Surface Water Assessment for

Eco Elementum (Pty) Ltd:

Roodepoort Colliery

on the farm

Roodepoort 151 IS (Portion 17)

Mpumalanga Province

September 2013

ENVIRONMENTAL & PROJECT MANAGEMENT PROFESSIONALS

Eyethu Coal

Title Page

Surface water assessment for the proposed mining activities on the farm Roodepoort 151 IS portion 17, Nkangala District Municipality, Mpumalanga Province.

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EXECUTIVE SUMMARY

Kebrafield (Pty) Ltd is applying for an environmental authorisation for an opencast coal mine. The project site is located close to Pullenshope, a small urban development between Middelburg and Hendrina in the Mpumalanga Province. In terms of the National Environmental Management Act, 1998 (Act 107 of 1998) and the environmental impact assessment (EIA) regulations, an EIA is required for the proposed development. M2 Environmental Connections (Menco) had been appointed to conduct the surface water assessment for the proposed project as part of the required specialist investigations.

The proposed site for the Kebrafield coal project is located on portion 17 of the farm Roodepoort. The site is north-west of the Hendrina Power Station and south west of the Optimum Coal operations.

The climate of the area is typical of the Highveld with moderate, wet summers and cold dry winters. The average rainfall is 735 mm per annum and average daily temperatures vary from 15°C in winter to mid 20°C in summer. The prevailing wind direction are from the north-east and north. The mean annual evaporation is in the excess of 1800 mm per annum.

The proposed Kebrafield Project lies within the B12B quaternary catchment of the Olifant River Basin. Surface water from the site is drained via an unnamed tributary of the Woestalleen Spruit towards the Klein Olifants River. Apart from a storage dam (possibly used for livestock watering) in the unnamed tributary on the farm Roodepoort, there are no other recognised water users within the boundaries of the project area.

The vegetation along the drainage line falls within the Eastern Highveld Grassland vegetation type. The vegetation unit on the property is poorly conserved and transformation has been extensive as a result of agricultural activities. Several roads and linear infrastructure (power lines and railway) has altered the natural drainage of the area. In addition several in-stream impoundments have changed the natural runoff from the site. These drainage areas on site have extensive reed and bulrush

invasions. The non-perennial streams investigated has numerous sedge species and hydrophilic grasses that provide sufficient habitat for macro-invertebrates.
Water quality of the Woestalleen Spruit based on the Department of Water Affairs database is evident of degradation that has occurred due to mining and power generation activities. The water quality in the receiving water resource (Woestalleen Spruit) can be classed as tolerable with variables such as TDS, EC and SO_4 exceeding the Target Water Quality Range for potable use.

Anticipated impacts stemming from the development and operation of the coal terminal has identified that effluent from the coal terminal could contribute towards further water resource degradation should appropriate water management measures not be implemented. These measures include the implementation of storm water management systems and a containment facility for impoundment of polluted water. This water needs to be contained for recycling purposes as the consumptive water use for a coal terminal is calculated at approximately 50 000m^3 per annum. As the catchment is a water stressed area, the applicant needs to apply for a water use authorisation for the taking of water from a resource.

Other water uses that had been identified that requires authorisation entails section 21(c) and (i) water uses for the envisaged open cast mining within a buffer zone of a wetland as well as section 21(g) for the construction and operation of a pollution control dam.

With the implementation of mitigatory measures the identified significant impacts on the surface water environment will be reduced from moderate to low. The Present Ecological Status of the Woestalleen Spruit will remain an Eco-Class D river system. A monitoring program for implementation will ensure that any potential impact be identified and that rectifying steps taken to address the consequences of the impact. From a surface water perspective there are no fatal flaws identified and it is recommended that the project be approved subject to the implementation of an approved EMP as well as adherence to the conditions other environmental authorisations.

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LIST OF ABBREVIATIONS

ADI	Area of Direct Influence
ADII	Area of Indirect Influence
BAT	Best Available Technology
DWA	Department of Water Affairs
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EISC	Environmental Importance Sensitivity Class
EMP	Environmental Management Plan
GA	General Authorisation
ISP	Interim Strategic Perspective
NEMA	National Environmental Management Act,
NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act, 1998 (Act 36 of 1998)
NWCS	National Wetland Classification System
PES	Present Ecological State
REC	Recommended Ecological Class
RQO	Resource Quality Objective
TDS	Total Dissolved Solids
WCDM	Water Conservation and Demand Management
WMA	Water Management Area
WSP	Water Service Provider
WULA	Water Use License Application

1 INTRODUCTION

The surface water assessment was undertaken with the aim of characterizing the surface water environment associated with the tributary of the Woestalleen Spruit in the Olifants WMA and the Upper-Olifants Sub WMA.

The project for which this study is undertaken includes the construction of mining infrastructure and associated activities that is expected to impact on this watercourse only. The surface water assessment further will set the Roodepoort Colliery monitoring programme to which there should be strictly conformed in order to protect the resource as best they can.

1.1 NAME, ADDRESS AND CONTACT DETAILS

The applicant for the development of the mine is Kebrafield Colliery (Pty) Ltd. The Environmental Assessment Practitioner (AEP) of the project is Mr. Henno Engelbrecht of Eco Elementum (Pty) Ltd who contracted Menco to act as Aquatic Ecologists and compile this study in support of the Water Use License Application Report (WULAR). Refer to **Table 1-1** for the relevant contact details of the client.

Table 1-1: Client Contact Details

Client	Ecological Elementum (Pty) Ltd	Eyethu Coal
Contact	Henno Engelbrecht	Mike Elliot
Address	26 Greenwood Crescent Lynnwood Ridge Pretoria	Stonehill Office Park Cnr Solomon Mahlangu Drive & Disselboom Ave Pretoria
Telephone	012 – 348 5214	012 807 0229
Facsimile	012 807 0339	012 807 0339
Mobile	082 690 9105	082 573 2793
E-mail	henno@ecoelementum.co.za	

1.2 SITE DESCRIPTION OF DEVELOPMENT

1.2.1 Mining Infrastructure

The proposed mine has multiple activities commonly associated therewith as indicated in **Figure 1-2**. This will be an Opencast Mining Operation with a number of other infrastructure related activities:

Pre-Mining Phase:

- Diverting the unnamed gravel road
- Construction of Contractor Yard
- Construct parameter fences, haul roads etc.

Mining Phase:

- Start first cuts in the opencast
- Topsoil Dumps that will also act as Visual Berms
- Overburden Dumps
- ROM Stockpiles

The post-mining phase will include the breakdown of all dumps and use that material for rehabilitation.

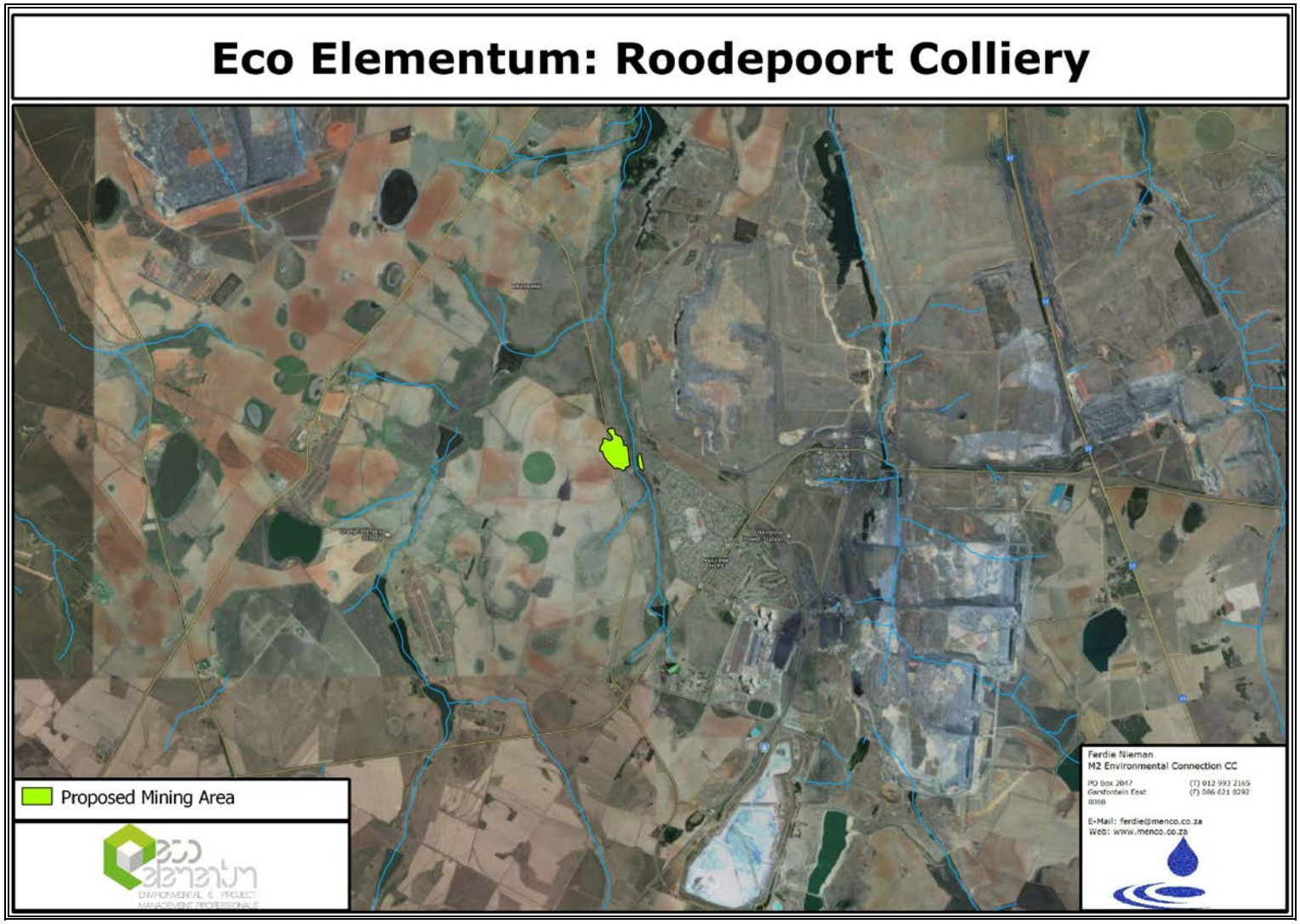

Figure 1-1: Regional Locality of the Project

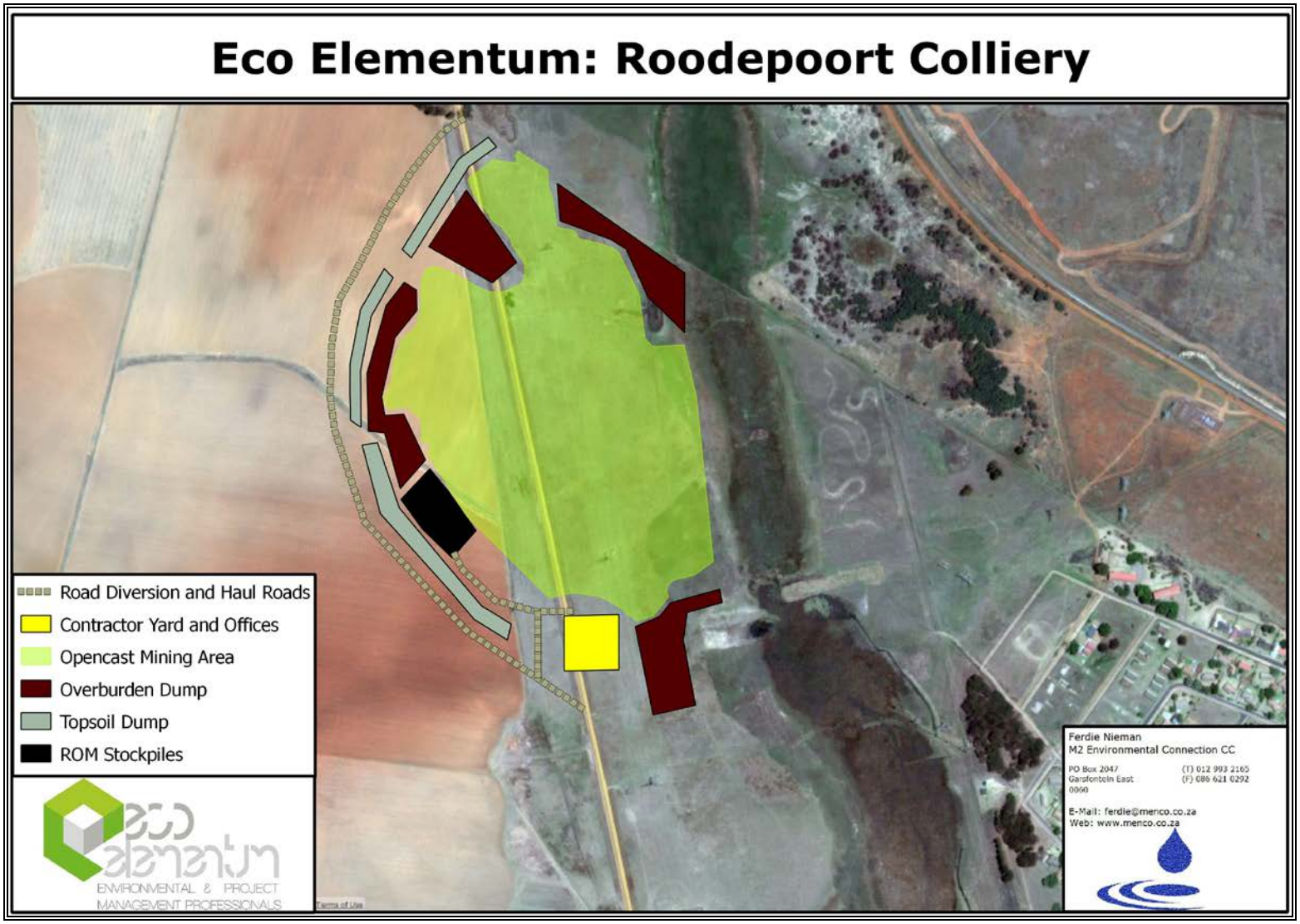

Figure 1-2: Site Plan

1.2.2 Water Uses

The following water uses have been identified and are being applied for, to be licensed in accordance with Section 40 of the National Water Act, 1998 (Act 36 of 1998), namely:

- Section 21 (a) – Taking of water from a resource;
- Section 21 (c) – Impeding or diverting the flow of water in a watercourse;
- Section 21 (g) – Disposing of waste which may detrimentally impact on a water resource (overburden dump, topsoil dumps, pollution control dam and ROM Stockpile);
- Section 21 (f) – discharge of waste water into a water resource through a pipe, canal, sewer or other conduit;
- Section 21 (i) - Altering the bed, banks, course or characteristics of a watercourse; and
- Section 21 (j) – Dewatering of the open pit to allow for safety and continuation of mining

1.3 LOCATION AND PROPERTY

The Roodepoort farm portion 17 (please refer to Figure 1-1) on which the project will be situated, is located just outside of the town Pullenshope, situated in Mpumalanga Province. It is under the jurisdiction of the Steve Tshwete Local Municipality and situated within the Nkangala District Municipality.

The land is currently being used for farming, crops and grazing, and there are also multiple coal mines in district. This is mainly due to the geology in the area.

The proposed mining area is situated within the northern section of the Witbank Coalfield. The strata in which the coal seams occur consist predominantly of fine, medium and coarse-grained sandstone with subordinate mudstone, shale, siltstone and carbonaceous shale. The No 2 and No 4 coal seam is economically viable and open cast is chosen as the best extraction method. Mining will be conducted through a conventional strip method (roll-over method). The Witbank Coalfield contains a large and important resource of high yield export quality coal (especially in the No. 4 Seam).

No processing will be conducted at the coal operation. ROM from the mining area will be crushed and screened at a crush and screening plant to be placed on site as indicated in the Integrated Water and Waste Management Report**.** Coal extracted from the open cast area will be transported to the ROM stockpile. Haulage trucks will transport the coal product from the product stockpile to markets.

The rehabilitation phase will include backfilling of open voids and seeding of backfilled areas. Backfilled areas will be free draining. The mine closure phase will be dedicated to the maintenance of rehabilitated areas as well as the compilation of a Closure Plan. Rehabilitation will run concurrently with the mining operation, typically of the technique used.

In terms of sensitive receptors it could be reported that the proposed mining site is situated next to a wetland system. The stream linked to the wetland is an unnamed tributary of the Woestalleen Spruit.

1.4 TERMS OF REFERENCE

Eco Elementum (Pty) Ltd as the Project Managers for the proposed mine on the Farm Roodepoort 151 IS, has appointed M^2 Environmental Connections (hereafter refer to as Menco) to conduct a surface water assessment study for the impacts associated with the development. The project area is limited to Portion 17 of the farm Roodepoort and the impacts has been identified, measured and mitigated accordingly.

1.5 STUDY METHODOLOGY AND APPROACH

This document is the Surface Water Assessment for the mine development in the Pullenshope, Mpumalanga area. It is prepared to adequately address the regulatory requirements as contemplated in environmental legislation such as:

- National Environmental Management Act
- National Water Act
- Mineral Petroleum Resources Development Act

Site surveillance and fieldwork were conducted by members of Menco (J. Maré and E.J. Nieman) on 13 June 2013. The fieldwork entailed transects and auger drilling to delineate the wetland area in relation to the project site. Water samples were collected

at an upstream, on site as well as downstream point to determine the background water quality for the affected catchment.

An aquatic ecological (bio-monitoring) assessment was conducted during the dry season (10 September 2013) in order to determine the Present Ecological Status (PES) as well as Environmental Integrity Sensitivity Class (EISC) of the sub-catchment. The eco-classification information will be used in order to qualify and quantify the impact of the development on the receiving environment.

Therefore, in consideration of the potential sensitivity of the area, this study involves the physically as well as chemically assessment of tributaries of the Olifants River in order to define the current/existing surface water condition. The study will therefore attempt to provide baseline information relating to the site hydrology by means of:

- Defining the affected catchment;
- Determining of the current status of the resource and relevant water resource management issues;
- Determine the mean annual and monthly runoff from the affected area;
- Determine normal dry weather flow of the affected streams;
- Determine flood volumes, peaks and flood lines of flood recurrence intervals of 1:50 and 1:100 years;
- Determine the drainage area of the area to be disturbed;
- Identification of downstream water uses/users;
- Identification of wetlands, springs and/or sensitive areas;
- Compilation of a project and environmental water balance;
- Identify and describe impacts of the proposed mining development on the receiving water environment; and
- Propose mitigation and management measures to be implemented.

1.6 STUDY LIMITATIONS

The study has been limited by the availability of time and budgetary constraints. The availability of the necessary Habitat during the SASS5 monitoring also proved problematic. The study was done site specific and is not to be considered for the entire catchment or region.

2 SURFACE WATER ASSESSMENT

2.1 DESCRIPTION OF AQUATIC ENVIRONMENT

The Department of Water Affairs (DWA) recognized the Olifant River Catchment as an area considered a high priority in terms of realizing basic human and environmental water necessities in the face of international obligations and the National Water Act (No. 36 of 1998).

The Olifant River Catchment is divided into three main secondary catchments namely the upper, middle and lower Olifants sub-water management areas (sub-WMA). The project area is located within the B12B quaternary catchment of the Upper Olifant River sub-WMA.

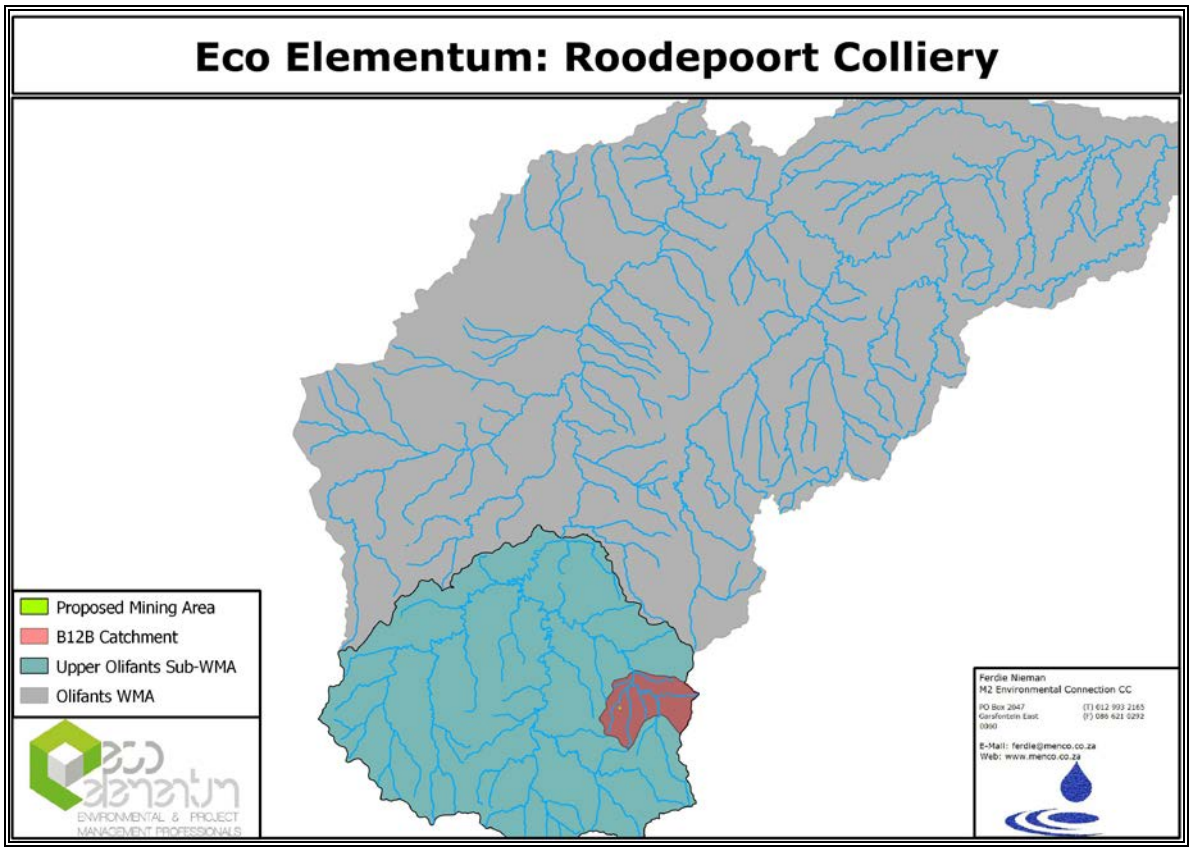

Figure 2-1: B12B drainage region within Upper Olifant WMA

In 1998 a study conducted by the DWAF determined that the runoff in the Upper Olifants sub-WMA has reduced by 62% from the natural conditions due to an increase in mining developments throughout the catchment. The primary river is the Olifants River with its main associated tributaries being the Klein Olifants River and Wilge River with tributaries down to the Loskop Dam. The headwaters of these rivers are located along the Highveld Ridge in the Secunda-Bethal area and the rivers then flow in a northerly direction towards Loskop Dam. The total catchment area is 12,285 km^2.

The mean annual precipitation (MAP) ranges between 500 and 700 mm and the mean annual evaporation (MAE) ranges between 1500 and 1600 mm.

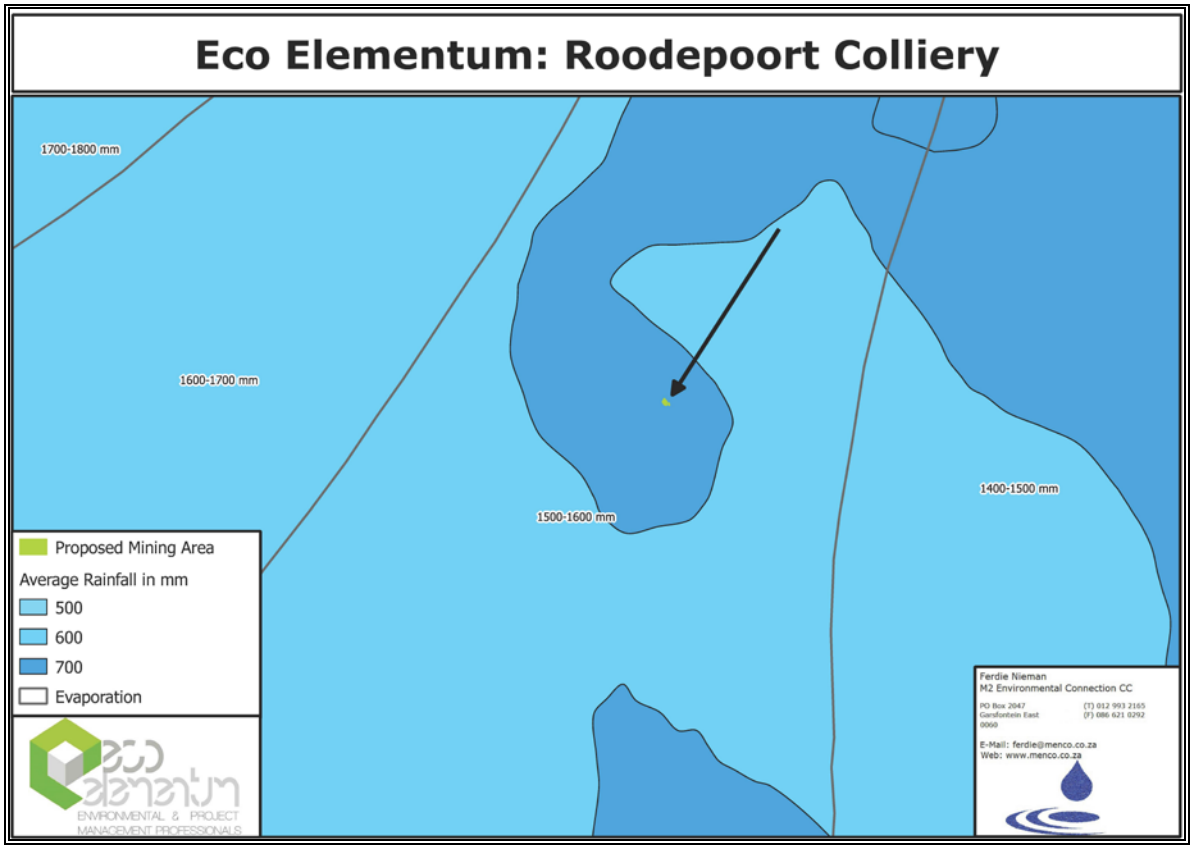

Figure 2-2: Mean Annual Precipitation and Evaporation Zones

Several wetlands are found in the sub-WMA, few of which have obtained recognition as National Freshwater Ecosystem Priority Area Wetlands (NFEPA wetlands) (also refer to the attached wetland delineation study). These elements contribute to the support of high levels of aquatic biodiversity and habitat diversity. Most of the wetlands in the

B12B quaternary drainage area are in a moderate impacted condition (C/D category) and rated as moderate EIS. The obtained PES scores of C/D in the catchment are mainly due to mining, agriculture and power generation (construction of power lines through wetland areas).

2.1.1 Affected River Basin

The site for the mine is situated within the Klein Olifant River sub-WMA of the Olifants WMA (refer Figure 2-1). The B12B catchment is drained by the Woestalleen Spruit. The Woestalleen Spruit has as its origin near Hendrina and joins the Klein Olifants River above Middelburg Dam. The Olifants water management area lies predominantly within the provinces of Mpumalanga and Limpopo.

The B12B catchment covers an area of 658.5 km^2 with an undeveloped MAR of 14.6 million m^3.

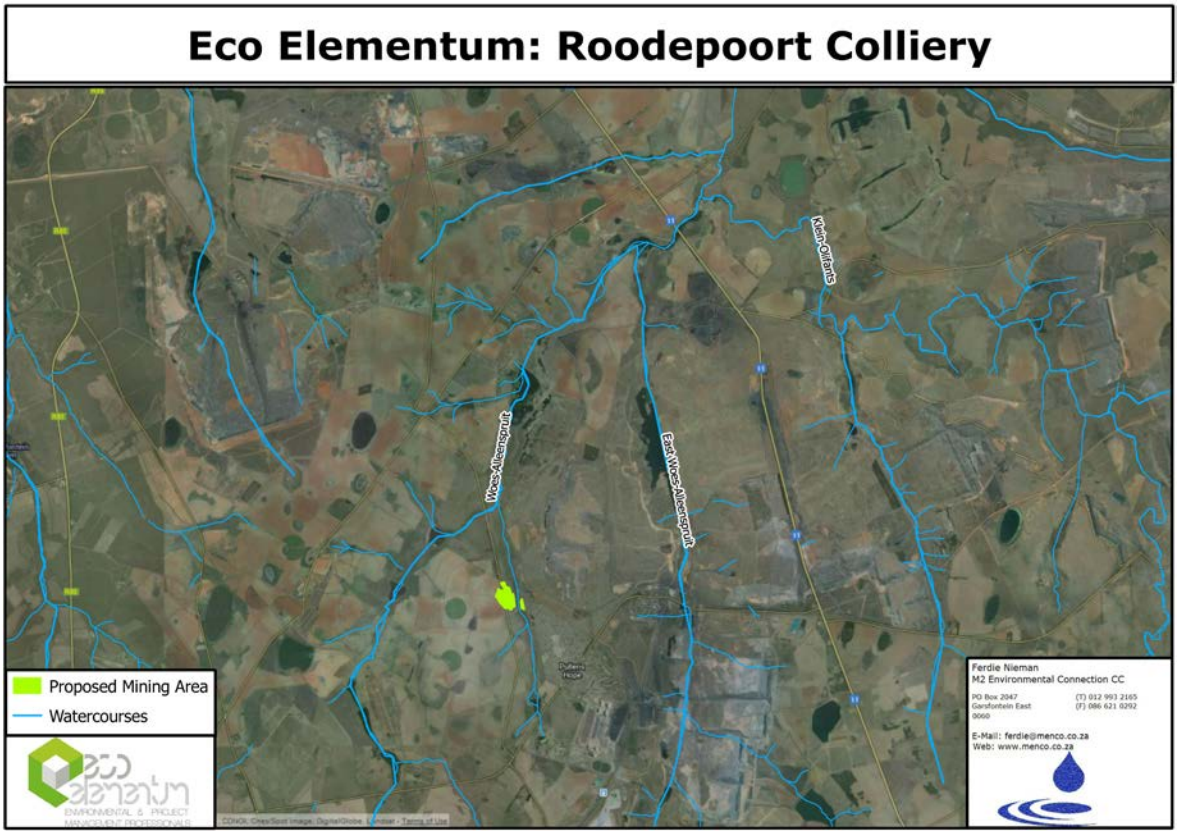

Figure 2-3: Surface Water Resource

2.1.2 Resource Classification and Reserve

The Resource Classification for the affected catchment is contained in **Table 2-1.**

Table 2-1: Resource description for the Woestalleen Spruit

Quaternary	River	EISC	PESC	REC
B12B	Woestalleen Spruit	Moderate	D: Largely modified	D

The preliminary Reserve for the Outlet of quaternary catchment B12B Klein Olifants River as contained in DWA Reserve with reference 26/8/3/3/264/1/7 was set at:

27.01% of the Mean Annual Runoff of 73.7 x 10^6 m^3

The amount as stated above accounts for both ecological (11.73% of MAR) and basic human needs (3.26% of MAR).

Table 2-2: Instream Flow Requirements for the Woestalleen Spruit (% of the virgin MAR for a class D Ecological Class)

Site	Virgin MAR x 10^6 m^3	EC	Long term % MAR	Maintenance year % MAR	Drought year % MAR
Woestalleen	6.251	D	11.73	1.86	0.9

Table 2-3: Low flows recommended for the Woestalleen Spruit during maintenance and drought conditions

Site	Class	Maintenance (m^3/s)	Drought (m^3/s)
Woestalleen	D	0.0357 – 0.77	0.025 – 0.113

2.1.3 Quaternary Catchment

The project site is located within B12B quaternary drainage area (refer ***Figure 2-1***). The potential source of water supply for the Roodepoort Colliery mining project is groundwater sources on the farm Roodepoort and the dam on the property that is fed by the unnamed tributary of the Woestalleen Spruit that transects the mining area (also refer Figure 2-7).

Most of the wetlands in the B12B quaternary catchment are not considered to be national priority wetlands (refer **Figure 2-3**). This indicates that the land use and intermittent streams and tributaries need to be managed in order to maintain the

wetlands in the catchment in a good condition (C or D health class) and for the protection of aquatic biodiversity in the quaternary catchment rated as *Highly Significant*.

2.1.4 Rainfall, Runoff and Evaporation

Overall the MAP is 672 mm for the project area (WR2005). The mean annual evaporation (MAE) for the B12B quaternary catchment is 1500 – 1600 mm with a mean annual precipitation (MAP) of 600- 700mm (refer **Table 2-4, Table 2-5** and **Figure 2-2**).

The net mean annual runoff (MAR) for the B12B quaternary catchment according to the Water Resources of 1990 was calculated at 14.6 million m^3/annum and the net MAR according to the latest Water Resources data of 2005 was calculated as 14.31 million m^3/annum. This indicates a 5.2% change in MAR.

Table 2-4: Average monthly rainfall

Month	Mean monthly rainfall (mm)	24 Hr maximum		No of rainy days
		Rainfall (mm)	Year	
October	78.7	62.8	8/10/2007	8.6
November	105.7	58	6/11/2007	12.7
December	117.6	72	8/12/2009	12.6
January	143.4	82.2	21/1/1999	14.6
February	85	91	11/2/1996	10.6
March	78.7	53.2	9/3/1997	9.6
April	26.3	32.2	5/4/2000	4.9
May	17.6	34.2	25/5/1997	3.1
June	8.1	24	10/6/2009	1.9
July	1.6	6.6	27/7/1997	0.8
August	6.1	29.6	15/8/2002	1.8
September	10.2	18.6	11/9/1998	2.4
YEAR	**679**			**83.8**

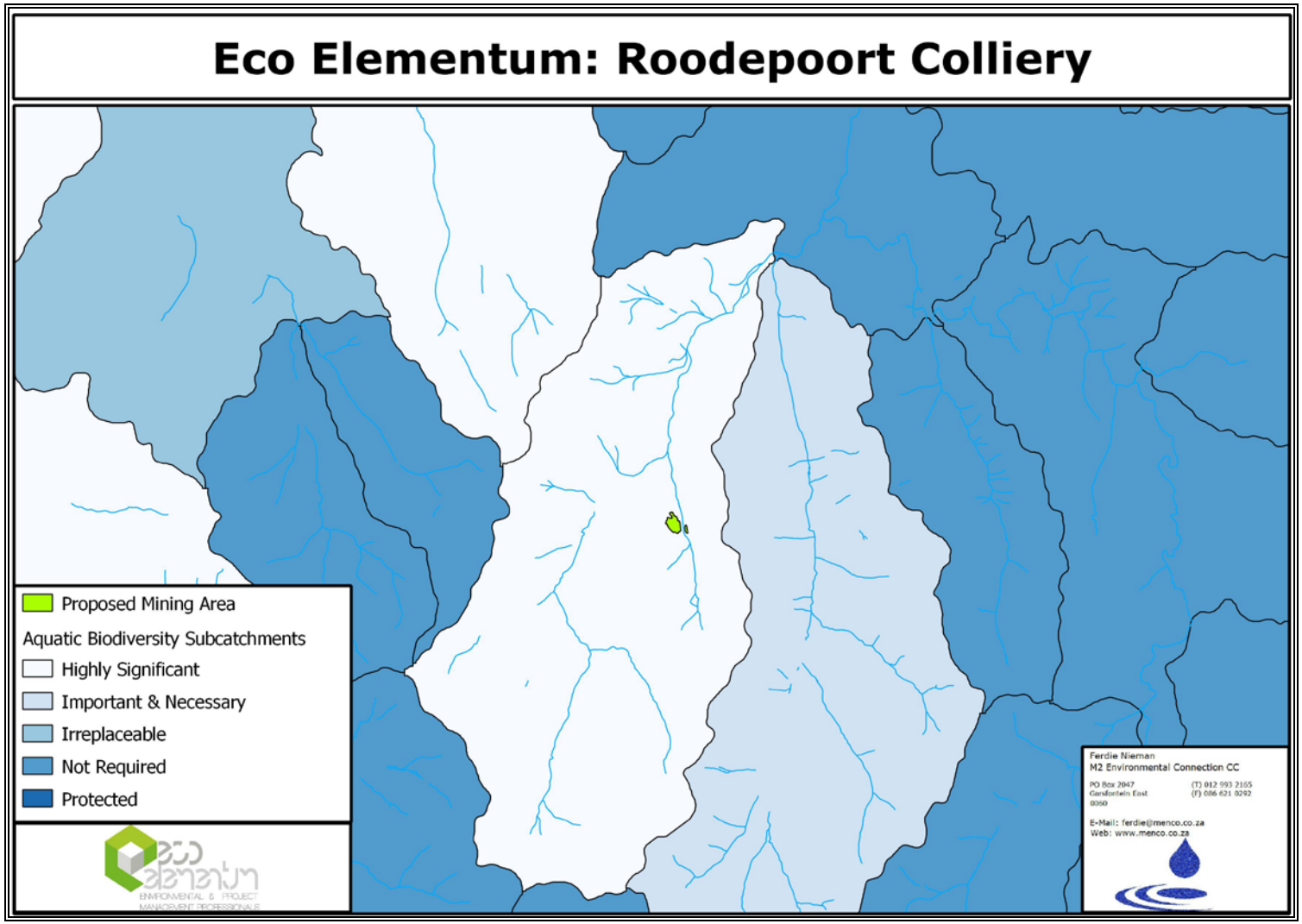

Figure 2-4: National Freshwater Ecosystem Priority Areas

Table 2-5: Mean monthly evaporation

Month	Mean (mm)	Symon's Pan (mm)	Class A Pan (mm)
October	178	164	192
November	173	163	182
December	181	170	192
January	179	174	185
February	144	145	143
March	145	134	156
April	107	99	114
May	80	81	79
June	73	67	79
July	75	73	76
August	105	100	110
September	149	139	159
YEAR	**1588**	**1508**	**1667**

Table 2-6: Quaternary Catchment characteristics (WR2005)

Quaternary Catchment	BASIC INFORMATION										COMPARISON OF MAR AGAINST WR90		
	Catchment area		Forestry	Alien veg.	Irrigation	Farm dams		Mean Annual Evaporation		Rainfall	MAR (WR90)	MAR (WR2005)	Change
	Gross (km²)	Net (km²)	Area (km²)	Area (km²)	Area (km²)	Area (km²)	Volume (mcm)	MAE WR2005 (mm)	MAE WR90 (mm)	MAP (mm)	Net (mcm)	Net (mcm)	in MAR %
B12B	387	387	24.5	3.9	10.4	2.06	4.58	1800	1750	677	13.6	14.31	5.2

2.2 SURFACE WATER QUALITY

2.2.1 Background Water Quality

An analysis of surface water in sufficient detail to characterize the water quality in the affected water catchment was obtained from the WMS database of the DWA, Directorate: Resource Quality Studies. The water quality as contained in **Table 2-7** is representative of the B12B quaternary catchment as obtained from the Water Resources 2005 database. The monitoring point is at the bridge below Hendrina Power Station and upstream of the proposed Roodepoort Colliery mine. The water quality is representative of the time period August 1993 until October 1995 until the monitoring point was decommissioned.

Recent water quality as sampled during September 2013 at the proposed site in the unnamed tributary of the Woestalleen Spruit is contained in **Table 2-8** and **Table 2-9**.

Table 2-7: Background water quality data for the B12B quaternary catchment (WR2005)

Variable	Unit	Mean	Minimum	Maximum
Calcium as Ca	mg/l	45.8	13.7	95.1
Chloride as Cl	mg/l	24.4	9.4	40.6
Total Dissolved Solids as TDS	mg/l	445.4	144	855
Electrical Conductivity as EC	mS/m	63.2	22.7	105.5
Fluoride as F	mg/l	0.59	0.27	0.98
Potassium as K	mg/l	7.95	2.56	16.17
Magnesium as Mg	mg/l	27.43	6.3	52.4
Sodium as Na	mg/l	42.56	15.7	64
Ammonium as NH4	mg/l	0.09	0.02	1.44
Nitrate and Nitrate (NO_3 and NO_2) as N	mg/l	0.28	0.02	1.98
pH	mg/l	7.79	6.62	9.63
Phosphate as PO_4	mg/l	0.06	0.008	0.405
Silicon as Si	mg/l	9.32	1.38	21.71
Sulphate as SO_4	mg/l	215.1	44.5	477.6
Total Alkalinity as $CaCO_3$	mg/l	65.46	41.3	95.9

Table 2-8: Current water quality (*In situ*) in the tributary of the Woestalleen Spruit

Variable	KFBM2	KFBM3	KFBM4
Electrical Conductivity as EC in mS/m	78.6	76.5	56.2
Total Dissolved Solids as TDS in mg/l	495.2	481.9	354.1
pH	8.8	7.2	6.3
Dissolved Oxygen as DO in mg/l	10.52	6.49	3.82
Dissolved Oxygen as DO in %			

Table 2-9: Current water quality (Sep 2013) Woestalleen Spruit tributary

Variable	Seep	Dam	KFBM3	KFBM2	KFBM4
pH	8.9	8.4	7.5	8.8	7.2
Electrical Conductivity as EC in mS/cm	284	79.8	77.2	78.8	57.7
Dissolved Oxygen as DO in mg/l	5.0	6.4	5.2	7.3	2.9
Total Dissolved Solids as TDS in mg/l	1914	530	518	528	374
Total hardness in $CaCO_3$ mg/l	430	262	274	260	169
Chloride as Cl in mg/l	193	36	34	40	34
Sulphate as SO_4 in mg/l	311	232	200	224	115
Nitrate as NO_3 in mg/l	0.6	<0.2	<0.2	<0.2	<0.2
Nitrite as NO_2 in mg/l	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho-Phosphate as PO_4 in mg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Sodium as Na in mg/l	547	49	50	47	47
Magnesium as Mg in mg/l	93	34	37	34	24
Potassium as K in mg/l	2.4	13.1	12.4	13.3	9.8
Aluminium as Al in mg/l	5.07	0.488	<0.100	<0.100	0.228
Iron as Fe in mg/l	3.5	0.522	0.924	0.102	76
Manganese as Mn in mg/l	0.082	0.200	0.044	0.025	3.07
Total Phosphorous as TP in mg/l	0.5	0.4	<0.2	0.2	2.7
Suspended Solids as SS in mg/l	197	75	17.2	3.6	324

If the current water quality at KFBM2 is compared against historic water quality as contained in **Table 2-7**, it is evident that only SO_4 seemed to increase in concentration while the remainder of the variables remained constant over the last decade.

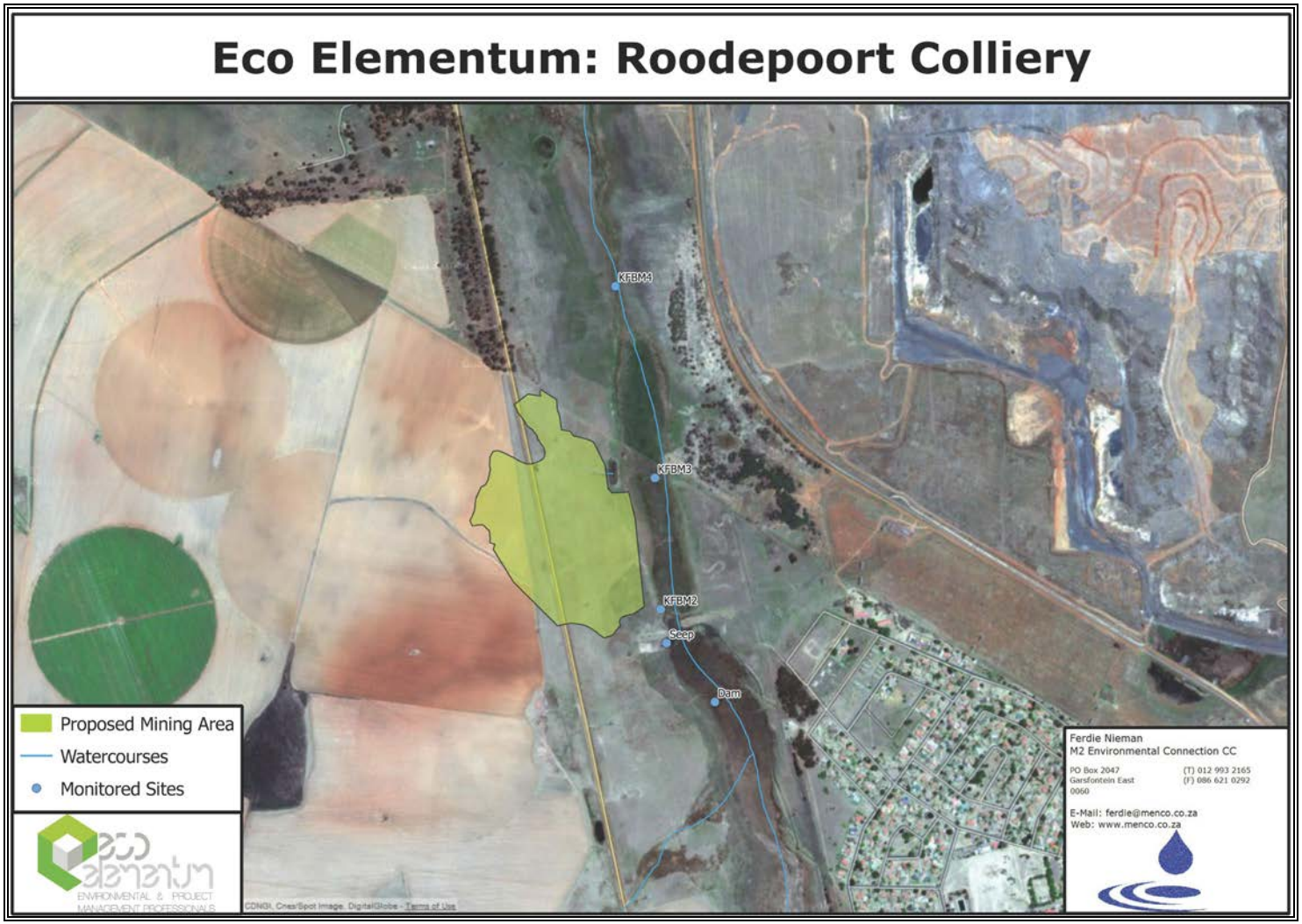

Figure 2-5: Points Monitored

2.2.2 Water Quality Objectives

In terms of section 12 of the National Water Act, 1998 (NWA) the Department of Water Affairs has the mandatory responsibility to establish a classification system for the water resources in the country. The following Resource Quality Objectives were obtained from the Olifants River Comprehensive Ecological Reserve (DWA, 2001).

2.2.2.1 Overall Objectives

Ecological Class	Resource Quality Objective
B	• To improve present ecological conditions. • To prevent short-term flow fluctuations. • To restore the most important components that makes up the natural seasonal variation in flow.

2.2.2.2 Social Objectives

Ecological Class	Resource Quality Objective
B	• To manage the river as a source of potable water to rural communities where there is no alternative water source. • To manage the river so that rural communities can use the river as a place to wash themselves and their clothes. • To manage the river so that rural communities can harvest supplementary foods in the form of fish and wild fruits. • To manage the river so that rural communities can harvest plant material for traditional medicine. • To manage the river so that rural communities can source building materials, including clay for bricks and reeds for thatching, in a sustainable manner. • To manage the river as a venue for religious and cultural gatherings.

2.2.2.3 Geomorphology

Ecological Class	Resource Quality Objective
D	General • To maintain the natural variation in flow to allow sediment erosion and deposition phases.

	Community • To reduce sediment deposition and erosion. Specific • To maintain the overall macro-channel structures and mosaic of cobbles and gravels. To keep cobbles clean. • To keep the channel stable and prevent undercutting of banks.

2.2.2.4 Riparian Vegetation

Ecological Class	Resource Quality Objective
D	General • To restore perennial flow and ensure natural seasonal flow variations. • To discourage bad land use practices such as bush clearing, vegetation removal, and extensive grazing and browsing. Community • To encourage the recovery of riparian species and discourage encroachment of additional exotic species and terrestrial species in riparian zone by periodic flooding. Specific • To stimulate recruitment and recovery of *Combretum erythrophylum* with periodic freshets which promote the establishment of suitable nursery areas, and deposit nutrients and sediments on the riparian terraces where these plants occur. • To discourage encroachment of additional exotic species and terrestrial species, particularly *Acacia karroo*, in the riparian zone by periodic flooding. To maintain existing flood terraces and deposition of sediments on these terraces to ensure optimum growth, spread and recruitment of these species.

2.2.2.5 Fish

Ecological Class	Resource Quality Objective
D	General • To restore perennial flow and ensure seasonal flow variations. • To avoid regular pulsed releases from Loskop Dam. Community

Ecological Class	Resource Quality Objective
	• To re-establish migration routes, which will lead to improved fish species diversity, as was indicated by historical surveys. • To re-establish sensitive fish species, • To reestablish flow-dependent species, such as the shortspine rock catlet *Chiloglanis pretoriae*. Specific • To maintain a high diversity of fish biotopes, including areas where water is slow and shallow, fast and shallow, slow and deep, and fast and deep.

2.2.2.6 Aquatic Invertebrates

Ecological Class	Resource Quality Objective
D	General • To restore the natural seasonal variation in flow. • Community • To maintain the diversity of biotopes. • Specific • To increase SASS5 scores within the range expected (except after major floods and during droughts). (Score >97, ASPT >5.1). To ensure that no group consistently dominates the fauna. • To periodically flush benthic diatoms and associated organic flocculants, particularly at the beginning of spring. • To provide periodic flushes to reduce populations of snail species which are intermediate hosts of bilharzia (*Biomphalaria pfeifferi* and *Bulinus africanus*).

2.2.2.7 Water Quality

Ecological Class	Resource Quality Objective
D	• General • To maintain the water quality in EC of Class D. • To maintain the natural seasonality of water quality changes. • Community • To release flows from Loskop Dam to reduce peak TDS concentrations (Concentrations exceeding 780 mg/l TDS). • To manage non-point source irrigation return flows from Loskop Irrigation Scheme to reduce impact on lower Olifants River. • Specific • To ensure that concentrations of TDS do not exceed

	780 mg/l. • To ensure that the present state of pH is maintained, or is within the range 5.5 to 8.5. • To ensure that the present state of Dissolved Oxygen is maintained, or is within the range 60-100% saturation. • To ensure that the present state of Water Temperature is maintained. • To ensure that the concentration of TSS is maintained, or does not differ by more than 25% from Loskop Dam • To ensure that the present nutrient levels are maintained or o Median PO4 < 0.10 mg/l o Median TP < 0.175 mg/l o TN:TP ratio <5:1 o %PO4:TP 40-60% o Median NH3-N <0.07 mg/l o Toxics: 95% of CEV and 99% AEV values specified in the SA Water Quality Guidelines.

2.3 SURFACE WATER QUANTITY

According to the Upper Olifants Comprehensive Ecological Reserve Report (DWA, 2001) the upper catchment provides large quantitites of water for intensive irrigation in farming and agriculture which has led to a significant reduction in the flow of formerly perrennial rivers. The current increase in salinity in the entire Olifants Catchment is mainly due to mining operations. The main impoundments situated in the catchment are the Witbank, Middelburg, De Hoop and Loskop Dams.

2.3.1 Mean Annual Runoff (MAR)

The MAR for the project area and the affected catchments are indicated in **Table 2-10**.

Table 2-10: Mean Annual Run-off for the B12B quaternary catchment

Component	B12B
Virgin Mean Annual Run-off (MAR) mm for catchment	73.7 x 10^6 m^3/a
Net MAR (10^6m^3) for quaternary catchment	42
Applicable Upper Olifants catchment area (km^2):	1300
Applicable river MAR (10^6m^3)	Not determined
Study Area (km^2)	13.5
Total Virgin MAR for study area (10^6m^3)	1.356

2.3.2 Flood Volumes

Flood peaks and volumes for recurrence intervals of 1:20, 1:50 and 1:100 years and the regional maximum flood for the project area was determined by utilizing the UPFlood Model software and is provided in **Table 2-11**.

Table 2-11: 24 Hour storm rainfall intensities

Duration	Recurrence Interval (years)					
	5	10	20	50	100	200
	Rainfall P (mm)					
1 day	74	88	104	126	144	164
2 days	96	117	140	172	200	230
3 days	109	132	157	194	224	258
7 days	136	163	192	232	265	301

Flood calculations by PG Consulting (Pty) Ltd with the UP Flood Model using the rationale method were also conducted (refer Appendix ll). Flood volumes were calculated to determine the storm water runoff which could potentially impact upon the proposed mining infrastructure in order to assist with the storm water management design. Information used for the storm water design purposes are contained in **Table 2-11** and **Table 2-12**.

Table 2-12: Flood volumes for the project area (m^3/s)

Flood peaks derived			
Values in m^3/s	Q_{50}	Q_{100}	Q_{200}
Rational – Implementation #1	126.6	158.4	-
Rational – Implementation #2	139.2	164.5	186.2
Rational – Implementation #3	119.6	172.9	224.9
Rational – Implementation #4	113.4	152.2	183.2
Empirical TR137 (K-region 4,6)	*104.7*	*134.6*	*164.0*
Average of all above	**120.7**	**156.5**	**189.6**

2.3.3 Drainage Density

The drainage density area (refer **Table 2-13**) for the project area was determined using the areas as indicated in **Figure 2-4**. The proposed project area has a low drainage density determined at 0.322 km/km^2.

Table 2-13: Drainage density of the project area

Description	Roodepoort Colliery
Total area (km^2)	13.915
Total drainage line length (km)	4.480
Drainage density (km/km^2)	0.322

2.4 SURFACE WATER USES

The tributary of the Woestalleen Spruit is not considered a biologically diverse and ecologically important riverine system. This is mainly due to impacts stemming from anthropogenic development, mining and power generation within the catchment.

In terms of the South African National Water Law, the river can be regarded as an aquatic resource, with social, ecological and economic benefits to the local population, and the downstream users. In this instance water users need to adhere to regulatory requirements to assist in water resource protection.

The main water users in the catchment are considered to be farmers, industrial activities by Eskom for power generation, coal mining and urban development.

2.5 WATER AUTHORITY

The provincial water authority for the B12B quaternary catchment is the Mpumalanga Regional Office situated in Bronkhorstspruit.

2.6 WETLANDS

There are wetlands in close proximity to the project area as confirmed by the desktop study conducted using the latest GIS data sets from SANBI (NFEPA and MBCP). The locations of the wetlands were confirmed during the field survey. The boundaries of the wetland system found on the property area were delineated (refer Menco document: 201306 Pullenshope Wetland). The delineated wetland types for the region are based on the National Wetland Classification System (NWCS) at levels 3 and 4 and have the characteristics indicated in **Table 2-14**.

Table 2-14: Desktop Wetland Attributes

Attribute Category	Attribute
NFEPA Status	Freshwater Priority Wetland
Natural or Artificial Wetland	Natural
NWCS Level 3	Valley Floor
NWCS Level 4	Channelled valley-bottom wetland
Wetland type	Eastern Highveld Grassland
Percentage Natural Land cover of the wetland	94%
Percentage Natural Land cover within 50m buffer of the wetland	73%
Percentage Natural Land cover within 100m buffer of the wetland	60 %
Percentage Natural Land cover within 500m buffer of the wetland	38%

Wetlands in the area are subjected to some forms of impact related to:

- Grazing and trampling of wetland vegetation by livestock;
- Agricultural activities alongside and within wetland boundaries;
- Road and railway crossings with associated bridges and culverts;
- Pylon construction for Eskom power lines; and
- Alien plant invasion and forestation

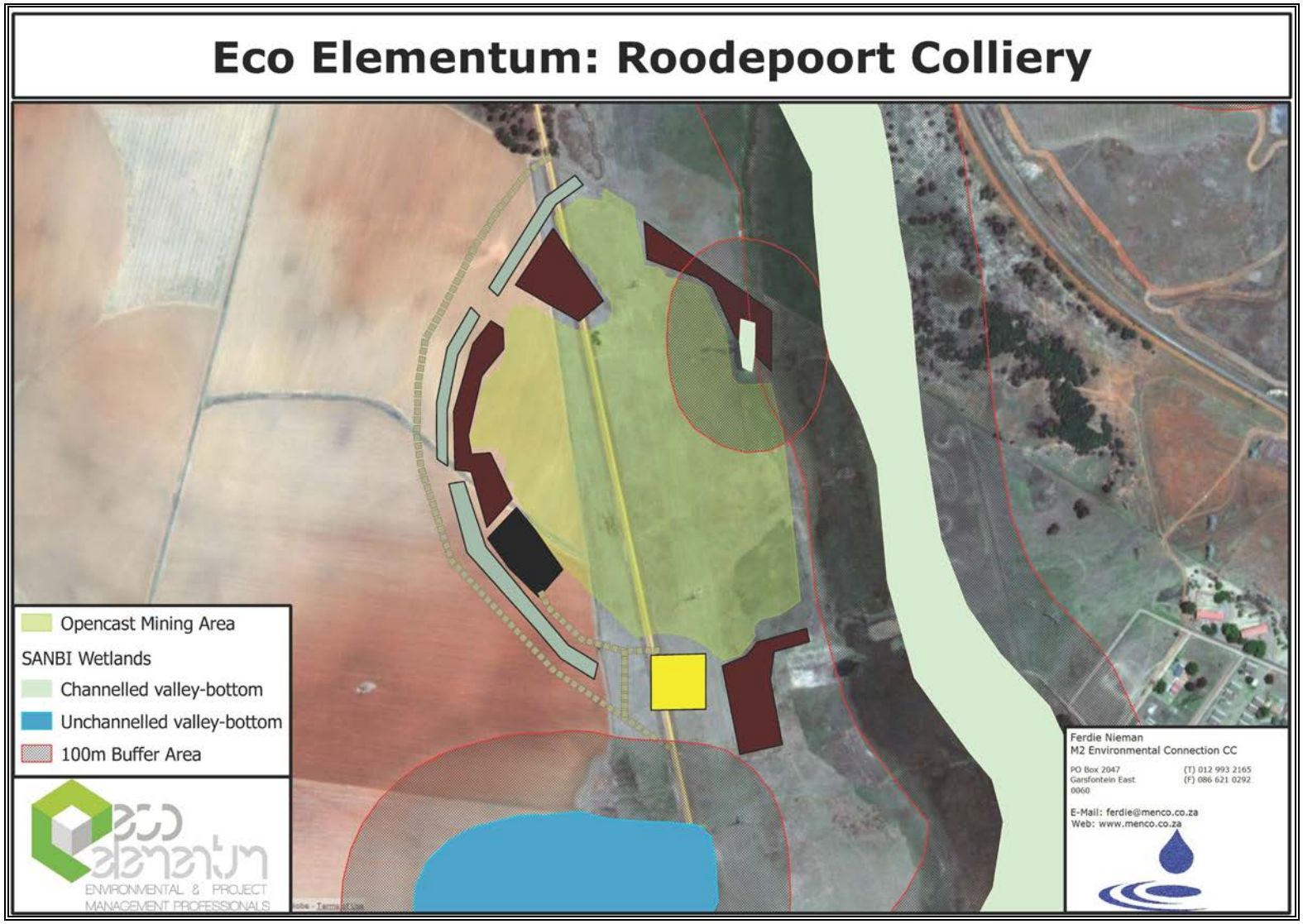

Figure 2-6: Delineated wetlands in the project area (NFEPA)

2.7 SOURCES OF WATER

The identified water sources for Roodepoort 151 IS are groundwater supply and the sruit that flow across the property. The stream (to the east of the property), is known as an unnamed tributary of the Woestalleen Spruit and this tributary conflux with the Woestalleen Spruit approximately 10 km downstream of the property. This tributary also flows into the Klein Olifants River.

2.8 WATER USE AUTHORISATION

The proposed development will require a water supply allocation to ensure the feasibility of the mining project.

The project will have to apply for an allocation from the Woestalleen Spruit or the groundwater supply in terms of section 40 of the NWA for a section 21(a) water use. Possible water use authorizations to be obtained from the Department of Water Affairs are contained in **Table 2-15**.

Table 2-15: Identified water uses that would require an authorisation

Section	Description
21(a)	Taking of water from resource
21(b)	Storage of water
21(c) and (i)	Changing natural characteristic of a resource
21(g)	Disposing of waste in a manner that may detrimentally impact on a water resource ((PCD, hards, overburden, stockpiles)
21(j)	Dewatering of open pit areas for the safe continuation of mining

3 DESCRIPTION OF THE PROPOSED PROJECT

The mining development for Roodepoort Colliery falls within the B12B quaternary catchment area of the upper Olifants River sub-WMA and runoff from the sites drains the unnamed tributary to the Woestalleen Spruit which flows north north west before its confluence with the Woestalleen Spruit.

The mining development will have a moderate impact on surface water and the groundwater resources of the area should all mitigation be adhered to. The only potential significant impact on surface water could stem from stormwater and PCD spillages. The surface water quality as taken during September 2013 is indicative of an acceptable class (as presented in **Table 2-9).**

There is a perennial drainage area located within 500 meters of the project area that feeds into a small Dam. The drainage line occurs to the west of the planned project area. The drainage line arises as a result of natural runoff generated by a shallow channelled valley wetland system on the property. The runoff from the drainage line is contained in the Dam and the overflow of the dam feeds the non-perennial drainage line. The construction of the dam wall within the drainage line has caused reduced base-flow altering the flow regime of the tributary. Flow in the lower parts of the tributary is intermittently due to a series of dams located downstream in the tributary.

As with any coal mining activity an impact on the water resource is to be expected. Should appropriate mitigation measures not be implemented the channelled valley bottom wetland in the vicinity of the mining area as well as the tributary of Woestalleen Spruit could be moderately impacted.

The **Figure 2-6** below provides for an overview of the drainage lines on the site. The coloured delineation on the figure is the location of extensions of the Pullenshope wetland system that borders the proposed project area.

The water quality in the dam currently on the site adheres to most departmental standards except for a slightly elevated electrical conductivity measurement as well as increased suspended solids. The water quality in the downstream water resource as

measured at KFBM4 is of generally good quality apart from suspended solids that was measured at 324 mg/l.

Surface water use in the immediate surrounding environment includes livestock watering and domestic use. No other water courses will be detrimentally impacted by the mining development either in terms of quantity or quality.

Although construction operations are to take place within 100 meters of the drainage path of the Woestalleen tributary and the Dam no river diversions are planned. The existing dam will not be used as part of the proposed mining water management infrastructure and will remain within the clean water system.

The mining development will follow a zero discharge policy and water management infrastructure will be designed in accordance with the requirements as contained in GN 704 Regulations as well as additional measures specified by the regulatory authorities. In this instance clean water separation will be induced allowing direct runoff towards natural watercourses.

3.1 PROCESS DESCRIPTION

The project entails the development of an opencast mine. There is no coal beneficiation processes involved with the mining development as only crush and screening activities will be experienced.

3.2 SURFACE WATER INFRASTRUCTURE

There is currently no development on portion 17 of the farm Roodepoort 151 IS apart from the small Dam. Storm water generated within the Pullenshope urban area drains in a westerly direction towards the spruit. There are two stormwater outlets along the outskirts of the town of Pullenshope draining rainwater towards the catchment. The local WWTW located upstream of the proposed mining area also discharge effluent into the stream. The entire Hendrina Power Station complex is situated upstream of the proposed mining area. Station drains also releases stormwater to the catchment

3.3 WATER POLLUTION MANAGEMENT FACILITIES

As this is a mining project with multiple development functions and activities, there are several possible source of pollution that needs to be considered.

The nature of mining has the potential for significant pollution if there are no dedicated water pollution management facilities in place. Roodepoort Colliery envisaged having the following water pollution management facilities:

- Pollution control dam for containment of contaminated water
- Separate clean and dirty water systems
- Package plant for waste water treatment stemming from ablution block
- Bunding around waste material dumps and stockpiles
- Bunding around diesel storage tanks
- Concrete lining in workshop areas with oil traps

3.4 STORM WATER

A complete storm water management plan as designed by Avon Engineering (Pty) Ltd will be included in the final design of the Roodepoort Colliery layout.

3.5 DISTURBANCE OF WATER COURSES

The drainage from the area could be described as a wetland system with the lower parts typical of a channeled valley bottom wetland. The wetlands in the area are depicted in **Figure 2-6** indicating that some parts of the proposed mining development are located within the 500 meter buffer zone for wetland protection. Roodepoort Colliery needs to apply for a section 21(c) and (i) water use for a relaxation of the buffer zone.

There is no river crossings planned although some mining activities are to take place within the riparian buffer zone of the receiving water resource. The impact on the resource will be most significant during the operational phase of this mining project and it is recommended that this be kept to a minimum and well managed when it can't be avoided.

Considering the legal requirements as stipulated in Government Notice GN 1198 of 18 December 2010 the proposed mining development is regarded as an activity that alters or changes the natural characteristics of a water resource. This development constitutes a water use as defined in terms of section 21(c) and (i) of the National Water Act, 1998 (Act 36 of 1998) which could only commence after a water use authorization had been granted.

4 ENVIRONMENTAL IMPACT ASSESSMENT

According to the Mpumalanga Biodiversity Conservation Plan (MBCP) the proposed project area is located within a sub-quaternary catchment with an aquatic ecosystem classified as “Ecosystem Maintenance”. This implies that any form of land use should aim to at least maintain the basic ecosystem functions of the aquatic environment and resources.

The main purpose of this surface water study is to understand the significance of potential impacts and to develop strategies to ensure that impacts can be minimised or mitigated to an acceptable level. The identification of potential issues is broad and covers the construction as well as the operational phase of the proposed project.

Issues or impacts of low significance will not be carried through to the Impact Assessment, with supporting reasons, to ensure that the Impact Assessment phase focuses on the potentially “significant impacts” identified for the proposed project. This section of the report identifies the full range of potential impacts.

4.1 IMPACT ASSESSMENT CRITERIA

The criteria for the description and assessment of environmental impacts were drawn from the EIA Regulations, published by the Department of Environmental Affairs and Tourism (April 1998) in terms of the NEMA.

The level of detail as depicted in the EIA regulations was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. An explanation of the impact assessment criteria is defined below in **Table 4-1**.

Table 4-1: Explanation of the EIA criteria

Extent	
Classification of the physical and spatial scale of the impact	
Footprint (F)	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
Site (S)	The impact could affect the whole, or a significant portion of the site.
Regional (R)	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
National (N)	The impact could have an effect that expands throughout the country (South Africa).
International (I)	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Duration	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
Short (ST)	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
Short to Medium(S-M)	The impact will be relevant through to the end of a construction phase (1.5 years)
Medium (M)	The impact will last up to the end of the development phases, where after it will be entirely negated.
Long (LT)	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
Permanent (P)	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
Intensity	
The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as	
Low (L)	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
Medium (M)	The affected environment is altered, but functions and processes continue, albeit in a modified way.
High (H)	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Probability	
This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
Probable (Pr)	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
Possible (Po)	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25 %.
Likely (L)	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50 %.
Highly Likely (HL)	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75 %.
Definite (D)	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied

	on. The chance of this impact occurring is defined as 100 %.

In order to assess each of these factors for each impact, the following ranking scales will be used.

Table 4-2: Assessment Criteria: Ranking Scales

PROBABILITY		**MAGNITUDE / INTENSITY**	
Description / Meaning	Score	Description / Meaning	Score
Definite/don't know	5	Very high/don't know	10
Highly likely	4	High	8
Likely	3	Moderate	6
Possible	2	Low	4
Improbable	1	Insignificant	2
DURATION		**SPATIAL SCALE / EXTEND**	
Description / Meaning	Score	Description / Meaning	Score
Permanent	5	International	5
Long Term	4	National	4
Medium Term	3	Regional	3
Short term	2	Local	2
Temporary	1	Footprint	1/0

4.2 DETERMINATION OF SIGNIFICANCE

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. The Significance Rating (SR) is determined as follows:

Equation 1:

$$Significance\ Rating\ (SR) = (Extent + Intensity + Duration) \times Probability$$

Other aspects to take into consideration in the specialist studies are:

- Impacts should be described both before and after the proposed mitigation and management measures have been implemented.
- All impacts should be evaluated for the full-lifecycle of the proposed mining development, including construction, operation, decommissioning and closure.

- The impact evaluation should take into consideration the cumulative effects associated with this mining project and other facilities which are either developed or in the process of being developed in the region.

The specialist studies must attempt to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the significance of identified impacts.

4.2.1 Identifying the Potential Impacts Without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a value for each impact (prior to the implementation of mitigation measures). Significance without mitigation is rated on the following scale:

Table 4-3: Significance Rating Scales without mitigation

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < SR < 60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 60	High (H)	Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale as contemplated in **Table 4-4**.

Table 4-4: Significance Rating Scales with mitigation

SR < 30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30 < SR < 60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels,

		the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR > 60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

4.3 AREAS OF INFLUENCE

In order to assess the impact of the opencast coal mine and associated mining infrastructure on surface water resources, various areas of potential impacts have been assessed. The first area is referred to as the "area of direct influence" (ADI) which is the area directly impacted upon by the proposed mining developments. The second area is referred to as the "area of indirect influence" (AII) which includes the broader catchment perspective.

4.3.1 Area of direct influence (ADI)

The ADI for water resources is determined by:

- Interception of watercourse and drainage areas due to the proposed mining activities, waste storage and containment, product stockpiling, access routes and coal transport system;
- Increased abstractions from the Woestalleen tributary and possible discharges into the wetland, and therefore the B12B catchment;
- Increased storm water runoff at the Roodepoort Colliery due to hardened surfaces, haulage roads, and areas of cleared vegetation; and
- Impact on catchment yield based on containment of water containing waste.

In terms of the EIA methodology, the spatial extent of the ADI is referred to as "Local" and "Site Specific".

4.3.2 Area of indirect influence (AII)

The Area of Indirect Influence (AII) is determined by the boundaries of the Upper Olifants WMA. In terms of the EIA methodology, the spatial extent of the AII is referred to as "Regional".

4.4 IDENTIFIED IMPACTS

4.4.1 Construction phase

Based on Google observations and available topographical maps made during the scoping phase as well as consideration of the infrastructure requirements of the proposed development of the Roodepoort Colliery, the primary concern is the potential impact on the wetland system adjacent to the project area.

The site consists of a shallow channelled valley, with the natural drainage flowing in a north-north westerly direction towards the tributary of the Woestalleen Spruit and the associated wetland and riparian areas.

An area of 50 hectares will be cleared for construction activities. It should be noted that the wetlands (riparian wetlands) present on the project site, are considered as sensitive areas due to their species composition and ecosystem functioning. Wetlands are considered a water resource and had been assessed as an integral part of the surface water study. It is noted that the PES score of the wetland in area is reported as class D, largely impacted.

Impact Description: Without Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
The construction phase will inevitably clear vegetation as preparation of the site. This may potentially remove or impact wetland areas on site/or in close vicinity of the site depending on the exact location of the infrastructure	6	2	2	4	40
Impact Description: With Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Impact on the potential wetland areas are to be reduced with proper delineation of wetland areas and planning of the site of the plant in relation to the wetland areas	4	2	1	2	14

The following potentially negative impacts on the surface water associated with the construction phase have been identified:

- Clearance of vegetation to prepare site for box cut;
- Storage of fuel and oil for earth moving machinery;
- Cement and concrete batching;

- Transportation of material to site and the storage of material on site; and
- Dust as a result of construction activities
- Impact on watercourses during road construction with installation of culverts for storm water diversion.

Impact Description: Without Mitigation	I/M	D	E/S	P	SR
The construction phase will inevitably clear vegetation as preparation of the site. This will cause and increase in sediment and silt load deposition towards the Woestalleen catchment	4	2	2	4	36
Impact Description: With Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Impact on the stream to be mitigated with the implementation of storm water management plan in accordance with GN 704 requirements	4	3	1	2	16

The abovementioned impacts associated with the construction phase are generic and can be adequately managed through the implementation of a construction Environmental Management Plan.

4.5 OPERATIONAL PHASE

The following potentially negative impacts on the surface water associated with the operational phase have been identified:

- Potential increase in the regional demand for water due to a reduction in flow and MAR for the tributary of the Woestalleen Spruit and subsequent Klein Olifants River.
- Potential exposure of aquifers draining into the wetland areas and the unnamed tributary due to mining development activities
- Potential disturbance of wetlands due to construction activities in close proximity to water resource buffer zones
- Disturbance of natural drainage channels towards the wetland areas
- Potential contaminated storm water run-off from the mining site.
- Potential for accidental spillages from the Pollution Control Dam
- Possible contamination of surface water resources (dam, stream, river and wetlands) as a result of the above mentioned impacts

4.5.1 Regional water demand

The majority of the rivers in the Olifants River WMA have experienced severe reductions in flows due to accumulating catchment pressures. This and limited water resources are causing reduced flows, which in turn are limiting the ability of the rivers to sustainably meet environmental (reserve) requirements.

However, there is an on-going demand for mining development, farming and power generation/industrial processes within the region that further stresses the available water resources. It is important for water reconciliation studies that these future developments be recognised and incorporated in the regional demand for the upper, middle and lower Olifant WMA's.

Impact Description: Without Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Over utilisation and injudicious use of ground and surface water resources will result in reduced flows of the unnamed tributary and subsequent Woestalleen Spruit. This will put pressure on the minimum in stream flow requirements necessary to be environmentally and socially sustainable.	3	5	3	3	33
Impact Description: With Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Judicious legal abstraction and utilisation of water that maintains the in stream flow requirements of the unnamed tributary and the wetland areas on the property.	2	3	2	2	14

4.5.2 Wetlands, Aquifers, drainage channels

The wetland areas located on the property area are mainly situated within the drainage area of the Unnamed Tributary and the Woestalleen Spruit. The wetland's water supply originates from the groundwater sources in the area as well as the seasonal runoff of the Woestalleen Spruit tributary.

A potential source supplying the wetland was noted during the site visit which was the two storm water drains from the Pullenshope residential area that drains towards the unnamed tributary.

The Roodepoort Colliery infrastructure development should strictly be limited outside of the wetland buffer zone and associated drainage channels and should not penetrate the wetland.

Impact Description: Without Mitigation	I/M	D	E/S	P	SR
Activities either in the construction phase or operational phase that is within the vicinity of wetlands can adversely affect these wetlands and possible impact permanently on their functionality.	8	4	2	4	56
Impact Description: With Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Construction must be well monitored and must receive extra attention when approaching wetland areas. Mining box cuts to be outside the 100 meter buffer zone. Dewatering of pit water not to be discharged to the wetland system	4	4	1	3	27

4.5.3 Storm water runoff

The construction area and proposed mining development is planned over the drainage areas of the B12B river system. It is inevitable that there will be increased runoff as the mining structures (workshops, office, parking bay, and weighbridge) do have hard surfaces and there will be a shortage of vegetation.

Impact Description: Without Mitigation	I/M	D	E/S	P	SR
The disruption of drainage paths takes place due to operational opencast mining activities.	8	4	3	4	60
Impact Description: With Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Mining footprint must remain as small as possible and rehabilitation must be done where needed. Dirty stormwater to be contained in PCD's	6	4	1	2	26

4.5.4 Surface water quality

The current surface water quality in the Woestalleen Spruit is indicative of pollution stemming from various mining and industrial activities in the catchment. Roodepoort Colliery will contribute towards the accumulative waste load in the system. Several point sources are identified that has the potential to cause significant pollution of surface water bodies. Spillage from the PCD has the potential to cause degradation of water quality with increase in variables such as EC, TDS, SO_4, Na, Cl, NO_3 and metals.

Illegal dewatering into the natural drainage system from the open pit areas will significantly impact on water quality with increased concentrations in all major cations and anions as listed above. The pH in the system may decrease towards acidic levels causing the mobilization of metals such as Al, Fe and Mn to reach toxic levels.

Impact Description: Without Mitigation	I/M	D	E/S	P	SR
Inappropriate water management based on illegal discharges, dewatering of access water and diffuse pollution to cause significant degradation of water quality in Woestalleen catchment.	8	4	3	4	60
Impact Description: With Mitigation	**I/M**	**D**	**E/S**	**P**	**SR**
Mining footprint to remain as small as possible with dirty stormwater to be contained in PCD's. PCD to be designed in accordance with GN 704 requirements. Managed PCD with 0.8 m free board at all times. Maintain water management and pollution control infrastructure	8	4	3	2	30

4.6 CLOSURE PHASE

This phase commences at the stage when all mining activities have ceased and entails the following activities:

- Filling of final voids;
- Removing of haul roads and 100mm of underlying material;
- Clearing of stockpile areas and rehabilitation;
- Redesign of storm water management measures incorporating passive water treatment;
- Removal of topsoil stock pile; and
- Initiation of monitoring programme.

As part of the decommissioning phase a closure application will be lodged with the DMR to rehabilitate the abandoned coal workings. A Closure Plan will be compiled inclusive of an Environmental Risk Report and specialist investigations to determine the latent and residual risks associated with the mine workings. The Closure Plan will be done taking cognisance of stakeholder comments as raised during the consultative public participation process.

4.7 POST- CLOSURE

In the case of open cast areas, increased water ingress on the rehabilitated areas as well as containment (open voids, seepage dams) will reduce run-off to the surface water streams. The possibility of Acid Mine Drainage may also pose a risk to the surrounding environment and will be confirmed by the geohydrological assessment. The decant volume and direction will be confirmed by geohydrological modelling.

Impact Description: Without Mitigation	I/M	D	E/S	P	SR
Impact of AMD decant on surface water quality from rehabilitated coal mine as a result of increased ingress of surface water in areas cracked areas and connected to seep zone	8	5	3	4	64
Impact Description: With Mitigation	I/M	D	E/S	P	SR
Impact on catchment RQO caused by long-term residual impacts to be mitigated by free draining rehabilitation, AMD and ABA modeling to understand calibration model. Closure Planning based on isolation of seep zones with clay material and compaction.	8	4	3	2	30

The impact is negative, possible, long term, of high magnitude but could extend from the site. The significance is high. Mitigation will be required.

The probable decanting volumes as calculated by modelling will be intercepted by a drain. The drain to be constructed as part of mitigation needs to be at a depth of at least one metre below surface in order to intercept the decanting water. Decant to be contained in lined PCD.

The possibility of acid mine drainage is limited due to the geology of the area, but needs to be confirmed and quantified by the geohydrological study. Acidic leachate and decant will be directed to a lined evaporation dam and artificial created wetland to assist with amelioration of impacted water bodies adjacent to the mining area.

4.8 ACCUMULATIVE RISK ASSESSMENT

The consideration of accumulative impacts were based on the water quality data obtained from the monitoring station WOS-S18 situated in the Woestalleen Spruit below Optimum Colliery. The water quality is depicted in Figure 4-1 and illustrates those key performance indicators for pollution stemming from mining is above the

RQO's set for the catchment. The cumulative assessment of all potential impacts within B12B is therefore stated below.

Nature:	Impacts are of physical nature
Extent:	Moderate and of regional nature
Probability:	Definite
Significance:	High

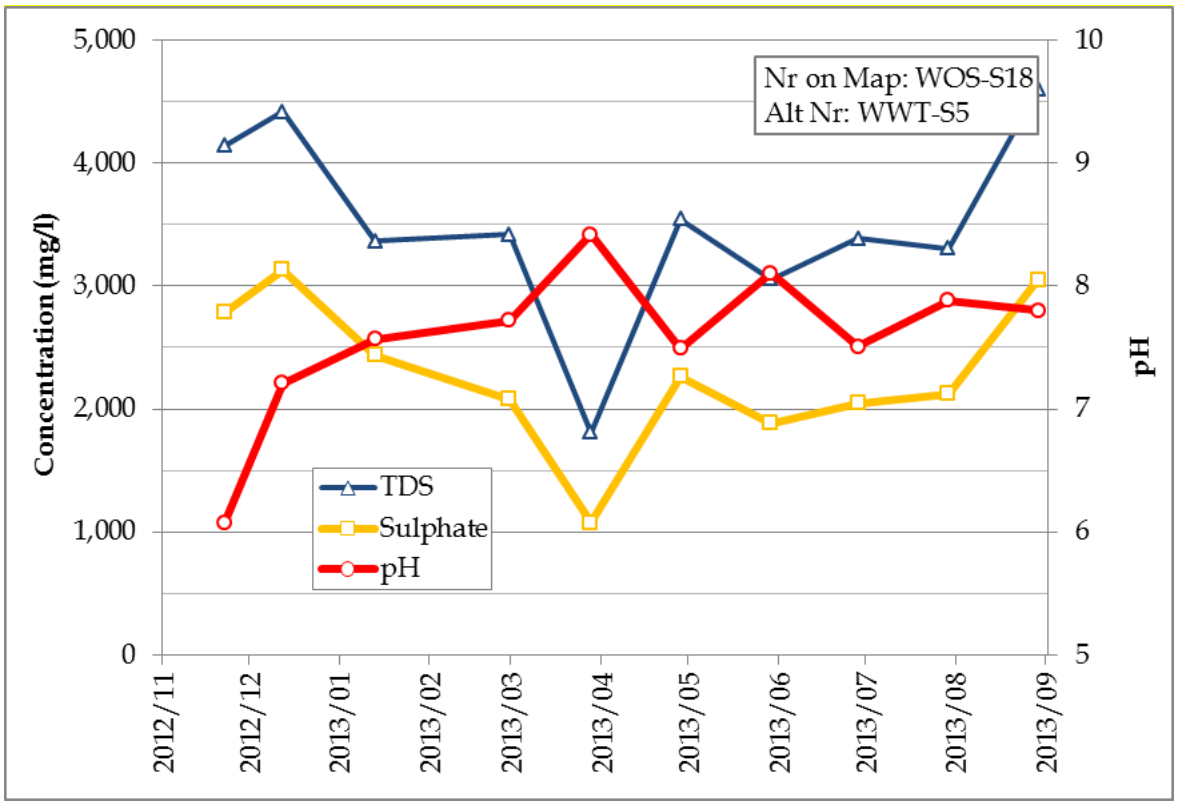

Figure 4-1: Water quality in Woestalleen Spruit below Optimum Colliery

It could be stated that there is an increasing trend in water quality deterioration with specific reference to SO_4 that fluctuates between 1000 – 3000 mg/l. Increased mining development in the catchment will further contributes towards degradation of the Klein Olifants WMA. Regional water management strategies for mining as contemplated in the National Water Resource Strategy needs to be implemented. It will therefore become a requirement for the implementation of regional water treatment works to treat acidic mine water from the mining sector.

5 MANAGEMENT OF IMPACTS

5.1 ENVIRONMENTAL AND MANAGEMENT OBJECTIVES

5.1.1 Water Use and Management

It is foreseen that there will be moderate impacts stemming from Roodepoort Colliery during the Life of Mine. Stormwater will be discharged into the unnamed tributary of the Woestalleen Spruit and water will from there flow into the Klein Olifants River. It can be assumed that this water will be contaminated to such an extent that it causes adverse effects on the B100 river system. It is therefore recommended that the mitigatory measures as discussed below be implemented to ensure impacts of low to moderate rating.

5.1.2 Surface Water Management

The following surface water management objectives will be applicable for the proposed Roodepoort Colliery development on the farm Roodepoort 151 IS:

- Identify any potential risks from the project on the surface water resource;
- Protect and conserve the aquatic and surface water environment from any impacts;
- Protect and conserve the wetlands from any impacts related to the development;
- Prevent the aquatic and surface water environment from degradation due to the activities of the mining development;
- Optimize water use on the project site;
- Preserve the water resources in line with the management objectives of the CMA/DWA for the management unit;
- Water use authorisation to be obtained from the relevant regulatory body; and
- To ensure compliance with the conditions of the environmental authorisations
- Adherence to the RWQO's for the Klein Olifants River tributaries at IFR3 as determined in the Comprehensive Reserve Determination Report (DWAF, 2001) and contained in **Table 5-1.**
-

Table 5-1: RQO's for IFR 3 for an Ecological Class C system (DWAF, 2001)

Water Quality Constituents		Reference conditions	Present status	EMC	Resource Quality Objectives											
MONTHS					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
System Variables (median values)	TDS(mg/l)		C	C	C	C	C	C	C	C	C	C	C	C	C	C
					<520	<520	<520	<520	<520	<520	<520	<520	<520	<520	<520	<520
	pH		A	C	Maintain pH within 1 pH unit of upstream reference site (B1H026Q01)											
	Temp (^{0}C)		-	C	21±4	20±4	20±4	17±4	15±4	13±4	13±4	15±4	18±4	19±4	20±4	20±4
	DO (%sat)		-	C	Maintain at greater than 60% of saturation.											
	TSS (mg/l)		-	C	Maintain at less than 30% change from upstream reference site (B1H026Q01)											
Nutrients and nutrient ratios (median values where specified)	Ammonia (mg N/l)		A	A	<0.007											
	Ortho-phosphate (mg/l)		B	C	<0.07											
	Total inorganic nitrogen: Total phosphorus ratio		D	C	>5:1											
	Ortho-phosphate: Total phosphorus ratio		D	C	<40%											
Toxics			Not tested	B	95% of time ≤ CEV[1] 99% of time ≤ AEV											

[1] Where TWQR is the Target Water Quality Range, CEV is the Chronic effect value, AEV is the acute effect value as defined in the *South African Water Quality Guidelines, Volume 7: Aquatic Ecosystems.* 1997. Department of Water Affairs & Forestry

5.1.3 Storm Water Management

Storm water management will be based on the objective of maximising clean water areas and minimising dirty areas.

The following objectives will apply:

- Keep clean water clean;
- Install oil traps;
- Install energy dispersion system in storm water culverts;
- Design in accordance with the 1:50 year flood event; and
- Compliance with Regulations as contained in GN 704

5.2 MANAGEMENT OBJECTIVES AND STRATEGIES

- Quantitative and qualitative assessment of the water resources on the property area to effectively conduct Integrated Water Resource Management;
- Optimise water use by means of waste minimisation, reuse and recycling;
- Effective and efficient use of the existing available water resources in all water use sectors within the footprint of the project area (WCDM);
- Responsible development in a water stressed area taking a sympathetic stance on the water needs of the local population;
- Minimisation and where possible prevention of water pollution stemming from urban development activities by compliance with and adherence to management commitments as specified in the EMP;
- Appropriate stormwater management over the entire footprint of the project area to ensure reduction in silt load and erosion especially during construction phase;
- Assessment of the cumulative impacts from adjacent farms, Pullenshope Township and Hendrina Power Station with the implementation of appropriate management measures to ensure sensitive downstream water users are not detrimentally impacted.

In terms of the mining development the following management measures as contained in **Table 5-2** are essential to implement mitigation measures to prevent and/or reduce environmental impacts:

- Obtain a Water Use License

- Development of an Integrated Water Resource Management Plan (as part of the WULA);
- Wetland areas to be considered as no go zones;
- Separation of clean and dirty water systems;
- Re-use, recycle and minimise all waste water generated on the site; and
- Implementation of compliance monitoring program with associated auditing and reporting

Table 5-2: Recommended mitigating measures

Reserve Component	Impact	Severity and Duration	Mitigation
Water quality	Increased sediment generation during operational phase	Moderate, long-term	- Strict erosion control - No development within riparian zone - Access roads to be well maintained - Stream-bank at dam spillway and downstream of dam to be well protected against flood damage and erosion
	Pollution of stream	Moderate, long-term	- Zero effluent discharge policy from Roodepoort Colliery (no discharge to dam or stream) - Strict regulatory control on all water containing waste generated and disposal of effluent (WWTW)
Water quantity	Reduction and stopping of stream flow during low flow periods	Moderate, long-term	- Allow for continuous release of base flow via pipe through dam wall to maintain normal stream flow downstream of dam during dry periods
In-stream biotic integrity	Introduction of harmful alien fishes	Moderate, long-term	- Stocking of indigenous species if possible

Reserve Component	Impact	Severity and Duration	Mitigation
			- Spillway/dam overflow to allow for fish passage
Riparian Habitat Integrity	Damage to riparian vegetation	Moderate, medium-term	- Introduce strict rehabilitation programme with erosion control and re-vegetation of disturbed areas using indigenous plants and shrubs - Disturbed footprint and rehabilitated areas to be monitored throughout life of the Roodepoort Colliery - Compliance with all environmental legislation
	Degradation of riparian areas by constructing and operation of Roodepoort Colliery	Moderate, long-term	- Activities secondary to mine construction and operation to be located out of riparian zone as far as possible - All work areas including access road and mining complex to be rehabilitated on completion
In-stream Habitat Integrity	Damage and degradation to the in-stream habitat caused by prolonged mining activities	Moderate, long-term	Strict control measures to be implemented in terms of impact minimisation on the in-stream habitat

5.2.1 Management during Construction Phase

In terms of the construction phase the following management and mitigation measures are required to prevent and/or reduce environmental impacts:

- Obtain the necessary Water Use License

- Development of an Integrated Water Resource Management Plan (as part of the WULA);
- Wetland and riverine areas to be considered as no go zones unless authorisation is obtained;
- Separation of clean and dirty water systems;
- Containment of all contaminated water in dedicated pollution control design facilities;
- Re-use, recycle and minimise all waste water generated on the site; and
- Implementation of compliance monitoring program with associated auditing and reporting

Project component/s	Construction of Roodepoort Colliery infrastructure
Potential Impact	• Clearance of project foot print could lead to increased sedimentation and siltation • Road construction to alter the natural characteristics of the drainage system • Accidental spills could lead to water pollution
Activity/risk source	Roodepoort Colliery located within quaternary drainage B12B that has PES and EIS category of D with largely disturbed areas of ephemeral and episodic drainage patterns
Mitigation: Target/Objective	• Water quality (for surface and groundwater) should adhere and comply with the Resource Quality Objectives set for the catchment; • Ecoclassification for the affected catchment in terms of PES and EISC shall be maintained at **Class D**

Mitigation: Action/Control	Responsibility	Timeframe
• The construction of roads and road servitudes (disturbance zones) in or adjacent to the wetland/riparian zone is to be managed and strictly controlled to minimize damage to the impoundment, rivers and wetlands.	General Manager Manager: SHE	During Life of Mine
• Where applicable, disturbed wetlands and riparian zones (i.e. for those areas that will not form part of the road and mine infrastructure operational footprint but that were disturbed as part of the construction	Manager: SHE Contractor (Mining)	On-going

activities) should be re-vegetated using site-appropriate indigenous vegetation and/or seed mixes.		
• In-stream habitat conditions (with regard to the river's morphology) should be recreated as far as possible; this pertains to those areas where construction activities have disturbed the in-stream habitat beyond the operational footprint of the mine.	Manager: SHE	On-going

Performance Indicator	PES, EISC Recommended Class: D
Monitoring	• Where vegetation removal has occurred adjacent to the new route, mining site and associated infrastructure, monitoring should take place to ensure successful re-establishment of natural vegetation. Alien vegetation should be removed from these disturbed areas on an ongoing basis to ensure the successful re-vegetation by indigenous species. • When debris collect at the base of culverts they create hydraulic obstacles resulting in the scouring (erosion) of the downstream banks (and this may also lead to an excessive soil deposition upstream of the culvert). It is therefore essential that a long-term monitoring and maintenance plan be implemented by the applicant whereby the applicant will be obligated to maintain bank stability (i.e. to control any erosion that has taken place as a result of the mining infrastructure) as well as to clear any debris away from the base of culverts (especially after high rainfall and flood events).

5.2.2 Management during Operational Phase

Project component/s	Operational phase of the Roodepoort Colliery
Potential Impact	• Overburden and waste material disposal to potentially degrade surface and groundwater resources • Accidental spills could lead to water pollution • Runoff from coal stockpiles, crushing and screening plant area and mining surface infrastructure to pollute water resources
Activity/risk source	Roodepoort Colliery located within quaternary drainage B12B that has PES and EIS category of D with largely disturbed areas of ephemeral and episodic drainage

	patterns
Mitigation: Target/Objective	Description of the target; include quantitative measures and/or dates of completion

Mitigation: Action/Control	Responsibility	Timeframe
Stormwater Control • Dirty and clean stormwater should be separated systems. Dirty stormwater to be contained • The erosion down verges on the approach to a water course should be minimised by including frequent discharge points with energy dissipaters before discharging storm water into the adjacent wetland and grasslands (where applicable). • Infiltration down the verges of the roads rather than surface runoff should be encouraged (this could for example include the use of grassed swales, Hyson Cells or grass blocks). The construction of small detention ponds filled with *Phragmites* reeds would allow sediment and debris/litter to be trapped before entering the unnamed drainage lines of the Woestalleen Spruit Catchment. • Where storm water enters the water resource sediment and debris trapping, as well as energy dissipation control structures should be put in place.	Manager: SHE Appointed Civil Engineer	Implementation during construction phase On-going
Water Pollution Control Facilities • Turbidity, sedimentation and chemical changes to the composition of the water must be limited. • The possibility of spillages should be catered for in the design of the infrastructure development where, pollution control dams or attenuation ponds prior to the discharge of storm water could be contained.	Manager: SHE Civil Engineer (on appointment)	On-going Rainy season

• Storm water systems to be designed in such a way that it can be easily sealed off after the occurrence of a spill. If a spill occurs during the operational phase of the water use, a qualified team of experts will need to be consulted, rehabilitation plan drawn up and implemented and the Regional DWA Office should be informed immediately.		
General • Dirty water collection at the station drains and sumps • Clean water diversion (bunds/ canals). • Good housekeeping (clean-up of spills and minimise informal storage of materials) • Leak detection through inspection • Good housekeeping (maintenance of equipment) • Storm water diversion upstream of the facilities • Either run off will be contained in paddocks for collection and evaporation or run off will be captured in the drain system and channelled to the PCD compartment. • Monitor seepage at PCD on a quarterly basis • Isolate pollution sources with roofs, concrete bases, traps, sumps and bund walls (e.g. diesel/petrol storage, wash bays and workshops) • Roads will be surfaced • Vehicle maintenance will be conducted on bunded concrete surfaces	Manager: SHE	On-going

Performance Indicator	SO_4, TDS, EC, pH, Na
Monitoring	• Chemical variables as per WULA specification but at least monthly • Water levels (during rainy season) daily • Aquatic Ecology, bi-annually (wet and dry)

6 MONITORING PROGRAMME

Effective surface water management and monitoring is essential for the long term sustainability and protection of the receiving water environment. There is a legal obligation on the water user to establish a monitoring programme on the site that needs to be registered on the National Monitoring System administered by D: RQS.

- Quantity, quality and use of water in the Upper Olifants sub-WMA;
- Compliance with RQO;
- Status of the aquatic health system; and
- Atmospheric conditions which may influence water resources in the area

6.1 SURFACE WATER (LOCATION, VARIABLES, FREQUENCY)

Water quality monitoring parameters proposed for Roodepoort Colliery to be monitored on a monthly frequency or as indicated are contained in **Table 6-1**.

Table 6-1: Surface water variables to be analyzed

Variable	Unit	Frequency
pH		Weekly
Electrical Conductivity as EC	mS/m	Weekly
Total Dissolved Solids as TDS	mg/l	Weekly
Suspended Solids as SS	mg/l	Quarterly
Sulphate as SO_4	mg/l	Monthly
Nitrate as NO_3	mg/l	Monthly
Sodium as Na	mg/l	Monthly
Chloride as Cl	mg/l	Monthly
Calcium as Ca	mg/l	Monthly
Potassium as K	mg/l	Monthly
Magnesium as Mg	mg/l	Monthly
Total hardness as $CaCO_3$	mg/l	Monthly
Total alkalinity	mg/l	Monthly
Fluoride as F	mg/l	Monthly
Dissolved Oxygen as DO	mg/l	Monthly
Chemical Oxygen Demand as COD	mg/l	Monthly
Ortho Phosphate as PO_4	mg/l	Monthly

The surface water monitoring point as indicated in **Figure 6-1** and described in **Table 6-2** was used to characterise the water resources in the project area. Site photographs are given in **Figure 6-2** and **Figure 6-3**.

Table 6-2: Surface water sample sites September 2013

Sampling point	Coordinates	
	Longitude	Latitude
KFBM4: At bottom valley channelled wetland. Unnamed tributary to Woestalleen Spruit	25°59'56.98" S	29°34'52.06" E
KFBM3: Tributary of Woestalleen Spruit, direct opposite from proposed mining area	26° 0'14.90" S	29°34'56.62" E
KFBM2: Tributary of Woestalleen Spruit, overflow from dam	26° 0'26.33" S	29°34'56.64" E
Dam: Grab sample from dam on property	26° 0'34.83" S	29°35'2.80" E
KFBM1: Upstream of mining area and below second dam on property	26° 1'14.71" S	29°35'9.44" E
Seep: Below dam wall seepage accumulated in riparian zone of wetland	26° 0'26.53" S	29°34'56.84" E

6.2 BIOLOGICAL MONITORING

It will be a stipulation in a water use authorization for Roodepoort Colliery to conduct biological monitoring in the tributary of the Woestalleen Spruit. The monitoring program must indicate that all reasonable steps were taken to allow migration of aquatic species. The biological monitoring program must determine the current level of diversity of biotopes, communities of animals, plants and microorganisms that must be maintained.

A qualified aquatic specialist must be retained to give effect to the various biological monitoring requirements to ensure compliance with the requirements of the National Water Act, 1998. In this instance the biological monitoring programme as conducted by Menco could be extended. It is proposed that six monthly aquatic macro-invertebrates (SASS5) and habitat integrity assessments (IHAS) be conducted delineating winter and summer conditions at the points as identified in the Bio-monitoring Report (September 2013).

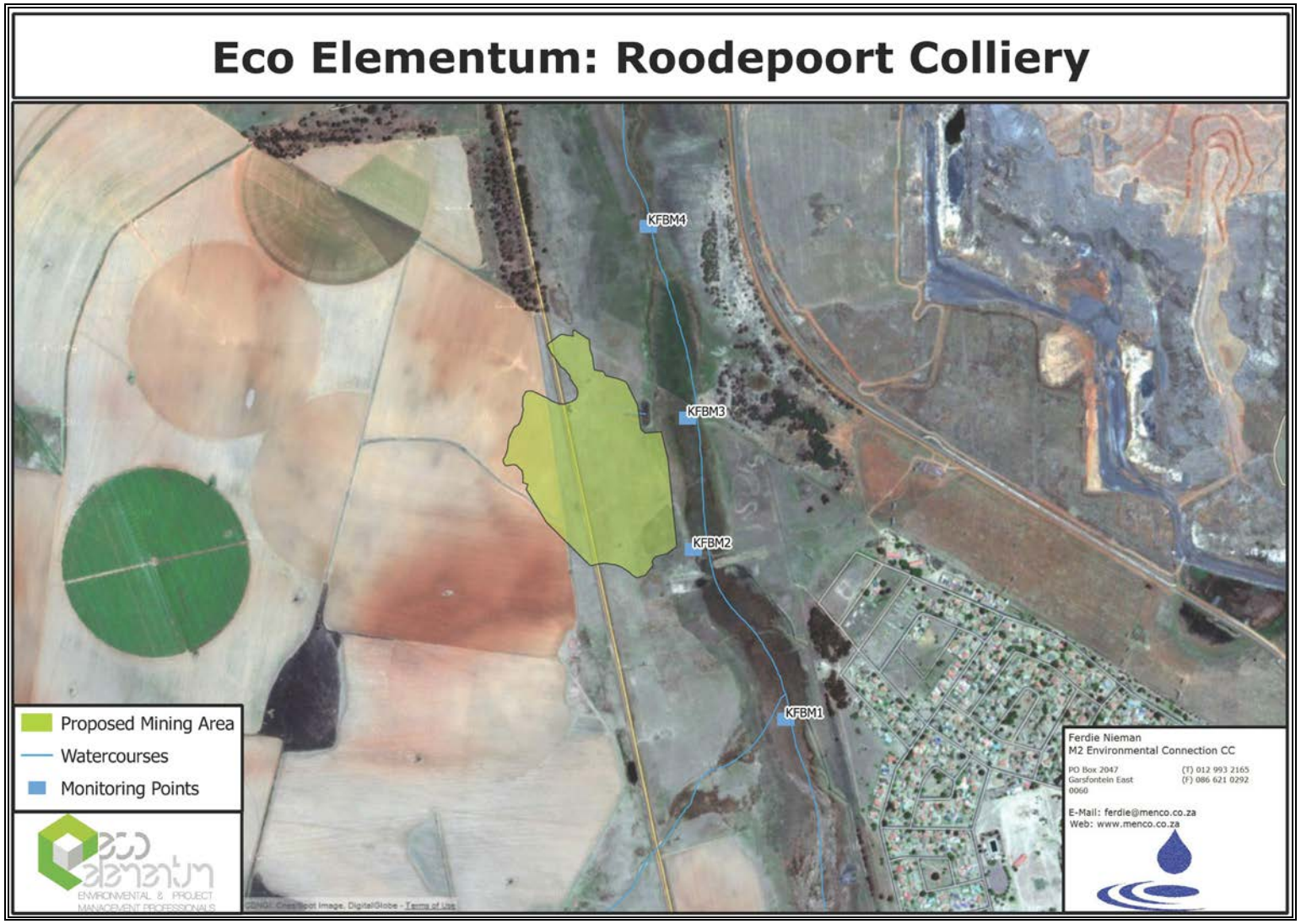

Figure 6-1: Location of September 2013 surface water sample sites

In addition in support of a section 21(c) and (i) water use Roodepoort Colliery needs to submit a Work Method Statement, site plans and detailed design drawings for the construction of all infrastructure impeding or altering the natural characteristic of the water course. The foregoing must indicate the regulated activities, marking the limits of disturbance in relation to impacted water courses, morphology of the water course, site specific impacts and environmental management with emphasis on erosion and sediment control, pollution prevention and management measures.

A monitoring program needs to be compiled that entails a water course management plan inclusive of streams, pans and wetlands in the area that addresses the management and maintenance objectives of all water courses within the mining right area. This plan has to indicate what wetland systems will be maintained at Class C/D and what wetland systems will be improved to Class C.

7 RECOMMENDATION AND CONCLUSION

The study entails the surface water assessment of the sub-quaternary catchment and its rivers and tributaries as it relates to the opencast coal mining Kebrafield Roodepoort Colliery project on portion 17 of the Farm Roodepoort 151 IS.

The identified water users within this area are agriculture, irrigation, livestock and grazing (cattle), mining, power generation as well as urban communities.

Water resources within the project area are moderately impacted with alleviated concentrations in SO_4, TDS, EC, Na and suspended solids. Upstream water quality conditions could be rated as Good and with appropriate water management measures in place, the proposed mining at Roodepoort will not significantly contributes towards further degradation of the Woestalleen catchment.

Although a wetland was identified on the property the project area is not located within an area classified as a national priority area for wetlands. In terms of the overall conservation of aquatic biodiversity of the area, the project should aim to minimize impacts on the aquatic resource in order to maintain its current basic ecosystem functions.

It is recommended that Kebrafield: Roodepoort Colliery applies for a Water Use License if the mining development proceeds. An Integrated Water Resource Management Plan needs to be compiled as a technical supporting document for the water use license authorisation process. The development will only be allowed to commence once all regulators grant approval for development within close proximity of a wetland area.

In the case that a WUL is obtained and development of the Roodepoort Colliery commences and all legislation and mitigation is followed and adhered to, all impacts are considered to be low to moderate and manageable.

Within the limits of the present knowledge of the area, there are no self-evident impacts in terms of the surface water resource that can reasonably be considered to represent a fatal flaw.

8 REFERENCES

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9 APPENDICES

Appendix A	Waterlab Analysis Certificate
Appendix B	Flood calculations: PG Consulting (Pty) Ltd

APPENDIX A

Water Analysis Certificate