Proponent: **Exxaro Reductants (Pty) Ltd**

Project: **Market Coke Plant and Co-generation Plant Project**

Report Name: **INTEGRATED WATER AND WASTE MANAGEMENT PLAN AMENDMENT**

Report Status: **Draft**

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For submission to: Limpopo Department of Water Affairs as part of the Water Use Licence Amendment Application

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PROJECT INFORMATION SHEET

PROJECT:
Market Coke and Co-generation Plant

REPORT DETAILS

Report Name:	Integrated Water and Waste Management Plan Amendment
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EXECUTIVE SUMMARY

Introduction

Exxaro Reductants (Pty) Ltd (Exxaro Reductants) propose to construct a Market Coke Plant and electricity Co-generation Plant adjacent to an existing Char Manufacturing Plant, within the boundaries of the Grootegeluk Coal Mine. The mine is located on the farm Daarby 458 LQ, approximately 20 km west of Lephalale (formerly Ellisras) in the Limpopo Province. The proposed Market Coke Plant will further process some of the coking coal on site before transporting it to customers. The electricity Co-generation Plant will produce electricity from the coke oven flue, hot waste gas, produced in the coking process.

The proposed sites of the Market Coke and Co-generation Plant are on a 49.4 ha portion of an old coal stockpile area within the Grootegeluk Mine. This site is also adjacent to an existing Char Manufacturing Plant which has been operational since 2009.

The Market Coke and Co-generation Plant will fall under the water use of Grootegeluk Mine which has an existing water use licence (WUL) (License number: 27072505) (refer to Appendix 1). In a previous project, the Char Manufacturing Plant Expansion Project, an amendment to the existing WUL was applied for specifically for that project (Char Manufacturing Plant Expansion Project). This current Market Coke and Co-generation Plant project will require a further amendment to that WUL. There is also an approved Integrated Water and Waste Management Plan (IWWMP) and a Supporting Technical Report for the WUL. A WUL amendment application for the amendment will be submitted to the Department of Water Affairs (DWA) and this IWWMP amendment will form part of the application.

As there is already an existing, approved IWWMP and technical report for the area where the Market Coke and Co-generation Plant will be, this IWWMP Amendment Report will form an Appendix to the existing IWWMP and will thus focus specifically on the Market Coke and Co-generation Plant. Synergistics Environmental Services (Pty) Ltd (Synergistics) has been appointed by Exxaro Reductants to undertake the WUL Amendment Application and compile this amendment to the existing, approved IWWMP to be submitted in support of the application.

This IWWMP Amendment has been compiled with the assistance of the DWA Draft Operational Guideline to assist in the Compilation of an Integrated Water and Waste Management Plan, dated September 2009.

Project Description

Coke, a carbonaceous agent, is used in the metals industry as a reductant of iron ore (rock containing iron and its oxides (FeO_3) and other metals and their oxides) in the presence of heat at melting point, by allowing the oxides contained in the ore to react with the carbon. Exxaro Reductants has entered into the reductants market with the proposed Market Coke Plant (and existing Char Manufacturing Plant) targeting the Ferrochrome market. Ferrochrome is the main constituent in the production of stainless steel. There is a demand for increased production of coke within this market, which the Market Coke Plant aims to address. Exxaro Reductants is in a prime position to manufacture and supply coke with readily available coal feedstock (from the Grootegeluk Mine) and in close proximity to their customers.

Exxaro Reductants is also proposing to develop an electricity Co-generation Plant which will utilise the waste heat contained in the exhaust gases of the Market Coke Plant to generate electricity. In the Coke plant, the coke oven flue gas (COFG) is fully combusted inside the coke ovens and enters the heat recovery, steam-generating boilers. The term 'waste gas' implies that, should the heat not be used

immediately, it would be 'wasted'. The steam generated from the extracted thermal energy, is expanded through a steam turbine that drives a generator, to generate 'Co-generated' electrical energy

Construction of the Market Coke and Co-generation Plant is due to begin in the first quarter of 2014. Construction should be complete by the end of 2016.

Water Uses

Section 21 of the National Water Act (No 36 of 1998) (NWA) lists water uses that require licensing prior to commencement. Water uses at the current Char Manufacturing Plant, which are included in the existing WUL are:

21 (a) abstracting water from a water resource (Licence number: 27072505) (see Appendix 1)

21 (g) disposing of waste in a manner which may detrimentally impact on a water resource (also licence number: 27072505).

21 (j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity, or for the safety of people (also licence number: 27072505).

A WUL Amendment application will be submitted to the Limpopo DWA for the following water uses at the Market Coke and Co-generation Plant:

21 (g) disposing of waste in a manner which may detrimentally impact on a water resource

There are no exemptions that have been granted for any of the section 21 water uses in terms of the NWA in the existing WUL. No exemptions from requirements of the NWA are requested for the Market Coke and Co-generation Plant.

There are no General Authorisations applicable to the Market Coke and Co-generation Plant Project.

Water Management

A pollution control dam (PCD) extension will be required to accommodate the increase in water received by the existing PCD. The current PCD (which is currently in use by the existing Char Manufacturing Plant) will also be partly utilised for the Market Coke and Co-generation Plant Project. This PCD will be expanded considerably to facilitate the additional plant. The PCD extension will be receiving all overflow from the existing PCD.

Process effluent and storm water will be collected in the PCD Extension which will be the primary source of process water for the Market Coke and Co-generation Plant, with make-up water being sourced from the Grootegeluk Mine process water system. A site water balance compiled for the PCD extension indicated that there is sufficient capacity to prevent spillage of contaminated water for storm events up to at least the 1:50 year recurrence interval (Jones and Wagener, 2012B).

Market Coke and Co-generation Plant Project is located within a dirty water area within the Grootegeluk Coal Mine, there are no clean areas surrounding or within the Market Coke and Co-generation Plant site area. A storm water cut-off drain will be constructed around the plant to separate the plant's dirty water from the surrounding environment.

Waste and stockpile Management

There will be no waste produced from the Coke manufacturing process. Gypsum will be produced as a by-product of the process and will be commercially sold.

General and hazardous waste disposal will tie in with the current practices and facilities of the existing operations at the adjacent Char Manufacturing Plant.

The site is currently serviced by a conventional waterborne sewerage system. All domestic waste water generated on the site is collected in a sump adjacent to the PCD. This sump has capacity for 300 people and thus has sufficient capacity to also handle the increased demand of the Market Coke and Co-generation Plant Project.

In addition to the wastes, the coke product and coal feedstock stockpiles will also require management to ensure that they do not impact on water resources. The coke stockpile areas will be lined with an HDPE liner and will have a hard stand compacted soil base. All water runoff and seepage from the stockpiles will be directed to the PCD and will not be disposed of into the environment.

Environmental Management and Monitoring

An Environmental Management Programme (EMP) has been compiled for the project. This programme will be implemented to ensure that environmental impacts are minimised as far as possible. Regular auditing will also be undertaken to ensure that the EMP is complied with.

A monitoring system has been set up to monitor potential groundwater and surface water impacts (quality and quantity), on both the Market Coke and Co-generation Plant site and on the neighbouring Grootegeluk Mine. All identified surface water and groundwater monitoring points for the plant shall be monitored.

Conclusions and Key Findings

The Market Coke and Co-generation Plant Project may possibly result in impacts on water resources; however, with the implementation of the EMP and water and waste management measures, the potential impacts are reduced to low or very low levels. As most of the assessment was undertaken using modelling exercises, it is vital that suggested monitoring is undertaken to ensure better understanding of the environmental impacts. It is also essential that the existing Grootegeluk Mine public forum includes the Market Coke and Co-generation Plant Project, so that potentially affected parties are able to regularly discuss and resolve waste and water-related issues they may be experiencing. There is no environmental or socio-economic reason why the WUL amendment should not be granted for the Market Coke and Co-generation Plant Project.

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LIST OF TERMS, ACRONYMS AND ABBREVIATIONS

BEE	Black Economic Empowerment
BID	Background information document
Char	Char is the solid material that remains after volatile gas (e.g. coal gas) and coal tar have been driven out or released from a carbonaceous material during the initial stage of combustion, which is known as carbonisation, charring or devolatilisation.
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CMA	Catchment Management Agency
COC	Contaminant of Concern
Coke	Coke is made by heating suitable coal in the absence of oxygen, to a temperature of around 1200°C for an extended period of time. During this heating cycle, coke is formed and volatile materials in the coal are released in the form of vapour, gas and smoke.
COFG	Coke Oven Flue Gas
DMR	Department of Mineral Resources
DWA	Department of Water Affairs (previously Department of Water Affairs and Forestry)
EAP	Environmental Assessment Practitioner i.e. the professional person that has been responsible for carrying out the EIA.
EC	Electrical Conductivity
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMC	Ecological Management Categories

EMP (EMPr for DMR)	Environmental Management Programme
EMS	Environmental Management System
General waste	Waste that does not pose an immediate hazard or threat to health or to the environment, and includes-*(a)* domestic waste; *(b)* building and demolition waste; *(c)* business waste; and *(d)* inert waste.
GHG	Greenhouse Gas Emissions
GN	Government Notice as published in the Government Gazette
Hazardous waste	Waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment.
HDPE	High-density polyethylene
IAPs	Interested and affected parties
IWWMP	Integrated Water and Waste Management Plan
IWULA	Integrated Water Use License Application
ktpa	kilo tonnes per annum
LEDET	Limpopo Department of Economic Development, Environment and Tourism
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbgl	meters below ground level
MCWAP	Mokolo and Crocodile Water Augmentation Project
Mℓ	Mega Litres
MPRDA	Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MSDS	Material safety data sheet
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:WA	National Environmental Management Waste Act, 2008 (Act No. 59 of 2008)
NSS	Natural Scientific Services
NWA	National Water Act, 1998 (Act No.36 of 1998)
NERSA	National Energy Regulator of South Africa
PAHs	Polycyclic Aromatic Hydrocarbons
PCD	Pollution Control Dam
PESC	Present Ecological Status Category
PPE	Personnel Protective Equipment
Reserve	As defined in the National Water Act (No. 36 of 1998), reserve means the quantity and quality of water required - *(a)* to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No. 108 of 1997), for people who are now or who will, in the reasonably near future, be – (i) relying upon; (ii) taking water from; or (iii) being supplied from, the relevant water resource; and *(b)* to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.
RQOs	Resource Quality Objectives, defined as: Quantitative and verifiable statements about water quantity, water quality, habitat integrity and biotic integrity that specify the requirements (goals) needed to ensure a particular level of resource protection.
SANS	South African National Standard
SHE	Safety, Health and Environment
SLP	Social and Labour Plan
TDS	Total Dissolved Solids
UNFCCC	United Nations Framework Convention on Climate Change
Waste	Any substance, whether or not that substance can be reduced, re-used, recycled and recovered-*(a)* that is surplus, unwanted, rejected, discarded, abandoned or disposed of; *(b)* which the generator has no further use of for the purposes of production; *(c)* that must be treated or disposed of; or *(d)* that is identified as a waste by the Minister by notice in the *Gazette*, and includes waste generated by the mining, medical or other sector, but-(i) a by-product is not considered waste; and (ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste.
WMA	Water Management Area
WML	Waste Management License
WUL	Water Use License
WWTW	Waste Water Treatment Works (Grootegeluk)

EXXARO REDUCTANTS (Pty) Ltd
MARKET COKE AND CO-GENERATION PLANT
Integrated Water and Waste Management Plan Amendment

1. INTRODUCTION

1.1 Project Background

Exxaro Reductants (Pty) Ltd (Exxaro Reductants) propose to construct a Market Coke Plant and an electricity Co-generation Plant adjacent to the existing Char Manufacturing Plant, within the boundaries of the Grootegeluk Coal Mine (Figure 1.1 and Figure 1.2). The Grootegeluk Mine is on the farm Daarby 458 LQ, approximately 20 km west of Lephalale (formerly Ellisras) in the Limpopo Province. The mine is situated within the Waterberg Coal field and has been in operation since the early 1980's. It is near to two major mine clients - the Eskom Matimba and Medupi Power Stations. Other neighbouring properties include private farms which are mainly used as game farms, and the Manketti Reserve on the Grootegeluk property which is managed by Ferroland (a subsidiary of Exxaro). Access to the mine is from an east-west aligned provincial tarred road, the D2001, between Lephalale and Stockpoort.

The Grootegeluk Mine is South Africa's largest single coal processing complex. Most of the production is thermal coal, which is sent to Eskom's Matimba and Medupi Power Stations by means of overland conveyor belt. About 18% of the mine's production consists of semi-soft coking and metallurgical quality coal, which is sold to local and international steel and ferro-chrome alloy plants. The proposed Market Coke Plant will further process some of the coking coal on site before transporting it to customers. The electricity Co-generation Plant will produce electricity from burning the off-gas, called coke oven flue gas (COFG), produced in the coking process. It is anticipated that approval to negotiate agreements for the possible sale of electricity, with institutions like Eskom and the National Energy Regulator of South Africa (NERSA) will be granted following completion of the Bankable Feasibility Phase by the end of 2012.

The proposed site of the Market Coke and Co-generation Plant is on a 49.4 ha portion of an old coal stockpile area (also known as the old coal middling stockpile area), which is currently being used as a laydown area. This site is also adjacent to an existing Char Manufacturing Plant which has been operational since 2009 (refer to figure 1.2). The Char Manufacturing Plant is owned by Exxaro Reductants, on land leased from the Grootegeluk Mine. The proposed Market Coke Plant and the proposed Co-generation Plant will also be owned and operated by Exxaro Reductants and will also be constructed on land leased by Exxaro Reductants from the Grootegeluk Mine.

The Market Coke and Co-generation Plant will fall under the water use of Grootegeluk Mine which has an existing water use licence (WUL) (License number: 27072505) (refer to Appendix 1). In a previous project, the Char Manufacturing Plant Expansion Project, an amendment to the existing WUL was applied for specifically for that project (Char Manufacturing Plant Expansion Project). This current Market Coke and Co-generation Plant project will require a further amendment to that WUL. There is also an approved Integrated Water and Waste Management Plan (IWWMP) and a Supporting Technical Report for the WUL. A WUL amendment application for the amendment will be submitted to the Department of Water Affairs (DWA) and this IWWMP amendment will form part of the application.

As there is already an existing, approved IWWMP and technical report for the area where the Market Coke and Co-generation Plant will be, this IWWMP Amendment Report will form an Appendix to the existing IWWMP and will thus focus specifically on the Market Coke and Co-generation Plant. Synergistics Environmental Services (Pty) Ltd (Synergistics) has been appointed by Exxaro Reductants to undertake the WUL Amendment Application and compile this amendment to the existing, approved

IWWMP to be submitted in support of the application.

This IWWMP Amendment has been compiled with the assistance of the DWA Draft Operational Guideline to assist in the Compilation of an Integrated Water and Waste Management Plan, dated September 2009.

1.2 Project Schedule

The project phases will include: Planning and Design, Construction, Operation, Decommissioning and Post Closure. Construction will involve clearing and levelling of the site and the construction of the Market Coke and Co-generation Plant and associated infrastructure. The required services will be expanded to the construction site by constructing the necessary trenches and erecting the poles required.

Construction of the Market Coke and Co-generation Plant is due to begin in the first quarter of 2014 and for completion at the end of 2016.

The expected lifetime of the new plant is 20 years.

1.3 Location of Project

The Market Coke and Co-generation Plant will be located on the Farm Daarby 458 LQ, within the boundaries of the Grootegeluk Coal Mine. The regional locality is illustrated in Figure 1.1; the location of the Market Coke and Co-generation Plant is shown in Figure 1.2.

Access to the mine and the proposed Market Coke and Co-generation Plant is from an east-west aligned provincial tarred road, the D2001, between Lephalale and Stockpoort.

The Market Coke and Co-generation Plant project site falls within quaternary catchment area A42J and the Limpopo Water Management Area.

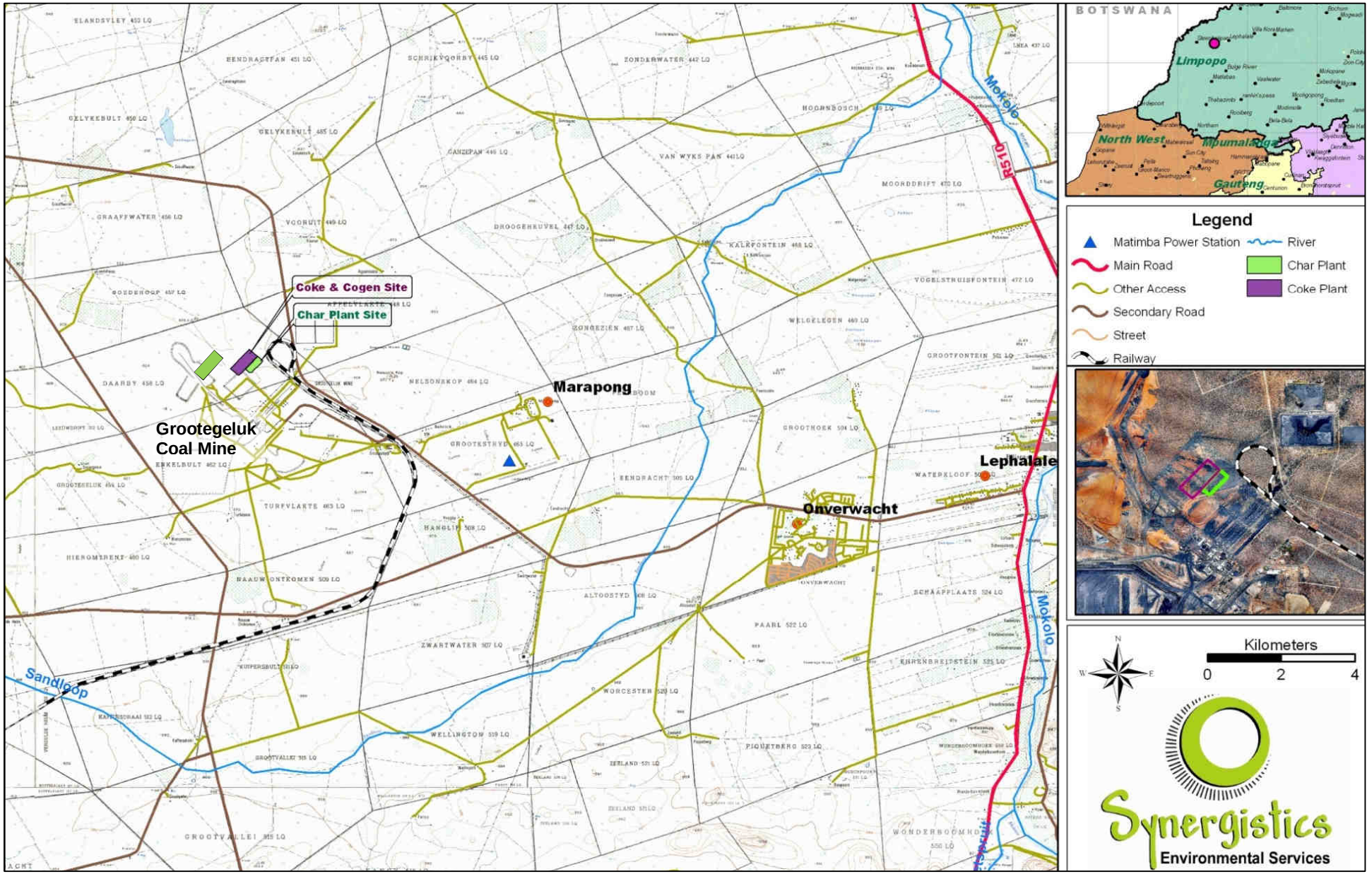


Figure 1.1: Regional location of Market Coke and Co-generation Plant (purple), adjacent to the existing Char Manufacturing Plant at the Grootegeluk Mine.

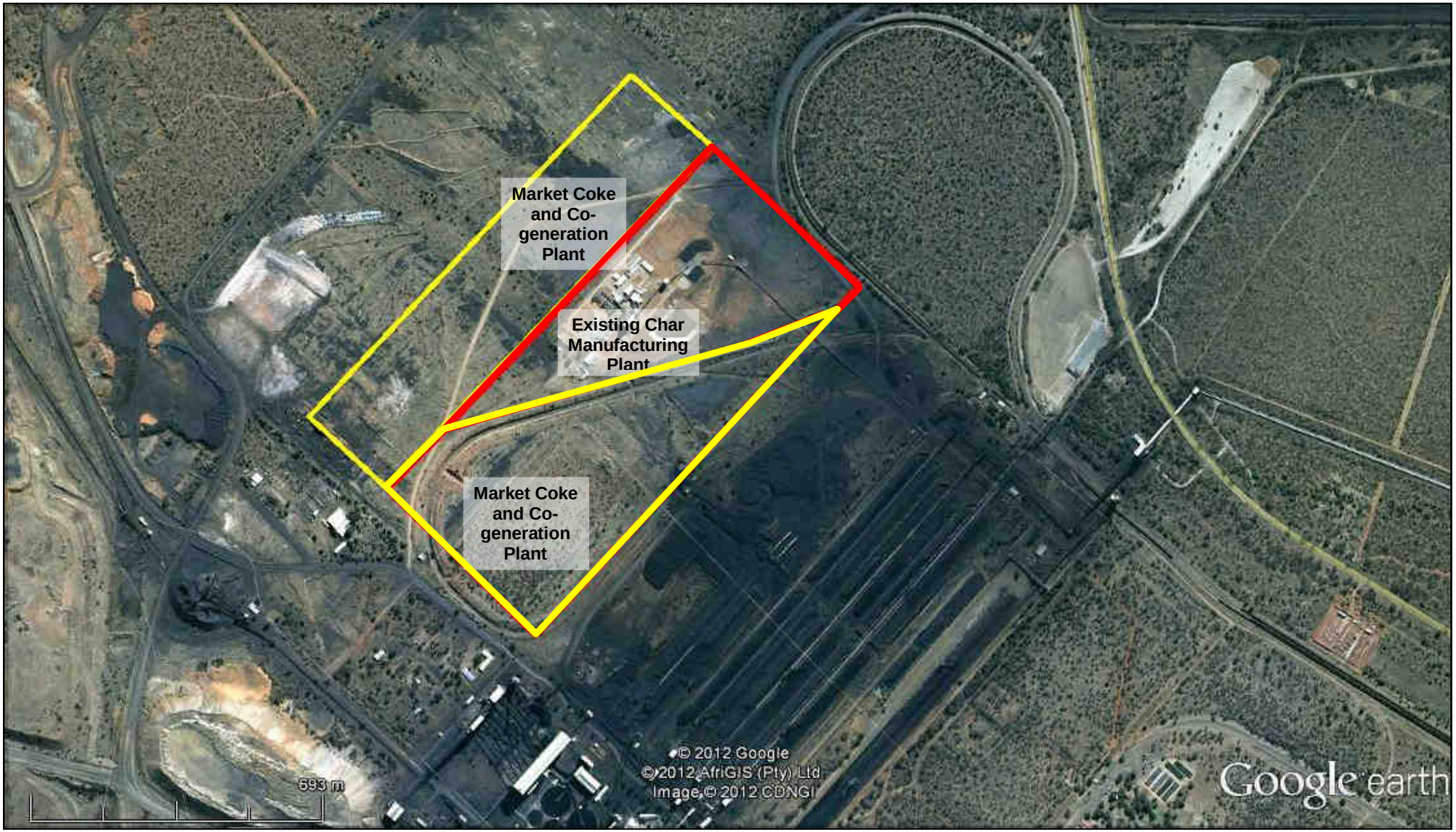


Figure 1.2: Market Coke and Co-generation Plant area (within the yellow outline) within the Grootegeluk Mine (aerial view)

1.4 Property Description

The land where the Market Coke and Co-generation Plant is planned to be constructed is owned by Exxaro Reductants, on land leased from the Grootegeluk Mine.

Exxaro owns a considerable area of land around the Grootegeluk Mine that is divided into a few sections under different forms of management. Ferroland, a subsidiary company of Exxaro, manages the bulk of the area as a nature reserve called the Manketti Reserve. Ferroland manage their land according to conservation principles and maintain breeding stocks of a variety of large wildlife species (Natural Scientific Services (NSS), 2010). The other developments and land uses nearby include two major Grootegeluk Coal Mine clients - the Eskom Matimba and Medupi Power Stations. Neighbouring properties include private farms which are mainly used as game farms. The nearest stream is the Sandloop stream and the closest river is the Mokolo River approximately 20 km east of the site (Jones & Wagener, 2012B).

1.5 Legal Assessment

1.5.1 Existing Lawful Uses

A WUL (Licence number: 27072505) is in place for the Site (refer to Appendix 1). This licence includes section 21(a), 21(g) and 21(j) authorisations under the National Water Act, 1998 (NWA) for the Grootegeluk Coal Mine and the Farm Daarby 458 on which the proposed Market Coke and Co-generation Plant is to be located.

There is also an approved IWWMP and a Supporting Technical Report for the WUL. The proposed Market Coke and Co-generation Plant requires an amendment to the existing WUL. A WUL application for the amendment will be submitted to the DWA and this IWWMP amendment will form part of the application. As there is already an existing, approved IWWMP and technical report for the site where the Market Coke and Co-generation Plant will be positioned, this IWWMP Amendment Report will form an Appendix to the existing IWWMP (Appendix 2 and 3).

There are no existing General Authorisations for the site, nor are there any existing General Authorisations on the site where the Market Coke and Co-generation Plant is going to be constructed. There are no General Authorisations applicable to the Market Coke and Co-generation Plant.

1.5.2 Summary of Water Uses

1.5.2.1 National Water Act (No. 36 of 1998)

For the Market Coke and Co-generation Plant project, a WUL Amendment application is being submitted to the Limpopo DWA for their approval. The WUL Amendment application will be submitted in November 2012. Section 21 of the NWA lists water uses for which a WUL must be obtained. In terms of the NWA, the following water uses are applicable for the Market Coke and Co-generation Plant:

- Section 21 (g) ‘disposing of waste in a manner that may detrimentally impact on a water resource’.
    - A PCD Extension will be constructed and will be utilised as part of this Market Coke and Co-generation Plant project. The extension will be adjacent to the existing PCD on the site and will collect all overflow from the existing PCD.
    - The coke product stockpiles will also require a 21 (g) even though they are not a waste; their temporary storage could have a potential impact on the environment.
    - The coal feedstock stockpiles will also require a 21 (g) even though they are not a waste; their temporary storage could have a potential impact on the environment.
    - There will be a settling pond at the quench tower to settle sediment out of the quench water before it is recycled into the process.

- Section 21 (h) 'disposing of water which contains waste from, or which was heated in, any industrial or power generation process'.
    - The water which will collect in the PCD Extension will contain water from an industrial process: Char manufacturing (separate project) and recovered quench water from coke plant ovens.

The application forms for each of these licenses will be to be submitted to DWA together with the Final IWWMP report.

1.5.3 Summary of Relevant Exemptions

1.5.3.1 National Water Act (No. 36 of 1998)

There are no exemptions that have been granted for any of the section 21 water uses in terms of the NWA for the Site of the Market Coke and Co-generation Plant. No exemptions from requirements of the NWA are requested for the Market Coke and Co-generation Plant.

1.5.3.2 Government Notice 704 (4 June 1999)

Government Notice (GN) 704, was published on 4 June 1999, in Government Gazette No. 20119, Vol. 408, in terms of Section 26 (1) (b), (g) and (i) of the NWA. The Regulations pertain to the use of water for mining and related activities and are aimed at the protection of water resources.

The Market Coke and Co-generation Plant Project will be located within the mining area of the Grootegeluk Coal Mine and thus GN 704 is applicable. There are no exemptions that have been granted for the Site of the Market Coke and Co-generation Plant. No exemptions from GN 704 are requested for the Market Coke and Co-generation Plant.

1.5.4 Summary of General Authorisations

In terms of GN 399 of 26 March 2004 "Revision of General Authorisations In Terms Of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998)"; GN 313 of 20 March 2009; GN 1199 of 18 December 2009; GN 837 of 23 September 2010 and GN 498 of 28 June 2012, the following is noted in terms of General Authorisations applicable to the Market Coke and Co-generation Plant:

- A general authorisation cannot be obtained for the PCD Extension or silt trap as the water being stored is neither a domestic nor biodegradable wastewater which is required in order to apply for a general authorisation under 21(g). Thus a WUL Amendment is required.
- A general authorisation cannot be obtained for the section 21(h) water use as the water being discharged into the PCD meets the definition of "complex industrial wastewater" in GN 399 of 26 March 2004. Thus a WUL Amendment is required.

1.6 Section 27 Motivation

1.6.1 Section 27(1) (a): Existing lawful water uses

These have been described in Section 1.5.1 above.

1.6.2 Section 27(1) (b): The need to redress the results of past racial and gender discrimination

The Mining Charter (updated in 2010) in South Africa states that all mining development is aimed at redressing previous racial and gender discrimination. With the promulgation of the MPRDA, and the establishment of the subsequent Black Economic Empowerment (BEE) scorecard, the mining industry is geared towards sustainable development, providing opportunities to the previously disadvantaged. The proposed construction and production activities at the Market Coke and Co-generation Plant are subject to compliance with the MPRDA legislation and the BEE scorecard, as they fall within a mining

area. The Market Coke and Co-generation Plant project is expected to have the following positive socio-economic impacts:

- Stimulation of regional and local economy;
- Increased government income (through taxes);
- Increase in local employment level - an estimated additional 275 people will be employed for the Market Coke and Co-generation Plant project;
- Increased standards of living for the nearby communities (as a result of higher incomes in the area); and
- Transfer of skills to unskilled workers.

The issuing of the water use license amendment is required before the Market Coke and Co-generation Plant Project can go ahead. Thus there would be no positive socio-economic benefits without a water use license.

1.6.3 Section 27(1) (c): Efficient and beneficial use of water in the public interest

As public trustee of the water resources, the DWA must ensure that the water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all users. The Minister, through the department, has to ensure that the water is allocated equitably and used beneficially in the public interest, while promoting environmental values.

The Market Coke and Co-generation Plant Project is committed to sustainable water use and one of the key focus areas in the WUL Amendment application is to investigate and put into practice, water efficient devices or techniques for the re-use of water containing waste, in an endeavour to conserve water at all times. The use of the water will be in the public interest as it will result in the positive socio-economic impacts described in the section below.

1.6.4 Section 27(1) (d): The socio economic impact

1.6.4.1 Socio-economic impact of the water use or uses if authorised

The socio-economic impacts of the plant have been discussed in detail in section 4.6.4 of this report. Exxaro Reductants' existing adjacent plant, the Char Manufacturing Plant, is included in the approved social and labour plan (SLP) for the Grootegeluk Coal Mine. The Market Coke and Co-generation Plant project will be incorporated into the next updated version of the SLP. The Market Coke and Co-generation Plant Project will directly assist in contributing positively to the existing socio-economic impacts of the area. The following positive impacts have been identified:

- Stimulation of economy - during the construction and operation phase of the expansion, due to increased financial spending from the plant, increased infrastructure investment and increased spending from employees.
- It is expected that an additional 275 employment opportunities will be created. A large percentage of these employment opportunities will benefit the surrounding communities.
- Increased standards of living for the nearby communities (as a result of higher incomes in the area).
- Increased government income will allow for a positive economic impact for the country, during the construction and operation phase. Income will be derived from the increase in the tax base from royalties, company tax, PAYE, UIF, SDL, service council levies and rates.
- Skills development is a prerequisite for human resource development and the skills development initiatives during the construction and operation phase of the plant will have a lasting impact on the economy and beneficiaries.

1.6.4.2 Socio-economic impact of the failure to authorise the water use or uses

If the WUL Amendment is not authorised then there will be none of the above-mentioned positive socio-economic impacts. If there is no amendment to the current WUL the Market Coke and Co-generation Plant Project will not be able to be implemented and thus jobs will not be created.

1.6.5 Section 27(1) (e): Any catchment management strategy applicable to the relevant water resource

The Market Coke and Co-generation Plant is situated within quaternary catchment area A42J. The Water Management Area is number 1 – Limpopo, and the relevant Catchment Management Agency (CMA) is the Limpopo CMA. A finalised Catchment Management Strategy has not yet been completed for this CMA. However the following reports have been written by the Department of Water Affairs: Limpopo WMA: Water Resources Situation Assessment (2003) and Internal Strategic Perspective: Limpopo Water Management Area (2004). These reports provide the initial baseline data to be used by the CMA to develop its catchment management strategy, objectives, plans, guidelines and procedures for the protection, use, development, conservation, management and control of the water resources in Limpopo.

Below in Table 1.1 and 1.2, are the management strategies for the Mokolo Key Area as outlined Part B of the Internal Strategic Perspective: Limpopo Water Management Area; (DWAF, 2004), which is applicable to the A42J catchment as it is a part of the Mokolo catchment area.

Table 1.1. Water Balance and Reconciliation- Mokolo Key Area (Source: DWAF, 2004)

Situation assessment	The surface water resources of the Mokolo Key Area are substantial, while groundwater is also used. The large Mokolo Dam, together with numerous dams in the upper reaches of the Key Area, as well as run-of-river, all contribute to a large surface water resource estimated at 77 million m^3/a, after allowing for the Ecological Reserve. The current groundwater resource is estimated at 11 million m^3/a and this is used to supply irrigation and domestic rural use. The Mokolo Key Area is approximately in balance. Potential future requirements of Mokolo Key Area are: • Fast growing urban population in Lephalale and an explosion of informal settlements in and around the town of Vaalwater • Water required for emerging farmers in the catchment • Potential large scale methane gas field development around the coal reserves • Ecological Reserve requirements • Small-scale economic development for poverty eradication • Water to meet basic needs of the rural communities
Broad Management Objectives	To better understand current and potential future water requirements in the Mokolo Key Area.
Overall Strategic Approach	The overall strategy for the Mokolo Key Area is to maintain the catchment in at least its current state of balance. This can be achieved by not issuing any more water use licenses for irrigation. Other user sectors will need to source their additional water requirements from groundwater if possible, failing which the construction of farm dams is also an option. In the longer-term, if large new requirements materialise relating to development of the gas fields or the possible additional power station, additional surface water could be obtained from: • Transfers in from the Lower Crocodile, • Raising of the Mokolo Dam wall, • Trading with the irrigation sector.
Actions, Responsibility & Priority	• Assemble better estimates of current water use, especially the irrigation sector, • Obtain reliable rural and urban population figures for the catchments and the corresponding growth rates. The information will assist in determining the trends, • Obtain projected future water demands from Kumba Resources (now Exxaro Coal) and ESKOM, • Use the estimates to calculate accurate future water requirements, • Investigate groundwater as an additional option for meeting future water requirements,

	• Determine the needs of future coal/gas mining activities.

Table 1.2. Water Quality Management - Mokolo Key Area (Source: DWAF, 2004)

Situation assessment	Informal settlements have developed rapidly around Vaalwater (A42C) leading to increasing demands on the water supply and a serious potential for groundwater pollution. A similar situation is occurring at Alma, south of Vaalwater. Groundwater quality could be seriously impacted from the uncontrolled growth of informal settlements around the existing settlements. The quality of the water resource could also be affected by pollution from the Grootegeluk Coal Mine. Some of the water quality problems that could result from the coal mine are acid mine water, low pH, and a concentration of TDS. The extent of diffuse pollution from the mine and other industries in the area must be investigated and quantified. Adverse impacts from activities within these catchments outside of Vaalwater and small settlements are unlikely.
Broad Management Objectives	This strategy seeks to ensure that the extent of water resource pollution by Grootegeluk Colliery, agricultural activities, uncontrolled growth of informal settlements and other industries such as Matimba Power Station is understood and this understanding is applied in the development of strategies to improve the situation.
Overall Strategic Approach	Studies need to be initiated to understand the extent of potential pollution as a result of uncontrolled growth of informal settlements, mining activities in the Grootegeluk Mine, and agricultural activities. Water quality monitoring at selected key strategic points is required to understand the situation better and develop effective management strategies. These need to be developed and implemented in close co-operation with local Municipalities and the Grootegeluk Colliery.
Actions, Responsibility & Priority	Undertake a water quality situation assessment study to better understand pollution from Grootegeluk Coal Mine, agricultural activities upstream and downstream of the Mokolo Dam, and uncontrolled growth of informal settlements around Vaalwater.

1.6.6 Section 27(1) (f): The likely effect of the water use to be authorised on the water resource and on the water users

The effect of the water use on the resource will be that the resource will be utilised in a sustainable manner. The Market Coke and Co-generation Plant will not directly abstract any water from surface water or groundwater resources for their operations. Stormwater runoff from the plant site will be captured in the existing PCD and PCD Extension and used in the process. Thus, this captured stormwater will be the only surface water used.

The clean water (raw water and potable water) required for the Market Coke and Co-generation Plant will be obtained from the Grootegeluk Coal Mine's existing raw water allocation from the Mokolo Dam. Dirty water required for the plant processes will be obtained from recycling dirty water from the existing PCD as well as using dirty water from other pollution control dams at the Grootegeluk Mine. Water will be recycled in the plant's processes as far as possible.

1.6.6.1 Quality of the ground and surface water

The potential to contaminate the water resource has also been considered and monitoring of ground water takes place to assess the changes in water quality. The results of the surface water and geohydrological studies (refer to Appendices 4 and 5) indicate that activities at the Market Coke and Co-generation Plant are unlikely to change the quality of water in the underlying aquifer or in the surface water used by surrounding users.

1.6.6.2 Quantity of the ground water

As no groundwater will be abstracted for the Market Coke and Co-generation Plant project, the water table will not be lowered in the vicinity of the plant. Groundwater modelling suggests that there could be potential water table rising in the vicinity of the project area due to artificial recharge through seepage (i.e. possible seepage from unlined dams situated on the basalt) (Jones and Wagener, 2012A). The

recharge is negligible - between 1.0 – 5.0 mm/annum.

1.6.6.3 Quantity of surface water

Within the Market Coke and Co-generation Plant site, 7 659 m^3/month (average) of rainfall water, runoff and seepage is estimated to be obtained from the dirty water area at the plant. This water runs into the existing PCD and the PCD Extension where it gets reused in the process. The exact value obtained will be dependent on the amount of rainfall received in the area.

Thus the capture and use of stormwater, runoff and seepage will reduce the amount of surface water in the catchment by approximately 91 908 m^3/annum.

1.6.6.4 Water users

Surface water

The surrounding landowners are heavily reliant on groundwater (boreholes) since surface water is only available for a short period after rainfall events. Some of the surrounding landowners are supplied with water piped from the Mokolo Dam.

The Market Coke and Co-generation Plant site is within a dirty water area at the Grootegeluk Mine and all storm water runoff is contained within the PCD, thus the contaminated water will not leave the site nor have an impact on water users.

In an emergency situation, if there were to be a spill within the site, only the Grootegeluk Mine area would be impacted as Market Coke and Co-generation Plant site is within the Grootegeluk mining area. There is also an additional Grootegeluk Mine PCD (called the Bosbok Dam) downstream of the existing PCD and proposed PCD Extension. If the PCD Extension were to overflow, this water would flow into the Bosbok Dam PCD downstream. Thus even in the unlikely event of an overflow, the dirty water would still not leave the Grootegeluk Mine site and would not impact other surface water users.

Ground water

The groundwater contribution to streams in Lower Mokolo catchment area (catchment A42J) is zero (DWAF, 2009). This implies that potential contaminants in the groundwater are highly unlikely to impact on the quality of streams in the area. Thus, the surface water users in the surrounding area are unlikely to be affected.

1.6.7 Section 27(1) (g): The class and the resource quality objectives of the water resource

Chapter 3, Part 2 of the NWA states: *"Under Part 2 the Minister is required to use the classification system established in Part 1 to determine the class and resource quality objectives of all or part of water resources considered to be significant. The purpose of the resource quality objectives is to establish clear goals relating to the quality of the relevant water resources. In determining resource quality objectives a balance must be sought between the need to protect and sustain water resources on the one hand, and the need to develop and use them on the other. Provision is made for preliminary determinations of the class and resource quality objectives of water resources before the formal classification system is established. Once the class of a water resource and the resource quality objectives have been determined they are binding on all authorities and institutions when exercising any power or performing any duty under this Act."* Thus, the Minister of Water Affairs is required to classify the significant water resources and set resource quality objectives (RQOs).

1.6.7.1 Water Resource Classification

The resource classification involved the assessment of the following ecological aspects:

- The presence of rare or endangered species,
- Habitat diversity,
- The importance of a river reach in providing connectivity between different sections of the river, and
- The sensitivity of the reach to environmental changes.

The water resource, A42J catchment (where the Mokolo Key area is situated) has been classified by the DWA as an ecological management Class C – Good Management Class and Good Water Resource Class (DWAF, 2004). DWAF (2006), states that the present ecological state of the Mokolo River Catchment (A42) lies predominantly in a Fair to Good Ecological Class. The DWAF 2004 '*Integrated water resource management: Guidelines for groundwater management in the areas, South Africa'* Report illustrates the relationship between the six distinct ecological management categories (EMC) and the management and water resource classes. These categories are also used to describe the present ecological status category (PESC). The table below (Table 1.3) captures the information relevant for EMC/PESC Class C (DWAF, 2004b).

Table 1.3. Illustration of the relationship between EMC/PESC and water resource class (Source- DWAF, 2004**b**)

MANAGEMENT CLASS	EMC/PESC	WATER RESOURCE CLASS
Excellent	A – (Un-modified/ natural)	Natural
Good		**Good**
	B- (Largely natural)	
	C - (Moderately modified)	
Fair		**Fair**
	D- (Largely Modified)	
	E- (Seriously modified)	Poor
	F- (Critically modified)	

DWAF (2006) added that while the Mokolo Catchment is currently in a Fair to Good state, increasing water demands within the catchment are likely to cause a downward trend in the overall status of the system.

1.6.7.2 Water Resource Quality Objectives

Table 1.4. Reserve and Resource Quality Objectives Strategy - General Strategy Applicable to the Whole WMA (Source- DWAF, 2004)

Situation assessment	None of the river systems in the Limpopo WMA have been classified nor have the resource quality objectives been determined. The methodology for classifying the river systems is in the process of being developed nationally. Rapid Reserve determinations have been done for some of the rivers based on the license applications, but none have yet seen either intermediate or comprehensive determinations. A need for the Reserve in the river systems of the Limpopo WMA are discussed below: Mokolo River: The Mokolo River system is perennial. The flow regime in the lower reaches downstream of the Mokolo Dam has been modified by releases from the dam. Irrigators also abstract water downstream of the Mokolo Dam. To ensure that there is a balance between the irrigators requirements and ecological environment, Reserve determination for the river reach downstream of the dam should be conducted at an Intermediate level. The Ecological requirements of the Mokolo Key Area have not been determined in any detail, but the National Water Resource Strategy estimates the impact of the Reserve on the currently available yield at

	17 million m^3/a. This can theoretically be supplied from currently available water although this would require a re-allocation from the Mokolo Dam and/or the curtailment to irrigation upstream of the dam.
Broad Management Objectives	This strategy seeks to ensure that all the river systems, their tributaries and reaches in the Limpopo WMA are classified according to Chapter 3 (sections 12-15) of the NWA and that the class and resource quality objectives have been determined for all or part of the river systems that have been considered significant. In addition this strategy seeks to prioritise the various main river systems in the Limpopo WMA in terms of Reserve determination.
Overall Strategic Approach	DWAF will do everything possible to set a stage for River Classification, determinations of the Resource Quality Objectives and Reserves. Once the river systems, reaches and tributaries have been classified and Resource Quality Objectives determined, the Department will determine the human & ecological Reserves in catchments where there is pressure to do so.
Actions, Responsibility & Priority	Prioritize the river systems with regard to Reserve determination. The following rivers should receive priority: - *Mokolo, Mogalakwena, Nzhelele and Nwanedi*. • Assemble the data that would assist in the classification of the river systems. Typically this would include aquatic ecosystems in each river reach, socioeconomic activities etc. • Once appropriate data has been assembled, classify the river systems, reaches and tributaries. • Once the methodology for classifying the river systems has been established, this should be applied to all systems. • Develop management guidelines and procedures for each river system • Liaise with all stakeholders to ensure that the concept of Reserve is well understood.

Due to the limited probability of any process water being released to the natural water flow system, through effective use of the Reductants' plants PCD system, there is unlikely to be impact on the area's river system.

1.6.8 Section 27(1) (h): Investments already made and to be made by water user in respect of the water use in question

Exxaro Reductants (Pty) Ltd is the developer of the Market Coke and Co-generation Plant Project. The Market Coke and Co-generation Plant will be at a total cost of about R4 Billion.

1.6.9 Section 27(1) (i): The strategic importance of the water use that has been authorised

The water use is required because the current and proposed activities at the Market Coke and Co-generation Plant will contribute positively towards the economic development of the site, area and region.

1.6.10 Section 27(1) (j): The quality of water in the water resource which may be required for the Reserve and for meeting international obligations

1.6.10.1 Groundwater

The groundwater quality in the area has been described in detail in section 3.4.2 of this report. The groundwater quality results from the site have been compared to the South African National Standards (SANS) 241 specifications of 2011 for drinking water.

Boreholes within and near the site were sampled for water quality. The pH in the majority of the borehole water samples near the site were generally neutral. The Groundwater report by Jones and Wagener (2012A) includes a list of boreholes sampled and their individual water quality results (Appendix 4). Metal concentrations sampled in 2011 were generally found to be within the standard limits, with marginal exceedences of vanadium, lead and selenium. Low concentrations of phenols and PAHs were detected in groundwater samples; this presence is likely to be related to the historical coal stockpile in the area (Jones and Wagener, 2012A).

1.6.10.2 Surface Water

The surface water quality in the PCD and the Bosbok Dam have been determined and described in detail in Section 3.3.3 of this report. The surface water quality results from the site have been compared to the (SANS) 241 specifications of 2011 for drinking water (Jones and Wagener, 2012B), even though the water will not be used for drinking purposes, as there is no applicable industrial water quality standard. The PCD water was found to exceed the drinking water standards for sulphate, magnesium, Total Dissolved Solids (TDS) and Total Petroleum Hydrocarbons (TPH). The Bosbok Dam water (which is re-used by Grootegeluk in their coal processing plant) has high conductivity, but no traces of Petroleum Hydrocarbons (indicating that there is no overflow from the existing Char Manufacturing Plant PCD reporting to this dam, thus with the addition of the PCD extension there is unlikely to be any overflow reporting to this dam).

1.6.11 Section 27(1) (k): The probable duration for any undertaking that a water use has been authorised

The water use requirements will apply for the life of the plant to ensure availability of water for the processes required, as well as to ensure safe production conditions for the reporting to this Market Coke and Co-generation Plant Project and its employees. The life of the plant is currently estimated to be approximately 20 years, but may vary depending on the economic conditions and other external factors. Construction of the Market Coke and Co-generation Plant is due to begin Q1 2014 and be operational by the end of 2016.

2. PROJECT DESCRIPTION

2.1 Purpose of the Document

The purpose of this report is to present the results of the investigations regarding water and waste issues for the reporting to this Market Coke and Co-generation Plant Project, in order to inform the Limpopo DWA and registered interested and affected parties (IAPs) of the issues and impacts of the project on the quality and quantity of water resources in the area. The report also presents the management and mitigation measures identified for the project.

2.2 Objectives of the Project

Coke, a carbonaceous agent, is used in the metals industry as a reductant of iron ore (rock containing iron and its oxides (FeO_3) and other metals and their oxides) in the presence of heat at melting point, by allowing the oxides contained in the ore to react with the carbon. Exxaro Reductants has entered into the reductants market with the proposed Market Coke Plant (and the existing Char Manufacturing Plant) targeting the Ferrochrome market. Ferrochrome is the main constituent in the production of stainless steel. There is a demand for increased production of coke within this market, which the Market Coke Plant aims to address. Exxaro Reductants is in a prime position to manufacture and supply coke with readily available coal feedstock (from the Grootegeluk Mine) and in close proximity to their customers.

Exxaro Reductants is also proposing to develop an electricity Co-generation Plant which will utilise the waste heat contained in the exhaust gas of the Market Coke Plant to generate electricity. In the Coke plant, the coke oven flue gas (COFG) is fully combusted inside the coke ovens and enters the heat recovery, steam-generating boilers. The term ‘waste gas’ implies that, should the heat not be used immediately, it would be ‘wasted’. The steam generated from the extracted thermal energy, is expanded through a steam turbine that drives a generator, to generate ‘Co-generated’ electrical energy

2.3 Physical Project Description

2.3.1 Overview of the Market Coke and Co-generation Plant

Coke is made by heating suitable coal in the absence of oxygen, to a temperature of around 1200℃ for an extended period of time. During this heating cycle, coke is formed and volatile materials in the coal are released in the form of vapour, gas and smoke. The coke oven flue gas (COFG) will be burned in stages to provide process heat and surplus heat energy which will be converted into electrical energy (co-generation). An overview of the process is shown in Figure 2.1. The Market Coke and its Co-generation Plant consist of the following sub-systems which are described in further detail in the sections below:

- The material handling system; mine stockpile, conveyors, mineral sizing and 3000 ton silo;
- 3 x 1000 ton day silos at the Coke plant site;
- Coal crushing and compaction system;
- Push-charge and discharge machines and rail system;
- Coke oven batteries, structures and door mechanisms;
- Coke oven flue gas ducting system;
- Quench car and rail system;
- Quench tower and water pumps;
- Settling and clarifying ponds;
- Sediment extraction system;
- Coke wharf;
- Product conveyor and stockpile;
- Product screen and mineral sizing system;
- Product Weigh bridge;
- Product loading and despatch (transport by truck or rail);
- Waste heat recovery boilers (WHRB);
- Desulphurising Plant;
- Chimney stack system;
- Common steam header system;
- Steam turbine system;
- Dry steam condensing system;
- Electricity generation system; and
- The connecting and transmission equipment.

The proposed Market Coke Plant will involve an energy recovery coke making process, which has fewer environmental impacts than traditional coke making processes in respect of air quality, effluent and solid waste.

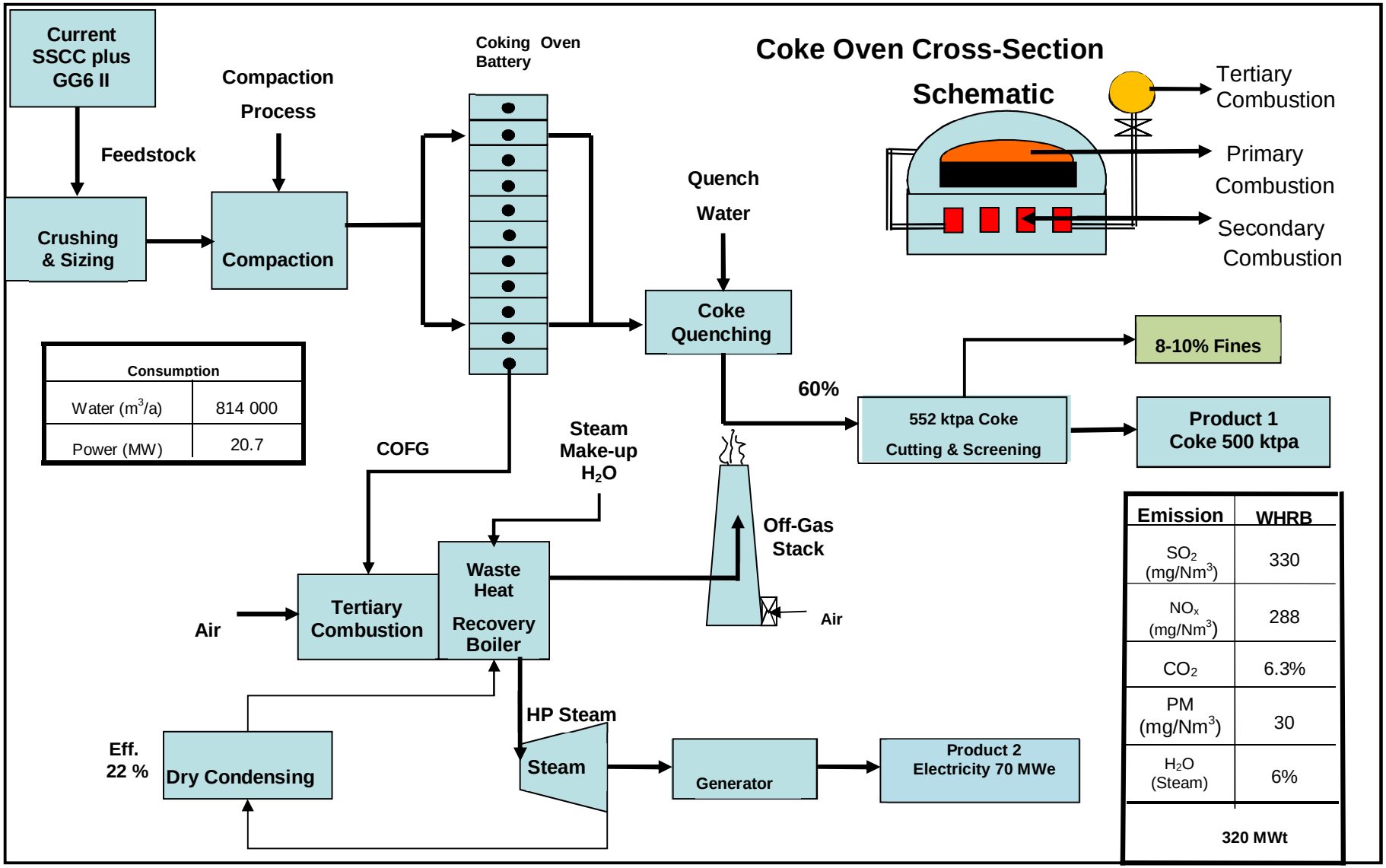


Figure 2.1: Schematic Market Coke and Co-Generation Power Plant – Process Block Diagram

2.3.2 Market Coke Manufacturing Process

2.3.2.1 Coal Feed System

Exxaro intends to use the Grootegeluk Mine's semi-soft coking coal as the only feedstock to the plant. Using only one type of coal significantly simplifies the feedstock handling plant. The Market Coke oven plant will be supplied with coal from the existing Grootegeluk (GG1) metallurgical coal stockpiles. The coal will be delivered to the coking coal silos via conveyor belts from the mine.

2.3.2.2 Coal Stockpiles and Storage

Storage of the coking coal will take place in two stages. The first stage will be in a concrete surge silo with a 3000 ton capacity, which will be built along the route of the conveyor from the mine's washing and screening plant. From there it will be conveyed to 3 x 1000 ton silos at the coke plant.

The second stage will be the conveying of the coking coal to the Market Coke Plant's two 1000 ton day-silos. The storing of coking coal in silos and not stockpiling is to limit ageing (oxidizing) of the coal so as to prevent deterioration of the coal's coking capabilities. Test work done on the Grootegeluk coal showed that 35% of the cokability of the coal can be lost after a week. Thus stockpiling is to be carefully managed and any storage will be of the first in, first out type. This implies feeding coal storage bins (hoppers) at the top and withdrawing material at the bottom.

2.3.2.3 Coal Grinding

The coal is grinded to the required grade. Normally more than 80 % of the coal will be smaller than 3 mm particle size. The coal is wetted to an optimum moisture content of normally 10% by mass. The coal is conveyed to the coal tower bin.

2.3.2.4 Coal Compaction

The quality of coke made can be dramatically improved by compacting the coal before feeding it into the oven. Coal is loaded from the coal tower into a compacting box where hydraulic compaction will be used. This will involve the compression of the coal layers from the top by a hydraulically activated compression plate (refer to the example in Figure 2.2). Practical considerations of reliability, availability and operating constraints demand two compaction stations. There will be two stationary compaction stations placed next to one another in the middle of the coke oven battery.

Compaction, and consequently the strength of the resulting coal cake, is improved by increasing the moisture content of the crushed coal. The moisture content of the feedstock is controlled by the addition of water, providing an opportunity for disposal of contaminated water which is used as compacting fluid and for coke quenching. Recycled, contaminated water will be used for this purpose, as the contaminants are destroyed in the coking process. The high temperatures in the oven, the passage of the gas and vapour combination through the high temperature coking zone and the high temperatures in the combustion process all combine to break down and oxidise any contaminants brought in by the water.

The size of the coal cake is determined by the size of the coke oven (refer to Figure 2.3 and Figure 2.4). Additional constraints on the coal cake size are the door design and the sizes and capacities of the push-charging and discharge machines and the quenching towers. Mechanical loading and unloading of the coal cakes limits the size to approximately 12 m in length. The thickness of the cake varies between 700 mm and 1100 mm and is governed by temperatures, coke oven floor conductivity, radiation from the oven dome, heat capacity of the oven and operating schedules and settings. A typical coal cake would have a mass between 30 and 45 tonnes with the density of the coal cake after compaction being 1.1 ton/m^3.

Figure 2.2: Coal cake being compressed by stamping machine (Courtesy Sinosteel)

Figure 2.3: Part of a coke oven battery (similar to proposed Market Coke Plant).

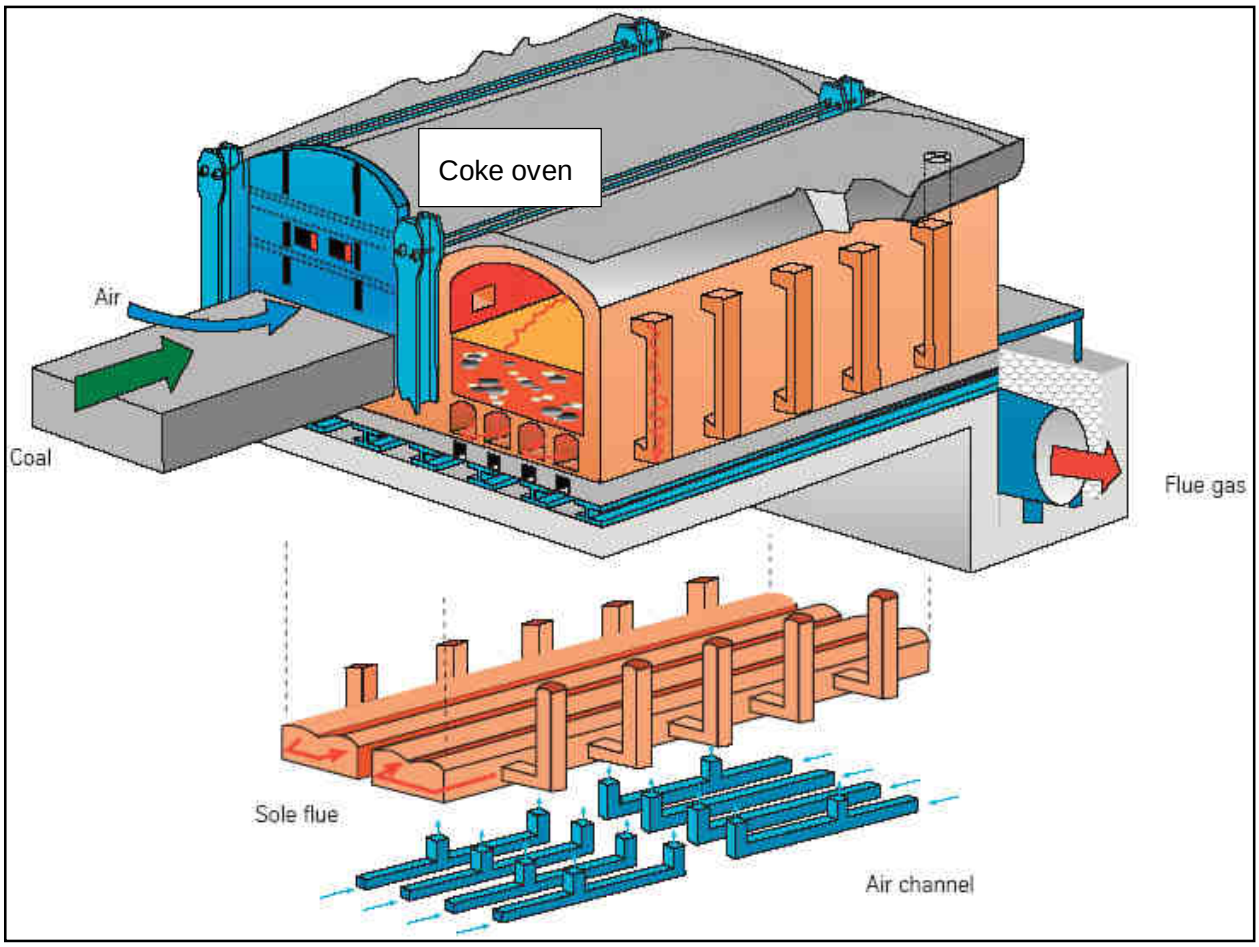


Figure 2.4: Proposed design of the Market Coke Plant coke ovens with underground common gas flue.

2.3.2.5 Loading the Coal Cake (Charging) and Unloading the Coal Cake (Pushing)

After stamping, the shaped and compacted coal cake is transferred to the charging / pushing car and is transported to the coke oven to be charged. The coke ovens are combined to form batteries (30 coke ovens form one battery) (see Figure 2.3) which are designed to give mechanical structural strength to contain the expansion of the ovens on heating.

Before charging (loading) an oven with a new coal cake, the coke already in the oven is pushed out onto the quenching car that is to receive the coke on the opposite side of the oven (refer to Figure 2.5 and Figure 2.6).

Figure 2.5: A coke cake which has been heated and is being pushed out of the coke oven (Courtesy Sinosteel).

Figure 2.6: A coke cake which has been pushed out of the coke oven onto the quenching car (Courtesy Sinosteel).

The oven is charged horizontally from the front with coal in the form of a stamped cake with dimensions to suit the oven. The combined charging / pushing machine loads and transports the coal cake to the selected oven, removes the coke oven door, checks with the control system for proper alignment of the quenching car, pushes out the coke already in the oven, pushes the new coal cake into the oven and closes the door (see Figure 2.7). The charging / pushing car is a large travelling machine (200 to 400 tons) running on rail tracks spaced about 10 to 15 m apart. It has a mechanism for opening oven doors, a long ram for pushing the already coked cake out of the oven and a mechanism for charging the fresh stamped cake into the oven (shown in Figure 2.7).

Figure 2.7: Pushing/charging machine opening coke oven door. View of heated coke cake in oven (Courtesy Sinosteel)

The pushing-charging process is the one part of the coking cycle when pollutants (such as unburnt hydrocarbon gas) could be released to the outside air. In the energy recovery type of coke oven, this problem has been greatly reduced, mainly by operating the coke oven under a slight negative pressure (vacuum). Furthermore the timing and size of the aperture during the charging and pushing cycle is an important design consideration. The infrequent pushing of large coke cakes also lowers the release of pollutants in comparison with traditional coke ovens.

2.3.2.6 Heating the Coal Cake

The coke heating time is mainly determined by the smallest dimension of the coal cake, and the coking temperature. Coke quality is partially dependent on attaining a high oven temperature. Insufficient time inside the oven causes the coke to release smoke and other pollutants when discharged too soon. The maximum achievable coking temperature is constrained by the oven construction. The coke is heated by the combustion of the volatile gas which is released from the coke during heating (refer to Figure 2.4). With the 37% volatile gas content of the Grootegeluk coking coal, the fuel (i.e. coke oven flue gas) for reaching high temperatures is available. Once the volatile gas has been driven off the coal cake, the cake should be kept at a temperature above 800ºC for a number of hours to allow the sintering (solidifying) process to complete.

Figure 2.4 shows that above the coal cake there is an arched free space where the released vapours are partially combusted, heating the coal cake from above. The hot gas is drawn through side ducts to the space below the oven floor where more combustion takes place; controlled by the amount of air added. This process heats the coal cake from below by heat conducted through the coke oven floor. From the ducts below the floor, the hot gas is drawn into the flues that run across the length of the coke oven battery. The flues conduct the hot gas to the waste heat recovery boilers (WHRB).

2.3.2.7 Quenching the Coke

Coke is pushed out of the oven by the pushing-charging car onto a quenching car (Figure 2.6). Coke is pushed from the oven red hot (temperatures higher than 900ºC) and would burn away if not quenched. Quenching is done by stopping the quenching car under a quenching tower (Figure 2.8), where the load of coke is sprayed with water. Approximately 700 ℓ of quenching water evaporates for each ton of coke

quenched (shown in Figure 2.9). The remaining water condenses in the quenching tower and is recycled after particulates are removed by means of a settling pond. This is a convenient way of disposing of plant effluents, but most of the soluble contaminants remain, eventually making the quenching water corrosive. Once the concentration of pollutants becomes too high, the re-cycled water is added to coal cake as compaction fluid. The quenching cycle duration is controlled to adjust the moisture content of the quenched coke to the desired value.

The quenching system comprises pumps for quenching water, a quenching tower, settling tank and a means of extracting fine coke sediment from the quenching water, typically a moving chain grate system. A typical quenching tower would be between 20 m and 30 m high, the lower part of concrete with a steel structure for the top part (Figure 2.8).

Figure 2.8: Typical quenching tower with quenching car underneath the tower (similar to proposed Market Coke Plant) (Courtesy Sesa Goa Ltd).

Figure 2.9: Coke cake undergoing quenching (Courtesy Sinosteel).

2.3.2.8 Market Coke Processing

After quenching, the quenching car dumps the load of coke onto a coke wharf (see Figure 2.10). This comprises a door opening mechanism, coke receiving tank and control mechanisms. The bin receiving the hot coke measures about 15 m by 3.6 m by 1.3 m and can be tilted to more than 30 degrees. The two side plates and base plates are lined with heat-resistant cast iron sheet.

Figure 2.10: Discharging quenched coke on to a coke wharf (similar to proposed Market Coke Plant) (Courtesy Sinosteel).

Coke is discharged from the coke wharf onto the wharf discharge conveyor and transported to a cutting and screening plant. The sizing screen will be equipped with a double screening deck with an aperture of 80 and 30 mm. Coke is sold either as lumps of coke sized between 30 mm and 80 mm, or as fines - pieces smaller than 6 mm. Coke lumps larger than about 80 mm are cut with a coke cutter to required

sizes. The coke will be stored in the different sizes. Depending on conditions, storage can be in separate bins or separate heaps. The coke product storage area is within the old railway loop as indicated in figure 2.12. The stockpile will be located on a compacted earth on clay layer to facilitate the operation of a front-end loader in reclamation and feeding the screening plant.

The coarse product will be conveyed to a 350-ton truck-loading bin and the fine product will be conveyed to a 70-ton truck-loading bin to be dispatched by road transport.

2.3.3 Electricity Co-generation from the Coking Process

In the energy recovery coke making process the volatile off-gas released during coal carbonisation is fully combusted by the controlled introduction of air (oxygen) to the different stages. The heat generated is used for coking the coal cake, so no external heating is required. The high temperatures and controlled addition of air combust the volatile hydrocarbon off-gas.

Only a portion of the heat generated by combustion is required for maintaining the coke oven temperatures for the coking process; the remaining heat is used downstream for raising steam in waste heat boilers. The steam is used to drive turbine-generators for generating electric power (refer to the process flow diagram in Figure 2.1).

2.3.3.1 Coke gas collection

A coke oven battery has large flues running the length of the battery (refer to Figure 2.4). All of the coke ovens in the battery discharge their hot off-gas into these flues. The flues transport the hot gas to the waste heat recovery boilers. In order to maximise the amount of energy that can be obtained from the gas, the flues are well-insulated. It is envisaged that each oven battery of 30 ovens will be equipped with a waste heat boiler.

2.3.3.2 Gas composition

Coke oven flue gas (COFG), which is produced during the heating of soft coking coal, is the primary source of energy available for co-generation. The expected temperature and flow rate of the gas is given in Table 2.1 below.

Table 2.1: Coke oven flue gas conditions at oven exit.

Description	Min	Max	Unit
COFG Temperature at Oven Exit	1100	1250	˚C
COFG Volumetric Flow Rate per Oven	1940	2143	Nm^3/hr

After combustion, the coke oven flue gas exits the waste heat recovery boilers (WHRB) with the following SO_2, NO_x, dust levels, H_2S and CO_2 (see Table 2.2). The coke oven flue gas has no calorific value, but sufficient thermal energy for recovery in the WHRBs.

Table 2.2: Gas and Dust Levels in emissions from COFG after flue gas desulphurisation and WHRB Heat Extraction.

Description	Value	Unit
Sulphur Dioxide (SO_2)	400	mg/Nm^3
Nitrogen Oxides (NO_x)	700	mg/Nm^3
Dust (PM_{10})	50	mg/Nm^3
Hydrogen Sulphide (H_2S)	0	mg/Nm^3
Carbon dioxide (CO_2)	7.1%	%

The flue gas which exit the WHRBs contains relatively high concentrations of sulphur dioxide (SO_2) that would exceed the latest AQA limits. In order to decrease the SO_2 gas emissions, the flue gas will pass through a Flue-Gas Desulphurisation (FGD) Plant where the majority of the SO_2 will be removed. The removal of SO_2 in the FGD plant occurs through wet scrubbing which involves spraying the flue gas with a scrubbing liquid so as to remove the SO_2. Activated hydrogenated lime (Calcium hydroxide CaOH**.**H20) scrubbing reagent will be used for the recirculating wet scrubbing which will produce calcium sulphate ($CaSO_4$). The calcium sulphate (more commonly known as gypsum) will form a by-product which will be sold.

2.3.4 Steam System

The steam header and power generation system includes the boilers, turbines, generators, ducting, pumps, piping, cladding and associated equipment such as valves, electrical switch gear, automation, instrumentation, de-aerators, dust disposal systems, fans, stacks, dry cooling condensers and water demineralisation treatment plants.

The design of the boilers requires all the gas to be completely combusted in the flues. The steam produced by heating water in the boilers drives the turbines. Four 80 MWt (thermal energy) boilers will be installed which will provide heat for the 60 MWe (electrical energy rated) capacity turbines.

2.3.4.1 Condensers and cooling

Once the feasibility study is completed, the method of cooling that will be used for the co-generation plant will be determined. Currently dry cooling is envisaged due to the scarcity of water in the region.

2.3.4.2 Electricity transmission

The electricity supply to the Grootegeluk Mine (and therefore to the project site) is through a 132 kV overhead line from the nearby Eskom Matimba power station. Dual 33 kV overhead lines are used for site distribution. The main Grootegeluk transformer sub-station capacity was recently upgraded with the addition of another 80 kVA transformer rendering total capacity of 160kVA. The Co-generation Plant will make use of the existing power distribution network at the Grootegeluk Mine.

2.3.5 Market Coke and Co-generation Plant Infrastructure and Equipment

Infrastructure and equipment associated with the Market Coke and Co-generation Plant that will be constructed as part of this project includes:

Market Coke Plant:

- Coal storage and reclaiming;
- Coal conveyor to Market Coke plant;
- Coal storage silos and hoppers;
- Coal compacting box;
- Hydraulic coal compactor;
- Four coke oven batteries comprising 30 ovens each, i.e. a total of 120 coke ovens;
- Pushing/charging car;
- Coke quenching car;
- Coke quenching tower;
- Coke wharf;
- Coke quench water settling ponds;
- Coke product stockpile;
- Coke conveyor to screening plant;
- 15 mm screening plant;

- Truck loading bins; and
- The COFG system.

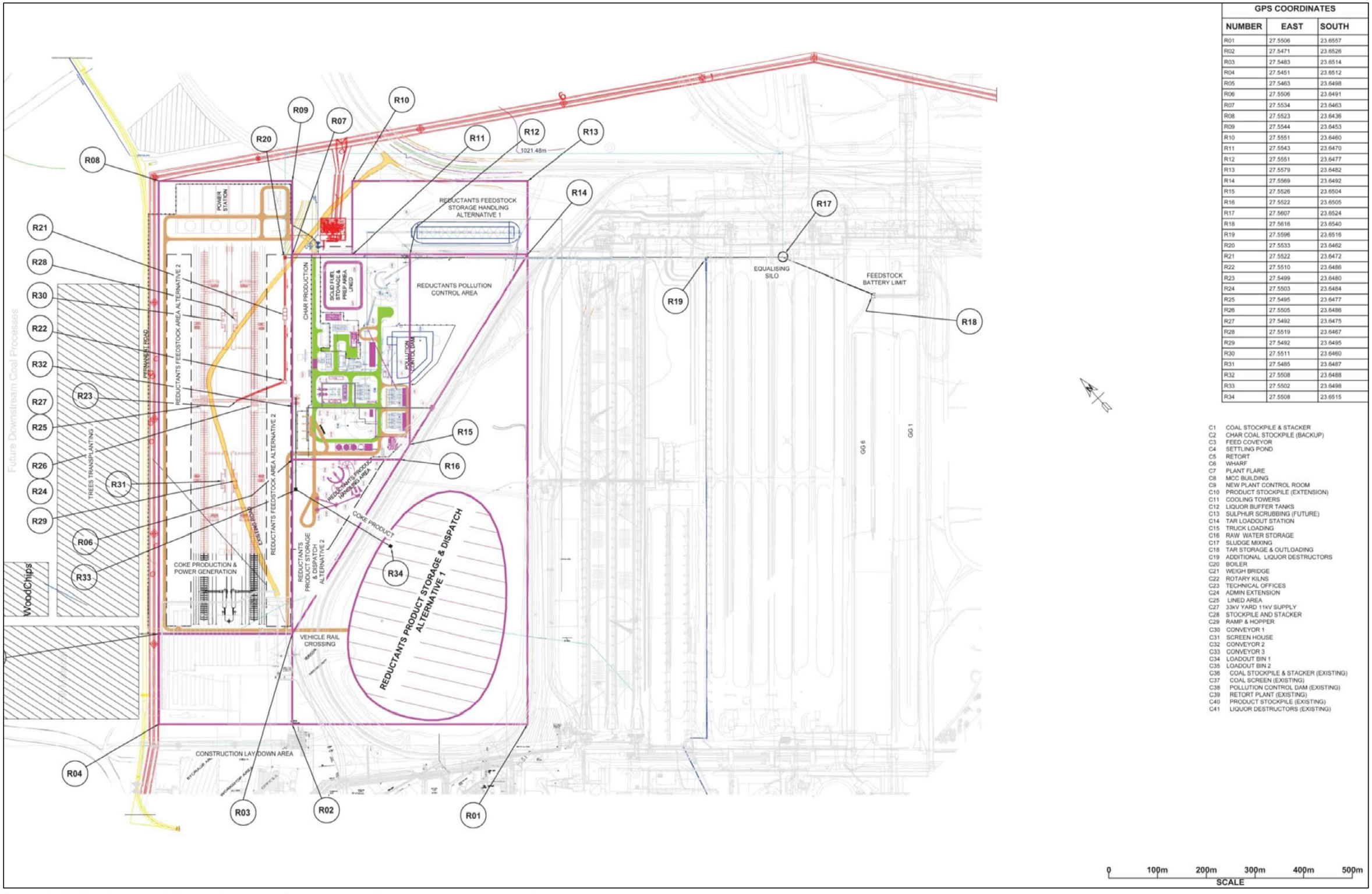
Co-generation Plant:

- The steam system (waste heat boilers, off-gas gas treatment system and Chimney stacks, turbines, generators and dry condensing system);
- Water demineralization treatment plant, feed water pumps, control and instrumentation switchgear and equipment;
- The electricity generating plant, buildings and associated infrastructure;
- COFG desulphurisation plant and dust filtering system;
- The connecting and transmission equipment; and
- Utilities – water, electricity, diesel (for back-up generators).

Other infrastructure such as admin offices, stores and a workshop will also be constructed.

Two new workshops may be constructed, one for plant maintenance and one for the maintenance of the steam turbines and generating plant. They will be located in close proximity to the plants they are to serve. The coke oven workshop will make provision for the maintenance of the coke ovens, conveyors, coal crushers, battery machines and associated plant. The electricity generating plant workshop will make provision for the specialised demands made by the maintenance of plant like steam turbines, large generators, high tension switchgear and control gear for the co-generation system.

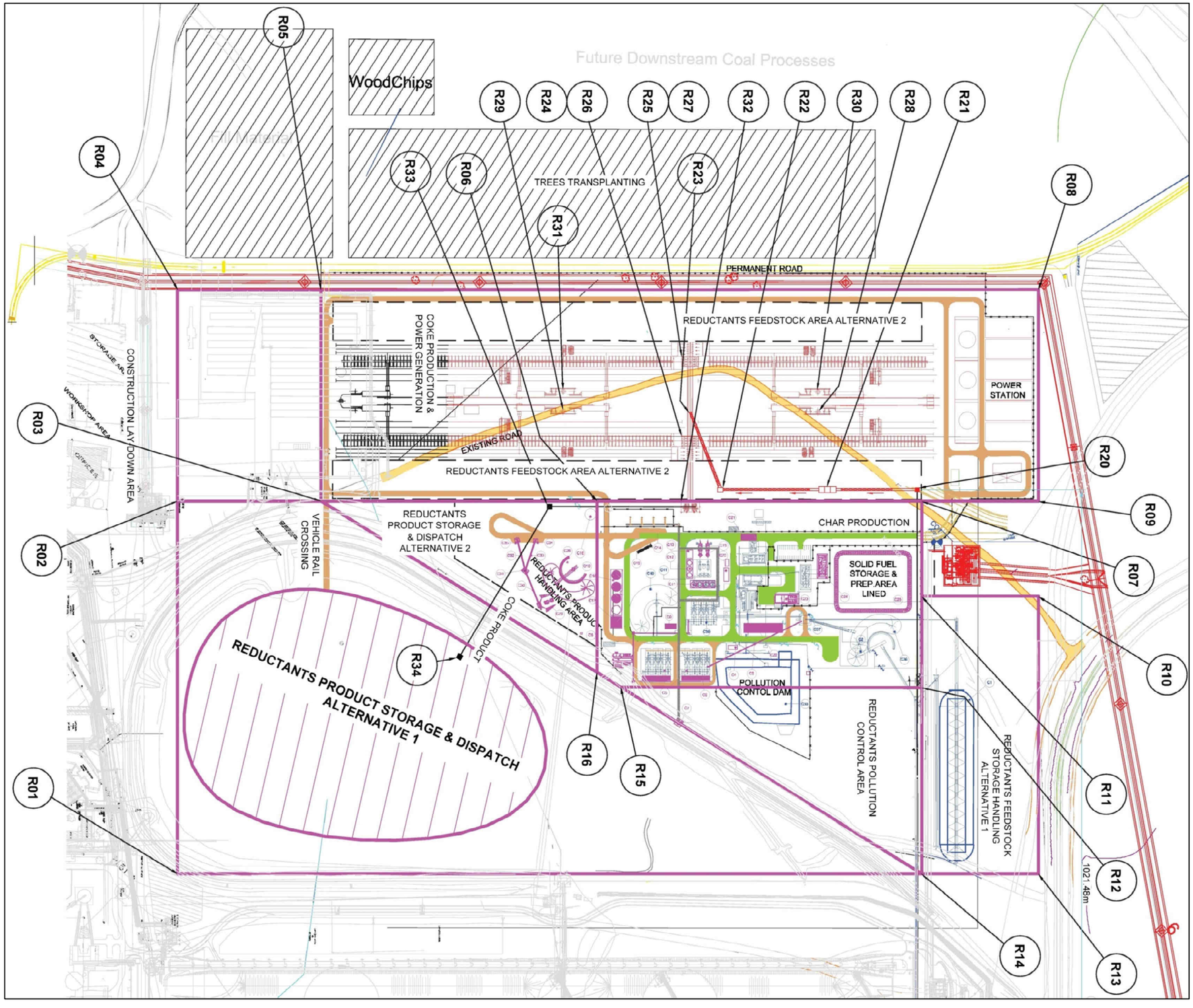
The water and waste related infrastructure requirements are described in further detail in Sections 6.2 and 6.3 of this report.



GPS COORDINATES		
NUMBER	EAST	SOUTH
R01	27.5506	23.6557
R02	27.5471	23.6526
R03	27.5483	23.6514
R04	27.5451	23.6512
R05	27.5463	23.6498
R06	27.5506	23.6491
R07	27.5534	23.6463
R08	27.5523	23.6436
R09	27.5544	23.6453
R10	27.5551	23.6460
R11	27.5543	23.6470
R12	27.5551	23.6477
R13	27.5579	23.6482
R14	27.5569	23.6492
R15	27.5526	23.6504
R16	27.5522	23.6505
R17	27.5607	23.6524
R18	27.5616	23.6540
R19	27.5596	23.6516
R20	27.5533	23.6462
R21	27.5522	23.6472
R22	27.5510	23.6486
R23	27.5499	23.6480
R24	27.5503	23.6484
R25	27.5495	23.6477
R26	27.5505	23.6486
R27	27.5492	23.6475
R28	27.5519	23.6467
R29	27.5492	23.6495
R30	27.5511	23.6460
R31	27.5485	23.6487
R32	27.5508	23.6488
R33	27.5502	23.6498
R34	27.5508	23.6515

C1 COAL STOCKPILE & STACKER
C2 CHAR COAL STOCKPILE (BACKUP)
C3 FEED COVEYOR
C4 SETTLING POND
C5 RETORT
C6 WHARF
C7 PLANT FLARE
C8 MCC BUILDING
C9 NEW PLANT CONTROL ROOM
C10 PRODUCT STOCKPILE (EXTENSION)
C11 COOLING TOWERS
C12 LIQUOR BUFFER TANKS
C13 SULPHUR SCRUBBING (FUTURE)
C14 TAR LOADOUT STATION
C15 TRUCK LOADING
C16 RAW WATER STORAGE
C17 SLUDGE MIXING
C18 TAR STORAGE & OUTLOADING
C19 ADDITIONAL LIQUOR DESTRUCTORS
C20 BOILER
C21 WEIGH BRIDGE
C22 ROTARY KILNS
C23 TECHNICAL OFFICES
C24 ADMIN EXTENSION
C25 LINED AREA
C27 33kV YARD 11kV SUPPLY
C28 STOCKPILE AND STACKER
C29 RAMP & HOPPER
C30 CONVEYOR 1
C31 SCREEN HOUSE
C32 CONVEYOR 2
C33 CONVEYOR 3
C34 LOADOUT BIN 1
C35 LOADOUT BIN 2
C36 COAL STOCKPILE & STACKER (EXISTING)
C37 COAL SCREEN (EXISTING)
C38 POLLUTION CONTROL DAM (EXISTING)
C39 RETORT PLANT (EXISTING)
C40 PRODUCT STOCKPILE (EXISTING)
C41 LIQUOR DESTRUCTORS (EXISTING)

Figure 2.11: Site Layout of Market Coke and Co-generation Plant with co-ordinates of units



Way Point No	Item Description
R 17	Equalizing Coal Feedstock Silo
R 18	Feedstock Battery Limit (Conveyor Pick-up point)
R 19	ROM Stockpile Transfer (to Feedstock Conveyor)
R 20	Main Transfer Point to Screen
R 21	Screen & Crusher
R 22	Transfer Point to Coal Tower
R 23	Tower Conveyor Transfer Point
R 24	Coal & Quench Tower Phase 1
R 25	Coal & Quench Tower Phase 2
R 26	Wharf Phase 1
R 27	Wharf Phase 2
R 28	Chimney Stack No1 (Phase 1)
R 29	Chimney Stack No2 (Phase 1)
R 30	Chimney Stack No 3 (Phase 2)
R 31	Chimney Stack No 4 (Phase 2)
R 32	Coke Crushing Station
R 33	Transfer Point Coke Crusher to Product Conveyor
R 34	Product Conveyor Off-load point
R 35	Gypsum Handling and Load Area
	Coke Oven Batteries Phase 1
	Coke Oven Batteries Phase 2

Figure 2.12: Site Layout of Market Coke and Co-generation Plant with unit descriptions

2.4 Residue and Emissions

2.4.1 Waste Stream Identification

The following solid waste streams have been identified for the Market Coke and Co-generation Plant Project: sediment from the PCD and PCD Extension, sediment in the settling pond and silt trap from the quenching tower and hazardous waste (workshop waste).

The following effluents / liquid wastes have been identified for the Market Coke and Co-generation Plant Project: dirty storm water and process water contained in the PCD and sewage (which flows to an existing wastewater treatment works). The dirty storm water and process plant effluent will be managed using the PCD and PCD Extension and recycled into the Market Coke manufacturing process at the plant site. The various waste streams are described in more detail in Section 6.2 of this report.

The coke product stockpile while not a waste stream could potentially have an impact on the surrounding environment. The product stockpile areas are to have HDPE and compacted earth on clay layer. All runoff and seepage from the stockpiles will be routed to the silt trap then the PCD and PCD Extension.

The coke product stockpiles and coal feedstock stockpiles are not waste stockpiles but have the potential to have an impact on the surrounding environment, thus they are discussed in the IWWMP and are being applied for in the section 21 (g) WUL applications.

The various waste streams are described in more detail in Section 6.2 of this report.

Please note that a Waste Management License (WML) application is not applicable, as there will be no waste generated on site that requires a waste management licence.

None of the activities included in the list of waste management activities will take place as part of the Market Coke and Co-generation Plant project. No waste of any kind will be stored or disposed of on site and no waste will be treated in any way. The Co-generation Plant will use heat generated from the coke manufacturing process to produce electricity. Thus, a WML is not required for this project.

2.4.2 Waste Stream Characterisation

Certain wastes, which will be produced during the Market Coke and Co-generation Plant Project, are classified as general waste according to the definition in the National Environmental Management Waste Act (Act 59 of 2008) (NEMWA). General wastes will include builders' rubble, office waste, canteen waste, scrap metal and possibly some workshop waste. The Market Coke and Co-generation Plant process itself will not produce any wastes.

Hazardous waste will also be produced at the plant site, which will include: used oils, rags contaminated with hydrocarbons, containers of hydrocarbons and solvents, soil contaminated with hydrocarbons and sewage. Market Coke and Co-generation Plant processes will not produce any hazardous wastes.

2.4.3 Waste Management

The detailed description of the management of the waste has been included in Chapter 6 of this report. Both hazardous and general waste will be produced, however none that require a waste management licence. Non-process general and hazardous waste disposal will tie in with the current practices and facilities of Grootegeluk Mine.

2.4.3.1 General Waste Management

General solid waste has the potential to impact on surface water through contaminated runoff and the generation of leachate. The waste management proposed for the site is discussed below. The following sources will generate general waste on the site:

- Construction waste from the construction of the Market Coke and Co-generation Plant project,
- Site offices,
- Canteen and ablutions,
- Workshops,
- Market Coke and Co-generation Plant stormwater system.

General waste disposal will tie in with the current practices and facilities of the existing Char Manufacturing Plant that is adjacent to the proposed Market Coke and Co-generation Plant project. Currently the domestic waste from the existing Char Manufacturing Plant is collected by the Grootegeluk Mine Services Department and taken to the Lephalale Municipal Landfill site for disposal. This same practice will be followed for the Market Coke and Co-generation Plant project. The colour coded bin system that is implemented by the existing Char Manufacturing Plant for the recycling of paper, glass, plastic and tins will also be implemented for the Market Coke and Co-generation Plant project. The scrap metal produced will also be included in the current contract with Reclam, where the scrap metal is collected in skips and removed from site for processing. All other, commercial, industrial waste, builders' rubble and other waste classified as General Waste (G) under the South African Minimum Requirements for waste disposal (Department of Water Affairs and Forestry, 1998) will be removed from the site by an appropriately licensed waste removal contractor and disposed of at a licensed general waste facility.

Stormwater runoff will enter the PCD and overflow will flow into the PCD extension and this water will then be recycled in the Market Coke and Co-generation Plant process. The contaminated water will not be allowed to enter the environment. The silt which collects in the silt trap, settling pond and PCD will be periodically removed and disposed of as general waste.

2.4.3.2 Hazardous Waste Management

Solid Waste

Some of the waste classified as hazardous (H or h), including grease, oils, acids, fluorescent tubes, medical waste etc. will also be handled by the existing Char Manufacturing Plant through their existing systems which will involve disposing of the waste at a licensed hazardous waste site through an authorized Hazardous Waste Service provider like Wastech or Wasteman.

Sewerage

The site is currently serviced by a conventional waterborne sewerage system. All domestic waste water generated on the site is collected in a sump adjacent to the PCD. This sump has capacity for 300 people and thus has sufficient capacity to also handle the increased demand. From the sump, two pumps (one duty and one standby – already installed) will pump the sewerage via the existing 100 mm diameter HDPE pipeline to the Grootegeluk Waste Water Treatment Works.

2.4.4 Waste Recovery and Reduction

Waste heat is produced from the coke ovens. Only a portion of the heat generated by combustion is required for maintaining the coke oven temperatures for the coking process; the remaining heat is used downstream for raising steam in waste heat boilers. The steam is used to drive turbine-generators for generating electric power. The term 'waste heat implies that, should the heat not be used immediately,

it would be 'wasted'.

Effluent from the Market Coke and Co-generation Plant process will be initially disposed of via a silt trap to the existing PCD and the proposed PCD Extension. From here, it will be pumped back to the plant for reuse in the process. Additionally, all the dirty storm water runoff that is directed to the PCD will be also re-used in the process.

Recycling of some of the solid general waste will also take place. Wastes will be separated into colour coded bins and recyclable waste will be recycled through the existing Grootegeluk Mine waste disposal system. Scrap metal will also be sold to a scrap metal recycling company.

2.4.4.1 Possible future waste reduction

The future option will be subject to the required applications and authorisations before implementation.

3. PRESENT ECOLOGICAL STATUS

3.1 Climate

3.1.1 Regional Climate

3.1.1.1 Mean rainfall

The study area is characterised by hot, moist summers and mild dry winters. The long-term annual average rainfall is 420 mm, occurring mostly between October and April, with the peak for the area being in January (Airshed, 2012). Long-term average rainfall, as recorded at the SAWS station in Lephalale, is depicted in Figure 3.1.

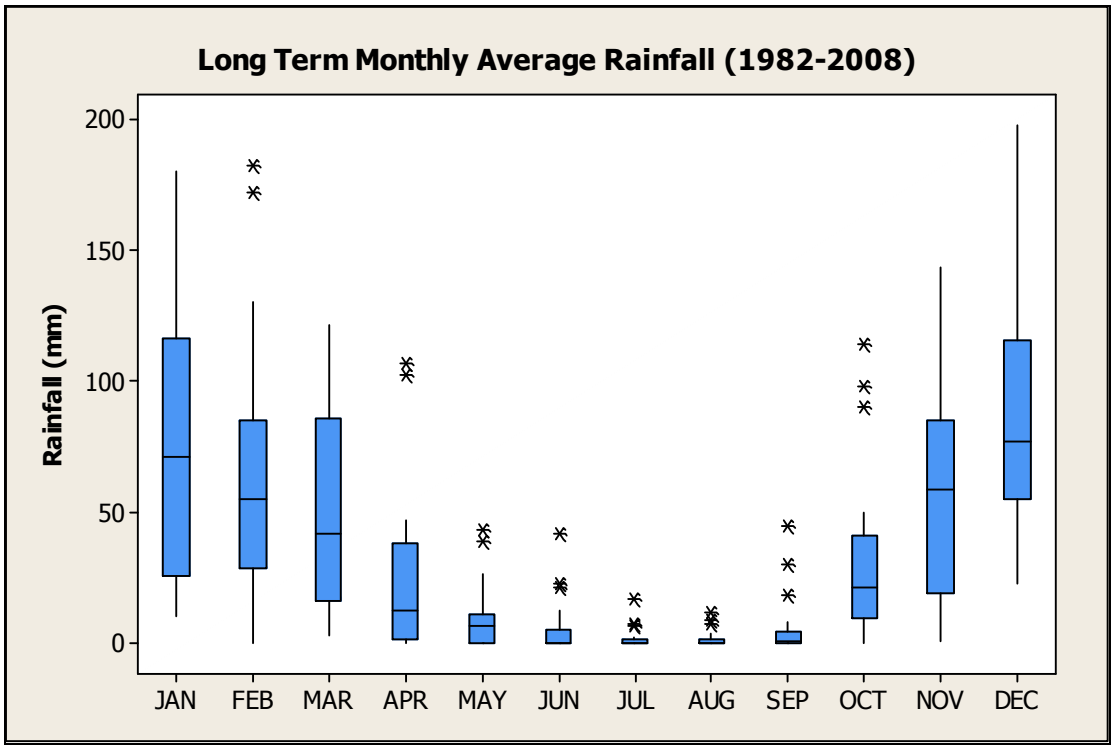


Figure 3.1: Monthly average rainfall for Lephalale (Airshed, 2012).

3.1.1.2 Evaporation

Evaporation in the area is high, with the annual evaporation being approximately 2 219 mm (refer to Table 3.1 in which the average monthly evaporation data for the Limpopo Province is summarised).

Table 3.1: Monthly average evaporation data for the Limpopo Province (Airshed, 2012)

Month	Mean Value	Maximum Value	Minimum Value
January	237 mm	292 mm	168 mm
February	193 mm	238 mm	146 mm
March	191 mm	222 mm	124 mm
April	152 mm	165 mm	132 mm
May	135 mm	152 mm	120 mm
June	114 mm	128 mm	101 mm
July	125 mm	136 mm	112 mm
August	164 mm	181 mm	142 mm
September	202 mm	239 mm	166 mm
October	233 mm	294 mm	187 mm
November	239 mm	287 mm	179 mm
December	234 mm	288 mm	175 mm

3.1.1.3 Maximum Rainfall

The highest annual rainfall experienced in the last 30 years was 762.3 mm in 1999/2000. The maximum monthly rainfall in the last 30 years was 237.5 mm in February 2000 (Table 3.2) (SAWS, 2012).

Calculations were completed to determine possible flood levels which may be experienced on the site with a 1 in 50 year return interval. These calculations showed that the maximum amount of rain which could fall in 24 hours is 98.7 mm and in 7 days is 177.7 mm (Jones and Wagener, 2012B, Appendix 5).

Table 3.2: Rainfall Data from 1980-2012 (Grootfontein and Grootegeluk weather station) Source: South African Weather Services (2012)

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	YEAR
1980/81	0.0	0.0	13.0	42.0	178.0	56.0	124.0	83.0	67.0	37.0	0.0	3.0	**603.0**
1981/82	0.0	12.0	7.0	13.0	56.0	31.0	96.0	98.0	30.0	15.0	2.0	0.0	**360.0**
1982/83	3.0	0.0	3.0	80.0	74.0	30.0	50.0	20.0	70.0	2.0	10.0	3.0	**345.0**
1983/84	7.0	8.0	0.0	12.0	69.0	67.0	53.0	37.0	85.0	15.0	2.0	17.0	**372.0**
1984/85	5.0	0.0	3.0	25.0	34.0	70.0	138.0	87.0	47.0	37.0	27.0	2.0	**475.0**
1985/86	1.0	0.0	10.0	35.0	2.0	84.0	6.0	37.0	5.0	82.0	0.0	0.0	**262.0**
1986/87	0.0	0.0	3.0	85.0	64.0	90.0	80.0	23.0	32.0	15.0	0.0	0.0	**392.0**
1987/88	0.0	0.0	23.0	30.0	21.0	111.0	38.0	167.0	123.0	25.0	0.0	1.0	**539.0**
1988/89	1.0	0.0	11.5	92.5	8.7	36.7	112.8	113.0	26.8	38.0	2.5	10.3	**453.8**
1989/90	0.0	4.5	0.0	10.0	104.0	112.3	36.4	68.3	80.3	35.0	0.9	0.0	**451.7**
1990/91	0.0	0.0	0.0	32.5	18.3	55.2	152.9	94.5	93.1	3.0	3.0	2.0	**454.5**
1991/92	0.0	0.0	0.0	16.6	39.7	195.5	19.3	34.0	18.3	15.0	0.0	0.0	**338.4**
1992/93	0.0	0.0	0.0	124.7	33.1	110.7	42.0	23.2	22.8	41.0	0.8	0.0	**398.3**
1993/94	5.5	3.7	0.5	55.5	71.1	167.5	76.6	108.5	37.0	6.0	0.0	0.0	**531.9**
1994/95	0.0	0.0	0.0	3.5	45.3	63.2	187.0	63.0	78.6	19.8	26.3	0.0	**486.7**
1995/96	0.0	0.0	0.0	25.0	75.0	164.1	79.1	165.9	31.0	0.0	24.5	0.0	**564.6**
1996/97	4.5	1.5	0.0	35.0	118.8	82.2	165.5	53.0	86.5	6.5	39.0	0.0	**592.5**
1997/98	0.0	0.0	8.0	9.5	74.8	25.7	39.0	45.5	46.5	32.5	0.0	0.0	**281.5**
1998/99	0.0	0.0	0.0	25.7	66.7	219.7	73.5	29.5	17.6	5.1	23.5	0.0	**461.3**
1999/2000	0.0	0.0	1.0	16.0	60.7	61.0	104.5	237.5	137.0	108.1	23.0	13.5	**762.3**
2000/01	0.0	0.0	0.0	38.8	27.0	34.0	35.2	92.0	54.8	24.5	8.0	21.0	**335.3**
2001/02	0.0	0.0	0.3	27.0	148.0	72.8	31.6	38.0	5.0	140.5	0.0	44.0	**507.2**
2002/03	0.0	0.2	1.5	42.0	0.0	86.4	83.0	37.5	5.0	0.0	0.0	39.0	**294.6**
2003/04	0.0	0.0	1.5	15.3	27.6	29.5	191.5	128.7	152.0	57.5	0.0	0.0	**603.6**
2004/05	0.0	0.0	0.0	10.3	41.5	186.1	45.0	13.1	48.0	33.5	0.0	0.0	**377.5**
2005/06	0.0	0.0	0.0	0.0	78.5	33.8	221.7	56.8	89.0	10.5	9.0	0.0	**499.3**
2006/07	0.0	0.8	5.0	0.0	37.5	108.0	11.0	25.5	32.0	33.7	0.0	0.0	**253.5**
2007/08	0.0	0.0	50.5	53.3	63.0	161.8	139.0	6.5	41.5	14.9	6.5	0.0	**537.0**
2008/09	3.0	0.0	0.0	25.5	132.0	88.0	158.9	51.8	64.5	0.0	26.0	26.5	**576.2**
2009/10	0.0	0.0	1.5	44.0	70.0	52.7	58.5	38.5	29.0	99.5	56.0	0.0	**449.7**
2010/11	0.0	0.0	0.0	0.0	77.7	63.0	152.0	5.0	19.5	17.2	14.0	3.0	**351.4**
2011/12	0.1	2.5	0.0	55.0	50.0	131.2	40.5	15.0	0.7	0.0	0.0	0.0	**295.0**

3.1.1.4 Temperatures

The area experiences average maximum temperatures of between 30 and 36 ℃ and average minimum temperatures of between 7 and 3 ℃ (Airshed, 2012). The long term maximum and minimum average monthly temperatures recorded at the South African Weather Service (SAWS) station in Lephalale are shown in Figure 3.2 and Figure 3.3 respectively. A visual representation of average temperatures throughout the day and year is provided in Figure 3.4, which depicts data recorded at the SAWS station at Lephalale in 2006.

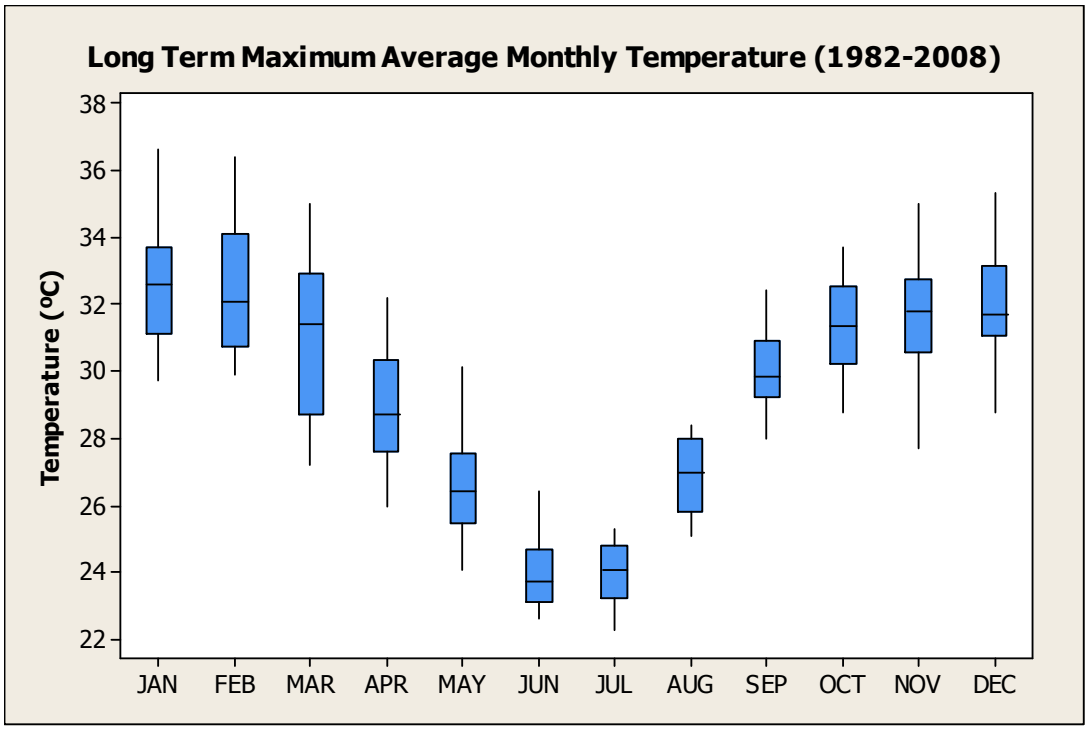


Figure 3.2. Long-term average maximum temperature for Lephalale (1982 – 2008) (Airshed, 2012).

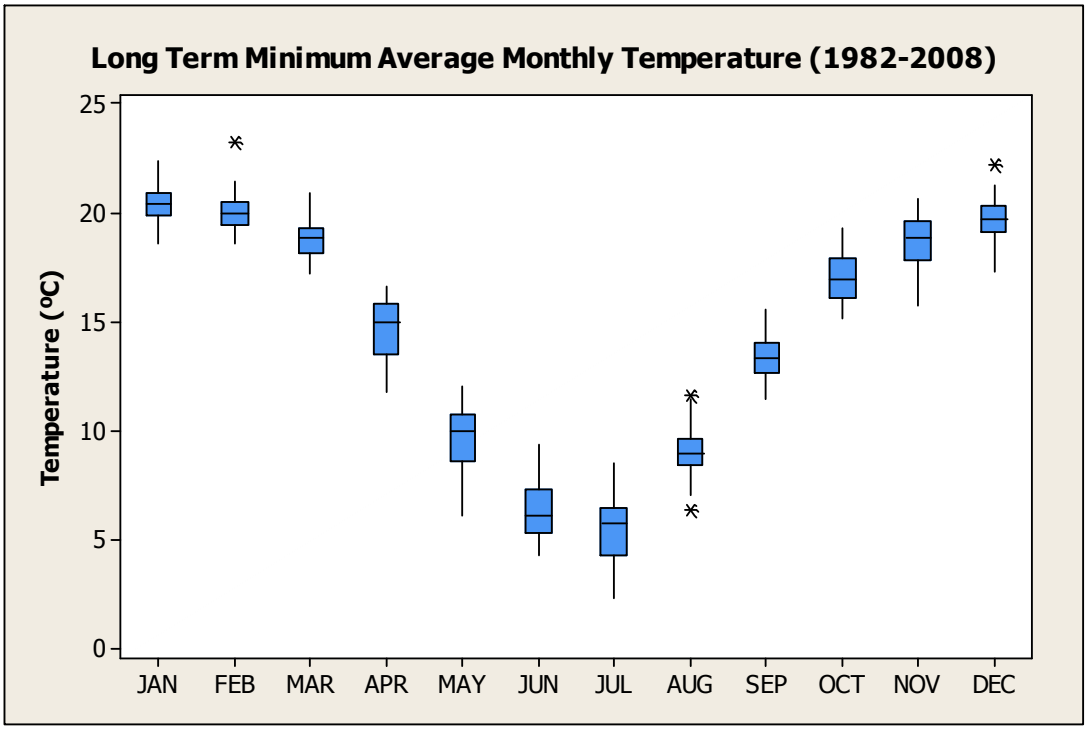


Figure 3.3: Long-term average minimum temperature for Lephalale (1982 – 2008) (Airshed, 2012).

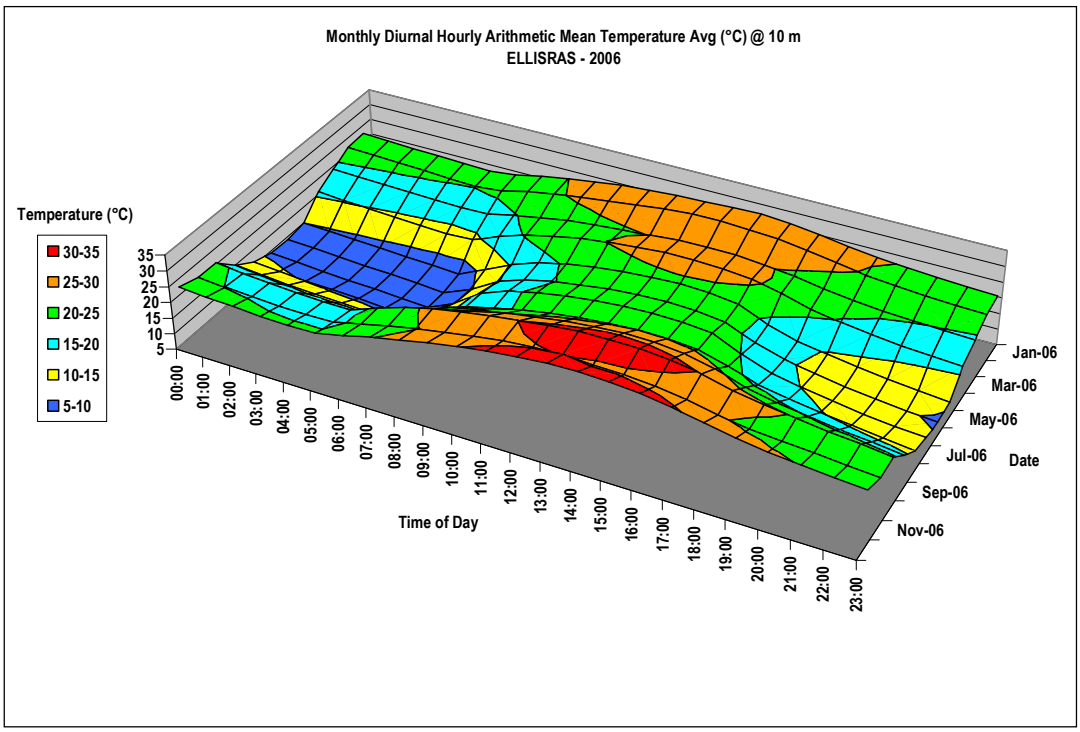


Figure 3.4: Monthly daily temperature profile of Lephalale in 2006 (Airshed, 2012).

3.1.1.5 Wind

The wind pattern of the area is dominated by east-north-easterly and north-easterly winds, as may be expected due to the continental high pressure. Winds are infrequently experienced from a westerly and south-easterly direction. East-north-easterly and north-easterly winds increase in frequency during summer months, and the percentage of north-easterly winds decreases in winter months. The highest wind speeds were recorded during the spring months (August to October) (Airshed, 2012). An annual average wind rose for the area is depicted in Figure 3.5 and seasonal average wind roses in Figure 3.6.

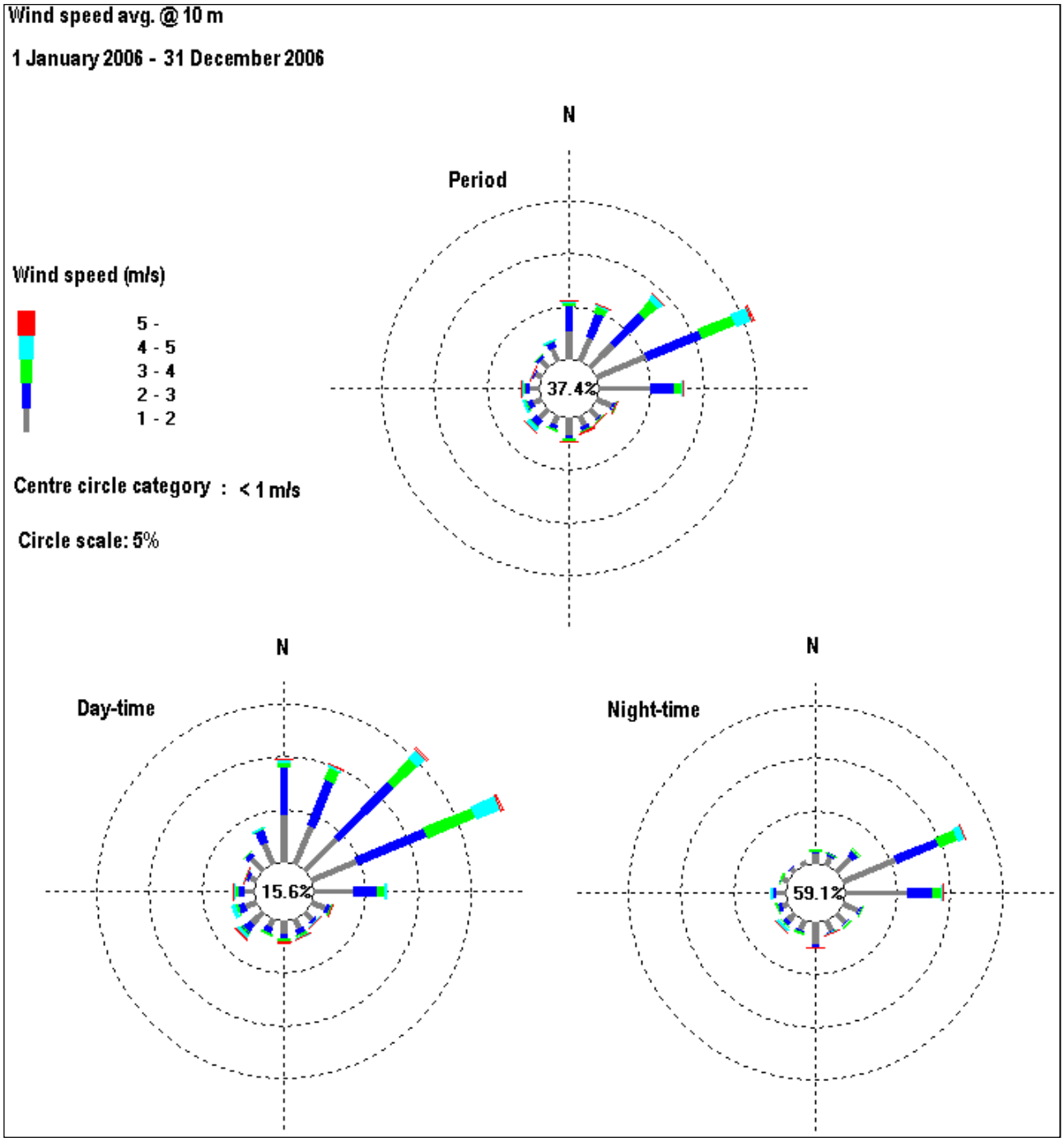


Figure 3.5: Period, Day and Night-time Wind Roses for the Lephalale (Ellisras) SAWS Station (2006) (Airshed, 2012)

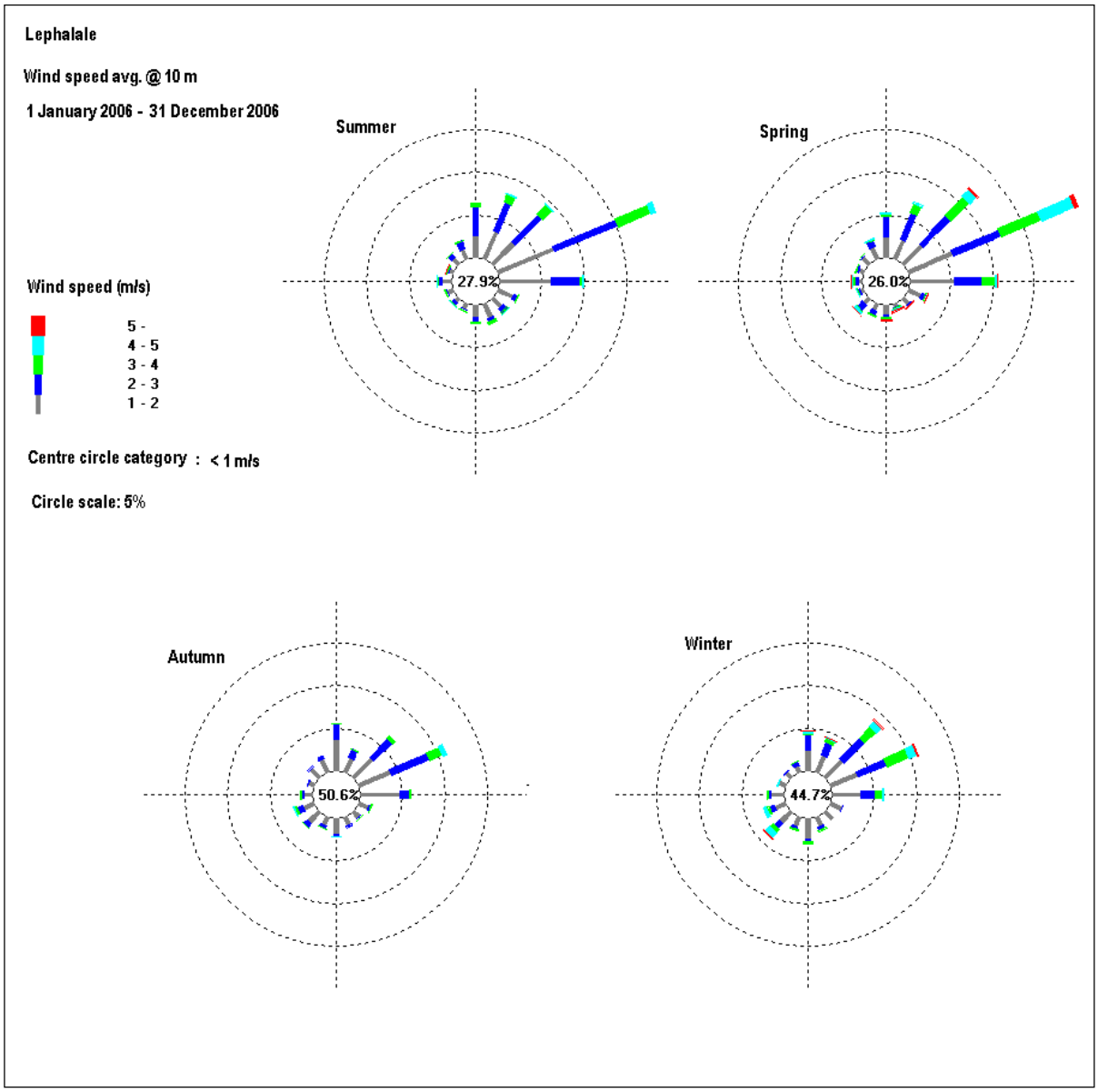


Figure 3.6: Seasonal Wind Roses for Lephalale (Ellisras) Weather Station (2006) (Airshed, 2012).

3.2 Soil and Land capability

3.2.1 Topography

The elevation of Grootegeluk Mine varies from 900 to 922 m above sea level (Figure 3.7). The area is generally flat and featureless, with the exception of Nelsonskop to the north and the Waterberg range to the south, which have elevations of 922 m and 3600 m above sea level respectively (Clean Stream, 2005). The elevation of the Market Coke and Co-generation Plant is approximately 915 m above sea level.

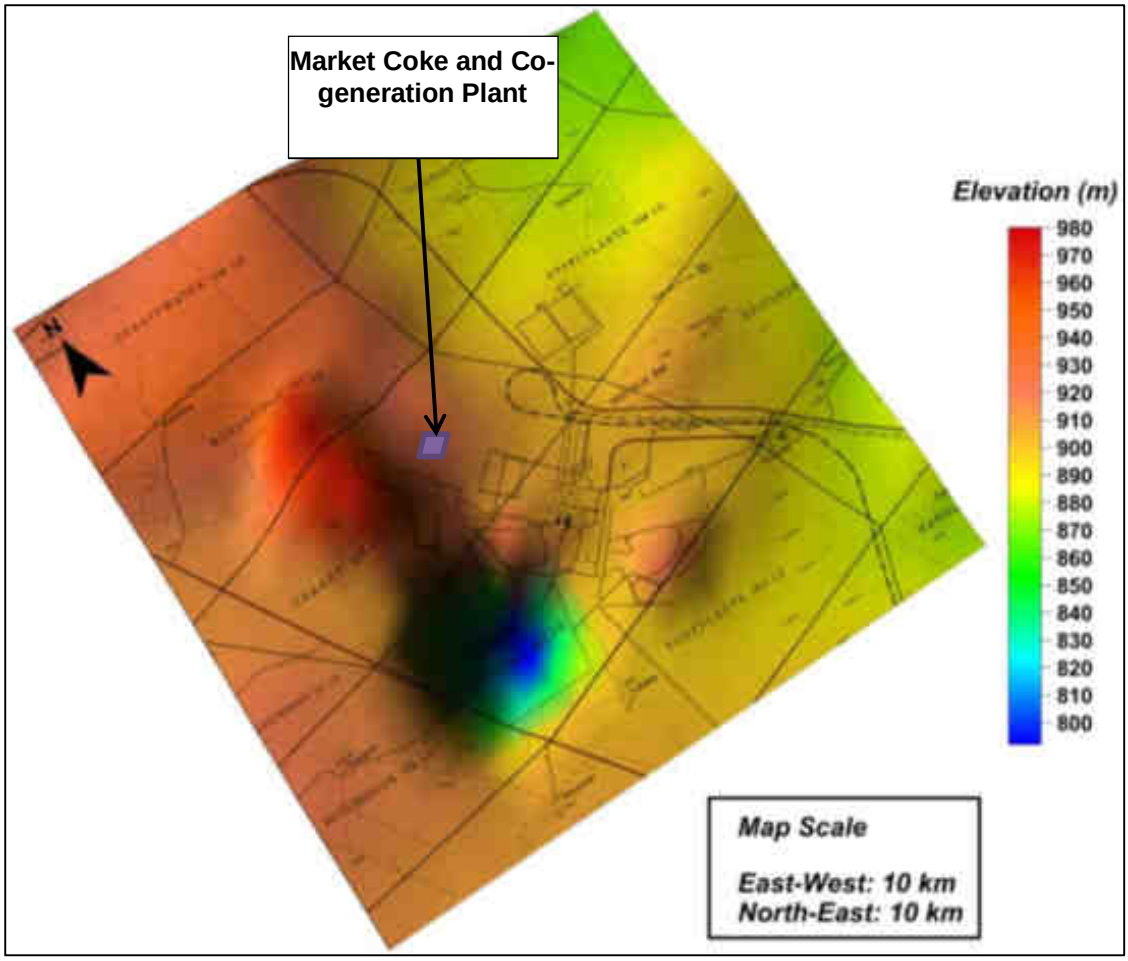


Figure 3.7: Topography of the proposed site (Airshed, 2012)

3.2.2 Soils and Land Capability

3.2.2.1 Geology

The proposed site is located in the Waterberg Coalfield. The coalfield extends westward into Botswana and covers an area of approximately 88 km (east to west) and 40 km north-south (ERM, 2012 *In* Jones and Wagener, 2012A). The coalfield is bounded by the Zoetfontein fault in the north and the Eenzaamheid fault in the south (Jones and Wagener, 2012A). The Daarby fault subdivided the coalfield in a northwest, then northeast direction (Jones and Wagener, 2012A).

3.2.2.2 Soil Forms

The variations in soil form are characterised by differences in the texture (grain size), colour, soil structure, and the effective rooting depths that result from the depth to bedrock and or inhibiting layers that occur.

Soils samples were collected from potentially contaminated areas within the plant. The samples were sent to Eurofins Analytico in Netherlands for analysis and the soil analytical data were evaluated by comparing them to soil screening values (SSV1) detailed in the Framework of the Management of Contaminated Land in South Africa (DWA, 2010) as well as the published background concentrations for South Africa by Henselman *et al.*, 2007. The soil was sampled at different depth intervals depending on the soil profile layers. The major soil types encountered on the site were a mixture of yellow-brown apedal soils and red apedal soils (Golder, 2011) (Appendix 6).

Soils in the study area can be grouped into five main categories (Figure 3.8):

- Red and Yellow: Well drained sandy soil with high base status
- Red soil with high base status
- Red, yellow and/or greyish soil with high base status
- Rock with limited soil
- Soils with negligible to weak profile development, usually occurring on deep alluvial deposits.

3.2.2.3 Nutrient Status and Chemical Characteristics

The waste stream analysis specialist study (Appendix 6) that was done for a separate study, the Char Manufacturing Plant Expansion project, also examined the composition of the soil on the proposed Market Coke and Co-generation Plant site. The results of this study show that the soil qualifies as a contaminated land in respect of the NEMWA. In 2005, 1839.36 hectares were surveyed within the Grootegeluk mining area with an area of 180.30 hectares being impacted by infrastructure associated with mining activities. The site for the proposed Market Coke and Co-generation Plant is included within the impacted area. The area surrounding the Grootegeluk Coal Mine is mainly used for cattle and game farming. Previously, the area used to be cultivated, however; there is no longer cultivation of crops in the area (Clean Stream, 2005).

The soils in the study area have been heavily impacted by the mining activities that have been occurring on the site for approximately 29 years. The proposed Market Coke and Co-generation Plant will be built on an area that was previously used for coal stockpiling. As such, top 5 to 10 cm of soil over most of the surrounding area is heavily impacted by coal contamination (Golder, 2011, Appendix 6; the Golder report was done for a separate project - the Char Manufacturing Plant Expansion project - which is adjacent to the Market Coke and Co-generation Plant, however the soil analysis is relevant for the Market Coke and Co-generation Plant project).

There are elevated levels of As, Pb and V concentrations in the soils, however, this is not as a result of spillage of wastes as the levels of these COC's in samples taken from waste samples (i.e. tar, liquor etc.) were low. Instead, these elevated As, Pb and V concentrations are associated with the infill material that was used during the construction of the existing Char Manufacturing Plant (Golder, 2011). Furthermore, these elevated COC's are unlikely to contribute to groundwater contamination as all these COC's are absorbed by clay particles and only move under acidic conditions (Golder, 2011).

3.2.2.4 Soil Physical Characteristics

A mixture of yellow-brown apedal soils and red apedal soils characterise the area around Grootegeluk Mine (Clean Stream, 2005). These soils are highly permeable. Water filters through the soil very fast, washing out nutrients and making these soil types unsuitable for cultivation. The yellow-brown apedal soils are well to moderately drained and shallow to very deep (0.4 m to >1.8m). They are the most dominant soil type area and generally occur in flat to gently sloping midslope to crest positions. The red apedal soils are relatively well drained soils with intermediate to very deep depths (0.3 m to >1.8 majority). The soils in the area are the Hutton type (Hu35) (Figure 3.8). They are sandy, with 70 to 90 % of sand in the top layer and 50 to 90 % in the sub layer. The clay content ranges from 5 to 25 % in the top layer and 5 to 45 % in the sub layer. This content puts the top layer in the sandy to sandy-clay-loam texture and the sub layer in the sandy to sandy-clay texture. Silt content is low in all the soil types.

3.2.2.5 Land Capabilities

Land capability is determined by the combination of soil capability and climate factors. A land capability

classification shows, in a general way, the suitability of soils for most kinds of field crops. The majority of the land in the Grootegeluk Mining area (and hence the Market Coke and Co-generation Plant area) falls within land capability classes V and VI (Figure 3.9). Land in these classes has very limited potential for use as arable landand is generally used as grazing land or wildlife habitat.

According to the IAPs, the area was cultivated in the past, but this activity no longer takes place, mainly due to decreased rainfall. A vast area (approximately 16 000 ha) is managed as a game farm (the Manketti Reserve) by Ferroland, a division of Exxaro Coal.

3.2.3 Land Use

As illustrated in Figure 3.10 below, the entire Grootegeluk Mine area is classified as grazing land. These soils are thus generally capable of sustaining palatable plant species on a sustainable basis. In addition, there should be no rocks in the upper horizons of any of the soil groups. If present, these would limit the land capability to wilderness land.

Figure 3.11, shows land cover in the study area, which provides some more details regarding land use, as the land subject to mining and quarrying is indicated. This map also shows the very small portion of land which is being cultivated in the region.

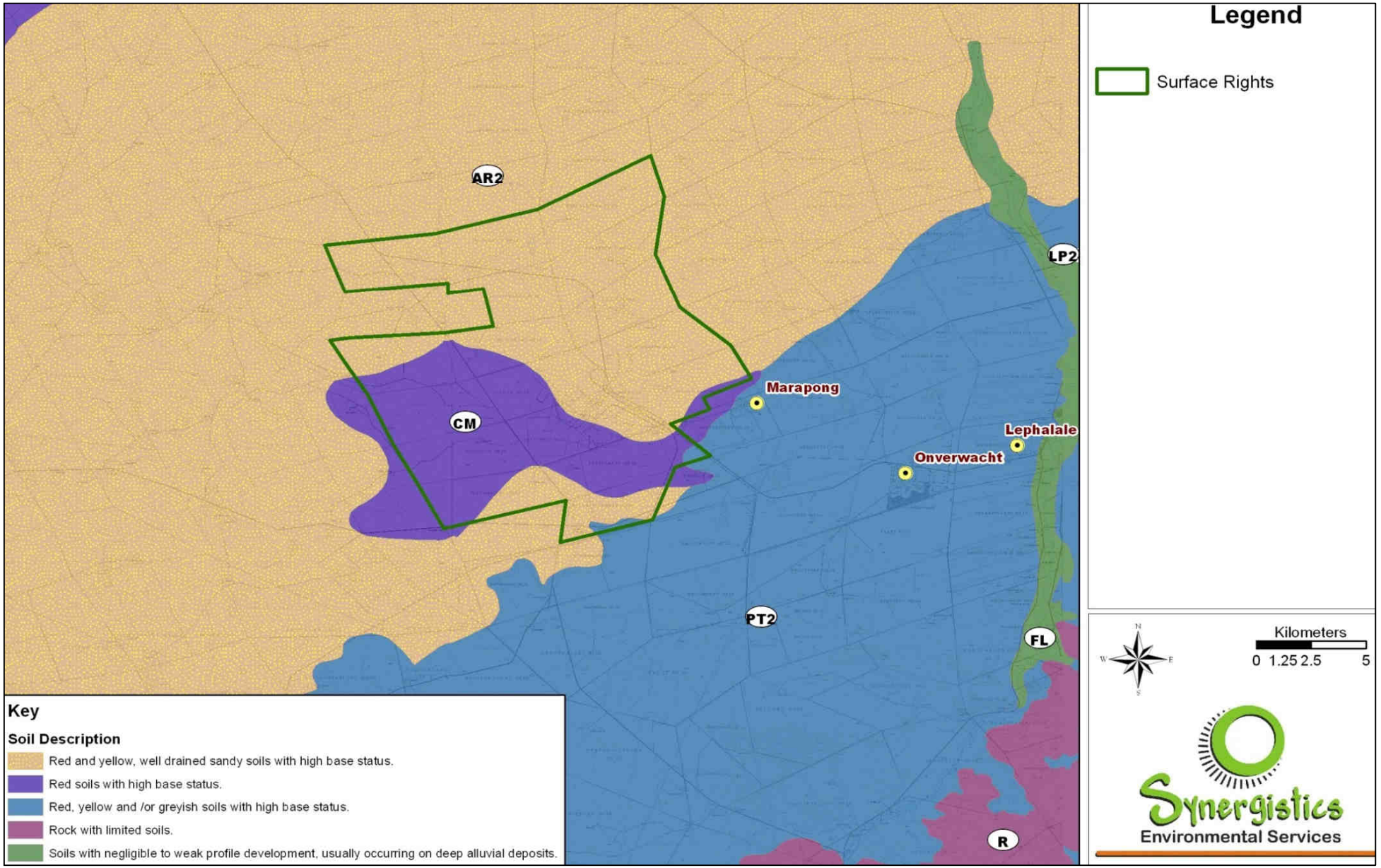


Figure 3.8: Soil types in the study area (the green polygon is the Grootegeluk Mine area)

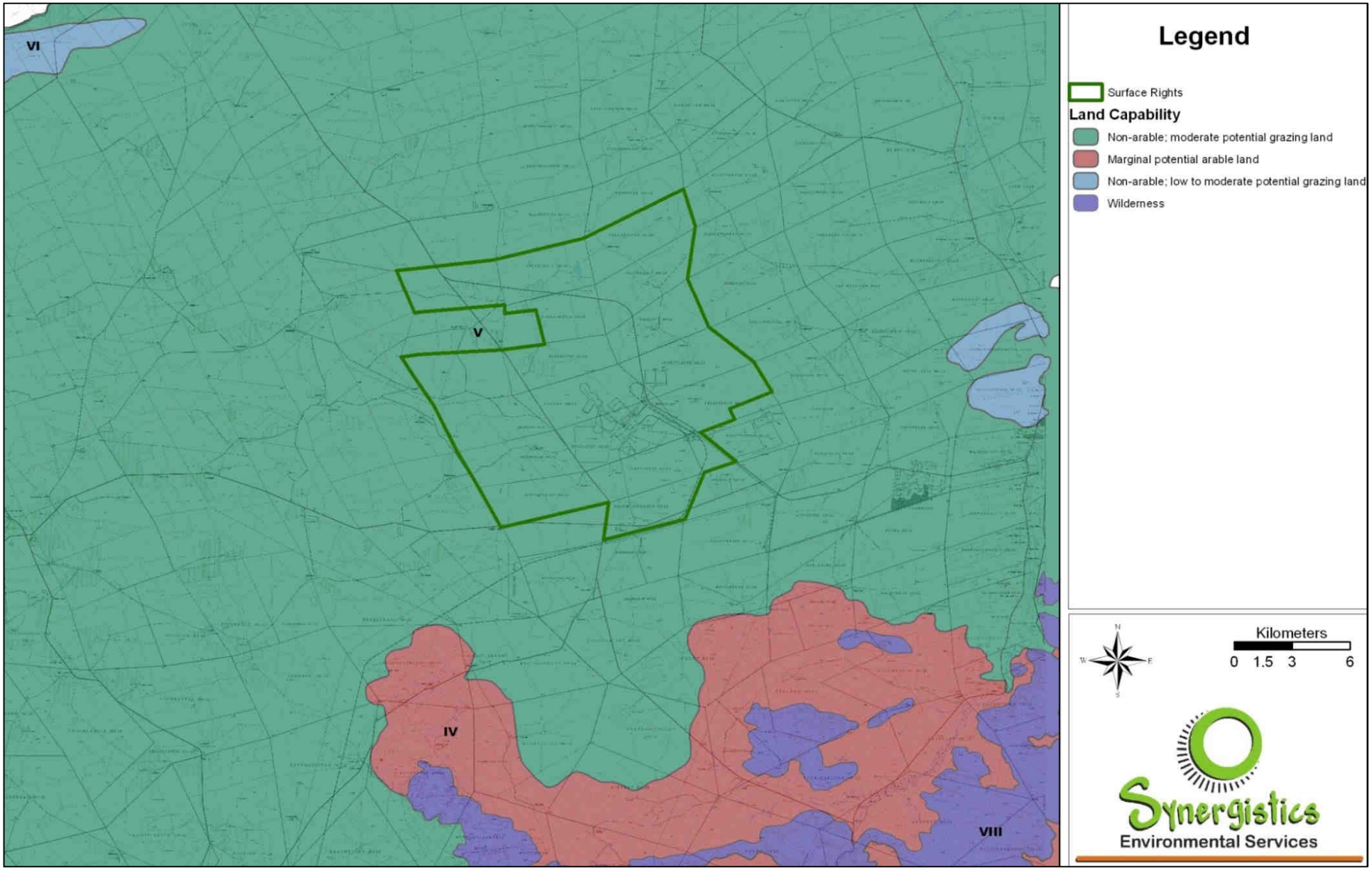


Figure 3.9: Land Capability in the Study Area

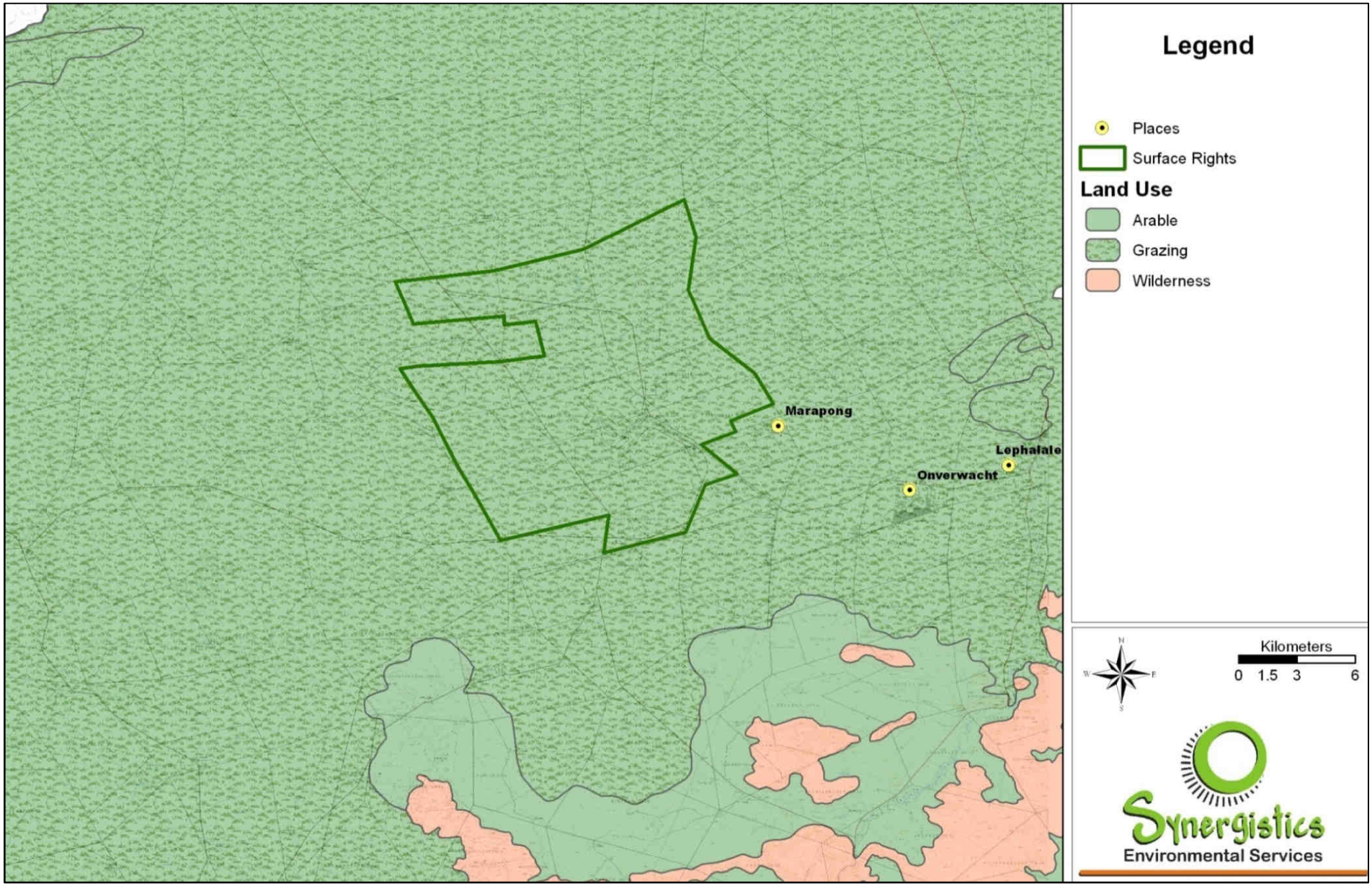


Figure 3.10: Land Use in the Study Area

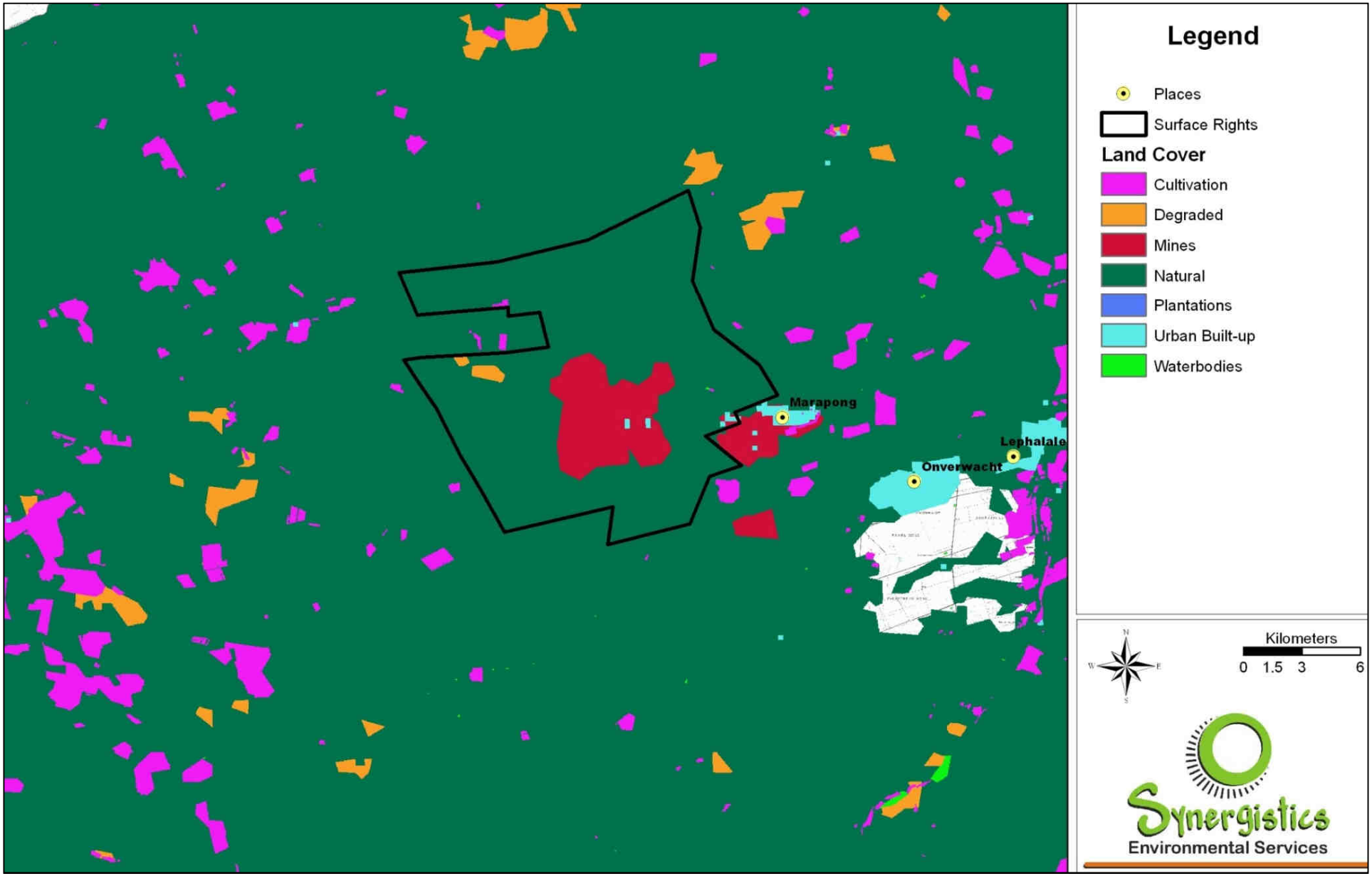


Figure 3.11: Land Cover Types in the Study Area (Natural Scientific Services, 2010).

3.3 Surface Water

A surface water specialist study was undertaken for this project in order to determine the baseline surface water environment and to assess the potential impacts of the Market Coke and Co-generation Plant Project on the surface water. This study is contained in Appendix 5.

3.3.1 Water Management Area

The Market Coke and Co-generation Plant Project site is located in the Limpopo Water Management Area (WMA 1) and the Primary catchment A (Limpopo River). The quaternary catchment is A42J (the Sandloop River) and the tertiary catchment is A42 (the Mokolo River).

3.3.2 Surface Water Hydrology

3.3.2.1 Drainage in surrounding areas

The overall pattern of surface water drainage in the area is north eastwards towards the Mokolo River, which then drains northwards towards the Limpopo River. The Mokolo River is approximately 810 m above sea level, while the project site is approximately 900 m above mean sea level. This results in an almost negligible gradient of 90:21000 m or 0.0043% (Bohlweki Environmental, 2006), and thus there is no fast flowing water and drainage from the area is slow. The area drains via a tributary of the Sandloop, which runs in an easterly direction, discharging initially into the ephemeral Sandloop River and then into the Mokolo River approximately 20 km east of the site (Figure 3.12). The Mokolo River has its source in the Waterberg mountains to the south east. It exits the mountainous region just south of Lephalale, drains across the flat plain between Lephalale and the Limpopo River, and discharges into the Limpopo about 50 km north of the Grootegeluk site (Jones & Wagener, 2012B).

Surface water on the site is found only after a rainfall event, and due to the relatively flat topography and sandy soil cover, most of the rainwater seeps into the groundwater aquifer. Small shallow pans or depressions occur in the veld where runoff may temporarily collect. There are no wetlands or dams located near the site. The closest wetland is the Eendragpan which is a large pan (1 km in length) located approximately 6.5 km from the project site. The nearest large dam is the Mokolo Dam located 41 km to the south east of the site. The receiving water body, that is the point below which the project's impact on the catchment is considered to be negligible, is the Mokolo River at the confluence with the unnamed tributary which drains the site (Jones & Wagener, 2012B).

3.3.2.2 Drainage in Market Coke and Co-generation Plant Site

Within the Market Coke and Co-generation Plant Project site a small, localised catchment drains towards the north western boundary of the Market Coke and Co-generation Plant Project site part of the Grootegeluk Mine dirty water area, this runoff is essentially dirty and is diverted around the southern boundary of the Market Coke and Co-generation Plant Project site by means of a storm water canal (Jones and Wagener, 2012B). All runoff from the Market Coke and Co-generation Plant Project site terrace will therefore be directed via a piped storm water system to the Market Coke and Co-generation Plant Project PCD and PCD extension. From here it is pumped to the Market Coke and Co-generation Plant Project for re-use in the process. If the PCD and proposed PCD Extension were to overflow, the water would drain towards another PCD at the Grootegeluk Mine – the Bosbok Dam located east of the Market Coke and Co-generation Plant Project site (refer to Figure 3.13 for the location of the Bosbok Dam).

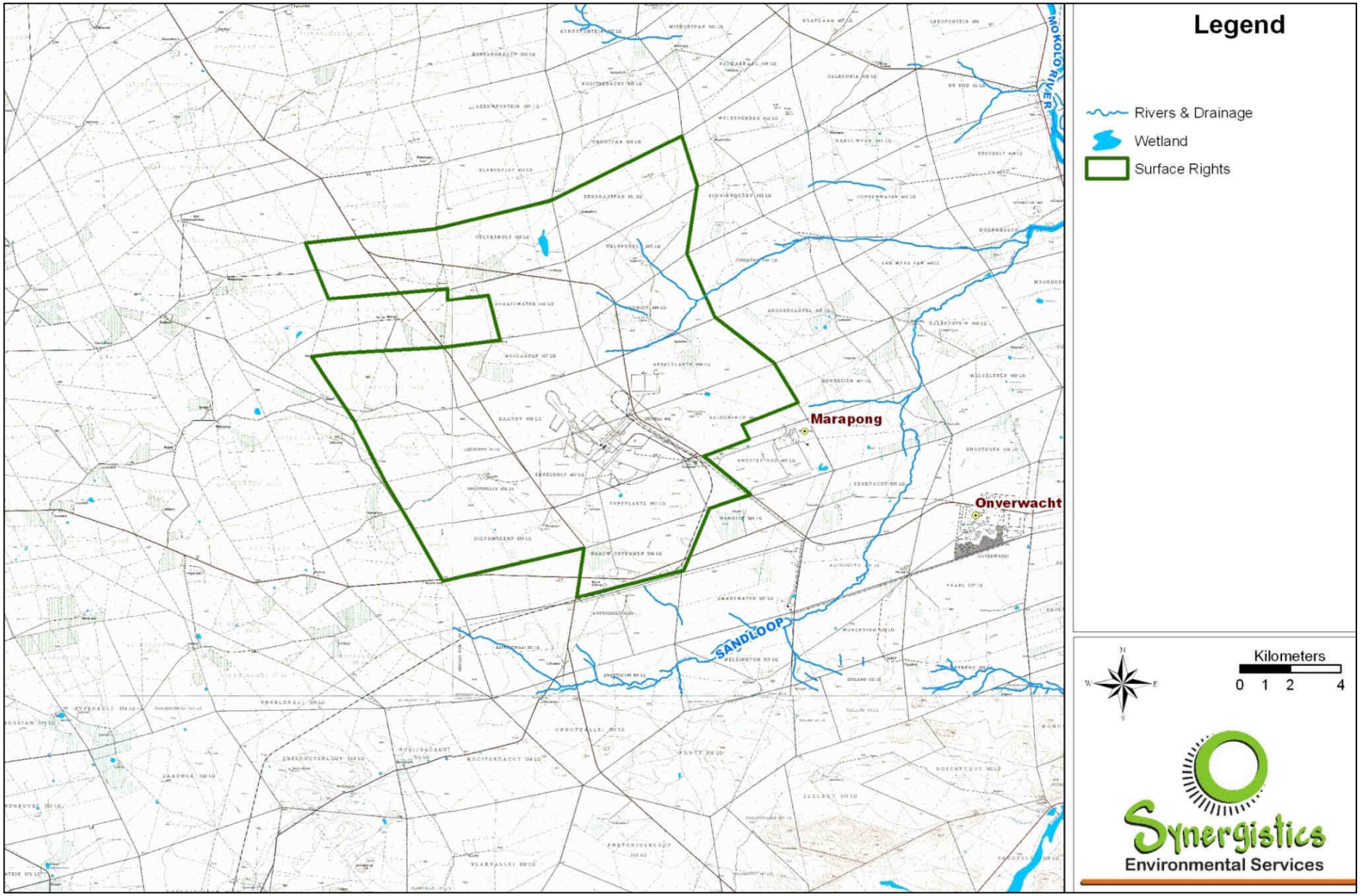


Figure 3.12: Surface Water Features in the Study Area

3.3.3 Surface Water Quality

The receiving water body is an important concept as it implies that aspects related to surface water, e.g. surface water users, need only be defined down to that point. The use of the aforementioned location as the receiving water body is motivated on the following basis (Jones & Wagener, 2012):

- By the time the water reaches the Mokolo River, it is required to be suitable for use for all of the expected uses (drinking water, agricultural, industrial and aquatic ecosystems). Thus, by achieving compliance in terms of these, no additional impacts are expected downstream of the Mokolo River.
- Beyond the confluence with the Mokolo River, the potential impact of the plant becomes small due to the water volumes in the catchment and the dilution effects.
- The total area of the Market Coke and Co-generation Plant site covers only 0.006% of the Mokolo River catchment and is therefore assumed to have a negligible potential impact on the catchment.
- The Market Coke and Co-generation Plant site is located within the greater Grootegeluk Colliery dirty water area. Any spillage of contaminated water from the site is collected in Grootegeluk Colliery's Bosbok Dam and a PCD (Jones & Wagener, 2012B).

3.3.3.1 Mokolo River and catchment quality

In 2006 a State-Of-The-Rivers report was written for the Mokolo River as the Mokolo River Catchment was prioritised as an area for study by Limpopo Environmental Affairs in 2002. The Mokolo catchment was found to be in a fair-to-good state with water quality through the study area considered to be good (Table 3.3. River health categories (source: DEAT, 2006)). However, pulsed releases from Mokolo Dam could possibly interfere with water temperatures within the lower reaches of the river, and the unseasonal flow patterns could also adversely affect the lower river system.

Table 3.3. River health categories (source: DEAT, 2006)

River Health Category	Ecological Perspective	Management Perspective
Good G	Ecosystems essentially in good state; biodiversity largely intact.	Some human-related disturbance but mostly of low impact.
Fair F	Sensitive species may be lost; lower abundances of biological populations are likely to occur, and/or higher abundances of tolerant or opportunistic species occur.	Disturbances associated with socio-economic development, such as: impoundment, habitat modification and water quality degradation.

3.3.3.2 Water quality around Market Coke and Co-generation Plant Project site

Sampling of the Existing Char Manufacturing Plant Pollution Control Dam (GES01 and GES02) (Figure 3.13) was carried out by Gondwana Environmental Solutions on 11 October 2010 and 16 March 2011, with analysis for selected inorganics and total hydrocarbons. As part of the surface water impact assessment, conducted by Jones and Wagener (2012B), a single water quality sampling run was also undertaken on 14 October 2011, when two grab samples were taken from the existing Char Manufacturing Plant PCD and Bosbok Dam (Figure 3.13). These were analysed for both inorganics and hydrocarbons. Please note that the water will not be used for drinking, but will be used in industrial processes. The drinking water standards have been used as a guideline of the water quality as there are no standards for industrial water. The composition may be slightly different when the runoff from the coke stockpile and water from the coke quench tower is added to the PCD water.

Figure 3.13: Surface Water Quality Monitoring Sample Locations.

The results of the water quality monitoring conducted by Gondwana Environmental Solutions (Gondwana, 2010), are detailed in Table 3.4 below. Values shaded in red exceed the SANS 241: 2011 Standard limits for drinking water.

Table 3.4: Surface water quality for the existing Char Manufacturing Plant, sampled by Gondwana (2010).

Parameter	SANS 241: 2011 Standard limits	Char Manufacturing Plant PCD			
		11 October 2010		16 March 2011	
Sample Code		GES01	GES02	GES01	GES02
pH (pH units)	≥ 5.0 to ≤ 9.5	6.56	6.59	7.22	7.17
Conductivity (mS/m)	≤170	207.1	206	260.7	261.4
Total Dissolved Solids (µg/L)	≤1200	1652	2190	2553	2224
Chloride (µg/L)	≤200	22.6	26.2	49.1	47.3
Nitrate (mg/L)	≤11	5.66	5.86	5.49	3.36
Sulphate (mg/L)	≤500	1115	1112	1904	1956
Aluminium as Al (µg/L)	≤300	<0.031	<0.031	<0.031	<0.031
Magnesium as Mg (µg/L)	≤70	106.69	110.04	68.62	66.09
Total Hydrocarbons (µg/L)		<1	<1	<1	<1

Levels of sulphate and magnesium were significantly above the upper limit prescribed for drinking water in SANS 241:2011 and thus would pose a health risk if it were consumed. However, magnesium levels were below the Standard limits in samples taken in 2011. Levels of conductivity, total dissolved solids and nitrate were elevated and also exceeded the Standard limits. Conversely, hydrocarbons tested were all less than 1 µg/L. According to Gondwana (2010), this result was unexpected, since a visual inspection of the dam showed that hydrocarbons were, at least, on the surface of the dam. The results of the water quality monitoring conducted by Jones and Wagener (2012B) are detailed in Table 3.5 below.

Table 3.5: Surface water quality for the existing Char Manufacturing Plant, sampled by Jones & Wagener (2011).

Parameter	SANS 241: 2011 Standard limits	Char Manufacturing Plant PCD	Bosbok Dam
Inorganics			
pH	≥ 5.0 to ≤ 9.5	8.7	8.1
Conductivity (mS/m)	≤170	370	290
Arsenic (mg/L)	≥ 0.010	0.0038	
Barium (mg/L)	NG	120	26
Cobalt (mg/L)	≥ 0.50	0.0026	0.0028
Molybdenum (mg/L)		0.012	0.0042
Nickel (mg/L)	≥ 0.07	0.0079	0.0072
Selenium (mg/L)	≥ 0.01	0.0092	0.012
Vanadium (mg/L)	≥ 0.2	0.0021	
Volatile Chlorinated Hydrocarbons	**Dutch Intervention Screening Guideline**		
Dichloromethane (µg/L)	0.2	0.8	-
Total Petroleum Hydrocarbons (TPH)			
TPH C10-C12 (µg/L)	15	13	
TPH C12-C16 (µg/L)	15	57	
TPH C16-C21 (µg/L)	15	54	
TPH C21-C30 (µg/L)	15	38	
TPH (sum C10-C40) (µg/L)	100	180	

Key: Screening Guidelines are according to the Dutch Intervention Limits.

Conductivity in both the PCD and the Bosbok Dam significantly exceeds the SANS standard, however this is not considered to be excessive considering the dams are designed to collect polluted water. A number of trace elements were detected at both the PCD and the Bosbok Dam, although none were found to exceed screening guidelines. Concentrations are generally lower in the Bosbok Dam than at the existing Char Manufacturing Plant, which will be adjacent to the Market Coke and Co-generation Plant and whose PCD will be utilised by the Market Coke and Co-generation Plant.

In terms of the organic constituents measured (petroleum hydrocarbons, volatile chlorinated hydrocarbons), South Africa does not have health risk based screening guidelines. The Dutch Intervention Limits were thus used for screening purposes. The screening guidelines for drinking water have been included with the data in Table 3.5.

As was expected, petroleum hydrocarbons and volatile chlorinated hydrocarbons were detected within the existing Char Manufacturing Plant PCD, with all measured parameters significantly exceeding the screening guideline values in the existing Char Manufacturing Plant PCD except for TPH C10-C12 (Table 3.5). Conversely, no hydrocarbons were detected within the Bosbok Dam, indicating that there is no overflow from existing Char Manufacturing Plant pollution control dam reporting to this dam. With the addition of the Market Coke and Co-generation Plant there will be overflow from the current PCD, therefore a PCD Extension is being built to accommodate the excess water to ensure no overflow enters the surrounding environment.

3.3.3.3 Contaminant sources

Major sources of potential surface water pollution should the unlikely event of spillage occur include:

- process or quenching water contained within the dirty water containment facility (silt trap and PCD) possibly containing high phenol concentrations; and
- recharge of contaminated water by means of seepage from the PCD and PCD Extension and any unlined storm water channels.

In addition, there are other potential surface pollution sources in the vicinity of the proposed Market Coke and Co-generation Plant, which are summarised in the table below. In order to protect the water quality in the environment, storm water control measures are currently and will continue to be in place. The management of storm water is further discussed in Chapter 6.

Table 3.6: Source Areas and Contaminants of Concern (ERM, 2012 *In* Jones and Wagener, 2012A) and (Jones and Wagener, 2012A)

Source Areas	Facilities
Hydrometallurgical plants	Existing Char Manufacturing Plant
Pollution Control Dams	Bosbok dam, Olifants dam
Contaminated water, hydrocarbons from Diesel, oil and lubricants used in machinery	Mine workshop areas, plant areas
Fine residue	Slimes dam
Coarse residue	Waste rock dumps 1 – 6, Coal stockpile area
Stockpiles	Char product
Stockpiles	Coke product

3.3.4 Mean Annual Runoff (MAR)

As illustrated in the figure below, the Mean Annual Runoff (MAR) in the study area is approximately 4.1 mm per year (AGIS, 2004) (Figure 3.14). The expected MAR for the site, the Sandloop River into which water from the study site drains, and the Mokolo River is presented in Table 3.7.

Table 3.7: MAR for catchments relevant to the Market Coke and Co-generation Plant (Jones & Wagener, 2012)

Description	Catchment area (km^2)	MAR ($m^3 \times 10^6$)	% of MAR at receiving water body
Char, Coke and Co-generation Plant catchment	0.555	0.004	0.001
Unnamed tributary of the Sand loop Stream at confluence with Mokolo River	70.78	0.52	0.17
Mokolo River at Limpopo River	8 395	312.3	100

Because of the dry climate, the dry weather flow (flow that is equalled or exceeded 70% of the time) is expected to be zero.

Peak flows were calculated based on the parameters of the upper catchment of the unnamed tributary where the proposed Market Coke and Co-generation Plant will be located. The catchment is small, with an area of 0.555 km^2 (Jones & Wagener, 2012). Table 3.8 presents the calculated peak flows for the catchment.

Table 3.8: Peak flows determined for the catchment draining past the Char, Market Coke and Co-generation Plants

Recurrence Interval	Peak flow (m^3/s)
1:2 yr	1.8
1:5 yr	2.6
1:10 yr	3.4
1:20 yr	4.5
1:50 yr	6.2
1:100 yr	8.0

Note that the Regional Maximum Flood (RMF) method is not applicable to catchments smaller than 1 km^2 and has therefore not been calculated here.

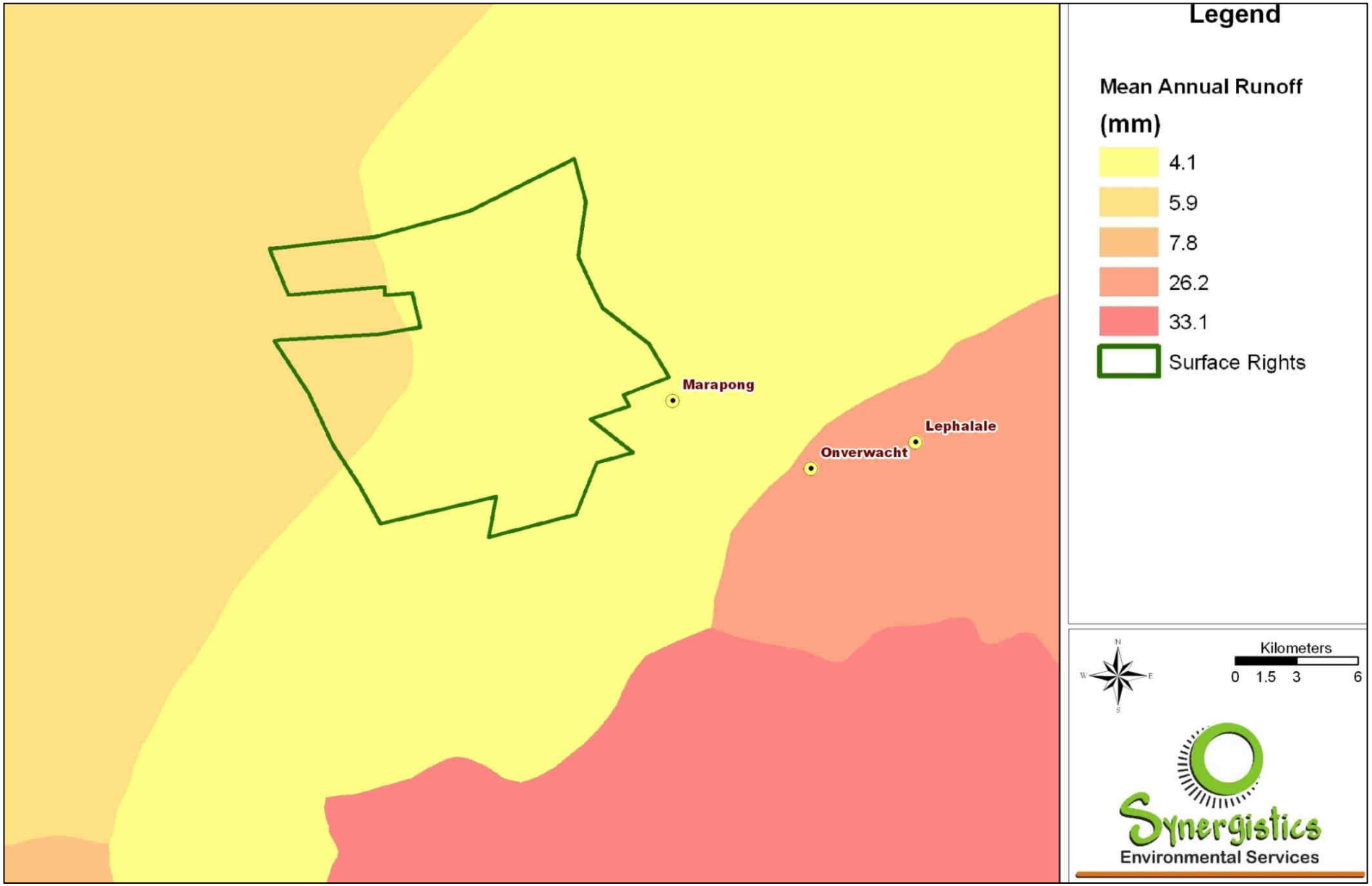


Figure 3.14: Mean Annual Runoff in the Study Area (AGIS Database, 2004)

3.3.5 Resource Class and River Health

3.3.5.1 Resource Class

The resource classification involved the assessment of the following ecological aspects:

- The presence of rare or endangered species,
- Habitat diversity,
- The importance of a river reach in providing connectivity between different sections of the river,
- The sensitivity of the reach to environmental changes.

The water resource, A42J catchment (where the Mokolo Key area is situated) has been classified by the DWA as an ecological management Class C – Good Management Class and Good Water Resource Class (DWAF, 2004). DWAF (2006), states that the present ecological state of the Mokolo River Catchment (A42) lies predominantly in a Fair to Good Ecological Class.

The DWAF 2004 '*Integrated water resource management: Guidelines for groundwater management in the areas, South Africa'* Report illustrates the relationship between the six distinct ecological management categories (EMC) and the management and water resource classes. These categories are also used to describe the present ecological status category (PESC). The table below (Table 1.3) captures the information relevant for EMC/PESC Class C (DWAF, 2004**b**).

Table 3.9. Illustration of the relationship between EMC/PESC and water resource class (Source-DWAF, 2004b)

MANAGEMENT CLASS	EMC/PESC	WATER RESOURCE CLASS
Excellent	A – (Un-modified/ natural)	Natural
Good	B- (Largely natural)	**Good**
Fair	**C - (Moderately modified)**	**Fair**
	D- (Largely Modified)	
	E- (Seriously modified)	Poor
	(Critically modified)	

DWAF (2006) added that while the Mokolo Catchment is currently in a Fair to Good state, increasing water demands within the catchment are likely to cause a downward trend in the overall status of the system.

3.3.5.2 River Health

The groundwater quality in much of the Mokolo Key Area is poor due to the coal and gas fields. However, the groundwater quality the North-Western part of the Mokolo Catchment (A42J) is generally good whereas the groundwater quality in the Northern part of the catchment is poor.

For surface water quality, as mentioned previously in section 3.3.3, the Mokolo River Catchment was found to be in a fair-to-good state of health (DEAT, 2006) (Table 3.10).

Table 3.10. River health categories (source: DEAT, 2006)

River Health Category	*Ecological Perspective*	*Management Perspective*
Good G	Ecosystems essentially in good state; biodiversity largely intact.	Some human-related disturbance but mostly of low impact.

Fair F	Sensitive species may be lost; lower abundances of biological populations are likely to occur, and/or higher abundances of tolerant or opportunistic species occur.	Disturbances associated with socio-economic development, such as: impoundment, habitat modification and water quality degradation.

3.3.6 Set Resource Class Objectives

According to DWAF (2004), the Mokolo catchment lacks a proper water quality management plan. The broad management objectives include gaining a better understanding of the current and potential future water requirements in the Mokolo catchments as well as the Mokolo key area (DWAF, 2004).

For the Limpopo Water Management Area (WMA), the resource quality objectives are described in the table below.

Table 3.11. Reserve and Resource Quality Objectives Strategy - General Strategy Applicable to Whole WMA (Source- DWAF, 2004)

Situation assessment	None of the river systems in the Limpopo WMA have been classified nor have the resource quality objectives been determined. The methodology for classifying the river systems is in the process of being developed nationally. Rapid Reserve determinations have been done for some of the rivers based on the license applications, but none have yet seen either intermediate or comprehensive determinations. A need for the Reserve in the river systems of the Limpopo WMA are discussed below: Mokolo River: The Mokolo River system is perennial. The flow regime in the lower reaches downstream of the Mokolo Dam has been modified by releases from the dam. Irrigators also abstract water downstream of the Mokolo Dam. To ensure that there is a balance between the irrigators requirements and ecological environment, Reserve determination for the river reach downstream of the dam should be conducted at an Intermediate level. The Ecological requirements of the Mokolo Key Area have not been determined in any detail, but the NWRS estimates the impact of the Reserve on the currently available yield at 17 million m^3/a. This can theoretically be supplied from currently available water although this would require a re-allocation from the Mokolo Dam and/or the curtailment to irrigation upstream of the dam.
Broad Management Objectives	This strategy seeks to ensure that all the river systems, their tributaries and reaches in the Limpopo WMA are classified according to Chapter 3 (sections 12-15) of the NWA and that the class and resource quality objectives have been determined for all or part of the river systems that have been considered significant. In addition this strategy seeks to prioritise the various main river systems in the Limpopo WMA in terms of Reserve determination.
Overall Strategic Approach	DWAF will do everything possible to set a stage for River Classification, determinations of the Resource Quality Objectives and Reserves. Once the river systems, reaches and tributaries have been classified and Resource Quality Objectives determined, the Department will determine the human & ecological Reserves in catchments where there is pressure to do so.
Actions, Responsibility & Priority	Prioritize the river systems with regard to Reserve determination. The following rivers should receive priority:- *Mokolo, Mogalakwena, Nzhelele and Nwanedi*. • Assemble the data that would assist in the classification of the river systems. Typically this would include aquatic ecosystems in each river reach, socioeconomic activities etc. • Once appropriate data has been assembled, classify the river systems, reaches and tributaries. • Once the methodology for classifying the river systems has been established, this should be applied to all systems. • Develop management guidelines and procedures for each river system • Liaise with all stakeholders to ensure that the concept of Reserve is well understood.

3.3.7 Surface Water User Survey

The majority of the area surrounding Grootegeluk Mine is utilised for cattle and game farming. No crop cultivation (either dryland or irrigation) occurs due to the sandy soils and relatively low rainfall. The surrounding landowners are heavily reliant on groundwater (boreholes) since surface water is only available for a short period after rainfall events. Some of the surrounding landowners are supplied with

water piped from the Mokolo Dam. Thus surface water use near the Market Coke and Co-generation Plant site is likely to be very limited. Only the Mokolo River itself may have enough surface water that could be used.

The water uses in the catchment broadly comprise of agricultural activities (>80%) industrial and mining activities (>10%), power generation and domestic water supply service sectors (municipalities) (<10%) (DWAF, 2005).

3.3.8 Sensitive Areas Survey

3.3.8.1 Sensitivity of vegetation and fauna on site

Natural Scientific Services (NSS) conducted a vegetation survey (NSS, 2010) of Grootegeluk Mine as part of an ecological impact assessment completed in 2010. The footprint of the proposed Market Coke and Co-generation Plant will be approximately 49.4 ha. However, the proposed site has been previously disturbed by coal stockpiling undertaken for many years and the biological environment of the site is completely transformed. The possibility of species or habitats of significance being found at the site are therefore considered negligible. The Market Coke and Co-generation Plant site is located within the Grootegeluk Mine and thus the land surrounding the plant is also highly disturbed through coal mining activities.

The Manketti Reserve, owned by Exxaro, is adjacent to the Grootegeluk mining area (refer to figure 3.15). The property was initially used for mixed livestock and game farming before the decision was made by the Ferroland Board to consolidate this valuable area into a single wildlife biosphere. The game fencing was completed in 2000, all livestock and related infrastructure were removed in 2001, and endemic game species such as sable antelope were reintroduced to the area. The reserve houses a variety of species, including a few endangered plants and animals. In 2008 the African and Giant bullfrogs were found for the first time. The Manketti Reserve should thus be included in the considerations of sensitive areas close to the Market Coke and Co-generation Plant Site.

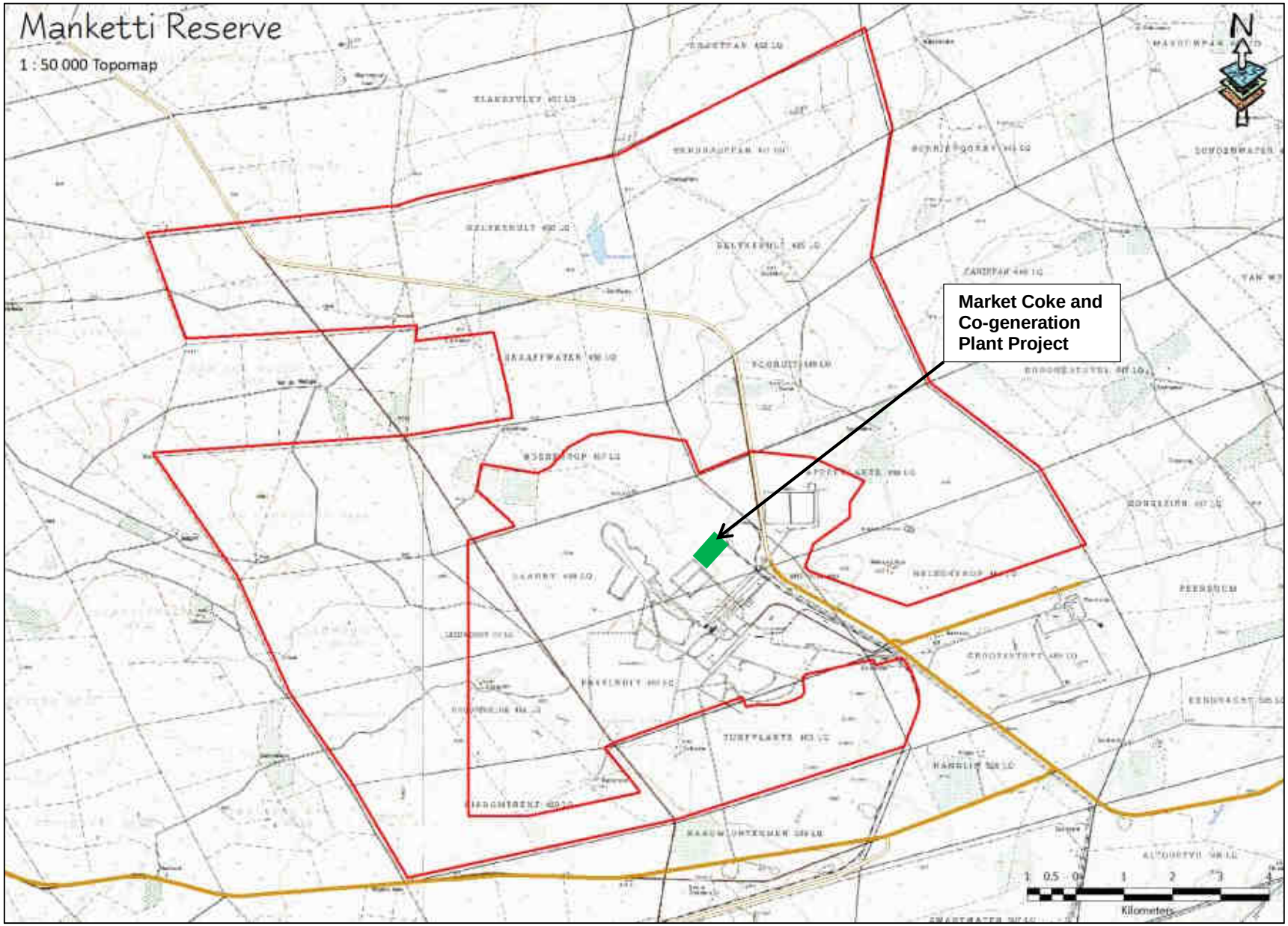


Figure 3.15: Locality map showing the Manketti Reserve (red outline) on Exxaro property, adjacent to the Grootegeluk Mine.

3.3.8.2 Regional Vegetation

The proposed site is in the Savanna Biome and falls entirely within the Limpopo Sweet Bushveld vegetation type (SVcb 19), as described by Mucina and Rutherford (2006). This Bushveld type is widely distributed in the region and is characterised by a grassy ground layer and an upper layer of woody plants (Mucina and Rutherford, 2006 *In* NSS, 2010). The conservation status of the Limpopo Sweet Bushveld is classified as Least Threatened. About 5% of the vegetation type has been transformed, mainly by cultivation. The area is good for game and cattle farming due to the high grazing capacity of sweet veld.

The proposed Market Coke and Co-generation Plant site falls entirely within the *Terminalia sericea – Digitaria eriantha* Kalahari sands woodlands vegetation unit which is the most widespread in the greater Grootegeluk study area (NSS, 2010). *Terminalia sericea* is the dominant woody species occurring in this vegetation unit while the grass layer is strongly dominated by *Digitaria eriantha* (NSS, 2010).

3.3.8.3 Plant Species of Special Concern

Sclerocarya birrea (Marula tree) is the only species found in the greater Grootegeluk study area that is listed as protected under the Limpopo Environmental Management Act, 1998. SANBI lists five plant species with a Red Data status as occurring in vegetation units identified in the greater study area. However, only one species, *Acacia erioloba* (Camel thorn tree), was identified in the greater Grootegeluk study area with the other four unlikely to occur there (NSS, 2010).

3.3.8.4 Faunal Species of Special Concern

As already indicated, the proposed Market Coke and Co-generation Plant site has been disturbed due to previous coal stockpiling activities. The site of the Market Coke and Co-generation Plant is still partially covered with a coal layer, which does not provide a suitable habitat for animal species. In addition, the location of the site adjacent to the proposed Market Coke and Co-generation Plant and close to other infrastructure, is also not a suitable habitat for animals.

However, faunal surveys conducted by NSS in 2008 and 2010 confirmed that a large diversity of faunal species occur in the surrounding area, including the Manketti Reserve which is adjacent to the Grootegeluk Mine.

Mammals

The study area supports a rich diversity of mammals. A large area of the greater Grootegeluk Study Area is managed as a nature reserve (Manketti Reserve) and has been stocked with a variety of large antelope and rhino species (NSS, 2010). The sex ratios and sizes of these populations are managed intensively to maintain a diversity of species and optimise the economic performance from the area (NSS, 2010). An impressive diversity of smaller mammals survives alongside the managed populations of larger mammals (NSS, 2010). These include carnivores, some of which thrive due to the significant conservation area with limited fragmentation by fences, roads and mining development (NSS, 2010).

A desktop study conducted by NSS (2010) identified 106 mammal species that can possibly be present in the region, of which 30 are Red Data species (NSS, 2010). The total mammal species identified represents a very large 63% of the provincial diversity of mammals (NSS, 2010). During their field survey, NSS (2010) identified 48 mammal species in the greater Grootegeluk study area, of which eight were red data species (Table 3.12). Sixteen of the 48 mammal species identified are considered to occur as managed or introduced populations.

Table 3.12: Red Data species identified in the Greater Study Area (NSS, 2010).

Species	Common Name	Red Data Status
Tatera leucogaster	Bushveld gerbil	data deficient species
Pipistrellus rusticus	Rusty pipistrelle	near threatened
Manis temminckii	Ground pangolin	vulnerable
Parahyaena brunnea	Brown hyaena	near threatened
Acinonyx jubatus	Cheetah	vulnerable
Diceros bicornis	Black rhinoceros (northeastern race)	vulnerable
Damaliscus lunatus	Tsessebe	endangered
Hippotragus niger	Sable	vulnerable

Birds

A potential of 394 bird species can possibly be present in the proposed areas of the development (Robert's, 2003 *In* Synergistics, 2006). Of the 394 birds recorded in the region, one is listed as endangered, namely the Saddle-billed Stork (*Ephippiorhynchus senegalensis*), 11 are listed as not threatened, 14 are listed as vulnerable species and 49 are listed as endemic species. A total of 27 Red Data species and 47 endemic species are listed by Robert's, 2003 *In* Synergistics, 2006 and can possibly be present at any given time.

During two field visits conducted by NSS in 2010, 94 bird species were identified (NSS, 2010). However, a combined list of birds including species from an adjacent area identified in a previous survey (NSS, 2008) has generated a list of 159 bird species for the greater study area. NSS confirmed the presence of three Red Data species in the greater study area, which include the White-backed Vulture (*Gyps africanus*) listed as vulnerable, the Kori Bustard (*Ardeotis kori*) also listed as vulnerable, and the Red-billed Oxpecker (*Buphagus erythrorhynchus*), listed as near threatened (Barnes, 2000 *In* NSS, 2010).

Reptiles and Amphibians

The Limpopo Province supports at least 148 reptile species and 46 amphibian species with 11 being endemic to the province (State of the Environment Report Limpopo, 2003 *In* NSS, 2010). Potential species occurring in the greater study versus those identified during a survey conducted by NSS (2010) are listed in Table 3.13.

Table 3.13: Numbers of faunal species (families for invertebrates) identified in the greater Grootegeluk Study Area (NSS, 2010).

Animal Group	Potential Species	Species Recorded	Percentage Representation
Snakes	33	9	27%
Agamas, chameleons & lizards	37	12	32%
Geckos	10	4	40%
Crocodile	1	0	0%
Terrapins and tortoises	5	3	60%
Frogs	23	13	57%
Total	109	41	38%

The greater study area was found to be particularly rich in reptile species, with 28 species or 33% of the potential diversity has been shown to be present in the area during three field surveys. One reptile species identified in the area, namely the Southern African python (*Python natalensis*), is listed as

vulnerable in the IUCN list of threatened species (Friedmann & Daly, 2004 *In* NSS, 2010)
In all, 13 amphibian species, representing a 57% of the potential amphibian fauna, was confirmed as being present in the greater study area. Two conservation important amphibian species – *Pyxiecephalus adspesus* (Giant bullfrog) and *P. edulis* (African bullfrog), have been reported to occur in the clay pans in the west and south regions of the greater study area (Peter Scott *pers. comm.* in NSS, 2010). The Giant Bullfrog is listed as near threatened while the African Bullfrog is listed as a species of least concern in the IUCN Red Data species list.

3.4 Groundwater

A groundwater specialist study was undertaken for this project in order to determine the baseline groundwater environment and to assess the potential impacts of the Market Coke and Co-generation Plant on the groundwater. This study is contained in Appendix 4.

3.4.1 Aquifer Characterisation

3.4.1.1 Regional Aquifers

The main feature from a geohydrological perspective is the Daarby fault, which divides the area into two major water compartments, described historically as the Northern and Southern water compartments (ERM, 2012 *In* Jones and Wagener 2012A). The Market Coke and Co-generation Plant site is situated on the Northern Compartment and is underlain by the Letaba and Clarence formations.

3.4.1.2 Letaba Formation Aquifer

This aquifer has the highest sustainable yields and transmissivity values as a result of fracturing and weathering (ERM, 2012 *In* Jones and Wagener 2012A). Sustainable yields of this aquifer are often above 2 L/s and ranging up to 12.7 L/s, it was postulated that the highest mobility of contaminants would be associated with this layer (ERM, 2012 *In* Jones and Wagener 2012A).

3.4.1.3 Clarence Formation Aquifer

The Clarence Formation has a lower transmissivity (0.01 – 10 m^2/d) than the Letaba Formation and is expected to be less conductive in terms of contaminant transport (ERM, 2012 *In* Jones and Wagener 2012A). It exhibits typical mounding in areas below unlined surface water features. Contamination is expected to be localized in relation to potential surface pollution generating areas. Faulting, fractures and joints within this unit will be more conductive to the movement of groundwater and transportation of possible contaminants.

3.4.1.4 Ground Water Levels

The groundwater level at the existing Char Manufacturing Plant site is more than 14 mbgl with an average depth of approximately 20 mbgl (ERM, 2012 *In* Jones and Wagener 2012A). The regional groundwater table can be seen in Figure 3.16.

3.4.1.5 Ground Water Receptors

Groundwater in the Lower Mokolo catchment area (catchment A42J), is used mainly for domestic supply, limited watering of gardens and livestock watering. Groundwater use in the catchment is relatively low due to the low aquifer yields as well as the abundant surface water available in the region. The low population density and low aquifer yields limit large-scale abstraction for irrigation and/ or other uses. As a result, the groundwater resources in the region are fairly underutilised (Jones and Wagener, 2012A).

The main receptor in the immediate vicinity of the Market Coke and Co-generation Plant is the Grootegeluk Mine, which extracts groundwater through dewatering boreholes in the Letaba Basalt for use in dust suppression and the mine's processing plants (Jones and Wagener, 2012A).

Groundwater contribution to streams in Lower Mokolo catchment area (catchment A42J) is zero (DWAF, 2009). This implies that contaminants in the groundwater are highly unlikely to impact on streams in the area.

3.4.2 Groundwater Quality

There is currently an on-going groundwater monitoring protocol in the vicinity of the adjacent existing Char Manufacturing Plant which will be applicable for the Market Coke and Co-generation Plant. Currently three boreholes are monitored annually.

3.4.2.1 Contaminant Sources

The major sources of potential groundwater pollution associated with the proposed Market Coke and Co-generation Plant include (Jones and Wagener, 2012A) (Figure 3.17):

- Contaminated storm water runoff;
- Process or quenching water contained within the dirty water containment facility (silt trap and PCD) possibly containing high phenol concentrations; and
- Recharge of contaminated water by means of seepage from the PCD and any unlined storm water channels.

Historical Data

The site is located in an area that has been previously disturbed by mining and other related activities. Historical Data exists for the inorganic chemistry of groundwater; however, there is no data available for the impact of the presence of hydrocarbons. As part of the groundwater study, the hydrocarbon impact was assessed up and down the gradient of the site (Refer to Appendix 4 for the Groundwater Study).

The groundwater quality results have been compared to the South African National Standards (SANS) 241 for drinking water (2011). This SANS standard is representative of water that is deemed to present an acceptable health risk for lifetime consumption (this implies an average consumption of 2 L of water per day for 70 years by a person that weighs 60 kg) (SANS 241-1, 2011).

Groundwater Chemistry

The inorganic and trace element qualities are presented in Table 3.14 (Jones and Wagener 2012A). The groundwater chemistry has been compared to the SANS 241 (2011) Guideline for Drinking Water. The groundwater results can be summarised as follows:

- The pH measured in the boreholes in May 2012 was generally Neutral, the boreholes that had low pH values were located directly near to waste sources.
- EC and TDS concentrations were elevated in most of the boreholes
- SO_4 concentrations were also elevated, this can be attributed to the mining activities in the area surrounding the proposed Market Coke and Co-generation Plant site.
- The calcium, magnesium and nitrate concentrations were also elevated in similar area as the elevated SO_4 concentrations.

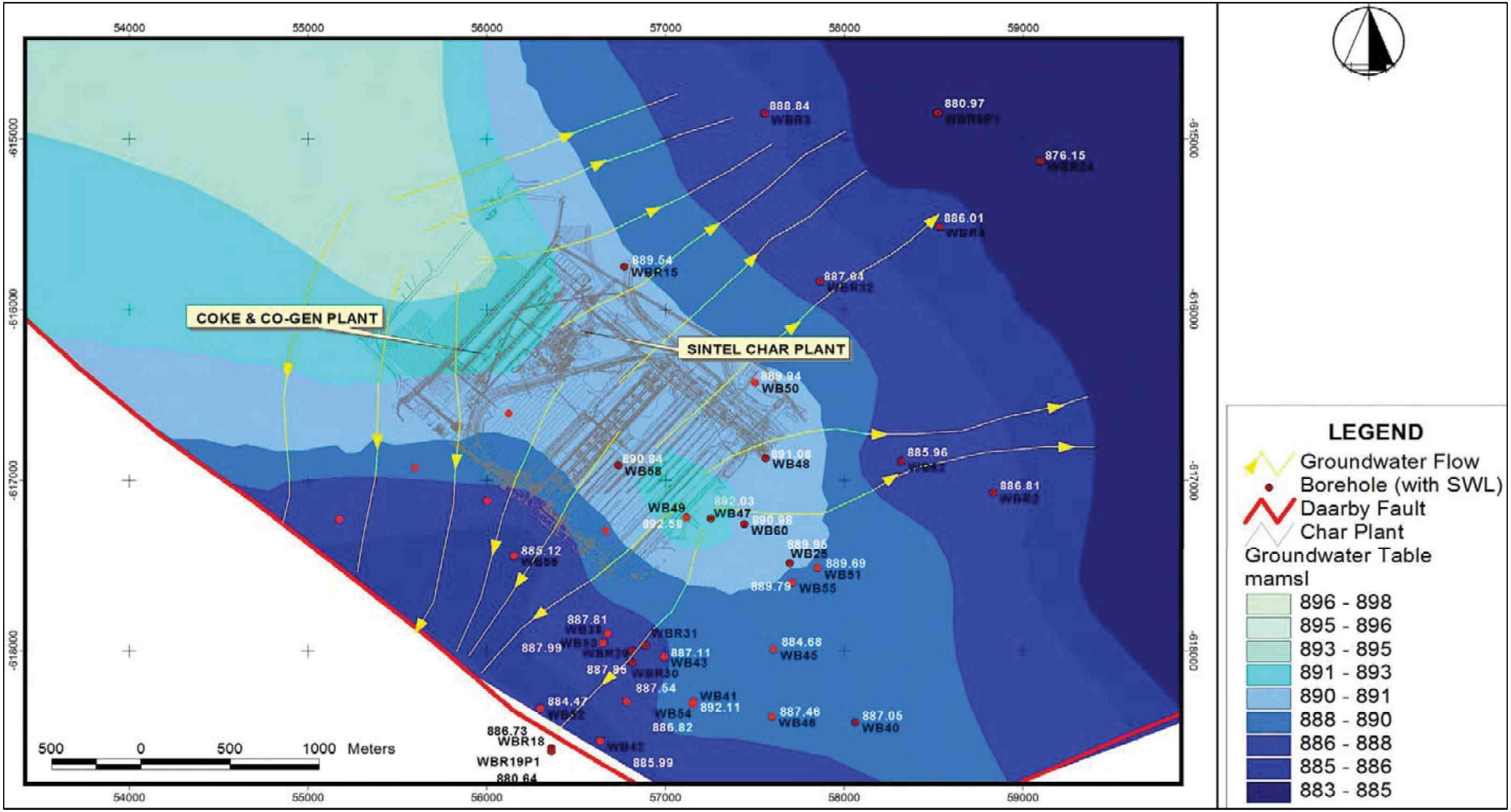


Figure 3.16: Groundwater Table around the proposed Market Coke and Co-generation Plant and positions of sampling boreholes (Jones and Wagener, 2012A)

Figure 3.17: Position of Potential Groundwater Pollution Sources (Jones and Wagener, 2012A)

Table 3.14: Table of the Groundwater Chemistry of boreholes around the area of the proposed Market Coke and Co-generation Plant Project.

BH ID	Date	pH	EC	TDS	Alkalinity	Ca	Mg	Na	K	Cl	SO4	N03	F	Fe	Mn	NH4
SANS 241 2011		5-9.7	170	1200	NG	NG	NG	200	NG	300	500	11	1.5	2	0.5	1.5
WB25	16 May 2012	7.68	34	221	157	22.7	20.5	5.7	10.8	6.14	2	1.30	<0.1	<0.05	<0.05	14.90
WB40	16 May 2012	8.37	49	319	180	13.4	27.4	67.2	1.4	33.50	54	<0.3	<0.1	<0.05	<0.05	<2.5
WB41	16 May 2012	7.91	273	1770	79	347.0	283.0	57.1	2.8	39.50	1820	21.80	1.18	<0.05	<0.05	<2.5
WB45	16 May 2012	8.34	79	512	254	60.0	80.4	24.9	3.9	10.30	219	<0.3	0.46	<0.05	<0.05	<2.5
WB46	17 Jan 2012	8.25	157	1670	205	173.0	154.0	39.8	4.7	33.00	719	52.10	0.87	<0.05	<0.05	<2.5
WB47	16 May 2012	5.67	292	1900	5	317.0	344.0	51.3	10.6	43.40	2070	5.28	<0.1	<0.05	1.79	<2.5
WB48	16 May 2012	6.75	140	907	186	45.3	153.0	51.5	28.1	55.50	579	4.46	<0.1	<0.05	0.46	20.00
WB49	17 Jan 2012	7.90	439	3020	171	488.0	293.0	51.2	8.2	42.70	2020	38.70	0.10	<0.05	<0.05	<2.5
WB50	16 May 2012	7.97	260	1690	115	300.0	232.0	124.0	5.7	74.90	1550	6.20	0.11	<0.05	<0.05	<2.5
WB51	16 May 2012	8.07	278	1810	173	232.0	352.0	72.9	10.6	79.90	1690	<0.3	0.14	<0.05	<0.05	<2.5
WB52	16 May 2012	7.84	211	1370	250	219.0	157.0	107.0	6.6	44.90	1020	62.90	0.30	<0.05	<0.05	<2.5
WB55	16 May 2012	8.03	288	1870	161	399.0	309.0	49.8	7.0	37.10	1930	4.84	0.17	<0.05	<0.05	<2.5
WB56	16 May 2012	8.02	163	1060	183	204.0	119.0	61.8	3.5	28.10	774	60.90	0.15	<0.05	<0.05	<2.5
WB58	16 May 2012	8.10	294	1910	164	423.0	300.0	51.3	3.6	27.20	1970	23.90	0.28	<0.05	<0.05	<2.5
WB60	16 May 2012	8.08	273	1770	104	280.0	340.0	43.7	10.7	36.80	1850	0.69	0.12	<0.05	0.22	<2.5
WB62	16 May 2012	7.44	164	1060	53	160.0	181.0	56.4	4.1	31.20	1070	5.03	<0.1	<0.05	<0.05	<2.5
WBR15	16 May 2012	7.37	15	96	25	20.5	4.4	2.3	1.4	3.69	42	1.71	0.37	<0.05	<0.05	<2.5
WBR18	16 May 2012	7.84	191	1240	77	288.0	123.0	49.8	16.9	31.70	1150	2.25	0.55	<0.05	0.06	<2.5
WBR19P1	16 May 2012	7.84	97	627	306	117.0	31.7	61.6	18.2	48.60	194	17.00	0.82	<0.05	<0.05	<2.5
WBR19P2	16 May 2012	7.07	145	941	488	142.0	61.1	86.7	21.8	83.40	262	<0.3	0.59	0.08	0.74	18.00
WBR2	16 May 2012	8.30	62	402	330	18.7	53.9	57.3	3.2	31.70	11	11.10	<0.1	<0.05	<0.05	<2.5
WBR24	16 May 2012	8.00	40	258	84	17.9	11.7	43.7	9.1	75.80	9	0.34	<0.1	<0.05	<0.05	<2.5
WBR29	16 May 2012	8.13	89	577	97	33.5	75.6	58.8	1.0	42.00	351	1.22	<0.1	<0.05	0.07	<2.5
WBR3	16 May 2012	8.14	277	1800	219	254.0	195.0	212.0	28.8	156.00	1420	1.21	0.19	<0.05	0.30	<2.5
WBR30	16 May 2012	6.97	97	629	10	69.8	53.7	75.5	2.4	27.40	482	10.20	<0.1	<0.05	1.64	<2.5

BH ID	Date	pH	EC	TDS	Alkalinity	Ca	Mg	Na	K	Cl	SO4	N03	F	Fe	Mn	NH4
SANS 241 2011		5-9.7	170	1200	NG	NG	NG	200	NG	300	500	11	1.5	2	0.5	1.5
WBR31	16 May 2012	8.42	102	663	236	29.5	127.0	42.4	1.4	19.20	399	<0.3	0.32	<0.05	0.08	<2.5
WBR32	16 May 2012	8.11	56	367	259	43.9	27.6	50.4	4.6	56.80	3	1.09	0.24	<0.05	<0.05	<2.5
WBR38	16 May 2012	7.52	347	2260	454	141.0	115.0	410.0	4.3	958.00	120	<0.3	0.32	0.72	0.46	19.80
WBR39	16 May 2012	8.67	70	455	425	63.4	78.5	41.1	0.7	29.30	16	0.38	0.63	<0.05	<0.05	<2.5
WBR4	16 May 2012	6.04	312	2030	7	409.0	311.0	79.9	18.4	72.40	2220	<0.3	0.11	1.31	6.22	<2.5
WBR40	16 May 2012	8.02	144	938	199	149.0	89.8	85.0	6.6	61.50	578	36.70	0.22	<0.05	<0.05	<2.5
WBR5P1	16 May 2012	8.07	69	446	299	64.3	30.6	47.1	10.2	66.90	19	2.81	0.17	<0.05	<0.05	<2.5
WBR8	16 May 2012	8.19	240	1560	286	8.1	16.7	505.0	9.5	515.00	213	<0.3	0.23	<0.05	<0.05	<2.5

Note: NG = No Guideline

A Piper Diagram for the groundwater study was created to interpret the groundwater chemistry data. The Piper diagram found that there was no apparent trend and that the character of the water sampled was mainly determined by the sample proximity to mining infrastructure rather than the aquifer type.

3.4.3 Hydrocensus

3.4.3.1 Groundwater Use and Users

The groundwater resources in the Limpopo WMA are largely used for irrigation and rural communities and to a lesser extent municipalities, mining and livestock.

A hydrocensus targeted boreholes located around the proposed extension area. The hydrocensus was undertaken to monitor the water within the proposed Market Coke and Co-generation Plant Project site and the surrounding area, extending 4km from the proposed Site (Figure 3.16 for borehole positions). Three additional boreholes were suggested for the site (ERM, 2012 *In* Jones and Wagener 2012A). The boreholes around the proposed Market Coke and Co-generation Plant site and the three proposed boreholes are depicted in Figure 3.18.

3.4.4 Potential Pollution Source Identification

Potential sources of water pollution have been identified and these have been described in further detail in Chapter 6 below. An assessment of the impacts of the potential pollution sources has been included in Chapter 4. Potential pollution sources are:

- Pollution control dam (PCD);
- Proposed PCD Extension;
- Silt traps;
- Proposed Coke stockpile;
- Contaminated soil on site; and
- Plant workshops and wash bays, existing Char Plant and proposed Market Coke and Co-generation Plant.

3.4.5 Groundwater Model

The details of the groundwater modelling can be found in the geohydrological report which was completed for the project (refer to Appendix 4).

Seepage modelling was carried out to quantify seepage volumes and qualities from potential contamination sources of the proposed plant area. The seepage modelling was based on monitoring data for the PCD and leachate data for char, however for coal no sulphate leachate concentrations were available and had to be estimated. The hydraulic properties of the foundation materials of the potential contamination sources are heterogeneous, composed of variable soil and rock as well as lining materials. In such systems where the hydraulic properties and groundwater depths are variable, numerical models are preferred to solve the seepage problem. Thus, a numerical model was undertaken.

A numerical groundwater model and transport model was used to simulate potential impacts of the project. The estimated impact of artificial recharge due to the seepage from the Char plant was considered to be minimal.

A solute transport model was also done to model the movement of potential contaminants into and through the groundwater. The sulphate concentrations in the groundwater in the vicinity of the existing Char plant are below ground concentrations with maximum concentrations below 10 mg/l. The total

amount of sulphate released until the end of mining (2065) for the entire facility is approximately 15 tons, therefore the expected groundwater impacts is low.
Full results of the groundwater model are presented in Chapter 4 where the possible impacts are described and assessed. It should be noted that the main limitations of the groundwater model are:

- Aquifer parameters applied are based on limited aquifer tests.
- Most sensitive model parameter is recharge, which was estimated using literature values and model calibration.

Since there is lack of site specific data, values for hydraulic conductivity of the modelled materials were solely based on literature values for similar materials. These, however, can vary over several orders of magnitude depending on site specific conditions. The confidence of the modelling results is low since the seepage rates are based on the results of a low confidence seepage model.

In order to increase the confidence of modelling ERM (ERM, 2012 *In* Jones and Wagener, 2012A), recommended that emphasis be put on a robust monitoring protocol in order to identify potential impacts of the proposed project on the groundwater environment.

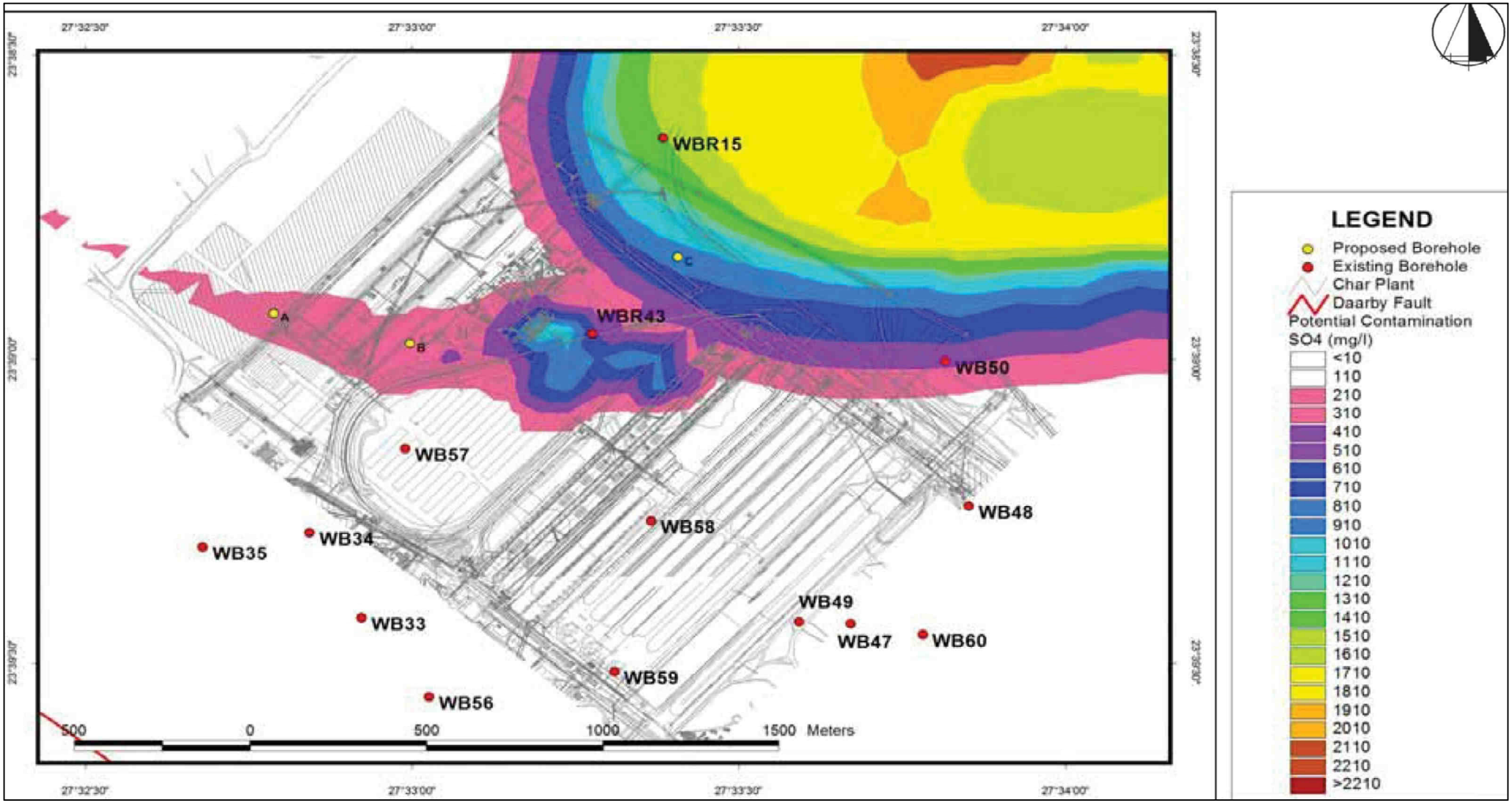


Figure 3.18: Monitoring Boreholes (red) in the vicinity of the Proposed Market Coke and Co-generation Plant Project with proposed additional boreholes (yellow) (Jones and Wagener, 2012A)

3.5 Socio-economic Environment

3.5.1 Regional Economic Context

The Waterberg District Municipality is a well-known tourist destination with an internationally recognised Biosphere Reserve and the Nylsvley Nature Reserve that has been accorded Ramsar Convention on Wetlands status. The district is one of the major mining regions within South Africa and has a population of approximately 596 092 (Statistics South Africa, 2007). The Waterberg district has a high proportion of people employed in the mining and agricultural sectors (Waterberg District Municipality: LED).

3.5.2 Local Economic Context

The Lephalale Local Municipality has a population of 80 141 (Statistics South Africa, 2007). Lephalale has approximately 49 proclaimed townships, 38 villages, and a number of service points and farm areas. All the townships are located around Lephalale town with the exception of Thabo-Mbeki, which is about 85km away in the north-eastern site in the location of the rural villages. Lephalale has been identified by Limpopo Employment Growth and Development Plan as a petrochemical cluster and has attained the status of national development node. More than 40% of the total coal reserve in South Africa is in the Waterberg coalfields.

The Market Coke and Co-generation Plant area is adjacent to the Grootegeluk Mine. There will be a spurt of economic development in Lephalale Local Municipality related to mining and energy generation due to the expansion of coal mining activities.

3.5.3 Employment and Underemployment

Lephalale has an unemployment level of 15.5%. This low unemployment rate needs to be balanced against the relatively high percentage (42.5%) of the municipality's population that is not economically active. Just over 45% of the households in the Lephalale local municipal area have an income of less than R9 600 per annum; however, the situation in the various wards differs considerably with those wards close to the Grootegeluk Mine, Eskom power stations and town of Lephalale.

The majority of people that are employed are in in elementary occupations (48%). The second major occupation category is skilled agricultural workers (13%). This structure shows that there is vulnerability of the workforce in the context of expanding medium to high technology industrial activities in the local economy.

3.5.4 Social Infrastructure

3.5.4.1 Education

There are 66 primary and secondary schools in the Phaklala south and North circuit areas alone. There are a further 20 schools on various farms and Ellisras circuit area. There are three secondary schools in Maropong, Ellisras. The population growth has resulted into the building of a fourth high school in Onverwacht. There is an FET college in Onverwacht and caters for training needs for the whole Waterberg district Municipality. Four secondary schools are located in Mogalakwena municipality but fall within Lephalale circuit area.

High levels of illiteracy make it difficult for local communities to enter skilled and semi-skilled employment markets. Most of the secondary schools do offer maths and science subjects which is a requirement for the entry into engineering careers. The lack of technical high schools limits career paths for students at an early age.

3.5.4.2 Housing

In Limpopo, the percentage of people living in informal dwellings is close to 6%, which is one of lowest in South Africa, with South Africa having 14.4%. Limpopo (as well as the Western Cape) has the highest percentage of municipalities having their households living in formal dwellings exceeding the national average of 70.6%. Limpopo also has the highest percentage of households owning their dwelling (69.2%) which exceeds the national average (61.6%) (Statistics South Africa, 2007). Lephalale Municipality has 80 141 people and 23 745 households which is likely to increase with the increase of work demand in the area.

3.5.4.3 Water and Sanitation

Mokolo dam is the main source of water in Lephalale. It delivers 16 million cubic metres of water per annum to three major customers of which Lephalale Municipality receives 22%. In the Lephalale Local Municipality 32.8% of the households have flush toilets, 16.8% Ventilation Improved Pit latrines, 44.3% have Pit toilets, with 6.1% of households not having any toilets. More than 50% of the households do not have hygienic toilets. Wastewater Treatment works needs an additional 10 ML/d capacity to meet current and future demands in the area.

27.5% of households have piped water in their dwelling, 14% have piped water in their yards, 22.6% have water less than 200 m away from their dwelling and 20.5% have water more than 200 m from their dwelling. 15% of the households have no formal piped water (Lephalale Integrated Development Plan for 2011/2012). The Department of Water Affairs has negotiated the upgrade of the Mokolo pipeline to meet the projected water needs with Exxaro, Eskom and the Lephalale Local Municipality.

3.5.4.4 Health Facilities

There are three hospitals (two public and one private) and six clinics in the Municipal area and three mobile clinics. The Marapong clinic requires upgrading to provide adequate service for the population, which has grown threefold compared to when the clinic was originally built. The provision of health services in urban Lephalale is adequate. However, the health sector in Lephalale is faced with several problems, and these include:

- Poor clinic services
- Lack of medical specialists and qualified nurses
- No public clinic in Onverwacht
- Overnight facilities needed for patients that are referred to Lephalale hospital
- Problems with the transport of state patients from rural areas to specialist services in Polokwane
- Need for public participation in HIV/Aids and TB awareness programmes

4. QUANTITATIVE RISK ASSESSMENT

4.1 Safety, Health, Environment and Quality Policy

4.1.1 Safety

Exxaro's safety and sustainable development governance model's minimum standards include meeting legislative requirements. The risk management systems and processes are then modelled around key risks for implementation at operational level. A risk-based approach also directs the way resources are allocated and used in the group to ensure on-going progress towards and beyond legal compliance (Exxaro, 2012). The safety plan that Exxaro operates with involves:

- **Leadership in making safety a way of life**: Leaders setting the example of safe behaviour by being directly involved in safety visits and ensuring compliance to safe work practices.
- **Zero-tolerance approach**: Introducing the 13 zero-tolerance safety rules that are a part of every employee's conditions of service. Employees who violate or ignore these rules are investigated and disciplinary action taken where necessary. This ensures that Exxaro effectively protect the lives of employees.
- **Knowledge — training for life:** Establishing a standard safety training programme across the group, for all job categories. Training is an on-going sustainable process to ensure every employee can identify and respond to a dangerous situation.
- **Identifying risks — formal process**: Reinforcing the need to take two minutes to conduct a mini-HIRA — a task that could prevent injury or save a life by becoming a conscious action, not just a thoughtless habit. The mini-HIRA standard is revised and training material developed to ensure all employees understand how to conduct one.
- **Communication — daily**: Talking about safety and having the tools to keep safety at top-of-mind awareness are key to ensuring safety practices become a way of life for group employees

Exxaro has a policy in place that details the group's approach to identifying, preparing for and responding to emergency situations affecting employees and surrounding communities. This spans all known types of emergency including fire, flood, bomb threats etc. (Exxaro, 2012).

Exxaro's ultimate target is Zero injuries and therefore Zero Fatalities. To achieve this they have an incremental target of 30% improvement in safety performance every year. They aim to achieve this through stringent application of management protocols, programmes and systems. Formal management-worker health and safety committees are in place at all operations, and meet regularly to ensure they reach their targets (Exxaro, 2012).

4.1.2 Health

Exxaro employees are made aware of their individual roles in preventing occupational diseases. They are made aware of hazards in the work environment, and the risks these pose to their personal health (Exxaro, 2012). In Exxaro's approach (from Exxaro, 2012):

- Health risks are identified, quantified and monitored through a ventilation and occupational hygiene surveillance programme,
- Employee health status is checked through the medical surveillance programme,
- Employees are:
    - Encouraged to be vigilant about conditions that could affect their own safety and health or that of their colleagues,
    - Provided with information on the health implications of exposure to various workplace risks,
    - Made aware of measures that should be taken for them to maintain their health.
- The exposure risk to workplace hazards is managed through a hierarchy of controls by:
    - Eliminating the hazard at source,
    - Substituting equipment that generates the hazard,
    - Controlling levels of exposure by moving employees out of the work area or providing personal protective equipment.

Employees are also made aware of how occupational diseases affect quality of life and loss of potential income and are encouraged to comply with mitigation measures in the workplace. In addition an interdisciplinary collaboration team between the health specialists and disciplines such as technology, information management, human resources and supply chain management has been established

(Exxaro, 2012).

4.1.3 Environment

Exxaro's core focus is on conserving natural resources and reducing the burden of pollutants on the environment by:

- Complying with all applicable environmental legislation — as a starting point. Their aim is to exceed compliance.
- Developing innovative policies and programmes for addressing environmental impacts.

All of their operations have Environmental Management Programmes as required under the Mineral and Petroleum Resources Development Act (MPRDA) and the National Environmental Management Act (NEMA). Exxaro also adopts the precautionary approach recommended by NEMA in evaluating the environmental impacts of business opportunities (Exxaro, 2012). Exxaro's desirable current and future state includes:

- Sustainable ecological systems at all Exxaro operations,
- Stable rehabilitation fund with a gradual decline in environmental liabilities as these liabilities are addressed during active operation,
- Full environmental compliance to sustainable development requirements ,
- No asset risk and reduction in land-holding costs.

Sustainable development issues are central to Exxaro's business, particularly the use of natural resources like water, air, biodiversity and land. Using these responsibly means:

- Ensuring all activities are properly authorised,
- Using energy and water as efficiently as possible,
- Ensuring activities are conducted responsibly, from the twin perspectives of compliance and natural resource use.

4.2 Objectives and Strategies

4.2.1 Objectives

The IWWMP has been compiled to achieve the following objectives:

- To provide Market Coke and Co-generation Plant with a document detailing water and waste related activities on site;
- To provide an ecological baseline for the current state of the environment;
- To assess the significance of potential impacts on the environment due to water uses and waste generating activities;
- To develop a management plan for protection of water resources; and
- To provide Market Coke and Co-generation Plant with a groundwater and surface water monitoring system.

4.2.2 Strategic Actions of the IWWMP

The strategic actions of the IWWMP will include:

- Establishment of the appropriate structures at corporate level and at the plant's operational level;
- Train and communicate with all incumbents to align with Exxaro Reductants' vision;
- Develop action plans for implementing water savings measures and targets;
- Commit and drive towards continuous improvement of all water systems; and
- Establish appropriate measurement and reporting systems.

4.3 Key Performance Areas and Indicators

Due to the fact that this is being built adjacent to another Plant, the initial performance indicators will be in line with the design specifications of the original and associated infrastructure. The objective will be to stay within the specifications designed for the following:

- Water recycled from the PCD;
- Dirty and clean storm water separation;
- Water usage at the plant;
- Waste treatment, storage and disposal; and
- Water used for dust suppression.

These indicators will be managed, and the drive will always be to optimise all water uses and waste management at the plant.

4.4 Methodology Followed for Impact Assessment

4.4.1 Impact Ranking Criteria

The criteria used for assessing the significance of the water-related impacts are given in Table 4.1. The impact assessment method takes into account the current environment, the details of the proposed project and the findings of the specialist studies. Cognisance has been given to both positive and negative impacts that may result from the development. The significance of the impact is dependent on the consequence and the probability that the impact will occur.

impact significance = (consequence x probability)

Where:

consequence = (severity +extent)/2

and

severity = [intensity +frequency + duration]/3

Each criterion is given a score from 1 to 5 based on the definitions given in Table 4.1. Although the criteria used for the assessment of impacts attempts to quantify the significance, it is important to note that the assessment is generally a qualitative process and therefore the application of this criteria is open to interpretation. The process adopted has thus involved the application of scientific measurements and professional judgement to determine the significance of environmental impacts associated with the project. The assessment thus largely relies on experience of the environmental assessment practitioner (EAP) and the information provided by the specialists appointed to undertake studies for the EIA.

Where the consequence of an event is not known or cannot be determined, the “precautionary principle” has been adhered to and the worst-case scenario assumed. Where possible, mitigation measures to reduce the significance of negative impacts and enhance positive impacts have been recommended. The detailed actions, which are required to ensure that mitigation is successful, are provided in section 6.5 of this report.

Consideration has also been given to the phase of the project during which the impact occurs. The phase of the development during which the impact will occur has also been noted to assist with the scheduling and implementation of management measures.

Table 4.1: Criteria for Assessing the Impact Significance

SEVERITY CRITERIA

INTENSITY = MAGNITUDE OF IMPACT	RATING
Insignificant: impact is of a very low magnitude	1
Low: impact is of low magnitude	2
Medium: impact is of medium magnitude	3
High: impact is of high magnitude	4
Very high: impact is of highest order possible	5

FREQUENCY = HOW OFTEN THE IMPACT OCCURS	RATING
Seldom: impact occurs once or twice	1
Occasional: impact occurs every now and then	2
Regular: impact is intermittent but does not occur often	3
Often: impact is intermittent but occurs often	4
Continuous: the impact occurs all the time	5

DURATION = HOW LONG THE IMPACT LASTS	RATING
Very short-term: impact lasts for a very short time (less than a month)	1
Short-term: impact lasts for a short time (months but less than a year)	2
Medium-term: impact lasts for the for more than a year but less than the life of operation.	3
Long-term: impact occurs over the operational life of the Market Coke and Co-generation Plant	4
Residual: impact is permanent (remains after plant closure)	5

EXTENT = SPATIAL SCOPE OF IMPACT/FOOTPRINT AREA/NUMBER OF	RATING
Limited: impact affects the mining area	1
Small: impact extends to the neighbouring farmers	2
Medium: impact extends to surrounding farmers beyond the immediate neighbours	3
Large: impact affects the area covered by the Waterberg District Municipality	4
Very Large: The impact affects an area larger than the district	5

PROBABILITY

PROBABILITY = LIKELIHOOD THAT THE IMPACT WILL OCCUR	RATING
Highly unlikely: the impact is highly unlikely to occur	0.2
Unlikely: the impact is unlikely to occur	0.4
Possible: the impact could possibly occur	0.6
Probable: the impact will probably occur	0.8
Definite: the impact will occur	1

IMPACT SIGNIFICANCE

NEGATIVE IMPACTS

≤1	Very low	Impact is negligible. No mitigation required.
>1≤2	Low	Impact is of a low order. Mitigation could be considered to reduce impacts. But does not affect environmental acceptability.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts. Mitigation should be implemented to reduce impacts.
>3≤4	High	Impact is substantial. Mitigation is required to lower impacts to acceptable levels.
>4≤5	Very High	Impact is of the highest order possible. Mitigation is required to lower impacts to acceptable levels. Potential Fatal Flaw.

POSITIVE IMPACTS

≤1	Very low	Impact is negligible.
>1≤2	Low	Impact is of a low order.
>2≤3	Moderate	Impact is real but not substantial in relation to other impacts.
>3≤4	High	Impact is substantial.
>4≤5	Very High	Impact is of the highest order possible.

4.4.2 Project Phases

The waste and water–related environmental impacts for the project have been assessed over five phases of the project i.e. the planning and design, construction, operation, decommissioning and post-closure phase.

The planning and design phase refers to the stage when the feasibility studies are being undertaken, the project description is being developed and the plant is being designed. During this phase the EIA is completed and environmental authorisations are applied for. This phase started in 2010 and is anticipated to be completed in late 2012.

The construction phase will commence after the WUL Amendment, AEL and environmental authorisations have been obtained. This phase will involve the physical construction of the plant and its associated infrastructure. Construction is anticipated to commence in July 2013 and end approximately in July 2016. The expected lifetime of the new plant is 20 years.

The decommissioning phase refers to the time in the plant life when operations are reduced in preparation for closure. This phase will occur once the end of the plant life has been reached. As it is anticipated that the Coke and co-generation production from the plant will last approximately 20 years, it is therefore estimated that decommissioning will commence in 2036.

The closure phase refers to when the plant is shut down and no further activities are undertaken, this phase will occur after successful decommissioning has been achieved.

4.4.3 Mitigation Measures

A **no net loss** approach has been adopted in terms of the management of impacts at the Market Coke and Co-generation Plant (see Figure 4.1):

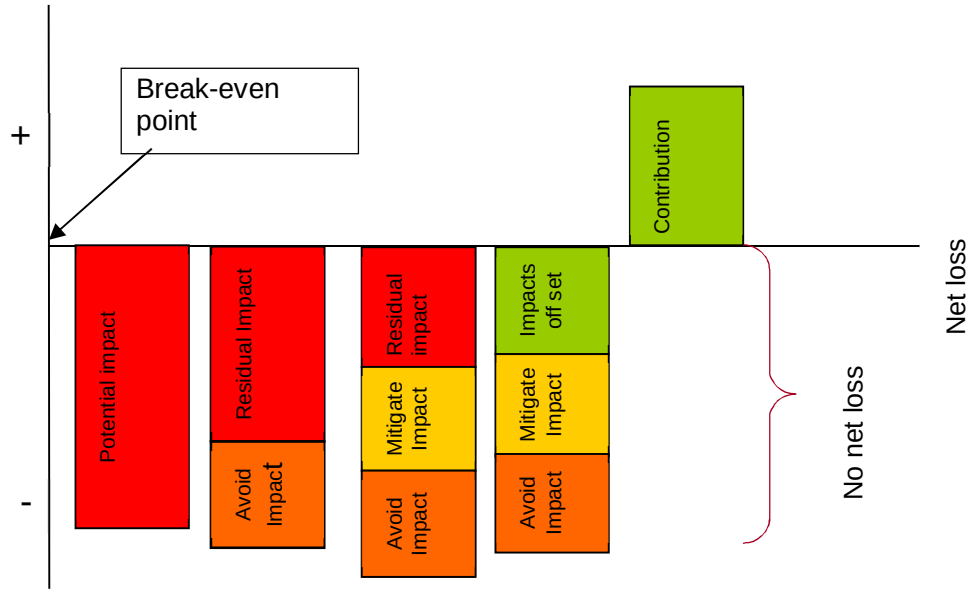


Figure 4.1: No Net Loss Approach to Environmental Management

- **Avoidance** – impacts are to be avoided where practicable e.g. through the implementation of alternatives including alternative locations or technologies;
- **Mitigation** – should it not be possible to avoid all impacts, the remaining impacts are to be mitigated to acceptable levels.
- **Offset** – should it not be possible to avoid and mitigate all impacts to acceptable levels it will be necessary to offset the remaining impacts. Suitable offsets will need to be identified.

Mitigation measures for significant impacts which cannot be avoided have been identified. The impacts have been ranked before and after the implementation of the mitigation measures. Consideration has also been given to the confidence level that can be placed on the successful implementation of the mitigation level as follows:

- **High Confidence:** mitigation measure easy and inexpensive to implement.
- **Medium Confidence:** mitigation measure expensive or difficult to implement.
- **Low Confidence:** mitigation measure expensive and difficult to implement.

Where mitigation is not sufficient to reduce the impact to acceptable levels offsets will need to be identified.

4.5 Possible Waste and Water-Related Impacts on the Environment and their Significance

The table below describes only the potential waste and water-related environmental impacts of the Market Coke and Co-generation Plant project. Please refer to the final EIA and EMP for the project for an assessment of all of the potential environmental impacts of the project.

4.5.1 Planning and Design

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	MITIGATION MEASURES
PROTECTION OF SOILS AND GROUNDWATER RESOURCES												
Loss of utilisable soils and contamination of groundwater.	Failure to include measures for the protection of soils and water resources in design.	3	2	5	3.3	1	2.2	0.8	1.7	High	Very Low	(1) Planning should provide for impervious surfaces, bunding and dirty water management areas. (2) Planning should allow for facilities for the management of general and hazardous waste. (3) Waste management procedure to be developed including the management of builders' rubble and recyclable wastes. (4) Agreements to be sought for the use of waste disposal sites and sewage treatment facilities which may be required. (5) Exxaro Reductants procurement contract to make provision for compliance with EMP. (6) Planning to include provision for the development of topsoil stockpiles.
PROTECTION OF SURFACE WATER RESOURCES												
Contamination of surface water.	Failure to include measures for the protection of surface water resources in design.	3	2	5	3.3	1	2.2	0.8	1.7	High	Very Low	(1) The storm water management measures must be designed by a suitably qualified person and in accordance with the requirements of Regulation GN 704, dated June 1999, under the National Water Act, 1998 (Act 36 of 1998).

4.5.2 Construction Phase

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	MITIGATION MEASURES
GROUNDWATER												
Decrease in groundwater availability	Abstraction of water for construction	2	3	4	3	2	2.5	0.4	1.1	Medium	Low	(1) Water abstraction is to comply with water use licensing requirements. (2) All groundwater-monitoring points for the plant shall be monitored on a quarterly basis. Boreholes to be monitored include WBR 50, WBR 57 and WBR 43. Both groundwater level and groundwater quality are to be measured.
Decrease in groundwater quality	Chemical pollutants from construction activities reaching groundwater	3	3	4	3.3	2	2.7	0.6	1.6	Medium	Low	(1) Pollution control measures for the protection of soils to be put in place. (2) Sampling is to be conducted by a suitably qualified and competent person using appropriate sampling techniques. The samples will be analysed at an accredited, independent laboratory for chemical and physical constituents normally associated with the presence of coal and carbonaceous material, as well as those which are specific to Market Coke and Co-generation Plant operations.
	Existing pollutants on site reaching groundwater	3	3	4	3.3	2	2.7	0.8	2.16	Medium	Low	(1) The remaining coal layer/carbonaceous material will be removed from the Market Coke and Co-generation Plant site and either returned to the Grootegeluk beneficiation plants or will be disposed of on the Grootegeluk discard dumps where there is no risk of combustion. The coal/carbonaceous material will not be stockpiled on the surrounding area. (2) The removal of the upper soil layer to a depth of 60cm where contamination has been identified (refer to the report by Golder, 2011 – Appendix 6). The contaminated soil must be disposed of at a Hazardous Waste Disposal Facility.
SURFACE WATER												
Decrease in surface water quality	Sedimentation of surface water run-off. Release of dirty water into environment.	3	3	4	3.3	2	2.7	0.8	2.16	Medium	Low	(1) Construction activities should be tied to take place in the dry season as far as practical (2) Footprint of disturbed areas to be minimised (3) "no-go" xones for construction plant and personnel will be delineated (4) Appropriate storm water management measures will be implemented, including the temporary diversion of upstream run-off from the construction and laydown areas. (5) Surface water management measured, such as stormwater canals and sediment traps are to be constructed first to ensure that runofff and dirty water spills are contained (6) Servicing of construction vehicles will take place only in dedicated areas that are equipped with drip trays (7) Bunded containment and settlement facilities will be provided for hazardous material, such as fuel and oil (8) Spill-sorb or a simialr type product must be kept on-site and used to clean up hydrocarbon spills in the event that they should occur (9) Erosion protection measures will be implemented at steep areas (10) Development of a waste management plan for the construction phase (11) An appropriate sewage management strategy will be implemented during the construction phase (12) Water quality monitoring will be undertaken downstream of the constructiona area, before and during construction where preactical, in order to detect any increase in suspended solids or turbidity (13) If erosion is evident or the water quality monitoring indicates an increase in suspended solids, water manageemnt around the construction areas will be reviewed.

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance			MITIGATION MEASURES
									Without Mitigation	Mitigation Confidence	With Mitigation	
Impact on Catchment Yield	Containment of runoff from the construction areas, including contractor's camp and laydown areas											(1) The site is located within the Grootegeluk Mine dirty water area and as such is already excluded from the natural catchement. There is therefore no incremental impact on catchement yield. (2) However, the containment of additional areas on the Grootegeluk Reductant Manufacturing process results in a potential reduction in the Quantity of the water reporting to the Bosbok Dam, incrementally reducing the amount of water available to the Grootegeluk Mine for use in their process. (3) The aerial extent of the disturbed areas will be kept to a minimum (4) Areas where dirty construction activities are carreid out (e.g. plant servicing areas and workshops, fuel storage areas, waste storage areas) will be minimised. (5) Upslope runoff will be diverted around construction activities
SOIL												
Contamination of soils by chemical spills.	Spillage of hydrocarbons and other hazardous chemicals, failure to contain dirty water run-off.	3	3	4	3.3	1	2.2	0.8	1.8	Medium	Low	(1) If vehicles or machinery will be serviced or maintained on site , this must be done on an impervious surfaces (hard-standing, drip trays etc.) (2) All vehicles must be checked for leaks before commencing work on site. All equipment that leaks fluid must be repaired immediately or removed from site when necessary. (3) Drip trays must be placed beneath parked vehicles which drip oil. (4) All spills of chemicals or hydrocarbons (oil, grease , diesel, petrol, etc.) will be cleaned with the use of suitable absorbent materials such as drizit or oclansorb. (5) All soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils shall take place should such a facility be available on site. (6) Within the plant area, self-contained bunded areas will be provided for the collection of spillage where the following substances are stored: (7) Hazardous waste storage facilities; (8) Flammable and combustible liquid; (9) Electrical transformers containing oil and/or PCBs and (10) Locations where spills are common, including trasfer points, workshops, and where hazardous substances are transferred and used on a regular basis. (11) The self-contained bunded areas will be lined with an impermeable material to limit seepage into the ground water environment. (12) For flammable liquids, bunded areas should have 110% of the capacity of the total storage volume for the flammable liquid. For other potentially dangerous/hazardous materials, the capacity of the bund should: (13) Equal 100% of the largest drum/tank/container; PLUS (14) 35% of the maximum intended stoage capacity ; PLUS (15) Additional capacity for firewater. (16) Material Safety Data (MSD) sheets for all chemicals must be displayed in close proximity to the area of storage. (17) Chemical spills are to be regarded as an environmental incident and reported through the incident reporting system. (18) Hazardous chemicals (such as those used for cleaning) must not be released into the environment or sewage treatment system. These materials must be contained and disposed of as hazardous waste. (19) All fuel tanks used in construction must be aboveground and bunded in accordance with the requirements for flammable liquids. (20) Hydrocarbon handling areas must be supplied with stormwater diversion measures. (21) The integrity of the bund for hydrocarbon storage is to be monitored regularly to ensure that no seepage escapes it.
Contamination of soils by wastes.	Spillage of sewage and incorrect management and disposal of waste.	3	3	4	3.3	1	2.2	0.8	1.8	Medium	Low	(1) All waste will be classified and disposed of accordingly. No illegal dumping or disposal will take place - general waste must be disposed of at a permitted landfill site and hazardous waste must be disposed of at a permitted hazardous waste site. (2) All hazardous waste must be handled on impervious surfaces. (3) Chemical toilets will be provided for construction personnel during the construction phase if the sewage system is found to be insufficient for the number of people on site during construction.

4.5.3 Operation Phase

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance			MITIGATION MEASURES
									Without Mitigation	Mitigation Confidence	With Mitigation	
SURFACE WATER												
Contamination of storm water	Contamination of surface water run-off. Release of dirty water into environment.	4	3	4	3.7	2	2.9	0.8	2.3	Medium	Low	(1) Sediment originating from operation activities is to be prevented from contaminating storm water. (2) Dirty water run-off is to be contained and not allowed to enter into the surrounding environment. (3) All identified surface water quality monitoring points for the plant shall be monitored 6 times per annum (every 2 months). Sampling points include the Pollution Control Dam (PCD), The PCD extension and the Bosbok Dam (which will need to also be sampled during a spill event). (4) Ground and surface water monitoring results must be kept on site and made available to the Plant Manager and the Environmental Manager on a monthly basis. Potential negative impacts should be identified and addressed as soon as possible. (5) A quarterly report must be submitted to DMR/ DWA and consist of the following: Brief compliance assessment description, brief description of monitoring actions performed, highlight significant issues that require immediate corrective/ preventative action, historical and present source chemistry report, hydrochemical imaging: Piper and Durov diagrams, time dependent graphs for the relevant water quality variables. (6) Appropriate storm water control measures will be maintained on the site, which will comply with the GN704 Regulations on the Use of Water for Mining and Related activities. (7) A storm water cut-off drain according to the Regulations (see 2.24) specifications will be maintained around the site. (8) The storm water control measures will be inspected on a weekly basis for signs of erosion or blockages during the first rainy season. Thereafter, inspections should occur on a monthly basis during the rainy and dry seasons. Any blockages or erosion should be repaired within 24 hours of discovery. (9) A water balance will have to be set up for the plant in order to accurately record the water usage and to monitor the potential impact on the overall Grootegeluk Coal Mine water system. (10) All spills will be contained within dedicated bunded areas (at workshops etc.) (11) All contaminated runoff and spills that escape the bunded areas will be collected and contained in the PCD and PCD extension. (12) Runoff from the upslope catchment will be diverted around the plants and associated infrastructure (13) The footprint of the Coking and Co-Generation Power Plants will be minimised as far as practical. (14) All storm water management facilities will be designed to have a risk of spill of 2% or less (1:50 year recurrence interval) in any one year (15) All pipeline routes will be inspected regularly to enable early detection of leaks (16) Sewage water will be collected in an adequately sized sump and pumped to the Grootegeluk sewage treatment plant (17) All storm water from coal and product handling facilities, as well as from the general plant area will be collected in the PCD. Surplus water will report from the PCD to the PCD extension. (18) A maintenance plan will be implemented on the storm water system to ensure that all oil skimming and sediment handling facilities are maintained and that storm water canals and pipelines remain unblocked and free flowing. (19) Bunded containment and settlement facilities will be provided for hazardous materials, such as fuel and oil. (20) Spill-sorb or a similar type product must be kept on site and used to clean up hydrocarbon spills in the event should that they occur.
Catchment Yield	Containment of runoff from the Coke and Co-generation Power Plant area	2	3	4	3	2	2.5	0.4	1.1	Medium	Low	(1) The site is located within the Grootegeluk Mine dirty water area and as such is already excluded from the natural catchment. There is therefore no incremental impact on catchment yield (2) However, the containment of additional areas on the Coke and Co-generation Power Plant results in a potential reduction in the quantity of water reporting to Bosbok Dam, incrementally reducing the amount of water available to Grootegeluk Mine for use in their process. (3) The aerial extent of the disturbed areas will be kept to a minimum (4) Upslope runoff will be diverted around the Coke and Co-generation Power Plant area. (5) Water required for the process plant will be sourced first from the pollution control dam, then from the PCD Extension, then from the Grootegeluk Mine dirty (process) water system.
GROUNDWATER												
Decrease in groundwater availability	Abstraction of water for operation	2	3	4	3	2	2.5	0.4	1.1	Medium	Low	(1) Water abstraction is to comply with water use licensing requirements. (2) All groundwater monitoring points for the plant shall be monitored on a quarterly basis. Boreholes to be monitored include WBR 50, WBR 57 and WBR 43. Both groundwater level and groundwater quality are to be measured.
Decrease in groundwater quality	Chemical pollutants from operation activities reaching groundwater	4	3	4	3.7	2	2.9	0.8	2.3	Medium	Low	(1) Pollution control measures for the protection of soils to be put in place. (2) Sampling is to be conducted by a suitably qualified and competent person using appropriate sampling techniques. The samples will be analysed at an accredited, independent laboratory for chemical and physical constituents normally associated with the presence of coal and carbonaceous material, as well as those which are specific to Coke Manufacturing Plant operations.

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	MITIGATION MEASURES
SOILS												
Contamination of soils by chemical spills.	Spillage of hydrocarbons and other hazardous chemicals, failure to contain dirty water run-off.	3	3	4	3.3	1	2.2	0.8	1.8	Medium	Low	(1) If vehicles or machinery are serviced or maintained on site , this must be done on an impervious surfaces (hard-standing, drip trays etc.) (2) All vehicles must be checked for leaks before commencing work on site. All equipment that leaks fluid must be repaired immediately or removed from site when necessary. (3) Drip trays must be placed beneath parked vehicles which drip oil. (4) All spills of chemicals or hydrocarbons (oil, grease , diesel, petrol, etc.) will be cleaned with the use of suitable absorbent materials such as drizit or oclansorb. (5) All soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils shall take place should such a facility be available on site. (6) Material Safety Data (MSD) sheets for all chemicals must be displayed in close proximity to the area of storage. (7) Chemical spills are to be regarded as an environmental incident and reported through the incident reporting system. (8) Hazardous chemicals (such as those used for cleaning) must not be released into the environment or sewage treatment system. These materials must be contained and disposed of as hazardous waste. (9) The integrity of the bund for hydrocarbon storage is to be monitored regularly to ensure that no seepage escapes it.
Contamination of soils by wastes.	Spillage of sewage and incorrect management and disposal of waste.	3	3	4	3.3	1	2.2	0.8	1.8	Medium	Low	(1) All waste will be classified and disposed of accordingly. No illegal dumping or disposal will take place - general waste must be disposed of at a permitted landfill site and hazardous waste must be disposed of at a permitted hazardous waste site. (2) All hazardous waste must be handled on impervious surfaces.

4.5.4 Decommissioning Phase

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	MITIGATION MEASURES
SOILS												
Contamination of soils	Pollution due to mishandling of hydrocarbons and other hazardous substances.	2	1	2	1.7	1	1.3	0.6	0.8	High	Very Low	(1) Spill prevention measures to be implemented during decommissioning phase as in operation phase. (2) All soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils shall take place should such a facility be available on site.
SURFACE WATER												
Water Quality	Mobilisation of contaminants during the clean-up, demolition and rehabilitation process	4	3	4	3.7	2	2.9	0.8	2.3	Medium	Low	(1) All waste from ablution facilities will be removed and treated prior to decommissioning (2) The dirty water management system (storm water drainage canals, pollution control dam and pollution control dam extension, including erosion control measures) will remain in place until the entire site has been decommissioned and rehabilitated. These components will be decommissioned last. (3) All traces of hydrocarbons and residual waste will be cleaned up and removed from the site (4) All remaining material in the feed coal and product stockpiles will be reclaimed and removed from the site before demolition of the stockpile areas. (5) The feed coal and product stockpiles will be completely removed, (6) Once all infrastructure has been demolished and removed from site, and all waste and contaminated material (including soils) has been removed and disposed of, the site will be reshaped, rehabilitated and grassed.
Catchment yield	Clean runoff draining back to the clean water system	2	3	4	3	2	2.5	0.4	1.1	Medium	Low	(1) The decommissioning, demolition and rehabilitation processes will result in the area being clean post closure, and runoff will be suitable for release to the natural system. No further mitigation measures are considered necessary.

4.5.5 Post Closure Phase

ENVIRONMENTAL IMPACT	IMPACT SOURCE/DESCRIPTION	Intensity	Frequency	Duration	Severity	Extent	Consequence	Probability	Impact Significance: Without Mitigation	Impact Significance: Mitigation Confidence	Impact Significance: With Mitigation	MITIGATION MEASURES
GROUNDWATER												
Groundwater contamination	Contamination of groundwater.	1	5	5	3.7	1	2.3	0.4	0.9	High	Very Low	(1) The groundwater monitoring programme should be continued for the period stipulated by the relevant authorities

4.6 Risk to the Environment

The direct impacts will be limited to the immediate neighbour of the plant – the Grootegeluk Mine. It is however expected that impacts on surrounding landowners will be low provided that mitigation measures are successfully implemented. However, as many of the potential impacts have been simulated through models, it is important that monitoring be undertaken to verify the impacts.

Effective surface and groundwater management and monitoring are essential for long-term sustainability of the supply and to protect the resource. A monitoring programme needs to be implemented for each surface water and groundwater resource, involving regular measurements of:

- Water levels;
- Abstraction; and
- Quality

In addition to monitoring, it is recommended that the existing forums be continued to ensure open communication and discussion of grievances that affected parties may have once project implementation commences.

4.6.1 Surface Water

In terms of assessing the impact of the project on the catchment, the total area of the Market Coke and Co-generation Plant is small compared to the Mokolo River catchment. The catchment area of the total site including the Char, Market Coke and Co-generation plants covers an area of approximately 1 km² compared to a catchment of just under 8400 km² for the Mokolo River (the site covers only 0.001% of the Mokolo catchment) (Jones and Wagener, 2012B).

A detailed description of the Market Coke and Co-generation Plant operation impacts on surface water is given in Appendix 5. There are no major surface water features in the plant area and run-off from the area is unlikely to reach surrounding catchments. Due to the limited gradient, surface water falling on site is likely to seep into the surface or evaporate. The PCD with the PCD extension is also adequately sized to prevent spillage of contaminated water for events up to at least the 1:50 year recurrence interval (in accordance with GN 704), for both the current and the additional operations. Thus, the risk of spillage from the PCD and PCD expansion is very low, with a risk of less than 2% in any one year. In the unlikely event of spillage, all spills would report to the Bosbok Dam and would be reused in the process.

Of concern is the risk of run-off from construction and plant areas becoming contaminated and this water being allowed to enter into the natural environment. Pollution control measures to contain hydrocarbons and other potential contaminants during the construction period is thus essential. Geochemical analysis of pollution sources show that there is a risk of contamination from waste sources at the Market Coke and Co-generation Plant site. Such water must be managed and prevented from entering the neighbouring environment. Provision has been made for the management of dirty water from the plant and maintenance areas and this water will be contained in the pollution control dams and prevented from entering into the surrounding environment.

The coke stockpile areas will be lined with 200-250 micron HDPE liner and will have a 500mm thick compacted earth on clay hardstand base. All water runoff and seepage from the stockpiles will be directed to the PCD and will not be disposed of into the environment.

Further, the dirty water generated on site is distinctly different from that generated on the mine, as it can potentially have high organic hydrocarbon content. It is therefore important that the same legislated

requirements that are set for clean and dirty water separation should also be set for containment of dirty water on the Market Coke and Co-generation Plant to ensure that this water does not get used in the mine process (however it is suitable for use in the Market Coke Plant Process) (Jones and Wagener, 2012B).

The proposed Market Coke and Co-generation Plant site are also located within the greater Grootegeluk Colliery dirty water area. Any spillage of contaminated water or storm water around the site is collected in Grootegeluk Colliery's Bosbok Dam.

4.6.2 Groundwater

A detailed description of the impacts on groundwater is given in the groundwater specialist report in Appendix 4.

4.6.2.1 Seepage and Groundwater Quality

The groundwater quality at the site is currently slightly polluted due to the historic use of the site (for coal storage). If the stormwater management system, PCD lining, coke product stockpile designs and waste management measures are implemented, then there is likely to be little additional effect on groundwater quality. Seepage water on the Market Coke and Co-generation Plant site will be routed to the PCD.

The existing soil at Market Coke and Co-generation Plant site is contaminated from previous and current practices. Therefore, the existing soil is a problem unless it is removed and treated appropriately. The removed soil will need to be managed once the construction starts. The fill material for the Site is also contaminated already, it is important to ensure that future fill material used is not contaminated (Golder, 2011). The contaminated soil which exists on the Market Coke and Co-generation Plant site will need to be removed and appropriately remedied or disposed of to ensure that groundwater quality is not further impacted. On-going quarterly monitoring of borehole water quality on site will continue. If groundwater impacts are detected, then the reasons for this will need to be examined and any problems remedied.

The coke and coal stockpile areas will be lined with 200-250 micron HDPE liner and will have a compacted earth on clay layer. All water runoff and seepage from the stockpiles will be directed to the PCD and will not be disposed of into the environment. Thus the stockpile areas will not result in groundwater pollution.

The PCD is lined and the PCD extension will be lined with bentonite and a geomembrane liner. The PCD Extension will be equipped with 2 mm thick HDPE liner on a compacted clay liner, with sub-soil drainage below the liner system.

A subsoil drainage / leakage detection layer, comprising a 150 mm thick layer of sand, with a perforated collector pipe and covering the entire base of the dam will be provided below the liner. This will be monitored to detect any leaks in the liner system (Jones and Wagener, 2012A). This also provides a cushioning layer for the protection of the liner from sharp rocks and edges (Epoch Resources, 2007). Thus, any possible groundwater quality effects from the PCD and PCD extension will be managed.

The PCD extension will be equipped with a spillway to cater for emergency overflows. The spillway will be located on the south eastern embankment and will be equipped with adequate erosion protection. The spillway will be sized to accommodate the required recommended design flood (RDF) and safety evaluation flood (SEF), as per the relevant South African National Commission on Large Dams (SANCOLD) guidelines (Jones and Wagener, 2012A).

The management of waste at the Market Coke and Co-generation Plant Site will be tied in with the current practices and facilities of the existing Char Manufacturing Plant. The general waste is removed by an appropriately licensed waste removal contractor and disposed of at a licensed general waste facility.

Solid hazardous waste will be disposed of at a licensed hazardous waste site. Should pollutants enter into the groundwater, the extent of contamination would be confined to a limited area around the source.

There is dewatering in the area with pit mine dewatering taking place around the mining area, this accounts for 23% of the water being removed from the system. The largest percentage (63%) is by regional groundwater outflow, there is also base flow to the Mokolo River (10%), aquifer storage (4%) and groundwater abstraction accounting for 0.1% (Jones and Wagener, 2012A)

4.6.2.2 Groundwater Levels

The use of water for the Market Coke and Co-generation Plant project is likely to have little effect on the groundwater levels in the nearby vicinity. No groundwater will be abstracted on the site and thus no dewatering of the aquifers will occur as a result of the Market Coke and Co-generation Plant project. The surface water on the site (storm water) will all be captured and contained in the PCD and the PCD extension. Thus there will be no groundwater recharge which will occur on the site, as water will not be allowed to percolate to the water table.

4.6.2.3 Groundwater Receptors

Groundwater contribution to streams in Lower Mokolo catchment area (catchment A42J) is zero (DWAF, 2009). This implies that contaminants in the groundwater are highly unlikely to impact on streams in the area. Thus water users are not likely to be affected by changes to the groundwater at the project site.

A water user that may be affected by the Market Coke and Co-generation Plant is the adjacent Grootegeluk Mine. As discussed above, the Market Coke and Co-generation Plant project is unlikely to have any negative effects on groundwater quality and thus is unlikely to impact the Grootegeluk Mine's water use. The removal of contaminated soil on the site for the proposed plant is likely to improve the quality of the groundwater in the long term.

4.6.3 Ecology

4.6.3.1 Waste and Water-related Impacts on Vegetation

NSS conducted a biodiversity assessment in 2010 of the Grootegeluk Mine, including the area that will be used for the Market Coke and Co-generation Plant. The diversity of the vegetation in the surrounding areas of Market Coke and Co-generation Plant site is included. The area where the Market Coke and Co-generation Plant Site is to be located is within the "Low Sensitivity Scale" meaning the area is a degraded and highly disturbed/transformed systems with little ecological function and is

generally very poor in species diversity (most species are usually exotic or weeds) (NSS, 2010)

The footprint of the Market Coke and Co-generation Plant will be approximately 49.4 ha. However, the proposed site has been previously disturbed by coal stockpiling undertaken for many years and the biological environment of the site is completely transformed. The possibility of species or habitats of significance being found at the site are therefore considered negligible. Therefore, the possibilities of waste or water-related impacts on vegetation near the Market Coke and Co-generation Plant are considered very low.

Measures already in place to manage the potential impacts of waste and water pollution will continue to function with the Market Coke and Co-generation Plant, to prevent contaminants from impacting the surrounding areas and affecting the surrounding vegetation.

4.6.3.2 Waste and Water-related Impacts on Faunal Species

As already indicated, the Market Coke and Co-generation Plant site has been disturbed due to previous coal stockpiling activities. The site of the Market Coke and Co-generation Plant is still partially covered with a coal layer, which does not provide a suitable habitat for animal species. In addition, the location of the site adjacent to the existing Char Manufacturing Plant and close to other infrastructure is also not a suitable habitat for animals.

NSS conducted a biodiversity assessment in 2010 of the Grootegeluk Mine including the Market Coke and Co-generation Plant site. The diversity of the faunal species in the surrounding areas of the Market Coke and Co-generation Plant site is included. As with the vegetation, the area where the Market Coke and Co-generation Plant Site is to be located is within the “Low Sensitivity Scale” meaning the area is a degraded and highly disturbed/transformed system with little ecological function and is generally very poor in species diversity (NSS, 2010).

As with the vegetation, measures in place to manage the potential impacts of waste and water pollution will continue to operate, to prevent contaminants from impacting the surrounding areas and affecting the surrounding fauna.

4.6.4 Socio-Economic Impacts

It is expected that for the Market Coke and Co-generation Plant, 275 employment opportunities will be created. A large percentage of these employment opportunities will benefit the surrounding communities. As far as possible, labour will be sourced from Lephalale Local Municipality especially neighbouring communities. In addition to employment, Exxaro Reductants will contribute to the surrounding communities through implementation of socio-economic development projects and skills development as stipulated in their Social and Labour Plan.

Major social impacts are unlikely due to the fact that the area is already undergoing a considerable amount of development. Additional housing, infrastructure and social services are being developed in the Lephalale area to cater for the increased demand from the growing population.

Some additional jobs will be created by the project which could result in an influx of additional people into the area. However, since Exxaro Reductants plans to implement appropriate recruitment practices including preferences to local labour during the construction and operational phases, it is expected that such impacts will be curtailed.

The direct Market Coke and Co-generation Plant operation impacts such as air quality, noise, and

groundwater impacts will be limited to the site, or possibly immediate neighbours (the Grootegeluk Mine). There are no sensitive receptors which have been identified nearby.

The development of the Market Coke and Co-generation Plant will also result in the following positive socio-economic impacts:

- Employment opportunities for local people;
- Providing and additional tax base; and
- Overall contribution to South Africa's economy.

4.7 Risks to Human Health

The greatest risk to human health would be a change in the surface or groundwater quality, or the mismanagement of wastes. Human health could also be affected if the plant workers are not appropriately trained in safe work procedures or if they do not wear the appropriate Personnel Protective Equipment (PPE).

Potential water pollution sources include the following facilities:

- Coke and coal stockpiles and handling areas;
- Settling pond / silt trap;
- Pollution Control Damn and Extension;
- Sewage pipelines;
- Existing soil (contaminated with coal); and
- Fill material for site construction (if this is contaminated).

The potential for seepage of contaminants from these sources into the groundwater is expected to be low due to the fact that suitable management measures will be in place for these areas. Storm water will be stored in the PCD and PCD extension and then recycled back into the process and will not be allowed to enter the environment. Thus, there is little risk of surface water pollution as a result of the activities at Market Coke and Co-generation Plant. Thus, there is little potential for water pollution reaching neighbouring users and affecting human health.

All facilities are provided with measures to mitigate the potential for contaminants entering the groundwater resource. These largely comprise the placement of impervious surfaces in areas where there is a risk of spillage or seepage of contaminants like the lining that is under the PCD and its settling pond.

As there is unlikely to be any water pollution, there are unlikely to be any human health impacts related to water at the Market Coke and Co-generation Plant Project.

5. COST-BENEFIT ANALYSIS

5.1 Requirement for a Cost-Benefit Analysis

The IWWMP has been compiled in accordance with the requirements stipulated in the Draft Operational Guideline to assist in the Compilation of an Integrated Water and Waste Management Plan, September 2009, compiled by the Department of Water Affairs. The guideline requires that a Cost-Benefit Analysis be compiled for all high-risk impacts stemming from industrial water use. As can be seen in the impact assessment section 4.5, there are no high-risk impacts as a result of the industrial water use. Thus, a detailed Cost-Benefit Analysis has not been included as it is not required for the level of impacts expected for the Market Coke and Co-generation Plant Project.

6. INTEGRATED ENVIRONMENTAL MANAGEMENT

6.1 Management Principles and Philosophy

There are several key principles that apply to all aspects of water management at the Market Coke and Co-generation Plant Project:

- The water management hierarchy approach shall be applied;
- Exxaro Reductants is the temporary and responsible steward of water on the Market Coke and Co-generation Plant project, and shall not cause harm or adverse social conditions through their use of this resource;
- Exxaro Reductants shall endeavour to optimally use water for business to generate value, both in the long and short term (within the concept of sustainable development);
- Water has both quantity and quality aspects that need to be considered for each Water Resource; and
- Access to water is considered a human right.

6.2 Environmental Management Systems and Procedures

Exxaro have developed an extensive Environmental Management System (EMS) for the Grootegeluk Mine. The Market Coke and Co-generation Plant project will incorporate this where applicable, into their EMS. A copy of the EMS has been attached as Appendix 8.

Environmental Management procedures have also been developed for the most significant environmental aspects at the existing Char Manufacturing Plant. These procedures will also be carried out for Market Coke and Co-generation Plant project. A copy of these procedures is also included in Appendix 8.

6.3 Water Use and Management

Exxaro Reductants is committed to the following DWA Resource Protection and Waste Management hierarchy of decision-making (see Figure 6.1). The hierarchy will inform the principles of water management applicable to Market Coke and Co-generation Plant Project.

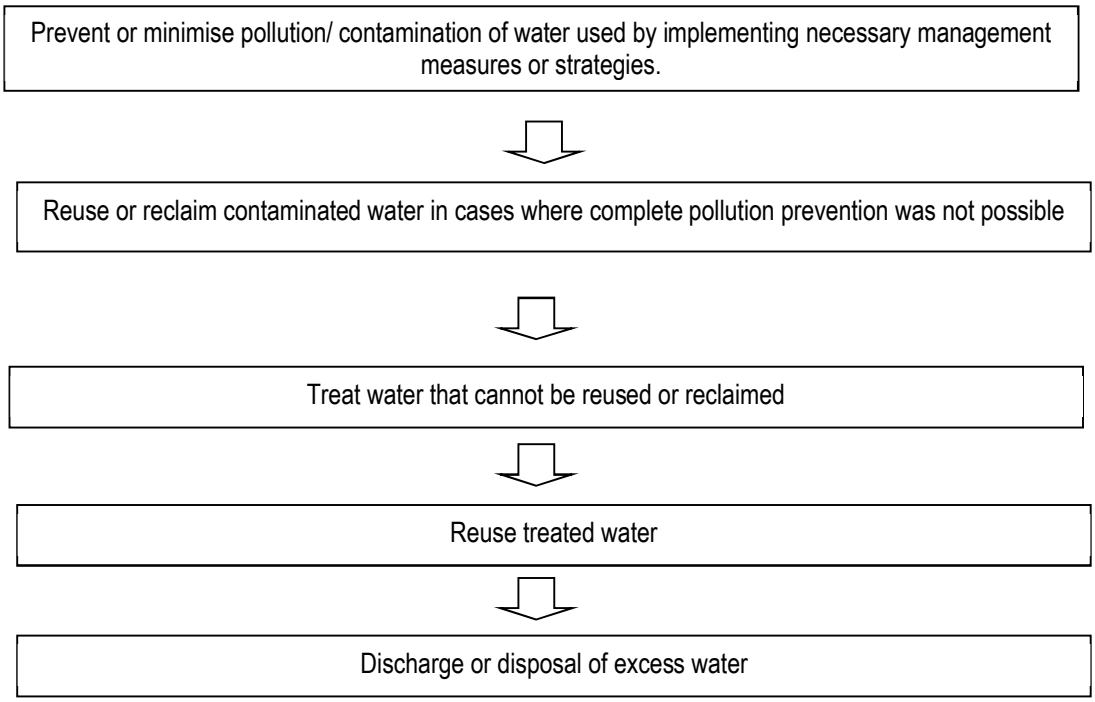


Figure 6.1: Resource Protection Hierarchy

6.3.1 Water Supply

The water supply process for the Market Coke and Co-generation Plant Project is illustrated in the water balance diagram below in Figure 6.2.

Total water use, including domestic use amounts to some 132 707 m3/month, details of each water use are provided in the sections below.

6.3.1.1 Groundwater abstraction

There will be no groundwater abstraction taking place for the Market Coke and Co-generation Plant project. Groundwater will not be used at the plant. The only time when small amounts of groundwater may be abstracted is during the monitoring of groundwater quality when samples will be analysed.

6.3.1.2 Raw Water Supply

Raw water is required for use in the production of steam in the boilers and for the gas cooling water circuit for the Market Coke and Co-generation Plant.

The Market Coke and Co-generation Plant will require an average of approximately 4242 m³/day of raw water. Raw water is sourced from the Mokolo Dam and delivered to the Grootegeluk Mine by an underground pipeline from where Grootegeluk manages the distribution of water to the various points of use at the mine (Refer to Figure 6.2 for the Schematic water balance of the Market Coke and Co-generation Plant). The Market Coke and Co-generation Plant project will also make use of the existing Grootegeluk water allocation for its potable and raw water needs. Grootegeluk Mine will thus increase its allocation of water to the site for the Market Coke and Co-generation Plant project.

Please note that the Grootegeluk Mine will not require any additional water from the Mokolo Dam as a result of this project. The additional water will come from the Grootegeluk Mine's existing allocation. A Service Level Agreement between the Grootegeluk Mine and Exxaro Reductants has been drawn up to clarify this (Appendix 11). The amount of raw water that will be required for the Market Coke and Co-generation Plant are tabulated below in Table 6.1.

Table 6.1. Water use at the Market Coke and Co-generation Plant

Plant	Water use	Quantity (m³/month)	Source
Water use at the Coking Plant	Quenching and Process Water Makeup: - demand - recycle from PCD - make-up from process system	 64 426 51 019 13 407	Modelled
Water use at the Co-generation Power Plant	Quenching and Process Water Makeup	180	Modelled

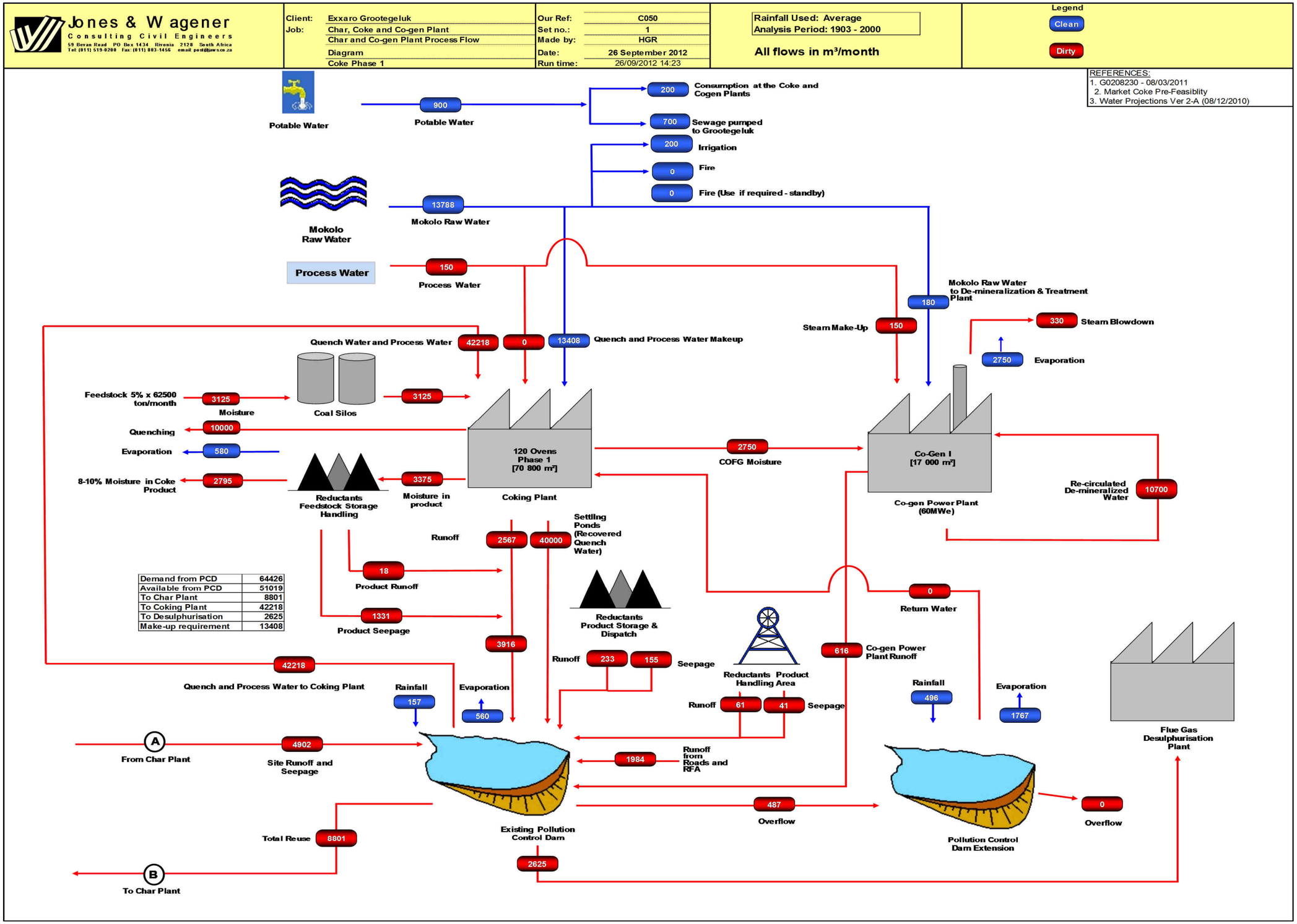


Figure 6.2: Schematic water balance diagram for the Market Coke and Co-generation Plant.

6.3.1.3 Potable Water Supply

The Market Coke and Co-generation Plant will require an average of approximately 30 m³/day of potable water. Additional pipelines which may be required within the Market Coke and Co-generation Plant area will be constructed as required. The monthly amount of potable water required is 900m^3. Potable water is obtained from the nearby Zeeland water treatment plant and is used on site for domestic purposes and washing of small plant spares at the workshop.

6.3.1.4 Process Water Supply

Process water for the Coke manufacturing process will be from Grootegeluk Mine via existing HDPE pipelines and the PCD dam as well as the PCD extension. The process water will be used for make-up water to the Market Coke and Co-generation plant (Table 6.2).
Process effluent and storm water will first be collected in the PCD with excess flowing to the PCD Extension. These dams will be the primary source of process water for the Char Plant (plant adjacent to coke and co-generation plant), the Coke Plant and the Co-generation Plant, with make-up from the Grootegeluk Mine process water system. Water from here will be abstracted and used in the Coke Plant.
At present no treatment is planned for this water, prior to reuse in the Char, Coke and Co-generation Plants.

Table 6.2. Process Water use at the Co-generation Power Plant

Water use	Quantity (m³/month)	Source
Co-gen Plant make-up	150	Modelled
Desulphurisation Plant	2625	Modelled

Process water is sourced from the both the Char and Coke Plants as well as the Grootegeluk Mine process water circuit via two dedicated pipelines to the Plant. This process water circuit draws water from the mine's dirty water dams. The water balance modelling indicates that the existing PCD has insufficient capacity to prevent spillage of runoff and effluent from the expanded site (including the Market Coke and Co-generation Plant and the Char Plant Expansion [separate project])), especially for extreme events. The expanded site will generate an average of 52 065 m^3/month in combined runoff and effluent (from the Char, Coke and Co-generation Plants). The plants' demand for water amounts to approximately 64 426 m^3/month. However, during the extreme periods an average surplus of some 487 m^3/month will be experienced. Therefore, the PCD Extension is required to accommodate this surplus/spillage. The modelling indicates that a capacity of 41 000 m^3 will be sufficient to limit the risk of spill to 2% or lower.

Please note that within the Char Manufacturing Plant and proposed Market Coke and Co-generation Plant, the process water from the PCD and the mine's dirty water dams becomes combined with recycled water in the system, thus the water in the table above does not show the full amount of water needed in the process. The schematic water balance (Figure 6.2) gives an indication of the total water needed in the various sections of the process.

6.3.2 Dams and Water Storage

The water storage for the settling pond and central pollution control for the Market Coke and Co-generation Plant are detailed in **Error! Reference source not found.** 6.3.

Table 6.3: Dams and water storage for the Market Coke and Co-generation Plant

Water Storage	m³
Settling pond at quench tower	75

PCD Extension	41 000

Please note that none of the dams will have walls higher than 5 m and thus none are classified as dams with a safety risk.

6.3.2.1 Settling Pond for Coke Quench Tower

A settling pond will be constructed to capture water from the coke quenching tower, where sediment will be settled out and the water will then be recycled into the quenching process.

Quenching is done by stopping the quenching car under a quenching tower, where the load of coke is sprayed with water. Approximately 700 ℓ of quenching water evaporates for each ton of coke quenched. The remaining water condenses in the quenching tower and is recycled after particulates are removed by means of a settling pond. Once the concentration of pollutants becomes too high, the re-cycled water is added to coal cake as compaction fluid. The quenching cycle duration is controlled to adjust the moisture content of the quenched coke to the desired value.

6.3.2.2 Pollution Control Dam Extension

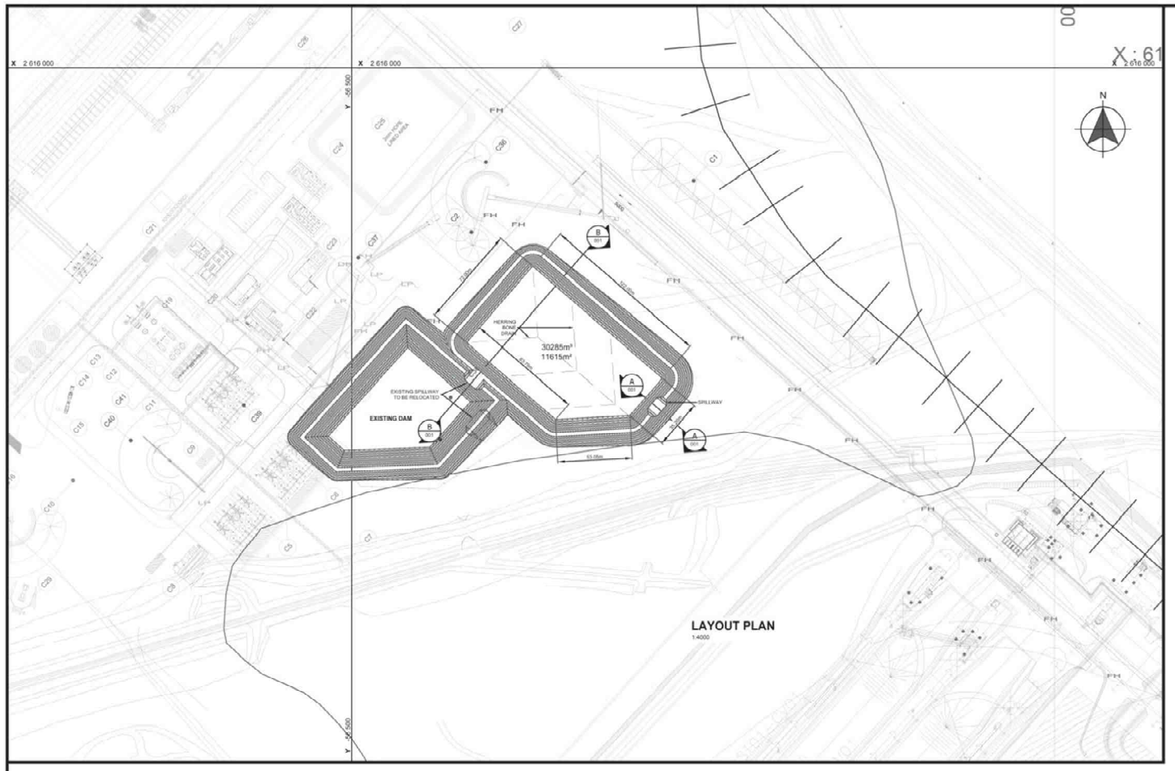
The main purpose of the PCD Extension is to capture and store overflow from the current PCD, which includes dirty storm water, used process water and seepage water. All runoff from the existing Char Manufacturing Plant site and the proposed Market Coke and Co-generation Plant is therefore directed via a storm water system to the PCD and PCD extension. From here it will be pumped to the Market Coke and Co-generation Plant for re-use in the process.The PCD will supply more than half of the process water (Figure 6.2).

The PCD has a small existing settling pond (shown in Plate 6.3), and a new one will be built as part of the Char Manufacturing Plant Expansion Project (a separate project). Thus, water flowing into the PCD Extension will first flow through the settling ponds, which allows for the trapping of silt before the storm water flows into the PCD and the PCD Extension.

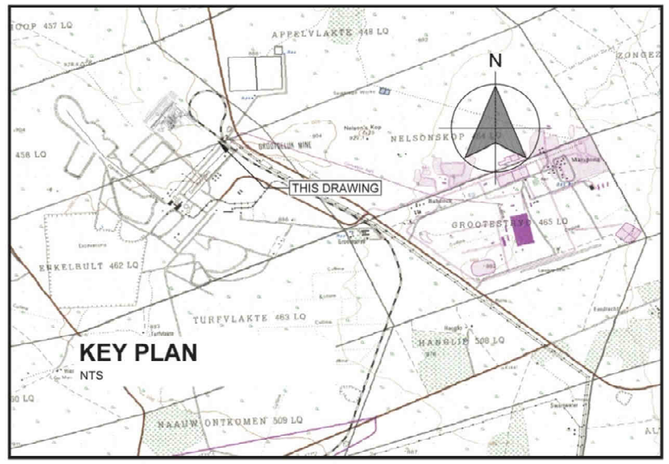
The silt traps are designed to allow the cleaning out of settled particles by mechanical means and they settle particles with a diameter equal to or larger than 200 micrometers. The silt trap design includes reinforced concrete design to accommodate the traffic from a TLB-type excavator for cleaning purposes. The silt traps have a pipeline from the char plant, 4 valves, an energy dissipater and two paddocks of the concrete lined settling facility. Different valves are opened or closed depending on when different paddocks need to be cleaned or water needs to re-enter after paddocks have been cleaned of sediment (Epoch Resources, 2007).

Figure 6.3: Existing silt trap to remove silt before water enters the PCD and PCD extension.

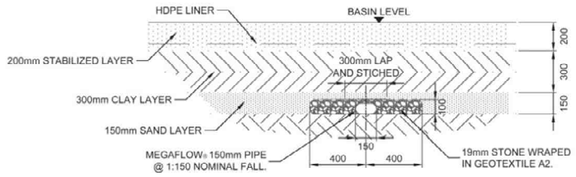
The PCD Extension has a maximum capacity of 41 000 m^3 at an operating depth of 1 m. The dam is operated to allow for the 1:50 year flood and with a minimum freeboard of 0.8 m, with a maximum available depth of 2.6 m (this is also a requirement of GN704). Refer to Figure 6.4 for the PCD Extension designs. The PCD has been designed with a leachate (leakage) detection system. A subsoil drainage/ leakage detection layer, comprising a 150 mm thick layer of sand, with a perforated collector pipe and covering the entire base of the dam will be provided below the liner. This will be monitored to detect any leaks in the liner system (Jones and Wagener, 2012B)



LAYOUT PLAN
1:4000



KEY PLAN
NTS



DAM LINING AND
HERRING BONE DRAIN DETAIL
SCALE 1:20

CONCEPTUAL ONLY
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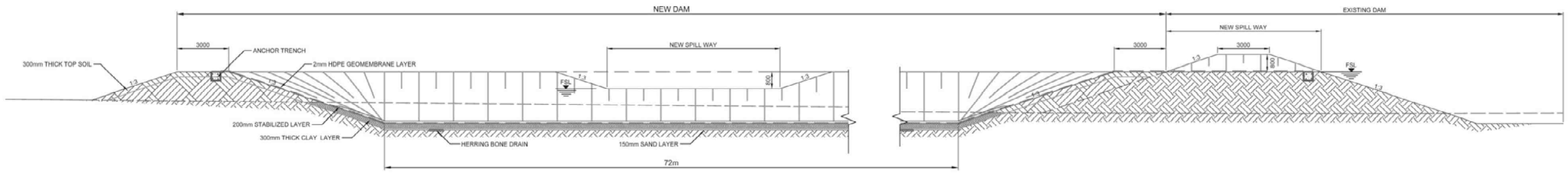

TYPICAL SECTION B-B
SCALE 1:250

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GROOTEGELUK REDUCTANT MANUFACTURING COMPLEX

Proposed PC Dam Extension - Conceptual layout and sections

Job No C050

Figure 4.5.2.(b)

Figure 6.4: PCD Extension dam design (Jones and Wagener, 2012B)

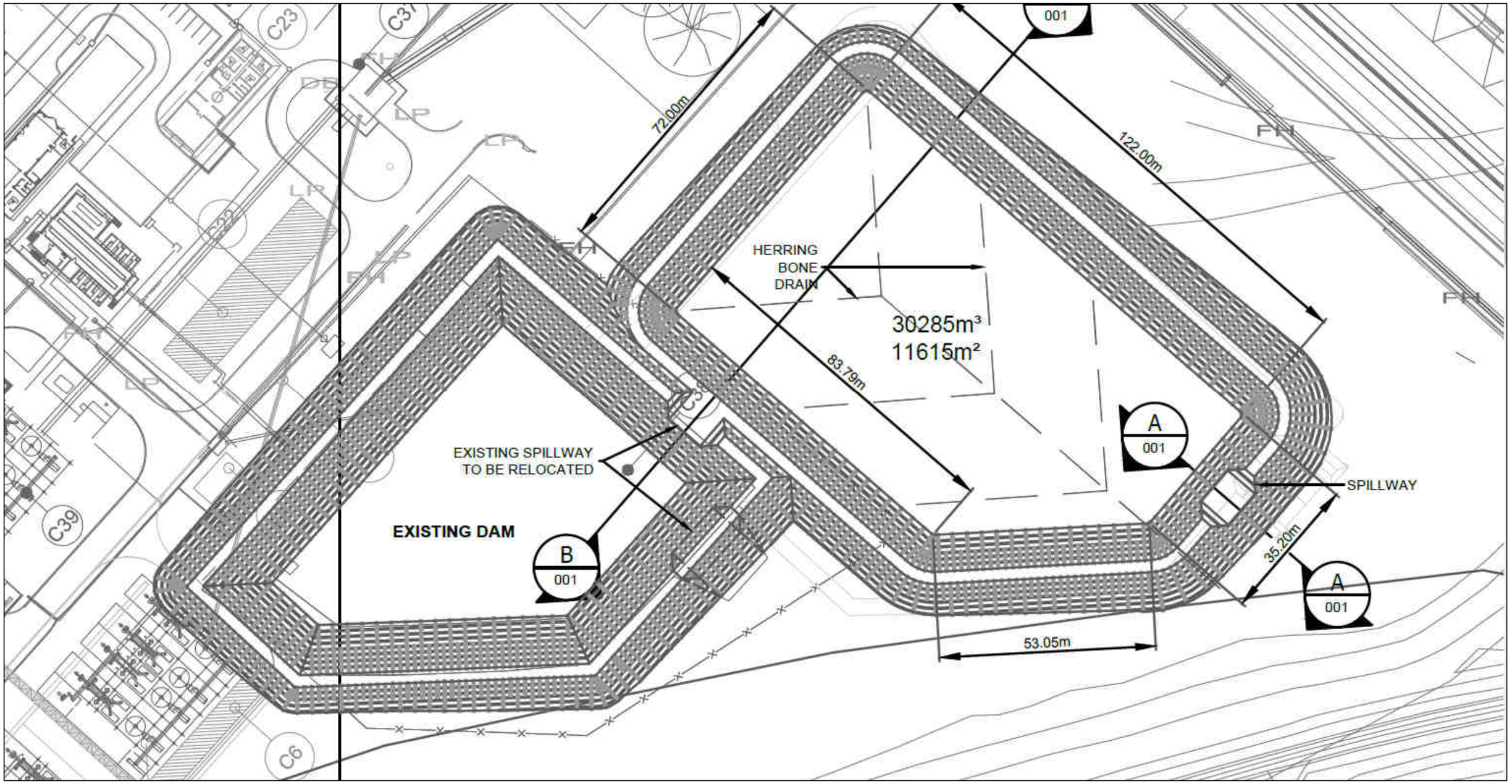
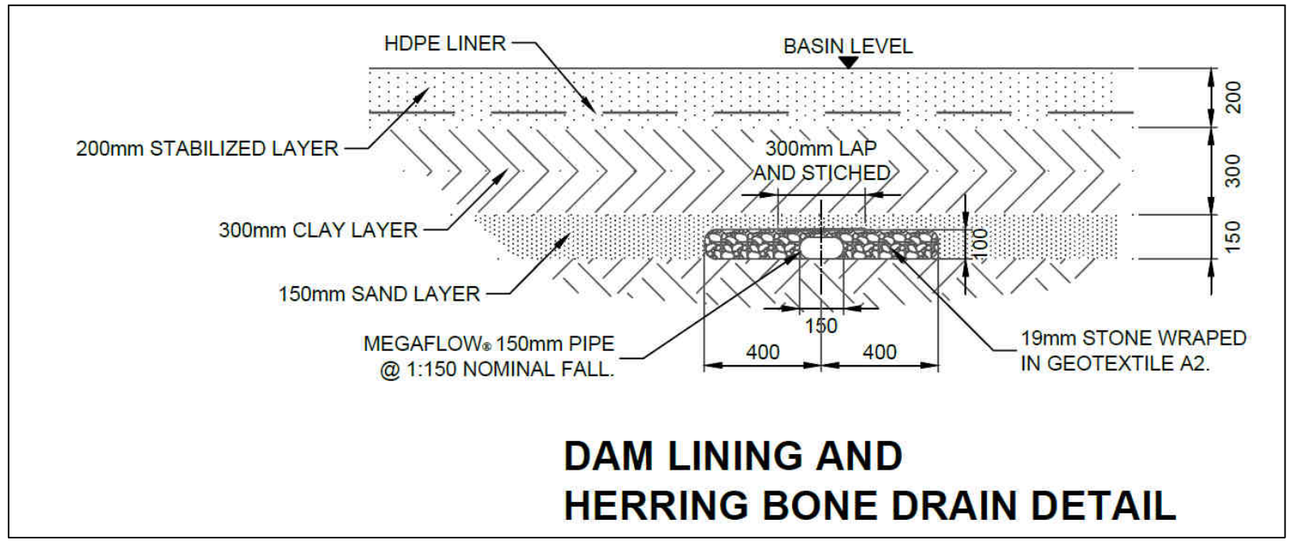


Figure 6.5: PCD Extension dam design showing PCD Extension dam only (Jones and Wagener, 2012B)



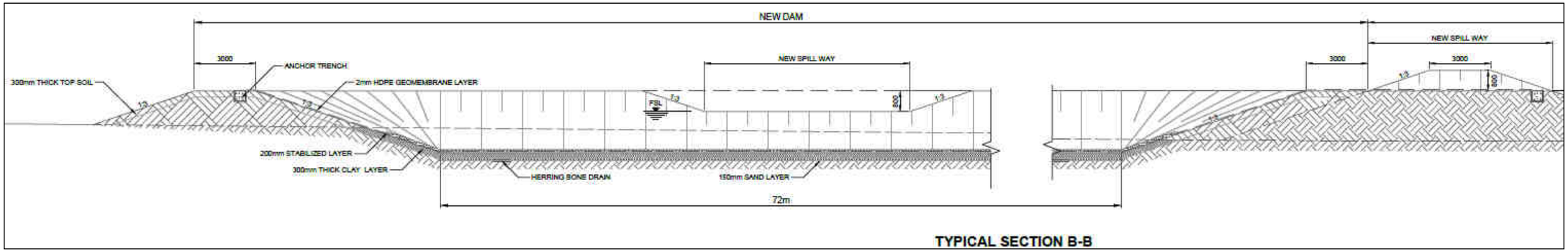


Figure 6.6: PCD Extension dam design showing dam lining and herringbone drain detail only (Jones and Wagener, 2012B)

A site water balance that was compiled indicated that the addition of the PCD Extension will allow for sufficient capacity to prevent spillage of contaminated water for rainfall events up to at least the 1:50 year recurrence interval, for current site operations and the addition of the proposed operations. The detailed inputs and outputs of the PCD are described in the table below (Table 6.5). All water is first directed to the PCD, only overflow flows into the PCD extension. The table below only indicates water processes relevant for the Market Coke and Co-generation Plant.

Table 6.5: Inputs and outputs of the PCD and PCD extension regarding the Market Coke and Co-generation Plant

PCD inputs	**(m3/month)**
Coke product stockpile seepage	1331
Coke product stockpile runoff	18
Co-gen power plant runoff	616
Total site runoff (excluding runoff mentioned above)	5461
Total site seepage (excluding seepage mentioned above)	196
Settling ponds- recovered quench water	40000
Rainfall (into PCD and PCD extension)	653
PCD outputs	**(m3/month)**
Abstraction for reuse in the plants	44843
Evaporation (from PCD and PCD extension)	2327
Overflow (from PCD into PCD extension **no overflow from PCD extension**)	487

With the addition of the Market Coke and Co-generation Plant, the current PCD will not have sufficient capacity to store the additional water. However, with the addition of the PCD Extension, there will be sufficient capacity for the additional water inputs. The performance of the PCD and the PCD Extension has been modelled and the modelled performance is depicted below in Figure 6.7 and 6.8.

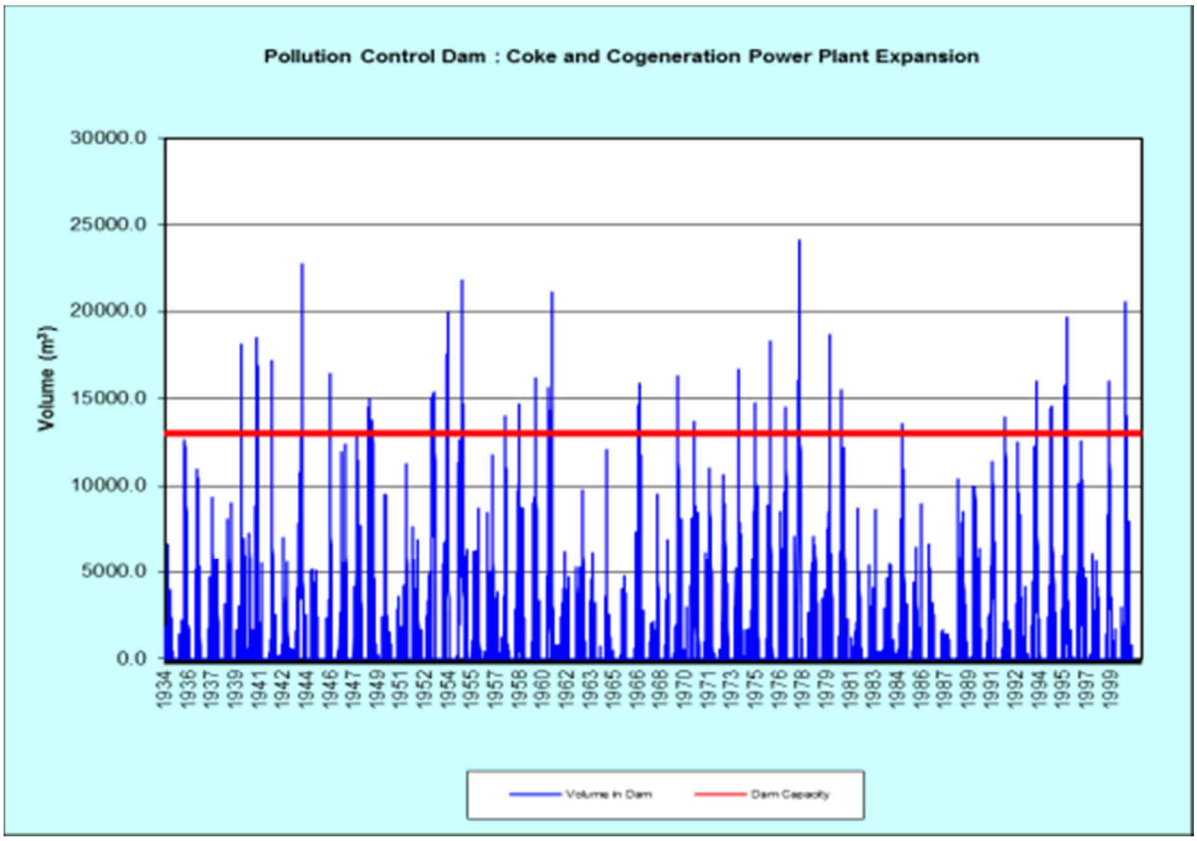


Figure 6.7: Modelled performance of PCD: Coke and Co-generation Power Plant

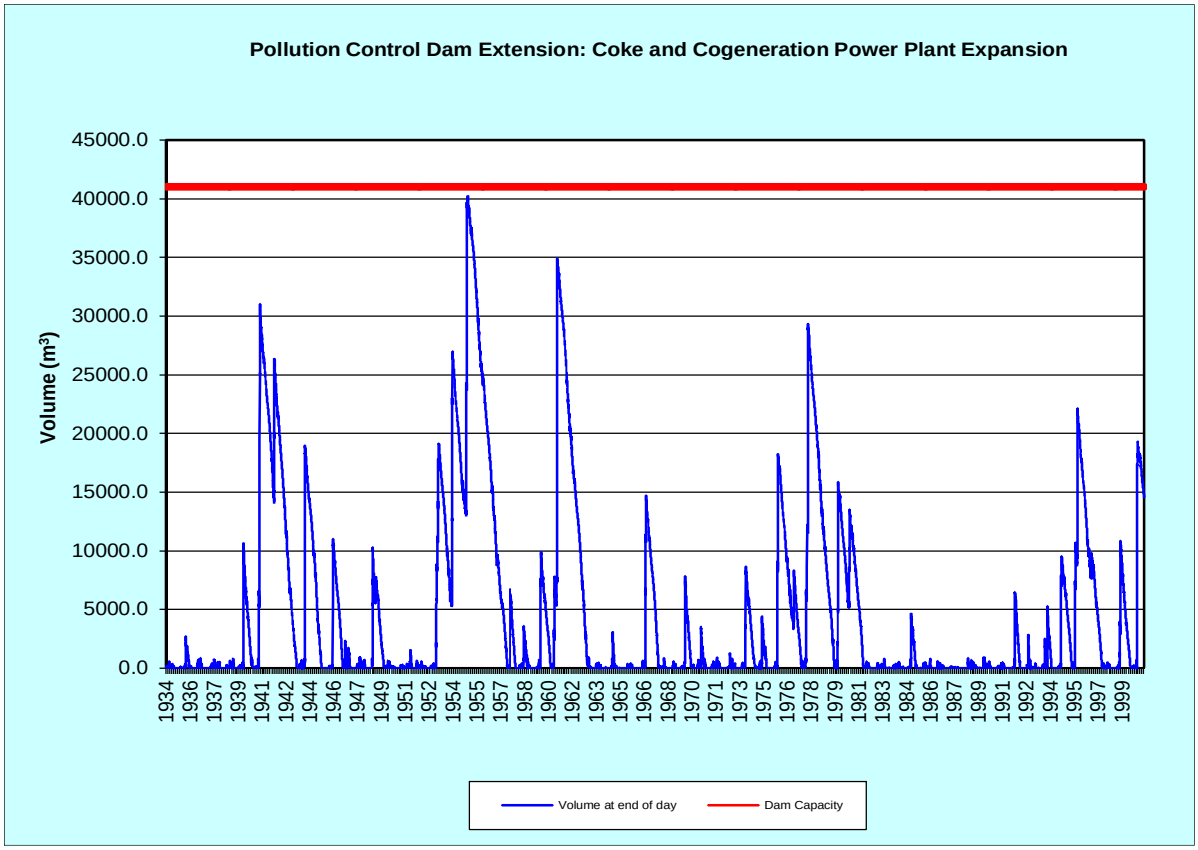


Figure 6.8: Modelled performance of PCD Extension: Coke and Co-generation Power Plant

It should be noted that the dam is only part of the overall water management strategy and as such the risk of spilling is dependent on several other components of the water management system, including operational practices in the plant and the rate of re-use of water from the dam. A commitment is made in the impact assessment to calibrate the water balance once actual data is available from the site.

6.3.3 Clean Water Management Facilities

As previously mentioned, the Market Coke and Co-generation Plant Site is located within a dirty water area on the Grootegeluk Mine property, there are no clean areas surrounding or within the Market Coke and Co-generation Plant Site area. All of the dirty storm water on the plant site, all used process water and all storm water runoff on the site will be collected in the PCD and PCD extension. A storm water cut-off drain will also be constructed around the perimeter of the site in accordance with Regulation GN 704 (of June 1999). Thus dirty storm water from the areas surrounding the site flow into the existing Bosbok Dam PCD on the Grootegeluk Mine (refer to figure 3.15 for the Bosbok dam).

6.3.4 Dirty Water Management Facilities

The dirty water management facility includes the Pollution Control Dam and extension which has been discussed in 6.3.2.1 above.

Further measures that are in place include a leachate detection system as well as a storm water management system that directs all storm water runoff to the PCD with overflow from the PCD flowing into the PCD extension. Further, storm water cut-off drains have been constructed around the site. A comprehensive groundwater-monitoring network has also been established to assess any changes in the state of groundwater (quality and depth). Details of the monitoring are contained in section 6.5.

Stockpile areas will have HDPE and compacted earth on clay layer. The stockpiles will also be equipped with a catchment channel and sump to pump coal stockpile seepage water to the existing PCD and PCD extension. The contaminated soil will also need to be removed and disposed of or appropriately remedied.

6.3.5 Sewage Management Facilities

The site is currently serviced by a conventional waterborne sewerage system. All domestic waste water generated on the site is collected in a sump adjacent to the PCD and pumped from there to Grootegeluk Mine for treatment in the existing sewage treatment plant at the mine. From the sump, two pumps (one duty and one standby – already installed) will pump the sewerage via the existing 100 mm diameter HDPE pipeline to the Grootegeluk Waste Water Treatment Works (WWTW). The WWTW has sufficient capacity to handle the extra demand of this project.

The sewerage sump has capacity for 300 people and thus has sufficient capacity to also handle the increased demand of the addition of the Market Coke and Co-generation Plant.

6.3.6 Storm Water Management Facilities

As mentioned previously the Market Coke and Co-generation Plant Project site is located within a dirty water area, there are no clean areas surrounding or within the Market Coke and Co-generation Plant area. Thus all storm water runoff on the site will be collected in the PCD and PCD extension. A storm water cut-off drain will also be constructed on the site in accordance with Regulation GN 704.

Stormwater runoff within the Market Coke and Co-generation Plant area will be directed towards and will run into the existing PCD with a settling pond, the overflow from the existing PCD will flow into the PCD Extension. The proposed Market Coke and Co-generation Plant is depicted in Figure 6.9 with the water management scheme represented in Figure 6.10. The catchment of the Market Coke and Co-generation Plant and its drainage is shown in Figure 6.11.

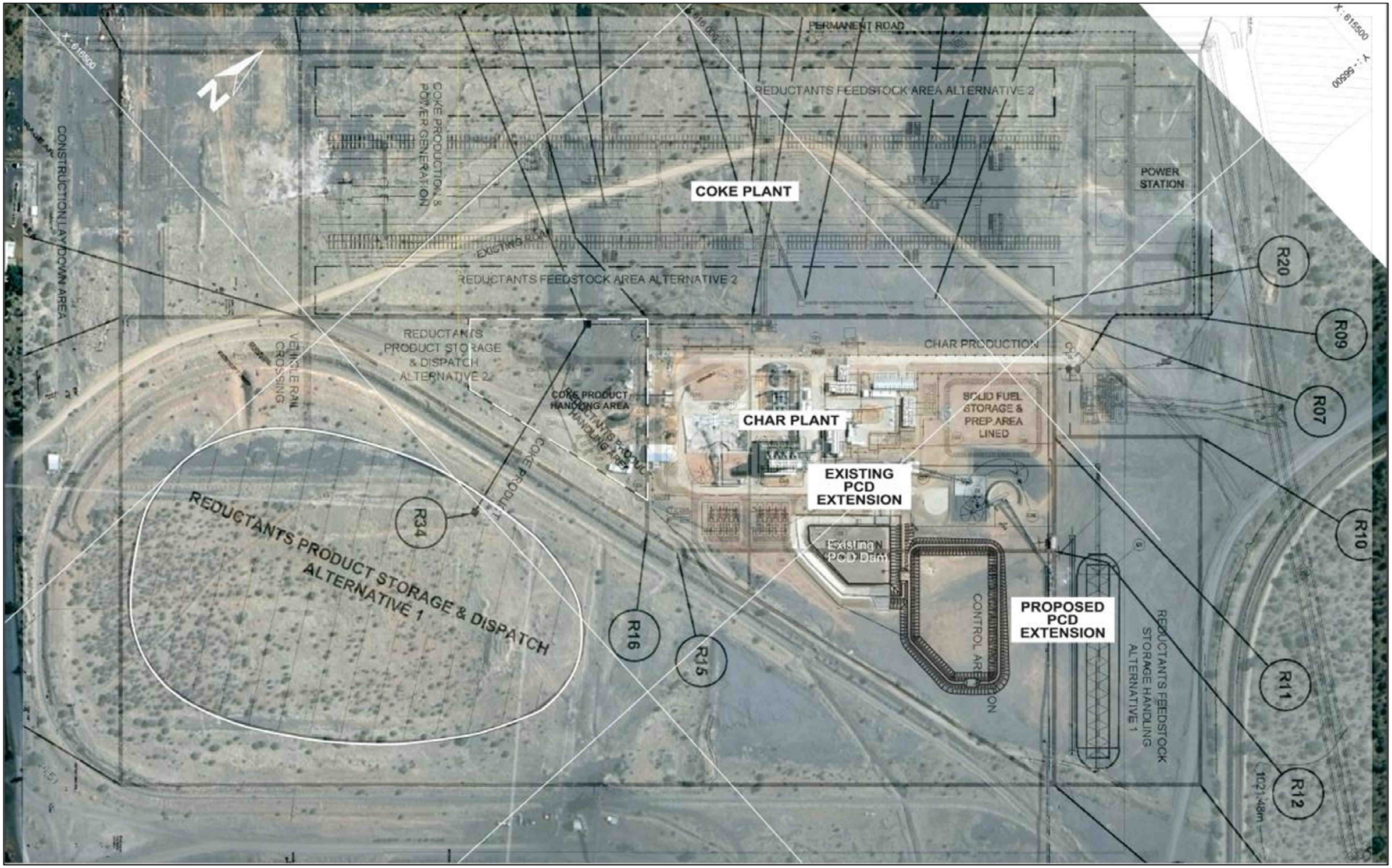


Figure 6.9: Proposed Layout of the Market Coke and Co-generation Plant project

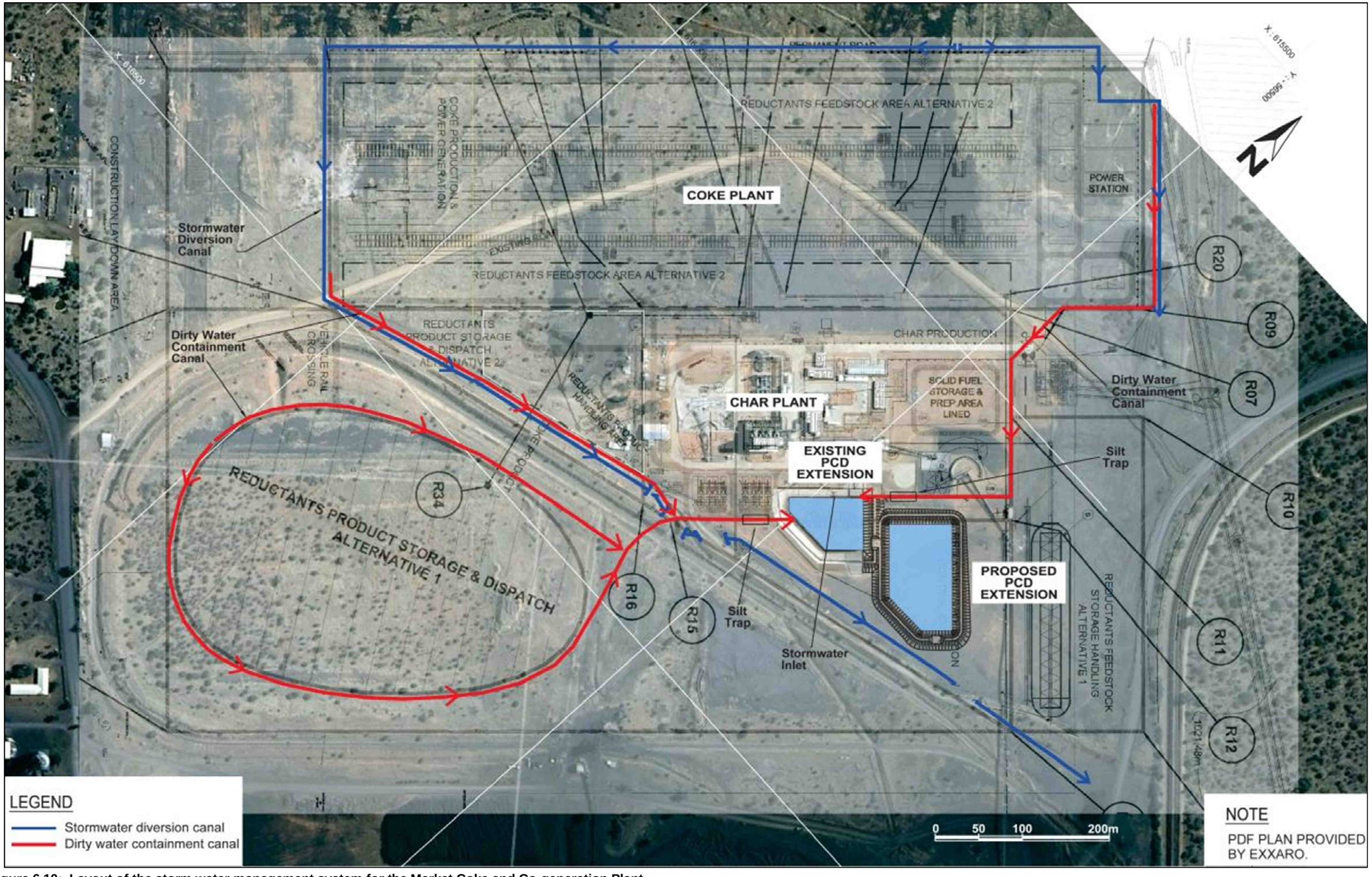


Figure 6.10: Layout of the storm water management system for the Market Coke and Co-generation Plant.

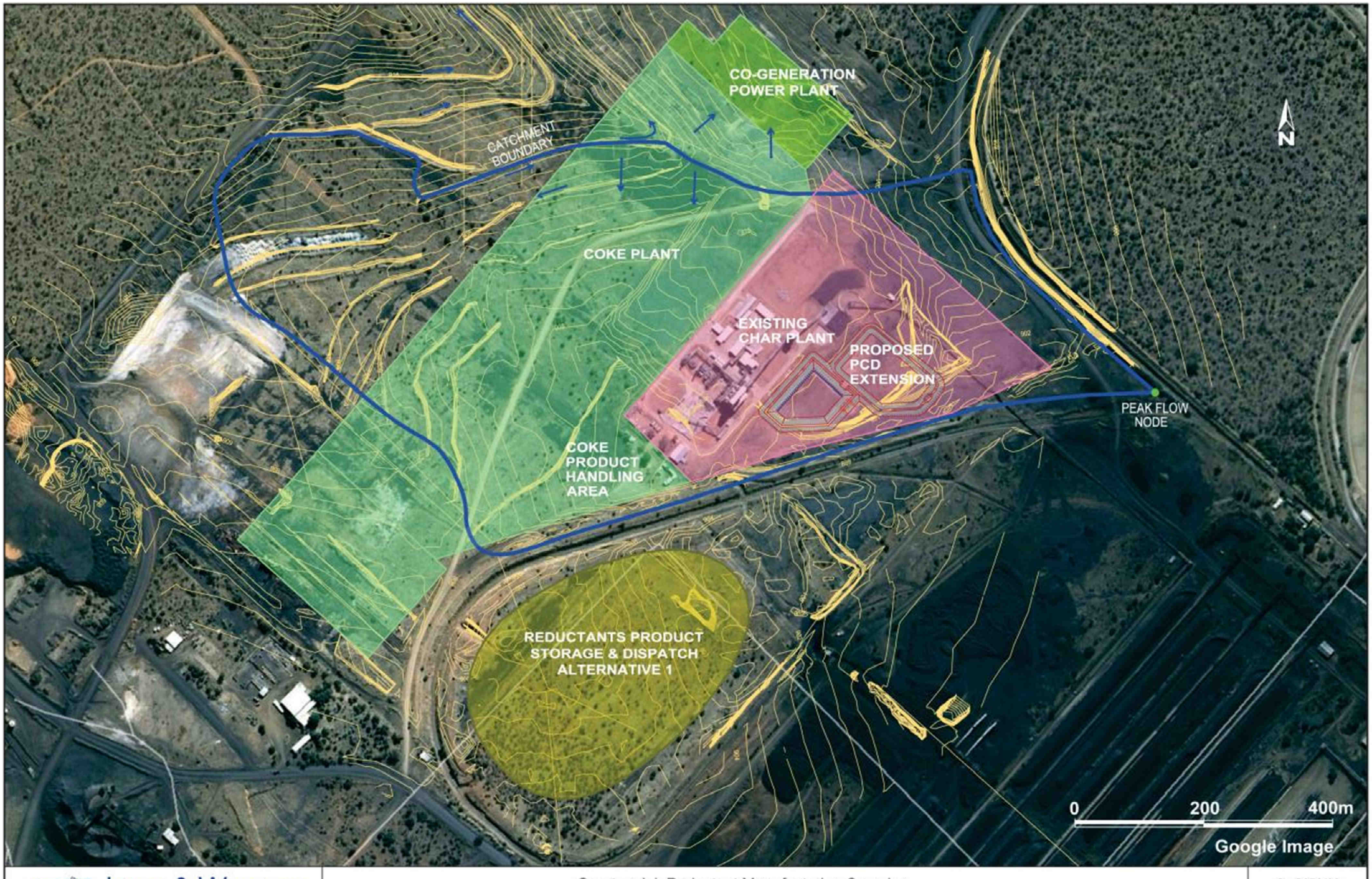


Figure 6.11: Catchment and Nodes around the proposed Market Coke and Co-generation Plant Site

6.3.7 Operational and Environmental Water Balance

A schematic water balance flow diagram is shown in Figure 6.2 for the Market Coke and Co-generation Plant, indicating the expected flows under average conditions.

6.4 Solid Waste Management

No Waste Management License (WML) is required for the proposed project as none of the waste generated on site falls within the activities that require a licence.

6.4.1 General Waste – Domestic and Industrial

General waste disposal for the Market Coke and Co-generation Plant will tie in with the current practices and facilities of the existing Char Manufacturing Plant. Currently the domestic waste from the existing Char Manufacturing Plant is collected by the Grootegeluk Mine Services Department and taken to the Lephalale Municipal Landfill site for disposal. This same practice will be followed for Market Coke and Co-generation Plant. The colour coded bin system that is implemented by the existing Char Manufacturing Plant for the recycling of paper, glass, plastic and tins will also be implemented for the Market Coke and Co-generation Plant. The scrap metal produced will also be included in the current contract with Reclam, where the scrap metal is collected in skips and removed from site for processing. All other, commercial, industrial waste, builders' rubble and other waste classified as General Waste (G) under the South African Minimum Requirements for waste disposal (Department of Water Affairs and Forestry, 1998) will be removed from the site by an appropriately licensed waste removal contractor and disposed of at a licensed general waste facility.

Stormwater runoff will enter the PCD and this water will then be recycled in the Market Coke and Co-generation Plant process. The contaminated water will not be allowed to enter the environment. The silt which collects in the settling ponds, PCD and PCD Extension will be periodically removed and disposed of as general waste.

6.4.2 Hazardous Waste – Domestic and Industrial

6.4.2.1 Solid Waste

The non-process waste classified as hazardous, including grease, oils, acids, fluorescent tubes, medical waste etc. of the Market Coke and Co-generation Plant will also be handled by the existing Char Manufacturing Plant through their existing systems which will involve disposing of the waste at a licensed hazardous waste site through an authorized Hazardous Waste Service provider like Wastech or Wasteman.

6.4.2.2 Liquid Waste

Sewerage

The site is currently serviced by a conventional waterborne sewerage system. All domestic waste water generated on the site is collected in a sump adjacent to the PCD. This sump has capacity for 300 people and thus has sufficient capacity to also handle the increased demand. From the sump, two pumps (one duty and one standby – already installed) will pump the sewerage via the existing 100 mm diameter HDPE pipeline to the Grootegeluk Waste Water Treatment Works.

Waste Water

The management of waste water has been discussed in detail in section 6.3 above.

6.4.2.3 Gaseous Waste

Waste heat will be produced during the Coking process. The purpose of the Co-generation Power Plant is to generate electricity from this waste heat. The heat will be used for raising steam in the boilers. This steam will then be used to drive turbine generators to generate electric power. This activity does not necessarily impact directly on surface water, but the indirect activities that can impact on surface water include the following:

- Coke gas collection
- Condensation and cooling
- Electricity transmission
- Offices, change house and ablution facilities
- Operation of the water management system, including sediment management and management of the water levels in the PCD.

In order to decrease the Air emissions of the power plant, a desulphurisation plant will be constructed to remove sulphur and convert it into gypsum with the addition of lime. The gypsum will be a by-product and not a waste and will be sold.

6.4.2.4 Construction of non-process facilities

The wastes described above include both process and non-process wastes. As mentioned above, non-process wastes classified as hazardous, include grease, oils, acids, fluorescent tubes, medical waste, sewerage etc.

General non-process wastes include construction waste from the construction of the Market Coke and Co-generation Plant, and domestic waste from site offices, the canteen and ablutions.

6.4.2.5 On-site accumulation of waste

There will not be any accumulation of waste on-site as discussed above.

6.4.2.6 Off-site waste disposal

General and hazardous waste which requires disposal should only be disposed of at appropriately permitted sites. In order to demonstrate compliance with this obligation, Exxaro Coal (Pty) Ltd. (who will dispose of Exxaro Reductants waste) should retain proof of the following:

- The off-site disposal facility is appropriately authorised for such purpose,
- The waste is suitable for disposal at the particular waste disposal facility in accordance with the methodology outlined in Chapter Five of the DWAF's Minimum Requirements for the Handling, Classification and Disposal of Waste, Second Edition, 1998,
- Proof that the waste was indeed disposed of at such appropriately permitted destination,
- The required disposal method for the particular waste type has been followed by the operator of the applicable landfill site.

Recycling of some of the solid general waste will also take place. Wastes will be separated into colour coded bins and recyclable waste will be recycled through the existing Grootegeluk Mine waste disposal system. Scrap metal will also be sold to a scrap metal recycling company. Appropriate records of wastes sent to recycling companies should also be kept.

6.4.3 Stockpiles

The coke and coal stockpiles are not waste storage facilities but stockpiles of product and feedstock

respectively. As previously mentioned, the stockpile areas will be lined with 200-250 micron HDPE liner and will have a compacted earth on clay layer. All water runoff and seepage from the stockpiles will be directed to the PCD and will not be disposed of into the environment. The positions of the stockpiles can be seen in the scale layout of Market Coke and Co-generation Plant showing plant and stockpile areas Figure 2.11 and 2.12.

Coke stockpile

The coal stockpile will deliver 810 000 tons/annum of coal feedstock. This will only be a portion of the existing Grootegeluk mine's GG1 stockpile and reclaimer system's production. The coal stockpiling will be continuous since the coke production will be continuous thus the minimum, maximum and average volumes will be the same. There is no final disposal of coal, the coal is an input to the coke manufacturing process and will be stored in silos.

The coke stockpile will cover an area of 14.42 ha and have a height of 13 m.

Coal stockpile

The coal stockpile will have 810 000 tons/annum of coal feedstock. The coal stockpiling will be continuous since the coke production will be continuous thus the minimum, maximum and average volumes will be the same. There is no final disposal of coal, the coal is an input to the coke manufacturing process and will only be temporarily stockpiled on site.

There are two alternatives for the coal stockpile, both of which have been applied for in the WUL amendment applications, the two options will both occupy a space of 0.28 ha and have a height of 13 m.

The semisoft coking coal composition was sampled in February 2012 by Dr G Coetzer. The report summary indicates that the coal and ash composition is fairly normal and that no evidence of contamination or abnormal oxidation could be detected in the coal. The full composition and results can be seen in the Report of the semisoft coking coal composition in Appendix 9.

6.4.4 Other Wastes

All wastes have been described above. There will be no other wastes generated at the Market Coke and Co-generation Plant site.

6.5 Rehabilitation and Mitigatory Measures

6.5.1 Mitigatory Measures - Environmental Management Programme

The Environmental Management Programme (EMP) outlined in this chapter presents commitments on actions to be taken to address the water and waste related impacts identified for the Market Coke and Co-generation Plant Project. This section also identifies environmental monitoring that will be undertaken for the project. The plan of action is detailed for all the pertinent stages of the development, which are listed below:

- **Planning and design** phase refers to the stage when the feasibility studies are being undertaken, the project description is being developed and the plant is being designed. During this phase, the EIA is completed and environmental authorisations are applied for. This phase started in 2011 and is anticipated to be completed in mid-2013.
- **Construction phase** will commence after the environmental authorisations have been obtained. This phase will involve the physical construction of the plant and its associated infrastructure. The required services will be expanded to the construction site by constructing the necessary trenches and placing the pipelines etc. Construction of the Market Coke and Co-

generation Plant is due to begin Q1 2014 and should be completed by the end of 2016.

- **Operations** of the Market Coke and Co-generation Plant is anticipated to last 20 years.
- **Decommissioning phase** refers to the time in the plant life when operations are reduced in preparation for closure. It is anticipated that plant activities will last 20 years, it is therefore estimated that decommissioning will commence in 2036.
- **Post-closure phase** refers to after the plant has been shut down and no plant activities are undertaken.

The structure of the EMP is presented in a way that for each impact that has been identified in the EIA report the following information will be included:

- The objectives of each of the actions to be implemented for management;
- The time periods in which the actions are to be implemented; and
- The person responsible for the implementation of the actions.

There is already an approved EMP for the existing Char Manufacturing Plant, which is adjacent to the proposed Market Coke and Co-generation Plant. An amendment to the existing EMP for Market Coke and Co-generation Plant has been compiled and the tables below from section 6.5.1.1 to 6.5.1.5 include the original and amended points. Please note that the table below is only for water and waste related impacts. The complete EMP for all impacts is included as part of the EIA for the project.

6.5.1.1 Planning and Design

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
1. SOILS AND GROUNDWATER RESOURCES					
Objective: Protection of utilisable soils and preventing contamination of groundwater.					
1.1.	Plan for impervious surfaces, bunding and dirty water management areas.	Reductants Plants Business Unit Manager	Prior to construction	Suitable engineering designs to plan for the management of this impact.	Not included in original EMP.
1.2.	Plan for facilities for the management of general and hazardous waste.	Reductants Plants Business Unit Manager	Prior to construction	Suitable engineering designs to plan for the management of this impact.	Not included in original EMP.
1.3.	Waste management procedure to be developed including the management of builders' rubble and recyclable wastes.	Reductants Plants Business Unit Manager	Prior to construction	Waste management procedure	Not included in original EMP.
1.4.	Agreements to be sought with the Grootegeluk Mine for the use of sewage treatment facilities.	Reductants Plants Business Unit Manager	Prior to construction	Service agreement with Grootegeluk Mine.	Not included in original EMP.
1.5.	Planning to include provision for the development of topsoil stockpiles (for uncontaminated topsoil).	Reductants Plants Business Unit Manager	Prior to construction	Plant layout to provide for a topsoil stockpile area.	Not included in original EMP.
Objective: To prevent any impact on the proposed Market Coke and Co-generation Plant Expansion in terms of geotechnical instability due to the high ground water table of the site and immediate surrounding area.					
1.6.	If necessary, appropriate measures will be implemented to ensure the geotechnical stability of the Market Coke and Co-generation Plant due to the high groundwater table.	Reductants Plants Business Unit Manager	As required	Consult a geotechnical engineer.	5.7 (c)
1.7.	Groundwater abstraction could be implemented in order to reduce the level of the groundwater table. The abstracted groundwater could be utilised for dust suppression during the construction phase or in the Market Coke and Co-generation Plant.	Reductants Plants Business Unit Manager	As required	Consult a geohydrologist.	5.7 (d)
1.8.	If ground water abstraction is implemented, then the appropriate water use licence in terms of the National Water Act, 1998 (Act 36 of 1998) must be obtained.	Environmental Practitioner	As required	N/A	5.7 (e)
2. SURFACE WATER QUALITY					
Objective: To ensure adequate planning regarding potential impacts on surface water prior to the construction phase.					
2.1.	The storm water management measures for the Market Coke and Co-generation Plant must be designed by a suitably qualified person and in accordance with the requirements of Regulation GN 704, dated June 1999,	Reductants Plants Business Unit Manager	Prior to construction	Specialist surface water engineer to compile a surface water (incl. storm water) management report.	5.2 (d); 5.6 (f)

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
	under the National Water Act, 1998 (Act 36 of 1998).				
2.2.	Storm water management for construction must be planned.	Reductants Plants Business Unit Manager	Prior to construction	Ensure that there are designs of suitable structures to contain stormwater runoff.	Not included in original EMP.
3. ENVIRONMENTAL AWARENESS AND TRAINING					
Objective: To ensure that all persons working at the Plant are aware of the objectives of the EMPR as well as the consequences of their individual actions					
3.1.	Environmental induction training material must be ready prior to construction period for use in environmental induction training.	Environmental Practitioner	Prior to construction	Review of environmental training requirements.	Not included in original EMP.
3.2.	Where necessary, Exxaro Reductants must develop Environmental Procedures to give effect to the commitments of the EMP.	Environmental Practitioner	Prior to construction	Review of EMP commitments.	Not included in original EMP.
3.3.	Exxaro Reductants procurement contracts to make provision for compliance with EMP by all contractors.	Reductants Plants Business Unit Manager	Prior to construction	Appropriate procurement contract	Not included in original EMP.
4. ENVIRONMENTAL LEGAL COMPLIANCE					
Objective: To ensure the Market Coke and Co-generation Plant is environmentally legally complaint					
4.1.	Exxaro Reductants to make provision for suitably qualified personnel to oversee and monitor EMP compliance during construciton and operations (ECO).	Environmental Practitioner	Prior to start of construction.	Appointment of ECO.	Not included in original EMP.
4.2.	Any operational changes or new projects at the Market Coke and Co-generation Plant must be reviewed by a suitably qualified person to ensure the necessary environmental authorisation procedures.	Environmental Practitioner	Prior to operational changes or new projects.	Review of environmental legislation.	Not included in original EMP.
4.3.	Exxaro Reductants must ensure overall environmental legal compliance with all relevant legislation.	Environmental Practitioner	Prior to construction.	Review of environmental legislation.	Not included in original EMP.

6.5.1.2 Construction

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
5. ENVIRONMENTAL AWARENESS AND TRAINING					
Objective: To ensure that all persons working at the Plant are aware of the objectives of the EMPR as well as the consequences of their individual actions					
5.1.	Environmental induction training must be provided to all persons undertaking work at the Market Coke and Co-generation Plant (to be	Reductants Plants Business Unit	Prior to site establishment.	Environmental induction and training material	5.15 (b)

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	incorporated into normal induction training) including permanent workers, contractors and consultants. As part of the induction all workers on site must be made aware of the conditions of the EMP.	Manager	For all new personnel.		
5.2.	All employees and contractors should be exposed to the environmental awareness programme.	Reductants Plants Business Unit Manager	Prior to site establishment.	Environmental awareness plan (Appendix 8)	Not included in original EMP.
5.3.	Compliance with the EMP must be included as a contractual condition in any contract with a contractor.	Reductants Plants Business Unit Manager	In tender documentation	Condition in contract	Not included in original EMP.
5.4.	All contractors must be provided with a copy of the EMP and all Environmental emergency procedures. Compliance with the EMP must be included as a contractual condition in contract with any contrator	Reductants Plants Business Unit Manager	On appointment of each contractor	EMP Environmental emergency procedures	Not included in original EMP.
6. ENVIRONMENTAL MONITORING					
Objective: To recognise impacts on air, ground and surface water resources in the area.					
6.1.	All groundwater monitoring points for the plant shall be monitored. Boreholes to be monitored include WBR 50, WBR 57 and WBR 43. Both groundwater level and groundwater quality are to be measured.	Environmental Practitioner	Quarterly	Groundwater monitoring schedule, protocol and equipment.	Not included in original EMP.
6.2.	All surface water quality monitoring points for the plant shall be monitored. Sampling points include the Pollution Control Dam (PCD), PCD extension and the Bosbok Dam.	Environmental Practitioner	Quarterly	Surface water monitoring schedule, protocol and equipment.	Not included in original EMP.
6.3.	All sampling is to be conducted by suitably qualified and competent persons using appropriate sampling techniques. All samples will be analysed at an accredited, independent laboratory for chemical and physical constituents normally associated with the presence of coal and carbonaceous material, as well as those which are specific to Market Coke and Co-generation Plant operations, or which are specified in the relevant environmental authorisations.	Environmental Practitioner	Quarterly	Check qualifications and competency of persons conducting sampling. Analysis of samples by an accredited laboratory.	Not included in original EMP.
6.4.	Records of monitoring must be kept for the site.	Environmental Practitioner	During construction	Record-keeping.	5.7 (i)
6.5.	Monitoring results must be made available to the Reductants Plants Business Unit Manager on a monthly basis. Potential negative impacts should be identified and addressed as soon as possible.	Environmental Practitioner	During construction	Record-keeping.	5.7 (j)
7. EMPR COMPLIANCE					
Objective: To ensure implementation of the required management measures and to ensure compliance with the EMPr					
7.1.	A copy of the EMP and all environmental authorisations must be kept at	Reductants Plants	During Construction	EMP, licences and authorisations,	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	the main site office.	Business Unit Manager			EMP.
7.2.	Each contractor must keep a copy of the EMP at their office and this copy must be available to their staff.	Contractor	Throughout length of contract.	EMP	Not included in original EMP.
7.3.	Contractors must comply with the EMP where it applies to the nature of their activities and their contract with Exxaro Reductants.	Contractor	Throughout the duration of the contract.	Appropriate contract with contractors.	Not included in original EMP.
7.4.	Contractors must implement any procedures and written EMP instructions issued to them by Exxaro Reductants.	Contractor	Throughout the duration of the contract.	Appropriate instructions and contract with contractors.	Not included in original EMP.
7.5.	Contractors must not deviate from the EMP or written instructions without approval from Exxaro Reductants.	Contractor	Throughout the duration of the contract.	Appropriate contract with contractors.	Not included in original EMP.
7.6.	A daily site diary must be kept by each contractor to record any environmental incidents for the day. Environmental incidents must be rectified and reported to the Environmental Practitioner.	Contractor	Throughout the duration of the contract.	Contractor's Environmental site diary	Not included in original EMP.
7.7.	Exxaro Reductants must appoint, in writing, a capable and suitably qualified ECO to monitor all environmental aspects and EMP compliance.	Environmental Practitioner	During construction	Appointment of ECO.	5.15 (a)
7.8.	The ECO will monitor and audit the construction activities to ensure compliance with this EMP and the Environmental Authorisation.	Environmental Compliance Officer	Weekly during construction	EMP Monitoring and auditing. Record-keeping.	5.15 (b)
7.9.	A register of all environmental incidents is to be maintained. The Environmental Practitioner is to be notified of all environmental incidents.	Environmental Practitioner	During construction	Environmental incident register.	Not included in original EMP.
7.10.	All environmental incidents must be investigated to assess: the cause; the effectiveness of the response; the actions taken to rectify the damage and measures needed to prevent recurrence. A close-out report must be compiled.	Environmental Practitioner	For each incident	Environmental incident report.	Not included in original EMP.
7.11.	Records relating to the compliance and non-compliance with the conditions of the EMP and Environmental Authorisation will be kept in good order. Such records will be available for inspection at the site office and must be made available to the relevant government departments within seven (7) working days of the date of the written request by the Department for such records.	Environmental Practitioner	During construction	Environmental compliance records.	5.15 (c), 5.15 (e)and 5.15 (f)
8. ENVIRONMENTAL EMERGENCIES AND RISKS					
Objective: To minimise the risk for environmental emergencies occurring and implement controls to deal with situations, should they occur.					
8.1.	Risk assessments are to be undertaken for all construction facilities and activities. Environmental emergency procedures are to be developed in	Environmental Practitioner	Prior to site establishment.	Risk assessments Environmental emergency procedures	Not included in original EMP.

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	response to potential risks.		For any new activty or facility.	(Appendix 8)	
9. GROUNDWATER RESOURCES					
Objective: To reduce the potential impact on the groundwater associated with the site.					
9.1.	The excavated coal layer/carbonaceous material (from the disused coal stockpile) must be removed from the Market Coke and Co-generation Plant site and either returned to the Grootegeluk beneficiation plants or disposed of on the Grootegeluk discard dumps where there is no risk of combustion. The coal/carbonaceous material may not be stockpiled on the surrounding area.	Reductants Plants Business Unit Manager	Commencement of construction	Discussions with Grootegeluk Mine to locate a suitable position for the material.	5.7 (a)
9.2.	Remove the upper soil layer to a depth of 60 cm, where contamination has been identified (Refer to the report by Golder, 2011 – Appendix 6). The contaminated soil must be disposed of on the Grootegeluk Mine discard dumps. Uncontaminated soil should be stockpiled separately for use in rehabilitation.	Environmental Practitioner	Commencement of construction	Discussions with Grootegeluk Mine to locate a suitable position for the material.	5.3 (c)
9.3.	~~An appropriate sewage system (e.g. Biogeza or Lily put system) will be implemented for the plant in order to reduce any potential impact on the ground water environment. This system will have sufficient capacity.~~ THIS MITIGATION MEASURE FROM THE ORIGINAL APPROVED EMP IS NO LONGER REQUIRED AS THE SEWAGE WILL BE PUMPED TO THE GROOTEGELUK MINE FOR TREATMENT IN THEIR SEWAGE TREATMENT PLANT.	~~Reductants Plants Business Unit Manager~~	~~During construction~~	N/A	~~5.7 (g)~~
9.4.	Chemical toilets will be provided for construction personnel during the construction phase if the sewage system is found to be insufficient for the number of people on site during construction.	Reductants Plants Business Unit Manager/ Procurement Manager	During construction	Estimation of sewerage system capacity and personnel numbers on site.	5.7 (f)
9.5.	Water use is to comply with water use licensing requirements.	Reductants Plants Business Unit Manager	During construction	A copy of the water use licence and regular compliance monitoring.	Not included in original EMP.
10. SURFACE WATER RESOURCES					
Objective: To reduce the potential impact on surface water run-off and reduce water consumption.					
10.1.	Appropriate storm water control measures must be provided for the site, and must comply with the GN704 Regulations on the Use of Water for Mining and Related activities.	Reductants Plants Business Unit Manager	During construction	Designs done according to specifications by a suitably qualified surface water engineer.	5.2 (b); 5.6 (d)
10.2.	A storm water cut-off drain according to the GN704 Regulations must be	Reductants Plants	During construction	Designs done according to specifications	5.2. (c); 5.6 (e)

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	constructed and maintained around the site.	Business Unit Manager		by a suitably qualified surface water engineer.	
10.3.	Designed storm water management measures will be implemented to contain all contaminated runoff generated within the dirty water management area.	Reductants Plants Business Unit Manager	During construction	Designs done according to specifications by a suitably qualified surface water engineer.	5.6 (g)
10.4.	No construction of any water management facilities will be undertaken with any material (such as coal residue or other carbonaceous material) that may cause pollution of water resources.	Reductants Plants Business Unit Manager	During construction	Obtain suitable material for the construction of these facilities.	5.2 (e), 5.6 (h)
10.5.	Sediment originating from construction activities is to be removed from storm water by installing sediment traps.	Reductants Plants Business Unit Manager	During construction	Sediment traps to be included in designs done according to specifications by a suitably qualified surface water engineer.	Not included in original EMP.
10.6.	Uncontrolled discharge of any contaminants such as fuels, oils, detergents, cement and organic materials into any watercourse or storm water drain is prohibited.	Reductants Plants Business Unit Manager	During construction	Include in environmental induction and training material	Not included in original EMP.
10.7.	Grey water from the office, kitchen and bathrooms shall be discharged into the sewage system for treatment.	Reductants Plants Business Unit Manager	During construction	The water reticulation infrastructure must be appropriately designed.	Not included in original EMP.
10.8.	Water used for dust suppression shall be in quantities small enough not to generate significant run-off.	Reductants Plants Business Unit Manager	During construction	Monitoring of dust suppression activities.	Not included in original EMP.
11. SOIL AND LAND CAPABILITIES					
Objective: To ensure that construction activities have the least impact on the apedal sandy soils in terms of soil quality, structure and erosion potential					
11.1.	The proposed Market Coke and Co-generation Plant site must be pegged out and fenced. All construction activities must take place within this area to limit the extent of impacts.	Reductants Plants Business Unit Manager	Prior to and during construction	Fencing and layout map showing site boundary.	5.2 (a); 5.3 (a); 5.5 (a); 5.6 (a) (b)
11.2.	If any non-contaminated soils are found on site, the upper 70 cm of soils should be removed and stockpiled for use in rehabilitation.	Environmental Practitioner	Commencement of construction	Designated topsoil storage area.	Not included in original EMP.
11.3.	Once the construction activity has been completed, the remaining disturbed area which will not be used must be topsoiled, sloped and re-vegetated as soon as possible using suitable grass species.	Environmental Practitioner	During and post construction	Topsoil, suitable grass seeds.	5.3.(e)
11.4.	The topsoil will be analysed to determine imbalances prior to the replacement of soil. Inorganic fertilisers will be used to supplement the soils before seeding of the area takes place.	Environmental Practitioner	As required	Topsoil analysis, inorganic fertilisers. Designated area for the safe storage of fertilisers.	5.3 (f)
11.5.	Appropriate soil conservation measures will be provided in order to prevent soil erosion and loss of topsoil.	Environmental Practitioner	Prior and during construction	N/A	5.3.(g)
11.6.	Topsoil stockpiles must be sloped to 1:3. No soil stockpile must be higher	Environmental	During soils	Topsoil benching and sloping.	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	than 15 m.	Practitioner	stockpiling		EMP.
11.7.	Topsoil stockpiles, that will be in place for longer than 3 months must be protected through seeding as soon as possible.	Environmental Practitioner	During soil stockpiling, within 30 days of stockpile formation	Suitable grass seeds.	Not included in original EMP.
11.8.	Topsoil which is contaminated may not be utilised as fill material. It must be suitably disposed of.	Environmental Practitioner	During and post construction.	Suitable disposal location must be found.	Not included in original EMP.
11.9.	All roads and compacted areas used during construction (which are not required for operation) are to be ripped and the establishment of vegetation promoted.	Contractor and Reductants Plants Business Unit Manager	After construction is complete.	Machine which can rip the soil.	Not included in original EMP.
11.10.	All infrastructure including foundations and concrete surfaces that will not be used during Market Coke and Co-generation Plant operations must be removed from site.	Contractor and Reductants Plants Business Unit Manager	After construction is complete.	Demolition equipment.	Not included in original EMP.
12. AIR QUALITY					
Objective: To ensure that construction activities have the least possible impact on air quality of the site and immediate surroundings.					
12.1.	Minimise the generation of dust as a result of construction activities. Such measures must include regular and effective wetting or chemical dust suppression of gravel access roads and working areas, sweeping of silt from roads and covering of stockpiles.	Reductants Plants Business Unit Manager/Contractor	During construction phase	Water supply for dust suppression purposes. Dust supression work procedures and equipment.	5.8 (a) and 5.8 (c)
12.2.	Intensify dust suppression or suspend dust generating activities during windy conditions.	Reductants Plants Business Unit Manager/Contractor	During construction phase	Dust supression work procedures and equipment.	5.8 (b)
12.3.	Dust suppression should be done with water hoses in inaccessible areas where vehicular traffic is impossible.	Reductants Plants Business Unit Manager/Contractor	During construction phase	Dust supression work procedures and equipment.	5.8 (d)
12.4.	Abstracted groundwater could be used for dust suppression purposes since groundwater quality only marginally exceeds SANS 241: 2011 drinking standards.	Reductants Plants Business Unit Manager/Contractor	During construction phase	Dust supression work procedures and equipment.	5.8 (e)
12.5.	Roads and loading areas must be regularly cleared of silt with the use of vacuum and/or broom sweepers.	Reductants Plants Business Unit Manager	During construction phase	Dust supression work procedures and equipment.	Not included in original EMP.
13. PUBLIC RELATIONS					
Objective: To ensure good relations with all Interested and Affected Parties (IAPs) by creating open channels of communication to address matters of concern that may arise.					
13.1.	The employment policy must give preference to local labour force.	Contractor / Human	During construction	Employment Policy	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
		Resources Manager	phase		EMP.
13.2.	Transparent employment and procurement policies must be in place and clearly communicated to the community leaders.	Human Resources Manager / Procurement Manager	During construction phase	Communication policy and protocol Procurement policy	Not included in original EMP.
13.3.	Under no circumstances is recruitment to take place at the gate.	Contractor and Reductants Plants Business Unit Manager	During construction phase	Employment Policy Appropriate signage	Not included in original EMP.
13.4.	Access control must be in place at the construction site.	Project Manager	During construction phase	Site security Appropriate signage Access control procedure	Not included in original EMP.
13.5.	Communication between the contractors, Grootegeluk Coal Mine and the various interested and affected parties will be established and maintained through regular notifications and providing IAPs with a means of providing feedback on an ongoing basis. The general public forum which is conducted by the Grootegeluk Mine, must also allow members of the community to raise their issues of concern regarding the Market Coke and Co-generation Plant project.	Public Relations Officer	During construction phase	Communication policy and protocols.	5.15 (a)
13.6.	Maintain a complaints register at the site entrance. The complaints register will record the following: Date when complaint/concern was received; Name of person to whom the complaint/concern was reported; Nature of the complaint/concern reported; The way in which the complaint/concern was addressed (date to be included).	Environmental Practitioner	During construction phase	Complaints register	5.15 (b) and (c)
13.7.	Any complaints regarding the said development will be brought to the attention of the Environmental Practitioner within 24 hours after receiving the complaint.	Environmental Practitioner	During construction	Complaints register	5.15 (d)
13.8.	The complaints must be investigated and remedied where possible. A response should be provided to the complainant.	Environmental Practitioner	During construction within 72 hours	Environmental Practitioner will determine what is required.	Not included in original EMP.
13.9.	The complaints register will be kept up to date for inspection by members of the LEDET.	Environmental Practitioner	During construction	Complaints register	5.15 (e)
14. SPILL PREVENTION					
Objective: To minimise environmental impact from spills.					
14.1.	Within the construction area, self-contained bunded areas must be provided at: • Chemical storage facilties	Reductants Plants Business Unit Manager	On commencement of construction	Construction of appropriate bunded areas.	5.7 (a)

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	• Hazardous waste storage facilities (e.g. liquor); • Flammable and combustible liquid stoage facilites (e.g. hydrocarbons); • Electrical transformers containing oil and/or PCBs and • Locations where spills are common, including transfer points, workshops, and where hazardous substances are transferred and used regularly.				
14.2.	The self-contained bunded areas must be lined with an impermeable material to limit seepage into the ground water environment. Any spillage must either be recycled or transferred to be treated to environmentally acceptable standards.	Reductants Plants Business Unit Manager	On commencement of construction	Work procedure for the recovery, transfer and recycling of spillage.	5.7 (b)
14.3.	For flammable substances, bunded areas should have 110% of the capacity of the total storage volume for the substance. Bunds should be provided with valves for the controled release of rainwater.	Reductants Plants Business Unit Manager	On commencement of construction	Construction of appropriate bunded areas.	Not included in original EMP.
14.4.	Non flammable hazardous substances must be stored within bunded areas with the capacity to contain 100% of the largest container stored.	Reductants Plants Business Unit Manager	On commencement of construction	Construction of appropriate bunded areas.	Not included in original EMP.
14.5.	Ensure adequate signage at hazardous storage areas and Material Safety Data (MSD) sheets for all chemicals must be displayed in close proximity to the area of storage.	Reductants Plants Business Unit Manager	During construction phase	Suitable signs and MSD sheets for all relevant chemicals	Not included in original EMP.
14.6.	Chemical spills are to be regarded as an environmental incident and reported through the incident reporting system.	Environmental Practitioner	During construction phase	Incident reporting system and procedure	Not included in original EMP.
14.7.	Hazardous chemicals (such as those used for cleaning) must not be released into the environment or sewage treatment system. These materials must be contained and disposed of as hazardous waste.	Reductants Plants Business Unit Manager	During construction phase	Hazardous chemical handling procedure. Environmental induction and training	Not included in original EMP.
14.8.	Fuel and other petrochemicals must be stored in receptacles that comply with SANS 100-1:2003 (SABS089-1:2003).	Reductants Plants Business Unit Manager	During construction phase	Construction / use of suitable receptacles.	Not included in original EMP.
14.9.	All fuel tanks used in construction must be above ground and bunded in accordance with the requirements for flammable liquids.	Reductants Plants Business Unit Manager	On commencement of construction	Construction of appropriate bunded areas.	Not included in original EMP.
14.10.	Appropriate containers must be used for storage and transport of hazardous substances.	Reductants Plants Business Unit Manager	During construction phase	Use of suitable receptacles.	Not included in original EMP.
14.11.	Personnel dealing with hazardous substances must be appropriately trained.	Environmental Practitioner	During construction phase	Environmental induction and training.	Not included in original EMP.
14.12.	Manage dedicated areas used for washing, maintenance and repair of	Reductants Plants	During construction	N/A	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
	vehicles and equipment.	Business Unit Manager	phase		EMP.
14.13.	Regular inspection is to be carried out on areas where hazardous substances are stored or handled.	Environmental Practitioner	During construction phase	Monitoring schedule and protocol.	Not included in original EMP.
14.14.	Obtain proof from contractors removing hazardous waste (such as used oil) of final destination and disposal.	Environmental Practitioner	During construction phase	Safe disposal cerficates.	Not included in original EMP.
14.15.	All vehicles must be checked for leaks before commencing work on site.	Reductants Plants Business Unit Manager	During construction phase	Inspection.	Not included in original EMP.
14.16.	Drip trays must be placed beneath parked vehicles which drip oil.	Reductants Plants Business Unit Manager	During construction phase	Inspection schedule and procedure Environmental induction and training	Not included in original EMP.
14.17.	All equipment that leaks fluid must be repaired immediately or removed from site when necessary.	Reductants Plants Business Unit Manager	During construction phase	Inspection. Environmental induction and training	Not included in original EMP.
14.18.	Vehicle and equipment maintenance and repair is only to be undertaken in designated areas.	Reductants Plants Business Unit Manager	During construction phase	Construction of vehicle maintenance area.	Not included in original EMP.
14.19.	Maintenance and workshop areas must be provided with impervious surfaces.	Reductants Plants Business Unit Manager	On commencement of construction	Construction of vehicle maintenance area.	5.7 (d)
14.20.	Hydrocarbon handling areas must be supplied with storm water diversion measures.	Reductants Plants Business Unit Manager	On commencement of construction	Designs done according to specifications by a suitably qualified surface water engineer.	Not included in original EMP.
14.21.	All spills of chemicals or hydrocarbons (oil, grease, diesel, petrol, etc.) will be cleaned with the use of suitable absorbent materials such as Drizit or Oclansorb.	Reductants Plants Business Unit Manager	During construction phase	Spill procedure. Drizit or oclansorb	5.7 (e)
14.22.	All soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils shall take place should such a facility be available on site.	Reductants Plants Business Unit Manager	During construction phase	Procedure for treatment or disposal of contaminated soils.	Not included in original EMP.
14.23.	Ensure appropriate inspections are conducted to ensure early detection of spills. The integrity of bunds are to be monitored regularly to ensure that no seepage escapes.	Reductants Plants Business Unit Manager	During construction phase	Monitoring schedule and protocol	Not included in original EMP.

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
15. WASTE MANAGEMENT					
Objective: To effectively manage wastes generated at the Plant.					
15.1.	Provide designated waste collection points and ensure that these have adequate capacity and are frequently cleaned.	Reductants Plants Business Unit Manager	During construction phase	Waste receptacles.	Not included in original EMP.
15.2.	No littering. Regular litter patrol and site clean-up.	Environmental Practitioner	During construction phase	Waste receptacles.	Not included in original EMP.
15.3.	No on-site disposal or burning of wastes.				
15.4.	Ensure regular inspections of waste handling, storage and disposal areas.	Environmental Practitioner	During construction phase	Monitoring schedule and protocol	Not included in original EMP.
15.5.	Records should be kept of quantities delivered, used and/or recycled.	Environmental Practitioner	During construction phase	Record keeping.	Not included in original EMP.
15.6.	Separate, signed waste receptacles must be provided for hazardous and general waste. No illegal dumping or disposal will take place.	Environmental Practitioner	During construction phase	Waste receptacles. Appropriate signage	5.7 (c)
15.7.	Separate receptacles should be provided for recyclable materials.	Environmental Practitioner	During construction phase	Waste receptacles. Waste recycling procedure	Not included in original EMP.
15.8.	Provide waste management training to all personnel. All contractors to be provided with a copy of the waste management procedure.	Environmental Practitioner	During construction phase	Waste management procedure Environmental induction and training	Not included in original EMP.
15.9.	General waste must be removed from site on a regular basis and disposed of at a licensed landfill site.	Reductants Plants Business Unit Manager	During construction phase	Waste disposal procedure	Not included in original EMP.
15.10.	All hazardous waste must be handled and stored on impervious surfaces. Max allowable capacity 35m^3.	Reductants Plants Business Unit Manager	During construction phase	Hazardous chemical handling procedure.	Not included in original EMP.
15.11.	Liquid and solid hazardous waste must be separated.	Reductants Plants Business Unit Manager	During construction phase	Hazardous chemical handling procedure.	Not included in original EMP.
15.12.	Hazardous waste which requires off-site disposal must be disposed of at a licensed hazardous waste site.	Reductants Plants Business Unit Manager	During construction phase	Waste disposal procedure.	Not included in original EMP.
15.13.	Chemical toilets will be provided for construction personnel during the construction phase if the sewage system is found to be insufficient for the number of people on site during construction.	Reductants Plants Business Unit Manager / Procurement Manager	On commencement of construction	Chemical toilets if required.	Not included in original EMP.
15.14.	Sewage must be disposed to a licenced sewage treatment works.	Reductants Plants	During construction	Waste disposal procedure.	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
		Business Unit Manager	phase	Service agreement with Grootegeluk Mine.	EMP.
16. OCCUPATIONAL HEALTH AND SAFETY					
Objective: To ensure safety of construction workers at the Market Coke and Co-generation Plant Manufacturing Plant Expansion.					
16.1.	The contractors will adhere (at all times) to the requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the Mine Health and Safety Act, 1996 (Act 29 of 1996).	Reductants Plants Business Unit Manager/ contractor	During construction phase	Induction and environmental training.	Not included in original EMP.
16.2.	All personnel must wear job-specific PPE at all times.	Reductants Plants Business Unit Manager/Contractor	During construction phase	Induction and environmental training. PPE. Signage at each work area.	Not included in original EMP.
16.3.	Fire fighting equipment must be available and maintained on site at all times, particularly in areas where any flammable substance is stored.	Reductants Plants Business Unit Manager/Contractor	During construction phase	Appropriate fire fighting equipment.	Not included in original EMP.

6.5.1.3 Operational Phase

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
17. ENVIRONMENTAL AWARENESS AND TRAINING					
Objective: To ensure that all personnel are aware of the objectives of the EMPR as well as the consequences of their individual actions					
17.1.	Environmental induction training is to be undertaken by all persons undertaking work at the plant (to be incorporated into normal induction training) including permanent workers, contractors and consultants. As part of the induction all workers on site must be made aware of the conditions of the EMP.	Environmental Practitioner	On appointment	Environmental induction training material	5.15 (b)
17.2.	On the job environmental training is to be undertaken by each person working at the plant.	Environmental Practitioner/ Supervisors	Throughout life of plant	General Environmental Training/Training of supervisors	Not included in original EMP.
17.3.	An environmental awareness programme is to be implemented for plant work force addressing pertinent topics as required.	Environmental Practitioner	Throughout life of plant	Programme for implementation of awareness topics. Environmental	Not included in original EMP.

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
				Awareness Plan (Appendix 10).	
17.4.	Environmental emergency procedures should be addressed as part of environmental training.	Environmental Practitioner	Throughout life of plant.	Environmental emergency procedures Environmental induction and training material	Not included in original EMP.
17.5.	A copy of the EMP and all environmental authorisations must be kept at the main site office.	Environmental Practitioner	Throughout life of plant.	EMP, licences and authorisations	Not included in original EMP.
17.6.	Compliance with the EMP must be included as a contractual condition in contract with any contrator	Reductants Plants Business Unit Manager	In tender documentation	Condition in contract	Not included in original EMP.
17.7.	If contractors are utilised during operation they must be provided with a copy of the EMP and all environmental emergency procedures.	Reductants Plants Business Unit Manager	On appointment of each contractor	EMP Environmental emergency procedures	Not included in original EMP.
17.8.	Each contractor must keep a copy of the EMP at their office and this copy must be made available to staff.	Contractor	Throughout length of contract.	EMP	Not included in original EMP.
17.9.	Create awareness about water and electricity consumption and encourage staff to use water and electricity sparingly. Appropriate waste disposal should also be explained.	Environmental Practitioner	Throughout life of plant.	Include in environmental awareness and induction and training material (refer to Appendix 10)	Not included in original EMP.
17.10.	Environmental emergency procedures should be addressed as part of environmental induction training.	Environmental Practitioner	Throughout life of plant.	Environmental emergency procedures (Appendix 10). Environmental induction and training material	Not included in original EMP.
17.11.	Operators of specialist equipment must be suitably trained/qualified. Operator training must include awareness of job-specific environmental risks.	Human Resources Manager	Throughout life of plant.	Training/qualification requirements for operators of specialist equipment. Checking training certificates before any job commences.	5.15 (e)
18. ENVIRONMENTAL MONITORING					
Objective: To recognise impacts on air, ground and surface water resources in the area.					
18.1.	All groundwater monitoring points for the plant shall be monitored. Boreholes to be monitored include WBR 50, WBR 57 and WBR 43. Both groundwater level and groundwater quality are to be measured.	Environmental Practitioner	Quarterly during operational phase	Groundwater monitoring schedule, protocol and equipment.	Not included in original EMP.
18.2.	All surface water quality monitoring points for the plant shall be monitored. Sampling points include the PCD, PCD extension and the Bosbok Dam	Environmental Practitioner	Quarterly during operational phase	Surface water monitoring schedule, protocol and equipment.	Not included in original EMP.
18.3.	Ambient air quality and emissions from the flares and stacks must be	Environmental	Quarterly or as	Air quality monitoring schedule, protocol	5.8 (e).

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
	monitored in accordance with the AEL.	Practitioner	required by AEL.	and equipment.	
18.4.	An air quality monitoring system specific to the plant will be put in place as required in terms of the legislation. The instantaneous peak, the 1-hour and 24-hour average as well as the monthly average will be obtained and the results compared to the limits in the AEL.	Environmental Practitioner	Monthly, or as stipulated in the AEL.	Emissions monitoring protocol and schedule.	5.8 (g)
18.5.	An ambient air quality monitoring programme must be set up.	Environmental Practitioner	As required by the AEL or other monitoring requirements.	Ambient air quality monitoring protocol and schedule.	5.8 (k)
18.6.	Ambient baseline PM_{10} monitoring as well as passive diffusive sampling of SO_2 and NO_2 is to be conducted.	Environmental Practitioner	As required by the AEL or other monitoring requirements.	Ambient air quality monitoring protocol and schedule.	Not included in original EMP.
18.7.	An air quality monitoring report will be forwarded to the province until such time that an air quality officer for the local municipality is appointed in terms of the National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004). A copy thereof will also be forwarded to the National Department of Environmental Affairs and Tourism.	Environmental Practitioner	As required by the AEL or other monitoring requirements.	Reporting requirements as per the AEL and National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)	5.8 (i)
18.8.	All sampling is to be conducted by suitably qualified and competent persons using appropriate sampling techniques. All samples will be analysed at an accredited, independent laboratory for chemical and physical constituents normally associated with the presence of coal and carbonaceous material, as well as those which are specific to Market Coke and Co-generation Plant operations, or which are specified in the relevant environmental authorisations.	Environmental Practitioner	Quarterly	Check qualifications and competency of persons conducting sampling. Analysis of samples by an accredited laboratory.	Not included in original EMP.
18.9.	Records of air, ground and surface water monitoring must be kept for the site.	Environmental Practitioner	Throughout life of plant.	Record-keeping.	5.7 (i)
18.10.	Air, ground and surface water monitoring results must be made available to the Reductants Plants Business Unit Manager. Potential negative impacts should be identified and addressed as soon as possible.	Environmental Practitioner	Monthly during operational phase.	Record-keeping. Management procedure to address potential negative impacts.	5.8 (h)
19. EMPR COMPLIANCE					
Objective: To ensure effective implementation of the EMPr					
19.1.	Monthly internal audits of EMP compliance	Environmental Practitioner	Monthly throughout life of plant	EMP checklist	Not included in original EMP.
19.2.	Annual external audit of EMP compliance	Independent Auditor	Annually	EMP	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
					EMP.
19.3.	Submission of external annual report to environmental authorities	Environmental Practitioner	Annually	N/A	Not included in original EMP.
19.4.	Performance assessments will be undertaken as required in Regulation 527 of the MPRDA.	Independent consultant	Every two years	EMP	Not included in original EMP.
19.5.	The proponent will appoint a suitably qualified person to conduct EMP Performance Assessments.	Environmental Practitioner	Every two years	N/A	Not included in original EMP.
19.6.	Annual update of financial provision for rehabilitation to ensure sufficient funding.	Environmental Practitioner	Annually	N/A	Not included in original EMP.
19.7.	A register of all environmental incidents is to be maintained. The Environmental Practitioner is to be notified of all environmental incidents.	Environmental Practitioner	Throughout life of plant.	Environmental incident register.	Not included in original EMP.
19.8.	All environmental incidents must be investigated to assess: the cause; the effectiveness of the response; the actions taken to rectify the damage and measures needed to prevent recurrence. A close-out report must be compiled.	Environmental Practitioner	For each incident	Environmental incident report.	Not included in original EMP.
19.9.	Records relating to the compliance and non-compliance with the conditions of the EMP and Record of Decision will be kept in good order. Such records will be available for inspection at the site office and must be made available to the LEDET within seven (7) working days of the date of the written request by the Department for such records.	Environmental Practitioner	Throughout life of plant.	Environmental compliance records.	5.15 (c), 5.15 (e)and 5.15 (f)
20. ENVIRONMENTAL RISKS AND EMERGENCIES					
Objective: To minimise the risk for environmental emergencies occurring and implement controls to deal with situations, should they occur.					
20.1.	Risks and emergencies must be managed in accordance with relevant Exxaro Reductants Emergency Procedures.	Environmental Practitioner	Throughout life of plant.	Environmental emergency procedures (Appendix 10)	Not included in original EMP.
20.2.	Telephone numbers of emergency services, including fire-fighting services, shall be clearly displayed on notice boards.	Environmental Practitioner	Throughout life of plant.	The required information should be displayed.	Not included in original EMP.
21. GROUNDWATER RESOURCES					
Objective: To minimise contamination risk to groundwater					
21.1.	Spill prevention measures are to be implemented during operational phase as described in construction phase.	Reductants Plants Business Unit Manager/Contractor	Throughout life of plant.	As described in construction phase.	As described in construction phase.
21.2.	All spills of chemicals or hydrocarbons (oil, grease, diesel, petrol, etc.) will be cleaned with the use of suitable absorbent materials such as drizit or oclanzorb. Appropriate soil remediation measures will be implemented where soil has been contaminated with oil.	Environmental Practitioner	Throughout life of plant	Suitable cleaning materials. Soil remediation procedure.	5.7 (e)

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
21.3.	Water abstraction is to comply with water use licensing requirements.	Reductants Plants Business Unit Manager	Throughout life of plant	Water abstraction records. Water Use Licence.	Not included in original EMP.
22. SURFACE WATER RESOURCES					
Objective: To reduce the potential impact on surface water run-off during the construction phase.					
22.1.	Surface water pollution prevention and spill prevention measures are to be implemented as described in construction phase.	Reductants Plants Business Unit Manager/ Environ-mental Practitioner/ Contractor	During operation phase.	As described in construction phase.	Not included in original EMP.
22.2.	The storm water control measures will be inspected on a weekly basis for signs of erosion or blockages during the first rainy season. Thereafter, inspections should occur on a monthly basis during the rainy and dry seasons. Any blockages or erosion should be repaired within 24 hours of discovery.	Reductants Plants Business Unit Manager	Throughout life of plant.	Inspection schedule and procedure. Work procedure for the maintenance of storm water control measures.	5.2 C(f); 5.2 O(c); 5.6 O(b) (c);
22.3.	~~Process water (0.5 m^3/h) will be bled into the mine process water system. A water meter would have to be provided in order to record the amount of process water bled from the plant.~~ THIS MITIGATION MEASURE FROM THE ORIGINAL APPROVED EMP IS NO LONGER REQUIRED AS THE MARKET COKE AND CO-GENERATION PLANT PROJECT WILL USE ADDITIONAL WATER FROM THE GROOTEGELUK MINE PROCESS WATER SYSTEM. WATER WILL NOT BE BLED FROM THE MARKET COKE AND CO-GENERATION PLANT TO THE GROOTEGELUK MINE'S WATER SYSTEM.	~~Environmental Practitioner~~	~~During operational phase~~	~~Installation of water meters where required~~	~~5.6 (e)~~
22.4.	Monitor the quality of the process water obtained from the Grootegeluk Mine to prevent any impact on the Market Coke and Co-generation Plant water system.	Reductants Plants Business Unit Manager	Monthly during operational phase	Monitoring schedule and protocol	5.6 (f)
22.5.	~~Washwater will also be returned into the mine water system. A water meter would have to be provided in order to record the amount of washwater returned into the mine water system.~~ THIS MITIGATION MEASURE FROM THE ORIGINAL APPROVED EMP IS NO LONGER REQUIRED AS THE MARKET COKE AND CO-GENERATION PLANT PROJECT WILL USE ADDITIONAL WATER	~~Environmental Practitioner~~	~~During operational phase~~	~~Installation of water meters where required~~ ~~Reporting procedure~~	~~5.6 (g)~~

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
	FROM THE GROOTEGELUK MINE PROCESS WATER SYSTEM. WATER WILL NOT BE BLED FROM THE MARKET COKE AND CO-GENERATION PLANT TO THE GROOTEGELUK MINE'S WATER SYSTEM.				
22.6.	~~Monitor the quality of the washwater in order to prevent any impact on the mine water system.~~ THIS MITIGATION MEASURE FROM THE ORIGINAL APPROVED EMP IS NO LONGER REQUIRED AS THE MARKET COKE AND CO-GENERATION PLANT PROJECT WILL USE ADDITIONAL WATER FROM THE GROOTEGELUK MINE PROCESS WATER SYSTEM. WATER WILL NOT BE BLED FROM THE MARKET COKE AND CO-GENERATION PLANT TO THE GROOTEGELUK MINE'S WATER SYSTEM.	~~Environmental Practitioner~~	~~During operational phase~~	~~Monitoring schedule and protocol~~	~~5.6 (h)~~
22.7.	A water balance will have to be set up for the plant in order to accurately record the water usage and to monitor the potential impact on the overall Grootegeluk Coal Mine water system.	Environmental Practitioner	During operational phase	Monitoring schedule and protocol. Water balance to be calculated by a suitably qualified geohydroligist.	5.6 (i)
22.8.	Dirty water run-off must be contained and not allowed to enter into the surrounding environment.	Reductants Plants Business Unit Manager	During operational phase.	Implementation of surface water control measures	Not included in original EMP.
22.9.	Sediment originating from operation activities is to be removed from storm water.	Reductants Plants Business Unit Manager	During operational phase.	Stormwater infrastructure must be maintained.	Not included in original EMP.
22.10.	Ensure adequate maintenance of water tanks, pipes and taps and repair all drips and leaks as soon as possible.	Reductants Plants Business Unit Manager	Throughout life of plant.	Regular maintenance should include water infrastructure when required.	Not included in original EMP.
22.11.	Maximise the recovery and re-use of water to minimise consumptive water use.	Reductants Plants Business Unit Manager	Throughout life of plant.	Operate the plant in accordance with the design specifications which incorporate water recycling.	Not included in original EMP.
22.12.	Water used for dust suppression shall be in quantities small enough not to generate significant run-off.	Reductants Plants Business Unit Manager	Throughout life of plant.	Monitoring of dust suppression activities.	Not included in original EMP.
23. SOILS AND LAND CAPABILITIES					
Objective: To minimise potential soil erosion and soil pollution during the operational phase.					
23.1.	Areas devoid of vegetation or where soil erosion has taken place should be	Environmental	During operational	As described in construction phase.	5.2 (g), (b); 5.3 (a)

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
	revegetated or remediated as soon as possible.	Practitioner	phase.		
23.2.	Spill prevention measures are to be implemented as in construction phase.	Environmental Practitioner/ Contractors	During operational phase.	As described in construction phase.	5.3 & 5.4
23.3.	In addition, the integrity of concrete surfaces is to be checked and maintained on a continuous basis to ensure contaminants do not enter into underlying soils.	Reductants Plants Business Unit Manager	During operational phase.	Stormwater infrastructure must be inspected and maintained if required.	Not included in original EMP.
24. AIR QUALITY					
Objective: To ensure that operational have the least possible impact on air quality of the site and immediate surroundings.					
24.1.	Use water sprays or dust extraction systems to limit coal dust generation when discharging coal at transfer points, into the coal silos/bunkers, at crushing station and compacting process	Reductants Plants Business Unit Manager	During operational phase.	Allocate water for this task.	5.8 (c)
Objective: To minimise dust creation at the Plant during Operations and from plant vehicles.					
24.2.	Minimise the generation of dust as a result of operation activities. Such measures must include regular and effective wetting or chemical dust suppression of gravel access roads and working areas, sweeping of silt from roads and covering of stockpiles.	Reductants Plants Business Unit Manager/ Contractor	Throughout life of plant	Water supply for dust suppression purposes. Dust supression work procedures and equipment.	5.8 (a) and 5.8 (c)
24.3.	Intensify dust suppression or suspend dust generating activities during windy conditions.	Reductants Plants Business Unit Manager/ Contractor	Throughout life of plant	Dust supression work procedures and equipment.	5.8 (b)
24.4.	Dust suppression should be done with water hoses in inaccessible areas where vehicular traffic is impossible.	Reductants Plants Business Unit Manager/ Contractor	Throughout life of plant	Dust supression work procedures and equipment.	5.8 (d)
24.5.	Abstracted groundwater could be used for dust suppression purposes since groundwater quality only marginally exceeds SANS 241: 2011 drinking standards.	Reductants Plants Business Unit Manager/ Contractor	Throughout life of plant.	Dust supression work procedures and equipment.	5.8 (e)
24.6.	Roads and loading areas must be regularly cleared of silt with the use of vacuum and/or broom sweepers.	Reductants Plants Business Unit Manager	Throughout life of plant.	Dust supression work procedures and equipment.	Not included in original EMP.

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
25. PUBLIC RELATIONS					
Objective: To ensure good relations with all interested and affected parties by creating open channels of communication to address matters of concern that may arise.					
25.1.	Measures to be implemented as described in Construction Phase	Public Relations Officer/ Environmental Practitioner	Throughout life of plant	Complaints register, Employment Policy, Procurement policy.	5.15 (c), (d), (e)
26. SPILL PREVENTION					
Objective: To minimise environmental impact from spills.					
26.1.	Ensure adequate signage at hazardous storage areas and Material Safety Data (MSD) sheets for all chemicals must be displayed in close proximity to the area of storage.	Reductants Plants Business Unit Manager	Throughout life of plant.	Suitable signs and MSD sheets for all relevant chemicals	Not included in original EMP.
26.2.	Chemical spills are to be regarded as an environmental incident and reported through the incident reporting system.	Environmental Practitioner	Throughout life of plant.	Incident reporting system and procedure	Not included in original EMP.
26.3.	Hazardous chemicals (such as those used for cleaning) must not be released into the environment or sewage treatment system. These materials must be contained and disposed of as hazardous waste.	Reductants Plants Business Unit Manager	Throughout life of plant.	Hazardous chemical handling procedure. Environmental induction and trianing	Not included in original EMP.
26.4.	Fuel and other petrochemicals must be stored in receptacles that comply with SANS 100-1:2003 (SABS089-1:2003).	Reductants Plants Business Unit Manager	Throughout life of plant.	Construction / use of suitable receptacles.	Not included in original EMP.
26.5.	Appropriate containers must be used for storage and transport of hazardous substances.	Reductants Plants Business Unit Manager	Throughout life of plant.	Use of suitable receptacles.	Not included in original EMP.
26.6.	Personnel dealing with hazardous substances must be appropriately trained.	Environmental Practitioner	Throughout life of plant.	Environmental induction and training.	Not included in original EMP.
26.7.	Manage dedicated areas used for washing, maintenance and repair of vehicles and equipment.	Reductants Plants Business Unit Manager	Throughout life of plant.	N/A	Not included in original EMP.
26.8.	Regular inspection is to be carried out on areas where hazardous substances are stored or handled.	Environmental Practitioner	Throughout life of plant.	Monitoring schedule and protocol.	Not included in original EMP.
26.9.	Obtain proof from contractors removing hazardous waste (such as oil and diesel) of final destination and disposal.	Environmental Practitioner	Throughout life of plant.	Safe disposal cerficates.	Not included in original EMP.
26.10.	All vehicles must be checked for leaks before commencing work on site.	Reductants Plants Business Unit Manager	Throughout life of plant.	Inspection.	Not included in original EMP.

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
26.11.	Drip trays must be placed beneath parked vehicles which drip oil.	Reductants Plants Business Unit Manager	Throughout life of plant.	Inspection schedule and procedure Environmental induction and training	Not included in original EMP.
26.12.	All equipment that leaks fluid must be repaired immediately or removed from site when necessary.	Reductants Plants Business Unit Manager	Throughout life of plant.	Inspection. Environmental induction and training	Not included in original EMP.
26.13.	Vehicle and equipment maintenance and repair is only to be undertaken in designated areas.	Reductants Plants Business Unit Manager	Throughout life of plant.	Construction of vehicle maintenance area.	Not included in original EMP.
26.14.	All spills of chemicals or hydrocarbons (oil, grease, diesel, petrol, etc.) will be cleaned with the use of suitable absorbent materials such as drizit or oclansorb.	Reductants Plants Business Unit Manager	Throughout life of plant.	Spill procedure. Drizit or oclansorb	5.7 (e)
26.15.	All soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils shall take place should such a facility be available on site.	Reductants Plants Business Unit Manager	Throughout life of plant.	Procedure for treatment or disposal of contaminated soils.	Not included in original EMP.
26.16.	Ensure appropriate inspections are conducted to ensure early detection of spills. The integrity of bunds are to be monitored regularly to ensure that no seepage escapes.	Reductants Plants Business Unit Manager	Throughout life of plant.	Monitoring schedule and protocol	Not included in original EMP.
27. WASTE MANAGEMENT					
Objective: To effectively manage wastes generated at the Plant.					
27.1.	Provide designated waste collection points and ensure that these have adequate capacity and are frequently cleaned.	Reductants Plants Business Unit Manager	Throughout life of plant.	Waste receptacles.	Not included in original EMP.
27.2.	Separate waste receptacles must be provided for hazardous and general waste. No illegal dumping or disposal will take place.	Environmental Practitioner	Throughout life of plant.	Waste receptacles. Appropriate signage	5.7 (c)
27.3.	Separate receptacles should be provided for recyclable materials.	Environmental Practitioner	Throughout life of plant.	Waste receptacles. Waste recycling procedure	Not included in original EMP.
27.4.	Records should be kept of quantities of waste generated, disposed and/or recycled.	Environmental Practitioner	Throughout life of plant.	Record keeping.	Not included in original EMP.
27.5.	Ensure regular inspections of waste handling, storage and disposal areas.	Environmental Practitioner	Throughout life of plant.	Monitoring schedule and protocol	Not included in original EMP.
27.6.	Provide waste management training to all personnel.	Environmental	Throughout life of	Waste management procedure	Not included in original

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANUFACTURING PLANT
		Practitioner	plant.	Environmental induction and training	EMP.
27.7.	General waste must be removed from site on a regular basis and disposed of at a licensed landfill site.	Reductants Plants Business Unit Manager	Throughout life of plant.	Waste disposal procedure	Not included in original EMP.
27.8.	All hazardous waste must be handled and stored on impervious surfaces.	Reductants Plants Business Unit Manager	Throughout life of plant.	Hazardous chemical handling procedure.	Not included in original EMP.
27.9.	Hazardous waste requiring off-site disposal must be disposed of at a licensed hazardous waste site.	Reductants Plants Business Unit Manager	Throughout life of plant.	Waste disposal procedure.	Not included in original EMP.
27.10.	Liquid and solid hazardous waste must be separated.	Reductants Plants Business Unit Manager	Throughout life of plant.	Hazardous chemical handling procedure.	Not included in original EMP.
27.11.	Sewage must be disposed to a licenced sewage treatment works.	Reductants Plants Business Unit Manager	Throughout life of plant.	Waste disposal procedure.	Not included in original EMP.
27.12.	Control of litter on an on-going basis.	Environmental Practitioner	Throughout life of plant.	Waste receptacles.	Not included in original EMP.
28. OCCUPATIONAL HEALTH AND SAFETY					
Objective: To ensure safety of workers at the Market Coke and Co-generation Plant Manufacturing Plant Expansion.					
28.1.	Exxaro and the contractors will adhere (at all times) to the requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the Mine Health and Safety Act, 1996 (Act 29 of 1996).	Reductants Plants Business Unit Manager/Contractor	Throughout life of plant	Induction and environmental training.	Not included in original EMP.
28.2.	All personnel must wear job-specific PPE at all times.	Reductants Plants Business Unit Manager/Contractor	Throughout life of plant	Induction and environmental training. PPE. Signage at each work area.	Not included in original EMP.
28.3.	Fire fighting equipment must be available and maintained on site at all times, particularly in areas where any flammable substance is stored.	Reductants Plants Business Unit Manager/Contractor	Throughout life of plant	Appropriate fire fighting equipment.	Not included in original EMP.

6.5.1.4 Decommissioning

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
29. AIR QUALITY					
Objective: To minimise the generation of dust during decommissioning.					
29.1.	Dust mitigation measures to be implemented as described in Construction Phase.	Reductants Plants Business Unit Manager/ Environmental Practitioner	During decommissioning phase	As described in construction phase.	Not included in original EMP.
30. SOCIO-ECONOMIC					
Objective: To minimise the impacts of job loss.					
30.1.	Measures identified in the SLP for promoting portable skills for workers must be implemented.	Reductants Plants Business Unit Manager / Human Resources Manager	During the Decommissioning phase	SLP	Not included in original EMP.
31. SOILS					
Objective: To minimise the impacts on soils after site closure and facilitate successful rehabilitation					
31.1.	All soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils shall take place should such a facility be available on site.	Environmental Practitioner/ Contractors	During decommissioning phase	Contaminated land assessment. Spill clean-up protocol. Hazardous chemical handling protocol.	Not included in original EMP.
31.2.	Spill prevention measures to be implemented as described in construction and operational phase.	Environmental Practitioner/ Contractors	During decommissioning phase	Chemical spill clean-up protocol Hazardous chemical handling protocol	Not included in original EMP.

6.5.1.5 Post Closure

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
32. SOCIO-ECONOMIC					
Objective: To minimise the impacts of job loss.					
32.1.	Measures identified in the SLP for promoting portable skills for workers must be implemented.	Reductants Plants Business Unit Manager	During post closure phase	SLP	Not included in original EMP.

REF.	ACTION	RESPONSIBILITY	TIME PERIOD FOR IMPLEMENTATION	REQUIREMENTS FOR IMPLEMENTATION	REF. IN APPROVED EMPr FOR EXISTING CHAR MANU-FACTURING PLANT
33. WATER					
Objective: To minimise groundwater and surface water contamination					
33.1.	The groundwater and surface water monitoring programme should be continued for the period stipulated by the relevant authorities.	Environmental Practitioner	After closure for a minimum of three years	Monitoring protocol	Not included in original EMP.

6.5.2 Rehabilitation and Closure Objectives

The closure objectives for the Market Coke and Co-generation Plant will be the same as those for the Grootegeluk Coal Mine. The following closure objectives have been extracted from the approved EMP for the Grootegeluk Mine:

- After closure, the safety and health of humans and animals will be safe from hazards resulting from mining (and plant) operations.
- Residual impacts will be identified and adequate management strategies will be put in place to ensure that these impacts will be adequately dealt with. Environmental damage or residual environmental impacts will be minimised through a public involvement programme, to such an extent that they are acceptable to all involved parties. The purpose of the EMP will also be to ensure that there are no foreseeable residual impacts that will be inherited by parties acquiring such land.
- As far as practicable, the land will be rehabilitated to its natural state or to a predetermined and agreed standard of land use, which conforms to the concept of sustainable development. The most probable final land use will be game farming.
- The physical and chemical stability of any remaining structures, such as residue dumps and infrastructure, will be such that the risk to the environment will not be increased by naturally occurring forces, to the extent that such increased risk cannot be contained by the installed measures.
- The EMP will predict long-term impacts and will focus on pollution prevention, minimisation and control. Monitoring programs will be used to confirm the accuracy of the predictions.
- The mine (and plants) will be closed efficiently and cost effectively.
- The mine (and plants) will make financial provision for post-closure environmental management and for the maintenance of pollution control measures.
- The Best Practical Guidelines that are available at the time of closure will be used.

Scientifically designed monitoring systems will be implemented as an integral part of the rehabilitation to ensure that preventative measures are adequate and efficient. The Market Coke and Co-generation Plant activities that have an impact on the environment over the remaining life of the plant will be determined and provisions for the financial assurances for the current and future plant site rehabilitation will be made.

In terms of current legislation (MPRDA), provision for plant closure has to be made during the operational life of the plant. Therefore, closure objectives have been set for the Market Coke and Co-generation Plant and a closure plan has been developed. Objectives have been set realistically and adequate provision has been made for meeting them. This includes taking legislative requirements, public concerns, technical constraints, economic planning, etc., into account.

It is foreseen that in some areas, rehabilitation will be done fully and that the environment will be returned to its original state, for example where old infrastructure is demolished and where waste and rubbish are removed. The potential for the re-use of such areas will be the same as it was before any mining activities took place.

Buildings and other usable structures could be used for the establishment of light industry on the site, if such industry is feasible. This will depend on the outcome and results of the social-economic assessment. Adherence to the EMP will ensure the closure objectives are achieved with the minimum impact on the environment and socio-economic environment.

6.6 Soil and Land Capability Management

The land use prior to the establishment of the Market Coke and Co-generation Plant was disused mining land within the Grootegeluk Coal Mine. The site is on a 49.4 ha portion of an old coal stockpile area (also known as the old coal middling stockpile area).

The site is within the boundaries of the Grootegeluk Mine and thus the immediate surrounding land use is mining and related activities. Other nearby land uses include livestock farming and game farming. No crop farming takes place in the vicinity. Closure objectives have therefore been developed to aim for these land uses can be continued after rehabilitation has successfully taken place.

During the different phases of the proposed Market Coke and Co-generation Plant project, namely Planning & Design, Construction, Operation, Decommissioning and Post Closure, there are various mitigation measures in place for soil and land management. During the planning & design phase, some mitigation measures in place include: planning for impervious surfaces to prevent soil pollution, bunding and dirty water management areas and planning to include provision for the development of topsoil stockpiles.

For the construction phase once construction has been completed, the remaining disturbed area, which will not be used, must be topsoiled, sloped and re-vegetated as soon as possible using suitable grass species. This re-vegetation will assist in reducing the potential for soil erosion. Contaminated topsoil may not be utilised as fill material or disposed of and topsoil stockpiles must be protected through seeding as soon as possible.

During the operational phase, areas devoid of vegetation or where soil erosion has taken place should be revegetated or remediated as soon as possible and no off-road driving will be allowed on site.

During the decommissioning and closure phases, all soils that have become contaminated with oils, fuels and lubricants must be removed and managed as hazardous waste. Bioremediation of contaminated soils could also take place should such a facility be available on site. The success of rehabilitation is to be monitored for at least 3 years after closure. Should rehabilitation not prove successful, a rehabilitation specialist must be included in the rehabilitation process.

For a more comprehensive list of the mitigation measures in place for soil and land capability management for the Market Coke and Co-generation Plant Project, refer to the EMP which forms part of the EIA.

7. MONITORING AND AUDITING SYSTEMS

7.1 Water Monitoring

7.1.1 Groundwater Monitoring

A well-established groundwater monitoring programme is currently implemented at Grootegeluk Coal Mine and at the existing Char Manufacturing Plant. Since the Market Coke and Co-generation Plant site is located within the existing Grootegeluk Coal Mine boundary area, this groundwater monitoring programme will be updated to include the Market Coke and Co-generation Plant site.

The main objective of the groundwater management that is currently implemented and will continue to operate at the Market Coke and Co-generation Plant site, is to prevent additional groundwater impacts as a result of the Market Coke and Co-generation Plant. The following objectives were considered for the development of the current groundwater management strategy at the Market Coke and Co-

generation Plant:

- Determination and quantification of additional impacts as a result of the manufacturing at the Market Coke and Co-generation Plant and related activities, or the lack thereof, on the groundwater at the site,
- Generation of information regarding the groundwater quality and quantity through monitoring,
- Managing the impacts on groundwater at the Market Coke and Co-generation Plant site to reduce the infiltration of contaminated surface water to the groundwater regime, and
- The prevention of possible further pollution of the groundwater.

Despite the best environmental practice design and anticipated operation of the Market Coke and Co-generation Plant site's water management system, proactive action will be taken to ensure that groundwater is not impacted on.

Monitoring is to be undertaken in accordance with the schedule presented in Table 7.1 below. The following activities will form part of the groundwater monitoring programme:

- Updating of the groundwater monitoring database as information becomes available. This information will be used in understanding the Market Coke and Co-generation Plant's groundwater impacts and updating the groundwater numerical model if required.
- Development of a monitoring response protocol after completion of the construction phase, this protocol is to describe procedures to be followed in the event that groundwater monitoring reveals that action must be undertaken.
- Compilation of an annual compliance report presenting results of the monitoring and submission to the Reductants Business Unit Manager.
- Updating and verification of the groundwater flow model on a 5 year basis to ensure that at least 5 years prior to plant closure the groundwater closure scenario is understood.

Table 7.1: Groundwater Monitoring Plan (Jones and Wagener, 2012A)

Monitoring Position	Sampling Interval	Analysis	Water Quality Standards
Operational Phase: First year of Processing Purpose: To establish a baseline dataset for at least one wet and one dry season, that can be used to verify model results			
All monitoring boreholes	Monthly	Groundwater levels	Not applicable
All monitoring boreholes	Quarterly (April, July, Oct, Jan)	Groundwater quality: Full chemical analysis	SANS 241; Permit
Rainfall	Daily at the operations Composite sample: Quarterly	Analysis for Chloride	Not Applicable
Operational Phase: Remaining life of Plant Purpose: To monitor trends in groundwater levels and quality. To trigger the Response Protocol, if required.			
All monitoring boreholes	Quarterly	Groundwater levels	Not applicable
All monitoring boreholes	Quarterly (April, July, Oct, Jan)	Groundwater quality: Full chemical analysis	SANS 241; Permit
Rainfall	Daily at the operations	No analysis	Not Applicable
Post-closure Phase (for 2 years after operations ceases)			
All monitoring boreholes	Quarterly (April, July, Oct, Jan)	Groundwater quality: Full chemical analysis Groundwater levels	SANS 241; Permit

Rainfall	Daily at the operations	No analysis	Not Applicable

7.1.2 Surface Water Monitoring

7.1.2.1 Surface water quality monitoring

Surface water monitoring will be carried out to ensure that the water management systems in place perform according to specifications, to act as a pollution early warning system, to check compliance with license requirements and for reporting purposes. The objectives of these systems will be achieved if there is no impact (attributable to the Market Coke and Co-generation Plant) on the quality and quantity of the downstream surface water (Jones and Wagener, 2012B).

As there are no watercourses upstream of the Market Coke and Co-generation Plant site and the upstream catchment is small with runoff occurring only during and immediately after rainfall events, the points that will continually be monitored are (refer to figure 3.15):

- The existing PCD
- The Bosbok Dam on Grootegeluk Mine

These two locations were selected since it was reasoned that any spillage from the site would be a spill from the PCD. Monitoring the water quality in the PCD will characterise the dirty water generated on the site. Since the PCD and PCD extension are expected to have similar water quality, it is unnecessary to sample both monthly; the PCD Extension can be sampled quarterly. Any spills from the site will flow into the Bosbok Dam. Any changes in the water quality in Bosbok Dam, particularly the presence of hydrocarbons, may be attributed to spillages from the Market Coke and Co-generation Plant. The frequency of sampling and analysis is detailed in Table 7.2.

Table 7.2: Surface water quality sampling and analysis

Location	Parameters to be analysed	Frequency
Existing PCD	• Full inorganics and trace elements, as well as pH and EC	12 times per year (Monthly)
PCD Extension	• Hydrocarbons	4 times per year(Quarterly)
Bosbok Dam	• Full inorganics and trace elements, as well as pH and EC	12 times per year (Monthly)
	• Hydrocarbons	4 times per year (Quarterly) During a spill event

7.1.2.2 Surface Water quantity monitoring (water balance monitoring)

For efficient management of water on the site, a good understanding of the site water balance will be required. To achieve this, the following monitoring will be needed:

- Rainfall – to be measured daily on the site
- Evaporation – this is not essential but would be useful for calibration of the water balance model
- Dam water levels – to be measured weekly
- Flows – including the following, to be measured weekly:
    - o Make-up water drawn from all systems (Grootegeluk process water, raw water and potable water)
    - o Inflows to the existing PCD
    - o Inflows to the PCD Extension

- o Water pumped from the PCDs for reuse in the process
- o Water circuits within the processing plant, including:
- o Make-up to cooling circuits
- o De-sulphurisation plant
- o Steam plant demineralization water circuit
- o Quench water
- o Moisture contents and tonnages of feed coal and coke and char product
- o Sewage volumes.

7.1.3 Bio-Monitoring

A bio-monitoring programme for the area is not necessary as there are no watercourses upstream of the Market Coke and Co-generation Plant site and the upstream catchment is small with runoff occurring only during and immediately after rainfall events. Additionally, all the dirty water will be captured in the PCDs.

There are also no watercourses immediately downstream of the site in which bio-monitoring could take place. The nearest defined surface water course is the Sandloop stream located approximately 10.3 km south east of the site.

7.2 Data Management and Reporting

7.2.1 Information System

The Market Coke and Co-generation Plant will develop a system that will allow the plant to capture and manage all water data. The system will incorporate groundwater quality and borehole levels as well as the water balances for the plant.

The data will provide the physical location and flow between water management structures. It also gives the opportunity to indicate the water resources used to supply the operation as well as all the receptors.

7.2.1.1 Internal Reporting

Internal reporting will include:

- Monthly reporting to the Market Coke and Co-generation Plant environmental meetings; and
- Quarterly reporting to the Exxaro Reductants Environmental Practitioner.

The time schedule of data management and reporting is tabulated below in Table 7.3.

Table 7.2: Data Management and Reporting

Reporting period	Report contents
Monthly	The monthly report is an internal report which is used to keep records of changing water qualities at the site. The report will include: ▪ Sites that are sampled ▪ Water qualities for the relevant constituents ▪ Dam levels and flow rates on site ▪ Highlight significant issues that require immediate corrective/ preventative action.
Bi-annually	The 6 month report may be submitted to DMR/ DWA and consists of the following components: ▪ Brief compliance assessment description ▪ Brief description of monitoring actions performed

	▪ Dam water level status report ▪ Highlight significant issues that require immediate corrective/ preventative action ▪ Historical and present source chemistry report ▪ Hydrochemical imaging: Piper and Durov diagrams. ▪ Time dependent graphs for the relevant water quality variables.
Annually	The annual report consists of all the active environmental components, and for the chapter on surface water, the following components should be included: ▪ System audit o Statutory/ regulatory requirements o Monitoring infrastructure o Data captured o Information generation o Management of system liquids ▪ Data audit o Verification of data o Compliance interpretation using SANS 241 Drinking Water Standard and management unit objectives o Setting of new objectives or recommendation of corrective measures o Historical and present source chemistry report o Dam level status report o Hydrochemical imaging: Piper and Durov diagrams.

7.2.1.2 Authority Reporting

A legal compliance register will be developed for the Market Coke and Co-generation Plant in order to manage its compliance with environmental legislation, regulations and documents. The legal register will advise on the requirements for authority reporting. This will allow the Market Coke and Co-generation Plant to ensure compliance with license and permit conditions.

Authority reporting on water resource issues will be in accordance with the conditions of the WUL Amendment to be issued.

7.3 Waste Monitoring

The amount of all general and hazardous wastes being produced and disposed of will be monitored and the data will be captured and stored. The following wastes will require this monitoring:

- Non-process solid hazardous waste: e.g. grease, oils, acids, fluorescent tubes, medical waste etc.
- Non-process liquid hazardous waste: e.g. sewerage and contaminated storm water.
- Process liquid hazardous waste: used process water returned to PCD.
- Process and non-process general wastes: construction waste, domestic waste, PCD silt.

Exxaro Coal (who will dispose of certain Exxaro Reductants' wastes) should retain proof of the following:

- The off-site disposal facility is appropriately authorised for such purpose,
- The waste is suitable for disposal at the particular waste disposal facility in accordance with the methodology outlined in Chapter Five of the DWAF's Minimum Requirements for the Handling, Classification and Disposal of Waste, Second Edition, 1998,
- Proof that the waste was indeed disposed of at such appropriately permitted destination,
- The required disposal method for the particular waste type has been followed by the operator of

the applicable landfill site.

Recycling of some of the solid general waste will also take place. Wastes will be separated into colour coded bins and recyclable waste will be recycled through the existing Grootegeluk Mine waste disposal system. Scrap metal will also be sold to a scrap metal recycling company. Appropriate records of wastes sent to recycling companies should also be kept.

7.4 Environmental Management System

The EMS and environmental procedures in place for the Market Coke and Co-generation Plant are explained in section 6.2 of this report and are attached as Appendix 8.

7.5 Incident Reporting and Investigation

7.5.1 Internal Reporting

The Market Coke and Co-generation Plant will develop an incident reporting and investigation system. This system is likely to require environmental incidents to be categorised according to their significance. Moderate and high significance incidents should be reported to Exxaro Reductants and the relevant authority.

A forum will be set up with the relevant interested and affected parties, which will allow the public to lodge any complaints. All public complaints will be managed as incidents, and investigated.

7.5.2 Authority Reporting

Incidents will be reported to the authorities in accordance with the conditions to be included in the WUL Amendment.

7.6 Environmental Impact Register

The Market Coke and Co-generation Plant will develop an environmental aspects and impact register where applicable. This register will provide the plant with the necessary information to develop environmental management procedures (if additional procedures are required) to mitigate environmental impacts.

7.7 Auditing and Reporting

Internal and authority reporting will take place as described in section 7.5 above.

An Environmental Compliance Officer (ECO) will be appointed for the construction phase of the project. The ECO will be responsible for monitoring all environmental aspects relating to the construction phase and auditing construction activities to ensure compliance with the EMP, the Environmental Authorisation and other environmental licenses.

An annual external audit of EMP compliance will also be carried out, for the life of the plant, by an external auditor and the results will be submitted to the relevant authorities.

8. OPERATIONAL MANAGEMENT

8.1 Organisational Structure

It is the responsibility of Exxaro Reductants to implement the EMP and to make sure that all the actions are carried out. The successful implementation of the EMP is however dependent on a clearly defined organisational structure and the allocation of roles and responsibilities for each of the management actions given. Roles have been ascribed to the following parties:

Table 8.1: Roles and Responsibilities for Environmental Management

Role	Responsibility
Reductants Business Unit Manager:	The person, from Exxaro Reductants, responsible for the overall management of the proposed Market Coke and Co-generation Plant including its construction, operational, decommissioning and post closure phases. Takes overall responsibility for implementation of the EMP.
Environmental Practitioner:	Environmental Scientist responsible for: • Overseeing day to day compliance with the EMP by the contractor's staff and sub-contractors and their staff; • Issuing instructions to remediate non-compliance; • Conducting regular inspection meeting with the Project Manager to report on compliance; and • Report non-compliance to the Reductants Business Unit Manager.
Environmental Compliance Officer (ECO):	Responsible for monitoring all environmental aspects relating to the construction phase and auditing construction activities to ensure compliance with this EMP, the Environmental Authorisation and other environmental licenses.
Operations Manager:	Engineer appointed to manage and oversee all Market Coke and Co-generation Plant operations.
Supervisor:	Persons responsible for work teams.
Public Relations Officer:	A designated person to deal with public issues.
Contractors:	Organisations or individuals that contracts with Exxaro Reductants for construction, maintenance, or any other activities required on the Market Coke and Co-generation Plant site during the life of the plant.
Human Resources Manager	Person responsible for employment of persons at the Market Coke and Co-generation Plant.
Procurement Manager:	Responsible for coordinating purchasing of goods and services on behalf of the Plant.

8.2 Environmental Management Resources

8.2.1 Human Resources

The Market Coke and Co-generation Plant Project will have an Environmental Practitioner that will be responsible for ensuring the overall environmental management taking place at the plant. The Environmental Practitioner is likely to be assisted by the Reductants Business Unit Manager, ECO and Environmental Specialists when required. External environmental consultants will also be appointed by the plant when required.

8.2.2 Environmental Equipment and Management Resources

Exxaro Reductants has numerous fixed environmental monitoring systems. The following equipment is likely to be present at the site, or will be utilised when monitoring is undertaken:

- Air quality monitoring (fallout dust buckets, PM_{10} monitors and gas emissions monitoring equipment);
- Groundwater and surface water monitoring (numerous boreholes, purger, bailers, dip meter, sample bottles etc.);
- Water usage meters (to measure the amount of water used by the plant and the amount provided to the plant by Grootegeluk Mine); and
- Energy usage meters.

The following environmental management infrastructure is already / will be developed at the plant to protect water resources from potential pollution:

- Temporary general waste storage dustbins;
- Pollution control dam;
- Pollution Control Dam Extension (and future additional dam/s);
- Bunds and impervious surfaces where hazardous chemicals are handled or stored;
- Impervious surfaces underneath stockpiles; and
- Storm water management structures (drains, culverts, berms).

8.3 Training and Awareness

8.3.1 Induction Training

The purpose of the induction training is to promote a general awareness of the sensitivity of the environment, the legal commitments, the aspirations of Exxaro Reductants in terms of environmental management and the environmental consequences of individual actions.

Induction is applicable to all employees, contractors and service providers that will be working within the Market Coke and Co-generation Plant area. The induction training for employees, contractors and service providers is to take the form of a presentation including:

- A description of environmental sensitivities in the Market Coke and Co-generation Plant environment.
- A description of environmental legal requirements and Exxaro Reductants' commitment to comply with these requirements;
- A description of broad-based objectives of environmental management at the Market Coke and Co-generation Plant;
- A discussion of how individual actions can impact on the environment;
- A discussion of how individual actions can assist in the successful implementation of the EMP;
- The Code of Conduct.

All employees are to sign that they have understood and will comply with the Code of Conduct. Employees are to be re-inducted on an annual basis (after returning from their annual leave).

8.3.2 General Environmental Awareness

The purpose of the general environmental awareness programme is to promote on-going environmental awareness amongst the workforce. It will focus on addressing particular environmental issues which have been identified as problematic through the Performance Assessment Programme and EMP compliance monitoring.

All members of the Market Coke and Co-generation Plant workforce and contractors are to be incorporated into the general environmental awareness programme. A monthly environmental awareness topic is to be chosen by management based on the outcomes of internal audits as well as topics of general environmental interest. The topic is to be communicated to the workforce through:

- Discussions at all Safety, Health and Environment (SHE) meetings (to be itemised on the agenda).
- Posters on notice boards.

Monthly environmental topics could include:

- What is the environment;
- The Market Coke and Co-generation Plant environment;
- You and the environment;
- Environmental emergency training;
- Preventing and cleaning up spills;
- Reduce, reuse and recycle;
- General versus hazardous waste;

- The Code of Conduct;
- Reporting environmental incidents;
- Environmental risks;
- Alien vegetation control;
- Saving water; and
- Saving energy.

8.3.3 Job Specific Environmental Awareness Training

The purpose of the job specific environmental awareness training is to ensure that employees within the specific management areas are equipped to implement the actions committed to in the EMP. All members of the Market Coke and Co-generation Plant workforce are to be subject to job specific environmental training. This training is to be undertaken by the managers of each of the management areas. Supervisors will be trained to assist with the implementation and training of the work force.

The environmental risks associated with each management area are to be identified by the supervisors together with the Reductants Business Unit Manager. The risks are to be documented and actions to reduce these risks should be developed. The actions are to ensure overall compliance with the commitments of the EMP. The findings of the performance assessment audits and EMP compliance monitoring will assist in identifying risks.

All members of the workforce (plant workers, contractors, administration etc.) are to be subject to job specific training. This may include but not be limited to:

- Preventing pollution;
- Spill prevention and clean-up procedures;
- The location and purpose of material safety data sheets (MSDSs);
- Managing wastes;
- No-go areas; and
- Incident reporting.

The aspects to be covered however are dependent on the findings of the individual risk assessments. This is to be undertaken for each management area initially. Thereafter all new members of the workforce are to undergo environmental training as part of the training required to do their particular job.

Corrective Action:

- Any actions undertaken by a worker that pose a risk to the environment are to be stopped immediately;
- The worker is to be instructed in how to correct the action; and
- Non-compliance is to be incorporated into the standard disciplinary procedure applicable to the Market Coke and Co-generation Plant.

8.3.4 Community Communication and Awareness

The purpose of the external communication and awareness programme is to:

- Inform neighbouring and nearby landowners and land users of the environmental risks associated with operations at the Market Coke and Co-generation Plant;
- Inform and update interested and affected parties regarding environmental issues and monitoring undertaken; and
- Provide a forum for communication of issues.

External communication is to include residents and land users on neighbouring and nearby farms, registered interested and affected parties, and interested authorities. A complaints register is to be kept at the administration office of the Market Coke and Co-generation Plant for the registration of internal complaints by employees and contractors. External persons must be able to officially register their

complaints in a register kept at a readily accessible point (e.g. the office at the main gate at the Grootegeluk Mine). Complaints are to be followed up by the appropriate manager and the person is to be notified (preferably in writing) of how the complaint has been addressed. Complaints can also be received by facsimile, mail or e-mail. Registered interested and affected parties are to be provided with contact details for the Market Coke and Co-generation Plant and encouraged to direct their queries through this preferred channel of communication.

Market Coke and Co-generation Plant personnel will participate in any relevant forums in the Lephalale Municipality or Waterberg District, with regard to issues at the plant or in the municipality/district.

8.4 Communication

Extensive communication and public participation has been undertaken for this project. The full details are contained in the Public Consultation Report in Appendix 7.

8.4.1 Identification of Stakeholders

The methodology followed for the project has taken into consideration the DEA guideline titled: "Integrated Environmental Management Guideline Series 7: Public Participation in the EIA process, 2010", and the DWA guideline titled: "Generic Public Participation Guidelines, 2001". An initial database of surrounding landowners was obtained from Exxaro Reductants based on information collated during prospecting work that has been undertaken in the area. This database was expanded based on responses to the press advertisement, networking and referrals, the identification of authorities with jurisdiction over activities to be undertaken at the mine and the local municipality. Response sheets were attached to the background information document (BID) requesting IAPs to supply details of other people who may have interest on the project. Please refer to Appendix 7 for a copy of the IAP database.

8.4.2 Public Liaison and Forum Participation

The general public forum which is conducted by the Grootegeluk Mine, must also allow members of the community to raise their issues of concern regarding the Market Coke and Co-generation Plant project. This forum will allow for open communication and discussion of grievances that affected parties may have once project implementation commences. The public and authorities can also ask questions or raise concerns about the project and its impacts. Representatives of the plant (Exxaro Reductants) would be present to answer technical and process related questions. The plant's environmental representative would also be present to respond to environmental questions and concerns about environmental impacts.

8.4.3 Distribution of Information

During the March 2011 rounds of public consultation, advertisements were placed in two newspapers, the Mogol Post (in English) and the Beeld (in Afrikaans), to advertise the project and to invite IAPs to the information sharing meetings. The adverts in the Mogol Pos/Post appeared on the 11th of March 2011 and the advert in the Beeld appeared on the 8th of March 2011. Copies of the adverts are attached in Appendix 7.

Press advertisements informed persons of the proposed development, the development location and provided details as to where further information could be obtained. Site notices informed persons of the proposed development, included a map indicating the site location as well as details of the public information sharing meeting. Proof of site and press notification is given in Appendix 7.

BIDs containing general information on the project, including water–related information and the

requirement for a WUL Amendment Application, were circulated to IAPs via email, facsimile or registered post prior to the public information-sharing meeting in March 2011. BIDs were available in English and Afrikaans.

8.4.4 Public Meeting

8.4.4.1 Initial Public Information-Sharing Meetings

Public information-sharing meetings were held on the 17th of March 2011 and the 19th of May 2011 to inform IAPs of the proposed project. Landowners, neighbours, registered IAPs, local authorities and environmental authorities were invited to the meetings. IAPs, representatives from Exxaro Reductants and Synergistics attended the meetings. The purpose of the meetings was to give more detailed information about the projects, to present the environmental processes to be followed and to provide an opportunity for attendees to ask questions and raise concerns. The meetings were facilitated by Synergistics Environmental Services. Minutes of the meetings are given in Appendix 7.

8.4.4.2 Authorities Meeting

A general meetings were held with individual authorities:

- Limpopo Department of Mineral Resources (DMR) on 16 March 2011;
- Limpopo Department of Economic Development, Environment and Tourism (LEDET) on 16 March 2011;
- Department of Water Affairs (DWA) (Polokwane office) on 16 March 2011;
- Lephalale Local Municipality on 17 March 2011. A representative of the Lephalale Local Municipality also attended the second public meeting held on 19 May 2011;
- Waterberg District Municipality on 17 March 2011; and
- LEDET on 3 April 2012 (to discuss the AEL).

The purpose of the meetings was similar to that of the public meetings, giving more detailed information about the project, presenting the environmental processes to be followed and to provide an opportunity for the authorities to ask questions. The minutes of the meetings and attendance registers are attached in Appendix 7.

8.4.5 Documents for Public Review

8.4.5.1 Review of the Draft and Final Scoping Reports

The draft scoping report was made available for public and authority review during February 2012. The public and relevant authorities were given a 30-day period to review the report and to add any comments. It also allowed them the opportunity to assess whether all their issues have been correctly captured. Registered IAPs were notified that the draft report was available for review at the Grootegeluk Mine main gate, at the Lephalale library as well as electronically on the Synergistics website. IAPs were informed that an electronic copy of the report, on CD, would be sent to anyone who requested it. Following the closure of the review period, final modifications were made to the scoping report. There were no comments received on the draft scoping report.

The final scoping report was made available for public and authority review for a period of 3 weeks from the 17 April 2012 until 28 May 2012. All registered IAPs were notified in writing of the availability of the document for review and were requested to submit comments. However, no comments were received from IAPs. All comments received from authorities on the final scoping report are collated and the proofs of the notifications are included in Appendix 7.

8.4.5.2 Review of the Draft and Final EIA Reports

Under the NEMA process, the draft EIA report was made available for public and authority review in September 2012 for 6 weeks (40 calendar days); from 18 September 2012 till 29 October 2012. The report was made available at the Main Gate Office at the Grootegeluk Mine, the Lephalale Library and the Synergistics website. CD copies were made available to authorities and extra CD copies or hard copies were available on request. All registered IAPs were notified in writing of the availability of the document for review at the Main Gate Office at the Grootegeluk Mine, the Lephalale Library and the Synergistics website and were requested to submit comments to Synergistics via post, fax or email before 29 October 2012. The comments received are addressed in the Final EIA report. Refer to Appendix 7 for proof of public consultation and comments received on the draft EIA.

The Final EIA was made available for for public and authority review on the 9th November 2012 until the 30th November, for 21 days. The notification method of the Final EIA was the same as for the Draft EIA and was available for viewing in the same locations.

The review periods for authorities are in accordance with GNR 543 for both the scoping and EIA reports (note that these regulations do not specify review periods for final reports).

The scoping and EIA reports were also circulated to the following authorities for review. These authorities will also receive copies of the draft IWWMP:

- Department of Mineral Resources
- Limpopo Department of Economic Development, Environment & Tourism
- South African Heritage Resources Agency
- Department of Water Affairs
- Lephalale Local Municipality
- Waterberg District Management Area

The public and authority comments received regarding water and waste related issues are included in tables 8.1 and 8.2 below.

8.4.5.3 Review of the Draft IWWMP Report

This draft IWWMP will be made available for public review for a period of 21 days during December and January from 19th December 2012 to 25th January 2013. Copies of the IWWMP will also be provided to the authorities mentioned above for their comment.

8.4.6 Collation of Issues of Concern

As part of the public participation process it is vital that the issues of concern of the stakeholders which include government, affected parties and interested parties (surrounding communities, surrounding farmers, NGO's, businesses and other parties not directly affected by the project) are taken into consideration in the EIA process. Issues of concern from the abovementioned parties were collated during the public meetings and authorities meetings, response sheets from IAPs, authorities and stakeholders and responses to the site notices, press advert and notifications sent via email.

Tables 8.2 to 8.8 provide a list of the issues of concern collated during the public participation phase. The tables include responses from the project team. Please note that only water and waste related issues have been included in the tables. Questions that were asked and answered during the meetings can be found in the meeting minutes. A complete record of all public participation is included in the comments and responses report which is attached as Appendix 7.

Table 8.2: Interested and Affected Parties Issues of Concern

Date	Name	Question/Issue Raised:	Answer:
17/03/2011	Tendani Mufamadi of Grootegeluk Mine (TM)	Are you going to extend the capacity of the pollution control dam?	GS: Yes we are. Charles Linstrom of Exxaro (CL): It is currently under investigation by Jones and Wagener (surface water specialists). We will update the public on the results of the specialists' studies.
17/03/2011	Elijah Mabogo (EM)	How long will construction of the plant take?	Lomeus Konradie of Exxaro (LK): We use special materials, and thus it can take two years, up to the end of 2014.
17/03/2011	TM	With regard to water use licenses required, a Section 21 A license is missing. Are you making provision for it?	CL: No, section 21 A applies to the Mokolo and Crocodile Water Augmentation Project (MCWAP). We already have an allocation from MCWAP for the Grootegeluk Mine. We will use the allocated water for the Char, Coke and Co-gen Plants as well.
4/3/2011	Susan Pretorius	Concerned about environmental impacts. Expansion of residential market could positively impact property development.	This has been addressed in the EIA report.
18/09/2012	Johan Van Rooyen from Exxaro	Mr Van Rooyen said he had previously complained on the existing environmental sewage pollution due to developments. • Over-population of people/contractors and sewage at Zongesien works not upgraded to handle development needs. • Sewage still running onto farm lands and in the Mogol River since 2009. • More people arriving for another development. In public meeting before Medupe and GG7/8, the public was promised that the role players will assist the Municipality to prevent pollution by upgrading the facilities.	Shelley Holt of Synergistics responded that Synergistics does not have a record of this complaint and enquired if the complaint had been sent to Synergistics or to another consultant. Shelley Holt requested Mr Van Rooyen to forward a copy of the previous complaint. His concerns regarding the appropriate management of sewage are assessed and discussed in further detail in the final EIA report.

Table 8.3: DMR Issues of Concern

Date	Name	Question/Issue Raised:	Answer:
16/03/2011	Azwi Malaudzi – DWA (AM)	Are you using waste coal?	CL: No, we are using coal product from bench 11 and 13 at Grootegeluk Mine which is ideal for process.
16/03/2011	AM	So the current plant is a Char Manufacturing Plant, and now you want to expand Char and construct Coke and Co-Generation plants?	Shelley Holt - Synergistics (SH) and CL: Yes, (explained process).
16/03/2011	Shelley Holt - SH (Synergistics)	We will do EMP amendment, update closure costing etc. This will be a separate document (from the current EMP update of the entire Grootegeluk Mine). This is due to different pollutants. Do you think this will be acceptable?	AM: For administrative purposes, we want one EMP and not several amendments to the EMP. CL: We will try to align the Char, Coke and Co-gen EMP with the whole Grootegeluk Mine EMP update.
16/03/2011	AM	Will there be water pollution as a result of these plants?	CL: We are decreasing existing water pollution on the mine property. The groundwater pollution plume

Date	Name	Question/Issue Raised:	Answer:
			is being reduced. In our water use license there are stipulations to manage this. We have written a water and waste management plan. SH: The new construction is not likely to have a significant detrimental impact on ground water. CL: Construction is to take place on old coal stockpile site used in the 1970s. We have taken out all coal from the construction area, so no further pollution will leach from this coal to the groundwater.

Table 8.4: LEDET Issues of Concern

Date	Name	Question/Issue Raised:	Answer:
16/03/2011	Victor Mongwe – LEDET (VM)	We must confirm whether the waste is hazardous waste or not. Waste management licensing is not the core of the project. If it is a by-product LEDET will deal with it.	MP: We think it is likely to be hazardous. We may add the tar to the gas for burning, to produce electricity. Tar is a by-product, not waste, as it can also be sold. We will also burn the liquor to produce heat and generate electricity. SH: We do have a waste specialist who is working on the project. MP: The specialist will classify the waste. All our "waste" will be converted to energy. The only "waste" will be atmospheric emissions. No solid or liquid waste will be left.
23/02/2012	LEDET	Issues relating to storm water management, potential groundwater pollution and air pollution must be assessed	This has been addressed in the EIA report
23/02/2012	LEDET	Potential impacts on fauna must be assessed and suitable mitigation measures identified	This has been addressed in the EIA report
23/02/2012	LEDET	The location of the coal and coke stockpiles	Refer to sections 3.2.2.2 and 3.2.2.7 of the final scoping report. This has also been addressed in the final EIA report.
23/02/2012	LEDET	Focus on the main impacts: air, groundwater and surface water	Refer to section 7.5 of the final scoping report. This will also be considered further in the EIA report.
23/02/2012	LEDET	Include reference to the IWWMP, APPA certificate amendment and EMP to be completed	Refer to sections 1.4.2, 1.4.3 and 1.4.4 of the final scoping report. This has also been included in the EIA report.
23/02/2012	LEDET	Consider each NEMA listed activity and its associated impacts	This has been addressed in the EIA report
23/02/2012	LEDET	Explain that there will be no waste produced by the plant	Refer to section 1.4.5 of the final scoping report. This has also been addressed in the EIA report.
23/02/2012	LEDET	Include the issue of acid rain	Refer to section 7.5.1 of the final scoping report. This is also considered further in the EIA report.
23/02/2012	LEDET	Include the issue of the salt and water balance. Show whether there will be enough water for the plant	Refer to section 7.5.3 of the final scoping report. This is also considered further in the EIA report.

Date	Name	Question/Issue Raised:	Answer:
23/02/2012	LEDET	Show the location of surface water features on site, provide further information on the water quality baseline and discuss the potential for impacts	Refer to section 4.1.6 of the final scoping report. This is also considered further in the EIA report.
24/05/2012	Foster K Baloyi- FKB (LEDET)	Proof of submission to the Department of Water Affairs (DWA) for the Integrated Water Use Licence Application (IWULA), must be provided.	This has been addressed in the EIA report.
24/05/2012	FKB	Proof that a Waste Management Licence application in accordance to NEMWA has been submitted to the Department of Environmental Affairs (DEA) must be provided.	Not relevant: discussed in the EIA report.
24/05/2012	FKB	An integrated waste management approach must be investigated as part of the compilation of the EIAR, and such an approach must be based on waste minimisation, and must incorporate reduction, recycling, re-use and disposal where appropriate.	This is not required; Discussed in the EIA report.
24/05/2012	FKB	All reasonable mitigation measures to curb and manage potential contamination of groundwater must be investigated.	This has been addressed in the EIA report

Table 8.5: DWA Issues of Concern

Date	Name	Question/Issue Raised:	Answer:
16/03/2011	V.B. Sengani – DWA (VBS)	What is the potential for acid rain from SO_2?	MP: We will design the plant to minimise SO_2 and CO_2. We will comply with regulations. Shelley Holt - Synergistics (SH): We are applying for an AEL
16/03/2011	Charles Linstrom – Exxaro (CL):	We will apply for a WULA under section 21 G and B of the NWA. We have a surface water specialist and a groundwater specialist, whose data we will use in the application. We will also update the Integrated Water and Waste Management Plan (IWWMP) for the mine.	NA
16/03/2011	VBS	Can we see a presentation of the results of the surface and groundwater monitoring?	CL: Yes, however we are in the early stages. We can give you the results at a later stage.
16/03/2011	Mike Plaskitt – MP (Exxaro)	Waste water dams will also be constructed.	CL: Does DWA still require a 2 mm HDPE lining on the pollution control dams? Animals at our plant damage the HDPE lining. We may need to make a concrete lining. MM: Give us 3 different options for dam lining and we will recommend the most appropriate one.
16/03/2011	VBS	Will there only be section 21 G and B applications?	MP: Regarding section 21 A, the Grootegeluk Mine has a current allocation from the Mokolo and Crocodile Water Augmentation Project (MCWAP).
16/03/2011	CL	Under the stockpile areas, what must we use to mitigate groundwater pollution from the stockpiles? We will also ask the groundwater specialist to recommend suitable measures.	VBS: Concrete. The leaching of sulphates can affect the ground water. We will check the application and whether the mitigation measures will reduce/prevent impacts.
16/03/2011	Mahlatji Malegodi-	Will you factor in the water balance and salt balance?	CL: The water balance will dictate storm water constraints, thus we may need to expand the

Date	Name	Question/Issue Raised:	Answer:
	MM (DWA)		pollution control dam, and ensure that it can withstand a 1:50 year flood. The water specialists will come up with a water monitoring programme. MP: The water specialist's water balance will ensure we recycle as much water as possible and that we have enough water.
16/03/2011	MM	There have been issues with the public regarding water in the area, so please include water issues in the public participation.	CL: Water issues will be included in public participation from the start.

Table 8.6: Waterberg District Municipality Issues of Concern

Date	Name	Question/Issue Raised:	Answer:
17/03/2011	Lily Mokonyane Waterberg Municipality (LM)	We have Integrated Water and Waste Management (IWWM) plans, Air management plans, and EMPs for our municipal area. The Environmental Management Framework combines all three. You should also consider the health impacts.	Shelley Holt - Synergistics (SH): We would like to obtain copies of those reports. Health impacts will be assessed during the EIA process.
17/03/2011	PM	How have water issues been considered?	CL: We will compile water balances for the plants. If we don't have sufficient water, we will not go ahead with project. We will update water balances to try save water. I think the water in the Mokolo Dam has been 100 % allocated. DWA has taken over management of the Mokolo Dam, so they allocate the water now. They indicated to us that our existing allocation is the maximum we will receive. MP: We will use the allocated water for the Grootegeluk Mine.

Table 8.7: Lephalale Local Municipality Issues of Concern

Date	Name	Question/Issue Raised:	Answer:
17/03/2011	Joshua Hlapa – Lephalale (JH)	The waste and air specialists should ensure that the applicable regulations are complied with. We would like a waste management plan, air monitoring plans and water monitoring plans. I spoke to Filomaine Swanepoel at Grootegeluk mine, they have an IWWMP. Is it not a good idea to incorporate the new plants into the IWWMP?	Shelley Holt - Synergistics (SH): Once the specialist studies are done, we will send you the reports and will update the Grootegeluk Mine IWWMP to include these plants.

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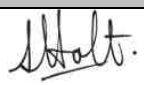
CONSULTANT'S EXPERIENCE
AND
DECLARATION OF INDEPENDENCE

Synergistics Environmental Services (Pty) Ltd is an independent environmental consultancy that was established in 2004. The company has extensive experience in environmental impact assessments; environmental management plans, programmes and systems; environmental auditing; environmental monitoring reporting; environmental performance assessments; closure and rehabilitation costing and planning; and development of environmental action plans.

Matthew Hemming is an Environmental Assessment Practitioner in South Africa has over 7 years' environmental management and assessment experience, specifically in the mining, waste and infrastructure development sectors.

The undersigned herewith declare that this report represents an independent, objective assessment of the environmental impacts associated with the proposed Market Coke and Co-generation Plant Project:

	Name	Designation	Signature	Date
Prepared by:	Shelley Holt	BSc Hons Zoology Senior Environmental Consultant		18/12/2012
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