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Proposed Development of Palmietkuilen Open Pit Coal Mine and Associated Infrastructure, near Springs, Gauteng Province

Wetland Assessment Report

Prepared for:

Canyon Coal (Pty) Ltd

November 2016

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Project Name:	**Proposed Development of Palmietkuilen Open Pit Coal Mine and Associated Infrastructure, near Springs, Gauteng Province**
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Name	**Responsibility**	**Signature**	**Date**
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EXECUTIVE SUMMARY

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. Digby Wells Environmental (Digby Wells) was commissioned by Canyon Resources (Pty) Ltd (Canyon) as the environmental consultant for the development of the Palmietkuilen Mine and to conduct the wetlands specialist studies to inform the project. The Project is a greenfields development planned on Portions 1, 2, 4, 9, 13 and 19 of the farm Palmietkuilen 241 IRl.

The aim of the wetland study was to conduct an assessment on the natural wetland habitats associated with the proposed project area according to recognised methodology that included delineation of all wetlands on site using soil and vegetation indicators; classification of wetlands into hydro-geomorphic units according to the terrain; ecological health assessment; ecosystem services and functionality assessment; and a sensitivity analysis. The proposed activities were then rated in the impact assessment and mitigation measures proposed.

The project site is located in the Upper-Vaal catchment management area and the Blesbokspruit water catchment area. The project site is mostly within the quaternary catchment C21E. The project area is dominated by the National Freshwater Ecosystem Areas (NFEPA) rank 1 valley floor floodplain wetland associated with Aston Lake, which drains into the Blesbokspruit River Ramsar wetland and Marievale Nature Reserve. The infield investigation confirmed the wetland boundaries and concluded that the proposed Mining Right Area (MRA) is characterised by multiple wetland systems, totalling approximately 1,550 ha. The remainder of the area is characterised by extensive hillslope seeps that drain into the valley bottom wetlands and pan wetlands at the tops of the hills.

The wetlands have been largely transformed by agricultural activities, compromising the natural ecological functioning and biodiversity maintenance role of these wetlands. However, the wetlands and landscape will play an important ecological role as they are tributaries to the Blesbokspruit Ramsar Wetland of International Importance and the Marievale Bird Sanctuary. Additionally, most of the project area is mapped as Ecological Support Areas according to the provincial conservation plan whilst some wetlands are Critical Biodiversity Areas.

The wetlands provide important hydrological services such as flood attenuation, streamflow regulation during low-flow periods and water quality improvement. The wetlands are important for the provision of the crops and for the cattle raised on the properties. Furthermore, these wetlands are an important water source for the land owners and surrounding communities. Due to the significant extent of hillslope seep wetlands, which indicate perched groundwater, the wetlands will also play an important role in catchment water recharge.

The predicted negative impacts to the local wetlands as a result of the Project and to the catchment area are major (Table i). The proposed mine will lead to the permeant loss of 255 ha of wetland from active soil and vegetation removal. In addition, surrounding wetlands will

be damaged by the operational drawdown; and potential continuous water quality deterioration is likely to occur due to post-mining Acid Mine Drainage (AMD) generation. There is no mitigation possible for the loss of wetland habitat and these wetlands will need to be offset if the Project is to go ahead. All other residual impacts to surrounding wetlands must be mitigated as far as possible and long-term passive water treatment options will need to be investigated by Canyon Coal to prevent untreated AMD decant water from entering the catchment[1].

Table i: Potentially significant project impacts

<table>
<tr><th colspan="2">Activity</th><th>Impact</th><th>Pre-mitigation</th><th>Post-mitigation</th></tr>
<tr><td colspan="5">Construction Phase</td></tr>
<tr><td>1</td><td>Site clearance within wetlands and their buffer areas</td><td>Removal of wetland soils and vegetation; loss of wetland habitat.</td><td colspan="2">Major negative (-119)</td></tr>
<tr><td>2</td><td>Construction of general infrastructure within wetlands and their buffer areas</td><td>Industrial activity within a natural ecosystem is a negative impact to habitat integrity.</td><td>Minor negative (-70)</td><td>Negligible negative (-32)</td></tr>
<tr><td colspan="5">Operational Phase</td></tr>
<tr><td>1</td><td>Open pit mining to a depth of 60m, requiring dewatering.</td><td>Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone.</td><td colspan="2">Major negative (-112)</td></tr>
<tr><td>2</td><td>General operational activities within and around wetland habitats such as the use and maintenance of haul roads, stockpiling of RoM coal, transportation of coal to the washing plant.</td><td>Similarly to the construction phase, the operational mining activities occurring within an ecologically sensitive catchment, which pose significant potential negative impacts to functioning wetlands and catchment.</td><td>Moderate negative (-84)</td><td>Minor negative (-44)</td></tr>
<tr><td colspan="5">Rehabilitation Phase</td></tr>
</table>

[1] Decant is expected to start 35 years post closure at a rate of 5 L/s.

Activity		Impact	Pre-mitigation	Post-mitigation
1	Decommissioning activities within and around remaining wetland habitats, such demolition and removal of all infrastructure, and subsequent rehabilitation of the final void and area	Similarly to the construction and operational phase, the decommissioning and rehabilitation activities occurring within an ecologically sensitive catchment pose significant potential negative impacts to functioning wetlands and catchment. Furthermore, the rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction, erosion and subsequent sedimentation into the wetland ecosystems.	**Minor negative (-65)**	**Minor negative (-36)**
2	Mine closure and post-mining environmental status	Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant will be acid forming (AMD).	**Major negative (-114)**	**Moderate negative (-84)**

ACRONYMS LIST

Acronym	Description
AMD	Acid Mine Draining
CARA	Conservation of Agriculture Resources Act
CBA	Critical Biodiversity Areas
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DRC	Democratic Republic of Congo
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
ESA	Ecological Support Area
FEPA	Freshwater Ecosystems Priority Area
FW	Facultative Wetland Species
GDARD	Gauteng Department of Agriculture and Rural Development
HGM	Hydro-geomorphic
MRA	Mining Right Area
MTPA	Mpumalanga Tourism Parks Agency
NEMA	National Environmental Management Act
NEMBA	National Environmental Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NMMU	Nelson Mandela Metropolitan University
NWA	National Water Act
OW	Obligate Wetland Species
PA	Protected Area
PCD	Pollution Control Dam
PES	Present Ecological State
RoM	Run-of-mine
SANBI	South African Biodiversity Institute
SFI	Soil Form Indicator
SWI	Soil Wetness Indicator
UCT	University of Cape Town

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLANS

LIST OF APPENDICES

1 Introduction

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, carbon storage, stream-flow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity (Kotze *et al.* 2009). 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.”

Wetlands in South Africa however, are poorly conserved owing primarily to a general underestimation of the ecological and economic importance of these systems (Swanepoel and Barnard, 2007). 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 (Oberholster *et al.*, 2011). South Africa holds extensive coal reserves and coal mining causes destruction of wetlands through direct impacts such as removal of habitat, alteration of flow and contamination of water, but also indirectly through the drawdown of groundwater resources during the dewatering process. Impacts on water resources are significant and include the leaching of acid mine drainage into streams and rivers causing acidification and salinisation by dissolved sulfates. Particularly, wetlands in the Witwatersrand have been subject to major hydrological and chemical alterations from the century of gold and coal mining that has occurred in the area.

According to the NWA, a water resource is not only considered to be the water that can be extracted from a system and utilised but the entire water cycle, where the entire ecosystem is acknowledged as a life support system. The NWA requires that sufficient water is to be reserved to maintain as well as sustain the ecological functioning of the country’s aquatic ecosystems which include rivers, wetlands, groundwater and estuarine systems. If the country’s water resources continue to be abused and deteriorate, this will result in an unavoidable loss of key ecosystem services that support social and economic development. The optimal use of natural resources for sustainable economic activity is essential in developing countries. 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).

This report serves to detail the findings of the wetlands ecological assessment of the Palmietkuilen Mine, where Canyon Resources (Pty) Ltd (Canyon) is proposing the development and operation of a new open pit coal mine and associated infrastructure near Springs in Gauteng Province.

2 Project Overview

Canyon Coal is planning the development of a new open pit coal mining operation, Palmietkuilen mining project, located near Springs within the Gauteng Province. The project is a greenfields development planned on portions 1, 2, 4, 9, 13 and 19 of the farm Palmietkuilen 241 IRI. Coal mining will be undertaken by conventional truck and shovel operations. A coal processing plant and associated infrastructure will be constructed, where run-of-mine (RoM) coal will be processed at the proposed plant and sold to local and export markets. Key infrastructure will include:

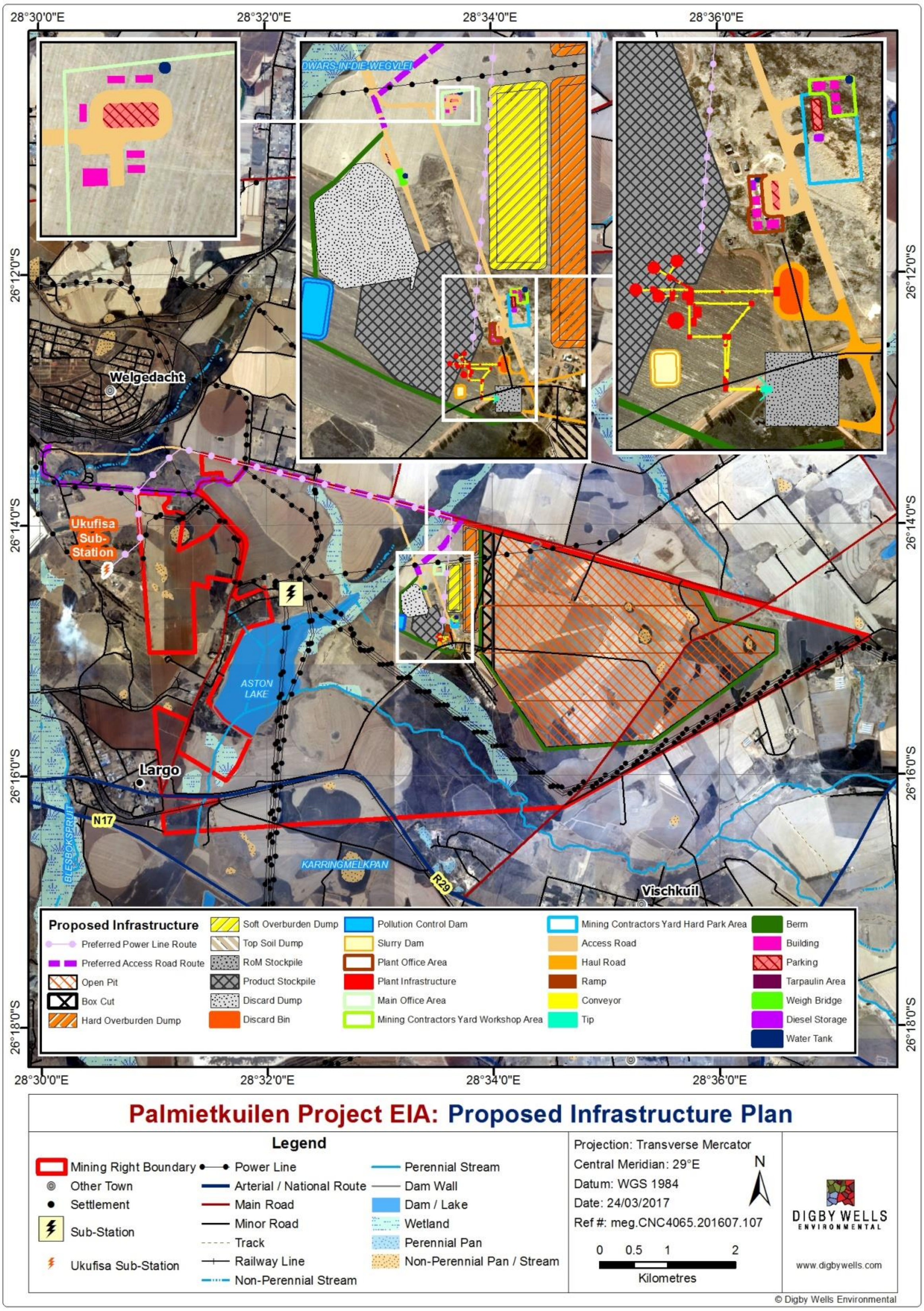
- Open pit for mining;
- Processing plant and fuel storage;
- Haul roads from pit to plant and from plant to mine access point, and various conveyor belts;
- Various overburden dumps and RoM stockpile area;
- Pollution control dam (PCD), stormwater trenches and sewage management systems; and
- Site offices and security offices.

The project activities will include the following:

- Construction
  - Site establishment;
  - Site clearing, including the removal of topsoil and vegetation;
  - Construction of mine-related infrastructure, including haul roads, pipes, dams;
  - Construction of washing plant;
  - Relocation of Infrastructure
  - Blasting and development of initial box-cut for mining, including stockpiling from initial box-cuts; and
  - Temporary storage of hazardous products, including fuel and explosives, as well as waste and sewage.
- Operation
  - Stripping topsoil and soft overburden;
  - Removal of overburden, including drilling and blasting of hard overburden;
  - Loading, hauling and stockpiling of overburden;
  - Drilling and blasting of coal.
  - Load, haul and stockpiling of RoM coal.

- Use and maintenance of haul roads for the transportation of coal to the washing plant;
- Water use and storage on-site; and
- Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste.

- Decommissioning and closure
  - Demolition and removal of all infrastructure, including transporting materials off site;
  - Rehabilitation, including spreading of soil, re-vegetation and profiling or contouring;
  - Environmental monitoring of decommissioning activities; and
  - Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste.
  - Post-closure monitoring and rehabilitation.



Plan 1: Proposed Infrastructure

3 Terms of Reference

Digby Wells Environmental (hereafter Digby Wells) was commissioned by Canyon as the environmental consultant for the development of the Palmietkuilen Mine project and to conduct the wetlands specialist studies to inform the project. The aim of the wetlands assessment through Scoping and Environmental Impact Assessment (EIA) phase is to provide a report and accompanying maps describing the following:

- Desktop scoping investigation of the potential wetlands for the project area;
- The identification and the delineation of wetlands within the area;
- A description and characterisation of the identified wetland areas;
- Determination of the wetland ecological health, importance and sensitivity as well as a 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.

4 Aims and Objectives

The aim of the wetland study is to conduct an assessment on the natural wetland habitats associated with the proposed project area. The wetland boundaries and the baseline ecological state, prior to the development, were determined. This information was to inform the project on the risks associated with the wetland ecosystems so that mitigation measures can be carried out according to best-practice and to set a baseline against which to monitor, if the project is to go ahead. The assessment aims to support the following regulations, regulatory procedures and guidelines:

- National Environmental Management Act, 1998 (Act 7 of 1998) (NEMA);
- National Environmental Biodiversity Act, 2004 (Act 10 of 2014) (NEMBA);
- Conservation of Agricultural Resources Act (CARA), 1993 (Act 43 of 1983)
- National Water Act (NWA, Act 36 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).

5 Details of the Specialist

The following specialists were part of the wetland ecological assessment:

- **Caroline Wallington**: Wetland Consultant; received a Bachelor of Science and Honours in Botany from the University of Cape Town (UCT) and is currently doing her MSc in Environmental Science at the University of the Witwatersrand part time. She is an environmental consultant specialising in wetland assessments that form part of baseline assessments, EIA's, and other projects. She also does terrestrial floral assessments, biodiversity land management plans and land rehabilitation. Caroline is competent in wetland assessment methodology and has experience in most Provinces of South Africa as well as in African countries outside South Africa including Malawi and the Democratic Republic of Congo (DRC). Caroline is the lead wetland consultant for this project and report writer.
- **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. Crystal is the support wetland consultant on this project and report reviewer.

6 Methodology

The approach followed for the wetlands study is shown in the simple flow diagram below, Figure 6-1, and each stage is briefly discussed in the following sections. This report details the results from the field investigation and the formal impact assessment and mitigation recommendations according to the mitigation hierarchy.

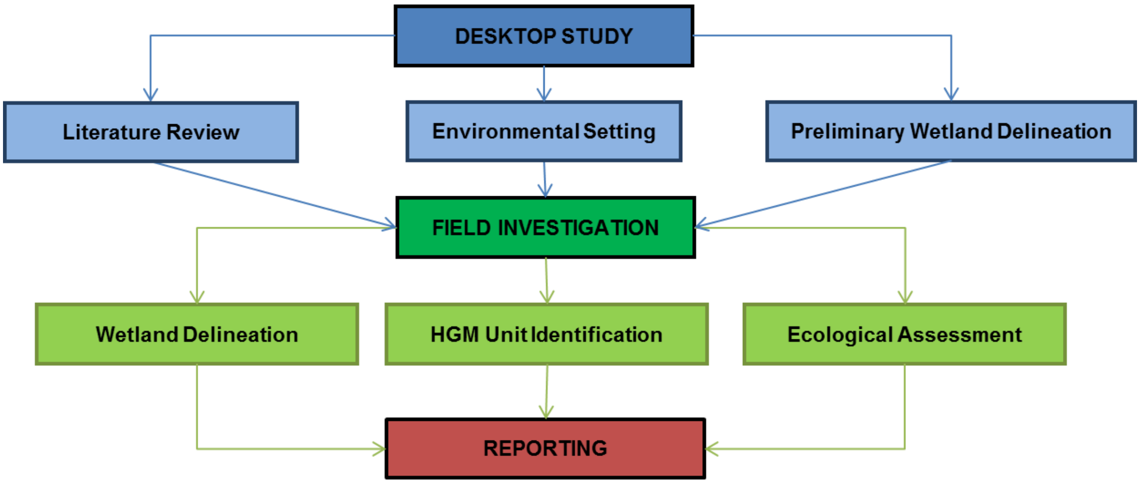


Figure 6-1: Simplified methodology followed for the wetland study

6.1 Literature Review and Desktop Assessment

Baseline and background information was researched and used to understand the area prior to fieldwork and to complete the screening (desktop) assessment. A regional understanding of the project area is gained through this process, which enables more accurate ecological assessment to be done. The information reviewed is summarised in Figure 6-2 and is detailed in this section.

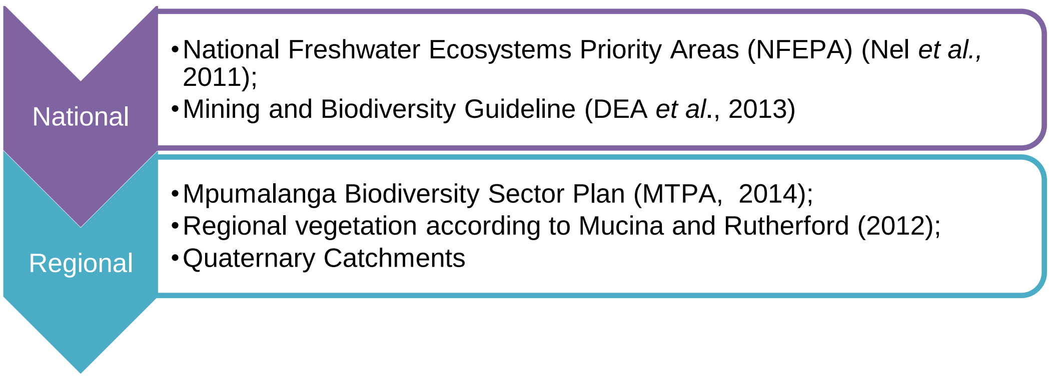


Figure 6-2: Flow diagram indicating the different levels of screening assessment data sourcing

6.1.1 National Freshwater Ecosystem Priority Areas

The NFEPA project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel *et al.* 2011). The spatial layers (FEPA's) include the nationally delineated wetland areas that are classified into hydro-geomorphic (HGM) types and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetland areas located within the project area. Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA layers. The NFEPA assessment does, however, hold significance from a national perspective. The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity and Table 6-1 below indicates the criteria that were considered for the ranking of wetland areas.

Table 6-1: 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

6.1.2 Gauteng Conservation Plan

The Gauteng Nature Conservation, a component of the Gauteng Department of Agriculture and Rural Development (GDARD), produced the Gauteng Conservation Plan Version 3 (CPlan3) in December 2010. The latest version is C-Plan 3.3 which became available in October 2011 and was revised in December 2013 (GDARD, 2014).

The main purposes of C-Plan 3.3 are:

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

The C-Plan (v 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 plan includes three categories of areas as summarised below.

Table 6-2: Gauteng C-Plan categories

Map category	Definition
PA	Those areas that are proclaimed as protected areas under national or provincial legislation, including Provincial and Municipal Nature Reserves; Other state owned protected areas; and Private Nature Reserves and Natural Heritage Sites with management plans that have biodiversity conservation as the primary objective.
CBAs	Any natural or near-natural terrestrial or aquatic area required to meet targets for biodiversity pattern and/or ecological processes.
ESAs	Natural, near-natural or degraded areas required to be maintained in an ecologically functional stare to supports CBAs; and areas with no natural habitat remaining but which retain potential importance for supporting ecological processes.

6.1.3 Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by the South African Biodiversity Institute (SANBI), the Department of Environmental Affairs (DEA), the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum in 2013 to provide the mining sector with a manual to integrate biodiversity into the planning process to allow informed decision about mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning prices. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining project. The country has been mapped into biodiversity priority areas including the four categories listed in Table 6-3 below, each with associated risks and implications. The guideline describes six key principles to achieve the objectives through each stage of the mining life-cycle, which are summarised in Figure 6-3 below.

Table 6-3: Mining and Biodiversity Guideline Categories (SANBI, 2013)

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

1. Apply the law as a minimum.
2. Use the best available biodiversity information.
3. Engage relevant stakeholders thoroughly.
4. Use best-practice environmental impact assessments (EIA) to identify, assess and evaluate impacts on biodiversity.
5. Apply the mitigation hierarchy when planning any mitigation-related activity and develop robust environmental management programmes (EMP's).
6. Ensure effective implementation of the EMP, including adaptive management.

Figure 6-3: Mining and Biodiversity Guideline Six Key Principles Summary.

6.2 Fieldwork and Seasonal Influence

In-field wetland assessments were completed on the 23rd August and 22nd September 2016 according to the methodology described herein. The wetland delineation procedure considers four attributes to determine the limitations of the wetland, in accordance with DWAF[2] guidelines (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 indicators tend to be the most important in practice. The remaining 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,

[2] now Department of Water and Sanitation (DWS)

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 (DWAF, 2005).

6.2.1 Terrain Unit Indicator

Terrain Unit Indicator (TUI) includes areas such as depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of aerial imagery and regional contours (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 6-4. HGM Units are then assessed individually for Present Ecological State (PES) and ecological services.

Table 6-4: Description of hydro-geomorphic units for wetland classification

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

Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

6.2.2 Soil Indicators

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.

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). 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.

6.2.3 Vegetation Indicator

As one moves along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas plant communities undergo distinct changes in species composition. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze and Marneweck, 1999; DWAF, 2005). This is summarised in Table 6-5 below. When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (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 6-5 becomes more important.

Table 6-5: 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.

6.3 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 6-6.

Equation 1: Overall Wetland Ecological Health Score

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

Table 6-6: 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

6.4 Wetland Ecosystem Service and Functional Assessment

Two tools are used to understand the goods and services provided by the wetlands as well as determine their relative importance and sensitivity. These methodologies are described below.

6.4.1 WET-EcoServices 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 rated as high are scored more than or equal to 2.8.

6.4.2 Wetland Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. The methodology outlined by DWAF (1999) and updated in Rountree 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 6-7.

Table 6-7: 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	>3 and <=4
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.	
High	>2 and <=3
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	
Moderate	>1 and <=2
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.	
Low/marginal	>0 and <=1

Ecological Importance and Sensitivity Category (EIS)	Range of Scores
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.	

6.5 Potential Environmental Impacts and Risks

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below. The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

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

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven (Table 6-8). The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this EIA/EMP Report. The significance of an impact is then determined and categorised into one of eight categories (Table 6-9 and Table 6-10). It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 6-8: Impact Assessment Parameter Ratings

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	<u>Province/ Region</u> 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.	<u>Municipal Area</u> 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/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 6-9: Probability/Consequence Matrix

Significance

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

Consequence

Table 6-10: Significance Rating Description

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

7 Assumptions and Limitations

- Fieldwork was undertaken in late winter and early spring of 2016. Grasses and forbs were not in flower and therefore most of them were not identifiable.
- Field assessments were completed to assess as much of the site as possible with focus on the proposed directly impacted areas; however it was not possible to ground-truth every wetland boundary and thus some extrapolation was required.

8 Baseline Environment

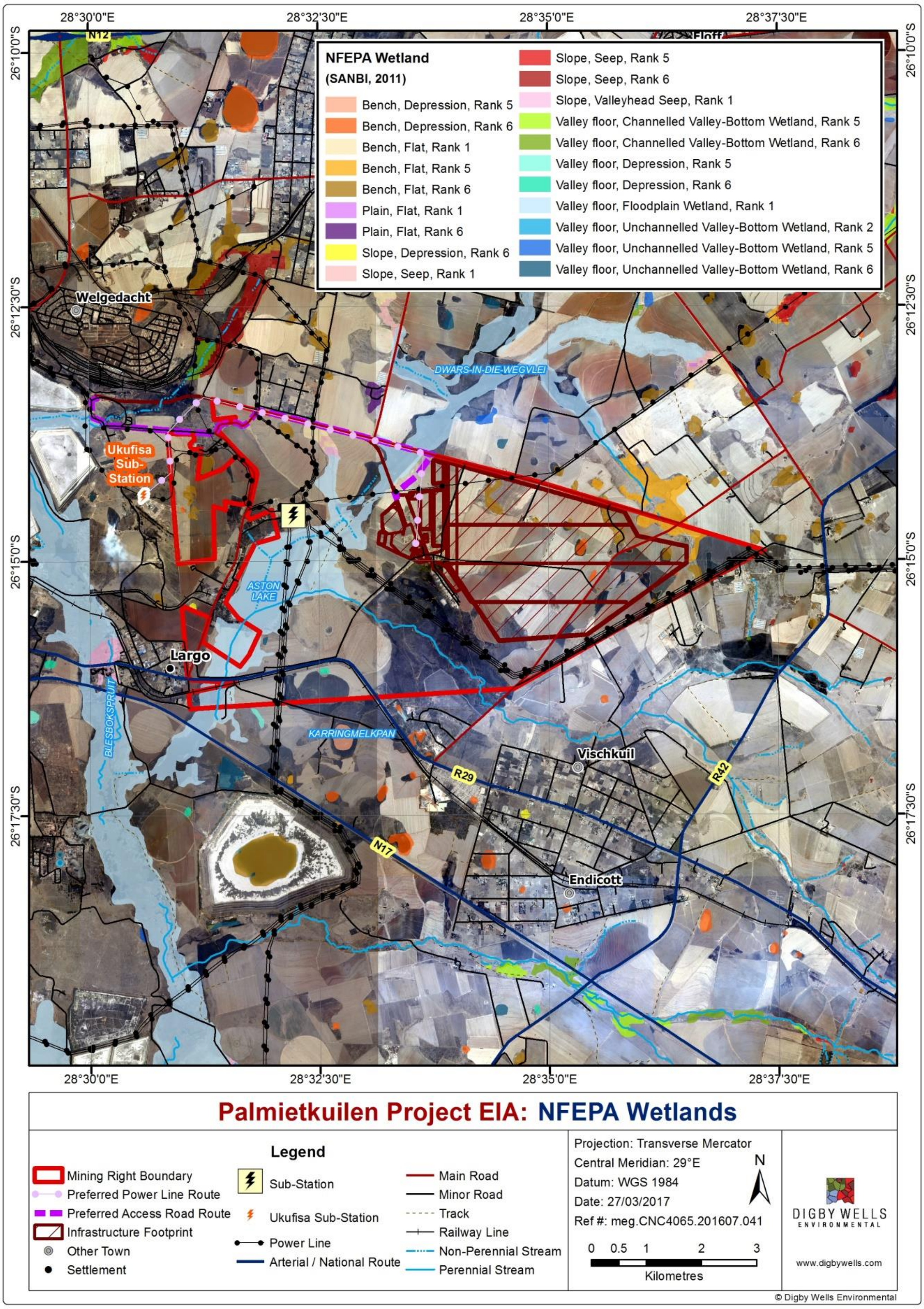
8.1 Drainage and Catchments

The project sites are located in the Upper-Vaal Catchment management area and within the Blesbokspruit Water Catchment Area. The project site is mostly within the quaternary catchment C21E, with a small part of the north-western corner within C21D (see the Aquatics and Surface Water Reports for more information, Digby Wells, 2016).

8.2 National Freshwater Ecosystem Priority Areas

The project area is dominated by the NFEPA valley floor floodplain wetland (rank 1) associated with Aston Lake, which drains into the Blesbokspruit River Ramsar wetland and Marievale Nature Reserve. The Blesbokspruit wetland is listed as a Ramsar wetland site of International Importance; one of 17 in South Africa and the only one in the Gauteng Province. It was designated as such in October 1986 as it was one of few permanent water bodies in the former Transvaal region with ecological significance (South African Wetlands Conservation Programme, 1999). Due to this status and the connectivity to the Bleskbokspruit watercourse, the valley bottom wetlands associated with the Aston Lake have an NFEPA rank of 1; the highest possible classification in the ranking criteria (Table 6-1).

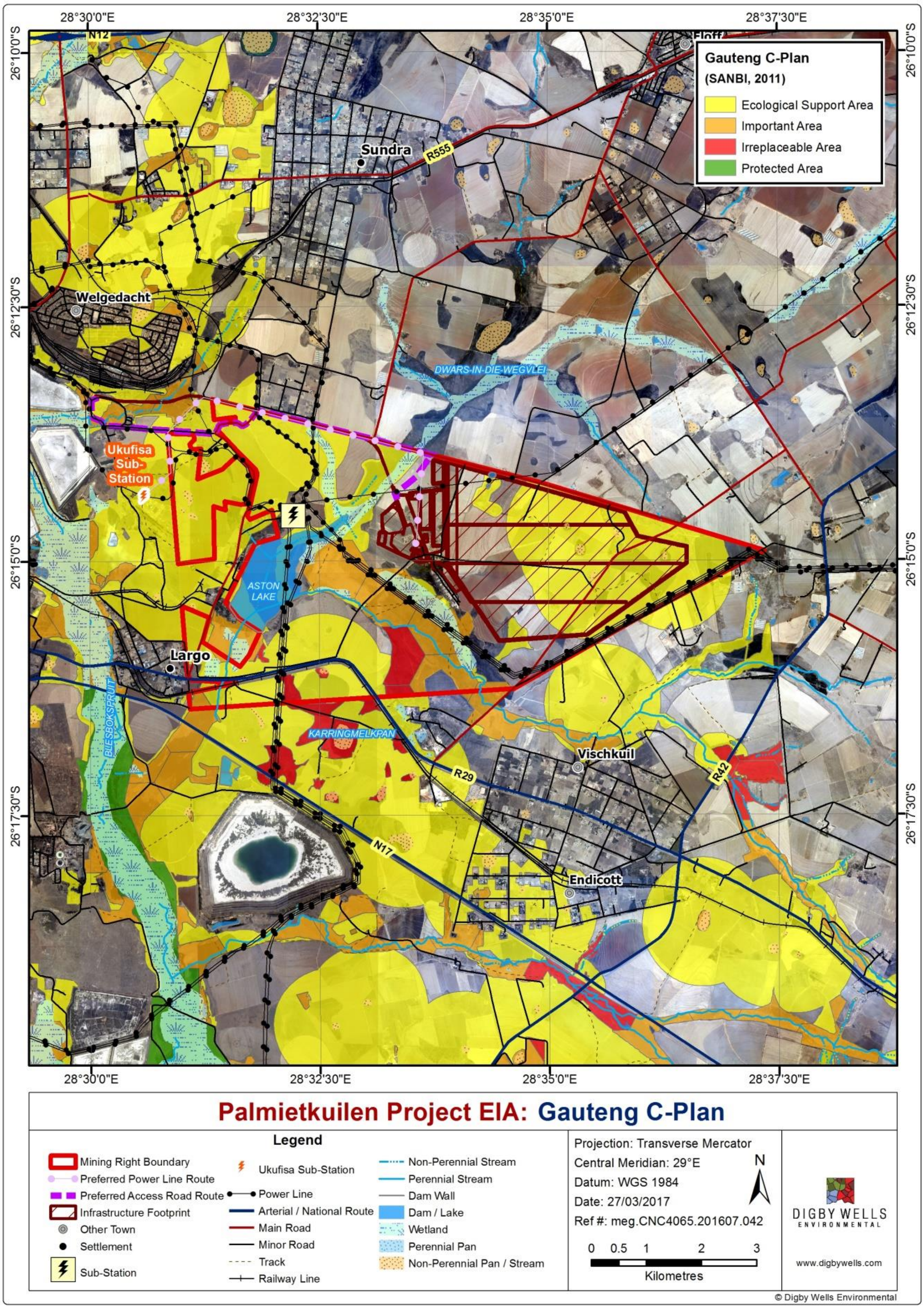
The other NFEPA wetlands within the project area include depressions, bench flats and some small areas of valley bottom wetlands, as shown on Plan 2. These are mostly located on hillslopes up to and including the catchment divide landscape positions and are mostly found within agricultural land. All of these wetlands are classed as “other natural wetlands” and thus have a FEPA ranking of 6.



Plan 2: NFEPA Wetlands

8.3 Gauteng C-Plan

The project area is characterised by both CBA's and ESA's as shown in Plan 3. The NFEPA wetlands and the buffer of 500m around them have been classified as ESAs, comprising a large proportion of the site. Furthermore, the tributary leading into Aston Lake, although not designated as an NFEPA wetland, is an 'Important' CBA and some natural areas have been identified as 'Irreplaceable'. The dominant floodplain valley bottom NFEPA wetland associated with Aston Lake and leading to the Blesbokspruit River and Ramsar wetland is designated as a mixture of ESA and CBA 'Important Areas'.



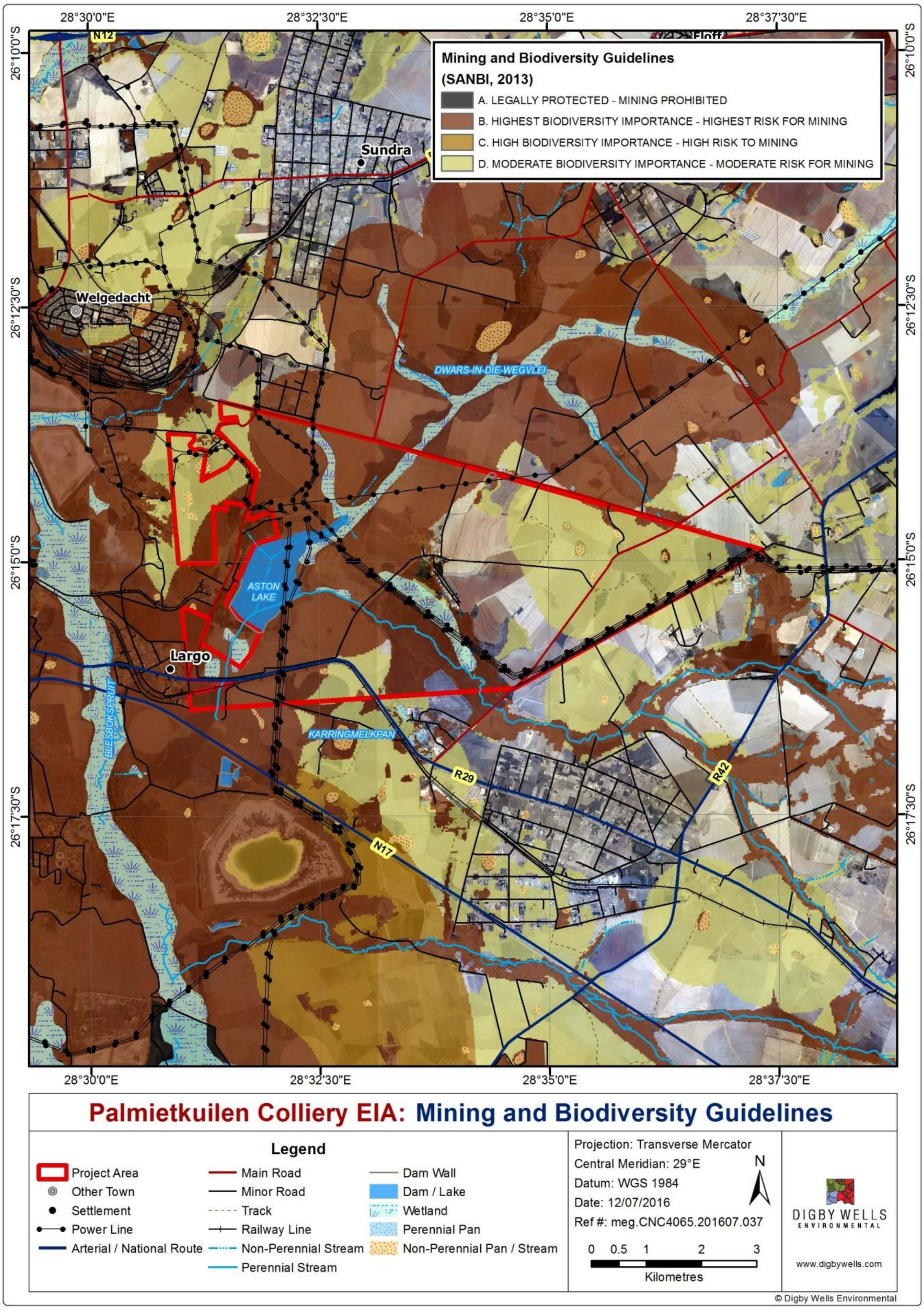
Plan 3: Gauteng Conservation Plan

8.4 The Mining and Biodiversity Guideline

The project has many areas with a risk to mining according to the guideline as shown in Plan 4 and summarised below:

Table 8-1: Mining and Biodiversity Guideline Categories (SANBI, 2013)

Category	Areas associated with mining project
Legally protected	No areas.
Highest Risk: Highest Biodiversity Importance	Areas of highest risk to mining are associated with the following areas due to highest biodiversity value: ▪ The dominant valley floor wetlands including Aston Lake (recognised by NFEPA as rank 1) and the 500m buffer area around this; and ▪ The Important and Irreplaceable CBA's.
High Risk: High Biodiversity Importance	No areas
Moderate Risk: Moderate Biodiversity Importance	▪ Other wetlands associated with NFEPA and their 500m buffers; and ▪ The ESA's



Plan 4: Mining and Biodiversity Guideline

9 Wetland Findings

9.1 Wetland Units and Indicators

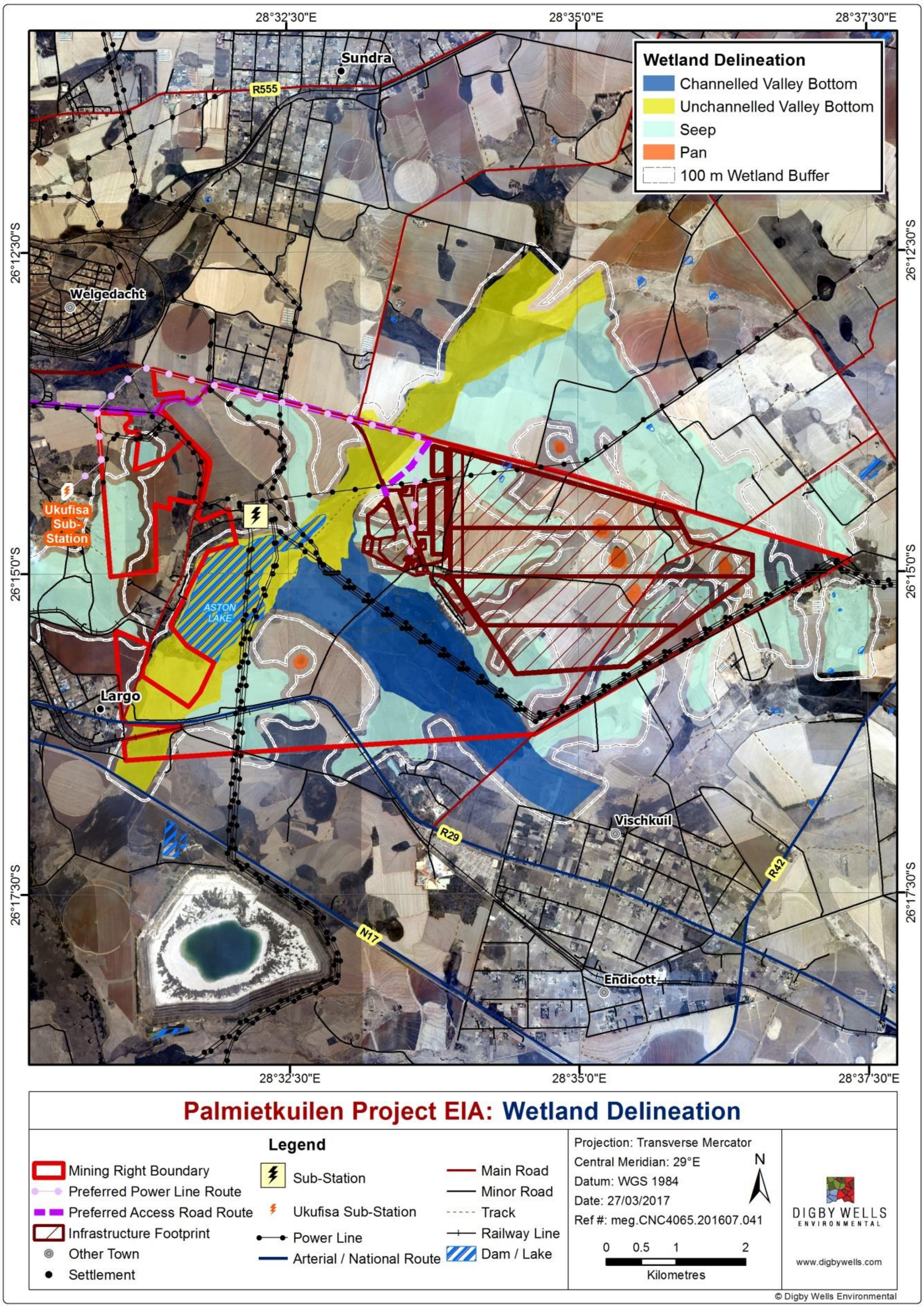
The proposed MRA is characterised by multiple wetland systems, totalling 1,550.4 ha (Plan 5). There are two major valley bottom systems, one being channelled and the other unchannelled; the latter draining into the former. The unchannelled system has been dammed and is referred to as Aston Lake, tis continues to the N17 and further. The remainder of the area is characterised by extensive hillslope seeps that drain into the valley bottom wetlands and pan wetlands at the tops of the hills.

The main floral indicators, identifiable at the time of sampling (August 2016), were *Imperata cylindrica* (Cottonwool Grass) found in the hillslope seeps (Figure 9-1c) and *Typha capensis* (Bullrush) in the permanent wet zones. Much of the vegetation was unidentifiable due to the timing of the site visit and also as the area has been grazed, burnt and replaced with crop plants across the majority of the wetlands.

The soils were thus the major indicator for the delineation of the wetlands. Terrestrial soils were typically associated with Hutton and Clovelly soil forms whilst the wetlands were characterised by Aracadia and Wesleigh soil form (Figure 9-2). A soils assessment has been completed and should be referred to for more detailed information (Soils, Land Use and Land Capability Report, Digby Wells, 2016).

Figure 9-1: Example photos of main wetlands present on site: a) Aston Lake; b) unchannelled valley bottom wetland; c) hillslope seep characterised by *Imperata cylindrica* (Cotton wool Grass) stand; and d) pan wetland

Figure 9-2: Characteristic soil forms identified on site showing: a) terrestrial soil, Hutton form; b) bleached E-horizon wetland soils found in the hillslope seeps, typical of Kroonstad form; and c) soils with mottling present and higher organic carbon content, typical of the valley bottom wetlands with Arcadia soil form



Plan 5: Wetland Delineation

9.2 Wetland Ecological Health and Functionality Assessment

The wetlands have been altered significantly from their natural state as the area has been largely transformed by agricultural activities. Croplands have replaced much of the naturally occurring vegetation and this has impacted the ability of wetlands to maintain biodiversity. This disturbance has also led to the establishment of alien and invasive plant species, further limiting the ability of the hydromorphic grasslands to function. The vegetation has been significantly impacted by cattle grazing and trampling. Please refer to the full floristic study for further information (Fauna and Flora Report, Digby Wells, 2016). The presence of urban developments and industrial infrastructure (such as powerlines and a sub-station) affect the ecological integrity of the wetlands and deter avifaunal populations.

The agricultural activities including cattle farming has resulted in impaired water quality of the wetlands associated with the site. These activities cause increased sedimentation of the systems due to exposed substrate. Sedimentation alters the natural hydrological and geomorphological functioning of the wetlands and may have an impact on aquatic life. The impaired water quality may also result from additional loading of phosphates and nitrates.

Whilst the current land use practices have compromised the natural ecological functioning and biodiversity maintenance role of these wetlands, these roles are still important, as they are linked to the greater stream network and are protected by the NWA. Most of the project area was mapped as ESA's according to the provincial conservation plan whilst some wetlands were CBA's (Section 8.3). The wetlands and landscape also play an important ecological role as they are tributaries to the Blesbokspruit Ramsar Wetland of International Importance and the Marievale Bird Sanctuary. The wetland, located ±1km west of the MRA and totalling 1 858 ha, was designated as such in October 1986 as it was one of few permanent water bodies in the former Transvaal region with high ecological significance (South African Wetlands Conservation Programme, 1999).

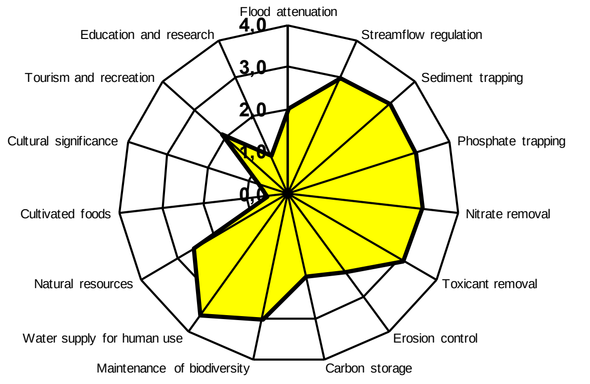
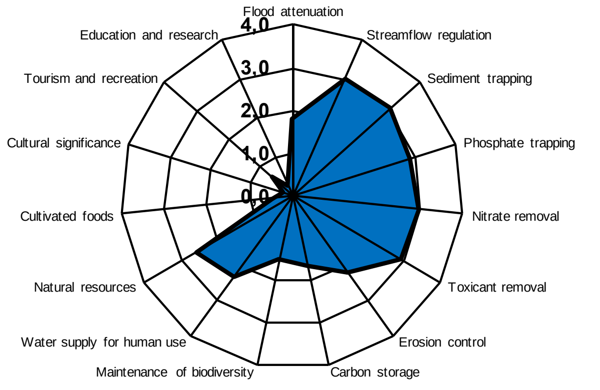
Additionally, the wetlands provide services such as flood attenuation, streamflow regulation during low flow periods and water quality improvement. The wetlands are important for the provision of the crops as well as the cattle raise on the properties. Due to the significant extent of hillslope seep wetlands, which indicate shallow groundwater, catchment recharge is an important function. The hydrofunctional role of the wetlands was found to be greater than the ecosystem services offered for maintenance of biodiversity (Table 9-1).

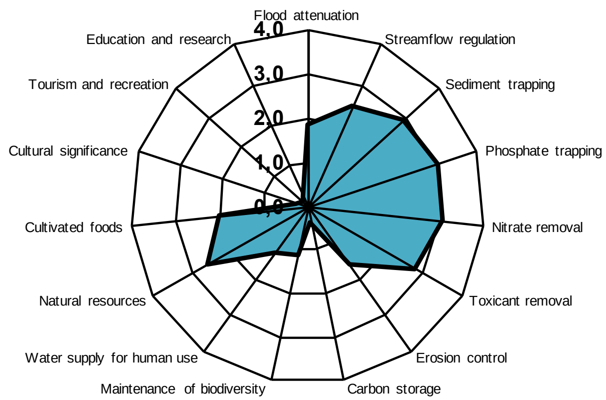
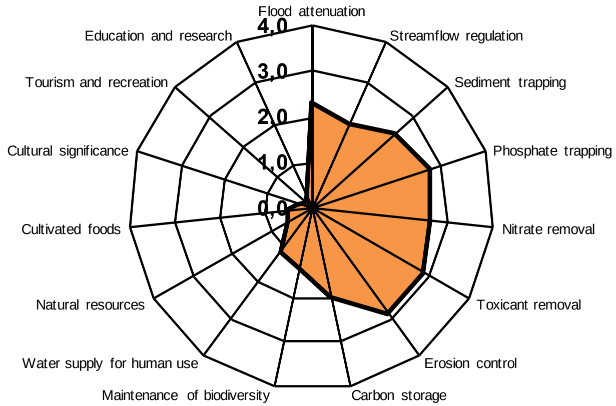
Figure 9-3: Examples of impacts to wetland systems: a) roads crossing through wetlands; b) culverts associated with major road crossings; c) agricultural fields replacing natural vegetation; and d) cattle in the wetlands

Table 9-1: Summary of wetlands present ecological state

Wetland HGM Unit	Area (ha)	PES and WET-Health Score
Unchannelled Valley Bottom with Aston Lake	423.5	D – Largely modified (5.0)
Channelled Valley Bottom	404,9	D – Largely modified (5.2)
Hillslope seeps connected to the valley bottom	695.2	E – Critically modified (6.3)
Pans	26.8	D – Largely modified (4.8)

Table 9-2: Summary of wetlands ecological importance, sensitivity and services provided

Wetland Unit	Importance and Sensitivity Assessment		WET-EcoServices Assessment	
Unchannelled Valley Bottom with Aston Lake	Ecological	High (2.2)	Water supply for human use (3.5) Sediment trapping (3.2) Phosphate trapping (3.2) Nitrate removal (3.2) Toxicant removal (3.1) Streamflow regulation (3.0) Maintenance of biodiversity (3.0) Natural resources (2.6)	
	Hydrological	High (2.1)		
	Direct Human Benefits	Moderate (1.3)		
Channelled Valley Bottom	Ecological	Moderate (1.8)	Sediment trapping (3.1) Streamflow regulation (3.0) Nitrate removal (3.0) Toxicant removal (2.9) Phosphate trapping (2.9) Natural resources (2.6)	
	Hydrological	Moderate (2.0)		
	Direct Human Benefits	Moderate (1.1)		

Hillslope seeps connected to the valley bottom	Ecological	Low (1.0)	Phosphate trapping (3.1) Nitrate removal (3.1) Sediment trapping (2.9) Toxicant removal (2.8) Natural Resources (2.6)	
	Hydrological	Moderate (1.9)		
	Direct Human Benefits	Low (0.8)		
Pans	Ecological	Low (0.6)	Erosion control (2.9) Toxicant removal (2.8) Phosphate trapping (2.7) Nitrate removal (2.6)	
	Hydrological	Low (0.9)		
	Direct Human Benefits	Low (0.5)		

10 Sensitivity Analysis and No-go Areas

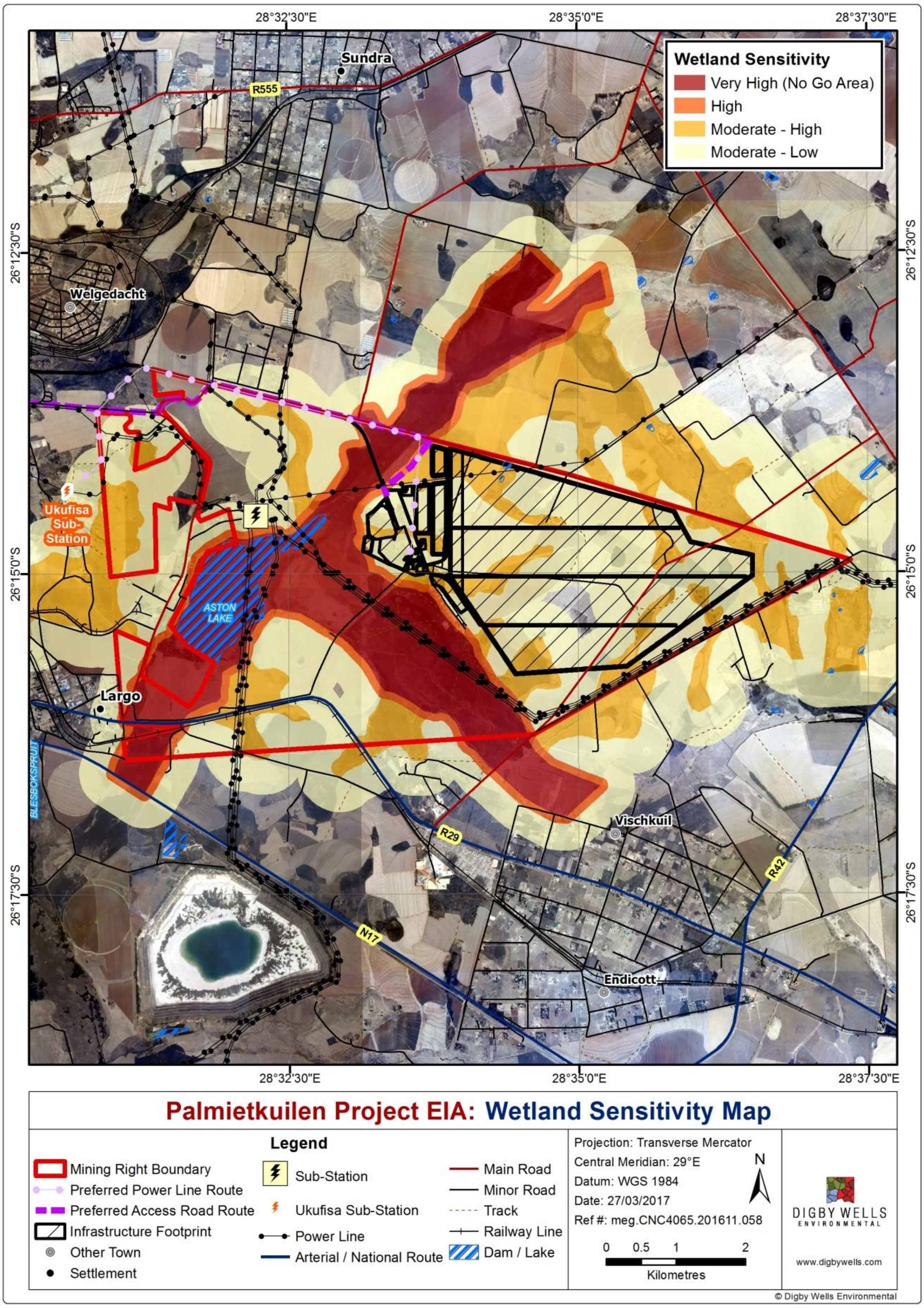
The Gauteng Conservation Plan (GDARD, 2014) shows a considerable area within and immediately around the MRA identified as ESAs; additionally with some 'Irreplaceable' and 'Important' CBAs. These areas are largely associated with the wetlands of the area and their buffer zones. Further to this, some of these wetlands are highlighted as NFEPAs and the Ramsar Status of the Blesbokspruit wetlands was assigned a rank of 1.

According to the Mining and Biodiversity Guideline (SANBI, 2013), the project area is characterised by large areas regarded as being highest risk to mining projects. These are areas are associated with the dominant valley floor wetlands including Aston Lake and the 500m buffer area around this as well as the identified CBA's. Some other areas are identified as having a moderate risk to mining and these are associated with other NFEPA wetlands on the hill top and their 500m buffers; as well as the ESA's.

Wetlands associated with the project area, as well as their buffers, were rated according to their ecological sensitivity as listed in Table 10-1 and represented in Plan 6. A buffer is the area surrounding the wetland within which land-use activities may directly affect the ecological character of the wetland itself, and the objective for land-use within the buffer zone should be one of sustainable use through ecosystem management, consistent with the maintenance of the ecological character of the wetland (Ramsar Convention Secretariat, 2010).

Table 10-1: Wetland sensitivity ratings

Sensitivity Rating	Wetland Areas identified
Very High – No Go areas	Valley bottom wetlands including Aston Lake.
High	The area constituting the immediate buffer area of the valley bottom wetlands; i.e. from the edge to 100 m.
Moderate – High	The hillslope seep wetlands.
Moderate – Low	The 500 m buffer zone of all wetlands as well as the impacted pans.



Plan 6: Wetland Sensitivity Ratings

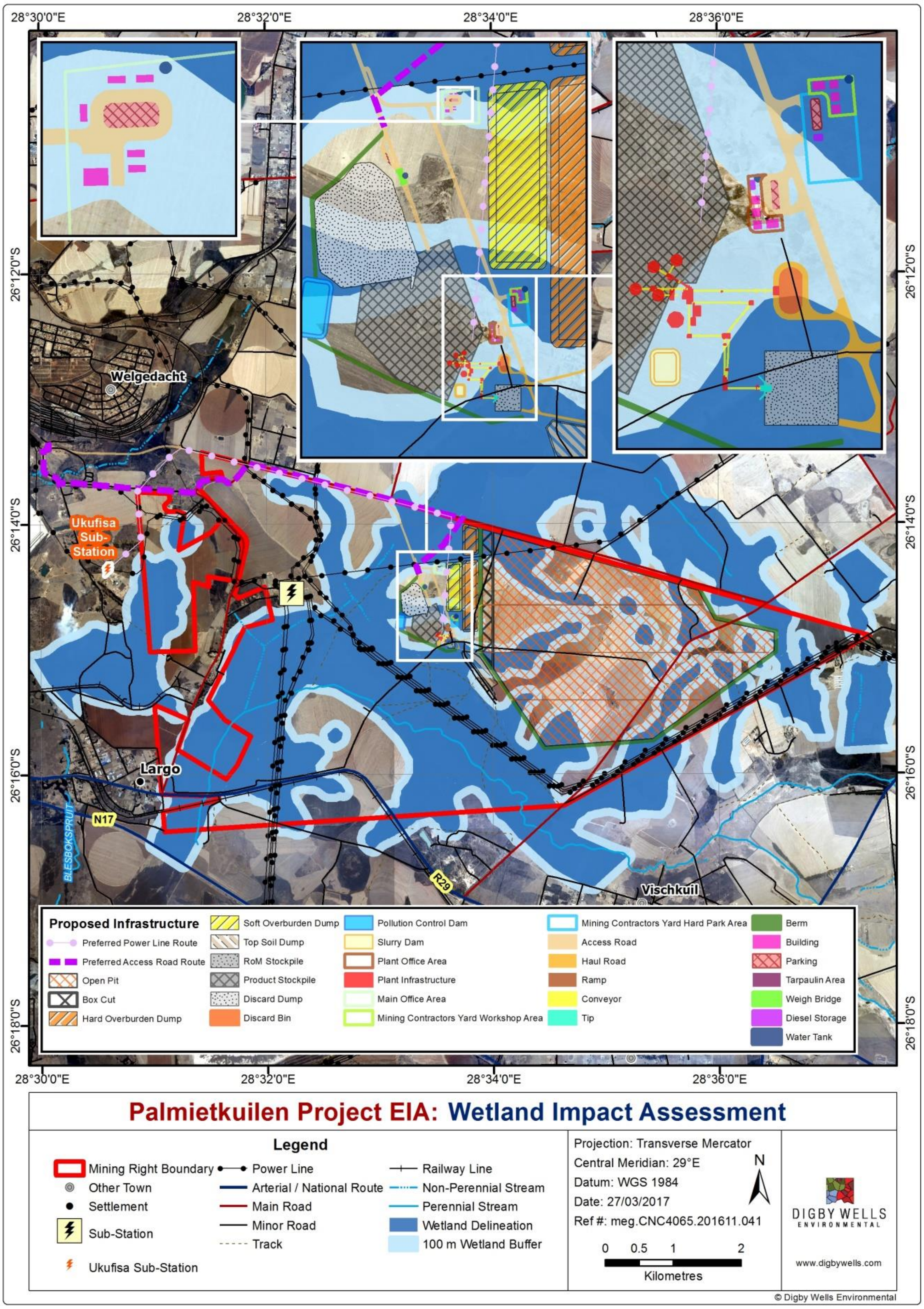
11 Wetland Impact Assessment

11.1 Summary of Proposed Project Interactions with Wetlands

The proposed project will interact and impact upon internationally recognised wetland resources associated with the area. A total of 255.2 ha of wetland area will be lost; of which 201.9 ha is associated with the open pit and 53.3 ha the supporting infrastructure (Table 11-1; Plan 7). The sections that follow detail the expected impacts to wetlands associated with the project.

Table 11-1: Areas of Wetlands Directly Associated with the Mine Plan and Infrastructure

Mine Plan and Infrastructure unit	Total area (ha) of wetland
Open pit mine area	201.9
All supporting infrastructure	53.3
Total	**255.2**



Plan 7: Wetland impact assessment

11.2 Construction Phase Impacts

11.2.1 Project Activities Assessed

The construction phase activities that will have an impact on the wetlands are summarised below.

Table 11-2: Construction Phase Interactions with Wetlands

Interaction		Impact
1	Site Clearance, including the removal of topsoil and vegetation, for the construction of mine-related infrastructure	Loss of wetland habitat (soils and vegetation) totalling 53.3 ha for infrastructure and 201.9 ha associated with the open pit area.
2	Construction of mine-related infrastructure and blasting and development of initial box-cut for mining	Construction and development activities within a greenfield site is a negative impact to functioning wetlands and catchment.

11.2.2 Impact Description

The construction phase will result in a loss of wetland areas of 53.3 ha for infrastructure and 201.9 ha for the open pit area. Since the impact is irreversible, this will result in permanent loss of ecosystem services provided by the wetlands in question.

Although the wetlands of the area are not in a pristine condition due to agricultural use, the proposed project activities will significantly alter the baseline state of the surrounding wetlands as these systems are not currently affected by industrial or mining activities. This is realised through habitat fragmentation, spreading of alien and invasive species, increased incidence of erosion, potential water quality deterioration and disturbance to avifauna and other fauna utilising the wetlands.

11.2.3 Management Objectives

Wetland management objectives are to inform Canyon Coal where there are interactions of the proposed activities with wetlands during the construction phase and how best they can mitigate and manage the impacts if the project is to go ahead. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region. These objectives are to prevent/minimise the loss of or further damage to natural wetland ecosystems and their buffer areas as protection of wetland ecosystem is a national objective; particularly of NFEPA wetlands.

11.2.4 Management Actions and Targets

The proposed project will result in significant residual impacts to the wetlands and thus rigorous management will be needed. From a perspective of ecological sensitivity, the proposed project could result in significant, irreversible impacts to wetlands. If the project is to go ahead, the Wetland Management Plan detailed in section 14 must be used to inform mitigation actions, including:

- The edge of the non-directly affected valley bottom wetlands must be clearly demarcated in the field as sensitive receptors and no-go zones. This should also include at least a 32 m buffer zone.
- Wetland monitoring must be carried out during the construction phase to ensure no unnecessary impact to wetlands is realised; and if so this action should be put in place as soon as possible;
- Mitigation and management actions provided in the following reports done by Digby Wells as part of this project should be used to guide the effective management of the ecological wetland resources affected by the proposed project:
  - Air Quality Report (Digby Wells, 2016 a);
  - Aquatic Ecology Report (Digby Wells, 2016b);
  - Fauna and Flora Report (Digby Wells, 2016c)
  - Groundwater Assessment Report (Digby Wells, 2016d);
  - Rehabilitation Plan (Digby Wells, 2016e); and
  - Surface Water Report (Digby Wells, 2016f).

11.2.5 Impact Ratings

The tables below summarise the results of the quantitative impact assessment with pre- and post- mitigation values. These cover the impacts listed in Table 11-2.

Table 11-3: Potential Impacts of Construction Phase Interaction 1 on Wetlands: Site Clearance Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction 1: Site Clearance, including the removal of topsoil and vegetation, for the construction of mine-related infrastructure and the pit area.			
Impact Description: Loss of wetland habitat (soils and vegetation) totalling 53.3 ha for infrastructure and 201.9 ha associated with the open pit area. This impact will be irreversible and will result in complete loss of wetland ecosystems or part thereof. Although these wetlands are not in pristine condition, they are providing significant ecological services at the local and catchment scale. This is of particular concern due to the link to the NFEPA rank 1 Ramsar listed wetland (Blesbokspruit).			
Prior to Mitigation/Management			
Duration	Permanent (7)	The removal of wetland soils and intact vegetation will be a permanent loss of wetland habitat.	**Major negative (-119)**
Extent	Municipal (4)	Loss of wetland ecosystems that are significant on a catchment scale.	
Intensity	Irreplaceable loss of highly sensitive environment (6)	Wetlands are sensitive natural ecosystems providing significant ecological services that are experiencing high levels of cumulative loss and damage. Thus, all remaining functional wetlands are even more important and sensitive to impacts that threaten their ecological integrity; directly or indirectly.	
Probability	Definite (7)	According to the given infrastructure layout, this impact will occur.	
Nature	Negative		
Mitigation/Management Actions			
▪ There are no mitigation measures for loss of habitat; however off-sets must be investigated in such a case.			

Table 11-4: Potential Impacts of Construction Phase Interaction 2 on Wetlands: General Construction Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: Construction of mine-related infrastructure and blasting and development of initial box-cut for mining.			

Dimension	Rating	Motivation	Significance
Impact Description: Construction and development activities within a greenfield site is a negative impact to functioning wetlands and catchment. This is realised through habitat fragmentation, spreading of alien and invasive species, soil compaction, increased incidence of erosion, sedimentation from dust and erosion, potential water quality deterioration and disturbance to avifauna and other fauna utilising the wetlands.			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impacts caused during the construction will have a long lasting effect if not mitigated. Impacts must be managed proactively.	**Minor negative (-70)**
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality or alien invasive species to travel significant distances; especially downstream. Habitat fragmentation is also a catchment scale impact.	
Intensity	Serious damage to or loss of sensitive environments (5)	These impacts are serious threats to the important and sensitive wetland habitats; especially in an area with high level of cumulative habitat loss and water quality deterioration as well as NFEPA Rank1 status (Blesbokspruit Ramsar Wetland).	
Probability	Likely (5)	These impacts are common of mining and industrial construction sites and project and thus have at least a 65% chance of occurring with some small mitigation measures assumed.	
Nature	Negative		
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
▪ The edge of the non-directly impacted wetlands, and at least a 32m buffer if possible, must be clearly demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the construction phase. ▪ Wetland monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible. ▪ Refer to the Surface Water Report (Digby Wells, 2016f) for details on a Storm Water Management Plan that is to be carried out. This must be in operation during the construction phase and wetlands must be highlighted as sensitive receptors. ▪ Refer to the Fauna and Flora Report (Digby Wells, 2016c) for mitigation measures relating to floristic impacts as well as faunal species disturbances; for example, o minimal bright lights should be left on at night time and they should not face outwards of the site; and o an alien and invasive plant species management programme must be in place from the construction phase.			
Post-Mitigation			
Duration	Medium term (3)	The potential impacts caused during the construction will remain a threat throughout the project life but the managed impact will have a medium term impact in the ecosystem.	**Negligible negative (-32)**
Extent	Local area (3)	Managing and mitigation measures will prevent the impacts from spreading beyond the local development site.	
Intensity	Minor (2)	With fully functional management, monitoring and mitigation plans, the impact to the ecosystem functioning will be minimal.	
Probability	Probable (4)	Despite all intentions to prevent impacts, it is probable that impacts will still be realised due to the nature of the activity and the proximity to sensitive wetland receptors. These potential residual impacts must be managed accordingly.	
Nature	Negative		

11.3 Operational Phase Impacts

11.3.1 Project Activities Assessed

The operational phase activities that will have an impact on the wetlands are summarised below.

Table 11-5: Operational Phase Interactions with Wetlands

Interaction		Impact
1	Open pit mining to a depth of 60 m, requiring dewatering.	Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone
2	General operational activities within and around wetland habitats such as the use and maintenance of haul roads, stockpiling of RoM coal, transportation of coal to the washing plant.	Similarly to the construction phase, the operational mining activities occurring within an ecologically sensitive catchment, which pose significant potential negative impacts to functioning wetlands and catchment.

11.3.2 Impact Description

Mining of coal within and around wetland ecosystems represents significant negative impacts to these ecosystems that function from a combination of surface and groundwater inputs. The open pit mining will result in irreversible loss of wetlands due to blasting of the base rock and puncturing of the aquifers. Furthermore, the mining may cause draw-down into the mining pit that will require dewatering and lead to significant hydrological impacts to the catchment. The surface water runoff from the project area will also not be reporting to the valley bottom and into the hydrological cycle as this will be captured into the dirty water storm water management system.

The handling, stockpiling and transport of the coal will have some impacts to the wetlands, particularly with respect to the haul road that crosses the NFEPA Rank 1 wetland, upstream of Aston Lake. Movement of coal openly through the environment will have some deposition of coal fines that will negatively impact the surrounding environment, particularly the water quality of the water resources. Furthermore, the maintenance of this haul road will require activities within the wetlands to continue through operational phase that may result in soil compaction, erosion and increased sedimentation into the aquatic environment.

11.3.3 Management Objectives

Wetland management objectives are to inform Canyon Coal where there are interactions of the proposed activities with wetlands during the operational phase and how best they can mitigate and manage the impacts if the project is to go ahead. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region. These objectives are to prevent/minimise the loss of or further damage to natural wetland ecosystems and their buffer areas as protection of wetland ecosystem is a national objective; particularly of NFEPA wetlands.

11.3.4 Management Actions and Targets

The proposed project will result in significant residual impacts to the wetlands and thus rigorous management will be needed. The Wetland Management Plan detailed in section 14 must be used to inform mitigation actions, including:

- The edge of the non-directly affected valley bottom wetlands must be clearly demarcated in the field during operation as sensitive receptors and no-go zones. This should also include at least a 32 m buffer if possible.
- Wetland monitoring must be carried out during this phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible;
- Mitigation and management actions provided in the following reports done by Digby Wells as part of this project should be used to guide the effective management of the ecological wetland resources affected by the proposed project:
  - Air Quality Report (Digby Wells, 2016a);
  - Aquatic Ecology Report (Digby Wells, 2016b);
  - Fauna and Flora Report (Digby Wells, 2016c);
  - Groundwater Assessment Report (Digby Wells, 2016d);
  - Rehabilitation Plan (Digby Wells, 2016e); and
  - Surface Water Report (Digby Wells, 2016f).

11.3.5 Impact Ratings

Table 11-6: Potential Impacts of Operational Phase Interaction 1 on Wetlands: Open pit mining

Dimension	Rating	Motivation	Significance
Activity and Interaction 1: Open pit mining to a depth of 60 m, requiring dewatering.			
Impact Description: Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone.			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Beyond project life (6)	Mining of wetlands and adjacent to sensitive wetland receptors (NFEPA Rank 1) may have an irreversible impact to the functioning of these ecosystems. The mining will also be a permanent change to the wetland setting and groundwater functioning.	**Major negative (-112)**
Extent	Municipal (4)	The affected wetlands drain directly into the sensitive Blesbokspruit River and catchment. Whilst these systems are not in pristine condition, further impacts as to the system from the proposed project to this area may have municipal / catchment level significance.	
Intensity	Irreplaceable damage to highly sensitive environments (6)	These rivers and wetlands are important for the ecological services they provide to society; particularly due to the high level of cumulative loss of wetland functioning in the area. Mining of these wetlands may lead to the loss of some of these areas and this is seen as an irreplaceable loss of these highly sensitive systems.	
Probability	Definite (7)	Mining of these wetlands will go ahead according to the proposed project and thus will lead to the impacts described.	
Nature	Negative		
Mitigation/Management Actions			
- There are no foreseen mitigation actions that may significantly lessen the impact on the receiving catchment. However, the following should be done: - Dirty water from the storm water system and pollution control dam should be treated and released back into the surrounding wetland systems; downstream of the dewatering cone of depression, this water can also be used for irrigation of surrounding land. - Off-sets must be investigated to mitigate the residual impact, this can be achieved by rehabilitating an impacted wetland system.			
Post-Mitigation			
Duration	Beyond project life (6)	Mining of wetlands and adjacent to sensitive wetland receptors (NFEPA Rank 1) may have an irreversible impact to the functioning of these ecosystems. The mining will also be a permanent change to the wetland setting and groundwater functioning.	**Major negative (-112)**

Dimension	Rating	Motivation	Significance
Extent	Municipal (4)	The affected wetlands drain directly into the sensitive Blesbokspruit River and catchment. Whilst these systems are not in pristine condition, further impacts as to the system from the proposed project to this area may have municipal / catchment level significance.	
Intensity	Irreplaceable damage to highly sensitive environments (6)	These rivers and wetlands are important for the ecological services they provide to society; particularly due to the high level of cumulative loss of wetland functioning in the area. Mining of these wetlands may lead to the loss of some of these areas and this is seen as an irreplaceable loss of these highly sensitive systems.	
Probability	Definite (7)	If approved, mining of these wetlands will go ahead according to the proposed project and thus will lead to the impacts described.	
Nature	Negative		

Table 11-7: Potential Impacts of Operational Phase Interaction 2 on Wetlands: General operational activities

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: General operational activities within and around wetland habitats such as the use and maintenance of haul roads, stockpiling of RoM coal, transportation of coal to the washing plant.			
Impact 1 Description: The operational activities will be occurring within an ecologically sensitive catchment and thus the handling, stockpiling and transport of the coal will have some impacts to the wetlands, particularly with respect to the haul road that crosses the NFEPA Rank 1 wetland, upstream of Aston Lake. Movement of coal openly through the environment will have some deposition of coal fines that will negatively impact the surrounding environment, particularly water quality. Furthermore, the maintenance of this haul road will require activities within the wetlands to continue through operational phase that may result in soil compaction, erosion and increased sedimentation into the aquatic environment			
Prior to Mitigation/Management			
Duration	Beyond Project Life (6)	Carbonaceous material will cause pollution of the water that may reside for a time longer than the operation of the project. Additionally, if erosion occurs from the increased vehicular activity around this area, the impact will last longer the project.	**Moderate negative (-84)**

Dimension	Rating	Motivation	Significance
Extent	Municipal (4)	The affected wetlands drain directly into the sensitive Blesbokspruit River and catchment. Whilst these systems are not in pristine condition, further impacts as to the system from the proposed project to this area may have municipal / catchment level significance.	
Intensity	On-going serious damage to sensitive environments (4)	These wetlands are sensitive receptors and this represents serious ecological damage to the health and functioning.	
Probability	Highly Probable (6)	The activities within and around the wetlands are very likely to lead to the impacts described.	
Nature	Negative		
Mitigation/Management Actions			
- The haul roads and servitude must also have well-designed stream crossings and drainage areas, which should be maintained. The wetlands outside of this must be demarcated as no-go areas. - Dust management programme must be in place (Air Quality Report, Digby Wells, 2016a) - The haul roads and servitude must be monitored and maintained to best operating standards. This should be done in the dry season. - The wetland must be monitored, by a qualified specialist, on a regular basis to ensure no residual impact to the wetland and river is realised; and if so that remediation measures are followed. - If possible, truck loads should be covered; particularly in dry and windy seasons. - Berms must be maintained as a buffer between the coal handling area and the sensitive receiving environment. - Culverts must be designed to prevent channelling. - Constructed wetlands combined with wetland rehabilitation will mitigate residual impacts.			
Post-Mitigation			
Duration	Project Life (5)	The activities and potential impacts will be present for the operational life of the project.	**Minor negative (-44)**
Extent	Local (3)	The mitigation measures can ensure the impacts will be limited to the development area.	
Intensity	On-gong moderate damage to sensitive environments (3)	These wetlands are sensitive receptors and the activities will still represent a moderate impact to the ecological functioning.	

Dimension	Rating	Motivation	Significance
Probability	Probable (4)	The activities within and around the wetlands are less likely to lead to the impacts described.	
Nature	Negative		

11.4 Decommissioning, Rehabilitation and Closure Phase

11.4.1 Project Activities Assessed

The decommissioning and rehabilitation phase activities that will have an impact on the wetlands are summarised below.

Table 11-8: Decommissioning and rehabilitation phase interactions with wetlands

Interaction		Impact
1	Decommissioning activities within and around remaining wetland habitats, such demolition and removal of all infrastructure, and subsequent final rehabilitation of the final void and area.	Similarly to the construction phase, the decommissioning and rehabilitation activities occurring within an ecologically sensitive catchment pose significant potential negative impacts to functioning wetlands and catchment. Furthermore, the rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction erosion and subsequent sedimentation into the wetland ecosystems.
2	Mine closure and post-mining environmental status	Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant will be acid forming.

11.4.2 Impact Description

This phase will require the rehabilitation of the final void, removal of the infrastructure and the rehabilitation of the site to an acceptable and sustainable landscape that will be functional in perpetuity. Similarly to the construction phase, this will require large scale activities within and around the wetland of the site and may have negative impacts if not managed correctly. It is particularly important to remediate highly polluted sites such as the PCD, screening and crushing plant and product stockpile areas.

The post-mining landscape will see the groundwater return to its natural level once dewatering stops. It is predicted that there will be decant points into the surrounding environment and it is anticipated that this decant will be acid forming[3]. These areas are in direct contact with the sensitive wetlands of the surrounding landscape and all wetlands drain in into the Aston Lake and surrounding wetlands, a NFEPA Rank 1 wetland and tributary to the Blesbokspruit Ramsar Wetland. This represents a major negative impacts to the wetlands and water resources of the local area and catchment.

11.4.3 Management Objectives

Wetland management objectives are to inform Palmietkuilen mining project where there are interactions of the proposed activities with wetlands during the decommissioning, rehabilitation and closure phase and how best they can mitigate and manage the impacts if the project is to go ahead. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region. These objectives are to prevent/minimise the loss of or further damage to natural wetland ecosystems and their buffer areas as protection of wetland ecosystem is a national objective; particularly of NFEPA wetlands. It is vital to note the following mitigation hierarchy and to understand the sequence of involvement.

The mitigation hierarchy which must be followed is as follows:

- **Avoidance** includes activities that change or stop actions before they take place, in order to prevent their expected negative impacts on biodiversity and decrease the overall potential impact of an operation.
- **Minimisation** measures are taken to reduce the duration, intensity, extent and/or likelihood of impacts that cannot be completely avoided.
- **Restoration** involves altering an area in such a way as to re-establish an ecosystem’s composition, structure and function, usually bringing it back to its original (pre-disturbance) state or to a healthy state close to the original.
- **Biodiversity offsets** are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimisation and restoration measures have been taken.

11.4.4 Management Actions and Targets

The proposed project will result in significant residual impacts to the wetlands and thus rigorous management will be needed. The Wetland Management Plan detailed in section 14 must be used to inform mitigation actions, including:

- [3] Geostratum Groundwater and Geochemistry Consultants (2016) identified that the waste rock material have a significant potential to generate AMD. These materials should be deposited at the base of the rehabilitated pit in such a way that it will be completely flooded with groundwater.
- The mine is predicted to decant after closure. Decant should be captured and treated before joining the tributaries. Groundwater should be monitored, to assess the time series water level and quality impacts and trends.

- The edge of the non-directly affected wetlands must continue to be clearly demarcated in the field. This should also include a 32 m buffer. The rehabilitation footprint kept as small as possible and all non-impacted wetlands must be avoided;
- Wetland monitoring must be carried out during the decommissioning and rehabilitation phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible;
- Mitigation and management actions provided in the following reports done by Digby Wells as part of this project should be used to guide the effective management of the ecological wetland resources affected by the proposed project:
  - Air Quality Report (Digby Wells, 2016 a);
  - Aquatic Ecology Report (Digby Wells, 2016b);
  - Fauna and Flora Report (Digby Wells, 2016c)
  - Groundwater Assessment Report (Digby Wells, 2016d);
  - Rehabilitation Plan (Digby Wells, 2016e); and
  - Surface Water Report (Digby Wells, 2016f).

11.4.5 Impact Ratings

Table 11-9: Potential Impacts of Rehabilitation Phase Interaction 1 on Wetlands: Removal of infrastructure and surface rehabilitation

Dimension	Rating	Motivation	Significance
Activity and Interaction 1: Demolition and removal of infrastructure, final void filling and surface rehabilitation.			
Impact Description: Similarly to the construction phase, the decommissioning and rehabilitation activities occurring within an ecologically sensitive catchment pose significant potential negative impacts to functioning wetlands and catchment. Furthermore, the rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction erosion and subsequent sedimentation into the wetland ecosystems.			
Prior to Mitigation/Management			
Duration	Long term (4)	The impacts caused during the rehabilitation activities will have a long lasting effect if not mitigated.	**Minor negative (-65)**
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality or alien invasive species to travel significant distances; especially downstream.	

Dimension	Rating	Motivation	Significance
Intensity	Serious damage to or loss of sensitive environments (5)	These impacts are serious threats to sensitive habitats such as wetlands; especially in an area with high level of cumulative habitat loss and water quality deterioration.	
Probability	Likely (5)	These impacts are common of mining and industrial construction sites and project and thus have at least a 65% chance of occurring with some small mitigation measures assumed.	
Nature	Negative		
Mitigation/Management Actions			
▪ The edge of the wetlands and at least a 32 m buffer must continue to be clearly demarcated as no-go areas and sensitive receptors. ▪ The rehabilitation footprint kept as small as possible and non-impacted wetlands must be avoided. ▪ Careful attention must be given to handling wetland soils, if any. ▪ Wetland monitoring must be carried out during the rehabilitation phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible. ▪ Please refer to the full Rehabilitation Plan Report (Digby Wells, 2016e) as part of this EIA for full mitigation and management actions.			
Post-Mitigation			
Duration	Medium term (3)	Impacts will last as long as rehabilitation activities are ongoing.	**Minor negative (-36)**
Extent	Local (3)	Mitigation will allow impacts to be within the local site.	
Intensity	Moderate damage to sensitive environments (3)	Rehabilitation activities may still have a moderate effect on the wetlands on the project area. These wetlands are sensitive environments and must be managed with caution.	
Probability	Probable (4)	Negative impacts to the wetlands during rehabilitation could occur given the nature of the task.	
Nature	Negative		

Table 11-10: Potential Impacts of Rehabilitation Phase Interaction 2 on Wetlands: Mine closure

Dimension	Rating	Motivation	Significance
Activity and Interaction 2: Mine closure and post-mining environmental status			
Impact 1 Description: Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant will be acid forming (acid mine draining, AMD).			
Prior to Mitigation/Management			
Duration	Permanent (7)	Decant of polluted and acidic underground water into the catchment will have negative impacts beyond the project life and will be irreversible if not managed or mitigated against.	**Major negative (-114)**
Extent	Regional (5)	The affected wetlands drain directly into the sensitive Ramsar Blesbokspruit Wetlands and catchment. Whilst these systems are not in pristine condition, further impacts as to the system from the proposed project to this area may have regional level significance.	
Intensity	Irreplaceable damage to highly sensitive environments (7)	These wetlands are sensitive receptors and this represents serious impacts to these systems that could lead to irreplaceable damage to and loss of ecological functioning.	
Probability	Highly Probable (6)	It is very likely to lead to the impacts described (65% - 80%).	
Nature	Negative		
Mitigation/Management Actions			
▪ Long-term passive water treatment (Constructed Wetland) options will need to be investigated by Canyon Coal to prevent untreated AMD decant water from entering the catchment. ▪ Investigate the option/feasibility of piping water to the large AMD treatment facility being constructed next to the Blesbokspruit. ▪ Groundwater and wetlands must be monitored post-mining for potential decant. ▪ Rehabilitation and remediation actions must be in place to respond to any decant or AMD discharge that is unforeseen.			
Post-Mitigation			
Duration	Permanent (7)	It is likely that the issue of polluted underground water will be a permanent catchment impact to manage.	**Moderate negative (-84)**
Extent	Local (3)	If adequate water treatment is carried out before discharge, then the impact can be managed at the local area.	

Dimension	Rating	Motivation	Significance
Intensity	On-going serious damage to highly sensitive environments (4)	These wetlands are sensitive receptors and altered water quality represents serious impacts to these systems.	
Probability	Highly Probable (6)	It is very likely to lead to the impacts described.	
Nature	Negative		

12 Cumulative Impacts

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 (Oberholster *et al.*, 2011). Coal mining causes destruction of wetlands via direct impacts such as removal of habitat, alteration of flow and contamination of water, but also indirectly through the drawdown of groundwater resources during the dewatering process (van Der Walt, 2011).

Dewatering has cumulative impacts on wetlands, which are complex, interlinked systems in the Highveld. Mining has frequently resulted ground and surface water contamination due to acidification and salinisation of nearby aquifers. The Witwatersrand area, where this project is located, is most certainly an area that has undergone significant cumulative impacts to the wetlands and their catchment. Due to the major impacts that will be caused by the proposed activities, this project will directly and significantly contribute to the cumulative negative impacts on wetland ecosystems in the local, municipal and regional area.

13 Unplanned Events and Low Risks

The planned activities will have known impacts as discussed above; however, unplanned events may happen on any project that may have potential impacts which will need mitigation and management. Table 13-1 below is a summary of the findings from a wetlands perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed by Canyon throughout all phases.

Table 13-1: Unplanned Events, Low Risks and their Management Measures

Unplanned event	Potential impact	Mitigation/ Management/ Monitoring
Hydrocarbon spill into wetland habitat	Contamination of wetland soil and water resources associated with the wetland.	A spill response kit must be available at all times. The incident must be reported on and if necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of wetland ecosystems leading to compromised functionality.	Erosion control measures must be put in place and if necessary a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
PCD overflow	The water resources of the catchment are stressed and any	The overflow must be stopped immediately and the impacted

	pollution will negatively impact the functioning of the wetlands and rivers. This could negatively impact fauna and flora that are found within the wetlands.	area remediated. Spill protection berms must be in place as well. If necessary, a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Airborne coal dust settling in wetlands	Carbonaceous material will cause pollution of the wetlands as well as potential sedimentation. This will compromise the ecosystem functioning of the wetland.	Wetland monitoring must be done throughout the life of the project to ensure that this impact is not reaching a critical level. Dust suppression will need to be improved and the wetland rehabilitated as far as possible. If necessary, a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Illegal activities within wetlands from staff.	Wetlands are sensitive ecosystems and undesirable human activity within these wetlands may cause significant negative impacts to their functioning. These impacts may interrupt the biodiversity related to the wetland or result in pollution of the water in the wetland.	The edge of the non-directly affected wetlands and a 32 m buffer where possible must be demarcated around the infrastructure areas and where they are at risk of being impacted from illegal activities. The impact, if realised, must be cleared as soon as possible and staff must be educated. Wetland monitoring must be done throughout the life of the project to ensure that this impact is not reaching a critical level. If necessary, a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled spilling of polluted material (including oils, coal fines etc) from the infrastructure areas due to failure in the dirty water and storm water management	The water resources of the catchment are stressed and any pollution will negatively impact the functioning of the wetlands and rivers. This could negatively impact fauna and flora that are found within	The spilling of the contaminant must be stopped immediately and the impacted area remediated. Spill protection berms must be in place as well. If necessary, a wetland specialist must investigate the

plan with	the wetlands.	extent of the impact and provide rehabilitation recommendations.

14 Wetland Management Plan

14.1 Project Activities with Potentially Significant Impacts

The following is a summary of the identified significant impacts to wetlands that will require mitigation measures for the project to go ahead.

Table 14-1: Potentially Significant Project Impacts

Interaction		**Impact**
Construction Phase		
1	Site Clearance, including the removal of topsoil and vegetation, for the construction of mine-related infrastructure	Loss of wetland habitat (soils and vegetation) totalling 53.3 ha.
2	Construction of mine-related infrastructure and blasting and development of initial box-cut for mining	Construction and development activities within a greenfield site is a negative impact to functioning wetlands and catchment.
Operational Phase		
1	Open pit mining to a depth of 60 m, requiring dewatering.	Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone
2	General operational activities within and around wetland habitats such as the use and maintenance of haul roads, stockpiling of RoM coal, transportation of coal to the washing plant.	Similarly to the construction phase, the operational mining activities occurring within an ecologically sensitive catchment, which pose significant potential negative impacts to functioning wetlands and catchment.
Decommissioning, Rehabilitation and Closure Phase		
1	Decommissioning activities within and around remaining wetland habitats, such demolition and removal of all infrastructure, and subsequent final rehabilitation of the final void and area.	Similarly to the construction and operational phase, the decommissioning and rehabilitation activities occurring within an ecologically sensitive catchment pose significant potential negative impacts to functioning wetlands and catchment. Furthermore, the rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction erosion and subsequent sedimentation into the wetland ecosystems.

Interaction		Impact
2	Mine closure and post-mining environmental status	Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant will be acid forming (acid mine draining, AMD).

14.2 Summary of Mitigation and Management

Table 14-2 provide 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. All of the mitigation measures have been previously listed in the impact assessment tables as well.

Table 14-2: Mitigation and Management Plan

Activities	Potential Impact	Size and scale of disturbance	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; loss of wetland habitat.	53.3 ha for infrastructure and 201.9 ha associated with the open pit area.	Construction	▪ There are no mitigation measures for loss of habitat. ▪ Avoid and minimise impacts where possible, else rehabilitate and offset wetland sections.	Section 19 of the NWA Section 21 (c), (g) and (i) of the NWA Section 24 of the Constitution NEM:BA NEMA Department of Water and Forestry (DWAF) guidelines for the delineation of wetlands (2005); Mining and Biodiversity Guideline (DEA *et al*., 2013).	Design and construction phase
Construction of general infrastructure within wetlands and their buffer areas	Industrial activity within a natural ecosystem is a negative impact to habitat integrity.		Construction	▪ The edge of the non-directly impacted wetlands, and at least a 32m buffer if possible, must be clearly demarcated in the field as no-go zones that will last for the duration of the construction phase. ▪ Staff need to be educated about the sensitivities of the wetland habitat. ▪ Wetland monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible. ▪ Refer to the Surface Water Report (Digby Wells, 2016f) for details on a Storm Water Management Plan that is to be carried out. This must be in operation during the construction phase and wetlands must be highlighted as sensitive receptors. ▪ Refer to the Fauna and Flora Report (Digby Wells, 2016c) for mitigation measures relating to floristic impacts as well as faunal species disturbances; for example, o minimal bright lights should be left on at night time and they should not face outwards of the site; and o an alien and invasive plant species management programme must be in place from the construction phase.		Design and construction phase
Open pit mining to a depth of 60m, requiring dewatering.	Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone.		Operational	▪ There are no foreseen mitigation actions that may significantly lessen the impact on the receiving catchment. However, the following should be done: ▪ Dirty water from the storm water system and pollution control dam should be treated and released back into the surrounding wetland systems; downstream of the dewatering cone of depression.		Design and operational phase

Activities	Potential Impact	Size and scale of disturbance	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
General operational activities within and around wetland habitats such as the use and maintenance of haul roads, stockpiling of RoM coal, transportation of coal to the washing plant.	Similarly to the construction phase, the operational mining activities occurring within an ecologically sensitive catchment, which pose significant potential negative impacts to functioning wetlands and catchment.		Operational	▪ The haul roads and servitude must also have well-designed stream crossings and drainage areas, which should be maintained to prevent channel formation. The wetlands outside of this must be demarcated as no-go areas. ▪ Dust management programme must be in place (Air Quality Report, Digby Wells, 2016a) ▪ The haul roads and servitude must be monitored and maintained to best operating standards. This should be done in the dry season. ▪ The wetland must be monitored on a regular basis to ensure no residual impact to the wetland and river is realised; and if so that remediation measures are followed. ▪ If possible, truck loads should be covered; particularly in dry and windy seasons. ▪ Berms must be maintained as a buffer between the coal handling area and the sensitive receiving environment.		Design and operational phase
Decommissioning activities within and around remaining wetland habitats, such demolition and removal of all infrastructure, and subsequent final rehabilitation of the final void and area	Similarly to the construction and operational phase, the decommissioning and rehabilitation activities occurring within an ecologically sensitive catchment pose significant potential negative impacts to functioning wetlands and catchment. Furthermore, the rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction erosion and subsequent sedimentation into the wetland ecosystems.		Decommissioning, Rehabilitation	▪ The edge of the wetlands and at least a 32 m buffer must continue to be clearly demarcated as no-go areas and sensitive receptors. ▪ The rehabilitation footprint kept as small as possible and non-impacted wetlands must be avoided. ▪ Careful attention must be given to handling wetland soils, if any. ▪ Wetland monitoring must be carried out during the rehabilitation phase to ensure no unnecessary impact to wetlands is realised; and if so that a remedy is put in place as soon as possible. ▪ Please refer to the full Rehabilitation Plan Report (Digby Wells, 2016e) as part of this EIA for full mitigation and management actions. ▪ An alien invasive plant management plant must be implemented.		Design and Rehabilitation phase
Mine closure and post-mining environmental status	Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant will be acid forming (acid mine draining, AMD).		Rehabilitation and Closure	▪ Long-term passive water treatment options will need to be investigated by Canyon Coal to prevent untreated AMD decant water from entering the catchment. ▪ Groundwater and wetlands must be monitored post-mining for potential decant. ▪ Rehabilitation and remediation actions must be in place to respond to any decant or AMD discharge that is unforeseen. ▪ Investigate the option/feasibility of piping water to the large AMD treatment facility being constructed next to the Blesbokspruit.		Rehabilitation and Closure phase

14.3 Monitoring Plan

Monitoring of the wetlands and mining activities is important to detect any predicted or unforeseen impacts to these sensitive systems and to understand the impact so that a remedial action can be carried out. Mining is an important activity for the economic growth of South Africa but has the potential to have impacts far beyond the boundaries of the project area and longer than the life of mine.

It is important to manage impacts to the environment and protect the ecosystem services that it provides; and this is particularly important with regards to wetlands and water resources. The below table summarises the recommended monitoring plan for the project.

Table 14-3: Monitoring Plan

Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions
All activities	General - All impacts and threats to wetlands predicted or not.	▪ Monitoring of the activities through all phases is important to ensure all impacts are remediated as soon as possible; thus preventing and long term residual impacts to the system that compromises the ability of the wetland to function. ▪ The wetlands immediately adjacent to the project area should be demarcated in the field as they are at particular risk of impacts. ▪ The valley bottom wetlands of high sensitivity should be monitored on a regular basis to detect if the mining activities are having any residual or unforeseen impact on the functioning of these important systems. The functional aspects of the wetland should be assessed such as floral diversity, water quality, use of wetland by faunal species, erosion and more. ▪ Monitoring for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. must be done and remediated where needed.	The environmental officer of the mine should monitor the wetlands at all times as part of managing the site and the surrounding area. Independent wetland specialist should carry out monitoring on a regular basis during all phases of the mining project and provide recommended remedial actions where required.	Internal monitoring should be done as often as possible according to the management practices of the mine. External independent wetland specialist monitoring should be done regularly and when needed, i.e. after an incident.
Site Clearance within wetlands and their buffer areas	Removal of wetland soils and vegetation; loss of wetland habitat.	▪ Ensure that the wetlands are demarcated in the field and that no impact is extended beyond the infrastructure area; ▪ Monitor for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils; ▪ Must ensure that all activities are done according to the detailed design and are implemented with the least possible impacts to the wetlands.		Construction activities should be monitored monthly by a wetland specialist.
Construction of general infrastructure within wetlands and their buffer areas	Industrial activity within a natural ecosystem is a negative impact to habitat integrity.			
Open pit mining to a depth of 60 m, requiring dewatering.	Perforation of rock and groundwater reserves leading to severe hydrological and geomorphological impacts to wetlands and catchment due to draw down cone.	▪ As mining progresses, wetlands should be monitored for evidence of loss of functionality due to groundwater changes (the draw down cone). ▪ Monitoring for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. must be done and remediated where needed.		Internal monitoring should be done as often as possible according to the management practices of the mine during operation. External independent wetland specialist monitoring should be done annually and when needed, i.e. after an incident.
General operational activities within and around wetland habitats such as the use and maintenance of haul roads, stockpiling of RoM coal, transportation of coal to the washing plant.	Similarly to the construction phase, the operational mining activities occurring within an ecologically sensitive catchment, which pose significant potential negative impacts to functioning wetlands and catchment.			

Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions
Decommissioning activities within and around remaining wetland habitats, such demolition and removal of all infrastructure, and subsequent final rehabilitation of the final void and area	Similarly to the construction and operational phase, the decommissioning and rehabilitation activities occurring within an ecologically sensitive catchment pose significant potential negative impacts to functioning wetlands and catchment. Furthermore, the rehabilitated area could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction erosion and subsequent sedimentation into the wetland ecosystems.	▪ Ensure that the wetlands are demarcated in the field and that no impact is extended beyond the infrastructure area; ▪ Monitor for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils; ▪ Must ensure that all activities are done according to the detailed design and are implemented with the least possible impacts to the wetlands.		Rehabilitation activities should be monitored monthly by a wetland specialist.
Mine closure and post-mining environmental status	Post-mining water decant is predicted to occur once the final void has been rehabilitated and groundwater levels are allowed to return back to natural level. It is anticipated that this decant will be acid forming (acid mine draining, AMD).	▪ Wetland monitoring should: Ensure that the wetlands are demarcated in the field and that no impact is extended beyond the infrastructure area; monitor for all risks at highlighted in Section 13 including uncontrolled erosion, hydrocarbon spills etc. and remediate; ensure proper handling and storage of wetland soils.		External independent wetland specialist monitoring should be done annually and when needed, i.e. after an incident.

15 Consultation Undertaken

No consultation has been undertaken for completion of the wetland study.

15.1 Comments and Responses

Results from the draft EIA comment period will be incorporated into the finalised report.

16 Conclusion and Recommendations

The proposed MRA is characterised by multiple wetland systems, totalling 1,550.4 ha, 255ha will be affected. There are two major valley bottom systems, which flow into the Blesbokspruit Ramsar Wetland. The one system has a large dam and this is referred to as Aston Lake. The remainder of the area is characterised by extensive hillslope seeps that drain into the valley bottom wetlands and pan wetlands at the tops of the hills.

The wetlands have been largely transformed by agricultural activities, compromising the natural ecological functioning and biodiversity maintenance role of these wetlands. However, the wetlands and landscape will play an important ecological role as they are tributaries to the Blesbokspruit Ramsar Wetland of International Importance and the Marievale Bird Sanctuary. Additionally, most of the project area is mapped as Ecological Support Areas according to the provincial conservation plan whilst some wetlands are Critical Biodiversity Areas.

The wetlands are providing important hydrological services such as flood attenuation, streamflow regulation during low flow periods and water quality improvement. The wetlands are important for the provision of the crops and for the cattle raised on the properties. Furthermore, these wetlands are an important water source for the land owners and surrounding communities. Due to the significant extent of hillslope seep wetlands, which indicate perched groundwater, the wetlands will also play an important role in catchment water recharge.

The predicted negative impacts as a result of the project to the local wetlands and to the catchment area are major. The proposed mine will lead to the permanent loss of 255 ha of wetland from active soil and vegetation removal. In addition, surrounding wetlands will be damaged by the operational drawdown; and potential continuous water quality deterioration is likely to occur due to post-mining AMD.

There is no feasible mitigation possible for the loss of wetland habitat and thus these wetlands will need to be offset if the project is to go ahead, however this can only be implemented after the mitigation hierarchy has been followed. All other residual impacts to surrounding wetlands must be mitigated as far as possible and long-term passive water treatment options will need to be investigated by Palmietkuilen mining project to prevent untreated AMD decant water from entering the catchment.

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Appendix A: CV of the Specialists