain (6)	Almost certain that the impact would be beneficial.	
Nature	Positive		

9.3 Cumulative Impacts

The overall closure of the Cooke Shafts and associated infrastructure would potentially have an overall benefit to the surrounding areas as contamination sources are removed and areas reinstated, however integration and longer term planning with other mining houses, community forums, authorities, NGO's and surrounding communities will need to be undertaken to ensure that a sustainable closure solution that both improves the environment, but also benefits the community is taken into consideration.

Based on the impact assessment and the groundwater report reviewed (2020), the risk for decant from the shaft areas after re-watering of the underground workings will not occur, however overtime recharge from the "eyes" will impact on water quality on the Wonderfonteinspruit as discussed in the impact assessment above. It is anticipated that overtime there would be an overall improvement of water quality within the Wonderfonteinspruit.

It is anticipated that if the correct closure process is adopted, there would be an overall positive impact for the larger surrounding area. The eventual closure of all Cooke Operations cannot be assessed in isolation, as many of the interactions currently undertaken and proposed closure measures have impacts on a much larger regional scale. It is advised that the overall closure and management of greater region is undertaken involving all role players involved to ensure a holisitic approach is adopted.

10 Environmental Management Plan

Table 10-1 provides a summary of the proposed project activities, environmental aspects and impacts on the receiving environment. Information on the frequency of mitigation, timing of implementation, and roles / responsibilities of persons implementing the EMP are summarised.

Table 10-1: Environmental Management Plan

Activity/ies	Potential Impacts	Aspects Affected	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
Decommissioning and removal of infrastructure.	Ingress of hydrocarbons and other spills into the surrounding wetland areas;	Wetlands	Decommissioning Phase	• Ensure that sound environmental management is in place during the proposed decommissioning phase; • Ensure that as far as possible all decommissioned infrastructures are placed outside of wetland/riparian areas and their associated buffer zones (recommended buffer zone of 100m) where possible; • Limit the footprint area of the decommissioning activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); • If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated. It is advised that the mitigation hierarchy needs to be followed from avoidance to offset in consultation with a wetland specialist, with offset considered as an absolute last resort; • All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation maintenance plan; • All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled; • A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones; • All areas of increased ecological sensitivity (C class and above) should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; • Existing crossing to be utilised to gain access to areas associated with decommissioning and rehabilitation activities; • Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the wetlands and the aquatic resources further downstream, should activities occur during the wetter months then appropriate stormwater control measure must be implemented with the aim to adhere to GNR 704 and ensure dirty water features are kept to a minimum dimension for storage only for a limited period of time; • No material may be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed decommissioning footprint, stockpiling areas should be located in areas to prevent the contamination of downstream water resources. Where stockpiling occurs for the purposes of rehabilitation and maintenance of water systems (dams and impacted wetland areas requiring rehabilitation), as material will be required to dry-out before disposal, the area must be upstream of	Control decommissioning activities within designated footprint and monitoring impact to wetlands on a monthly basis.	During the decommissioning phase.

Activity/ies	Potential Impacts	Aspects Affected	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
				the impacted water systems such that any run-off feeds back into the impacted water system and not a clean environment; • The creation of new dirty areas for stockpiling must be discouraged; • The disturbance of sediment within flowing systems must not occur as this will result in further downstream pollution, should sediment removal be deemed a requirement, suitable diversion structure must be implemented; • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated buffer zones. All vehicles must remain on demarcated roads and within the decommissioning area footprint; • All vehicles must be regularly inspected for leaks; • Re-fueling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; • All spills should be immediately cleaned up and treated accordingly; • Appropriate sanitary facilities must be provided for the duration of the decommissioning activities and all waste must be removed to an appropriate waste facility; • Monitor all systems for erosion and incision; and • Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint areas and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.		
Removal and disposal of sediments for surface dams, concrete channels and dams. Rehabilitation of Magazine Pan and other wetland areas;	Sedimentation and release of contaminations into wetland systems.	Wetlands	Decommissioning Phase	• Ensure that sediment that is removed from these footprints is not stored within the buffer zones and that it is removed offsite and disposed of at an appropriate authorised facility; • Development of specific rehabilitation plans for Magazine Pan and other wetland areas that are going to be rehabilitated; and • Monitoring of wetland rehabilitation activities that are undertaken both during the rehabilitation phase and post closure.	Control decommissioning activities within designated footprint and monitoring impact to wetlands on a monthly basis.	During the decommissioning phase and Post closure
Rewatering of underground workings	Rewatering may alter discharge patterns and could have an impact on surface water flow and wetlands. Rewatering from the “eyes” will occur in the long term and will impact upon the water quality	Wetlands	Decommissioning Phase	• Consideration to the rehabilitation options that should be considered for Magazine Pan even though this is an artificial system that has been created, there is an opportunity to maintain this system as a wetland and improve the functionality of the system and overall the biodiversity despite reduced inflows;	Monitoring during the post closure and final closure phases of the project.	Post closure.

Activity/ies	Potential Impacts	Aspects Affected	Phase	Mitigation Measure	Mitigation Type	Time period for implementation
	and quantity of the Wonderfonteinspruit. As a result of the above there could be an overall change of water quality and quantity discharge to the environment, which could have both positive and negative impacts.			• Design capping of the shafts to minimise the potential risk of decant from these areas, as informed by the requirements of the Hydrogeological assessment report; • Ongoing groundwater monitoring and modelling to determine if there is the potential that additional decant points would occur overtime to ensure that the appropriate mitigation measures are implemented to protect water resources in the event that decant does occur; • Consider treatment options for the larger closure scenarios for the region; • Ensure rehabilitation is done according to a plan and monitoring of these areas is undertaken for a period of 3-5 years; • Ongoing monitoring of the Wonderfonteinspruit system, its water quality, wetlands (Wet-Health) and aquatic biota to detect changes that would occur as a result of the cessation of pumping activities. Sibanye will address impacts only directly associated with its activities and not other water users activities; • Monitor all systems for erosion and incision; and • Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint areas and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.		

11 Monitoring Programme

The Wet-health and Wet-Ecoservices tools should be used to re-evaluate PES and eco-services on an annual basis by a suitably qualified wetland specialist for at least 3-5 years after the decommissioning and closure of the proposed project during the summer/wet monitoring season.

Thereafter, monitoring is recommended every two years until the system is deemed appropriately rehabilitated. If monitoring results necessitate corrective action in terms of alien vegetation removal and erosion control, these corrective measures should be implemented as quickly as possible. The erosion and eradication measures must be well thought out and elevated and in some cases designed and approved.

The Environmental Management Officer (EMO) must be present on-site during decommissioning and rehabilitation phases and must ensure that the wetland areas and their associated zones of regulation are clearly demarcated and that no unnecessary clearing of vegetation takes place. Refer to Table 11-1 for specific monitoring actions for the decommissioning activities.

Table 11-1: Wetland Monitoring Plan for Decommissioning Activities

Monitoring Action	Reasoning	Frequency of monitoring
Monitoring of all wetlands during decommissioning phase to record any negative impact that may occur. Wetland specialist with Faunal and Flora specialists is recommended.	Vegetation is an indicator of wetland health and can be used to monitor the decline in the wetland.	Monthly during decommissioning phase.

12 Stakeholder Engagement Comments Received

No comments from Interested and Affected Parties have been received thus far.

13 Recommendations

- It is critical that monitoring of surface water resource, wetland systems and aquatic biota be undertaken within the Wonderfonteinspruit to identify changes in water quality and quantity overtime to understand the overall impacts that would occur to this system as a result of decommissioning and post closure activities;
- A rehabilitation plan needs to be compiled for Magazine Pan;
- All wetlands requiring potential future rehabilitation as well as areas within the 500m buffer must be included as part of the Section 21 (C) and (i)'s applications.
- Groundwater numerical modelling to be updated as information changes to ensure the potential for decant is managed; and

- Water treatment options to be considered for the longer term closure scenario, if required.

14 Reasoned Opinion Whether Project Should Proceed

Based on the impact assessment, mitigation measures and recommendations proposed it is the opinion of the specialist that the project should proceed. It is anticipated that the potential positive impacts would outweigh the negative impacts in the long terms and thus the associated closure activities would ultimately be beneficial for the receiving environment in the long term. Furthermore, the lack of alternative options to continue with pumping in light of the economic and illegal mining situation causing impacts upon the health, safety and environment of the area provides furthermore motivation for the need of the project to proceed.

15 Conclusion

The proposed decommissioning activities may have direct impacts to the wetlands adjacent to the shaft areas that are decommissioned. If the appropriate mitigation measures are adopted these impacts should be minimal as the activities to be undertaken are not directly within wetland areas, but within the 500m buffer zone of the wetlands. To reduce the significance of associated impacts decommissioning activities must not extend beyond the current footprints of the shafts. With the removal of this and associated infrastructure the overall benefit to the receiving environment would positive as areas are rehabilitated and natural drainage paths reinstated. In addition to this the removal of contamination sources would have a beneficial positive impact.

It is recommended that monitoring and updating of the groundwater numerical models is still done as information becomes available to ensure that if additional mitigation measures are required they can be implemented in a timeously to avoid further degradation to the environment occurring.

In addition to the above the stopping of discharge to the receiving environment would both have positive and negative impacts as a result in changes in quantity and quality of water being discharged. There is a risk that some of the wetland areas that water is currently being discharge into will shrink, such as Magazine Pan as this is an artificial system fed by water discharged.

It is anticipated that when discharge activities are stopped, there will be a deterioration within the water quality within the Wonderfonteinspruit for an interim period (five years). It is anticipated that in the longer term, as recharge continues and re-watering from the “eyes” starts, it is anticipated that eventually the water quality would improve.

The overall rehabilitation of Magazine Pan and other wetlands within the area would improve the functionality of the associated systems. In addition to this it would be anticipated that there would be an overall improvement of ecological services provided for by these systems.

Even though the wetlands assessed and discussed have been impacted upon as a result of several different activities within the region these systems still play a major role major role in

controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream. They are also important as they support a range of ecological processes and biodiversity in the region. It is thus finally recommended that any activities that are undertaken within the region take into account potential ways in improving the functionality of these systems in the long term.

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Appendix A: Impact Assessment Methodology

1.1 Impact Assessment Methodology

To clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though Digby Wells, and the majority of environmental impact assessment practitioners, propose a numerical methodology for impact assessments, one has to accept that the process of environmental significance determination is inherently subjective.

The weight assigned to each factor of a potential impact, and also the design of the rating process itself, is based on the values and perception of risk of members of the assessment team, as well as that of the I&AP's and authorities who provide input into the process. Whereas the determination of the spatial scale and the duration of impacts are to some extent amenable to scientific enquiry, the severity value assigned to impacts is highly dependent on the perceptions and values of all involved.

It is for this reason that it is crucial that all EIAs make reference to the environmental and socio-economic context of the proposed activity to reach an acceptable rating of the significance of impacts. Similarly, the perception of the probability of an impact occurring is dependent on perceptions, aversion to risk and availability of information.

It has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. The methodology employed for the environmental impact assessment is divided into two distinct phases, namely, impact identification and impact rating.

1.1.1 Impact Rating

The impact assessment methodology utilised during the EIA Phase for the Project consists of two phases namely impact identification and impact significance rating.

Impacts and risks have been identified based on a description of the activities to be undertaken. Once 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 particular environmental risk.

The severity of an impact is determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact is 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.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

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

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 3. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this EIA/EMP Report. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 2. The description of the significance ratings is discussed in Table 3.

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.

Table 1: Impact Assessment Parameter Ratings

Rating	Intensity/Replaceability		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. <80% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
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.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
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 extending only as far as the development site 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 to the site and its immediate surroundings.	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.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
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 2: Probability/Consequence Matrix

Probability \ Significance	-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
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

Consequence

Table 3: Significance Rating Description[1]

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) (-)

[1] It is generally sufficient to only monitor impacts that are rated as negligible or minor