Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project

Ecological Wetland Assessment Report

Project Number:

GOL2376

Prepared for:

Sibanye Gold Limited

November 2015

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Report Type:	**Ecological Wetland Assessment Report**
Project Name:	**Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project**
Project Code:	**GOL2376**

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EXECUTIVE SUMMARY

Digby Wells Environmental (Digby Wells) was commissioned by Sibanye Gold Ltd (SGL) as the environmental consultant for the West Rand Tailings Retreatment Project (WRTRP) and therefore to conduct the wetlands specialist studies to inform the project. The project involves the reclamation of existing tailings storage facilities (TSF) in the West Rand area for reprocessing to extract remaining gold and uranium. There will therefore be the need for a new regional TSF as well as a new processing plant and a series of pipelines. The wetlands study involved an ecological wetland assessment, the results of which are described in this report. This report should be read in conjunction with the various other specialists studies undertaken by Digby Wells for this EIA; specifically the Fauna and Flora, Aquatic Ecology and Surface Water reports.

Given the linear nature of this project as well as the large extent of the area, only wetlands within a 500m radius of the study area from the infrastructure areas were assessed in detail; this included the pipelines, powerlines and the footprints of the West Block Thickener (WBT), Central Processing Plant (CPP) and the Regional Tailings Storage Facility (RTSF) with associated infrastructures as well as the reclamation sites. A series of site visits were undertaken of the study area in January, February and April 2015. The majority of the fieldwork was conducted within and towards the end of the summer rainfall season. The wetland delineation procedure utilises physical indicators such as the presence of water, hydromorphic soils, topography and hydrophilic vegetation. Wetland areas were delineated and then identified according to their respective hydro-geomorphic (HGM) units. An ecological health assessment was conducted for the identified wetland areas to describe the current state and ecological relevance of each wetland unit using WET-Health of the Wetland Management Series. An ecological functionality assessment of the associated wetland areas was undertaken using the WET-EcoServices tool to determine services provided by each wetland unit. In addition, the Ecological Importance and Sensitivity (EIS) assessment was completed and refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. Finally, an impact assessment was completed to give an understanding of the impacts of the proposed project on the wetlands, and the issues that need to be addressed by mitigation. This will also give the regulators information on which to base their decisions.

Twenty one (21) different wetlands interact with the proposed project infrastructure in the study area. Due to the undulating terrain, valley bottom wetlands characterise the area, both channelled and unchannelled. In addition, in the flatter areas pans are present. 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 wetlands Present Ecological State (PES) is assessed to determine the integrity (health) of the characterised HGM unit. Most wetlands were rated a PES of 'D' (moderately modified) but some were rated 'E' (largely modified). It is generally known that the wetlands in the Witwatersrand and surrounding gold mining areas have been subject to major hydrological and chemical alterations from the century of gold mining that defines the area. This is true for the study area and many wetlands are directly impacted by open pit and underground mining as well as the surface processing and waste facilities. This has led to serious impacts to the quality of these systems and has contributed to direct loss of wetland habitat. The road infrastructure is extensive in the area and has led to considerable impacts to wetland connectivity and natural flow of water.

The proposed development and operation of the new WRTRP will have direct impacts to these wetlands. The main impact to the wetlands will be the loss of 54.6 ha of wetland habitat due to the proposed infrastructure placement. It is recommended that an offset strategy be investigated for the wetlands permanently lost due to the RTSF. For the wetlands impacted by the CPP and WBT, wetland habitat must be fully rehabilitated; if this is done an offset strategy may not be needed for these wetlands. There are also significant potential threats to the wetlands if unplanned events are to occur. The table below is a brief summary of the impacts per Mining Right Area (MRA) that received a **moderate** or **major** negative rating and therefore is seen to be activities with significant negative impacts.

Table i: Summary of Significant Negative Impacts of the WRTRP to Wetlands

Aspects	Potential Significant impacts
Kloof Mining Right Area	
Placement of the CPP and RTSF around and in wetlands	Loss of wetland habitat.
Decommissioning of the RTSF; this is to remain in perpetuity.	This will represent a significant threat to the surrounding wetlands and water resources if mitigation measures are not in place. The RTSF is a significant source of pollution due to the properties of the content as well as due to the magnitude (size) of the facility.
Abstraction of water from K10 and Cooke 1 shafts.	Desiccation and potential loss of the wetland habitat may occur due to the volume of water being released into the system decreasing from 45 to 13 Mℓ/day.
Discharging of treated water into the Leeuspruit from the AWTF, increasing flows and volumes by ~35%.	Wetland habitat downstream affected by the change in hydrology with a potential increase in saturated area. Wetland habitat downstream affected with a potential increase in erosion due to a 35% increase in river flows.
Blast curtain with subsequent cone of dewatering	Loss of groundwater input to wetlands with subsequent potential indirect loss of 712 ha of wetland habitat due to the dewatering cone of 100 years post-closure. Affecting the aquatic and wetland flora and fauna, and compromising the functioning of the wetlands from a hydrological point of view.
Driefontein Mining Right Area	

Aspects	Potential Significant impacts
Placement of the WBT and BWSF around and in a pan wetland	Loss of wetland habitat.
Cooke Mining Right Area	
There are no predicted impacts to wetlands within this MRA of a significance rating of moderate or major.	
Ezulwini Mining Right Area	
There are no predicted impacts to wetlands within this MRA of a significance rating of moderate or major.	

The historical TSFs are sources of AMD and radioactivity. The project will have positive impacts to the wetlands and their catchments as the reclamation, remediation and rehabilitation of the TSFs and their footprints will remove current sources of highly significant pollution to the wetlands. It is recommended that a Biodiversity and Land Action Management Plan should be compiled with specific recommendations for the general improvement of wetland biodiversity on site. There is potential for the wetlands within the land owned by SGL for the WRTRP area to have their general ecological state improved.

The wetlands assessed and discussed in this report play a 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. If the recommendations within this report and others are followed through, the WRTRP will have a positive impact to the wetlands on the area.

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Acronym	Description
AMD	Acid Mine Drainage
AWTF	Advanced Water Treatment Facility
bgl	Below ground level
BWSF	Bulk Water Storage Facility
CBA	Critical Biodiversity Areas
CBD	Convention on Biological Diversity
CPP	Central Processing Plant
CTSF	Central Tailings Storage Facility (Expanded from the Driefontein TSF)
CUP	Cooke Uranium Project
DEA	Department of Environmental Affairs
DWA(F)	Department of Water Affairs (and Forestry)
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Programme
EMS	Environmental Management Systems
EN	Endangered
ESIA	Environmental and Social Impact Assessment
GDARD	Gauteng Department of Agriculture and Rural Development
GFIMSA	Gold Fields International Mining South Africa Proprietary Limited
ha	Hectare
hds	High density separation
HGM	Hydrogeomorphic
I&AP	Interested and Affected Parties
IDP	Integrated Development Plan
IHAS	Invertebrate Habitat Assessment System
IWRMP	Integrated Water Resources Management Plan
LoM	Life of Mine
mamsl	Meters above mean sea level

Acronym	Description
mbgl	Metres below ground level
mlbs	Million pounds
mm	millimetre
Moz	Million Ounces
Mt/month	Million Tonnes per month
NBSAP	South Africa's National Biodiversity Strategy and Action Plan
NEMBA	National Environmental Management Biodiversity Act of 2004 (Act No.10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act (NWA, Act 36 of 1998)
PCDs	Pollution Control Dams
PES	Present Ecological State
RTSF	Regional Tailings Storage Facility
SANBI	South African National Biodiversity Institute
SEP	Stakeholder Engagement Process
SGL	Sibanye Gold Limited
SIA	Socio-economic Impact Assessment
SQR	Sub Quaternary Reaches
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
WBT	West Block Thickener
WMA	Water Management Areas
WRD	Waste Rock Dump
WRTRP	West Rand Tailings Retreatment Project
WWP	West Wits Project

1 Introduction

This report discusses the wetlands found within the West Rand area of Gauteng Province where the West Rand Tailings Retreatment Project (WRTRP) is proposed. This area has been associated with gold mining for more than a century; due to this extensive history of gold mining, combined with the impacts of anthropogenic activity in the West Rand area. Impacts to the local water resources can be divided into a *quantitative* aspect as well as a *pollution* aspect (Coetzee, 2004). Those impacts affecting the availability of water are quantitative impacts, which include the dolomitic aquifers that were dewatered by the mining activities. Pollution impacts are associated with the quality of water that has been seriously compromised due to controlled/uncontrolled and point/non-point source pollution being released into the catchments due to the mining activities.

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, toxicant assimilation, carbon storage, streamflow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity (Kotze *et al*., 2007). The Ramsar Convention on Wetlands refers to wetlands as one of the most important life support systems on earth owing to the services provided.

Wetlands are defined according to the National Water Act (NWA, Act 36 of 1998) as: *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."* Furthermore, a water resource is considered to be the entire water cycle, not only the water that can be taken from a system and utilised. This is significant as it includes physical processes such as evaporation and precipitation as well as the aquatic ecosystems containing the structural aquatic habitats, the biota, and the physical, chemical and ecological processes that link all of these.

Biodiversity is a vital component for maintaining ecological processes and thus in ensuring sustainability of the ecosystem goods and services which is vital for successful water resource management (MacKay *et al.,* 2004). Although slightly outdated, South Africa's National Biodiversity Strategy and Action Plan (DEAT, 2005) acknowledges that there is cause for significant concern due to the declining status of ecosystems and that degradation of ecosystems leads to a reduction in ecosystem services. This may result in a reduced capacity to generate clean water and a loss of food production due to land degradation.

Wetlands in South Africa are poorly conserved owing primarily to a general underestimation of the ecological and economic importance of these systems (Swanepoel and Barnard, 2007). It is approximated that between 35-50% of all the wetland areas within South Africa have been destroyed as a result of anthropogenic stressors (Swanepoel and Barnard, 2007) and a cumulative loss of these important systems is on-going. Some of the major contributing factors to the decline of wetlands in South Africa include mining, industrial and agricultural activities as well as poor treatment of waste water from industry and mining.

1.1 Ultimate Project

Simplistically, Sibanye Gold Limited's (SGL) historical TSF holdings in the West Rand can be divided into four Mining Right areas; the Cooke, Ezulwini, Kloof and Driefontein Mining Right areas as shown in Plan 1. Each of these Mining Right areas contains a number of historical TSFs as detailed below:

- Kloof Mining Right area: Kloof 1 TSF, Kloof 2 TSF, Leeudoorn TSF, Libanon TSF, Venterspost North and Venterspost South TSFs. Venterspost North and South TSFs will be processed with the concurrent construction of Module 2 float and gold plants. The remainder of the TSFs will be processed once Module 3 of the CPP has been constructed;
- Driefontein Mining Right area: Driefontein 1, 2, 3, 4 and 5 TSF. Once the Driefontein 3 and 5 TSFs have been depleted the remainder of the Driefontein TSFs, namely Driefontein 1, 2 and 4 TSFs, will be processed through the CPP;
- Cooke Mining Right Area: Cooke TSF C4S TSF, and the Millsite Complex (38, 39 and 40/41 and Valley) TSFs. C4S will be processed subsequent to Driefontein 3 and 5 TSFs and in parallel with the Cooke TSF. Millsite Complex will be processed with the concurrent construction of Module 2 float and gold plants; and
- Ezulwini mining Right Area: during initial implementation no Ezulwini TSFs will be reclaimed. The Ezulwini uranium plant will however be used to treat 50 000 k/m of concentrated uranium slurry.

Each of the Mining Right areas will be reclaimed in a phased approach; where the Driefontein 3 TSF, concurrently with the Cooke TSF, will be reclaimed first. Following reclamation of Driefontein 3 TSF, Driefontein 5 TSF and Cooke 4 Dam south (C4S) will be reclaimed.

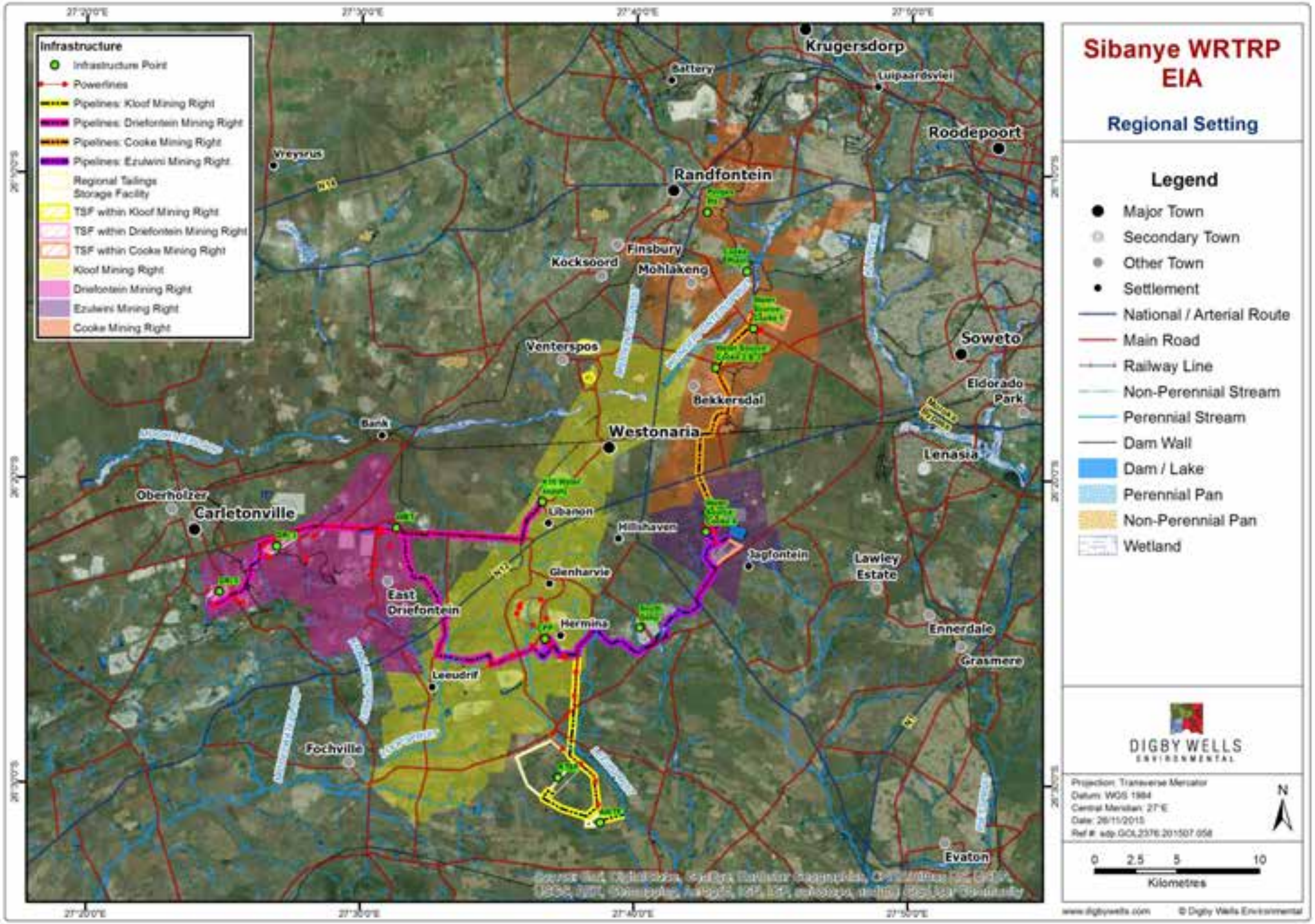
Once commissioned the project will initially reclaim and treat the TSFs at a rate of 1.5 Mt/m; 1 Mt/m from Driefontein 3 TSF, followed sequentially by Driefontein 5 and C4S TSFs and 0.5 Mt/m from Cooke TSF. Reclamation and processing capacity will ultimately ramp up to 4 Mt/m over an anticipated period of 8 years. At the 4 Mt/m tailings retreatment capacity, each of the Mining Right area TSFs will be reclaimed and processed simultaneously as well as the underground arisings being accommodated.

The tailings material will be centrally treated in a CPP. In addition to gold and uranium extraction, sulfur will be extracted to produce sulphuric acid which in turn will be re used in the uranium plant leach section.

To ensure the economic viability of the project the upfront capital required for the WRTRP will be minimised, only essential infrastructure will be developed during initial implementation. Use of existing and available infrastructure may be used to process gold and uranium until the volumetric increase in tonnage necessitates the need to expand the CPP.

The authorisation, construction and operation of a new deposition site for the residue from the CPP will be located in an area that has been extensively studied as part of the original Gold Fields WWP and the Rand Uranium CUP and Geluksdal TSF. The “deposition area” on which the project is focussing, has been termed the RTSF and is anticipated to accommodate the entire tonnage from the district. The RTSF if proved viable will be one large facility as opposed to the two independent deposition facilities proposed by the WWP and CUP respectively.

SGL has various authorisations and approvals for elements of the WWP and CUP projects, with authorisations and approvals for certain aspects of the respective projects still outstanding. The WRTRP aims to combine the WWP and CUP projects, as per stakeholder concerns and suggestions based on the WWP and CUP projects. Should the WRTRP not proceed, SGL will continue with the CUP and WWP projects for activities that have been authorised, as well as proceeding with the application processes for the outstanding authorisations.



Plan 1: Regional Setting

1.2 Initial Implementation

Due to commercial imperatives in developing a project of this magnitude, it needs to be implemented over time. The initial investment and development will be focused on those assets that will put the project in a position to partially fund the remaining development.

This entails the design and construction of the initial components of the CPP (gold module, floatation plant, uranium plant, acid plant and a roaster), to retreat up to 1.5 Mt/m concurrently from the Driefontein 3 and 5 TSFs, C4S TSF (1Mt/m) and the Cooke TSF (0.5Mt/m). Driefontein 3, 5 and C4S TSFs will be mined sequentially over 11 years, whilst the Cooke TSF will be mined concurrent to these for a period of 16 years. The resultant tailings will be deposited onto the first stage of the new RTSF.

A high grade uranium concentrate, produced at the CPP, will be transported to Ezulwini (50 k tonnes per month) for the extraction of uranium. The tailings from this process will be deposited on the existing operational Ezulwini North TSF.

Figure 1-1 provides a high-level overview of the process to be undertaken in the Initial Implementation of the WRTRP whilst Plan 2 provides a visual overview of where the project is to be implemented in the various phases.

Figure 1-1: Initial Implementation Process Summary

The CPP and RTSF are likely to be the two components of the project with the most significant potential environmental impacts and will be developed as the project progresses. The CPP will be developed in 3 phases over a period of approximately eight years, however this application is for the entire CPP site i.e. Modules I, II and III, uranium plants, roasters and acid plant. Similarly the RTSF will be developed in two phases over the life of the project, but this application is for the entire RTSF footprint and will be assessed as such. The decision to take this approach, as opposed to authorising these components in stages as they are developed, is to provide the regulators and the public with an impact assessment that takes the whole project into consideration. This approach allows the authorities to make a decision based on a complete impact assessment as opposed to incremental applications for each new phase.

The primary activities to take place during the *Initial Implementation* of the WRTRP are listed in Table 1-1, with the pipeline routes outlined in Table 1-2. Refer to Plan 2 for the layout of this infrastructure.

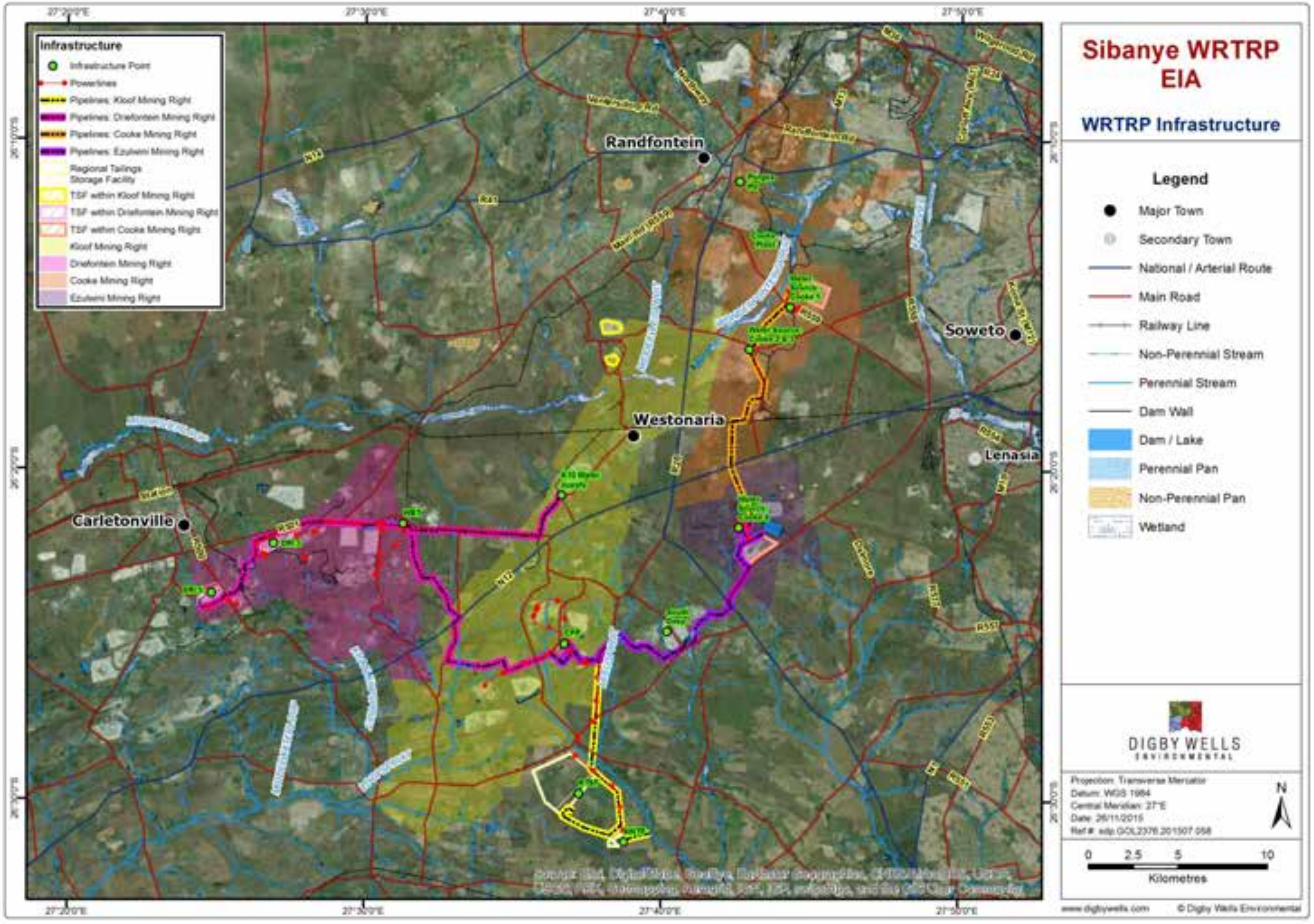
Table 1-1: Primary Activities of the WRTRP initial implementation

Category	Activity
	Kloof Mining Right area
Infrastructure	Pipeline Routes (residual tailings).
	Central processing Plant (CPP) incorporating Module 1 float and gold plants and uranium, roaster and acid plants.
	The Regional Tailings Storage Facility (RTSF), RTSF Return Water Dam (RWD) and the Advanced Water Treatment Facility (AWTF). Collectively known as the RTSF complex.
Processes	Abstraction of water from K10 shaft
	Disposal of the residue from the AWTF.
	Gold, uranium and sulfur extraction at the CPP (tailings to RTSF)
	Water distribution at the AWTF for discharge into the Leeuspruit.
Pumping	Pumping of up to 1.5 Mt/m of tailings to the RTSF.
	Pumping water from the RTSF return water dams to the AWTF.
	Discharging treated water to the Leeuspruit.
Electricity supply	Power supply from Kloof 1 substation to the CPP.
	Power supply from Kloof 4 substation to the RTSF and AWTF.
	Driefontein Mining Right area
Infrastructure	Pipeline Routes (water, slurry and thickened tailings).
	West block Thickener (WBT) and Bulk Water Storage Facility (BWSF) complex.
	Collection sumps and pump stations at the Driefontein 3 and 5 TSFs

Category	Activity
Processes	Hydraulic reclamation of the Driefontein 3 and 5 TSFs.
Pumping	Pumping water from K10 to the BWSF located next to the WBT.
	Pumping water from the BWSF to the Driefontein TSFs that will be reclaimed.(Dri3 & 5 TSFs)
	Pumping slurry from the TSF sump to the WBT (for Driefontein 3 and 5 TSFs).
	Pumping the thickened slurry from the WBT to the CPP.
Electricity supply	Power supply from West Driefontein 6 substation to Driefontein 3 TSF.
	Power supply from West Driefontein Gold substation to Driefontein 5 TSF.
	Power supply from East Driefontein Shaft substation to WBT and BWSF.
Cooke Mining Right area	
Infrastructure	Pipeline Routes (water, slurry and thickened tailings).
	Cooke thickener and BWSF.
	Collection sumps and pump stations at the Cooke TSF.
Processes	Abstraction of water from Cooke 1 shaft.
	Hydraulic reclamation of the Cooke TSF (which include temporary storage of the slurry in a sump).
Pumping	Pumping 500 kt/m of tailings from the Cooke TSF to the Cooke thickener.
	Pumping from the Cooke thickener to the CPP via Ezulwini.
Electricity supply	Power supply from the Cooke substation to the Cooke thickener.
	Power supply from the Cooke Plant to the Cooke TSF
Ezulwini Mining Right area	
Processes	Uranium extraction at Ezulwini (tailings to Ezulwini North Dump).
	Abstraction of water from Cooke shaft.
Pumping	Pumping water from Cooke 4 Shaft to the C4S TSF for reclamation.
	Pumping slurry from the TSF sump to the CPP.
Electricity supply	Power supply from Ezulwini plant to the C4S TSF

Table 1-2: Pipeline Route Lengths

Name	Length (m)	Type
Driefontein 3 TSF to WBT	7 665	Slurry Pipeline -dilute
Driefontein 5 TSF to Driefontein 3 TSF	6 646	Slurry Pipeline -dilute
WBT to CPP	17 473	Slurry Pipeline -thickened
Cooke TSF to Cooke Thickener	TBC	Slurry Pipeline-dilute
Cooke Thickener to CPP	TBC	Slurry Pipeline-thickened-existing approved route GDARD,NNR
Ezulwini South TSF to CPP	TBC	Slurry Pipeline-thickened
CPP to RTSF	17 908	Tailings Pipeline – thickened (alternate routes)
CPP to Ezulwini	18 502	Tailings Pipeline (Uranium Rich) - dilute
BWSF to DRI3	7 699	Water Pipeline
BWSF to DRI5	14 168	Water Pipeline
K10 to west BWSF	10 477	Water Pipeline
Cooke shafts to Cooke TSF	TBC	Water Pipeline – existing approved route GDARD , NNR
Cooke 4 shaft to C4S TSF	TBC	Water Pipeline
RWD to AWTF	1 960	Water Pipeline
WBT to CPP (Alternative Route)	13 284	Slurry Pipeline (Alternative Route)



Plan 2: Primary Infrastructure and MRA's

1.3 Terms of Reference

Digby Wells was commissioned by SGL as the environmental consultant for the WRTRP to conduct the wetlands specialist studies. The wetland study and accompanying maps describe the following:

- Screening assessment for the Ultimate Project was done to gain a broad knowledge of wetlands associated with the greater project area;
- Desktop scoping investigation of the potential wetlands for the initial implementation the WRTRP area;
- The identification and the delineation of wetlands within the area of the proposed infrastructure;
- A description and characterisation of the identified wetland areas;
- Determination of the wetlands present ecological state (PES) and ecological importance and sensitivity (EIS);
- The description of ecological services provided by the wetlands;
- Assessment of Potential Impacts to the wetlands from the activities; and
- Discussion of recommended mitigation measures to be taken into account through the mitigation hierarchy.

2 Details of the Specialist

The following is a list of the Digby Wells' staff that were involved in the wetlands assessment study:

- **Caroline Wallington**: Wetland Consultant; received a Bachelor of Science and Honours in Botany from the University of Cape Town (UCT) and is an environmental consultant specialising in wetland assessments and land rehabilitation. Caroline is competent in wetland assessment methodology and has experience in the Democratic Republic of Congo (DRC), as well as throughout the Gauteng, Free State and Mpumalanga Provinces of South Africa.
- **Crystal Rowe** (Pr. Sci. Nat. Botanical Science), wetland and flora specialist: received a Bachelor of Science and Honours in Botany at Nelson Mandela Metropolitan University (NMMU) and is an environmental consultant specialising in vegetation and wetland assessments. Experience includes ecological impact assessments, baseline vegetation assessments, estuarine ecological state assessments and wetland health assessments. Project experience includes various countries such as the DRC, Ethiopia, the Ivory Coast, Mali, Mozambique, Sierra Leone and extensively within South Africa.

- **Danie Otto** (Pr. Sci. Nat) is a Director and Manager of the Natural Sciences Division at Digby Wells. The division includes water, air quality, rehabilitation, fauna & flora, aquatics, wetlands and soil. He holds an M.Sc in Environmental Management with B.Sc Hons (Limnology, Geomorphology, GIS and Environmental Management) and B.Sc (Botany and Geography & Environmental Management). He is a registered Professional Natural Scientist since 2002. Danie has 20 years of consulting experience within the mining industry undertaking environmental assessments and compiling Environmental, Water & Waste Management Plans. He has wetland and geomorphology working experience across Africa including specialist environmental input into various water resource related studies. These vary from studies of swamp forests in central Africa to alpine systems in Lesotho.

3 Aims and Objectives

The aim of the wetland study is to conduct an ecological wetland assessment for the WRTRP. The screening assessment was complete for the areas associated with the ultimate project area to highlight any potential fatal flaws and significant impacts that may be realised by the full intent of the ultimate project. The study thereafter aimed to assess in detail the wetlands associated with the initial implementation of the project. The aim of this wetlands Environmental Impacts Assessment (EIA) specialist report is to give the baseline environmental information for the project area through desktop analysis and field investigation.

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

- Section 19 of the National Water Act (Act 36, 1998);
- Section 21 (c), (g) and (i) of the National Water Act (Act 36 of 1998);
- Section 21 of the Environment Conservation Act, 1989;
- Section 24 of the Constitution – Environment (Act 108 of 1996);
- Section 5 of the National Environmental Management Act (Act 108 of 1998);
- Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas; and
- Gauteng Department of Agriculture and Rural Development (GDARD) Minimum Requirements for Biodiversity Studies.

4 Methodology

The methodology taken for the wetlands study is shown in the simple flow diagram below.

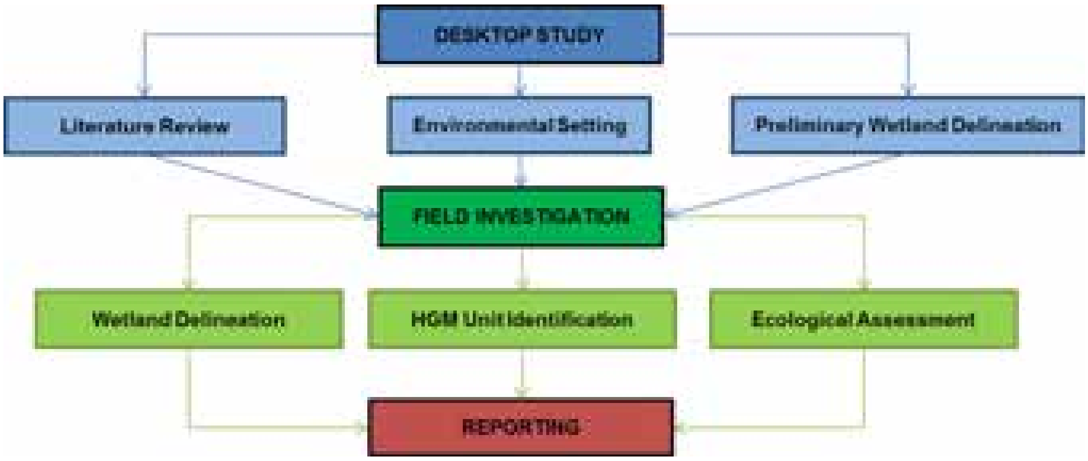


Figure 4-1: Simplified Methodology followed for the Wetland Study

4.1 Literature Review and Desktop Assessment

With the aid of Google Earth Imagery (Google Inc., 2013), maps generated from 1:50 000 topographic data, plus aerial photographs, the potential wetland areas were identified and preliminary boundaries were delineated at the desktop level. Baseline and background information was researched and used to understand the area prior to fieldwork; this included:

- National data:
  - National Freshwater Ecosystems Priority Areas (NFEPA) (Nel et al., 2011); and
  - Water Management Areas (WMA) and Quaternary Catchments.
- Regional data:
  - Gauteng Conservation Plan (C Plan version 3.3); and
  - West Rand District Municipality (WRDM) Environmental Management Framework (EMF).

In addition to the abovementioned existing data, relevant publications were reviewed and incorporated into a summarised literature review. For a list of publications, refer to the references list at the end of the report.

4.2 Fieldwork and Seasonal Influence

Given the linear nature of this project as well as the large extent of the area, only wetlands within a 500 m study area from the infrastructure areas (500 m either side) were studied in detail; this included the pipelines, powerlines, existing historical TSFs and the footprints of the new WBT,CBT, CPP and RTSF, see Plan 3. A series of site visits were undertaken in the study area in January, February and April 2015. The fieldwork was conducted within and towards the end of the summer rainfall season. The wetland delineation procedure utilises cues such as the presence of water, hydromorphic soils, topography and hydrophilic vegetation. This is described in detail below.

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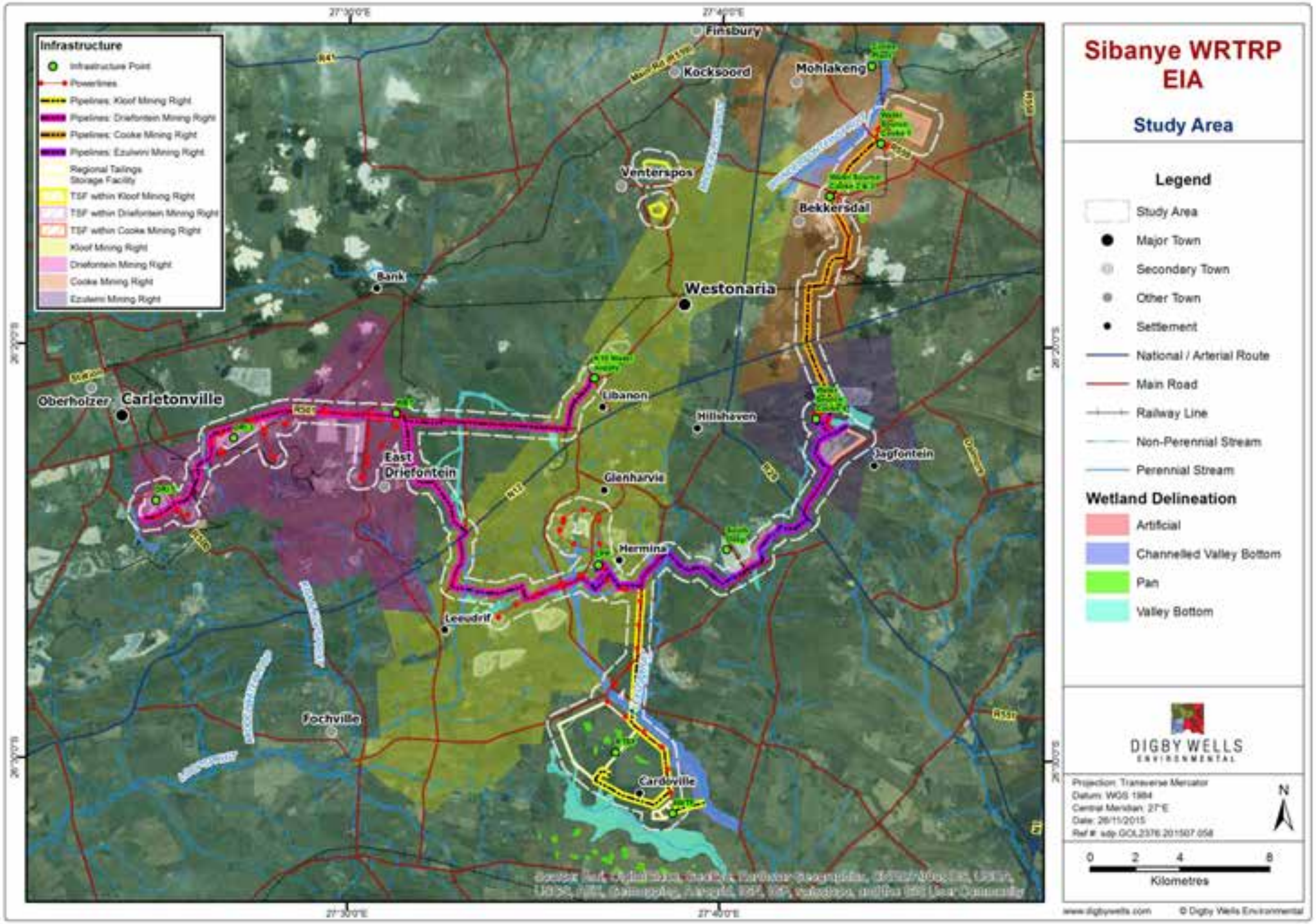


Plan 3: Wetlands Study Area

4.2.1 Wetland Delineation and Identification

For the purpose of this study, wetlands are considered as those ecosystems defined by the National Water Act as: *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."* The wetland delineation procedure considers four attributes to determine the limitations of the wetland, in accordance with DWAF guidelines (now Department of Water and Sanitation (DWS) (2005)). The four attributes are:

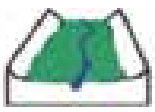
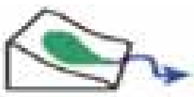
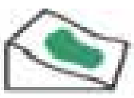
- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

In accordance with the definition of a wetland in the NWA, vegetation is the primary indicator of a wetland, which must be present under normal circumstances. However, the soil wetness indicator tends to be the most important in practice. The remaining three indicators are then used in a confirmatory role. The reason for this is that the response of vegetation to changes in the soil moisture regime or management are relatively quick and may be transformed, whereas the morphological indicators in the soil are significantly more long-lasting and will hold the indications of frequent and prolonged saturation long after a wetland has been drained (perhaps several centuries) (DWAF, 2005). This tends to be very difficult under black clay vertic soil conditions as wetness indicators are lacking, and therefore topography, geomorphology and vegetation indicators play a stronger role (as found in some places of this study).

4.2.1.1 Terrain Unit Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, aerial photographs and engineering and town planning diagrams (DWAF, 2005). The 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 / topographic setting. Once wetlands have been identified, they are categorised into HGM Units as shown in Table 4-1. HGM Units are then assessed individually for PES and ecological services.

Table 4-1: Description of the difference Hydrogeomorphic Units for Wetland Classification

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

4.2.1.2 Soil Form Indicator

Hydromorphic soils are taken into account for the Soil Form Indicator (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (DWAF, 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 results in alternation between aerobic and anaerobic conditions in the soil (DWAF, 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 of temporarily saturated (DWAF, 2005).

4.2.1.3 Soil Wetness Indicator

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (DWAF, 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 (DWAF, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (DWAF, 2005). In order for a soil horizon to qualify as having signs of wetness in the temporary, seasonal or permanent zones, a grey soil matrix and/or mottles must be present. This is however difficult in vertic black soil with very high clay content.

4.2.1.4 Vegetation Indicator (VI)

If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (DWAF, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineated wetland areas. In this assessment the SWI has been relied upon to delineated wetland areas in addition, the identification of indicator vegetation species and the use of plant community structures has been used to validate these boundaries. 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 and Marneweck, 1999; DWAF, 2005). This is summarised in Table 4-2 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 (DWAF, 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 4-2 becomes more important.

Table 4-2: Classification of Plant Species according to occurrence in Wetlands (DWAF, 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.

4.3 Wetland Ecological Health Assessment

According to Macfarlane *et al.* (2009) the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A 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 characterised HGM units for the project area. A PES analysis was conducted to establish baseline integrity (health) for the associated wetlands.

The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions. The overall health score of the wetland is calculated using Equation 1, which provides a score ranging from 0 (pristine) to 10 (critically impacted in all respects). The rationale for this is that hydrology is considered to have the greatest contribution to health. The PES is determined according to Table 4-3.

Equation 1: Overall Wetland Ecological Health Score

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

Table 4-3: Impact scores and Present Ecological State categories used by Wet-Health

Description	Combined Impact Score	PES Category
Unmodified, natural.	0-0.9	A
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
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
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D
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
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

4.4 Wetland Functional Assessment

In accordance with the method described by Kotze *et al*. (2007), an ecological functional assessment of the associated wetland was undertaken. This methodology provides for a scoring system to establish the services of the wetland ecosystem. The onsite wetlands are grouped according to homogeneity and assessed utilizing the functional assessment technique, WET-EcoServices, developed by Kotze *et al,* (2007) to provide an indication of the benefits and services. This methodology computes a score out of 4 for each index and provides an indication of the ecological services offered by the different HGM units for the study area. Results are given in the form of a radial plot showing the relative importance of the 15 indices. Ecoservices were rated as high are scored more than or equal to 2.8.

4.5 Ecological Importance and Sensitivity

The 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 and Kotze, (2012, in Rountree *et al*. (2012) 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 DWA 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 4-4.

Table 4-4: Interpretation of overall Ecological Importance and Sensitivity (EIS) scores for biotic and habitat determinants (Rountree & Kotze, 2012)

Ecological Importance and Sensitivity Category (EIS)	Range of Scores
Very high	
Wetlands 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	
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these floodplains 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	
Wetlands 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	
Wetlands 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

4.6 Environmental Impact Assessment

4.6.1 Assessment of Potential Impacts

The aim of the Impact Assessment is to strive to avoid damage or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (DEA, 2013). Offsets that compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is described in Table 4-5.

Table 4-5: Mitigation Hierarchy

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

The EIA process involves a series of steps; the first of which is to identify the activities that could potentially interact with the natural or social environment (aspects). These interactions could have an impact, which needs to be assessed and mitigated. The following are terms and definitions are applicable to the EIA concept (ISO 14001), with mining specific examples and Figure 4-2 provides a simplified flow diagram of the EIA process.

- **Project Activity:** Activities associated with the project that result in an environmental interaction during the different phases (construction, operation and decommissioning), e.g., new processing plant, new stockpiles, development of open pit, dewatering, water treatment plant;

- **Interaction:** An "environmental interaction" is an element or characteristic of an activity, product, or service that interacts or can interact with the environment. Environmental interactions can cause environmental impacts (but may not necessarily do so). They can have either beneficial impacts or adverse impacts and can have a direct and decisive impact on the environment or contribute only partially or indirectly to a larger environmental change.
- **Environmental Aspect:** The term "environmental aspect" refers to the various natural and human environments that an activity may interact with. These environments extend from within the activity itself to the global system, and include air, water, land, flora, fauna (including people) and natural resources of all kinds.
- **Environmental impact:** An "environmental impact" is a change to the environment that is caused either partly or entirely by one or more environmental interactions. An environmental interaction can have either a direct and decisive impact on the environment or contribute only partially or indirectly to a larger environmental change. In addition, it can have either a beneficial environmental impact or an adverse environmental impact.

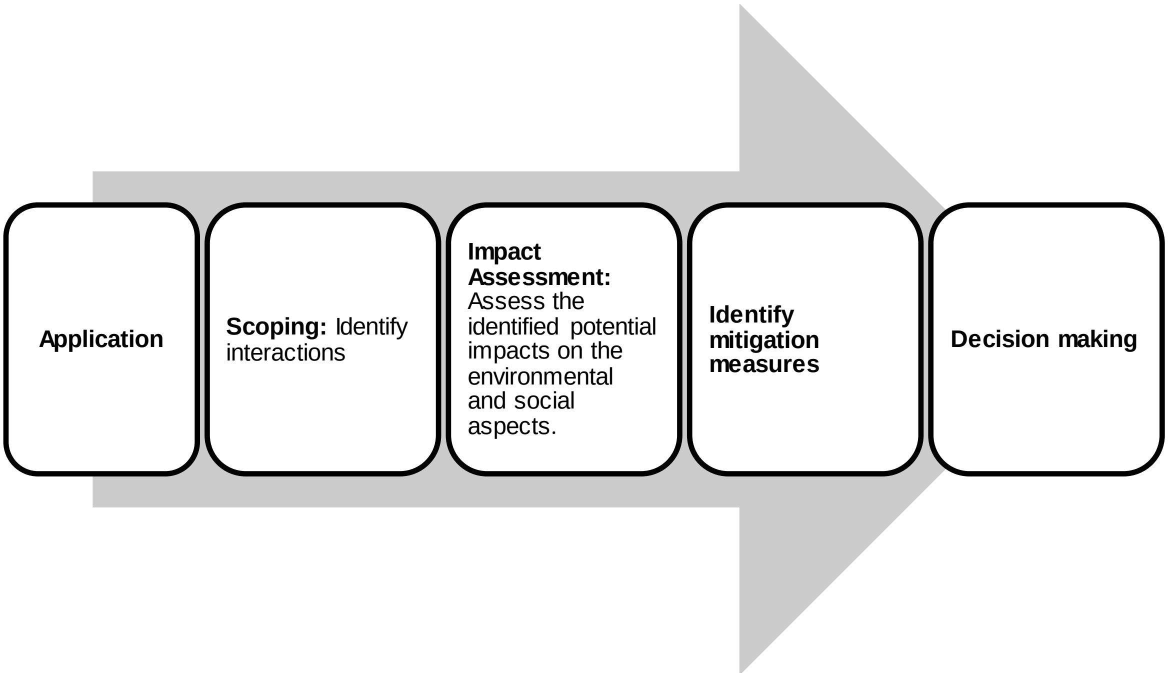


Figure 4-2: Simplified Flow Diagram of the EIA Process

The impacts are assessed based on the impact's magnitude as well as the receiver's sensitivity, culminating in an impact significance which identifies the most important impacts that require management.

Based on international guidelines and South African legislation, the following criteria are taken into account when examining potentially significant impacts:

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

A clearly defined rating scale was used to assess each impact in terms of severity, spatial extent and duration (which determines the consequence) and in terms of the frequency of the activity and the frequency of the related impact (which determines the likelihood of occurrence). The overall impact significance, was then determined via a significance rating matrix (Table 4-7) utilising the scores obtained for consequence and likelihood of occurrence, to assign a final impact rating.

Impacts are rated prior to mitigation and again after consideration of the mitigation has been applied; post-mitigation is referred to as the residual impact. The significance of an impact is determined and categorised into one of seven categories. The descriptions of the significance ratings are presented in Table 4-8. It is important to note that the pre-mitigation rating takes into consideration the activity as proposed; i.e. there may already be some mitigation included in the engineering design. If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 4-6: Impact Assessment methodology.

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	**Positive impacts**			
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/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	**Positive impacts**			
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/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	**Positive impacts**			
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/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	**Positive impacts**			
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.

Equation 2: Impact Significance

$$Significance = (Severity + Scale + Duration) \times Probability$$

Table 4-7 Significance Categories

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

Table 4-8: Significance Ratings

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)

4.6.2 Assessment of Unplanned Events and Low Risks

A risk is defined as the potential consequence(s) of an interaction combined with its likelihood. Should a risk eventuate, it will manifest as an impact. The identification of project risks should take place. Low risks can be monitored to gauge if the baseline changes and mitigation is required. Unplanned events may happen on any project, and the aim of assessing these is to provide information on the potential impacts of those events and how to manage them, if they occur.

4.6.3 Contributing to the Environmental Management Plan

The objective of an Environmental and Social Management Plan (ESMP) is to (a) present mitigation measures to manage undue or reasonably avoidable adverse impacts associated with the development of a project and (b) to enhance potential positives. Mitigation measures will sometimes be built into the base of a project and should be considered as part of the “pre-mitigation” scenario; additional mitigation must be recommended if the impact assessment indicates it is necessary.

The key objectives of environmental and social management plans are to give mitigation measures to:

- Identify the actual environmental, socio-economic and public health impacts of the project and check if the observed impacts are within the levels predicted in the ESIA;
- Determine that mitigation measures or other conditions attached to project approval (e.g. by legislation) are properly implemented and work effectively;
- Adapt the measures and conditions attached to project approval in the light of new information or take action to manage unanticipated impacts if necessary;
- Provide an auditable management plan that can follow the Deming Cycle;
- Gauge if predicted benefits of the project are being achieved and maximized;
- Gain information for improving similar projects and ESIA practice in the future; and
- The ESMP must consider each activity and its potential (significant) impacts during the construction, operational, decommissioning and post closure phases.

5 Assumptions and Limitations

The report is based on the following assumptions and limitations:

- The project was assessed according to the project activities listed herein (that were made available to Digby Wells by the client);
- Only the areas that coincide directly with infrastructure and development were assessed in detail. Given the linear nature of this project, as well as the large extent of the area, only wetlands within a 500 m study area from the infrastructure areas (500 m either side) were studied in detail; this included the pipelines, powerlines, existing historical TSFs and the footprints of the WBT,CBT, CPP and RTSF;

- It is important to note that not all wetland floral indicators or important species may have been identified as the sampling methodology aims to be representative of the project site and does not cover the entire surface area; and
- Similarly to the Fauna and Flora specialist studies, whilst every effort was made to record all plant species, it is possible that the flowering period or seed-bearing phases of plant life-cycles of some plants may not have coincided with the time of sampling.

6 Screening Assessment

The aim of the screening assessment is to use available information to understand the broad environmental setting of the ultimate project area. This assessment aims to report on the baseline findings for the wetlands in the area and identify any fatal flaws or critical outcomes with regards to wetlands for the ultimate project. To do this, different sources of information were used, which are outlined in Figure 6-1 below. The findings are outlined in this section and the findings of the field investigation and wetland assessments for the study area of the initial implementation of the project are described in the next section.

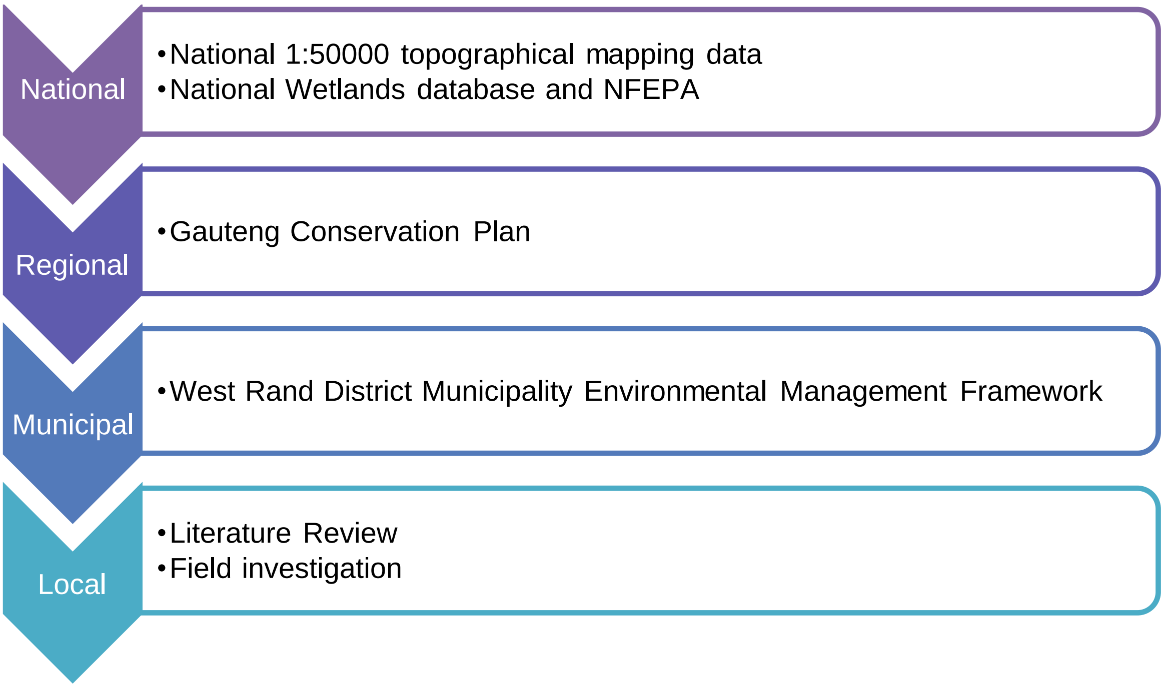


Figure 6-1: Flow Diagram Indicating the Different Levels of Screening Assessment Data Sourcing

6.1 Climate

The climate is typical of the Highveld with warm to hot summers and moderate to cool winters and summer rainfall. The WRTRP covers a large area of the West Rand District Municipality (WRDM) and thus climate information has been sourced from the WRDM Environmental Management Framework report (2013). In addition, a site specific meso-scale model meteorological data (known as MM5) for full three calendar years (2012 – 2014) was obtained from the Lakes Environmental Consultants in Canada to determine local prevailing weather conditions. This is detailed in the Air Quality Report (Digby Wells, 2015a).

The climate information and the sources are summarised in the Table 6-1 below. Climate is an important factor for the regional functioning of wetlands as it determines the surface water input into the systems and can be a main determinant (besides geomorphology and others) for the types of wetlands likely to be found (Tooth and McCarthy, 2007).

Table 6-1: Typical climatic parameters for the WRDM

Parameter	Measurement	Source
Average Minimum temperature	a) 9.3 °C b) 8.0 °C	a) Mogale City weather Station; station number 0474456 b) Carletonville weather station, station number 0474680
Average Maximum temperature	a) 22.2 °C b) 23.9 °C	
Mean Annual Precipitation (MAP) (mm)	a) 736 b) 646 c) 591 d) 563 e) 616 f) 700 g) 604 h) 700 i) 596 Ave = 650	a) Krugersdorp weather station b) Carletonville weather station c) WRTRP modelled data (Digby Wells, 2015) d) Bank (SAR) 0475019 W e) Leeuwpoort 0475056 W f) Kloof (GM) 0475174 W g) Venterspos (Old Homestead) 0475227 W h) Randfontein 0475370 AW i) Luipaardsvlei 0475404 W

6.2 Topography, Drainage and Quaternary Catchments

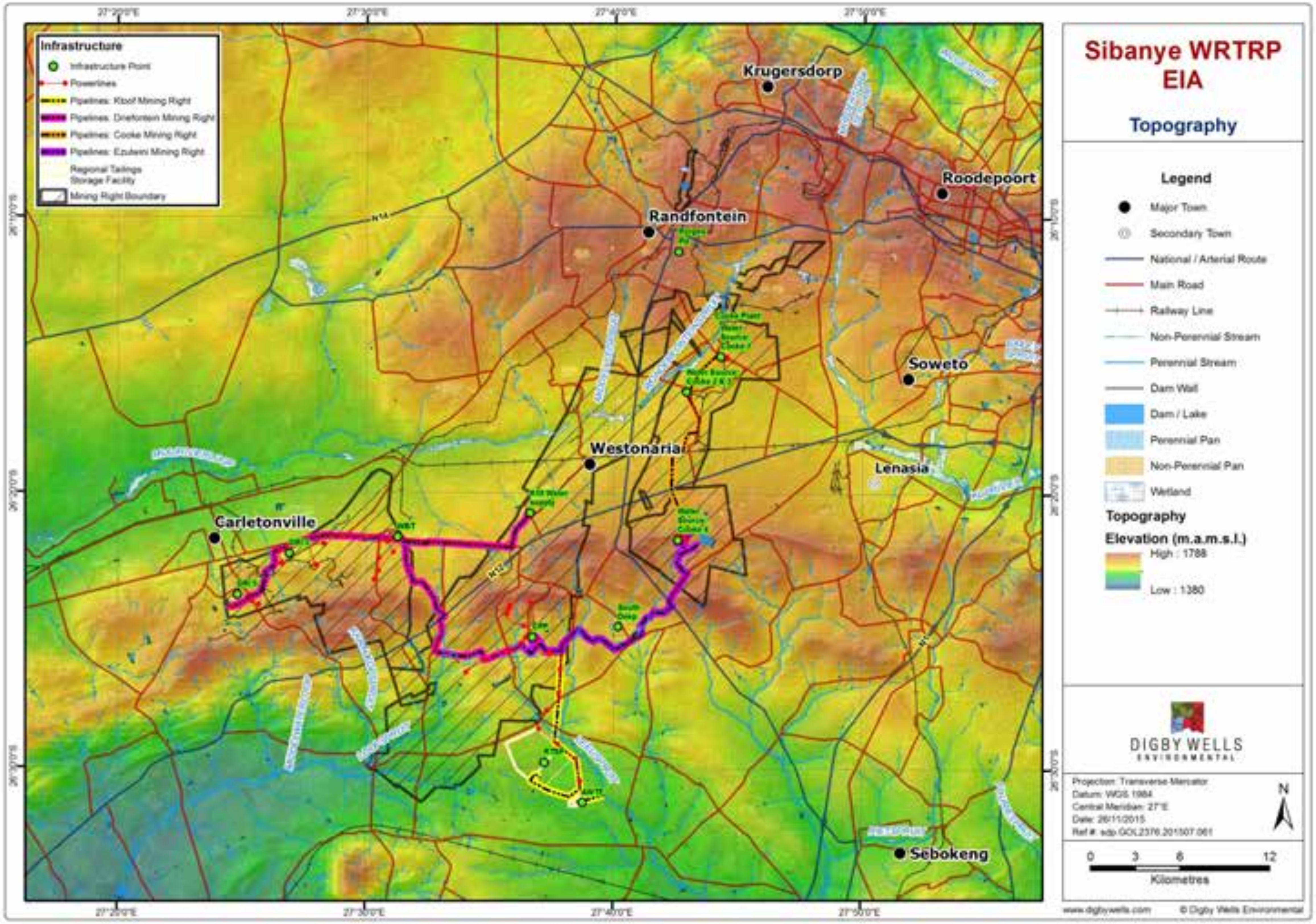
The project area is large and is characterised by different topographies. The digital elevation model of the project area is shown in Plan 4. The project is predominantly within the Upper Vaal Water Management Area (WMA8) with the very north parts of the greater project area being in the Crocodile (West) and Marico WMA(3); as shown in Plan 5.

The water resources of South Africa have been divided into Quaternary Catchments, which are regarded as the principal water management units in the country (DWAF 2011). A Quaternary Catchment is a fourth order catchment in a hierarchical classification system in which the primary catchment is the major unit. The WRTRP spans a number of Quaternary Catchments as shown in Plan 6, and summarised in the table below.

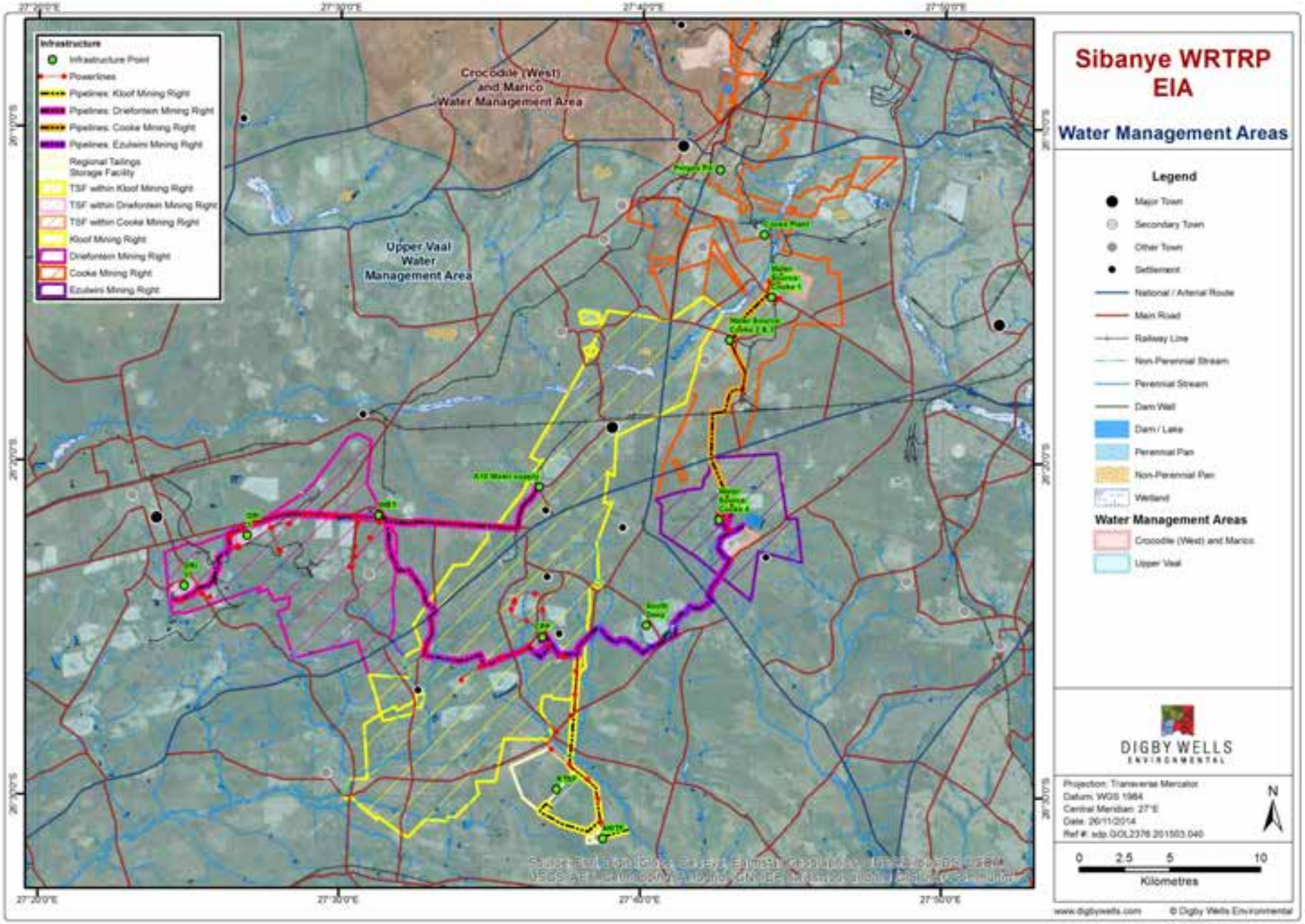
Within the quaternary catchments are Sub Quaternary Reaches (SQR), these are the smallest units for which the PES has been calculated. There are number of rivers draining the WRTRP area (including the Wonderfonteinspruit, Mooirivierloop, Rietspruit, Loopspruit and the Leeuspruit, which are classified as perennial rivers) together with a few unnamed non-perennial streams that form tributaries to the main rivers mentioned. Not all of these rivers are directly involved in the project area; please refer to the Aquatics Report (Digby Wells, 2015b) for details on the PES of the sub-quaternary reach rivers involved in the project. The table below gives a summary of the catchments of the WRTRP.

Table 6-2: Upper Vaal WMA quaternary catchments and main river system(s); * indicates overlapping quaternary catchments

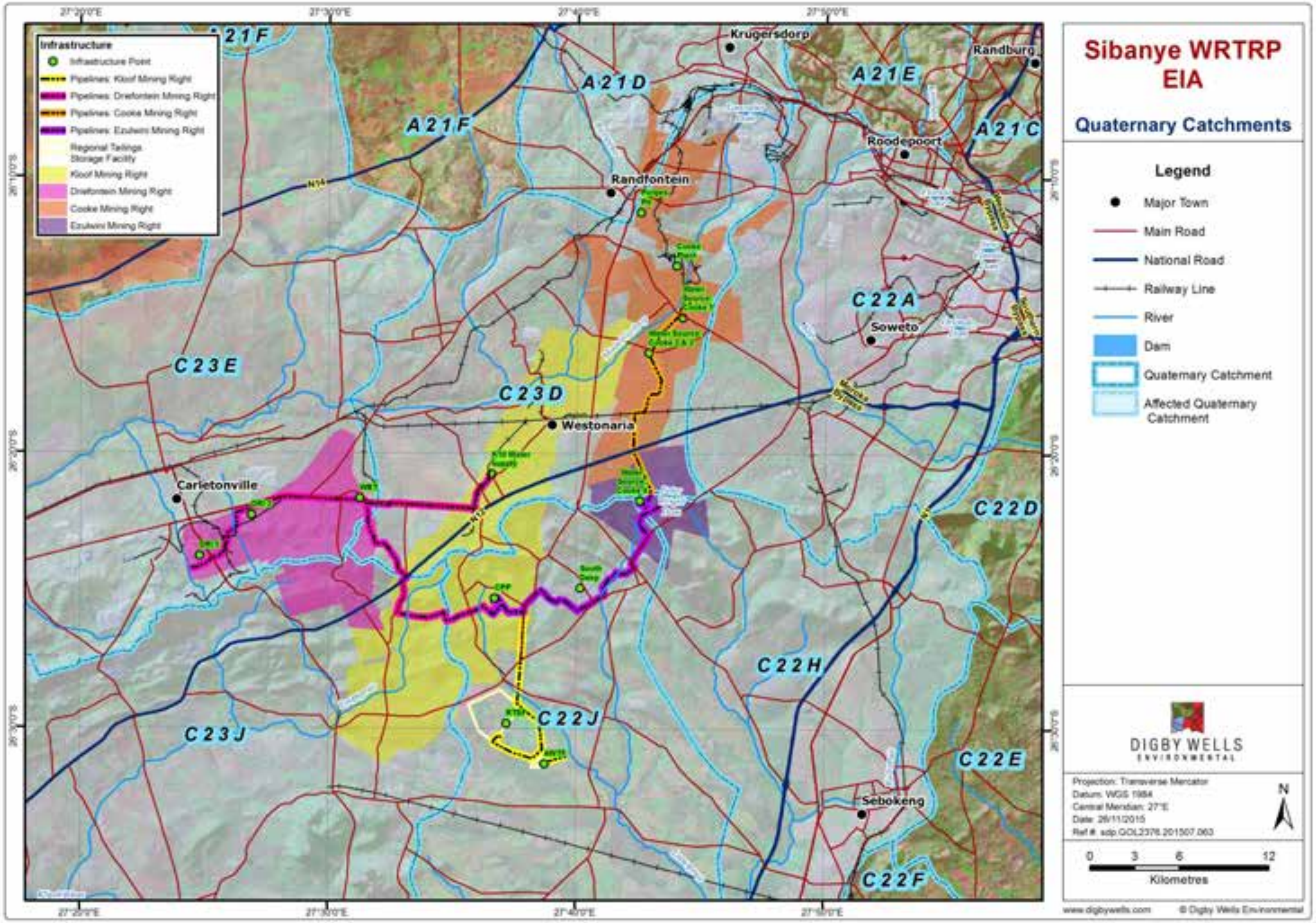
Quaternary catchments	Upper Vaal (WMA8) River System
C22A, *C23D	Rietfonteinspruit; MiddelMeispruit; *Wonderfonteinspruit; Klip River
*C23D, C23E	*Wonderfonteinspruit; *Mooirivierloop
C22J, *C23J	Loopspruit; Leeuspruit



Plan 4: Topography (DEM)



Plan 5: Water Management Areas



Plan 6: Quaternary Catchments

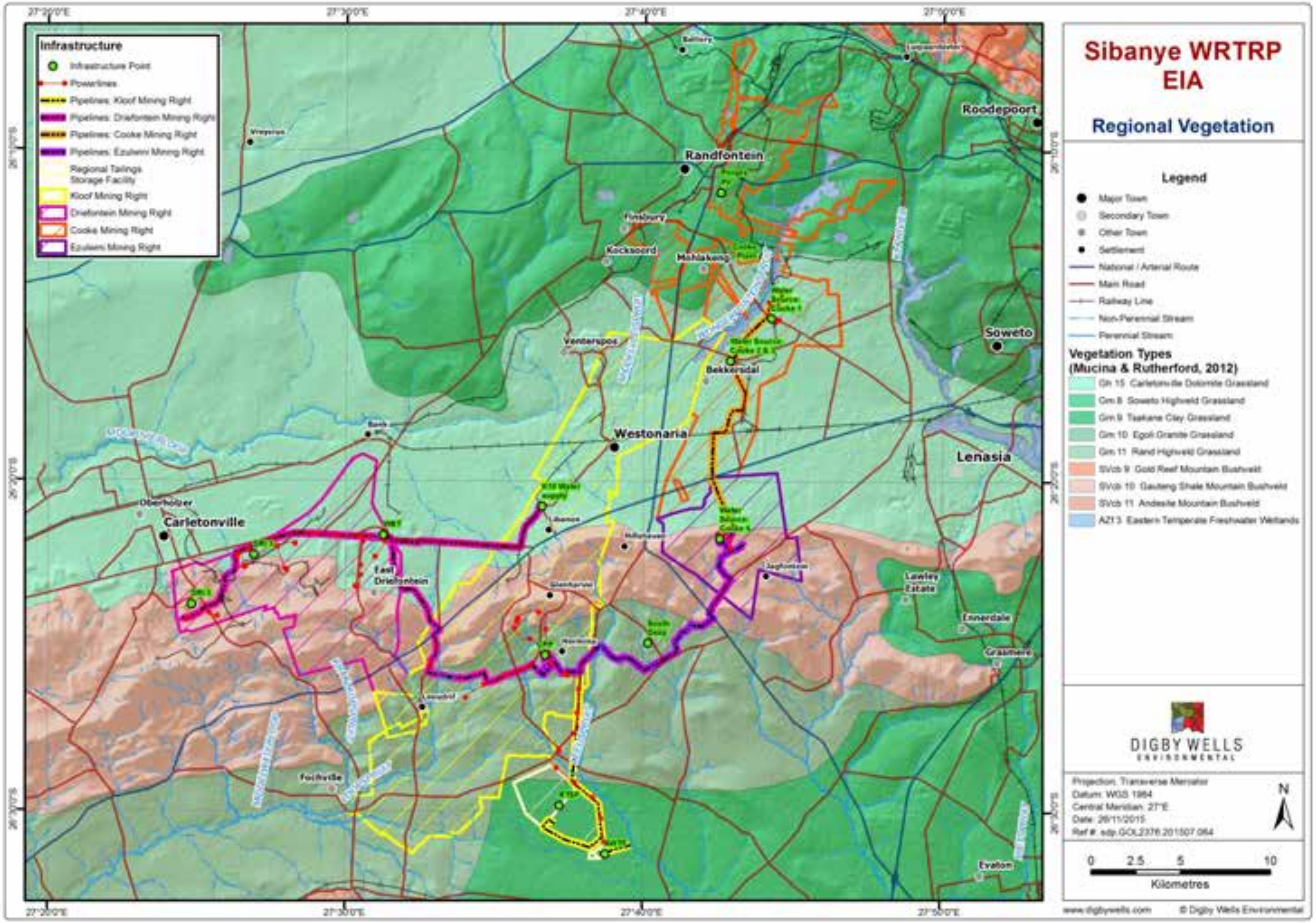
6.3 Regional Vegetation

The study area falls within five vegetation types according to Mucina and Rutherford (2006), being:

- Carletonville Dolomite Grassland;
- Gauteng Shale Mountain Bushveld;
- Rand Highveld Grassland;
- Soweto Highveld Grassland; and
- Eastern Temperate Freshwater Wetlands.

The Eastern Temperate Freshwater Wetlands are flat landscapes or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands. Only about 5% are statutorily conserved, with a target of 24%. Some 15% has been transformed to cultivated land, urban areas or plantations. Intensive grazing and use of lakes and freshwater pans as the drinking pools for livestock cause major damage to the wetland vegetation.

These vegetation types are shown in Plan 7 and detailed in the Fauna and Flora Report (Digby Wells, 2015c).



Plan 7: Regional Vegetation

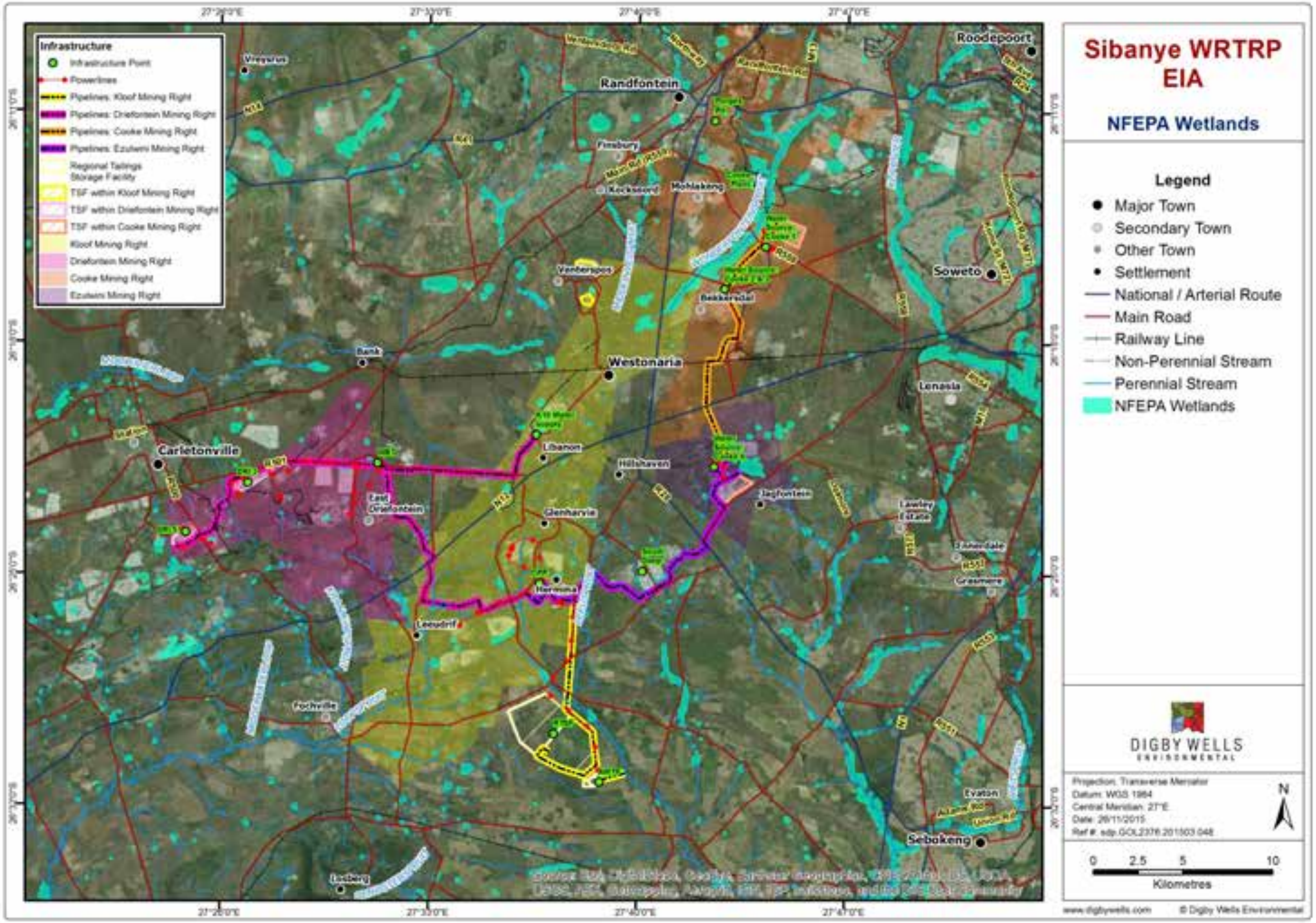
6.4 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources were considered to evaluate the importance of the wetland areas located within the greater Sibanya project area (Nel *et al.* 2011). Spatial layers (FEPA's) used include the wetland classification and ranking. The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. Table 6-3 below indicates the criteria which were considered for the ranking of wetland areas.

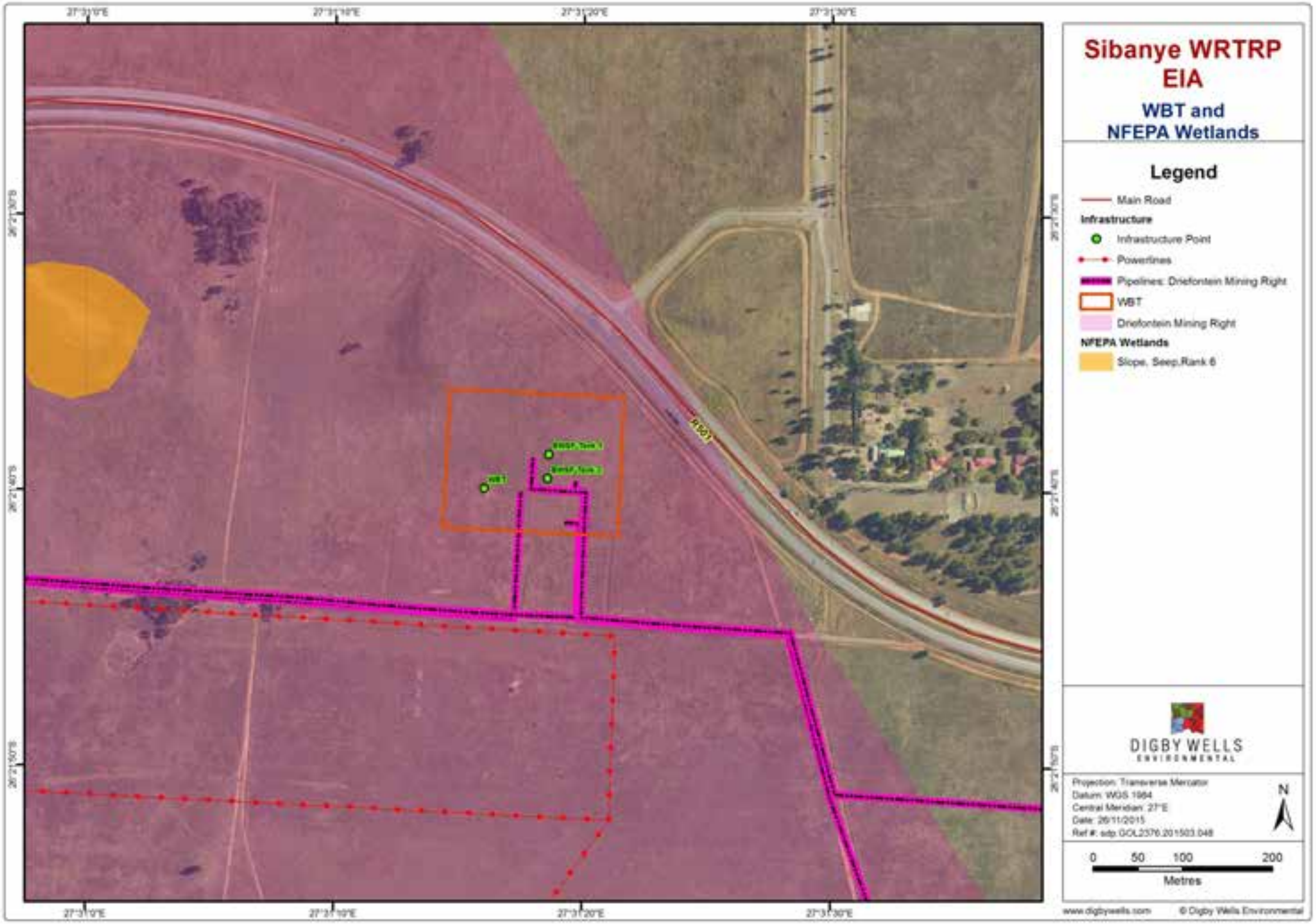
Table 6-3: NFEPA wetland classification ranking criteria

Criteria	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 waterbird 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

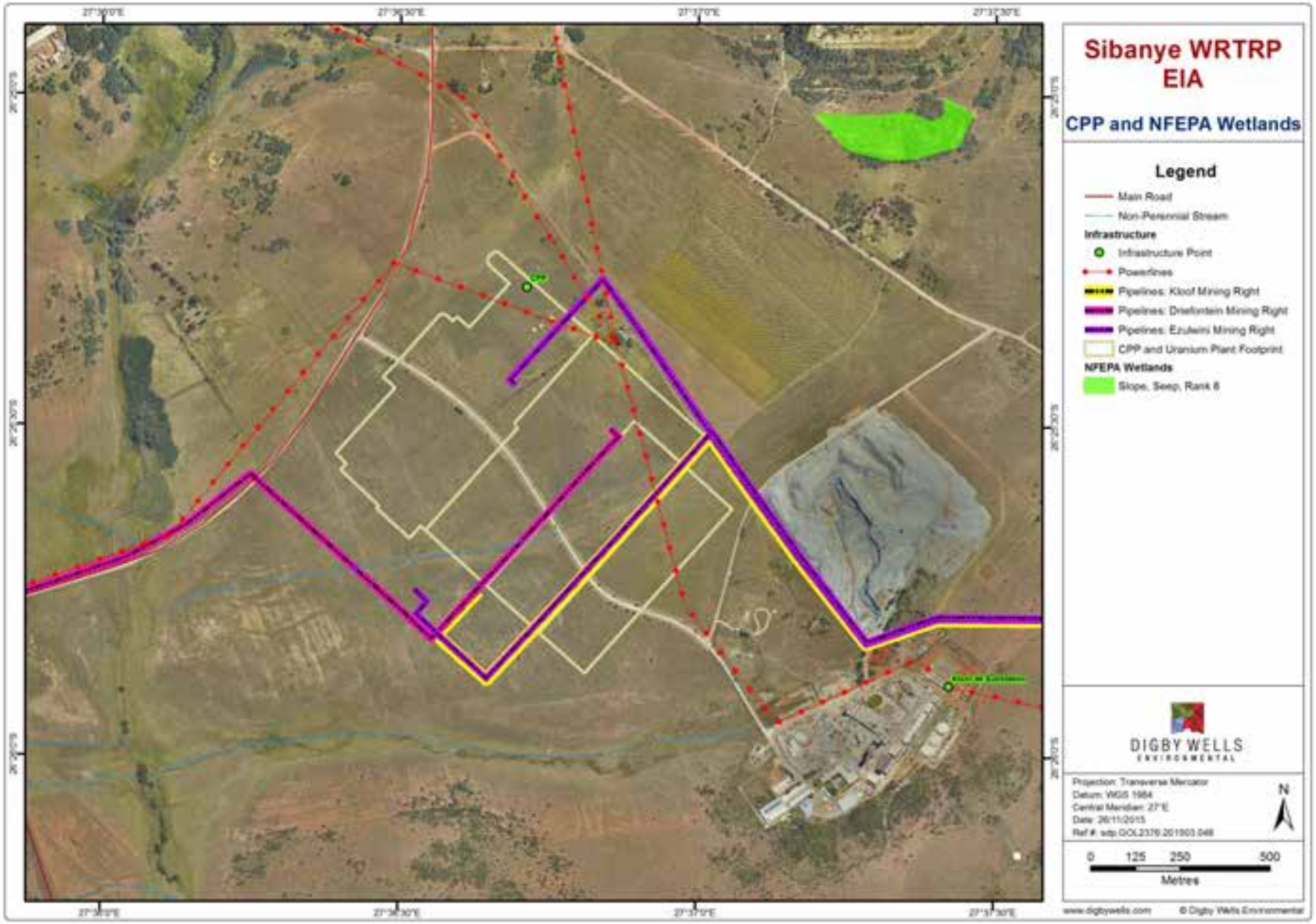
Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA layers. The NFEPA assessment does, however, hold significance from a national perspective. Refer to Plan 8to Plan 11 for the NFEPA wetlands associated with the Project Area as a whole and the three main infrastructure development areas.



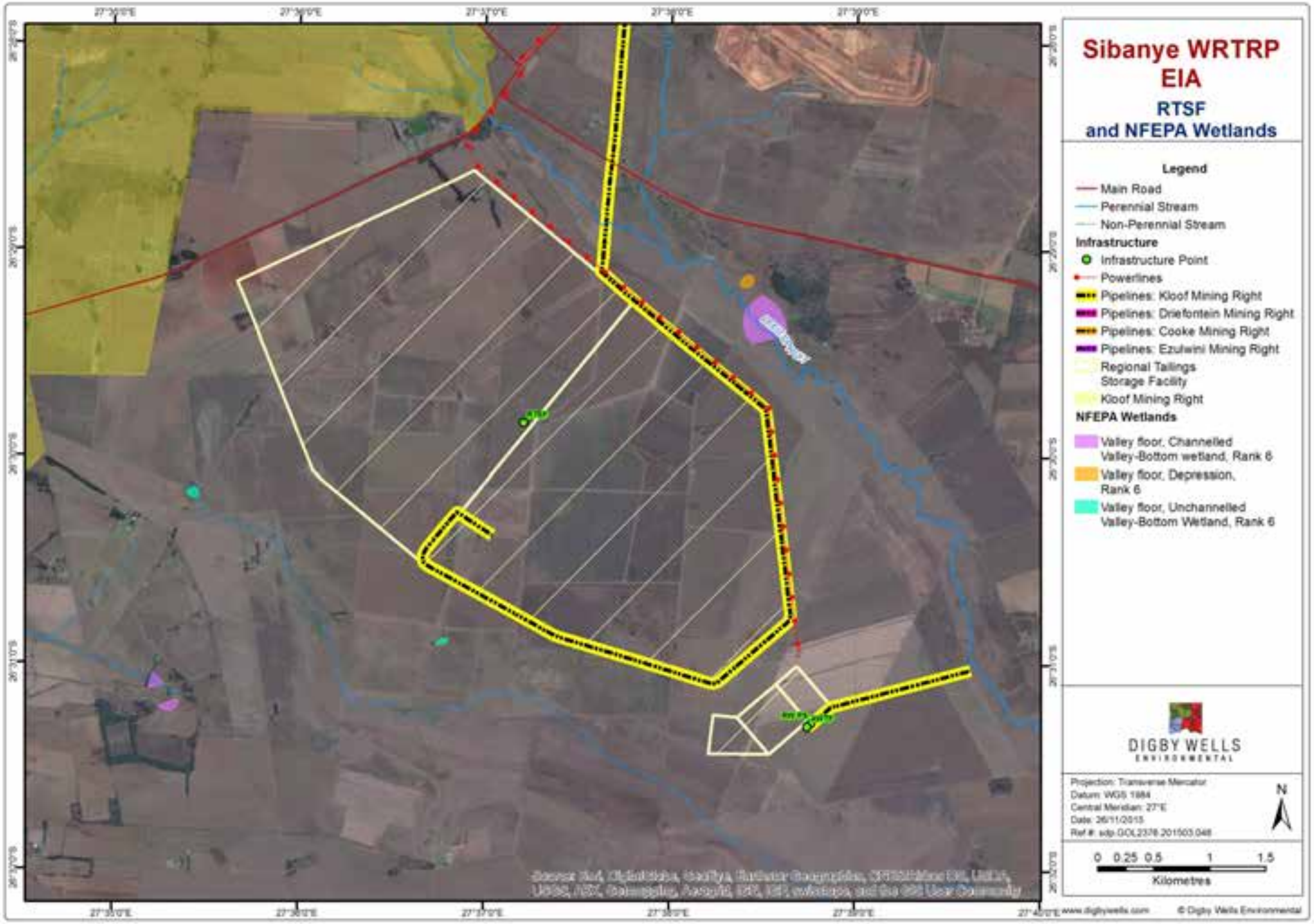
Plan 8: NFEPA Wetlands and the Ultimate Project Area



Plan 9: NFEPA Wetlands and the WBT and BWSF



Plan 10: NFEPA Wetlands and the CPP



Plan 11: NFEPA Wetlands and the RTSF

6.5 Gauteng Province Conservation Tools

6.5.1 Gauteng Conservation Plan Background

Gauteng Nature Conservation, a component of the Gauteng Department of Agriculture and Rural Development (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 Environmental Impact Assessment (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.

6.5.2 C-Plan Areas in the Project Area

According to the C-Plan, the routes traverse many places associated with *Important Areas* and *Ecological Support Areas*. There are some small areas designated as *Irreplaceable* surrounding the pipeline routes; and the tailings pipeline crosses through an area designated as such (these are, however, not formally protected areas). Please refer to the Fauna and Flora Report (Digby Wells, 2015c) for more detailed information regarding this.

6.6 West Rand District Municipality Conservation Tools

6.6.1 WRDM Environmental Management Framework and Bioregional Plan

The WRDM, according to the WRDM 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 National Environmental Management Act, 1998 (Act 102 of 1998, NEMA) Environmental Management Framework (EMF) Regulations, an EMF is define 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:

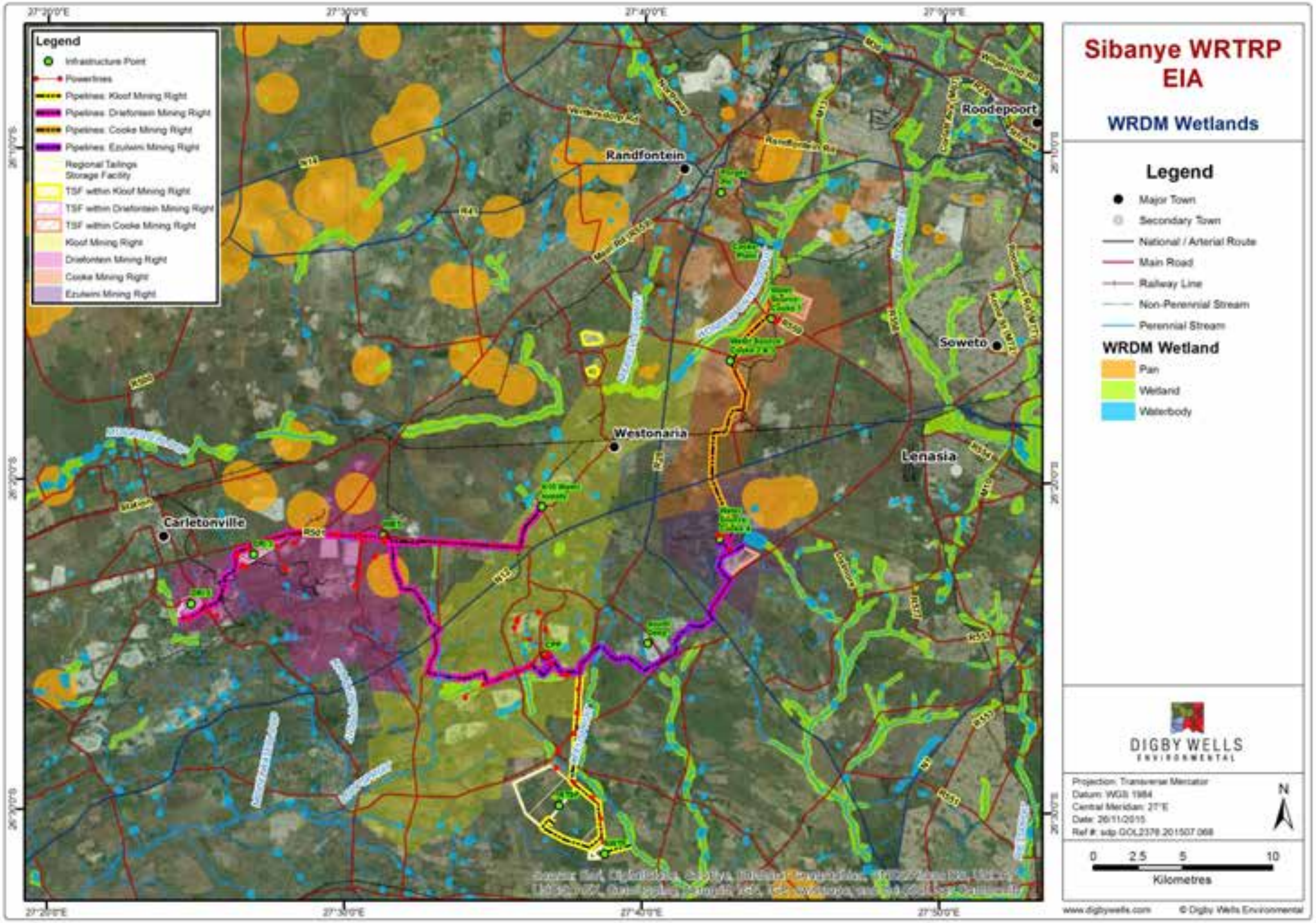
- Promote sustainability;
- Secure environmental protection; and
- Promote cooperative environmental governance.

Bioregional plans (BRP) are one of a range of tools provided for in the National Environmental Management: Biodiversity Act (No. 10 of 2004) 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 bioregional plan 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.

6.6.2 WRDM EMF and BRP Wetlands in the Project Area

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 960ha 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 Plan 12 on the following pages. The pan wetland systems are highlighted as circular cluster areas (as seen in yellow in the plans); the waterbodies are associated with dams and other non-natural wetland conditions; and the wetlands are associated with valley bottom systems.



Plan 12: WRDM Wetlands

6.7 Literature Review

According to van Wyk *et al.* (2006) the water "resource" is defined to include a water course, surface water, estuary and aquifer, on the understanding that a water course includes rivers and springs, the channels in which the water flows regularly or intermittently, wetlands, lakes and dams into or from which water flows, and where relevant, the banks and bed or the system. Historically, wetlands have been perceived to be wastelands (Maltby, 1986) and this has resulted in the exploitation, alteration and in many cases the complete destruction of these valuable ecosystems, with an accompanying loss of associated ecosystem goods and services (Begg, 1986). It is now acknowledged that these ecosystems perform functions making them invaluable to the management of both water quantity and quality, and as a result wetlands are regarded as integral components of catchment systems (Jewitt and Kotze, 2000; Dickens *et al.,* 2003).

With the growth of the mining industry in the late 19th Century, more water was required for the mines and the city of Johannesburg than could be sourced locally. This led to the creation of the Rand Water Board and the supply of water from the Vaal Barrage and later from the Vaal Dam (Coetzee *et al.,* 2005). Once this water has been used within the mines, factories and households, it is discharged to the streams which drain the city. The large volumes and continuous flow have considerably enlarged existing wetlands and created the new wetland systems in the Wonderfonteinspruit, Klip and Blesbokspruit River Catchments. The inflow of nutrients from the mines and the city has led to the formation of lush reedbeds which have become characteristic of these areas.

It can be suggested with confidence that the wetlands in the Witwatersrand and surrounding gold mining areas have been subject to major hydrological and chemical alterations from the century of gold mining that defines the area. The report by Coetzee *et al.* (2005) describes the contamination of the Witwatersrand wetlands by the mining activities, including the Wonderfonteinspruit catchment associated with this project area. These wetland systems are described as having a significantly altered hydrology and their integrity is compromised by the poor water quality, leading to high levels of pollution seen today (Coetzee *et al.,* 2005).

A form of pollution that is associated with gold mining is Acid Mine Drainage (AMD). Exposure of sulphide minerals to the air and humidity results in oxidation that forms sulphur acid. The process can be exacerbated in the presence of naturally occurring sulphur reducing bacteria, which catalyse (cause/ speed-up) the oxidation process. The low pH of the water solubilises metals such as aluminium, arsenic, cadmium, copper, iron, lead, nickel, and zinc. AMD takes several years to develop, where after the metal-rich acidic water often end up in rivers, streams and wetlands (Coetzee *et al.,* 2005).

Mining deposits that contain sulphide minerals are one of the most serious long-term environmental problems affecting the gold sector; and AMD probably presents the single most important factor in dealing with these tailings and waste rock legacies and their impact on the environment. According to the 2007 report by Oelofse *et al*., there are more than 270 tailings dams in the Witwatersrand Basin, covering approximately 400 km^2 in surface area. Most of these dams are unlined and many are not vegetated, providing a source of extensive dust, as well as soil and water (surface and groundwater) pollution.

The proposed WRTRP will reclaim and treat a number of TSFs in the West Rand area. The tailings reclamation process entails hydraulically reclaiming these TSFs to the natural ground level and the footprint will be rehabilitated to a suitable land use. There have been previous projects done in the West Rand area that have included wetland findings. The table below (Table 6-4) is a brief summary of the relevant reports made available to Digby Wells. The findings were not very detailed in the below-listed studies and therefore this report details the local findings on wetland associated with the WRTRP.

Table 6-4: Summary of wetland findings from previous projects

Report Name and Date	Brief Description	Specialist Remarks
Geluksdal EIA Wetland Specialist Assessment by Digby Wells 2012	Wetland assessment for the proposed Gold One TSF in the Geluksdal area and its associated infrastructure and pipeline to the Cooke Plant in Randfontein.	Various wetland units were identified for the project area. These included but weren't limited to; hillside seepages, valley bottoms and depressions (pans).
Kloof Mine EMP 2011	Consolidates general biodiversity information for Libanon, Kloof, Leeudoorn and Venterspost.	Indicates that no wetlands were present on the mine site but that a small wetland, associated with a stream, had developed south-west of tailings dam No.1.
IWWMP for the South Deep Gold Mine 2010	IWWMP for the South Deep Gold Mine summarising the water system characterisation and water use at the time of the study.	Two wetlands were identified to occur on the mine property, one directly south of South Shaft (an artificial wetland area known to the mine as the South Delta), and one west of the new tailings dam in the Kariegaspruit. No wetland delineation map, classification or ecological health assessment was conducted.

Report Name and Date	Brief Description	Specialist Remarks
West Wits Ecology report, by Renier Terblanche of Anthene Ecological cc. 2009	Extensive report, lots of protected species mentioned.	Wetlands identified on site based on the presence of hydromorphic vegetation and are reported to be sensitive ecological habitats. Watercourses were not classified as wetlands, as specified by the National Water Act (Act No. 36 of 1998). However, wetlands on site are, based on desktop evaluation, associated with the Leeuspruit system (major watercourse on site). No wetland delineation map, classification or ecological health assessment was conducted.
West Rand Gold Operation (WERGO) Witfontein Tailings Disposal Facility: Giant Bullfrog Habitat Suitability Assessment - Appendix 12 of Appendix F 2009	Assessment of the suitability of habitat at Witfontein for Giant Bullfrog (*Pyxicephalus adspersus)*.	The presence of wetlands on site was confirmed and suitable habitat for Giant Bullfrog (*Pyxicephalus adspersus) was* identified. No wetland delineation map, classification or ecological health assessment was conducted.
Driefontein Biodiversity Assessment by Natural Scientific Services (NSS) 2009	Biodiversity Assessment including a flora and fauna component.	Although wetland areas are identified, a wetland assessment had not yet been completed.
Driefontein Gold Mine EMP by Ecopartners 2009	EMP	Confirms the presence of wetlands on site, south of the No. 2 tailings dam near Pitseng shaft rock dump. No wetland delineation map, classification or ecological health assessment was conducted.

6.8 Screening Conclusion

The Project Area is characterised by valley bottom wetlands associated with multiple river systems across different quaternary catchments. In addition, the area has pan wetlands, which are found in the flatter areas. These wetlands have been significantly impacted upon from the mining, agriculture and urbanisation in the West Rand. The majority of the wetlands form part of the Upper Vaal WMA and are thus important water sources feeding the water management systems of the Witwatersrand. The wetlands are in need of rehabilitation and although they are not in a pristine condition, further impacts to these important ecological systems should minimised or prevented. The removal of TSF's from the environment and wetland catchments will remove a significant pollutant if done correctly.

7 Wetland Findings (Baseline Environment)

7.1 Wetland Delineation and Classification

The project area was surveyed and 21 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. A brief definition of these hydrogeomorphic settings is given in Table 7-1; based on the system first described by Brinson (1993), modified by Marneweck and Batchelor (2002), further developed by Kotze *et al.* (2004) and Ellery *et al*, 2009. Each of the wetlands is briefly described in the summary section in Table 7-2.

Table 7-1: The definition of the wetland units occurring in the study area

Wetland type	Description	Inputs	Throughputs	Outputs
Channelled Valley Bottom (CVB)	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. Water inputs are mainly from adjacent slopes while the channel itself is typically not a major source of water for the wetland.	Channel flow and adjacent hill slopes	Diffuse flow on elevated valley bottom and channel flow	Channel flow and evapotranspiration
Valley Bottom without a Channel (VB)	Valley bottom areas of low relief with no clearly defined stream and situated on alluvial fill	Channel entering the wetland and adjacent slopes.	Diffuse surface and subsurface flow	Channel outflow and evapotranspiration.
Depression / Pan	A basin shaped area with a closed elevation contour that usually is not connected via an outlet to the drainage network.	Variable	Insignificant	Evapotranspiration

7.2 Ecological Health and Sensitivity

The wetlands identified are impacted as a result of the surrounding land-uses which is dominated by mining, agriculture and road infrastructure. These impacts are typical of the West Rand, as described in Section 6.7. Many wetlands are directly impacted by open pit and underground mining as well as surface processing and the waste facilities (mainly TSFs). This has led to serious impacts to the quality of these systems and has contributed to direct loss of wetland habitat. 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 7-2.

7.3 Ecological Services

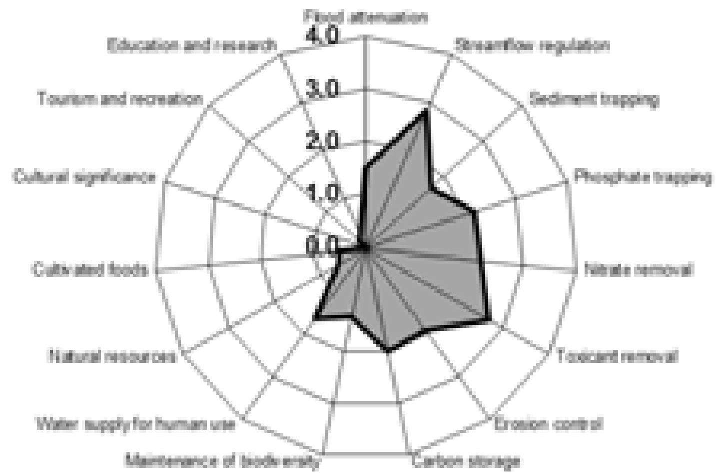
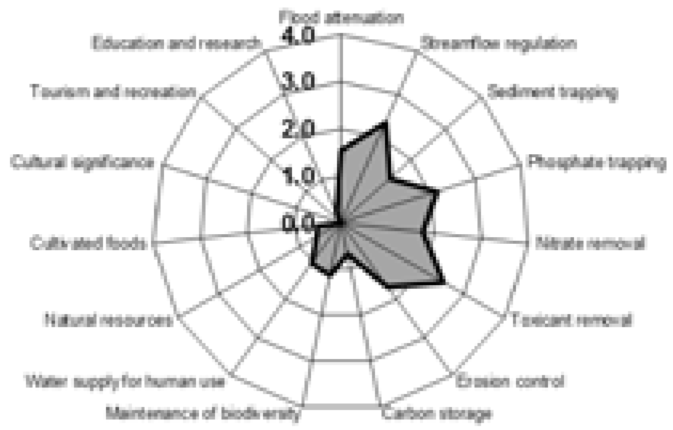
The general features of each wetland unit were assessed in terms of functioning and the overall importance of the HGM unit was then determined at a landscape level. The results from the Wet Eco-services tool for the respective wetland units are presented the Summary section in Table 7-2. The eco-services 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 a 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 reduction 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 7-2.

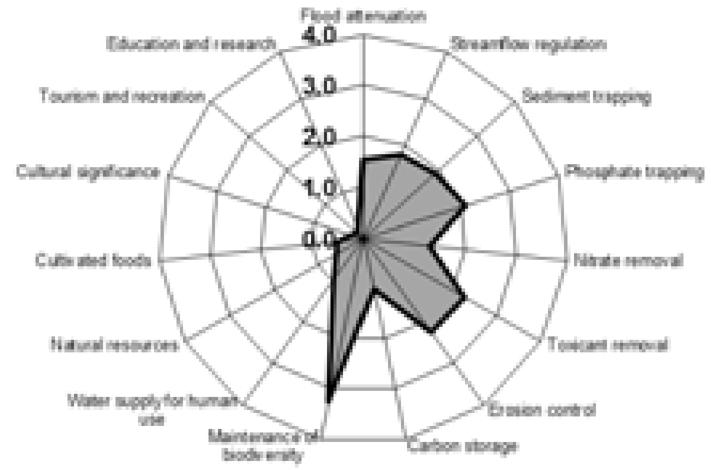
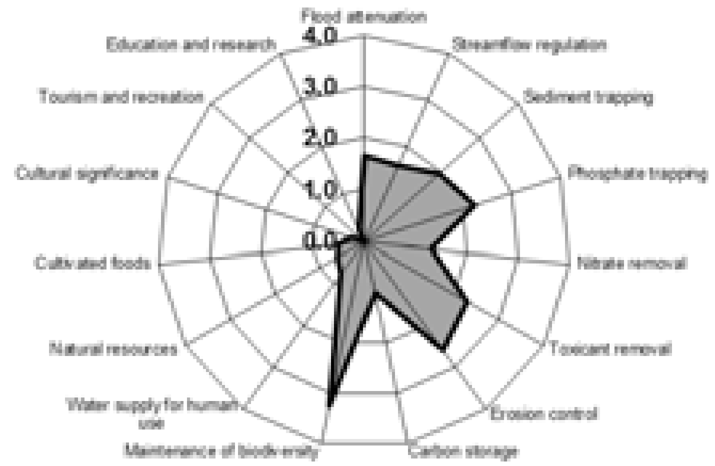
7.4 Wetland Findings Summary

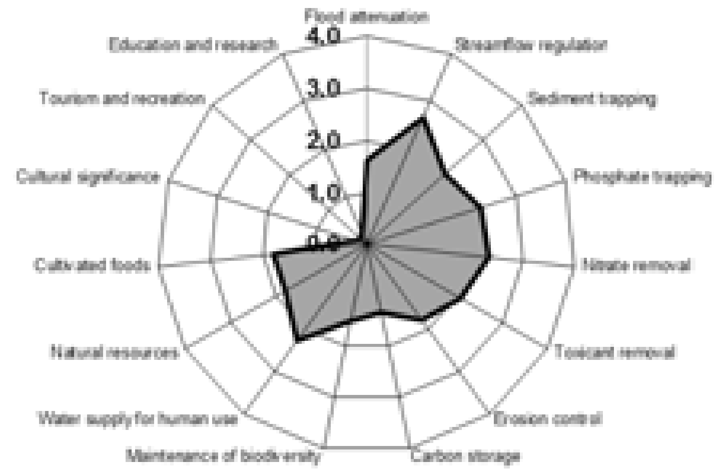
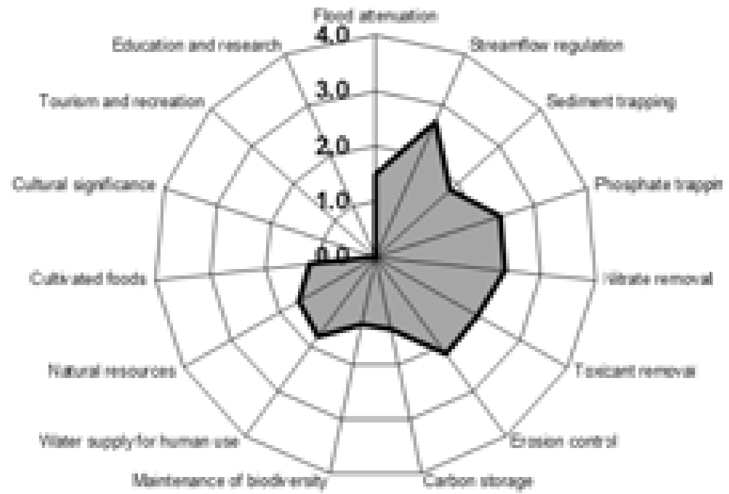
Table 7-2 below and on the following pages serves as a comprehensive summary of the wetlands found and assessed in the study area. Also refer to Plan 13 to Plan 18 for the mapping of these wetlands and Figure 7-1 to Figure 7-22 for the photo plates.

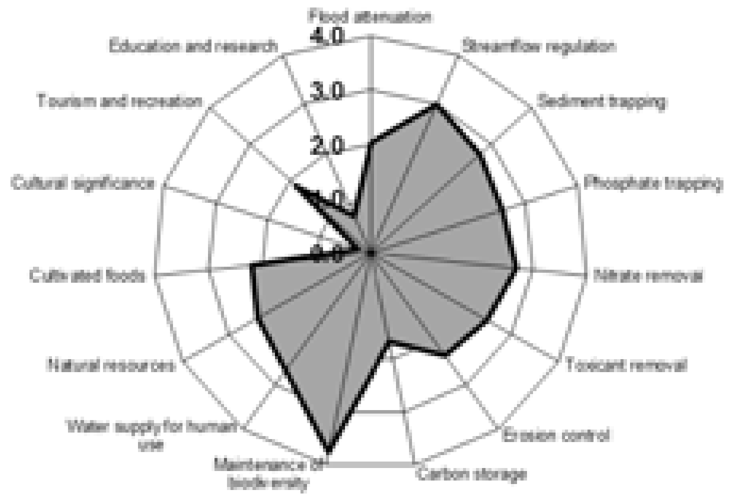
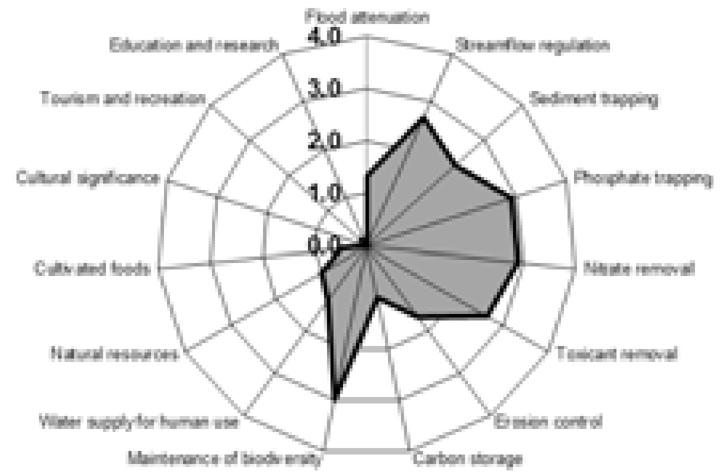
Table 7-2: Wetlands Findings

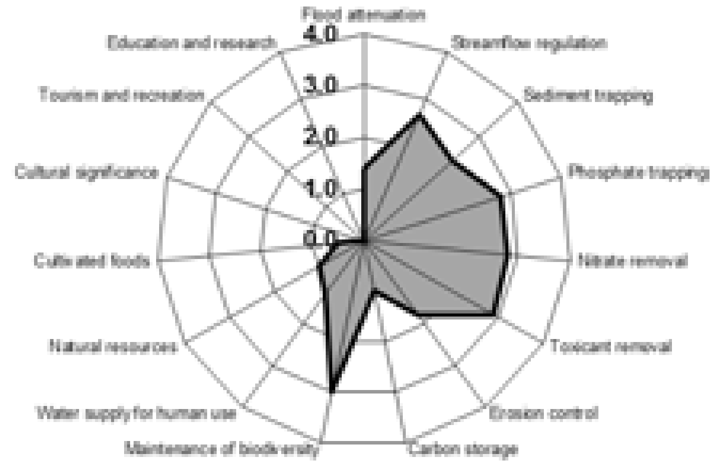
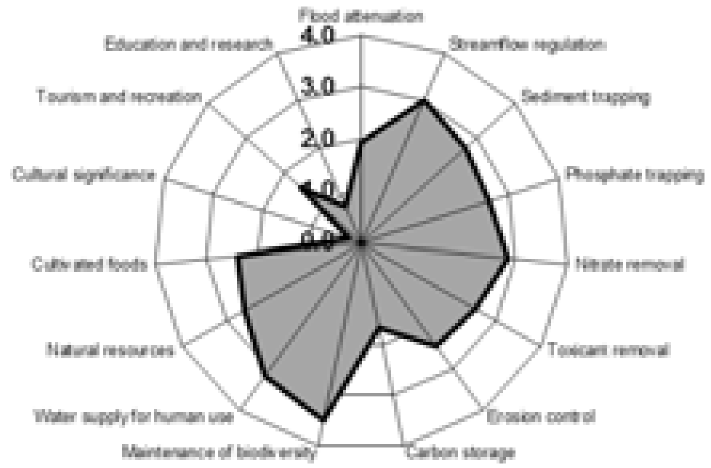
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
C23E	1	CVB	Drie	40.9	This is a small unnamed stream flowing northwards past the western side of the Driefontein 5 TSF. This wetland has been significantly impacted upon by the mining activities immediately adjacent to the wetland. Water quality has therefore been significantly compromised. The wetland hydrology has been altered due to the establishment of numerous farm dams. Parts of the wetland have been significantly impacted by colonisation of alien species, particularly Acacia mearnsii (Black Wattle). With regard to ecological sensitivity, no Red Data species were recorded in this wetland area and there is no suitable habitat to support such species. Further to this, due to the general transformation of habitat, significant natural features were absent. This wetland still serves an important role in streamflow regulation.	Plan 14	E 6.2	Low 1.0	
	2	VB	RC1	17.1	This is a small unnamed stream flowing northwards past the western side of the Driefontein 3 TSF . This wetland has been largely impacted on through drainage modifications, vegetation removal due to historical mining activities and part of the upstream wetland has been completely destroyed through mining. Given the severity of the impacts to this wetland, the services provided by the wetland are low and therefore the importance and sensitivity is low. The EcoServices too are not significant. This wetland would require significant rehabilitation measures to restore functionality. The pipeline from D5 to D3 TSF will cross over this wetland. This pipeline then continues on from D3 towards the WBT and follows along the R501 road. Coming from the opposite direction are two additional pipelines bringing water from the BWSF (found with the WBT); these too will cross the wetland. These pipelines in addition cross over two artificial drainage lines that have been put in place to manage water within these highly impacted areas such as the two TSF's. These are not delineated as wetlands. Similarly, the PCDs associated with the TSFs are not delineated as wetlands.	Plan 14 Figure 7-1	E 6.8	Low 1.0	

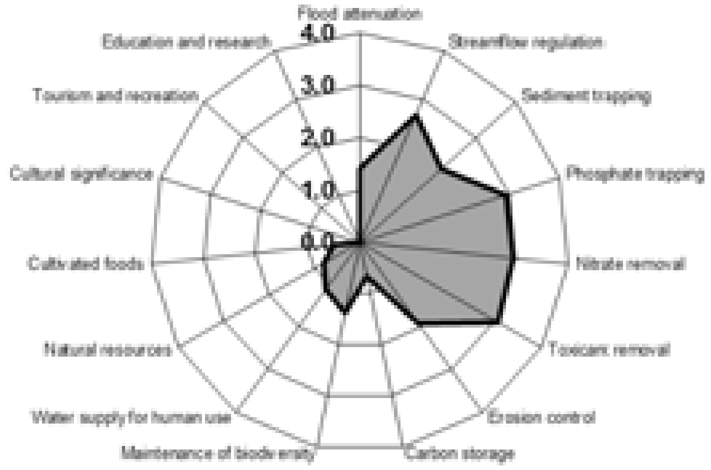
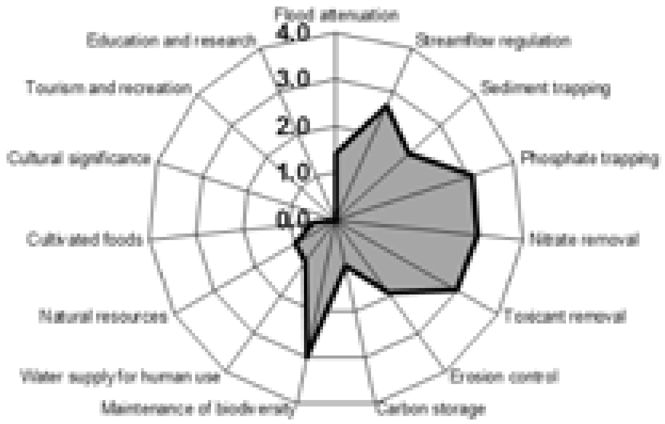
[1] This refers to the code used for the WULA per wetland/ stream being a crossing (RC) or just within 500m of the wetland (WB). This is subject to change and those changes may not be captured in this report.

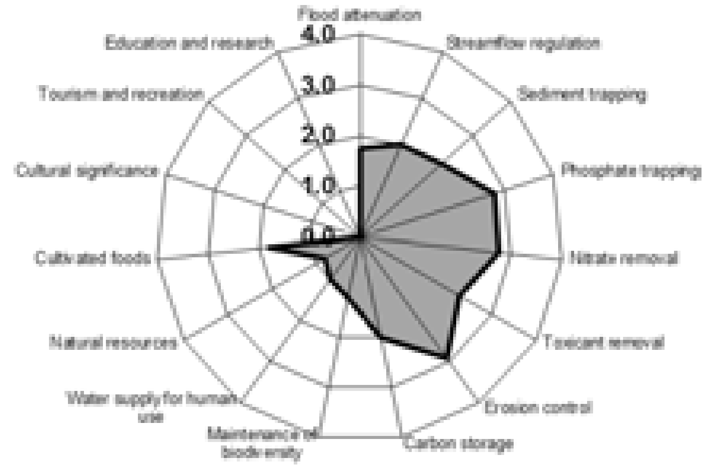
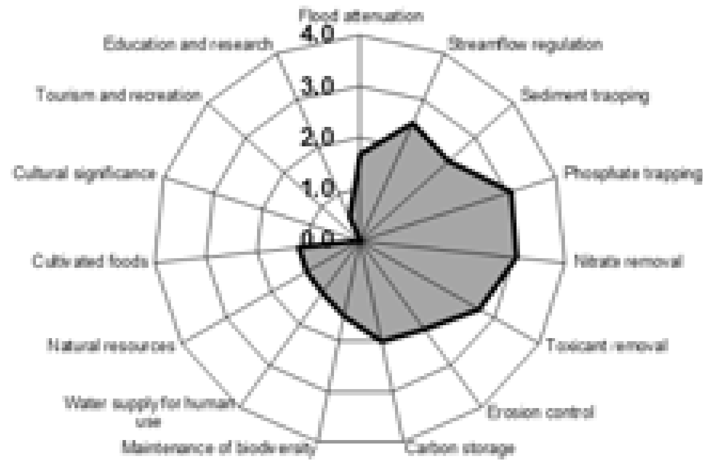
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	3a	**Pan**	RC23	4.7	This is a small pan found in the bend of the R501 road, approximately 230m wide by 310m in the longest reach. It is a very shallow depression as it is found on a thick layer of hard plinthite (ferricrete). The dominant wetland indicator grass species were Snowflake Grass (*Andropogon eucomis)* and Golden Bristle Grass (*Setaria sphacelata* var. *sericea*). The Giant Bullfrog (Pyxicephalus adspersus) has been recorded in this pan based on the Driefontein Biodiversity Assessment Report (NSS, 2009). This pan is delineated as an NFEPA wetland, designated as an artificial hillslope seep. The pan has been significantly impacted as the plinthite has been quarried, most likely leading to deeper depression than that which naturally occurred. Within the wetland and the immediate catchment, unnatural depressions due to the collapse of unconsolidated strata are present due to the historical underground mining of gold. This remains a risk due to the presence of unstable dolomite layers in the area. The vegetation, although mostly intact, showed low diversity and signs of over grazing. Given the reports of the Giant Bullfrog as well as the rarity of the wetland type, this wetland is important for the maintenance of biodiversity. The EIS score however was determined to be low as the wetland itself has been significantly impacted upon and it is found within a highly impacted catchment. Despite the wetland not being in pristine condition, it remains important for conservation purposes. The proposed pipeline from the D3 TSF will run past along the farm road just south of the pan. The pipeline in running eastwards towards the WBT, which is to be placed within immediate surroundings. Coming from the opposite direction are the pipelines carrying water from the BWSF (found together with the WBT) to D5 and D3 TSFs.	Plan 15 Figure 7-2	D 4.5	Low 1.0	
	3b	**Pan**	RC24 WBT3	2.7	This, too, is a small pan found in the bend of the R501 road, located 230m east of the pan Wetland 3a. This wetland is approximately 55m in width with a length of almost 450m; giving it an atypical shape. The dominant wetland indicator grass species was Red Autumn Grass (*Schizocarium sanguineum*) and Snowflake Grass (*Andropogon eucomis)*. The hydrology of the pan has been impacted by the surrounding land-use, predominantly road construction and farming as well as potentially from undermining. The native invasive and indicator of overgrazed/ overused grassland, Bankrupt Bush (*Seriphium plumosum),* was present in this wetland and its immediate catchment. This pan was found to be intact with regard to geomorphology. Due to the HGM unit being that of a threatened wetland, as well as due to an intact vegetation component, this wetland was seen to be important for maintenance of biodiversity. The EIS score however was determined to be low as the wetland is found within a highly impacted catchment. The proposed placement of the WBT and the BWSF is within this wetland. The pipeline containing tailings slurry from D5 and D3 TSFs reports to the WBT. The BWSF receives water from a pipeline coming from the K10 shaft water supply. From the WBT, a pipeline is designated to carry the thickened slurry to the CPP. There are two alternative routes that this pipeline is designated to follow.	Plan 15 Figure 7-3	D 4.0	Low 1.0	

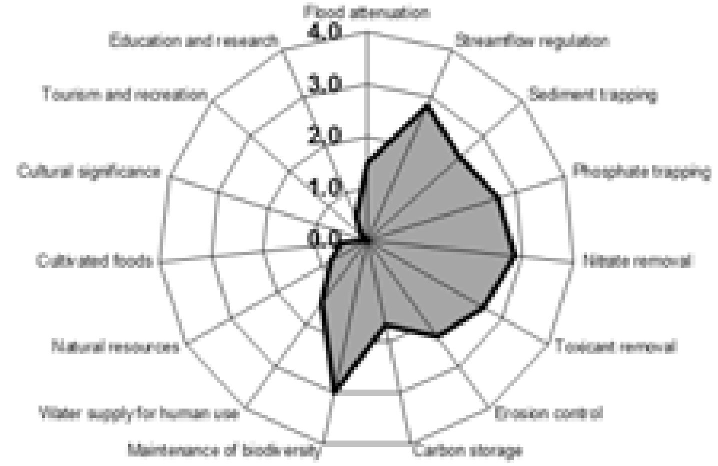
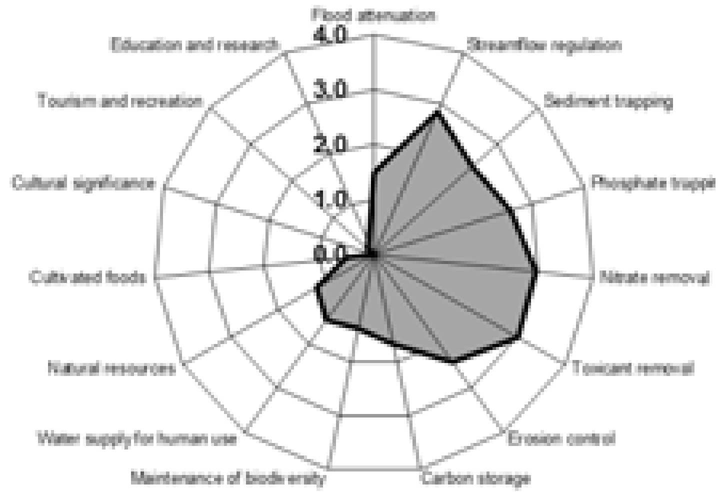
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
C23D	4	VB	RC2 RC3 RC27	154.3	This is an unchannelled valley bottom system associated with the Bank Fault Spruit, which leads to the Wonderfonteinspruit. The wetland indicator grass species present was Red Autumn Grass (*Schizocarium sanguineum*) and Garden Bristle Grass (*Setaria pumila).* The natural vegetation wetland indicators, however, were difficult to identify in many places due to the land-use impacts that have led to long-term vegetation changes, which mainly included grazing and intense agriculture. The wetland and its immediate catchment are dominated by farming activities that have significantly impacted on the natural vegetation. The farming activities mainly include maize (*Zea mays*) crops and cattle farming. In addition, this wetland has been affected by surrounding infrastructure (including a large sub-station) and damming of the water flow. The common invasive species of impacted wetlands, Garden Cosmos (*Cosmos bipinnatus*), is dominant in many parts of the wetland. The most important service provided by this wetland is that of streamflow regulation as it is associated with the Bank Fault Spruit. The wetland is highly transformed from its natural state with respect to hydrology and vegetation and therefore plays little to no role in maintenance of biodiversity. The wetland has therefore scored low on the EIS rating. This wetland will potentially interact with two pipelines of the project, being the tailings pipeline from the WBT to the CPP and the water pipeline running along the R501 from K10 shaft to the BWSF. The tailings pipeline to the CPP has two alternative routes; both routes are designated to cross this wetland.	Plan 15 Figure 7-4	D 5.6	Low 1.0	
	5	VB	RC20	25.1	This is a small unchannelled valley bottom wetland, which appears to be a leading towards Wetland 4, which leads to the Wonderfonteinspruit. Wetland vegetation found in this wetland includes Common Reed (*Phragmites australis*) and Yellow Nut Sedge (*Cyperus esculentus*). Part of this wetland has been delineated as an NFEPA wetland and characterised as a natural hillslope seep. This wetland has been significantly impacted upon by multiple surrounding land-uses, including pipeline routes, roads and farming. A water pipeline is crossing this wetland, which runs through a maize farm, and not only does this pipeline impact on the wetland by traversing through it, the pipeline was recorded to be leaking. The pipe has been leaking for a long time through investigation of historical imagery and this has led to the wetland being wider below the leak. This has also led to permanently wet conditions being created that may not be present naturally. Upstream of this wetland there are mining activities, which appear to be discharging water into this wetland as well through a culvert under the N12 national road. This too had led to unnatural permanently wet conditions and a potential decrease in water quality. The hydrology therefore has been significantly impacted. The vegetation has also been altered significantly from the natural state as much of the wetland is now under maize farming and other areas are dominated by *Phragmites australis.* The wetland is highly transformed from its natural state with respect to hydrology and vegetation and therefore plays little to no role in maintenance of biodiversity. The wetland has therefore scored low on the EIS rating. Streamflow regulation is the major service provided by this wetland. This wetland will interact with the proposed route of the water pipeline that runs along the R501 road from the K10 shaft to the BWSF. This same area of contact is had with the alternative route for the tailings pipeline from the WBT to the CPP.	Plan 15 Figure 7-5	E 6.1	Low 1.0	

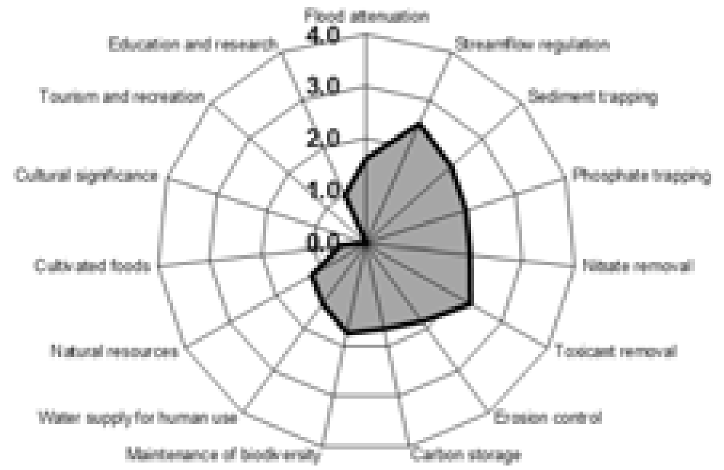
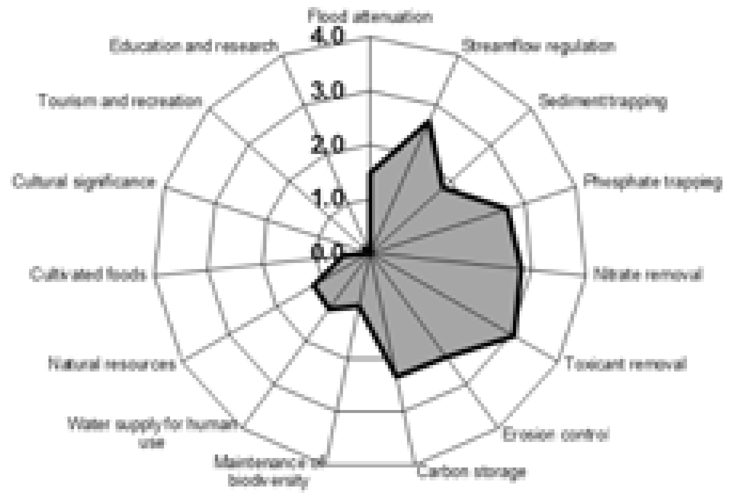
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
C23J	6	CVB	RC4 RC5	50.3	This is a long and narrow channelled valley bottom wetland associated with the Loop Spruit River. The upper reaches are very steep as they are in the ravines characteristic of upper catchment areas. Wetland vegetation recorded in the studied transects included Common Reed *(Phragmites australis)* and Common Rush (*Juncus effuses)*. Mine water is being released into the stream and wetland at the coordinates: longitude 26°25'53.45"S; latitude 27°33'9.40"E. (this was not investigated further). The wetlands hydrology as well as natural vegetation has been impacted upon mainly from farming and damming of the river at the base of the steep areas as well as due to the rtelaease of treated mine water. A large dam exists just below the water release, after which extensive farming becomes dominant adjacent to the river and extended into the wetland as well. The wetland is greatly utilised by the land owners. Alien invasive plants are also a problem in the catchment and the wetland, including Black Wattle (*Acacia mearnsii).* This wetland, although not in a pristine condition, has been scored a moderate importance and sensitivity. There is habitat within the upper reaches that are suitable for species of special concern and therefore is very important for maintenance of biodiversity. The wetland also forms an important role in the ecological services of streamflow regulation and trapping of sediments, phosphates and nitrates. The pipeline from the WBT to the CPP is designated to run along farm roads that traverse this wetland in two places; one just below the N12 national road and one at the spring.	Plan 15 Figure 7-6	D 5.9	Moderate 2.0	
	7a	VB	RC6	12.6	This is a small unchannelled wetland leading to the Loop Spruit, namely Wetland 6. At the confluence to the river, it is characterised by Common Bulrush (*Typha capensis*). This wetland appears to originate artificially from a mine water pipeline output (similar to that of Wetland 6) at longitude 26°26'0.90"S; latitude 27°33'45.14"E. A small dam wall has been put in place to collect water. The hydrology and geomorphology has been highly impacted due to the pump and dam placed at the origin as well as due to the presence of drainage network found below this dam. This area too has been overgrazed and thus the natural vegetation has been significantly altered. The alien and invasive grass species Kikuyu (*Pennisetum clandestinum*) has colonised most of this area. As an unchannelled wetland feeding a river system, this wetland is important for streamflow regulation. Additionally, due to the surrounding inputs of nitrates and sediment from the surrounding land-use activities (such as cattle grazing and dirt road infrastructure), the wetland would play a role in trapping of these inputs. The EIS was scored to be low due to the current impacts as well as the surrounding land-uses. The proposed tailings pipeline, which continues on from crossing the Loop Spruit, is located along the farm road approximately 50m from the origin of this wetland.	Plan 15 Figure 7-7	D 5.2	Low 1.0	

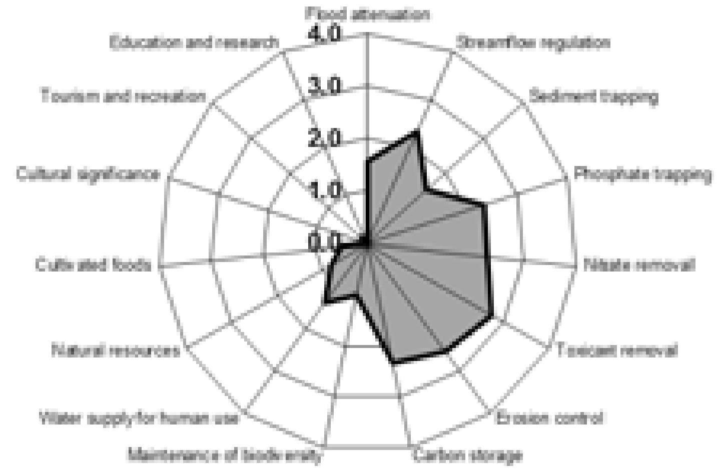
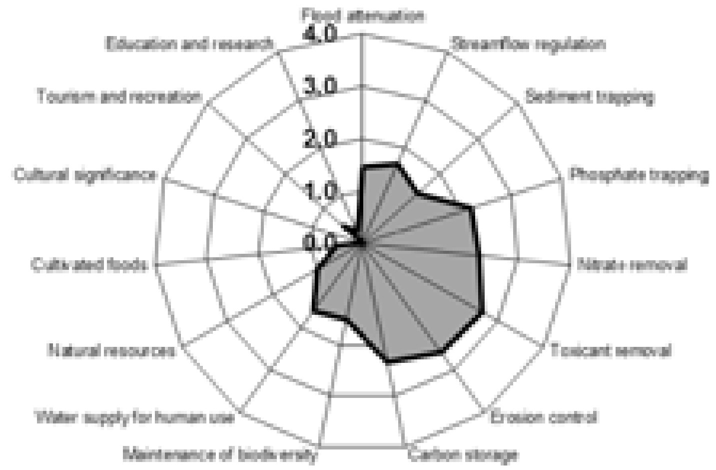
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	7b	**VB**	RC7	54.9	This is an unchannelled valley bottom wetland, similarly and in parallel to Wetland 7a that is designated as a tributary of the Loop Spruit, also to Wetland 6. This wetland is greatly impacted by overgrazing and thus is dominated by invasive vegetation such as Garden Cosmos (*Cosmos bipinnatus*), *Verbena bonariensis and* Kikuyu Grass (*Pennisetum clandestinum*). Additionally, this wetland is significantly impacted by mining and industrial activities immediately adjacent to it. This has greatly affected the quality of the water due to seepage from the mining impacted environment. The importance and sensitivity of this wetland was found to be low, despite playing a role in biodiversity maintenance and streamflow regulation. Additionally, due to the surrounding inputs of toxicants and sediment from mining and industrial activities, the wetland would play a role in removal of these. Similarly to Wetland 7a, the proposed preferred route for the tailings pipeline continues on along the top of these wetlands, crossing through this wetland in one location, towards the CPP.	Plan 15 Figure 7-8	D 4.8	Low 1.0	
C22J	**8**	**CVB**	RC9 RC12 RC19 RC26	754.2	This is channelled valley bottom system associated with the Leeuspruit. Wetland vegetation recorded in the studied transects included Common Reed (*Phragmites australis),* Common Bulrush (*Typha capensis*) and Common Rush (*Juncus effuses).* This river and wetland are greatly impacted by the surrounding mining and industrial activities as well as farming practices. This includes impacts to the hydrology due to the river being dammed multiple times in the upper reaches, as well as significant impacts to the natural vegetation as dense stands of alien invasive trees are present within the wetland and the catchment, mainly Black Wattle (*Acacia mearnsii*). The industrial and agricultural land-uses in the catchment of the Leeuspruit have led to the water quality being significantly compromised as well as over sedimentation occurring as erosion is a problem.This therefore leads to the characteristic dominance of parts of the wetland and stream by the Common Reed (*Phragmites australis)* and Common Bulrush (*Typha capensis*). The EIS of this wetland was determined to be moderate as the Leeuspruit is an important tributary to the Vaal River. The system therefore plays an important role in water supply for human use. There is diversity still within the system that would support important species and thus the wetland plays a role in the maintenance of biodiversity. As a main river system, the wetland is also playing an important service for streamflow regulation and trapping of sediments. Although this wetland has received a low health state of D (largely modified), it is still a very important wetland and river and all efforts to protect and rehabilitate it should be done. This wetland and river interacts with the proposed infrastructure on more than one occurrence. Firstly, the pipeline continues from the interaction with Wetland 7b to reach the CPP that is found in close proximity to this wetland, which interacts with a wetland tributary to the Leeuspruit, see Wetland 9b. From the CPP, a pipeline containing the waste will run southwards, crossing over this wetland towards the new RTSF location, which is found adjacent to this wetland further downstream. The RTSF and the associated PCD is proposed to be immediately southwest of this wetland; between this wetland and Wetland 11. This wetland is delineated as a large connected river and channelled tributaries and therefore is the wetland that is to be the most interacted with for the proposed project infrastructure.	Plan 15 & Plan 16 Figure 7-9	D 5.3	Moderate 2.0	

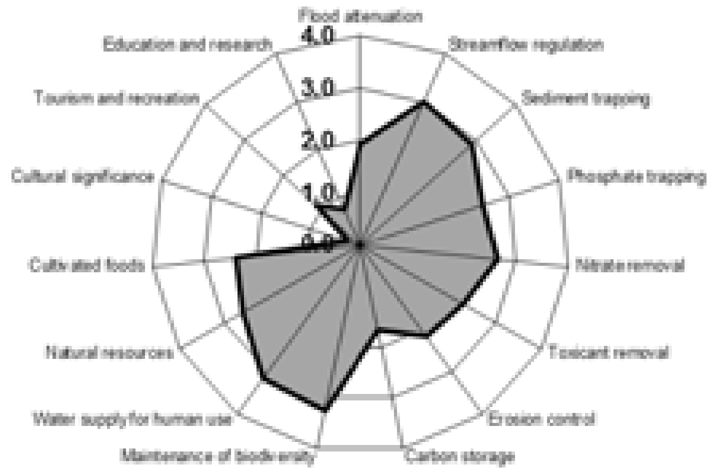
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	9a	VB	RC8	22.1	This is an unchannelled valley bottom wetland leading eastwards towards Wetland 8, associated with the Leeuspruit. This wetland has been significantly impacted by the surrounding land-uses, which are dominated by mining and related activities, industrial activities, farming and grazing as well as road infrastructure. Through analysis of historical imagery, there is evidence of mining of this wetland. Upon investigation with a hand auger, it was found that a layer of approximately 10cm of tailings material is found within the soil profile. Planted rows of grasses indicate that this area has undergone rehabilitation. Further downstream, this wetland has been dammed many times before it reaches the Leeuspruit main channel, Wetland 8. All aspects of this wetland, being hydrology, geomorphology and the natural vegetation have been significantly impacted in parts of this wetland. Given the above described impacts, the wetland was found to be of a low importance and sensitivity and a health state of E (significantly modified). The ecological services provided by this wetland have been compromised and thus it plays a small role in streamflow regulation and toxicant removal where vegetation is intact. This wetland is designated to coincide with the tailing pipeline preferred route, which continues on to reach the CPP, as mentioned in Wetland 8.	Plan 15 Figure 7-10	E 6.5	Low 1.0	
	9b	VB	RC10 RC11	49.8	This wetland consists of two unchannelled valley bottom wetlands, leading westwards towards Wetland 8, associated with the Leeuspruit. The natural vegetation of the wetlands is impacted by the surrounding land uses which are predominantly cattle grazing, infrastructure and mining related activities. An existing pipeline runs through both the wetlands and was found to be leaking at a point in the one wetland at latitude 26°25'6.25"S; longitude 27°36'46.69"E. The pipe appears to have been leaking for a significant time period through investigation of historical imagery. This has also led to permanently wet conditions being created that may not be present naturally, thus altering the natural hydrological conditions of the wetland. Industrial activities and infrastructure is found upstream of and around these wetlands; which include a TSF, substation and processing plant; this impacts on the water quality. Due to the current impacts, the wetlands were found to be of low ecological importance and their main ecological services provided are trapping and some removal of the toxicants and sediments that are unnatural fed to this system due to the surround land-use impacts. The wetland, too, would play a role in maintenance of biodiversity as it is a sensitive ecological system and is a tributary of the Leeuspruit. These wetlands will be impacted by the proposed placement of the CPP as well as the pipelines leading to and from the CPP. 11.0 ha is designated to be removed by placement of the CPP.	Plan 15 Figure 7-11	D 5.2	Low 1.0	

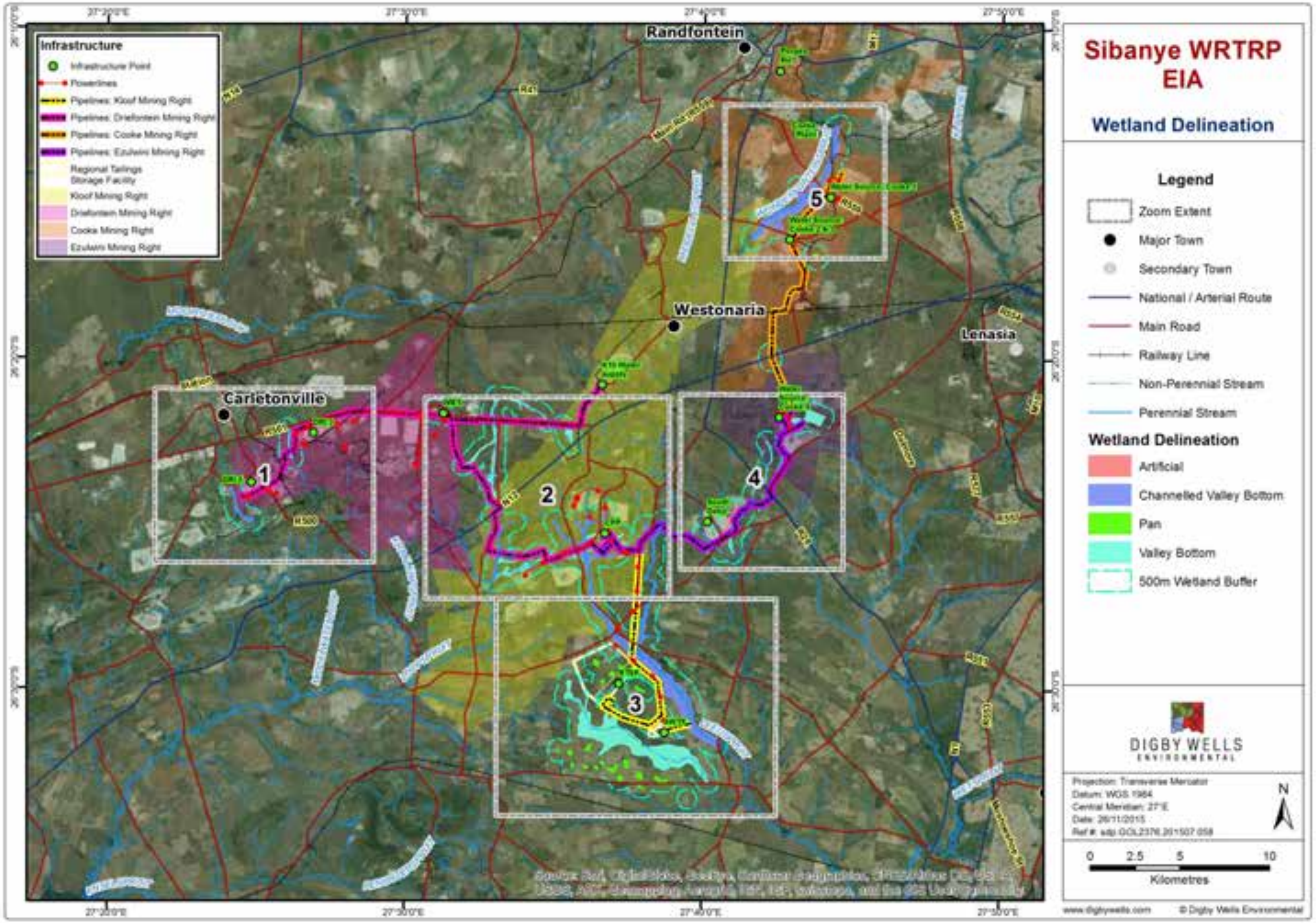
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	10	**PAN**	PAN1 to PAN5	38.5	Five pans, between 100-250m apart, form a cluster across a relatively flat topography. These pans were small and shared the same catchment. Found completely within agricultural farms of maize and sunflowers, the natural vegetation of this area has been significantly altered. This has also impacted the soil, which comprised of mostly black turf, showing limited signs of wetness. In some places, soft and hard plinthite had been displaced by the farming activities. Due to these impacts, the pans are characterised by limited natural vegetation indicators, and therefore dominated by plants such as Garden Cosmos (*Cosmos bipinnatus*) (a problem plant) and Garden Bristle Grass (*Setaria pumila*), which is a grass that dominates in disturbed places especially where water collects. These pans are largely modified and their EIS was scored to be low. Their main role is trapping of inputs and erosion control. Due to these pans being transformed hydrologically as well as having little to no natural vegetation left as they are found fully within agricultural fields, their role in biodiversity maintenance is little to none. These pans are designated to be destroyed through the placement of the new RTSF.	Plan 16 Figure 7-12	D 5.0	Low 1.0	
	11	**VB**	WET1 WET2	811.6	This is an extensive unchannelled valley bottom wetland system leading to the Leeuspruit. Similar to the other wetlands in this area, much of the natural vegetation has been removed and thus the remaining wetland indicator species such as Garden Cosmos (*Cosmos bipinnatus*), Yellow Nut Sedge (*Cyperus esculentus*), Garden Bristle Grass (*Setaria pumila*) and Golden Bristle Grass (*Setaria sphacelata var. sericea)*, most of which are or can be problem plants. There is a spring present in this wetland at longitude: 26°31'15.61"S; latitude 27°36'44.71"E according to the farm owner; it was not observed to be flowing at the time of assessment. This wetland is significantly impacted by the surrounding land-use of agricultural practices. Through investigation of historical imagery, a portion of this wetland has been ploughed through the entirety of the wetland width. This doesn't seem to be the case for the entire wetland length where crops are only planted up to the approximate wetland edge. Given the highly compromised hydrology of this wetland as well as very little natural vegetation remaining, this wetland is found to be low in EIS. Due to the extensive nature of this diffuse unchannelled wetland, the main ecological services it provides is streamflow regulation (as it leads towards the Leeuspruit) and phosphate and nitrate trapping. This wetland is immediately adjacent to the placement of the new RTSF. Some small upper parts of the wetland, 4.4 ha, will be removed as it falls within the footprint.	Plan 16 Figure 7-13	D 5.2	Low 1.0	

Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	12	**CVB**	RC13 RC14 WB3	128.4	This is a channelled valley bottom wetland and is a tributary of the Leeuspruit River. This is a long wetland unit and the characteristics vary along the wetland. The banks of the channel and valley wetland are characterised by wetland indicators such as Common Bulrush (*Typha capensis*) and Cottonwool Grass (*Imperata cylindrica*) in most parts; Popplar trees are found in the stream in the southern extent near the confluence with main Leeuspruit River, where *Knifofia ensilfolia* was found to occur as well. The hydrology of and water quality entering into this wetland is impacted by the surrounding land use, which mainly includes agriculture, grazing, damming and some mining activity. These impacts continue throughout the wetland length. The natural vegetation of the wetland and its local catchment is impacted upon significantly by grazing as well as alien and invasive species, mainly Black Wattle (*Acacia mearnsii*), *Seriphium plumosum* (Banktrupt Bush) and *Verbena bonariensis*. The Common Bulrush (*Typha capensis*) has become dominant in long stretches of the stream. Being a tributary of the Leeuspruit, this wetland serves the purpose of streamflow regulation as well as biodiversity maintenance; even thought his wetland is not in a pristine condition. Given the many current impacts to the ecological catchment, the EIS was determined to be low. Nitrate and toxicant removal as well as phosphate trapping were found to be important ecological services provided by the wetland. This wetland is involved with two pipeline routes: The proposed pipeline that will transport the uranium rich slurry from the CPP to the Ezulwini uranium treatment plant is designated to traverse this wetland on two occasions. These crossings (RC13 and RC14) follow existing roads and bridges, however these will need to be upgraded and improved; especially RC14 and it is in very poor condition. The proposed pipeline transporting the tailings material from the CPP to the RTSF is within 500m (WB3) of this wetland as it follows towards and crosses over the Leeuspruit (see Wetland 8).	Plan 15 and Plan 17 Figure 7-14 and Figure 7-15	D 5.8	Low 1.0	
	13	**CVB**	RC15	12.0	This is a small channelled valley bottom wetland, linked to the Kariega tributary of the Leeuspruit River. The Common Bulrush (*Typha capensis*) is a main wetland indicator found in this wetland and it has become dominant in long stretches of the stream. This wetland is significantly impacted upon from the mining infrastructure and industrial activities that have been built in direct contact with the wetland. This has had major negative effects on the natural hydrological and geomorphological state of the wetland. In addition the vegetation has been altered significantly from its natural condition in many parts with alien plants present; including Black Wattle (*Acacia mearnsii*) and *Eucalyptus* sp. Agricultural transformation of the wetland vegetation is also a main impact, mostly downstream of the delineated wetland. This has led to the wetland being scored and E, being significantly impacted. Given the above, the wetland was determined to have an EIS of low. The wetland serves little to no role in biodiversity maintenance; however the wetland is still important for streamflow regulation as well as removal of toxicants and nitrate inputs. The proposed pipeline that will transport the uranium rich slurry form the CPP to the Ezulwini uranium treatment plant is designated to traverse this wetland. The proposed route follows an existing pipeline servitude.	Plan 17 Figure 7-16	E 6.1	Low 1.0	

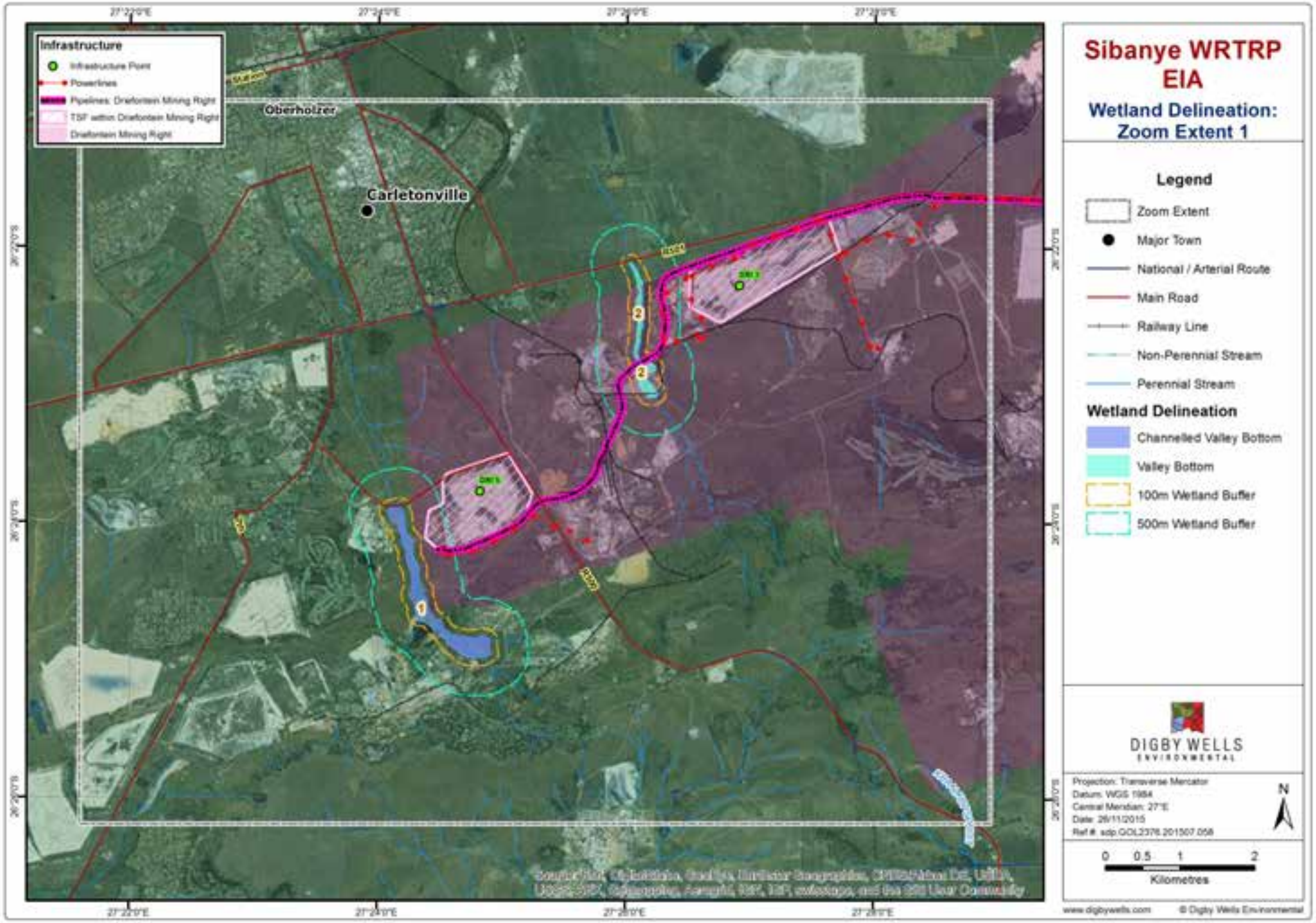
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	14a	**CVB**	WB1 WB2	20.6	This is a narrow channelled valley bottom wetland that is characterised as a tributary of the Leeuspruit. Typical of impacted wetlands in this catchment, the Cape Bullrush (*Typha capensis*) is a main wetland indicator and has become dominant in much of the stream. The catchment and wetland is used for grazing and is also open for local community use, although privately owned. The health of this wetland was found to be a D, largely modified, due to the impacts instream as well as in the surrounding catchment. These include grazing, agriculture, dense alien trees, erosion as well as some mining activities. The EIS therefore is low but the wetland still provides some important ecological services. These are predominantly streamflow regulation and pollutant removal.	Plan 17 Figure 7-17	D 4.6	Low 1.0	
	14b	**CVB**	RC16 RC17	61.2	This is a continuation of the 14a channelled valley bottom wetland that is characterised as a tributary of the Leeuspruit. This wetland is a significantly impacted part of the channelled wetland and this is due to the mining and industrial activities through which this stream and wetland flows. Further upstream (Wetland 14a) and downstream of this section of wetland this wetland resembles a more natural state; however for this 3km stretch this wetland has been markedly altered; so far so that part of the wetland has been designated as artificial. The hydrology has been almost fully compromised due to the adjacent TSF and mining activities and the adjoining series of roads and pipes. The exotic species Pampus Grass (*Cortaderia selloana)* is dominant in this altered wetland. Cattle were also present within the wetland which will have an impact on water quality from the defecation and urination. This wetland is significantly impacted and therefore receives a PES of E. Additionally this wetland scored a low for EIS. The wetland will play some role in streamflow regulation and, due to the significant sources of pollution around the wetland, the wetland will assist in toxicant and nitrate removal from the system as it flows into the Leeuspruit catchment. The proposed pipeline that will transport the uranium rich slurry from the CPP to the Ezulwini uranium treatment plant is designated to traverse this wetland. The proposed route follows existing pipeline and road servitudes.	Plan 17 Figure 7-18	E 6.5	Low 1.0	

Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
C22H	15	VB and Dam	RC18 RC25	92.5 ha	This is a valley bottom wetland at the top of the catchment that leads into Peter Wright Dam. This wetland is significantly impacted upon as it found at the top of the catchment where the dominant land-use is industrial and mining. This wetland is found between the Ezulwini uranium treatment plant and the Ezulwini South TSF. The hydrology of this area has been almost completely altered from its natural condition due to the surrounding industrial activity and the wetland is dammed. Water quality of this wetland is also significantly compromised as pollution sources are found immediately adjacent to these systems. Due to the described impacts, the natural vegetation is no longer present and alien and invasive trees such as Black Wattle are a major impact. Further downstream, this wetland becomes a little more natural and the major influence is the adjacent agricultural practices. Due to the above, the wetland PES has been assessed to be an E and the EIS of the wetland is determined to be low. The wetland serves little to no maintenance of biodiversity. The wetland will play a small role in streamflow regulation and, due to the significant sources of pollution around the wetland; the wetland will assist in toxicant and nitrate removal from the system. There are a few proposed pipeline routes near and traversing the wetland as the uranium plant will be used and the tailing from Cooke Dump needs to get the CPP.	Plan 17 Figure 7-19	E 6.9	Low 1.0	
C23D	16	Pan	RC22	8.9	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. 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 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.	Plan 17 Figure 7-20	D 4.7	Low 1.0	
	17	Pan	NA	9.8	This is a pan wetland east of the Cooke 2 and 3 shafts. The catchment of this pan is characterised by Dresden soil type where there is shallow topsoil over hard plinthite. This indicates that this area was an extensive wetland historically as plinthite indicates old wetland conditions. The present wetland; however is at a smaller extent than before. Similarly to other wetlands in this area, the hydrology has been significantly altered due to surround industrial and agricultural activities; this includes the release of water into the pan creating an artificially large open-water extent. The water quality appears to be significantly compromised. Cattle and agriculture have significant impacts on the natural vegetation as well on the natural state of the wetland. The dominant wetland plant is *Juncus effusus* (common rush). This wetland is outside of 500m from the tailings pipeline from Cooke dump running south.	Plan 18 Figure 7-21	Not assessed (outside 500m of proposed infrastructure)			

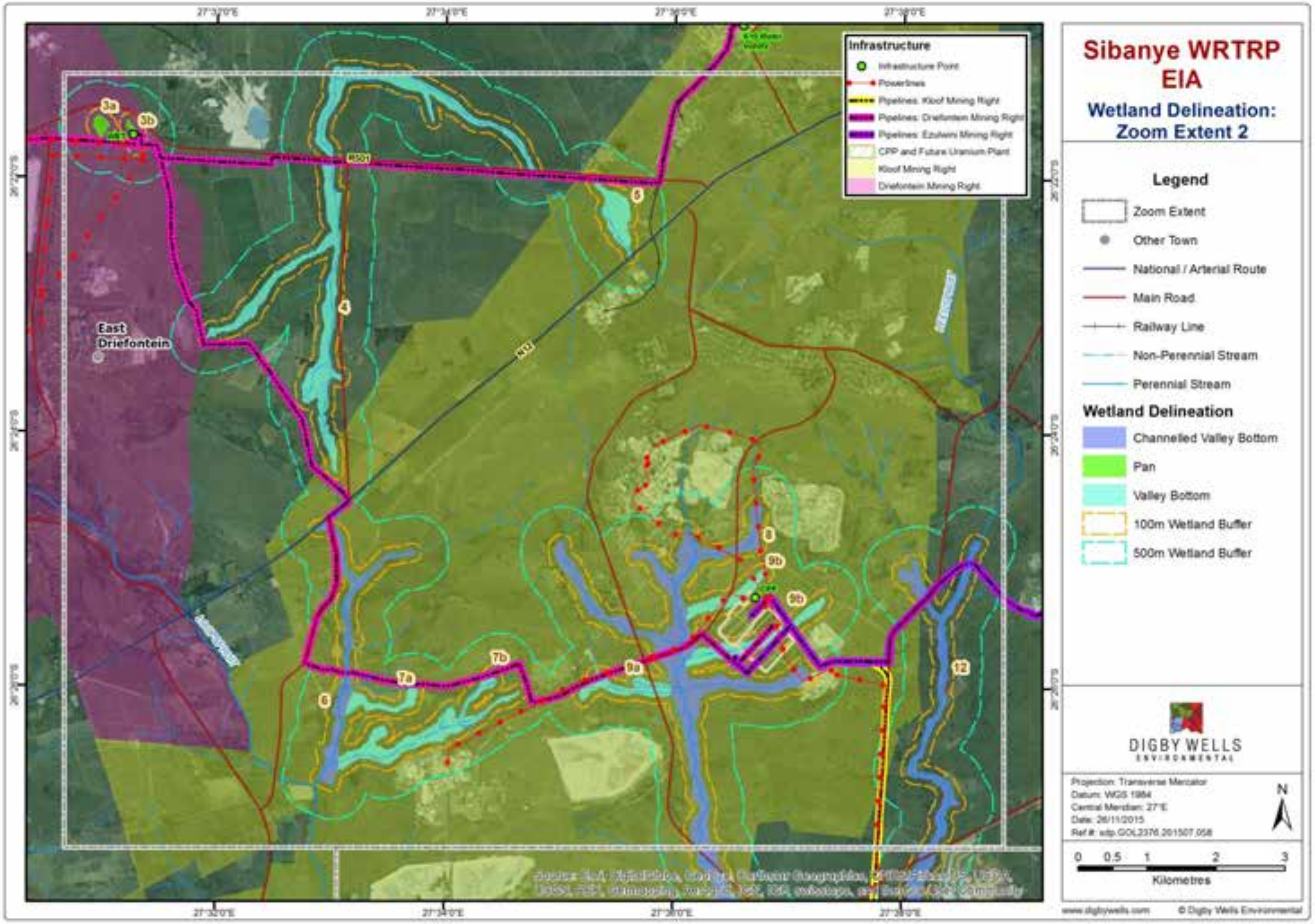
Catchment	Wetland and HGM unit		Interaction code[1]	Area (ha)	Description and Associated infrastructure	Plan and Figure Reference	PES	EIS	EcoServices Radial Plot
	18	CVB	WB4	372.1	This is the Wonderfonteinspruit River and wetland, which is delineated from Cooke 2 and 3 to the Cooke Dump; however it extends 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. 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. 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.	Plan 18 Figure 7-22	E 6.6	Low 1.0	



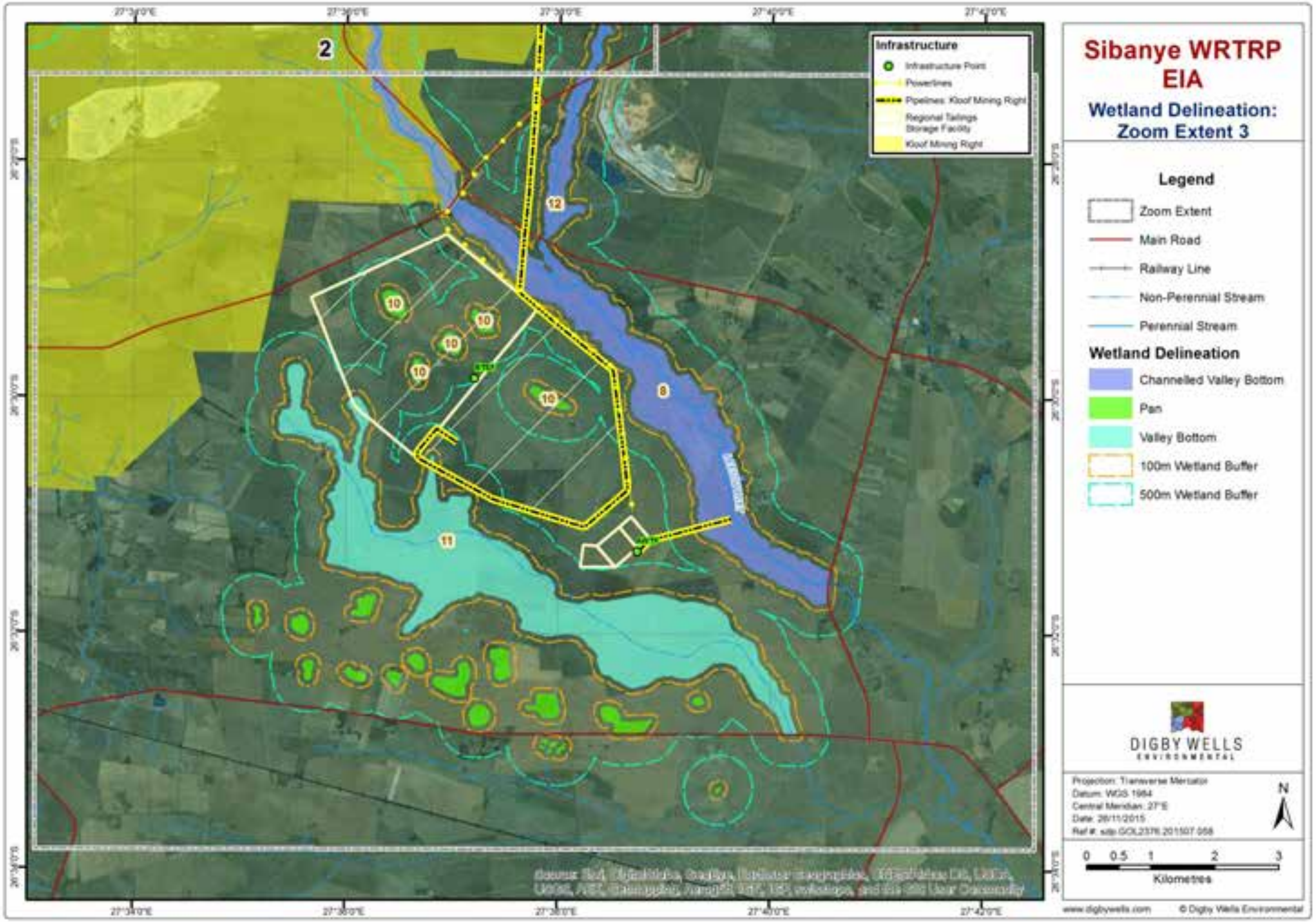
Plan 13: Wetland Delineation: Overall



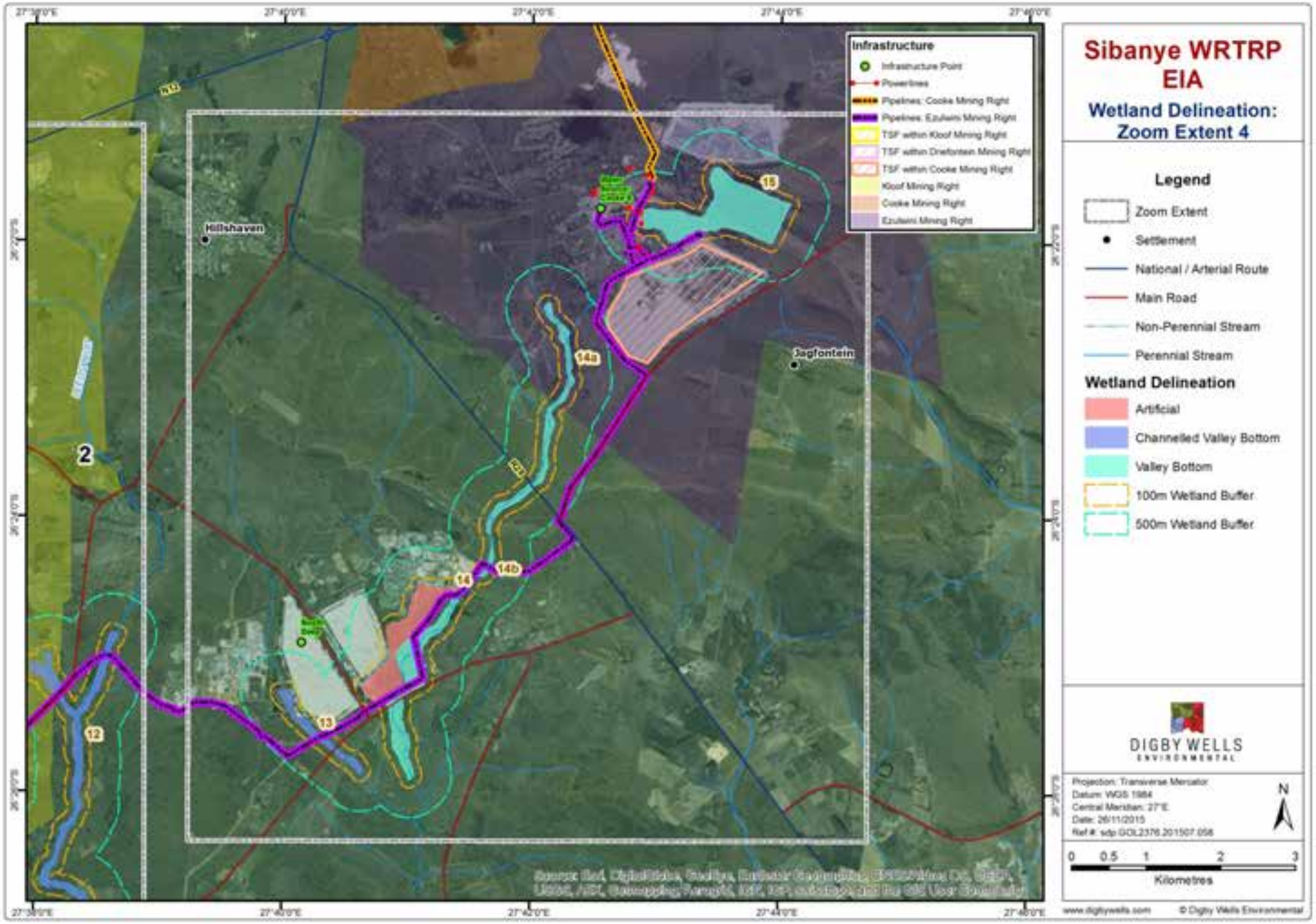
Plan 14: Wetland Delineation: Zoom Extent 1



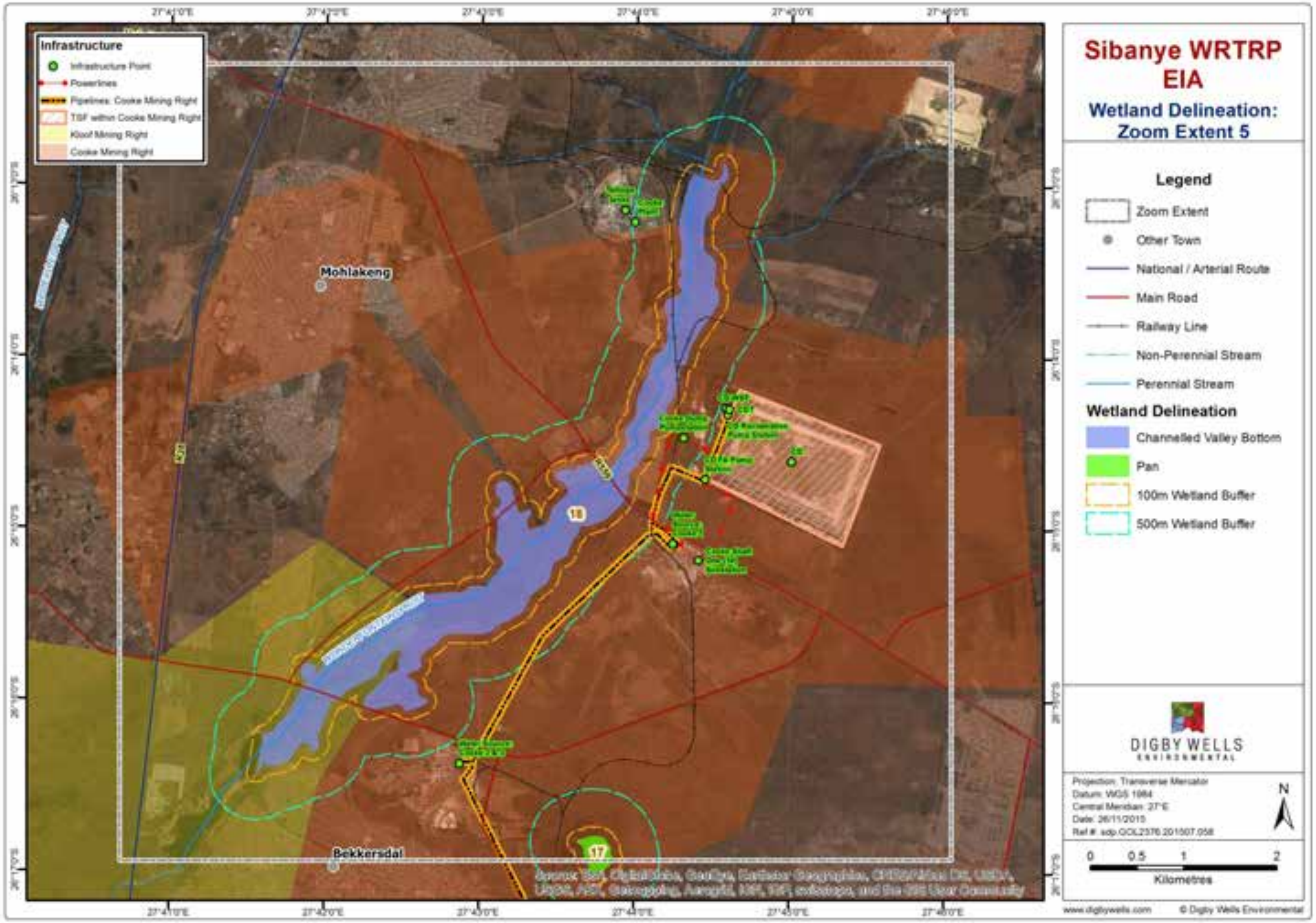
Plan 15: Wetland Delineation: Zoom Extent 2



Plan 16: Wetland Delineation: Zoom Extent 3



Plan 17: Wetland Delineation: Zoom Extent 4



Plan 18: Wetland Delineation: Zoom Extent 5

Figure 7-1: Wetland 2 (VB) photos: a) general wetland area; b) *Imperata cylindrica*; and c) impacts including abandoned infrastructure, pipeline and alien invasive trees

Figure 7-2: Wetland 3a (Pan) photos: a) general shape of the depression; b) *Andropogon eucomis*; c) evidence of quarrying, exposing the hard plinthite (ferricrete) layer; and d) open water in centre of pan

Figure 7-3: Wetland 3b (Pan) photos: a) general wetland catchment area, dominated by the Red Autumn Grass (*Schizocarium sanguineum),* also shown in b); c) Snowflake Grass (*Andropogon eucomis*); and d) presence of Bankrupt Bush (*Seriphium plumosum)*

Figure 7-4: Wetland 4 (VB) photos: a) Garden Cosmos (*Cosmos bipinnatus*) dominates in many parts; b) weland soil sample showing wetness indicator mottling; c) Garden Bristle Grass (*Setaria pumila*); d) Red Autumn Grass (*Schizocarium sanguineum)*; and e) Golden Bristle Grass (*Setaria sphacelata* var. sericea)

Figure 7-5: Wetland 5 (VB) photos: upstream dominated by includes Common Reed (*Phragmites australis*); b) pipe traversing wetland that was leaking; c) Garden Cosmos (*Cosmos bipinnatus*) and Yellow Nut Sedge (*Cyperus esculentus*); d) Golden Bristle Grass (*Setaria sphacelata* var. sericea); and e) evidence of water pooling below leaking pipe and maize crops

Figure 7-6: Wetland 6 (CVB- Loop Spruit) photos: a) part of the channel where mine water is being released into the Loopspruit; b) impact of the road crossing the wetland; c & d) downstream channel showing water flow and dominance of Common Reed *(Phragmites australis*); and e) Common Rush (*Juncus effuses)*

Figure 7-7: Wetland 7a (VB) photos: a) impacts of artificial drainage, pipes and cattle; b) the mine water release valve/pump and dam wall; c) wetland soil sample showing unconsolidated soil with signs of wetness; d & e) Common Reed *(Phragmites australis*)

Figure 7-8: Wetland 7b (VB) photos: road cutting through top of wetland where pipeline will follow; b) wetland edge soil sample with subtle mottling; and c) general vegetation condition is poor as predominantly Garden Cosmos (*Cosmos bipinnatus*) and *Verbena bonariensis*

Figure 7-9: Wetland 8 (CVB – Leeuspruit) photos: a) bridge crossing looking downstream; b) high clay, gleyed wetland soil sample; c) thick wetland vegetation along banks of river; d) dense patch of Common Bulrush (*Typha capensis*) with bird activity; e) Yellow Nut Sedge (*Cyperus esculentus*); f) cattle in wetlands; and g) road crossing and flooding impacts

Figure 7-10: Wetland 9a (VB) photos: a) general wetland area; b) evidence of wetland vegetation being replanted; and c) evidence of white/grey tailings material in auger sample

Figure 7-11: Wetland 9b (VB) photos: a) general wetland environment; and b) evidence of leaking pipe

Figure 7-12: Wetland 10 (Pans) photos: a) typical pan and state of the vegetation; b) Garden Bristle Grass (*Setaria pumila*); and c) soft plinthite

Figure 7-13: Wetland 11 (VB) photos: a) general wetland area with very shallow gradient; b) evidence of the maize crops extending into the wetland as seen together with Yellow Nut Sedge (*Cyperus esculentus*); c) high clay, gleyed and pedocutanic soil sample; d) *Agrostis* sp.; and e) black turf soil sample.

Figure 7-14: Wetland 12 (CVB) photos at pipeline crossings RC13 & RC14: a) view upstream showing channel and the valley bottom; b) impact caused by road across the stream; and c) invasive trees in the catchment, mainly Black Wattle

Figure 7-15: Wetland 12 (CVB) photos at lower reaches: a) narrow stream showing cattle and some erosion; b) *Knifofia ensilfolia*; c & d) impacts at road crossings showing pipes and Popplar trees.

Figure 7-16: Wetland 13 (CVB) photos: a) view downstream from road crossing showing dominance of Common Reed *(Phragmites australis*) in the channel; and b) view upstream of road crossing showing also dominance of Common Reed and upstream mining impacts as well as bridge

Figure 7-17: Wetland 14a (CVB) photos showing the dominant Common Reed *(Phragmites australis*) in the stream channels with impacts of litter and the road

Figure 7-18: Wetland 14b (CVB) photos: a) stretch of wetland impacted by road crossings and the exotic species Pampus Grass (*Cortaderia selloana);* b) impacts of pipeline servitudes through the wetland; and c) general condition of the wetland with multiple impacts

Figure 7-19: Wetland 15 (VB) photo showing the highly impacted wetland and environment

Figure 7-20: Wetland 16 (Pan) phots: pan wetland with limited natural vegetation and no open water, showing existing impacts such as the pipeline servitude under the N12

Figure 7-21: Wetland 17 (Pan) showing extensive (artificially fed) open water with *Juncus effuses* the dominant wetland vegetation

Figure 7-22: Wetland 18 photo showing the Wonderfonteinspruit CVB with existing impacts such as roads, pipelines and powerlines.

8 Sensitivity Analysis and No-Go Areas

8.1 Wetlands of Importance

The Ramsar Convention of Wetlands of International Importance has not identified any wetlands within the project area as important under the convention. NFEPA, however, has identified some wetlands as having national importance and therefore high sensitivity. Based on the findings detailed in this report, there are many more wetlands associated with the proposed project infrastructure than identified by NFEPA. These wetlands can be considered to form a part of the Eastern Temperate Freshwater Wetlands as described by Mucina and Rutherford (2006). These are important ecosystems within the grassland biome and greater protection of these systems is needed.

8.2 Wetland Buffers

According to the National Water Act, 1998 (Act 39 of 1998) (NWA), Regulation GN1199, development within a 500 metre radius (can be considered the wetland buffer zone) from the boundary of any wetland will require a Water Use Licence (WUL). The 500 metre radius stipulated in the NWA is not considered as a protection buffer, only that if you are within 500 metres that you will need to apply for a WUL. Therefore, in the absence of national protocol, a generic 100m buffer is recommended to be established around wetlands as best practise to ensure protection of these systems. This is in agreement with Regulation 704, whereby material and activities with the potential to impact on a water resource, within 100m of a watercourse or within the relevant floodline, should be licenced.

In the local Gauteng legislation and regulations (Gauteng Conservation Plan (Compaan, 2011), GDACE (2006) and GDARD (2011)), it states that the edge of the wetland must be clearly demarcated and a 30m buffer zone is to be delineated as sensitive (30m for areas within the urban edge; 50m outside the urban edge). More specifically, the edge of the wetland must be clearly demarcated in the field that will last for the duration of the construction phase. The in-field labelling must be colour-coded as follows:

- RED – Indicating the edge of the wetland and no vehicles or building materials are allowed in this zone. These should be put along the entire length of the project area;
- ORANGE – Indicating the edge of the buffer zone (30 m within urban areas and 50 m outside urban areas). However, allowance must be made for sensitive species that require larger areas, e.g. Grass Owl, Giant Bullfrog, etc

With regards to pan wetlands, the buffer area should be designated as the local catchment area of the individual pan. The pans delineated win this project are already significantly impacted upon with the buffer area already containing agricultural field (in the case of wetland 10) or road infrastructure (in the case of wetland 3a and 3b).

8.3 Sensitivity

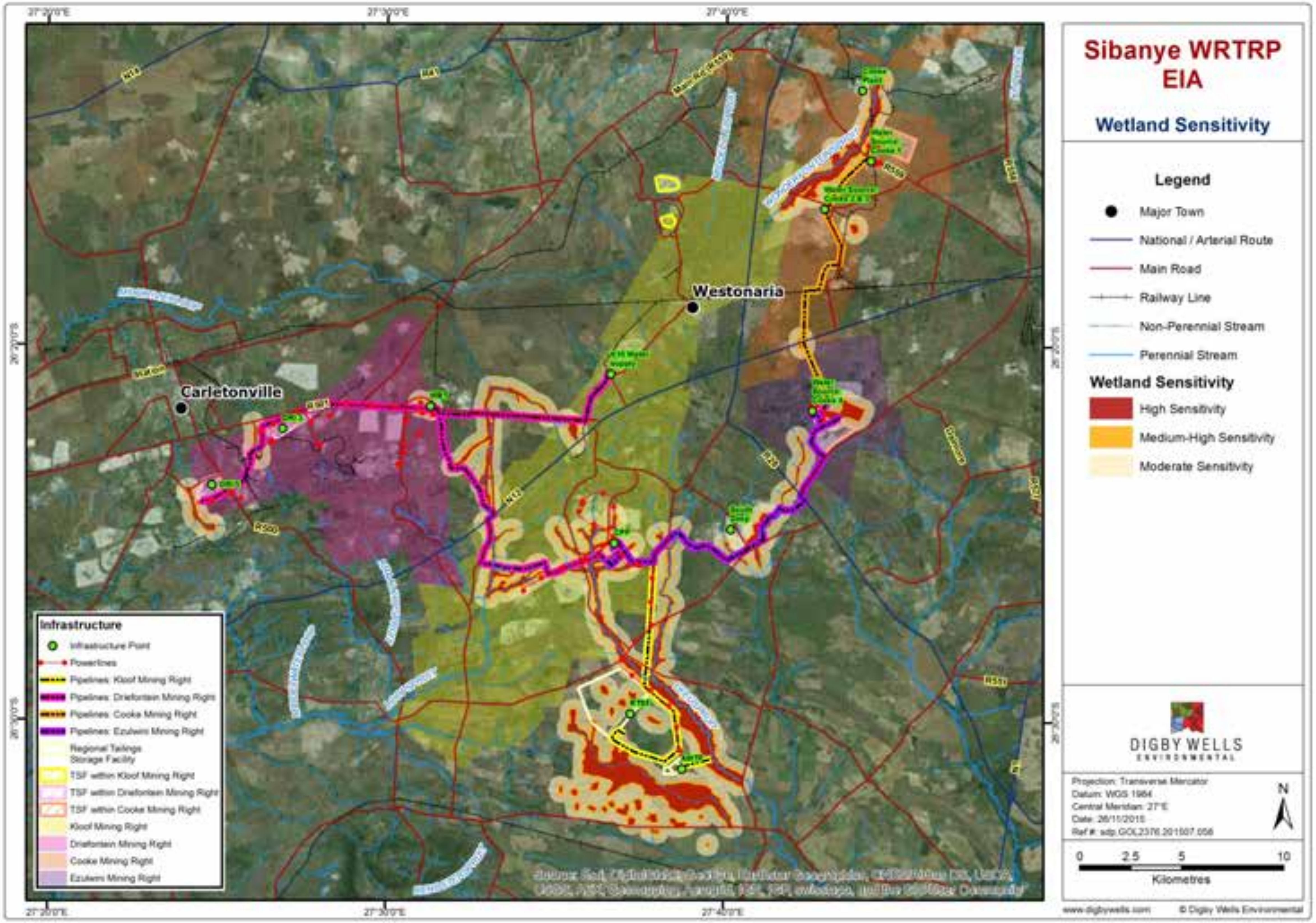
For the purpose of this project, all wetlands are assigned an ecological sensitivity of "**High**" as they are protected under the NWA and they provide numerous ecosystem services that are fundamental to the maintenance of biodiversity, ecosystems and for human use. South Africa is a water scarce country and as a consequence, it is critical that further deterioration of water resources is minimised or prevented.

In addition, a 100 m buffer area around the wetlands has been allocated a sensitivity of "**Moderately High**" as this buffer area is necessary from a water quality perspective in providing functional filtering capacity to the wetland from surrounding impacts (WRDM EMF, 2013). Furthermore and in support of (GN) 1199, a 500m buffer area around the wetlands has been assigned a sensitivity of '**Moderate'**. This is shown in Plan 19.

However, there are wetlands that are designated to be removed by the placement of infrastructure, namely the WBT, CPP and RTSF. The types of wetlands and areas affected are summarised in the table below. In addition, these are shown in Plan 20 to Plan 22 in the Impact Assessment section.

Table 8-1: Areas of wetland types impacted by infrastructure placement

Infrastructure	Wetland type	Total Wetland Area	Directly Affected Footprint	% Wetland affected
WBT	Pan	2.7 ha	1.0 ha	38.8 %
CPP	Valley Bottom without a channel	49.8 ha	10.7 ha	21.5 %
RTSF	Pan	38.5 ha	38.5 ha	100 %
	Valley Bottom without a channel	881.6 ha	4.4 ha	0.5 %



Plan 19: Wetland Sensitivity

9 Impact Assessment

SGL is proposing the development and operation of the new WRTRP; the details of the project and the activities involved therein are described in Section 1. This project interacts with wetlands, which, after detailed assessment, are described in Section 7. The project will therefore have impacts on the wetlands and these impacts are assessed based on the magnitude of the impact as well as the sensitivity of the receiving area, culminating in an impact significance that identifies the most important impacts that require management. The aim of the Impact Assessment is to, as far as possible, avoid irreversible damage or loss of ecosystems and services that they provide. In addition, where these impacts cannot be avoided, the impacts should be reduced and mitigated against (DEA, 2013). As a last resort, offsetting to compensate for loss of habitat is considered after all efforts have been made to avoid, reduce and mitigate.

The impacts associated with the proposed development are discussed separately according to which MRA they fall within and they are thereafter assessed according to the three main stages of the project. Technical information specifically relating to wetlands is summarised in Section 9.1 below; where after the sections following describe the findings of the wetland impact assessment.

9.1 Technical Wetland Information and Mitigation Measures

9.1.1 Pipeline crossings

The project has gone through multiple iterations of pipeline routes and infrastructure footprints, and many of these changes have been to minimise or remove interactions with wetlands. The applicant and technical teams already have significant mitigation measures in place in planning for the wetland impacts from the proposed pipelines. The Patterson and Cooke Report (Rev 0, 16 October 2015) details the pipeline specifications with regards to river and wetland crossings; where the safety factor with regards to the operating pressure is way above the minimum required factor. Furthermore in this report, the pipeline wetland and river crossings have been classified into the following three classes:

- Class 1: Passing within 100m of a Wetland;
- Class 2: Narrow River Crossing; and
- Class 3: Wide Wetland Crossing with River.

Mitigations measures proposed for these wetland and river classes include the following, where applicable to the abovementioned class (not an exhaustive list):

- Pipelines are to be supported on reclaimed railway sleepers placed at 9m intervals as it approaches the wetland;
- The pipeline will be unsupported across the 15m wetland/ river span and this will also contain a continuous HDPE liner;

- The pipeline will not contain any flanges for the full length of the wetland crossing;
- 50m before and after the wetland crossing, the pipeline will be supported on plinths (an in-situ cast concrete support) with foundations located at 9m intervals and also fitted with steel straps;
- The pipeline will be fitted with inspection points;
- All flanges within 100m of the wetland will be fitted with spray prevention plates; and
- The spillage paddock will be located outside on the wetland.

9.1.2 Water Sources

The WRTRP has recognised that water is a scarce and strategic commodity and hence mine impacted water will be used preferentially over Rand Water or other higher quality sources. Water will be supplied to the reclamation areas from the identified sources via water storage facilities. A number of water sources have been identified from which water will be abstracted and supplied to the surface reclamation operations, these include:

- 20 Mℓ/d from K10 Shaft (Kloof MRA; catchment C23D);
- 12 Mℓ/d from Cooke 1 Shaft (Cooke MRA; catchment C23D); and
- Cooke 4 South Shaft (Ezulwini MRA; catchment C22H).

Approximately 30 Mℓ/day is being discharged into the Wonderfonteinspruit from the K10 Shaft together with additional discharges of 15 Mℓ/d from Cooke 1 (refer to the Surface Water Report, Digby Wells, 2015f) thus total flows discharged to the Wonderfonteinspruit currently amounts to 45 Mℓ/day. The above listed water abstraction amounts of 20 and 15 therefore will decrease this by an estimated 32 Mℓ/day to only to 13 Mℓ/d being discharged into the Wonderfonteinspruit.

Once the impacted mine water has been used in the hydraulic reclamation process, it will be pumped with the slurry to the RTSF. As water builds up in the RTSF it will be drained to the RWD and treated at the AWTF. The water will then be treated to acceptable standards and this will be discharged into the Leeuspruit due east of the AWTF in the Kloof MRA. Approximately between 11 Mℓ/day and 18 Mℓ/day will be discharged into the river and this relates to an increase of an estimated 35% in the river flows (Surface Water Report, Digby Wells, 2015f).

The project therefore incorporates a proposed inter-basin transfer as water is being abstracted from quaternary catchments C23D and C22H, where after it is being discharged into catchment C22J. The direct and cumulative as well as the local and catchment scale impacts of the water abstraction and discharge are incorporated into this Wetland Report and are captured the Kloof MRA Operational phase, Section 0. It is also important to note that other aspects of this impact are discussed in the Surface Water and Aquatic Ecology reports.

9.1.3 Infrastructure Placement

In addition to the pipelines, the project proposes the construction of necessary infrastructure such as the WBT, CPP and RTSF. All of these interact with wetlands and as an overall project, the main impact to the wetlands will be the direct loss of 54.6 ha of wetland habitat due to this proposed infrastructure placement within wetlands. These areas are shown in Plan 20 to Plan 22. The wetlands have been avoided as far as possible but unfortunately for these impacts, offsetting will need to be considered as there is no mitigation for the loss of wetland habitat.

Further to this, the proposed RTSF has the potential to negatively impact the groundwater through seepage of undesired contaminants as discussed in detail in the Groundwater Report (Digby Wells, 2015d). A number of options have been considered to minimise the potential impact of the RTSF where a blast curtain design (or extended depth cut off perimeter drains) is the preferred option. The blast curtain operates on the principle of dewatering along the RTSF boundaries to intercept the contaminant plume. This will have a side effect as a cone of dewatering will be formed. This is shown in Figure 9.1 below. This creates sensitive areas defined in terms of the area that will be impacted by the cone of dewatering It is important to note that groundwater flow mimics the topography and moves towards surface water drainage courses as baseflow; generally from the northwest to southeast. The water level will be lowered by at least 10 m in an area of 23.7 km^2, see Plan 23. This is significant for the Leeuspruit and wetlands associated with the RTSF.

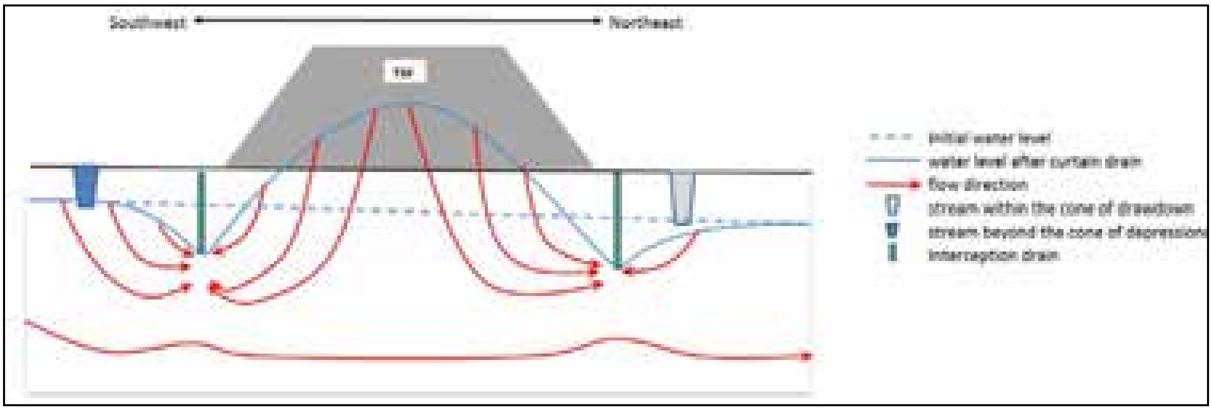
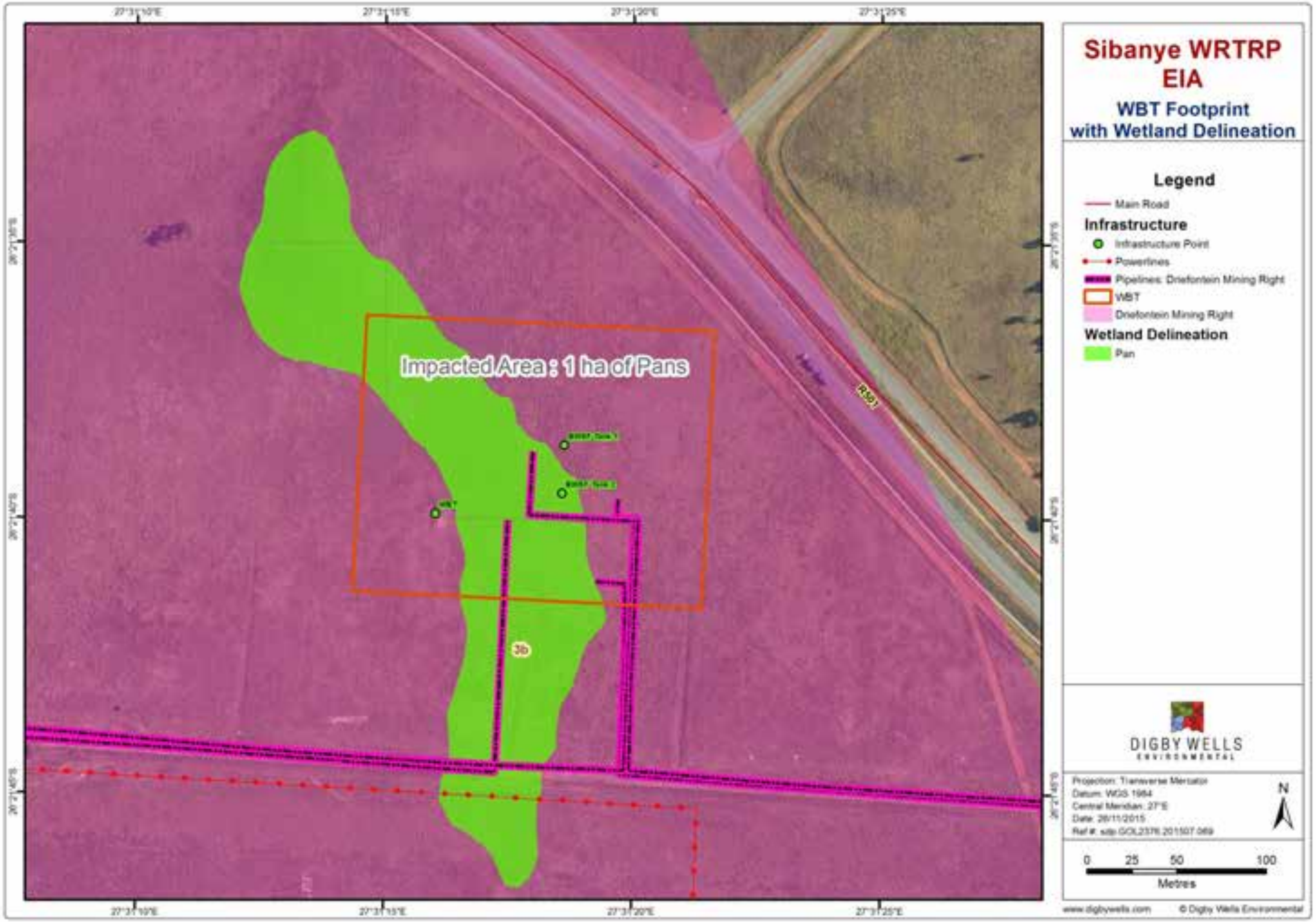
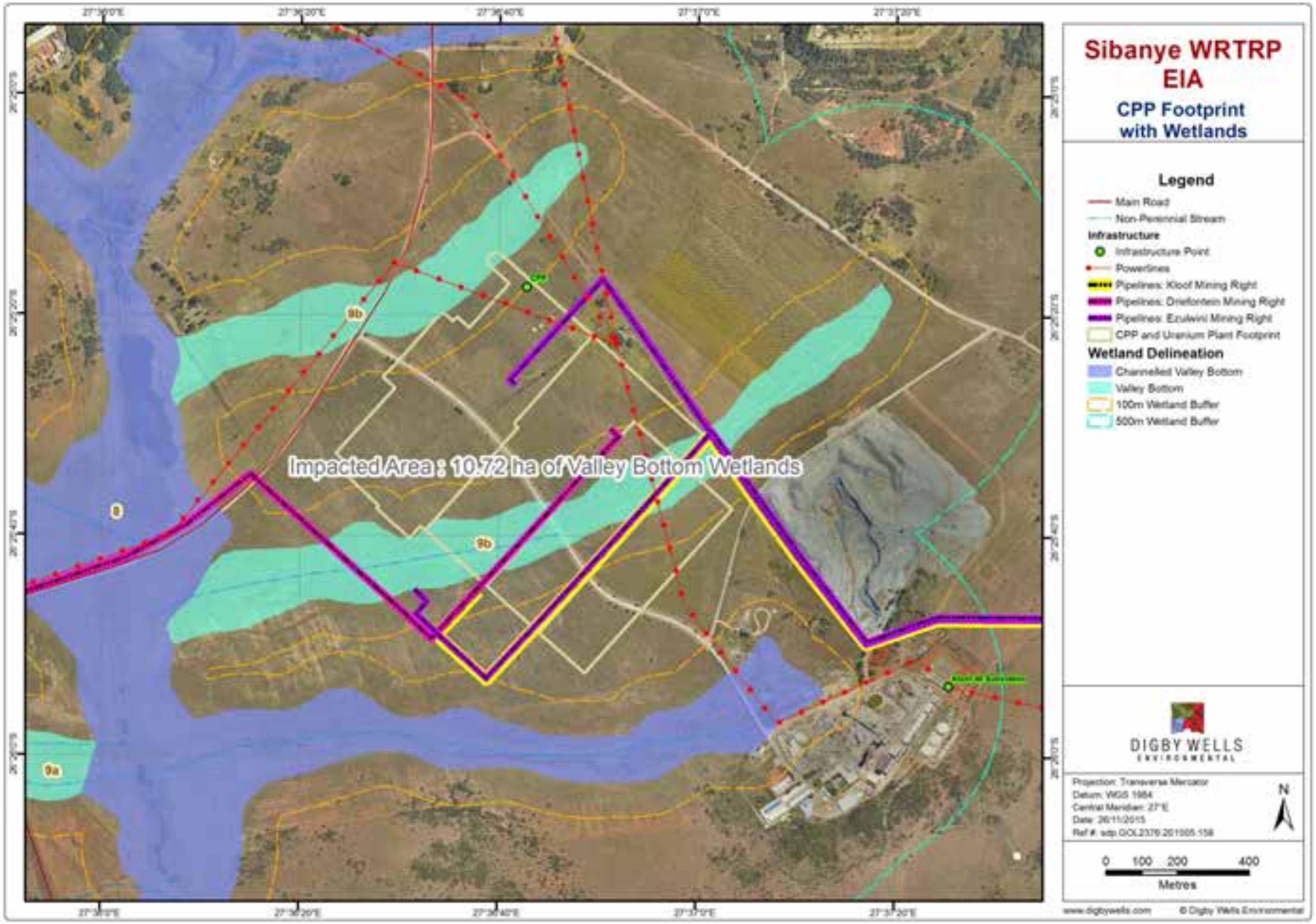


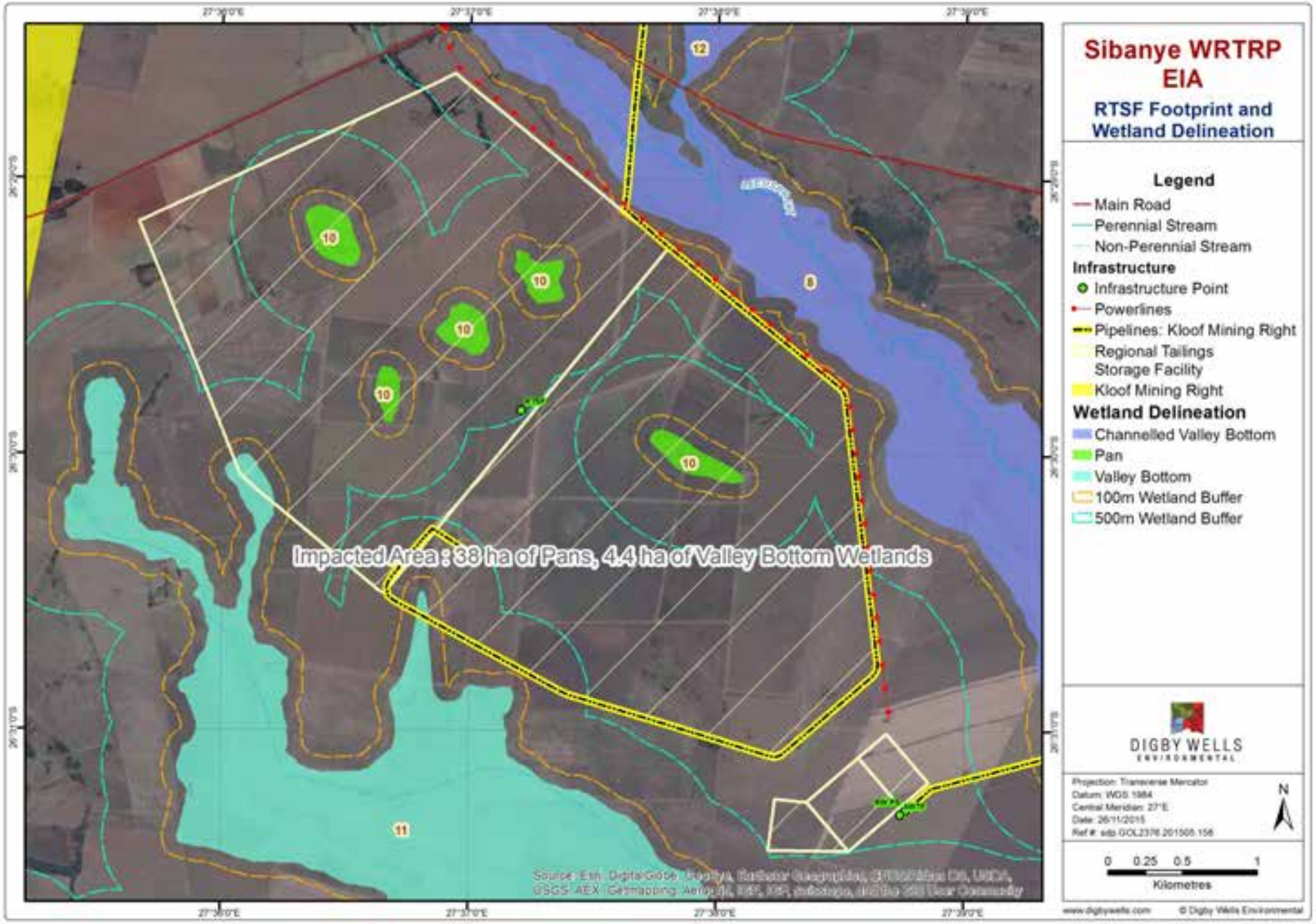
Figure 9.1: General conceptual design of the blast curtain



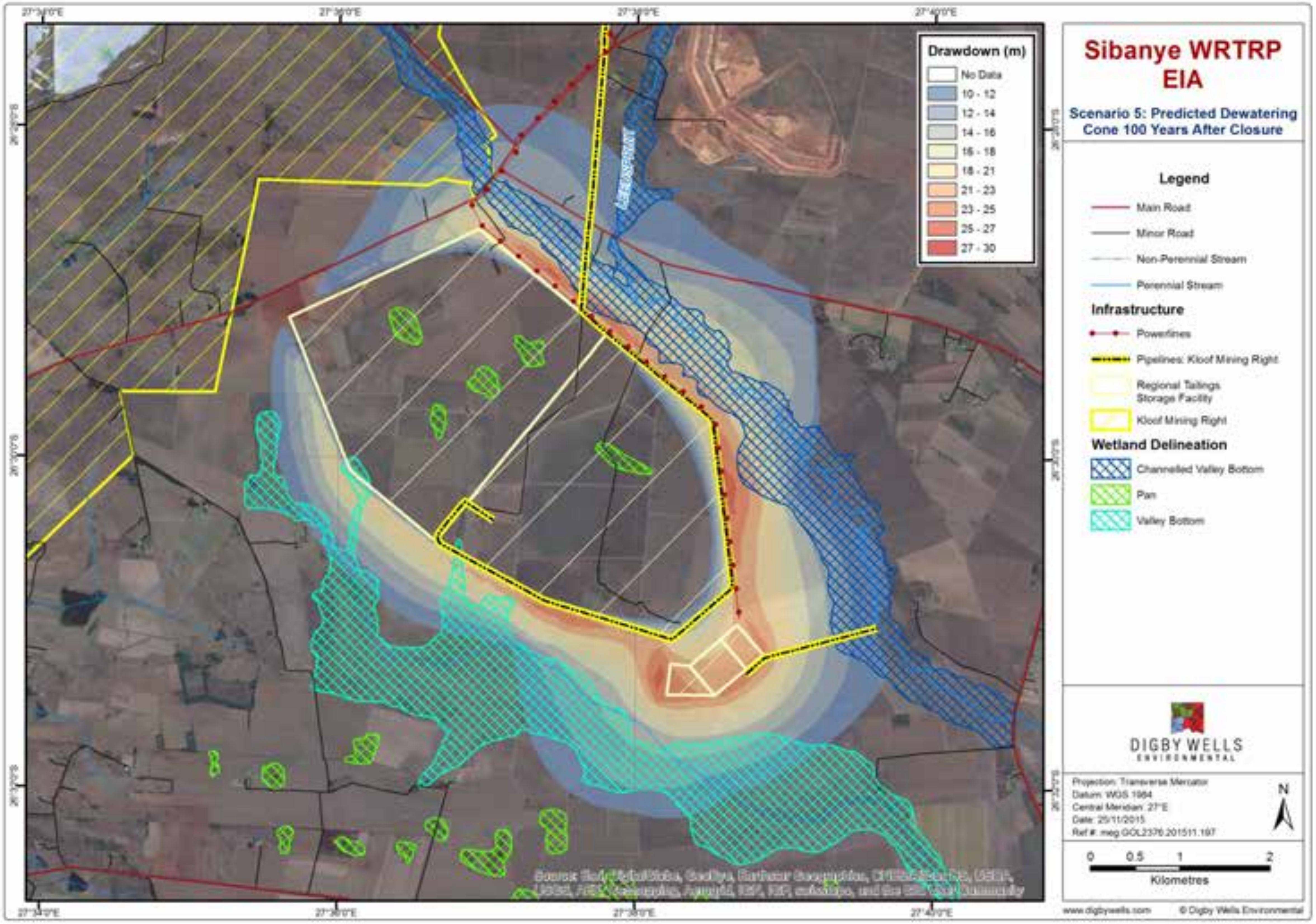
Plan 20: WBT Footprint and Wetland Delineation



Plan 21: CPP Footprint and Wetland Delineation



Plan 22: RTSF Footprint and Wetland Delineation



Plan 23: Predicted Cone of Dewatering interaction with Wetlands from the implementation of the Blast Curtain

9.2 Kloof Mining Right Area Impact Assessment

The Kloof MRA will include the construction of the new CPP, where tailings material will be centrally treated for gold and uranium extraction. The RTSF is also to be constructed under this MRA and the pipelines that are to run from the CPP to the RTSF are included herein. The blast curtain design is the preferred option to mitigate against groundwater contamination, which will create a cone of dewatering that will have significant impacts on the surface water resources, including the wetlands. These impacts are therefore captured herein. In addition, the abstraction of water from K10 and Cooke 1 shafts (catchment C23D) and the discharge of treated water into the Leeuspruit (catchment C22H) from the ATWF are captured within this MRA.

9.2.1 No-Go Option and Current Impacts

The wetlands within the Kloof MRA are significantly impacted due to the current alterations and threats to these sensitive systems and their catchments. As discussed in the Wetland Findings, Section 7, the surrounding land-uses are dominated by mining, agriculture and road infrastructure, which impacts significantly on the wetland habitat and functionality. These current impacts are rated below.

Table 9-1: Current Interactions and Impacts to the Wetlands in the Kloof MRA

Interaction	Impact
Presence of road infrastructure, agricultural farms, cattle, and historical and existing mining activities, including TSFs, underground and open pit mining.	Direct loss of wetland habitat
	Chemical contamination of water in wetlands from AMD and other pollution sources
	Alien plant infestation and erosion in wetlands and their catchments
	Altered hydrology

Table 9-2: Summary of wetland impact ratings for the current impacts in the Kloof MRA

Activity and Interaction: Current impacts to wetlands: presence of road infrastructure, agricultural farms, cattle, and historical and existing mining activities, including TSFs, underground and open pit mining			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Direct loss of wetland habitat.			
Duration	Permanent (7)	Wetland habitat is lost due to farming and mining in wetland	-112 “Major negative”
Extent	Local (3)	The loss of wetlands occurs locally.	

Intensity	Irreplaceable loss (6)	Loss of natural wetland habitat is an irreplaceable impact to highly sensitive environments.	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Pollution of wetlands			
Duration	Beyond 'Project' Life (6)	Pollution may be irreversible due to current pollution sources and the long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Pollution of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Alien plant infestation and erosion.			
Duration	Beyond 'Project' Life (6)	Invasion and erosion are long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Invasion and erosion of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Altered hydrology			
Duration	Permanent (7)	Hydrological impacts are permanent with long-lasting impact to sensitive systems	-119 "Major negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Irreplaceable loss (6)	Hydrological impacts to highly sensitive wetland systems significantly limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		

If the project does not go ahead, the impacts as rated above would be the status quo for the Kloof MRA wetlands and, in addition to this, there would not be the loss of 42.9 ha of wetlands due to the construction of the CPP and the RTSF. Although the wetlands are not in a pristine condition, this is still seen as a significant loss of wetland habitat. The pipelines within the Kloof MRA will not be installed and therefore added industrial infrastructure will not become additional threats to the wetland functionality.

9.2.2 Construction Phase

9.2.2.1 Impact Description

The construction of the CPP and RTSF will lead to the direct loss of 53.6 ha of wetland habitat, which is designated as a sensitive environment. This consists of 15.1 ha of VB wetland and 38.5 ha of Pan wetlands. These areas will be transformed and the RTSF will remain in perpetuity. The proposed RTSF has the potential to negatively impact the groundwater through seepage of undesired contaminants and therefore the blast curtain design is the preferred mitigation option. This will be constructed in this phase however the impact is not expected to be significant due to the short duration and early phase of the impacts.

The construction of the pipeline traverse directly over wetlands in two areas; one near the CPP and the other is where the pipeline crosses the Leeuspruit River en route to the RTSF site. Most of this route follows existing servitudes, being dirt and tarred roads. The pipeline will cross over an existing bridge over the Leeuspruit River as one option or the other option is at a farm road.

The major impacts anticipated due to the proposed interaction are listed in the table below.

Table 9-3: Interactions and Impacts of the WRTRP Kloof MRA construction phase

Interaction	Impact
Site clearing for infrastructure placement	Direct loss of 42.9 ha of wetland habitat.
	Alien plant infestation due to disturbance.
	Loss of ecosystem services.

9.2.2.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the construction of the WRTRP infrastructure in the Kloof MRA. These objectives are to prevent/minimise the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and

Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.2.2.3 Management Actions and Targets

During the construction of the WRTRP infrastructure in the Kloof MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- A Wetland Offset Strategy will need to be compiled for lost wetlands. See Section 12.2.1.
- The edge of the wetlands and at least a 30m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. A 100 m buffer is recommended. See Section 8.2.
- Minimise footprint area disturbed by construction activities.
- Rehabilitation Plan for disturbed wetland must be in place.

9.2.2.4 Impact rating

Table 9-4: Summary of wetland impact ratings for the Construction phase in the Kloof MRA

Activity and Interaction: Site clearing due to placement of the **RTSF** in and around wetlands			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Loss of 42.9 ha of wetland habitat.			
Prior to mitigation/ management			
Duration	Permanent (7)	Wetland habitat inside the footprint will be permanently impacted by the construction of the RTSF.	-119 “Major negative”
Extent	Municipal (4)	The wetland catchments within the	

		municipal boundaries will be impacted.	
Intensity	Irreplaceable loss (6)	Loss of wetlands is a serious impact to sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			
▪ There is no mitigation for the loss of 42.9 ha of wetland habitat in the RTSF footprint. An offset strategy should be compiled to compensate for the wetlands that are lost to the proposed project prior to any development on site. ▪ This includes 4.4ha of VB wetland being lost and 38.5ha of pans being lost.			
Post- mitigation			
Duration	Permanent (7)	There is no mitigation for the permanent loss of wetland habitat removed by the construction of the RTSF.	-119 "Major negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries will be impacted.	
Intensity	Irreplaceable loss (6)	Loss of wetlands is a serious impact to sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Activity and Interaction: Site clearing due to placement of **CPP** in and around wetlands			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Direct loss of 10.7 ha of wetland habitat (VB) and resultant indirect loss of the same wetland as disconnected from stream network.			
Prior to mitigation/ management			
Duration	Beyond Project Life (6)	Wetland habitat will be impacted by the construction of the CPP, even after the project has ceased.	-112 "Major negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries will be impacted.	
Intensity	Irreplaceable loss (6)	Loss of natural wetlands is a serious and irreplaceable impact to highly sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed	

		mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			
▪ The CPP is not a permanent constructed impact as it will be decommissioned and removed. It is imperative that the wetland be rehabilitated back to functional wetland. This wetland will, however, no longer be natural.			
Post- mitigation			
Duration	Project Life (5)	Rehabilitation of the wetland will allow the impact to be mitigated and decreased; however the wetland will not be natural.	-98 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries will be impacted; mitigation will not decrease this.	
Intensity	Serious loss (5)	Loss of natural wetlands is a serious impact to highly sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		

9.2.3 Operational Phase

9.2.3.1 Impact Description

9.2.3.1.1 CPP

This phase will include the operation of the CPP, which has resulted in the removal of wetland habitat and therefore will operate within and around wetlands. This has the potential to increase wind and water blown sediments and pollutants into these systems, which will have a negative impact on the wetland integrity.

9.2.3.1.2 RTSF and Blast Curtain

This phase will include the growth and operation of the RTSF and all associated infrastructure, which is of particular importance as it is adjacent to the Leeuspruit River and wetland systems. The footprint of this will result in some loss of water input from the catchment of the wetlands. The RTSF too has the potential to increase wind and water blown sediments and pollutants into these systems, which will have a negative impact on the wetland integrity. Finally and of greatest significance is the blast curtain that be in place, which will result in significant dewatering of the water resources.

9.2.3.1.3 Interbasin Transfer of Water Resources

This MRA and phase will also include the abstraction of water from the Wonderfonteinspruit (catchment C23D and C22H) and the discharge of water into the Leeuspruit (catchment C22J). Approximately 30 Mℓ/day is being discharged into the Wonderfonteinspruit from the K10 Shaft together with additional discharges of 15 Mℓ/d from Cooke 1 (refer to the Surface Water Report, Digby Wells, 2015f) thus total flows discharged to the Wonderfonteinspruit currently amounts to 45 Mℓ/day. The proposed water to be abstracted will decrease this by an estimated 32 Mℓ/day to only 13 Mℓ/d being discharged into the Wonderfonteinspruit. An approximated volume of between 11 Mℓ/day and 18 Mℓ/day will be discharged into the Leeuspruit River and this relates to an increase of an estimated 35% in the river flows (Surface Water Report, Digby Wells, 2015f).

In relation to the above Section 9.2.3.1.2 about the blast curtain impacts, the11 Mℓ/day to 18 Mℓ/day water will be discharged below the RTSF and cone of dewatering so that the water is not lost into the blast curtain. These two impacts will interact but will have different signatures in the different part of the Leeuspruit River and wetland. It is anticipated that the river and wetland stretch affected by the dewatering cone will become drier as the groundwater input into the system will be lost. This section will be purely rainwater fed. Downstream of the pipeline and water discharge, the wetland and river will be reinstated.

9.2.3.1.4 Pipelines

This phase will also include the operation of the pipes that traverse from between the CPP and RTSF. These will mainly be following existing servitudes and therefore will have a minimal impact. These pipelines will need to be maintained and will represent an industrial negative impact where they interact with wetlands.

9.2.3.1.5 Summary

The major impacts anticipated due to the proposed interaction are listed in the table below.

Table 9-5: Interactions and Impacts of the WRTRP Kloof MRA Operational Phase

Interaction	Impact
Operation of CPP and RTSF in and around wetlands.	This will include significantly increased general activity in the area. Wind and water spread sediments and pollutants have the potential to impact upon the surrounding wetlands, especially the Leeuspruit River.
Operation of the pipeline between the CPP and RTSF, including maintenance on the pipeline.	Minimal impact to wetlands as following existing servitudes; however operation will still be recognised as a current industrial negative impact to wetland integrity as this will interact with wetlands, mainly the Leeuspruit where it has to cross it.
Loss of water input from catchment to wetlands due to RTSF footprint	Water input from the catchment to the wetlands will be decreased due to the footprint being transformed and contained. This water however will be contained in the RWD with other water, treated and discharged to the Leeuspruit.

Interaction	Impact
Abstraction of water from K10 and Cooke 1 shafts resulting in the reduction of discharged water in the Wonderfonteinspruit.	Desiccation and potential loss of the wetland habitat may occur due to the volume of water being released into the system decreasing from 45 to 13 Mℓ/day. This will impact obligate wetland species and potentially wetland fauna.
Discharging of treated water into the Leeuspruit from the AWTF, increasing flows by 35%.	Wetland habitat downstream of this discharge in the Leeuspruit may have larger saturated or flooded areas. This is important as wetland habitat is affected by the level of saturation which in turn affects the wetland dependant flora and fauna as well as the terrestrial flora and fauna. The increased flow may also create erosion or exacerbate existing erosion.
Blast curtain with subsequent cone of dewatering	Loss of groundwater input to wetlands with subsequent loss of wetland habitat, affecting the aquatic and wetland flora and fauna, and compromising the functioning of the wetlands from a hydrological point of view.

9.2.3.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the operation of the WRTRP infrastructure in the Kloof MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.2.3.3 Management Actions and Targets

During the operation of the WRTRP infrastructure in the Kloof MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The Wetland Offset Strategy compiled for lost wetlands will need to be implemented and maintained. See Section 12.2.1.
- The edge of the wetlands and a 100m buffer must be managed as a no-go area. See Section 8.2.
- The wetlands in the general area of the WRTRP should be managed through a Land Management Plan to potentially increase their general functionality. See Section 12.2.4.
- Pipeline structures must be managed and maintained to ensure their safe functioning, especially over wetland crossings.
- The inter-basin transfers involving abstraction from the Wonderfonteinspruit and discharge into the Leeuspruit must be managed to the best of the applicant ability so as to reduce any secondary impacts.

9.2.3.4 Impact Rating

Table 9-6: Summary of Wetland Impact Ratings for the Operational Phase in the Kloof MRA

Activity and Interaction: Operation of the CPP and RTSF in and around wetlands. This will include significantly increased general activity in the area.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Sediment and pollution impacting wetland integrity around CPP and RTSF.			
Prior to mitigation/ management			
Duration	Project Life (5)	Impact will only occur during the operation of the CPP and RTSF.	-84 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries will be impacted.	
Intensity	Serious (5)	This represents serious damage to sensitive environments.	
Probability	Highly probable (6)	This is highly probable due to the nature of the activity.	
Nature	Negative		
Mitigation/ Management actions			

<table>
<tr><td colspan="4">

- Dust suppression for the farm roads will decrease the windblown sediments. Please refer to the Air Quality Report (Digby Wells, 2015a.
- Anti-erosion methods can assist in reducing dust. This can be achieved through a Land Management Plan.
- The CPP and RTSF footprints must be fully contained and have minimal contact with the surrounding environment, especially the Leeuspruit River and tributaries. This is of particular relevance to storm water control.

</td></tr>
<tr><td colspan="4">Post- mitigation</td></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>Mitigation will not decrease the duration of the operation of the CPP and RTSF.</td><td rowspan="5">-30
“Negligible negative”</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>The mitigation measures will allow the impacts to be kept to a local extent.</td></tr>
<tr><td>Intensity</td><td>Minor effects (2)</td><td>The wetlands will be subjected to minor impacts with mitigation measure employed.</td></tr>
<tr><td>Probability</td><td>Unlikely (3)</td><td>Mitigation will decrease the likelihood of impacts significantly.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Impact Description: Loss of water input to wetlands from RTSF footprint.</td></tr>
<tr><td colspan="4">Prior to mitigation/ management</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Impact will be permanent as RTSF is to remain in perpetuity.</td><td rowspan="5">-91
“Moderate negative”</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>The local wetlands will be impacted.</td></tr>
<tr><td>Intensity</td><td>Moderate loss (3)</td><td>This represents a moderate loss and impact to wetlands.</td></tr>
<tr><td>Probability</td><td>Certain (7)</td><td>The loss of the area from the RTSF footprint is definite according to project plan</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation/ Management actions</td></tr>
<tr><td colspan="4">

- This impact will be mitigated during the operational phase as 15Ml of treated potable water will be discharged into the Leeuspruit at the RTSF site.
- This impact will be permanent and no mitigation will be possible after decommissioning.

</td></tr>
<tr><td colspan="4">Post- mitigation</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Impact will still be permanent as RTSF is to remain in perpetuity.</td><td>-77
“Moderate</td></tr>
</table>

Extent	Limited (2)	A limited extent of wetlands will be impacted.	negative"
Intensity	Minor loss (2)	This represents a minor loss and impact to wetlands.	
Probability	Certain (7)	The loss of the area from the RTSF footprint is definite according to project plan	
Nature	Negative		
Activity and Interaction: Operation of the pipeline between the CPP and RTSF will interact with wetlands, mainly the Leeuspruit where it has to cross it. This phase will include maintenance on the pipeline.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: The pipeline will be running over the Leeuspruit and will add to the surrounding industrial activities. It will have a minimal impact as it is following the existing servitude of a road.			
Prior to mitigation/ management			
Duration	Project Life (5)	Impact will only occur during the operation of the pipeline.	-30 "Negligible negative"
Extent	Local (3)	The pipeline will only impact a local extent.	
Intensity	Minor effects (2)	The wetlands will be subjected to minor impacts as the pipeline is to cross over the wetlands along an existing road and bridge.	
Probability	Unlikely (3)	It is unlikely that the operation of the pipe will have significant impacts to the wetland.	
Nature	Negative		
Mitigation/ Management actions			
▪ The section of pipe crossing the wetland (mainly the Leeuspruit River), should be continuous, flangeless and fitted with HDPE sleeves and must be monitored and maintained in good running order. Monitoring and maintenance should occur in the dry-season for potential spillages.			
Post- mitigation			
Duration	Project Life (5)	Mitigation will not decrease the duration of the operation of the pipeline.	-18 "Negligible negative"
Extent	Limited (2)	The mitigation measures will allow any impacts to be limited to the site and its immediate surroundings.	
Intensity	Minor effects (2)	No change here.	

Probability	Improbable (2)	Mitigation measures will decrease the probability slightly.	
Nature	Negative		
Activity and Interaction: Abstraction of water from K10 and Cooke 1 shafts resulting in the reduction of discharged water in the Wonderfonteinspruit.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Desiccation and potential loss of the wetland habitat.			
Prior to mitigation/ management			
Duration	Beyond Project Life (6)	Impact will occur during the operation of the project but may remain for some time after.	-78 "Moderate negative"
Extent	Local (3)	Although the Wonderfonteinspruit is a major river eventually draining into the Vaal, the desiccation impact is likely to only be local.	
Intensity	Serious loss (4)	The loss of 32 Mℓ/day constitutes ~71% of the current volume of water being released into the wetland, which leads to a serious loss of wetland habitat and impacts wetland dependant flora and fauna.	
Probability	Highly probable (6)	The activity is definite; however the impact is highly probable.	
Nature	Negative		
Mitigation/ Management actions			
▪ There is no mitigation proposed for the local loss of wetland habitat as the water will not be able to be discharged back into the Wonderfonteinspruit as it will be discharged into the Leeuspruit. Note that both of these rivers drain into the Vaal.			
Post- mitigation			
Duration	Same as pre-mitigation.		-78 "Moderate negative"
Extent			
Intensity			
Probability			
Nature	Negative		
Activity and Interaction: Discharging of treated water into the Leeuspruit from the AWTF, increasing flows and volumes by ~35%.			
Dimension	**Rating**	**Motivation**	**Significance**

<table>
<tr><td colspan="4">Impact Description: Wetland habitat downstream affected by the change in hydrology with a potential increase in saturated area.</td></tr>
<tr><td colspan="4">Prior to mitigation/ management</td></tr>
<tr><td>Duration</td><td>Beyond Project Life (6)</td><td>Impact will occur during the operation of the project but may remain for some time after.</td><td rowspan="5">-72
“Minor negative”</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Although the Leeuspruit is a major river eventually draining into the Vaal, the impacts are likely to only be localised to the Leeuspruit itself.</td></tr>
<tr><td>Intensity</td><td>Moderate effect (3)</td><td>Wetland habitat impacted by the increase in flooding and saturation will be a moderate change to the sensitive wetland environment.</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td>The activity is definite; however the impact is highly probable.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation/ Management actions</td></tr>
<tr><td colspan="4">▪ There is no mitigation for this.</td></tr>
<tr><td colspan="4">Post- mitigation</td></tr>
<tr><td>Duration</td><td colspan="2" rowspan="4">Same as pre-mitigation.</td><td rowspan="5">-72
“Minor negative”</td></tr>
<tr><td>Extent</td></tr>
<tr><td>Intensity</td></tr>
<tr><td>Probability</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Impact Description: Wetland habitat downstream affected with a potential increase in erosion due to a 35% increase in river flows.</td></tr>
<tr><td colspan="4">Prior to mitigation/ management</td></tr>
<tr><td>Duration</td><td>Beyond Project Life (6)</td><td>Impact will occur during the operation of the project and will remain for some time after. Impact is manageable and reversible.</td><td rowspan="2">-96
“Moderate negative”</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>The impacts are likely to only be localised to the Leeuspruit itself as the further away from the discharge point the lesser the flow rate impact will be. Therefore this is not seen as a municipal impact.</td></tr>
</table>

Intensity	Irreplaceable damage to highly sensitive environment (7)	Erosion within wetland habitat will be a serious and irreplaceable impact to the sensitive wetland environment.	
Probability	Highly probable (6)	The activity is definite; however the impact is highly probable.	
Nature	Negative		
Mitigation/ Management actions			
▪ Energy dissipation designs will need to be created and installed at the discharge point. ▪ It is recommended that an inspection of the Leeuspruit be undertaken prior to the discharge of water and all erosion hotspots (if any) should be highlighted. This should occur for at least 3km downstream. If needed, rehabilitation interventions could be investigated for high erosion areas. ▪ Once discharge occurs, it is recommended that the areas previously identified are monitored to observe any further significant erosion. This should be done at least once a year and if significant erosion problems are identified, a rehabilitation and remediation strategy should be investigated and implemented.			
Post- mitigation			
Duration	Beyond Project Life (6)	Impact will still occur during the operation of the project and will remain for some time after. Impact is manageable and reversible.	-44 “Minor negative”
Extent	Local (3)	The impacts are still likely to only be localised to the Leeuspruit itself as the further away from the discharge point the lesser the flow rate impact will be.	
Intensity	Minor (2)	Erosion within wetland habitat will be a minor impact if prevented or rehabilitated.	
Probability	Probable (4)	The activity is definite; however the impact is only probable with mitigation.	
Nature	Negative		
Activity and Interaction: Presence of the Blast Curtain (a groundwater mitigation measure)			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dewatering of the water resources will have a negative impact on the wetland hydrological functioning.			
Prior to mitigation/ management			
Duration	Permanent (7)	Wetland habitat within the dewatering cone will be permanently impacted by the dewatering as this will occur in perpetuity.	-112 “Major

Extent	Local (3)	Despite the connectivity of water resources in a catchment, the impact to wetland is seen to be local; especially due to the water discharge downstream will mitigate downstream desiccation.	negative”
Intensity	Irreplaceable loss (6)	Loss of natural wetlands is a serious and irreplaceable impact to highly sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			
▪ There is no mitigation measure for this from a wetlands perspective as this action is itself an important mitigation measure to prevent pollution of the water resources from the RTSF.			
Post- mitigation			
Duration	Same as pre-mitigation.		-112 “Major negative”
Extent			
Intensity			
Probability			
Nature	Negative		

9.2.4 Decommissioning Phase

9.2.4.1 Impact Description

The impacts anticipated due to the proposed interaction are listed in the table below.

Table 9-7: Interactions and Impacts of the WRTRP Kloof MRA Decommissioning Phase

Interaction	Impact
Decommissioning of the CPP infrastructure.	This may result in negative impacts to the wetland area remaining due to increased traffic to the site and water quality impacts may also occur. The impact has already been quantified in the Construction Phase; however decommissioning without mitigation may lead to additional impacts due to heavy machinery being used.

Interaction	Impact
Decommissioning of the pipeline from the CPP to the RTSF	This will have a negative impact on the identified wetlands due to activity has direct contact with wetlands.
Decommissioning and rehabilitation of the RTSF; this is to remain in perpetuity	Significant and permanent impact to the catchment of the wetlands.
	Limited yet present pollution source to remain in perpetuity.
Permanent blast curtain with subsequent cone of dewatering.	Permanent loss of groundwater input to wetlands with loss of wetland habitat.

9.2.4.2 Management Objectives

Management objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.2.4.3 Management Actions and Targets

Decommissioning of the WRTRP infrastructure in the Kloof MRA will be a significant rehabilitation activity. General mitigation and management actions provided in the other studies done by Digby Wells as part of this project should still be used to guide the effective management of wetland ecological resources, most particularly the Rehabilitation Report (Digby Wells, 2015e). However, it is recommended that this be updated regularly, especially immmediately prior to the decommissioning phase.

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The wetlands offset as part of the Wetland Offset Strategy compiled for lost wetlands will need to be monitored and proven sustainable.
- Rehabilitation of the footprints must be done according to the Rehabilitation Plan (Digby Wells, 2015e). See Section 12.2.2.
- The edge of the wetlands and a 100m buffer must be managed as a no-go area. See Section 8.2.
- The wetlands in the general area of the WRTRP should be managed through a Land Management Plan to potentially increase their general functionality. See Section 12.2.4.
- Pipelines must be flushed clean and rendered safe for decommissioning and removal.

- Decommissioning and rehabilitation should be done in the dry season where possible.

9.2.4.4 Impact rating

Table 9-8: Summary of wetland impact ratings for the Decommissioning phase in the Kloof MRA

Activity and Interaction: Decommissioning of the CPP infrastructure.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: This may result in negative impacts to the wetland area remaining due to increased traffic to the site and water quality impacts may also occur.			
Prior to mitigation/ management			
Duration	Medium term (3)	Impact will only occur during the short lived decommissioning phase.	-66 "Minor negative"
Extent	Local (3)	The local wetland could be impacted.	
Intensity	Serious (5)	This represents serious damage to sensitive environments.	
Probability	Highly probable (6)	This is highly probable due to the nature of the activity.	
Nature	Negative		
Mitigation/ Management actions			
▪ Storm water management must be put in place to prevent run-off of any pollutants. ▪ The footprint should be fully rehabilitated according to the rehabilitation plan; where the wetland should be reinstated. ▪ Decommissioning and rehabilitation will be done in the dry season (April to October).			
Post- mitigation			
Duration	Short Term (2)	Mitigation may decrease the potential impact	-18 "Negligible negative"
Extent	Limited (2)	The mitigation measures will allow the impacts to be kept to a limited extent.	
Intensity	Minor effects (2)	With mitigation measure employed, the wetlands will be subjected further to minor impacts.	
Probability	Unlikely (3)	Mitigation will decrease the likelihood of negative impacts.	
Nature	Negative		
Activity and Interaction: Decommissioning of the pipeline from the CPP to the RTSF			

Dimension	Rating	Motivation	Significance
Impact Description: This will have a negative impact on the identified wetlands due to activity has direct contact with wetlands.			
Prior to mitigation/ management			
Duration	Short term (2)	Impact will only occur during the short lived decommissioning phase.	-60 "Minor negative"
Extent	Local (3)	The local wetland could be impacted.	
Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Highly probable (6)	This is highly probable due to the nature of the activity.	
Nature	Negative		
Mitigation/ Management actions			
▪ Pipelines must be flushed clean and rendered safe for decommissioning and removal. ▪ Rehabilitation of the footprints must be done according to the Rehabilitation Plan (Digby Wells, 2015e) ▪ Decommissioning and rehabilitation should be done in the dry season.			
Post- mitigation			
Duration	Short Term (2)	Mitigation may decrease the potential impact	-18 "Negligible negative"
Extent	Limited (2)	The mitigation measures will allow the impacts to be kept to a limited extent.	
Intensity	Minor effects (2)	The wetlands will be subjected to minor impacts with mitigation measure employed.	
Probability	Unlikely (3)	Mitigation will decrease the likelihood of impacts significantly.	
Nature	Negative		
Activity and Interaction: Decommissioning and rehabilitation of the RTSF; this is to remain in perpetuity.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: This will represent a permanent threat to the surrounding wetlands and water resources as the RTSF is a source of pollution.			
Prior to mitigation/ management			

Duration	Permanent (7)	This will have long-lasting permanent negative impacts on the wetlands beyond the project life as this is to remain in perpetuity.	-68 "Minor negative"
Extent	Regional (5)	Water quality impacts are a highly significant impact to the greater catchment if it is not contained. The Leeuspruit River is an important river and wetland and flows to the Vaal, making this a potential Regional impact.	
Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Probable (4)	The wetlands will certainly be impacted if the RTSF is not designed and decommissioned responsibly as this represents a significant pollution source.	
Nature	Negative		
Mitigation/ Management actions			
▪ The design of the RTSF must take into consideration the long-term impacts that it represents. The groundwater and surface water impacts are to be managed accordingly. Refer to the relative reports for more detail, particularly the Rehabilitation Plan (Digby Wells, 2015e) ▪ Rehabilitation of the RTSF according to the rehabilitation plan will aim to manage this as pollution source. Vegetation must be established as soon as possible and monitored. Rehabilitation must occur concurrent to operation as much as possible.			
Post- mitigation			
Duration	Permanent (7)	Mitigation will not decrease the permanence of the RTSF.	-45 "Minor negative"
Extent	Local (3)	Sound mitigation measures can decrease the impact to extend only as far as the local development area.	
Intensity	Serious (5)	This still represents serious damage to highly sensitive environments.	
Probability	Unlikely (3)	The RTSF will unlikely impact on the surrounding wetlands with all mitigation measures employed.	
Nature	Negative		
Activity and Interaction: Permanent presence of the Blast Curtain (a groundwater mitigation measure)			
Dimension	**Rating**	**Motivation**	**Significance**

<table>
<tr><td colspan="4">Impact Description: Dewatering of the water resources will continue to have a negative impact on the wetland hydrological functioning.</td></tr>
<tr><td colspan="4">Prior to mitigation/ management</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Wetland habitat within the dewatering cone will be permanently impacted by the dewatering as this will occur in perpetuity.</td><td rowspan="5">-112
“Major negative”</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Despite the connectivity of water resources in a catchment, the impact to wetland is seen to be local; especially due to the water discharge downstream will mitigate downstream desiccation.</td></tr>
<tr><td>Intensity</td><td>Irreplaceable loss (6)</td><td>Loss of natural wetlands is a serious and irreplaceable impact to highly sensitive environments.</td></tr>
<tr><td>Probability</td><td>Definite (7)</td><td>This will occur according to the proposed mine plan and infrastructure layout.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation/ Management actions</td></tr>
<tr><td colspan="4">▪ There is no mitigation measure for this from a wetlands perspective as this action is itself an important mitigation measure to prevent pollution of the water resources from the RTSF.</td></tr>
<tr><td colspan="4">Post- mitigation</td></tr>
<tr><td>Duration</td><td colspan="2" rowspan="4">Same as pre-mitigation.</td><td rowspan="5">-112
“Major negative”</td></tr>
<tr><td>Extent</td></tr>
<tr><td>Intensity</td></tr>
<tr><td>Probability</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
</table>

9.3 Driefontein Mining Right Area Impact Assessment

The Driefontein MRA will include the mining of the Driefontein 3 and 5 TSFs via hydraulic reclamation. This is a contained process and should not have any impact on the surrounding wetlands; an impact will only be realised if an unplanned event occurs. The construction and operation of the WBT and the BWSF will also be within the Driefontein MRA as well as the series of pipelines containing slurry from Driefontein 3 and 5 TSFs to the WBT, water from the K10 water supply to the BWSF and the Driefontein 3 and 5 TSFs for the hydraulic reclamation process, as well as the pipeline from the WBT to the CPP.

9.3.1 No-Go Option and Current Impacts

The wetlands within the Driefontein MRA are significantly impacted due to the current alterations and threats to these sensitive systems and their catchments. As discussed in the Wetland Findings, Section 7, the surrounding land-uses are dominated by mining, agriculture and road infrastructure, which impacts significantly on the wetland habitat and functionality. These current impacts are rated below.

Table 9-9: Current Interactions and Impacts to the Wetlands in the Driefontein MRA

Interaction	Impact
Presence of road infrastructure, agricultural farms, cattle, and historical and existing mining activities, including TSFs, underground mining, open pit mining and subsidence.	Direct loss of wetland habitat.
	Chemical contamination of water in wetlands from AMD and other pollution sources.
	Alien plant infestation and erosion in wetlands and their catchments.
	Altered hydrology.

Table 9-10: Summary of Wetland Impact Ratings for the Current Impacts in the Driefontein MRA

Activity and Interaction: Current impacts to wetlands: presence of road infrastructure, agricultural farms, cattle, and historical and existing mining activities, including TSFs, underground mining, open pit mining and subsidence.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Direct loss of wetland habitat.			
Duration	Permanent (7)	Wetland habitat is lost due to farming and mining in wetland and land under historic TSFs	-112 "Major negative"
Extent	Local (3)	The loss of wetlands occurs locally.	
Intensity	Irreplaceable loss (6)	Loss of natural wetland habitat is a irreplaceable impact to highly sensitive environments.	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Pollution of wetlands			
Duration	Beyond 'Project' Life (6)	Pollution may be irreversible due to current pollution sources and the long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Pollution of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Alien plant infestation and erosion.			
Duration	Beyond 'Project' Life (6)	Invasion and erosion are long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Invasion and erosion of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		

<table>
<tr><th colspan="4">Impact Description: Altered hydrology</th></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Hydrological impacts are permanent with long-lasting impact to sensitive systems</td><td rowspan="5">-119
“Major negative”</td></tr>
<tr><td>Extent</td><td>Municipal (4)</td><td>The wetland catchments within the municipal boundaries are impacted.</td></tr>
<tr><td>Intensity</td><td>Irreplaceable loss (6)</td><td>Hydrological impacts to highly sensitive wetland systems significantly limits ecosystem functioning</td></tr>
<tr><td>Probability</td><td>Definite (7)</td><td>This is a current impact</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
</table>

If the project does not go ahead, the impacts as rated above would be the status quo for the Driefontein MRA wetlands. In addition to this, there would not be the loss of 1.0 ha of a pan wetland due to the construction of the WBT. Although the wetlands are not in a pristine condition, this is still seen as a significant loss of wetland habitat. The pipelines within the Driefontein MRA will not be installed and therefore added industrial infrastructure will not become additional threats to the wetland functionality.

However, if the no-go option is realised, the Driefontein 5 TSF and the Driefontein 3 TSF will not be reclaimed, will stay in situ and remain a significant pollution source (specifically AMD) to the wetlands as will the rest of the TSFs in the Driefontein MRA.

9.3.2 Construction Phase

9.3.2.1 Impact Description

The construction of the WBT and the BWSF is currently over a pan wetland and will result in the direct loss of 1.0 ha of this wetland habitat, which is 2.7 ha in full extent. It is recommended that these are moved outside of the pan and associated 100m buffer. This wetland is significantly impacted on already (PES of D) and it is preferable if it is not further impacted; however options are limited for the WBT due to the underlying dolomites. If this location is used then offset will need to be calculated.

In addition, pipelines will be constructed from D3 and D5 to the WBT and a water pipeline will be constructed from the K10 shaft water supply to the BWSF. The water pipeline will thereafter continue on to the D3 and D5 TSF’s for the hydraulic reclamation process. These pipelines are following existing roads for the majority of the route, which will decrease the potential impact. The pipeline containing tailings slurry has the potential to impact the wetlands if an unplanned spill occurs.

From the WBT, there is a pipeline route to the CPP that will follow existing roads for the majority of the route and cross over multiple wetlands. This will have a direct impact on wetlands, but the greatest risk of impact is from unplanned spills.

The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-11: Interactions and Impacts of the WRTRP Driefontein MRA construction phase

Interaction	Impact
Site clearing for infrastructure placement (WBT and BWSF)	Direct loss of 1.0 ha of wetland habitat, of a 2.7 ha pan.
	Loss of ecosystem services
Activity around and in the wetlands with heavy machinery for the construction of the pipelines from the TSF's to and from the WBT and the BWSF, as well as the pipeline from K10.	Potential pollution and resultant negative impacts on wetlands with the building of the pipelines over wetlands.

9.3.2.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the construction of the WRTRP infrastructure in the Driefontein MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.3.2.3 Management Actions and Targets

During the construction of the WRTRP infrastructure in the Driefontein MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and at least a 30m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. A 100 m buffer is recommended. See Section 8.2.
- Minimise footprint area disturbed by construction activities.
- Rehabilitation Plan for disturbed wetland must be in place.

9.3.2.4 Impact Rating

Table 9-12: Summary of Wetland Impact Ratings for the initial Construction Phase in the Driefontein MRA

Activity and Interaction: Vegetation clearing due to infrastructure placement in and around wetlands: WBT and BWSF			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Loss of wetland habitat			
Prior to mitigation/ management			
Duration	Beyond Project Life (6)	Wetland habitat will be impacted by the construction of the WBT and BWSF according to the current placement even after the project has ceased	-112 "Major negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries will be impacted.	
Intensity	Irreplaceable loss (6)	Loss of wetlands is a serious impact to sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			
▪ The WBT and BWSF are not permanent constructed impacts as it will be decommissioned and removed. It is imperative that the wetland be rehabilitated back to functional wetland. This wetland will, however, no longer be natural. ▪ An offset strategy may be compiled to compensate for the current wetlands that are damaged due to the proposed project prior to any development on site. ▪ However it is recommended that an alternative location outside of the wetland is used as the location of this infrastructure – this is however limited due to underlying dolomitic structures making founding conditions onerous. If this is carried through as a mitigation measure, the impact can be lessened significantly as no wetland habitat will need to be lost.			

Post-mitigation			
Duration	Project Life (5)	Rehabilitation of the wetland will allow the impact to be mitigated and decreased; however the wetland will not be natural.	-98 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries will be impacted; mitigation will not decrease this.	
Intensity	Serious loss (5)	Loss of natural wetlands is a serious impact to highly sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Activity and Interaction: Activity around and in the wetlands with heavy machinery for the construction of the pipelines from the TSF's to and from the WBT and the BWSF, as well as the pipeline from K10.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Potential pollution and resultant negative impacts on wetlands with the building of the pipelines over wetlands.			
Prior to mitigation/ management			
Duration	Medium term (3)	The construction activities involving heavy machinery will be active in and around the wetlands. The construction will be short-term but the impacts can have a medium term impact.	-55 "Minor negative"
Extent	Local (3)	Local wetlands will be impacted	
Intensity	Serious long term (5)	Water quality deterioration is a serious impact to sensitive environments.	
Probability	Likely (5)	Pollution from the proposed activities is likely to occur as the pipeline is crossing wetlands, however the pipe is following existing servitudes and therefore probability is not certain.	
Nature	Negative		
Mitigation/ Management actions			
▪ Responsible construction to protect the surrounding environment will mitigate this impact. This should include aspects such as vehicles must be in good working order; construction should occur in the dry-season; and particular care must be taken when constructing the wetland crossings ▪ In addition, the sections of pipe crossing wetlands should have no joints and must be fitted with HDPE sleeves. See Section 9.1.			

Post- mitigation			
Duration	Short term (2)	The construction will be short term and if mitigated so will the impacts be short term.	-32 "Negligible negative"
Extent	Limited (2)	The mitigation measures will allow the impacts to be kept to a limited impacted extent.	
Intensity	Serious medium term (4)	Water quality deterioration is a serious impact to sensitive environments but can be lessened with mitigation measures.	
Probability	Probable (4)	Mitigation measures will decrease the probability; however given the high impact of the proposed project the impact is probably still likely to occur.	
Nature	Negative		
Activity and Interaction: Activity around and in the wetlands with heavy machinery for the construction of the pipeline from the WBT to the CPP.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Potential resultant negative impacts on wetlands with the construction of the pipelines over wetlands. This option has many interactions with wetlands.			
Prior to mitigation/ management			
Duration	Medium term (3)	The construction will be short term but the impacts can have a medium term impact.	-55 "Minor negative"
Extent	Local (3)	Local wetlands will be impacted as existing servitudes are mainly to be used.	
Intensity	Serious long term (5)	Water quality deterioration through erosion and sedimentation is a serious impact to sensitive environments.	
Probability	Likely (5)	The proposed activity is likely to have an impact if no mitigation is taken.	
Nature	Negative		
Mitigation/ Management actions			
▪ Responsible construction to protect the surrounding environment will mitigate this impact. This should include aspects such as vehicles must be in good working order; construction should occur in the dry-season where possible; and particular care must be taken when constructing the wetland crossings ▪ In addition, the sections of pipe crossing wetlands should have no joints and must be fitted with HDPE sleeves. See Section 9.1.			
Post- mitigation			
Duration	Short term (2)	The construction will be short term and if mitigated so will the impacts be short term.	-32 "Negligible

Extent	Limited (2)	The mitigation measures will allow the impacts to be kept to a limited impacted extent.	negative”
Intensity	Serious medium term (4)	Water quality deterioration is a serious impact to sensitive environments but can be lessened with mitigation measures.	
Probability	Probable (4)	Mitigation measures will decrease the probability; however given the high impact of the proposed project the impact is probably still likely to occur.	
Nature	Negative		

9.3.3 Operational Phase

9.3.3.1 Impact Description

This phase constitutes the operation of the WBT and the BWSF within the Driefontein MRA as well as the series of pipelines containing slurry and water. In addition, this phase will include the reclamation of the Driefontein 5 and 3 TSFs. This will result in an increase in the industrial activities occurring around wetlands, which impacts on wetlands due to wind and water transported pollutants and sediments. This impact is of minor significance, but still represents an impact. The reclamation activities will not have an impact on the wetlands as this activity is to be fully contained and occur outside the wetlands.

The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-13: Interactions and Impacts of the WRTRP Driefontein MRA operational phase

Interaction	Impact
Operation of the mining site, the WBT and BWSF, the tailings pipelines from the TSF’s to the WBT, the pipelines from the BWSF to the TSF’s, the pipeline from K10 as well as the chosen pipeline from the WBT to the CPP.	This will have some impact on the identified wetlands due to increased activity in the area, where wind and water spread sediments and pollutants have the potential to impact upon these wetlands.

9.3.3.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the operation of the WRTRP infrastructure in the Driefontein MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.3.3.3 Management Actions and Targets

During the operation of the WRTRP infrastructure in the Driefontein MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and a 100m buffer must be managed as a no-go area. See Section 8.2.
- The wetlands in the general area of the WRTRP should be managed through a Land Management Plan to potentially increase their general functionality. See Section 12.2.4.
- Pipeline structures must be managed and maintained to ensure their safe functioning, especially over wetland crossings. See Section 9.1.

9.3.3.4 Impact rating

Table 9-14: Summary of wetland impact ratings for the Operational phase in the Driefontein MRA

Activity and Interaction: Operation of the WBT and BWSF (current placement), the tailings pipelines from the TSF's to the WBT, the pipelines from the BWSF to the TSF's, the pipeline from K10 as well as the pipeline from the WBT to the CPP.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: This will have some impact on the identified wetlands due to increased activity in the area, where wind and water spread sediments and pollutants have the potential to impact upon these wetlands.			
Prior to mitigation/ management			
Duration	Project Life (5)	Impact will only occur during the operational phase.	-84 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries could be impacted.	

Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Highly probable (6)	This is highly probable due to the nature of the activity.	
Nature	Negative		
Mitigation/ Management actions			

▪ Monitoring of the pipelines and continuous maintenance, especially over wetlands to include:
  ▪ Alien and Invasive flora management along the project area according to the Fauna and Flora Report (Digby Wells, 2015c)
  ▪ Erosion control and continuous rehabilitation as per the Rehabilitation Plan (Digby Wells, 2015e).
▪ Dust suppression on any haul roads will decrease the windblown sediments.
▪ The mining site, WBT and BWSF footprints must be fully contained and have no contact with the surrounding environment. A storm water management plan must be in place.			

Post- mitigation			
Duration	Project Life (-5)	Mitigation will not decrease the duration of the operation.	
Extent	Local (-3)	The mitigation measures will allow the impacts to be kept to a local extent.	-30 “Negligible negative”
Intensity	Minor effects (-2)	The wetlands will be subjected to minor impacts with mitigation measure employed.	
Probability	Unlikely (-3)	Mitigation will decrease the likelihood of impacts significantly.	
Nature	Negative		

9.3.4 Decommissioning Phase

9.3.4.1 Impact Description

The decommissioning phase will involve the removal of the WBT and BWSF infrastructure and rehabilitation of their impacted footprints. Some of the pipelines will be left in situ for use on other dam reclamations. This will also involve the rehabilitation of the reclaimed TSF footprints.

The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-15: Interactions and Impacts of the WRTRP Driefontein MRA decommissioning phase

Interaction	Impact
Rehabilitation of the infrastructure: including the WBT and BWSF footprints, as well as the series of pipelines	This will have some impact to the identified wetlands habitat and functionality due to activity has direct contact with wetlands
Decommissioning of the reclaimed Driefontein 3 and 5 TSF footprints.	With rehabilitation of the footprints, this will have a positive impact to surrounding wetlands as a significant negative impact is being removed and rehabilitated.

9.3.4.2 Management Objectives

Management objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.3.4.3 Management Actions and Targets

Decommissioning of the WRTRP infrastructure in the Driefontein MRA will be predominantly a rehabilitation activity. General mitigation and management actions provided in the other studies done by Digby Wells as part of this project should still be used to guide the effective management of wetland ecological resources, most particularly the Rehabilitation Report (Digby Wells, 2015e). However, it is recommended that this be updated regularly, especially immmediately prior to the decommissioning phase.

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- Rehabilitation of the footprints must be done according to the Rehabilitation Plan (Digby Wells, 2015e). See Section 12.2.2.
- The edge of the wetlands and a 100m buffer must be managed as a no-go area. See Section 8.2.
- The wetlands in the general area of the WRTRP should be managed through a Land Management Plan to potentially increase their general functionality. See Section 12.2.4.
- Pipelines must be flushed clean and rendered safe for decommissioning.
- Decommissioning and rehabilitation should be done in the dry season where possible.

9.3.4.4 Impact Rating

Table 9-16: Summary of wetland impact ratings for the Decommissioning phase in the Driefontein MRA

Activity and Interaction: Rehabilitation of the infrastructure: including the WBT and BWSF footprints, as well as the series of pipelines.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Wetland habitat and functionality potentially impacted upon.			
Prior to mitigation/ management			
Duration	Medium term (3)	Impact will only occur during the short lived decommissioning phase.	-66 "Minor negative"
Extent	Local (3)	The local wetland could be impacted.	
Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Highly probable (6)	This is highly probable due to the nature of the activity.	
Nature	Negative		
Mitigation/ Management actions			
▪ Pipelines must be flushed clean and rendered safe for decommissioning as they will be left in situ indefinitely. ▪ The WBT and BWSF footprints should be fully rehabilitated according to the Rehabilitation Plan (Digby Wells, 2015e). ▪ Rehabilitation of the impacted pan must be conducted. ▪ Decommissioning and rehabilitation should be done in the dry season.			
Post- mitigation			
Duration	Short Term (2)	Mitigation may decrease the potential impact	-18 "Negligible negative"
Extent	Limited (2)	The mitigation measures will allow the impacts to be kept to a limited extent.	
Intensity	Minor effects (2)	The wetlands will be subjected to minor impacts with mitigation measure employed.	
Probability	Unlikely (3)	Mitigation will decrease the likelihood of impacts significantly.	
Nature	Negative		

Activity and Interaction: Decommissioning of the reclaimed Driefontein 3 and 5 TSF footprints.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: This will have a positive impact on the identified wetlands if rehabilitation occurs as this is removing a current highly significant negative impact to the wetlands. If rehabilitation of the footprint is not done, a negative impact will persist.			
Prior to mitigation/ management			
Duration	Beyond project Life (6)	Impact will have long-lasting negative impacts on the wetlands beyond the project life.	-105 “Moderate negative”
Extent	Municipal (4)	The wetland catchments within the municipal boundaries could be impacted.	
Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Definite (7)	The wetland will certainly be impacted if the footprint is not remediated as this represents a significant pollution source.	
Nature	Negative		
Mitigation/ Management actions			
▪ Remediation and rehabilitation of the TSF footprints according to the Rehabilitation Plan (Digby Wells, 2015e) will aim to remove this pollution source. This will have a positive impact on the wetlands as a very significant pollutant source will be removed from the catchment.			
Post- mitigation			
Duration	Beyond project Life (6)	Remediation will have a long lasting positive impact beyond the project life.	+105 “Moderate positive”
Extent	Municipal (4)	Removal of these pollutant sources will have a positive impact in the municipal catchment	
Intensity	Average (5)	Rehabilitation will allow a positive impact but will only remediate a small part of the existing impacts.	
Probability	Definite (7)	Rehabilitation is will result in a positive impact.	
Nature	Positive		

9.4 Cooke Mining Right Area Impact Assessment

The Cooke MRA involves the hydraulic reclamation of the Cooke TSF and the Cooke 4 South TSF as well as the pipeline from the Cooke TSF to Ezulwini. The pipeline route interacts with one pan wetland as the pipeline crosses the N12. The Wonderfonteinspruit is found west of the Cooke TSF and is just within 500m from the infrastructure. The reclamation of the Cooke TSF may potentially have positive impacts in the decommissioning phase if rehabilitation and remediation of the footprint is done as this will remove a significant current impact to the wetlands.

9.4.1 No-Go Option and Current Impacts

The wetlands within the Cooke MRA are significantly impacted due to the current alterations and threats to these sensitive systems and their catchments. This mainly refers to the Wonderfonteinspruit River and associated wetlands. As discussed in the Wetland Findings, Section 7, the surrounding land-uses are dominated by mining, agriculture and road infrastructure, which impacts significantly on the wetland habitat and functionality. These current impacts are rated below.

Table 9-17: Current Interactions and Impacts to the Wetlands in the Cooke MRA

Interaction	Impact
Presence of road infrastructure, pipeline within Wonderfonteinspruit ,agricultural farms and historical and existing mining activities and discharges of mine impacted water from the Cooke 1 shaft	Direct loss of wetland habitat.
	Chemical contamination of water in wetlands from AMD and other pollution sources.
	Alien plant infestation and erosion in wetlands and their catchments.
	Altered hydrology.

Table 9-18: Summary of wetland impact ratings for the current impacts in the Cooke MRA

Activity and Interaction: Presence of road infrastructure, pipeline within Wonderfonteinspruit, agricultural farms and historical and existing mining activities			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Direct loss of wetland habitat.			
Duration	Permanent (7)	Wetland habitat is lost due to farming and mining in wetland	-112 “Major negative”
Extent	Local (3)	The loss of wetlands occurs locally.	
Intensity	Irreplaceable loss (6)	Loss of natural wetland habitat is a irreplaceable impact to highly sensitive environments.	

Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Pollution of wetlands			
Duration	Beyond 'Project' Life (6)	Pollution may be irreversible due to current pollution sources and the long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Pollution of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Alien plant infestation and erosion.			
Duration	Beyond 'Project' Life (6)	Invasion and erosion are long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Invasion and erosion of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Altered hydrology			
Duration	Permanent (7)	Hydrological impacts are permanent with long-lasting impact to sensitive systems; i.e. piped Wonderfonteinspruit and discharges of mine impacted water	-119 "Major negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Irreplaceable loss (6)	Hydrological impacts to highly sensitive wetland systems significantly limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		

If the project does not go ahead, the impacts as rated above would be the status quo for the Cooke MRA wetlands. Although the wetlands are not in a pristine condition, these are still seen as significant wetland habitats. The pipelines within the Cooke MRA will not be installed and therefore added industrial infrastructure will not become additional threats to the wetland functionality.

However, if the no-go option is realised, the Cooke TSF and the Cooke 4 South TSF will not be reclaimed, will remain in situ and will remain a significant pollution source (specifically AMD) to the wetlands.

9.4.2 Construction Phase

9.4.2.1 *Impact Description*

The construction of pipeline route from the Cooke TSF to Ezulwini is to pass within a pan wetland as the pipeline crosses the N12. There is an existing culvert and built servitude running under the N12 that is to be used, which is within the wetland. Limited construction will be needed which will decrease the impact. The pipeline containing tailings slurry has the potential to impact the wetlands if an unplanned spill occurs.

The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-19: Interactions and Impacts of the WRTRP Cooke MRA construction phase

Interaction	Impact
Activity around and in the wetlands with machinery for the construction of the pipelines from the Cooke TSF to Ezulwini under the N12 through a wetland.	Potential pollution and resultant negative impacts on wetlands with the building of the pipelines through wetlands.

9.4.2.2 *Management Objectives*

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the construction of the WRTRP infrastructure in the Cooke MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.4.2.3 *Management Actions and Targets*

During the construction of the WRTRP infrastructure in the Cooke MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and at least a 30m buffer must be clearly demarcated in the field that will last for the duration of the construction phase.
- Minimise footprint area disturbed by construction activities.
- Rehabilitation Plan for disturbed wetland area must be in place.

9.4.2.4 Impact Rating

Table 9-20: Summary of Wetland Impact Ratings for the initial Construction Phase in the Cooke MRA

Activity and Interaction: Pipeline placement in and around wetland at N12			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Disturbance of wetland habitat.			
Prior to mitigation/ management			
Duration	Short Term (2)	Wetland habitat will be impacted by the construction of the pipeline according to the current placement but construction will be a short term impact.	-70 “Minor negative”
Extent	Limited (2)	The wetland will be impacted only to a limited extent due to planned mitigations and the small areas needed for the pipeline installation.	
Intensity	Moderate loss (3)	Loss of wetlands is a serious impact to sensitive environments.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			

▪ Responsible construction to protect the surrounding environment will mitigate this impact. This should include aspects such as vehicles must be in good working order; construction should occur in the dry-season in the shortest time possible; and particular care must be taken when constructing in the wetland. ▪ In addition, the sections of pipe crossing wetlands should have no joints and must be fitted with HDPE sleeves. See Section 9.1.			
Post-mitigation			
Duration	Immediate (1)	Rehabilitation and mitigation could decrease the duration of the impact to occur within one month.	-35 "Negligible negative"
Extent	Limited (2)	The wetland catchments within the municipal boundaries will be impacted.	
Intensity	Minor loss (2)	Mitigation of the impact will lead to a minor effect on a limited area of the pan.	
Probability	Definite (7)	This will occur according to the proposed infrastructure layout.	
Nature	Negative		

9.4.3 Operational Phase

9.4.3.1 Impact Description

The existence and operation of the pipeline route from the Cooke TSF to Ezulwini will continue to be within the pan wetland as the pipeline crosses the N12. There is an existing culvert and built servitude running under the N12 that is to be used, which is within the wetland. The pipeline containing tailings slurry has the potential to impact the wetlands if an unplanned spill occurs.

The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-21: Interactions and Impacts of the WRTRP Cooke MRA construction phase

Interaction	Impact
Existence, operation and maintenance of the pipeline through the pan wetland, under the N12.	Minimal impact to wetlands as following existing servitude under the N12; however operation will still be recognised as an industrial negative impact to wetland integrity.

9.4.3.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the construction of the WRTRP infrastructure in the Cooke MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.4.3.3 Management Actions and Targets

During the operation of the WRTRP infrastructure in the Cooke MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and a 100m buffer should be managed as a no-go area. See Section 8.2.
- The wetlands in the general area of the WRTRP should be managed through a Land Management Plan to potentially increase their general functionality. See Section 12.2.4.
- Pipeline structures must be managed and maintained to ensure their safe functioning, especially over wetland crossings. See Section 9.1.

9.4.3.4 Impact Rating

Table 9-22: Summary of Wetland Impact Ratings for the initial Operational Phase in the Cooke MRA

Activity and Interaction: Pipeline in and around wetland at N12			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Disturbance of wetland habitat as the pipeline is an industrial negative impact to wetland integrity.			
Prior to mitigation/ management			
Duration	Project Life (5)	Wetland habitat will be impacted by the pipeline for the duration of the project.	-70 “Minor negative”
Extent	Limited (2)	Only a limited extent of the pan wetland will be impacted.	

Intensity	Minor effect (3)	This constitutes a minor effect to the wetland.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			

▪ Monitoring of the pipeline and continuous maintenance, especially over wetlands to include:
  ▪ Alien and Invasive flora management along the project area according to the Fauna and Flora Report (Digby Wells, 2015c)
  ▪ Erosion control and continuous rehabilitation as per the Rehabilitation Plan (Digby Wells, 2015e).
▪ Note: Demarcating the wetland and the buffer with rehabilitation interventions could have a positive impact.			

Post-mitigation			
Duration	Project Life (5)	Rehabilitation and mitigation will not decrease the duration of the pipeline being in situ.	-63 "Minor negative"
Extent	Very limited (2)	Only isolated parts of the pan wetland will be impacted.	
Intensity	Minor effect (2)	This constitutes a minor effect to the wetland.	
Probability	Definite (7)	This will occur according to the proposed infrastructure layout.	
Nature	Negative		

9.4.4 Decommissioning Phase

9.4.4.1 Impact Description

The decommissioning phase will involve the rehabilitation of the reclaimed TSF footprints. The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-23: Interactions and Impacts of the WRTRP Cooke MRA decommissioning phase

Interaction	Impact
Decommissioning of the reclaimed TSF footprints.	With rehabilitation of the footprints, this will have a positive impact to surrounding wetlands as a significant negative impact is being removed and rehabilitated.

9.4.4.2 Management Objectives

Management objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.4.4.3 Management Actions and Targets

Decommissioning of the WRTRP infrastructure in the Cooke MRA will be predominantly a rehabilitation activity. General mitigation and management actions provided in the other studies done by Digby Wells as part of this project should still be used to guide the effective management of wetland ecological resources, most particularly the Rehabilitation Report (Digby Wells, 2015e). However, it is recommended that this be updated regularly, especially immmediately prior to the decommissioning phase.

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- Rehabilitation of the reclaimed TSF footprints must be done according to the Rehabilitation Plan (Digby Wells, 2015e).
- The edge of the wetlands and a 100m buffer must be managed as a no-go area. See Section 8.2.
- Pipelines must be flushed clean and rendered safe for decommissioning.
- Decommissioning and rehabilitation should be done in the dry season.

9.4.4.4 Impact rating

Table 9-24: Summary of wetland impact ratings for the Decommissioning phase in the Cooke MRA

Activity and Interaction: Decommissioning of the mined Cooke and Cooke 4 South TSF footprints.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: This may have a positive impact on the surrounding wetlands if rehabilitation occurs as this is removing a current highly significant negative impact to the wetlands. If rehabilitation of the footprint is not done, a negative impact will be realised.			
Prior to mitigation/ management			
Duration	Beyond project Life (6)	Impact will have long-lasting negative impacts on the wetlands beyond the project life.	-105 “Moderate

Extent	Municipal (4)	The wetland catchments within the municipal boundaries could be impacted as the footprint may impact upon the Wonderfonteinspruit (Cooke) and Leeuspruit (Cooke 4 South)	negative”
Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Definite (7)	The wetland will certainly be impacted if the footprint is not remediated as this represents a significant pollution source.	
Nature	Negative		
Mitigation/ Management actions			
▪ Remediation and rehabilitation of the TSF footprints according to the rehabilitation plan will aim to remove this pollution source. This will have a positive impact on the wetlands as a very significant pollutant source will be removed from the catchment.			
Post- mitigation			
Duration	Beyond project Life (6)	Remediation will have a long lasting positive impact beyond the project life.	+105 “Moderate positive”
Extent	Municipal (4)	Removal of these pollutant sources will have a positive impact in the municipal catchment	
Intensity	Average (5)	Rehabilitation will allow a positive impact but will only remediate a small part of the existing impacts.	
Probability	Definite (7)	Rehabilitation is will result in a positive impact.	
Nature	Positive		

9.5 Ezulwini Mining Right Area Impact Assessment

The Ezulwini MRA will include the construction and operation of the pipelines between the CPP and the Ezulwini plant including: the pipe containing uranium concentrate for recovery of uranium from the CPP to Ezulwini plant; the pipelines containing water from the CPP to Ezulwini plant; and the pipeline from Cooke 4 South to the CPP. These all follow the same route.

9.5.1 No-Go Option and Current Impacts

The wetlands within the Ezulwini MRA are significantly impacted due to the current alterations and threats to these sensitive systems and their catchments. As discussed in the Wetland Findings, Section 7, the surrounding land-uses are dominated by mining, agriculture and road and pipeline infrastructure, which impacts significantly on the wetland habitat and functionality. These current impacts are rated below.

Table 9-25: Current Interactions and Impacts to the Wetlands in the Ezulwini MRA

Interaction	Impact
Presence of road and pipe infrastructure, agricultural farms, cattle, and historical and existing mining activities, discharge of mine impacted water into the Kleinwesspruit.	Direct loss of wetland habitat
	Chemical contamination of water in wetlands from AMD and other pollution sources
	Alien plant infestation and erosion in wetlands and their catchments
	Altered hydrology

Table 9-26: Summary of wetland impact ratings for the current impacts in the Ezulwini MRA

Activity and Interaction: Presence of road and pipe infrastructure, agricultural farms, cattle, and historical and existing mining activities.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Direct loss of wetland habitat.			
Duration	Permanent (7)	Wetland habitat is lost due to farming and mining in wetland	-112 “Major negative”
Extent	Local (3)	The loss of wetlands occurs locally.	
Intensity	Irreplaceable loss (6)	Loss of natural wetland habitat is a irreplaceable impact to highly sensitive environments.	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Pollution of wetlands			
Duration	Beyond ‘Project’ Life (6)	Pollution may be irreversible due to current pollution sources and the long-lasting impact to sensitive systems	-105 “Moderate negative”
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Pollution of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		

Impact Description: Alien plant infestation and erosion.			
Duration	Beyond 'Project' Life (6)	Invasion and erosion are long-lasting impact to sensitive systems	-105 "Moderate negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Serious damage (5)	Invasion and erosion of highly sensitive wetland systems limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		
Impact Description: Altered hydrology			
Duration	Permanent (7)	Hydrological impacts are permanent with long-lasting impact to sensitive systems	-119 "Major negative"
Extent	Municipal (4)	The wetland catchments within the municipal boundaries are impacted.	
Intensity	Irreplaceable loss (6)	Hydrological impacts to highly sensitive wetland systems significantly limits ecosystem functioning	
Probability	Definite (7)	This is a current impact	
Nature	Negative		

If the project does not go ahead, the impacts as rated above would be the status quo for the Ezulwini MRA wetlands. Although the wetlands are not in a pristine condition, they are still seen as significant wetland systems. The pipeline within the Ezulwini MRA will not be installed and therefore added industrial infrastructure will not become additional threats to the wetland functionality.

9.5.2 Construction Phase

9.5.2.1 Impact Description

The construction of the pipelines directly interacts with wetlands identified, but impacts will be minimised as the pipelines will be using existing servitudes (roads) that cross over the wetlands currently. The existing South Deep servitude will be for some distance; this is mostly around Wetland 13 and 14. The contents of the pipelines represent a significant threat to the wetlands if an unplanned spillage occurs.

Table 9-27: Interactions and Impacts of the WRTRP Ezulwini MRA construction phase

Interaction	Impact

Interaction	Impact
Activity around and in the wetlands with heavy machinery for the construction of the pipelines between the CPP to the Ezulwini plant.	Potential pollution and resultant negative impacts on wetlands with the building of the pipelines over wetlands.

9.5.2.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the construction of the WRTRP infrastructure in the Ezulwini MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.5.2.3 Management Actions and Targets

During the construction of the WRTRP infrastructure in the Ezulwini MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- Where possible, the edge of the wetlands and at least a 30m buffer must be clearly demarcated in the field that will last for the duration of the construction phase. A 100 m buffer is recommended. See Section 8.2.
- Minimise footprint area disturbed by construction activities.

9.5.2.4 Impact Rating

Table 9-28: Summary of wetland impact ratings for the Construction phase in the Ezulwini MRA

Activity and Interaction: Activity around and in the wetlands with heavy machinery for the construction of the three pipelines between the CPP and the Ezulwini plant containing uranium concentrate, slurry and return water.

Dimension	Rating	Motivation	Significance
Impact Description: Potential pollution and resultant negative impacts on wetlands with the building of the pipelines over wetlands.			
Prior to mitigation/ management			
Duration	Medium term (3)	The construction activities involving heavy machinery will be active in and around the wetlands. The construction will be short term but the impacts can have a medium term impact.	-60 "Minor negative"
Extent	Municipality (4)	Impacts are a significant impact to the greater catchment if not contained.	
Intensity	Serious long term (5)	Water quality deterioration is a serious impact to sensitive environments.	
Probability	Likely (5)	Pollution from the proposed activities is likely to occur as the pipeline is crossing wetlands, however the pipe is following existing servitudes and therefore probability is not certain.	
Nature	Negative		
Mitigation/ Management actions			
▪ Responsible construction to protect the surrounding environment will mitigate this impact. Vehicles must be in good working order. Construction should occur in the dry-season. Particular care must be taken when constructing the wetland crossings and no vehicles are to enter wetlands. ▪ In addition, the sections of pipe crossing wetlands should have no joints and must be fitted with HDPE sleeves. See Section 9.1.			
Post- mitigation			
Duration	Short term (2)	The construction will be short term and if mitigated so will the impacts be short term.	-36 "Minor negative"
Extent	Local (3)	The mitigation measures will allow the impacts to be kept to a locally impacted extent.	
Intensity	Serious medium term (4)	Water quality deterioration is a serious impact to sensitive environments but can be lessened with mitigation measures.	

Probability	Probable (4)	Mitigation measures will decrease the probability; however given the high impact of the proposed project the impact is probably still likely to occur.	
Nature	Negative		

9.5.3 Operational Phase

9.5.3.1 Impact Description

The existence and operation of the three pipelines between the CPP and the Ezulwini plant containing uranium concentrate slurry and return water will continue to be associated with the wetlands through the operational phase. The pipeline containing tailings slurry has the potential to impact the wetlands if an unplanned spill occurs.

The major impacts anticipated due to the proposed interactions are listed in the table below.

Table 9-29: Interactions and Impacts of the WRTRP Ezulwini MRA Operational phase

Interaction	Impact
Existence, operation and maintenance of the pipelines through multiple wetlands.	Operation is still be recognised as an industrial negative impact to wetland integrity.

9.5.3.2 Management Objectives

Management objectives are to inform SGL where there are wetland interactions with the proposed activities during the construction of the WRTRP infrastructure in the Ezulwini MRA. These objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.5.3.3 Management Actions and Targets

During the operation of the WRTRP infrastructure in the Ezulwini MRA, general mitigation and management actions provided in the following studies done by Digby Wells as part of this project should be used to guide the effective management of wetland ecological resources affected by the proposed project:

- Aquatic Ecology Report (Digby Wells, 2015b);
- Fauna and Flora Assessment Report (Digby Wells, 2015c);
- Groundwater Assessment Report (Digby Wells, 2015d);

- Rehabilitation Plan (Digby Wells, 2015e); and
- Surface Water Report (Digby Wells, 2015f).

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and a 100m buffer should be managed as a no-go area. See Section 8.2.
- The wetlands in the general area of the WRTRP should be managed through a Land Management Plan to potentially increase their general functionality. See Section 12.2.4.
- Pipeline structures must be managed and maintained to ensure their safe functioning, especially over wetland crossings. See Section 9.1.

9.5.3.4 Impact Rating

Table 9-30: Summary of Wetland Impact Ratings for the initial Operational Phase in the Cooke MRA

Activity and Interaction: Existence, operation and maintenance of the pipelines through multiple wetlands			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Disturbance of wetland habitat as the pipeline is an industrial negative impact to wetland integrity.			
Prior to mitigation/ management			
Duration	Project Life (5)	Wetland habitat will be impacted by the pipeline for the duration of the project.	-77 "Moderate negative"
Extent	Local (3)	The local extent of the wetlands will be impacted.	
Intensity	Minor effect (3)	This constitutes a minor effect to the wetland.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		
Mitigation/ Management actions			
▪ Monitoring of the pipeline and continuous maintenance, especially over wetlands to include: ▪ Alien and Invasive flora management along the project area according to the Fauna and Flora Report (Digby Wells, 2015c); ▪ Erosion control and continuous rehabilitation as per the Rehabilitation Plan (Digby Wells, 2015e).			
Post-mitigation			

Duration	Project Life (5)	Wetland habitat will be impacted by the pipeline for the duration of the project.	-70 “Minor negative”
Extent	Limited (2)	Impacts can be limited to the site and its immediate surroundings.	
Intensity	Minor effect (3)	This constitutes a minor effect to the wetland.	
Probability	Definite (7)	This will occur according to the proposed mine plan and infrastructure layout.	
Nature	Negative		

9.5.4 Decommissioning Phase

9.5.4.1 Impact Description

The decommissioning of the pipeline directly interacts with wetlands identified, but impacts will be minimised as the pipeline will be using existing servitudes (roads) that cross over the wetlands currently. The contents of the pipeline represent a significant threat to the wetlands if an unplanned spillage occurs.

Table 9-31: Interactions and Impacts of the WRTRP Ezulwini MRA decommissioning phase

Interaction	Impact
Activity around and in the wetlands with heavy machinery for the decommissioning of the pipelines between the CPP and the Ezulwini.	Potential pollution and resultant negative impacts on wetlands with the building of the pipelines over wetlands.

9.5.4.2 Management Objectives

Management objectives are to prevent the loss of or further damage to wetland ecosystems and their buffer areas. This is important as the wetlands play a major role in controlling the hydrology of the West Rand, which has national importance as the Vaal and Crocodile River systems are downstream, and support a range of ecological processes and biodiversity in the region (WRDM EMF, 2013).

9.5.4.3 Management Actions and Targets

Decommissioning of the WRTRP infrastructure in the Ezulwini MRA will be predominantly a rehabilitation activity. General mitigation and management actions provided in the other studies done by Digby Wells as part of this project should still be used to guide the effective management of wetland ecological resources, most particularly the Rehabilitation Report (Digby Wells, 2015e). However, it is recommended that this be updated regularly, especially immmediately prior to the decommissioning phase.

The Wetland Management Plan detailed in Section 12 must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- The edge of the wetlands and a 100m buffer must be managed as a no-go area. See Section 8.2.
- Pipelines must be flushed clean and rendered safe for decommissioning.
- Decommissioning and rehabilitation should be done in the dry season.

9.5.4.4 Impact rating

Table 9-32: Summary of wetland impact ratings for the Decommissioning phase in the Ezulwini MRA

Activity and Interaction: Decommissioning of the pipelines.			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: This will have some impact on the identified wetlands due to activity that has direct contact with wetlands.			
Prior to mitigation/ management			
Duration	Medium term (3)	Impact will only occur during the short lived decommissioning phase.	-66 "Minor negative"
Extent	Local (3)	The local wetland could be impacted.	
Intensity	Serious (5)	This represents serious damage to highly sensitive environments.	
Probability	Highly probable (6)	This is highly probable due to the nature of the activity.	
Nature	Negative		
Mitigation/ Management actions			
▪ The pipeline must be flushed clean and rendered safe for decommissioning as it will be left in situ indefinitely.			
Post- mitigation			
Duration	Short Term (2)	Mitigation may decrease the potential impact	-18 "Negligible negative"
Extent	Limited (2)	The mitigation measures will allow the impacts to be kept to a limited extent.	
Intensity	Minor effects (2)	The wetlands will be subjected to minor impacts with mitigation measure employed.	
Probability	Unlikely (3)	Mitigation will decrease the likelihood of impacts significantly.	
Nature	Negative		

10 Cumulative Impact Assessment

10.1 Kloof MRA

The activities within this MRA will directly contribute to the cumulative loss of wetlands in the local area, municipality and province. This project will lead to the direct loss of 11.0 ha of a VB due to the CPP and 38.5 ha of pans due to the RTSF as well as 4.4 ha of VB wetlands. SGL will need to investigate an offset strategy for the loss of these wetlands. This project may also lead to the indirect loss of approximately 712 ha of wetland habitat due to the dewatering cone of 100 years post-closure from the blast curtain mitigation measure to be implemented at the RTSF to prevent groundwater pollution, which will create a significant drawdown cone.

The inter-basin transfer comprising removing water from the Wonderfonteinspruit and adding it to the Leeuspruit will have negative impacts that too will add to the unnatural and compromised hydrology of the area. However, both the Wonderfonteinspruit and the Leeuspruit report to the Vaal River and therefore there will not be a nett loss at the regional scale. Local scale impact to wetland habitat will still be realised.

In addition, unplanned spills of contaminants into the wetlands will directly contribute to the continued decrease in the quality of the wetlands in the West Rand area due to water pollution.

10.2 Driefontein MRA

The activities within this MRA will directly contribute to the cumulative loss of wetlands within the local area as this project will lead to the loss of 1.0 ha of a pan due to the WBT placement; however the entire pan (2.7 ha) will be affected by this. SGL will need to investigate an offset strategy for the loss of this wetland if the location is not able to be moved. In addition, unplanned spills of contaminants into the wetlands will directly contribute to the continued decrease in the quality of the wetlands in the West Rand area due to water pollution.

However, it must be noted that the reclamation of the existing mine dumps is almost certain to have a positive impacts on the wetlands as this process is removing a current impact that contributes to the cumulative impacts to the wetlands.

10.3 Cooke MRA

The activities within this MRA will not directly contribute to the cumulative impact to wetlands of the area. If rehabilitation and remediation of the Cooke TSF is done the activity will result in a positive impact to wetlands as the current very significant negative impact to the wetlands (the Cooke TSF) will be removed from the catchment

10.4 Ezulwini MRA

The activities within this MRA have the potential to directly contribute to the cumulative negative impacts to wetlands of the local area, municipality and province. The contents of the pipeline represent a significant threat to the wetlands and water resources of the catchment as it is uranium rich. This is captured in the unplanned events section below.

If rehabilitation and remediation of the Ezulwini South TSF is done, the MRA will see a positive impact to wetlands as the current very significant negative impact to the wetlands (the Ezulwini South TSF) will be removed from the catchment. The wetlands are however still significantly impacted by the remaining negative impacts.

11 Unplanned Events and Low Risks

11.1 Kloof MRA

The activities taking place in the Kloof MRA have the potential to result in unplanned events that may have significant impacts to the wetlands of the area and catchment. These are described in the table below.

Table 11-1: Unplanned events and impacts to wetland in the Kloof MRA

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spillage in/near wetlands	Wetland contamination and compromised integrity	Vehicles must only be serviced within designated service bays. Procedures should be put in place to clean-up spillages in the event that they should occur. Spill kits need to be obtained and should be available on site to clean up any leaks or spills. Spillages of magnitude (please refer to the Rehabilitation Report (Digby Wells, 2015e) should also be reported to the authorities within 24 hours and an internal incident reporting system implemented. Construction will take place in the dry-season.
Tailings slurry pipeline burst over or near to wetlands, particularly the Leeuspruit.	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts. This is of particular importance due to the crossing of the pipeline over the Leeuspruit, which is a tributary to the Vaal River.	Shutdown valves and continuous flow monitoring on pipelines to identify bursts and leaks timeously as well as visual regular monitoring. In the event of pipeline failure, valves must be shut down immediately and the impact investigated and remediated, please refer to the Rehabilitation Report (Digby Wells, 2015e).

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
RTSF RWD spillage	Significant contamination of wetland ecosystems. This is of particular importance at the crossing of the Leeuspruit, a tributary to the Vaal River.	Engineering design of the RTSF and RWD must consider the prevention of any spillage from entering wetlands. This will include catering for freeboard and the 1:100 year floods,

11.2 Driefontein MRA

The activities taking place in the Driefontein MRA have the potential to result in unplanned events that may have significant impacts to the wetlands of the area and catchment. These are described in the table below.

Table 11-2: Unplanned events and impacts to wetland in the Driefontein MRA

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spillage in/near wetlands	Wetland contamination and compromised integrity	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could take place.
Tailings slurry spill (over or near to wetlands, particularly the Loopspruit) due to a pipeline burst or during hydraulic reclamation of the TSF's.	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts. This is of particular importance due to the crossing of the pipeline over the Loopspruit, which is a tributary to the Vaal River.	Monitoring of the pipeline and it's flows must be a continuous mitigation effort or to identify a leak as soon as possible. Should it occur, valves need to be shut down to prevent spillage of hazardous material. Investigation into the impact to the Loopspruit must be undertaken if necessary, and remediation actions must take place.

11.3 Cooke MRA

The mining of the Cooke TSF and C4S in the Cooke MRA has the potential to result in unplanned events that will have significant impacts to the wetlands of the area and catchment. These are described in the table below.

Table 11-3: Unplanned events and impacts to wetland in the Cooke MRA

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring

Hydrocarbon spillage in/near wetlands	Wetland contamination and compromised integrity	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could take place.
Tailings slurry spill during hydraulic reclamation of the Cooke and Cooke 4 South TSF's, with particular relevance to the Wonderfonteinspruit.and the Leeuspruit	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts. This is of particular relevance to the Wonderfonteinspruit./Leeuspruit	All precautions should be put in place to prevent any spill from the mining of the TSF. Should a spill occur, investigation into the impact to the Wonderfonteinspruit /Leeuspruit must be undertaken and remediation actions must take place.

11.4 Ezulwini MRA

The mining of the Cooke 4 South TSF in the Cooke MRA also has the potential to result in unplanned events that will have significant impacts to the wetlands of the Ezulwini MRA and catchment. These are described in the table below.

Table 11-4: Unplanned events and impacts to wetland in the Ezulwini MRA

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spillage in/near wetlands	Wetland contamination and compromised integrity	Vehicles must only be serviced within designated service bays. Hydrocarbon spill kits must be available on site at all locations where hydrocarbon spills could take place.
Tailings slurry spill during hydraulic reclamation of the Ezulwini South TSF.	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts.	All precautions should be put in place to prevent any spill from the mining of the TSF. Should a spill occur, investigation into the impact to the surrounding wetlands must be undertaken and remediation actions must take place if necessary.
Uranium rich slurry spill due to a potential pipeline burst.	This will result in highly significant contamination of the wetland ecosystem if this spill occurs near one of the wetland crossings. The uranium-rich content of the pipeline represents a serious risk to the water resources. The wetlands are sensitive receptors to water	Monitoring of the pipeline and its flows must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. Should it occur, valves need to be shut down to prevent spillage of hazardous material. Investigation into the impact to the Leeuspruit must be undertaken if necessary and remediation actions must take place.

	quality impacts. This is of particular importance due to the crossing of the pipeline over tributaries of the Leeuspruit which is a tributary to the Vaal River.	

12 Wetland Management Plan

A Wetland Management Plan is a tool to maintain and/ or improve the ecological integrity of wetland systems whilst allowing sustainable use of these areas for different reasons (Ramsar Secretariat, 2010).The first step, which has been achieved through this study, is to define the ecological integrity of the wetlands present. A management plan can then be developed to define goals of maintenance, conservation and rehabilitation efforts for the wetlands. Ongoing monitoring of these efforts as well as the identified impacts can then take place through which further management actions can be developed if necessary. These steps ensure the ecological descriptions of the wetlands are updated and this feeds back into the Wetland Management Plan (WMP), shown in Figure 12-1.

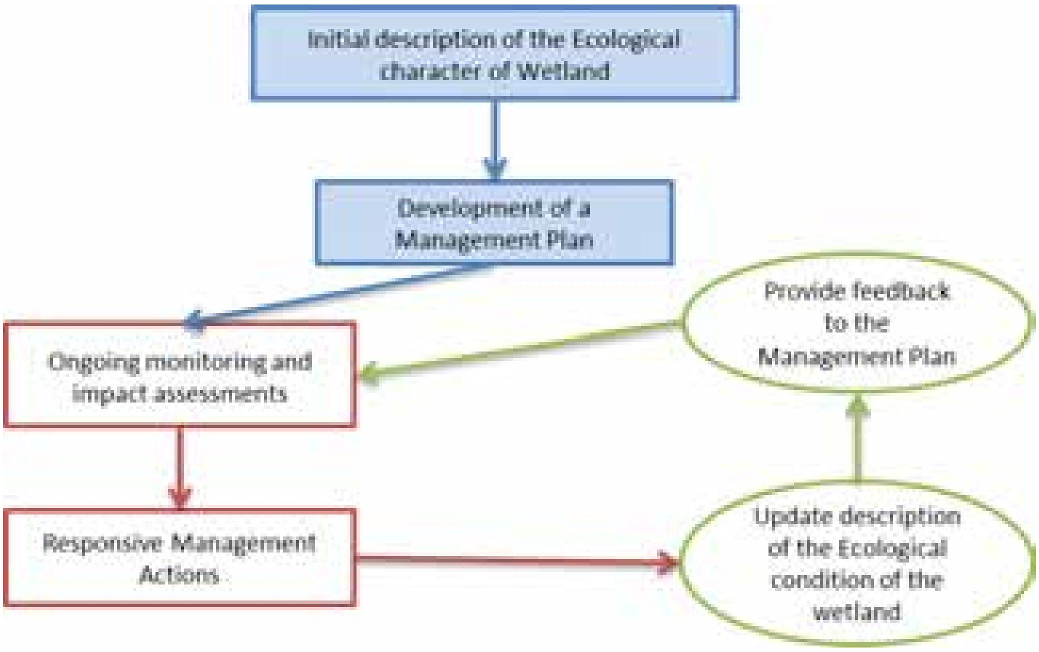


Figure 12-1: Organogram of the process involved in wetland management planning (adapted from Ramsar Convention Secretariat, 2010)

Described herein is a preliminary WMP for the WRTRP, however due to the large scale of the project area, it is recommended that a standalone detailed WMP be written if the project is to go ahead. The mitigation and management of the wetlands in the project area can be divided into four different sectors. These are summarised in Figure 12-2 and discussed in the Section 12.2 below.

Figure 12-2: Summary of the four sectors of Wetland Mitigation and Management

12.1 Project Activities with Potentially Significant Impacts

The table below is a brief summary of the impacts per MRA that received a moderate or major rating and therefore are seen to be activities with significant impacts.

Table 12-1: Potentially Significant Impacts of the WRTRP to wetlands

Aspects	**Potential Significant impacts**
Kloof Mining Right Area	
Placement of the CPP and RTSF around and in wetlands	Loss of wetland habitat.
Decommissioning of the RTSF; this is to remain in perpetuity.	This will represent a significant threat to the surrounding wetlands and water resources if mitigation measures are not in place. The RTSF is a significant source of pollution due to the properties of the content as well as due to the magnitude (size) of the facility.
Abstraction of water from K10 and Cooke 1 shafts.	Desiccation and potential loss of the wetland habitat may occur due to the volume of water being released into the system decreasing from 45 to 13 Mℓ/day.
Discharging of treated water into the Leeuspruit from the AWTF, increasing flows and volumes by ~35%.	Wetland habitat downstream affected by the change in hydrology with a potential increase in saturated area. Wetland habitat downstream affected with a potential increase in erosion due to a 35% increase in river flows.

Aspects	Potential Significant impacts
Blast curtain with subsequent cone of dewatering	Loss of groundwater input to wetlands with subsequent loss of wetland habitat, affecting the aquatic and wetland flora and fauna, and compromising the functioning of the wetlands from a hydrological point of view.
Driefontein Mining Right Area	
Placement of the WBT and BWSF around and in a pan wetland	Loss of wetland habitat.
Cooke Mining Right Area	
There are no predicted significant impacts to wetlands within this MRA	
Ezulwini Mining Right Area	
There are no predicted significant impacts to wetlands within this MRA	

12.2 Summary of Mitigation and Management

12.2.1 Wetland Offsetting

There is no mitigation for the loss of wetlands and therefore it is recommended that an offset strategy be implemented to compensate for the wetlands that would be lost due to the proposed project prior to any development on site. SANBI, in collaboration with the DWS, has developed a guideline for wetland offsets in South Africa (DWS, 2014). The guideline aims to provide guidance on wetland offsetting, with particular reference to loss of wetlands due to mining-related activities and defines 'biodiversity offsets' as "*measurable conservation outcomes resulting from actions to compensate for residual negative impacts on biodiversity*". The following list outlines the goals proposed in SANBI's guideline:

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

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

There are wetlands that are designated to be removed by the placement of infrastructure, namely the WBT, CPP and RTSF. The CPP and WBT wetlands may be rehabilitated / reinstated after the closure of the project, but this is still seen as a loss of wetland natural habitat. It is therefore recommended that SGL implement an offset strategy for all of these wetlands as this is very likely going to be a requirement from the DWS as a condition as part of the WUL. The types of wetlands and areas affected are summarised in the table below.

Table 12-2: Summary of wetlands directly impacted by infrastructure placement

Infrastructure	Wetland type	Total Wetland Area	Directly Affected Footprint	% Wetland affected	Permanent?	Offset recommended?
WBT	Pan	2.7 ha	1.0 ha	38.8 %	No	Yes
CPP	VB	49.8 ha	10.7 ha	21.5 %	No	Yes
RTSF	Pan	38.5 ha	38.5 ha	100 %	Yes	Yes
	VB	881.6 ha	4.4 ha	0.5 %	Yes	Yes

The wetland offset strategy should include an investigation of potential offset wetlands within the property owned by the client. This will afford control over the protection of selected candidate offset wetlands. To allow for the quantification of a suitable offset for the wetlands lost from the RTSF, it is important to establish a common unit or currency that will allow residual losses (due to the proposed impacts) and gains (due to the proposed offset) to be consistently measured and compared. This is central to the concept of offsets, and the 'no-net-loss' approach. In the past, the area of wetland residually affected (as measured in hectares, for example) was a commonly used currency and is still used in many instances. The wetland *hectare equivalent* concept, however, uses a more refined currency that better incorporates a measure of ecological function, quality and/or integrity (Cowden and Kotze 2009). Wetland hectare equivalents are to be determined using three wetland calculators as represented in Figure 12-3.

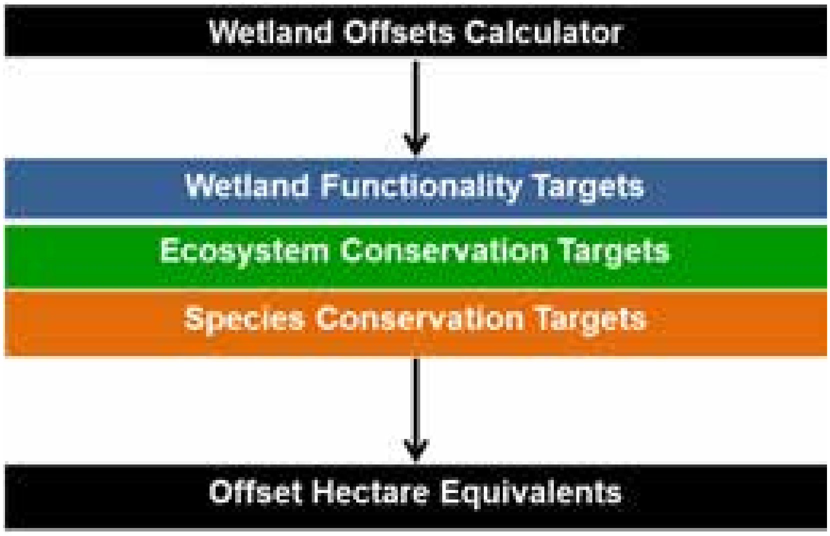


Figure 12-3: Wetland Calculator Components

12.2.2 Wetland Rehabilitation

There are two wetlands that are impacted by the construction of infrastructure that will result in the loss of natural wetland habitat; this is the CPP and the WBT. This however will not be a permanent infrastructure and will be decommissioned at the end of the project and therefore the wetland habitat may be reinstated through rehabilitation efforts. This will likely be in addition to an offset strategy if requested from the DWS.

The construction and operation of the WBT is within the Driefontein MRA. The placement of this is currently over a pan wetland and will result in the loss of this wetland habitat. If possible, it is recommended that the infrastructure be moved outside of the pan and associated 100m buffer. The construction and operation of the CPP is within the Kloof MRA. The placement of this leads to the loss of 11.0 ha of a VB wetland. These wetlands are significantly impacted on already (PES of D), however it is preferable if it is not further impacted. Therefore these wetlands will need to be rehabilitated once decommissioning commences.

These wetlands are situated in the grassland biome and wetland-dependant plant species that occur naturally in wetlands in the region are listed in Table 12-3 and examples of some of these species is represented in Figure 12-4. It is advisable that all plants used for revegetation are native highveld grassland species.

Table 12-3: Grass and sedge species recommended for re-seeding

Species	Common Name	Degree of wetland tolerance
Agrostis lachnantha	African Bent Grass	Permanent hydrophyte
Andropogon appendiculatus	Blue Grass / Blougras	Facultative hydrophyte
Andropogon eucomis	Snowflake Grass	Permanent hydrophyte

Cynodon dactylon	Couch Grass	Facultative hydrophyte
Eragrostis gummiflua	Gum Grass	Facultative hydrophyte
Imperata cylindrica	Cottonwool Grass	Permanent hydrophyte
Juncus effusus	Common Rush	Permanent hydrophyte
Setaria sphacelata	Golden Bristle Grass	Permanent hydrophyte
Sporobolus africanus	Spear Grass	Facultative hydrophyte

Figure 12-4: Examples of species to be used for revegetation: A) Andropogon eucomis; B) Agrostis lachnantha, C) Cynodon dactylon

12.2.3 Wetland Buffers

Buffer zones are a requirement of the NWA to facilitate the protection of the delineated wetland areas within the project area. The purpose of the establishment of buffer zones is to minimise the anthropogenic impacts associated with the proposed development on the receiving water resources. A buffer zone is defined as:

"*the strips of undeveloped, typically vegetated land (composed in many cases of riparian habitat or terrestrial plant communities) which separate development or adjacent land uses from aquatic ecosystems (rivers and wetlands).*"

The following justifications have been provided for the establishment of buffer zones, some of which are listed below:

- Reducing the impacts of adjacent land uses on water resource quality and the associated biodiversity; and
- Sustaining or improving the ability of the water resources to provide goods and services to the current and future water end users within the catchment area.

In the absence of national protocol, a generic 100m buffer is recommended to be established around wetlands as best practise to ensure protection of these systems. This is in agreement with Regulation 704, whereby material and activities with the potential to impact on a water resource, within 100m of a watercourse or within the relevant floodline, should be licenced. According to local Gauteng legislation and regulations, the edge of the wetland must be clearly demarcated and a 50m buffer zone is to be delineated as sensitive. In addition, the edge of the wetland must be clearly demarcated in the field that will last for the duration of the construction phase. Refer back to Section 8.2 for more detail.

12.2.4 General Wetland Management

The Ultimate Project area is large and therefore many wetlands are found within it. There are 21 wetland interactions with the proposed project infrastructure. There is the potential of the project to have an overall positive impact by removing and rehabilitating the TSF sites and improving the current wetland management practices in the project area; especially for the land owned by SGL. A detailed Biodiversity and Land Management Plan is recommended to be compiled with specific detailed recommendations for the general improvement of wetland biodiversity on site if the project goes ahead (see Fauna and Flora Report, Digby Wells, 2015c). These efforts are subject to land ownership and / or land use and therefore where possible, the following should be undertaken to increase or maintain the general functioning of the wetlands associated with the project area.

12.2.4.1 Alien Invasive Plant Control

Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). The national list of invasive plant species listed in NEMBA represents the following categories:

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and
- Category 3: Invasive species controlled by activity.

Not only are landowners under legal obligation to remove alien invasive plant species, but these plants are also detrimental to the ecological functioning of landscapes and this is particularly true for wetlands. The use of chemicals for removal of problem plants is not recommended and mechanical removal should be employed. Species should be removed prior to flowering time (preferably over the winter season) by hand-hoeing. All stems and plant parts should be removed from the site to prevent further spread. The species listed in the table below were recorded within the wetlands as problem plants; also refer to the Fauna and Flora Report (Digby Wells, 2015c).

Table 12-4: Problem plants identified in wetland areas

Species	Common Name	Invasive Category	Flowering time
Cyperus esculentus	Yellow-nut Sedge	Native invasive	Early to mid-summer
Seriphium plumosum	Bankrupt Bush	Native invasive	Early to mid-winter

Species	Common Name	Invasive Category	Flowering time
Tagetes minuta	Khakibos	No category	Early spring to late autumn
Verbena brasiliensis	Common Vervain	No category	Mid-summer to autumn (2-3 months)

12.2.4.2 Removal of Cattle

Cattle have many significant impacts on wetlands that include:

- Trampling and compaction of soil;
- Trampling and increase risk of erosion;
- Trampling of rare and important species;
- Grazing on natural wetland vegetation;
- Aid in the spread of alien and invasive species; and
- Defecation and urination in wetlands that can lead to eutrophication.

Removal or decrease of cattle activity in the wetland will have a positive result and assist in the general improved wetland management practices.

12.2.4.3 Re-Establish Natural Wetland Flora

As discussed in the Wetland Findings, section 7, the wetlands are impacted as much of the natural vegetation is no longer being present. Rehabilitation efforts for the wetlands may increase the PES of the systems and contribute to an overall increased functionality. Refer to Section 12.2.2 for details on the recommended wetland species for revegetation.

12.2.5 Summary Tables

Table 12-5 to 10-4 provides a summary of the proposed project activities, environmental aspects and impacts on the receiving environment. Information on the frequency of mitigation, relevant legal requirements, recommended management plans, timing of implementation, and roles / responsibilities of persons implementing the EMP are summarised.

Table 12-5: Wetlands Impacts

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
Kloof Mining Right Area					
Placement of the CPP and RTSF around and in wetlands	Pre-construction and construction	53.6 ha of wetland lost	There is no mitigation for the loss of habitat. An offset strategy will need to be compiled for the RTSF. Impacted wetlands associated with the CPP are to be rehabilitated	SANBI, in collaboration with the DWS report on "Wetland offsets: a best-practice guideline for South Africa" (ref: Macfarlane, et al. (2014))	An offset strategy will need to be compiled prior to construction. Rehabilitation to wetland habitat to take place after decommissioning of CPP.
Stabilisation and rehabilitation of the RTSF; this is to remain in perpetuity.	Rehabilitation	Footprint area	The design of the RTSF must take into consideration the long-term impacts that it represents. The groundwater and surface water impacts are to be managed accordingly. Refer to the relative reports for more detail. Rehabilitation of the RTSF according to the rehabilitation plan will aim to manage this as pollution source. Vegetation must be established as soon as possible and monitored.	See Rehabilitation Report (Digby Wells, 2015)	Rehabilitation should take place concurrent to operations of the RTSF and thereafter in the Decommissioning phase to be completed.

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
Unplanned spills from the pipelines	Operational	Local	Monitoring of the pipeline and its flows must be a continuous mitigation effort monitor for a leak or burst or to identify a burst as soon as possible. Should it occur, valves need to be shut down to prevent spillage of hazardous material. Investigation into the impact to the Leeuspruit must be undertaken if necessary and remediation actions must take place.		Operational phase.
Driefontein Mining Right Area					
Placement of the WBT and BWSF around and in a pan wetland	Pre-construction and construction	1.0 ha of wetland lost	Impacted wetlands associated with the WBT and BWSF are to be rehabilitated.	SANBI, in collaboration with the DWS report on "Wetland offsets: a best-practice guideline for South Africa" (ref: Macfarlane, et al. (2014))	Rehabilitation of wetlands must take place after decommissioning of the WBT and BWSF.
Unplanned spills from the pipelines	Operational	Local	Monitoring of the pipeline and its pressure must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to minimise spillage of hazardous material. Investigation into the impact Loopspruit must be undertaken if necessary and remediation actions		Operational phase.

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			must take place.		
Cooke Mining Right Area					
Unplanned spills from the pipelines	Operational	Local	Monitoring of the pipeline and its flows must be a continuous mitigation effort to identify a leak or burst or to identify a burst as soon as possible. Should it occur valves need to be shut down to minimise spillage of hazardous material. Investigation into the impact to the Leeuspruit must be undertaken if necessary and remediation actions must take place.		Operational phase.
Ezulwini Mining Right Area					
Unplanned spills from the pipelines	Operational	Local	Monitoring of the pipeline and its pressure must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to minimise spillage of hazardous material. Investigation into the impact to the Leeuspruit must be undertaken if		Operational phase.

Activities	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
			necessary and remediation actions must take place.		

Table 12-6: Wetlands Objectives and Outcomes of the EMP

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
Kloof Mining Right Area					
Placement of the CPP and RTSF around and in wetlands	Loss of wetland habitat.	Wetlands	Pre-construction and construction	There is no mitigation for the loss of habitat from the RTSF. An offset strategy will need to be compiled. Rehabilitation of wetlands impacted by CPP.	Wetland offsets and rehabilitation

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
Rehabilitation of the RTSF; this is to remain in perpetuity.	This will represent a significant threat to the surrounding wetlands and water resources if mitigation measures are not in place. The RTSF is a significant source of pollution due to the properties of the content as well as due to the magnitude (size) of the facility.	Wetlands	Rehabilitation	The design of the RTSF must take into consideration the long-term impacts that it represents. The groundwater and surface water impacts are to be managed. Refer to the relative reports for more detail. Rehabilitation of the RTSF according to the rehabilitation plan will aim to manage this as pollution source. Vegetation must be established as soon as possible and monitored.	See Rehabilitation Report (Digby Wells, 2015)
Unplanned spills from the pipelines	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts. This is of particular importance due to the crossing of the pipeline over the Leeuspruit, which is a tributary to the Vaal River.	Wetlands	Operation	Monitoring of the pipeline and its flows must be a continuous mitigation effort minimise a leak or burst or to identify a burst as soon as possible. Should it occur, valves need to be shut down to prevent spillage of hazardous material. Investigation into the impact to the Leeuspruit must be undertaken if necessary and remediation actions must take	

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
				place.	
Driefontein Mining Right Area					
Placement of the WBT and BWSF around and in a pan wetland	Loss of wetland habitat.	Wetlands	Pre-construction and construction	Rehabilitation of wetland habitat must be done if wetland cannot be avoided.	Wetland habitat rehabilitation and restoration of functionality
Unplanned spills from the pipelines	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts. This is of particular importance due to the crossing of the pipeline over the Leeuspruit, which is a tributary to the Vaal River.	Wetlands	Operation	Monitoring of the pipeline and its flows must be a continuous mitigation effort minimise a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to minimise spillage of hazardous material. Investigation into the impact to the Loopspruit must be undertaken if necessary and remediation actions must take place.	
Cooke Mining Right Area					
Unplanned spills from the pipelines	This will result in significant contamination of the wetland ecosystem as these are sensitive receptors to water quality impacts.	Wetlands	Operation	Monitoring of the pipeline and its flows must be a continuous mitigation effort minimise a leak or burst or to identify a burst as	

Activities	Potential impacts	Aspects affected	Phase	Mitigation	Standard to be achieved/objective
				soon as possible. Should it occur, emergency valves need to be shut down to minimise spillage of hazardous material. Investigation into the impact to the Wonderfontein must be undertaken if necessary and remediation actions must take place.	
Ezulwini Mining Right Area					
Uranium rich slurry spill due to a potential pipeline burst.	This will result in highly significant contamination of the wetland ecosystem if this spill occurs near one of the wetland crossings. The uranium-rich content of the pipeline represents a serious risk to the water resources. The wetlands are sensitive receptors to water quality impacts. This is of particular importance due to the crossing of the pipeline over tributaries of the Leeuspruit which is a tributary to the Vaal River.	Wetlands	Operation	Monitoring of the pipeline and its flows must be a continuous mitigation effort minimise a leak or burst or to identify a burst as soon as possible. Should it occur, emergency valves need to be shut down to minimise spillage of hazardous material. Investigation into the impact to the Leeuspruit must be undertaken if necessary and remediation actions must take place.	

Table 12-7: Wetlands Mitigation

Activities	Potential impacts	Aspects affected	Mitigation type	Time period for implementation	Compliance with standards
			Kloof Mining Right Area		
Placement of the CPP and RTSF around and in wetlands	Loss of wetland habitat.	Wetlands	There is no mitigation for the loss of habitat due to the RTSF. An offset strategy will need to be compiled. Rehabilitation of the wetlands impacted by the CPP.	An offset strategy will need to be compiled prior to any construction for at least the RTSF wetlands. Rehabilitation must occur after decommissioning of the CPP.	SANBI, in collaboration with the DWS report on "Wetland offsets: a best-practice guideline for South Africa" (ref: Macfarlane, et al. (2014))
Rehabilitation of the RTSF; this is to remain in perpetuity.	This will represent a significant threat to the surrounding wetlands and water resources if mitigation measures are not in place. The RTSF is a significant source of pollution due to the properties of the content as well as due to the magnitude (size) of the facility.	Wetlands	The design of the RTSF must take into consideration the long-term impacts that it represents. The groundwater and surface water impacts are to be managed accordingly. Refer to the relative reports for more detail. Rehabilitation of the RTSF according to the rehabilitation plan will aim to manage this as pollution source. Vegetation must be established as soon as possible and monitored.	This is to take place in the design and Rehabilitation phases of the project.	See Rehabilitation Report (Digby Wells, 2015e)

Driefontein Mining Right Area					
Placement of the WBT and BWSF around and in a pan wetland	Loss of wetland habitat.	Wetlands	Rehabilitation of wetland habitat must be done if wetland cannot be avoided.	Rehabilitation must be done after decommissioning.	See Rehabilitation Report (Digby Wells, 2015e)

Table 12-8: Prescribed environmental management standards, practice, guideline, policy or law

Specialist field	**Scale**	**Applicable standard, practice, guideline, policy or law**		
Wetlands	**National:**	National Water Act (NWA, Act 36 of 1998)	Section 21 of the Environment Conservation Act, 1989	Section 5 of the National Environmental Management Act (Act 108 of 1998)
		Department of Water Affairs and Forestry (DWAF, 2005) "A practical field procedure for identification and delineation of wetlands and riparian areas"	National Freshwater Ecosystems Priority Areas (NFEPA, Nel *et al*., 2011)	SANBI, in collaboration with the DWS report on "Wetland offsets: a best-practice guideline for South Africa" (Macfarlane, *et al*., 2014)
	Provincial:	The Gauteng Department of Agriculture and Rural Development (GDARD), Gauteng Conservation Plan Version 3 (C-Plan 3) and Minimum Requirements for Biodiversity Studies.		
	Municipal:	West Rand District Municipality (WRDM) Environmental Management Framework (EMF).		

12.3 Monitoring Plan

Monitoring of the wetlands and the above discussed mitigation measures is important as the impacts from the activities need to be identified and rectified as far as possible. This will be mostly relevant during the construction phase. Monitoring should be done by a qualified wetland specialist and/ or the Safety Health and Environmental (SHE) offices for the project. Monitoring actions can include, but are not limited to the following:

Table 12-9: Monitoring Actions and Reasoning

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

13 Consultation Undertaken

Through this process, stakeholders have the opportunity to comment on all aspects of the project and specialist studies. Consultation was undertaken with farm owners/occupiers to gain access to farm portions where specialist wetland investigation was required. Consultation was undertaken with the owner of the farm portions associated with the RTSF boundary. The site was traversed with the land owner to find pan areas.

14 Comments and Responses

No comments have been received at this point with regards to the scope of this study.

15 Conclusion and Recommendation

The proposed development and operation of the new WRTRP will have direct impacts to the wetlands as well as their catchments. The main impact to the wetlands will be the loss of a total of 54.6 ha of wetland habitat due to the proposed infrastructure placement. It is recommended that an offset strategy be investigated for the wetlands lost due to the RTSF, CPP and WBT. There is an additional approximate indirect loss of 712 ha of wetland habitat due to the dewatering cone of 100 years post-closure from the implementation of a blast curtain drawdown cone at the RTSF.

The pipelines represent significant threats to the wetlands if unforeseen spillages occur; however with adequate design and suitable mitigation measures in place, these should have a minimal impact to the wetlands. An emergency spill procedure needs to be implemented to adequately address any potential leakage or accidental spill.

The historical TSFs are sources of AMD and radioactivity. The project will have positive impacts to the wetlands and their catchments as the reclamation, remediation and rehabilitation of the TSFs and their footprints will remove current sources of highly significant pollution to the wetlands.

For the overall ecological management of the WRTRP area, it is recommended that a Biodiversity and Land Action Management Plan should be compiled with specific recommendations for the general improvement of wetland biodiversity on site. There is potential for the wetlands within the land owned by SGL for the WRTRP area to have their general ecological state improved. This is to be done in conjunction with the other ecological specialists.

The wetlands assessed and discussed in this report play a 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. If the recommendations within this report and others are followed through, the WRTRP will have a nett positive impact to the wetlands on the area.

16 References

Begg, G. (1986). The Wetlands of Natal (Part 1). An Overview of their Extent, Role and Present Status. Pietermaritzburg: Natal Town and Regional Planning Commission.

Coetzee, H. (compiler) 2004: An assessment of sources, pathways, mechanisms and risks of current and potential future pollution of water and sediments in gold-mining areas of the Wonderfonteinspruit catchment WRC Report No 1214/1/06, Pretoria, 266 pp.

Coetzee, H., Venter, J., & Ntsume, G. (2005). Contamination of wetlands by Witwatersrand gold mines - processes and the economic potential of gold in wetlands. Council for Geoscience.

Compaan, P. (2011). *Gauteng Conservation Plan Version 3.3.* Department of Agriculture and Rural Development.

Dickens, C., Kotze, D., Mashigo, S., Mackay, H., & Graham, M. (2003). Guidelines for Integrating the Protection, Conservation and Management of Wetlands into Catchment Management Planning. Pretoria: Water Research Commission.

Digby Wells, 2015a. Air Quality Baseline Report. Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project.

Digby Wells, 2015b. Aquatic Ecology Report. Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project

Digby Wells, 2015c. Fauna and Flora Assessment. Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project.

Digby Wells, 2015d. Groundwater Assessment. Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project.

Digby Wells, 2015e. Rehabilitation Plan. Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project.

Digby Wells, 2015f. Surface Water Report. Environmental Impact Assessment for Sibanye Gold Limited's West Rand Tailings Retreatment Project.

DWAF, 1999. Determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). Version 1.0. 24 September 1999.

DWAF, 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Department of Water Affairs and Forestry, Pretoria.

Ellery WN, Grenfell M, Grenfell S, Kotze DC, Mccarthy TS, Tooth S, Grundling PL, Beckedahl H, Le Maitre D AND Ramsay L, 2008. WET-Origins: Controls on the distribution and dynamics of wetlands in South Africa. WRC Report No TT 334/08, Water Research Commission, Pretoria.

Kleynhans, C.J. and Louw, M.D. 2007. Module A: Ecoclassification and ecostatus determination in river ecoclassification: Manual for ecostatus determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report.

Kotze, D.C. and Marneweck, G.C. 1999. Guidelines for delineating the boundaries of a wetland and the zones within a wetland in terms of South African Water Act. As part of the development of a protocol for determining the ecological reserve for wetlands in terms of the Water Act resource protection and assessment policy implementation process. Department of Water Affairs and Forestry, South Africa.

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.C., and Collins, N.B. 2007. A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.

MacKay, H., Ashton, P., Neal, M., & Weaver, A. (2004). Investment Dtrategy for the Crosscutting Domain: Water and the Environment. Water Research Commission Report No. KV 148/04.

McCarthy T. S. 2011. The impact of acid mine drainage in South Africa. South African Journal of Science 107: 7pp.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. and Goge, C. 2007. A technique for rapidly assessing wetland health: WET-Health. WRC Report TT 340/08.

Nel J.L., Murray K.M., Maherry A.M., Petersen C.P., Roux D.J., Driver A., Hill L., van Deventer H., Funke N., Swartz E.R., Smith-Adao L.B., Mbona N., Downsborough L., Nienaber S. 2011. Technical report for the National Freshwater Ecosystem Priority Areas.

Ramsar Convention Secretariat. (2010). Managing Wetlands: Frameworks for managing Wetlands of International Importance and other wetlands sites. *Ramsar handbooks for the wise use of wetlands, 4th edition, vol 18.*

Rountree, M.W., H. Malan and B. Weston (editors). 2012. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study.

Swanepoel, C.M. and Barnard, R.O., 2007. Discussion Paper: Wetland in agriculture. Water Research Commission, Pretoria, South Africa, pp. 1-49.

Tooth, S. and McCarthy, T. S. 2007. Wetlands in drylands: geomorphological and sedimentological characterisations, with emphasis on examples from southern Africa. *Progress in Physical Geography*.

West Rand District Municipality Environmental Management Framework (WRDM EMF), 2013. Revision 2. Prepared by BKS (Pty) Ltd for West Rand District Municipality.

Appendix A: Curriculum Vitae of the Specialists