mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Basic Assessment / Regulation 31 Amendment Report And Environmental Management Programme

for Listed Activities, Amendment and Consolidation Associated with the Sigma Colliery: Mooikraal and Sigma Colliery: 3 Shaft

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

Name of Applicant:	Sasol Mining (Pty) Ltd
Tel no:	016 970 6121
Fax no:	-
Postal Address:	P.O. Bx 32, Sasolburg, 1947
Physical Address:	Sigma Colliery: Mooikraal Farm Saltberry Plain 137, Sasolburg, 1947
File Reference Number SAMRAD:	30/5/1/2/3/2/1 (221) EM; EMB/28/14/43

This document has been prepared by Digby Wells Environmental.

Report Type:	**BAR/Regulation 31 Amendment and EMPr**
Project Name:	**Basic Assessment and Regulation 31 Amendment/Consolidation for Sigma Colliery: Mooikraal and Sigma Colliery: 3 Shaft**
Project Code:	**SAS5175**

Name	**Responsibility**	**Signature**	**Date**
Anita Gutu	Report Writer		December 2018 Updated March 2019
Claire Wannenburgh	Report Writer & Reviewer		February 2019
Barbara Wessels	Report Reviewer		February 2019

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining “will not result in unacceptable pollution, ecological degradation or damage to the environment”.

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the environmental impact assessment process is to, through a consultative process: -

- determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
- describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
- determine the: -
  - nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
  - degree to which these impacts: -
  - can be reversed;
  - may cause irreplaceable loss of resources, and
  - can be avoided, managed or mitigated.
- identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
- identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
- identify suitable measures to manage, avoid or mitigate identified impacts; and
- identify residual risks that need to be managed and monitored.

EXECUTIVE SUMMARY

Introduction

Sasol Mining (Pty) Ltd (hereafter Sasol Mining) owns and operates the Sigma Colliery which consists of two components, namely Sigma Colliery: Mooikraal (hereafter referred to as Mooikraal) and Sigma Colliery: 3 Shaft (hereafter referred to as 3 Shaft) near Sasolburg, Free State Province.

Mooikraal intends to reconfigure and relocate the existing crusher facility and associated conveyor belt series within the primary plant area at 3 Shaft as it is currently located within a wetland area, in addition to other activities within the Mooikraal Mining Right Area. Furthermore, Mooikraal also wishes to amend and consolidate the approved Mooikraal EMPr to include all activities and properties associated with the operations as well as additional activities which are proposed to be undertaken as part of the integrated operation.

This report constitutes the draft integrated Basic Assessment and Regulation 31 Report which is submitted to Interested and Affected Parties (I&APs) and relevant authorities for review and comment in terms of the application for Environmental Authorisation under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations, 2014 (as amended).

Project applicant

The details of the Project Applicant are included in the table below.

Project Applicant:	Sasol Mining (Pty) Ltd
Registration number:	1950/038590/07
Responsible Person:	Sigma Colliery: Mooikraal Mine Manager
Contact person:	Lisa Grobler
Physical address:	Sigma Colliery: Mooikraal Farm Saltberry Plain 137, Sasolburg, 1947
Postal address:	P.O. Box 32, Sasolburg, 1947
Telephone:	016 970 6121
Email:	Lisa.Grobler@sasol.com

Project overview and Need for the Project

The current operation at Mooikraal comprises coal extraction of underground mining sections utilising underground bord and pillar mining method, in some areas high extraction mining (rib-pillar extraction) is taking place to optimally mine the reserves. Mooikraal accesses the underground workings via an incline shaft which was constructed utilising the box cut method. The incline shaft is utilised to allow vehicles, machinery and personnel to both enter and exit the underground workings.

The Run-of-Mine (ROM) coal is transported via underground section belts and main belts to surface via the same incline/decline shaft which is used to enter the mine (MK1). The coal passes a crusher and is then stored in a silo. Subsequently the ROM coal is conveyed via an 18 km overland conveyor belt from Mooikraal to 3 Shaft, where the coal is crushed and stockpiled, before it is transferred to Sasolburg Operations for further industrial use.

The primary plant (crusher) at 3 Shaft is historic infrastructure developed in 1952 and is located within a delineated wetland which presents persistent adverse environmental impacts to the Leeuspruit. This has been recognised as a major non-conformance. To rectify this, Mooikraal is now proposing to relocate the primary plant well outside of the wetland area including the reconfiguration of the associated conveyor belt series. This proposed activity forms the basis of this application, in addition to the following activities which are also proposed to be include to form part of future activities at the operation:

- Drilling of exploration, monitoring and rescue boreholes (some of which are located within the vicinity of water resources); and
- Potential establishment of ventilation shafts associated with the progression of underground mining.

For better management of environmental impacts associated with the entire operation (inclusive of Mooikraal and 3 Shaft) Mooikraal is also proposing to undertake an amendment and consolidation process of the approved authorisations for the operation. To this end this environmental authorisation process aims to achieve the following:

- Authorise Listed Activities now triggered in terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended) (Government Notice No. R. 982 of 4 December 2014 as amended by Government Notice No. R.326 of 7 April 2017) referred to hereinafter as the EIA regulations, 2014 (as amended) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) by proposed new activities; and
- Incorporate all the activities at Mooikraal and 3 Shaft operations into an amended EMPr so as to ensure that all activities are lawfully executed.

Environmental consultants

Digby Wells and Associates (South Africa) (Pty) Ltd (Digby Wells) has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment/ Regulation 31 Amendment Process. The details of the EAP are provided in below.

Name of Practitioner:	Claire Wannenburgh
Telephone:	011 789 9495
Fax:	011 069 6801
Postal Address	Private Bag X10046, Randburg, 2125, South Africa
Email:	claire.wannenburgh@digbywells.com

Approach and methodology for the Public Participation Process

A Public Participation Process (PPP) was initiated during the Scoping Phase, which is central to the investigation of environmental and social impacts, as it is important that stakeholders that may affected by the project are given an opportunity to identify concerns and to ensure that local knowledge, needs and values are understood and taken into consideration as part of the impact assessment process.

This draft Basic Assessment/ Regulation 31 Amendment Report has been submitted to the public for their input and comments for a period of 30 days. The commenting period is from the on 26 March 2019 and ends on 2 May 2019. The report is available for review available on the Digby Wells website (www.digbywells.com). Electronic copies (CDs) are available from the Digby Wells Public Participation Office as well as at the locations listed below:

- Zamdela Public Library; and
- Sasolburg Public Library.

A public meeting will be held during this commenting period to present the report and obtain comments from Interested and Affected Parties (I&APs). Subsequently the report will be updated with all the comments received from the I&APs prior to submission to the DMR for consideration. Once the DMR has made a decision this will be communicated to all the registered I&APs.

Environmental Baseline

Mooikraal is located approximately 18 kilometres (km) from the Sigma Defunct Colliery and 18 km southwest of Sasolburg in the Fezile Dabi District Municipality, Free State Province. The mine began operation in 2005 and has an approximate Life of Mine (LoM) of 34 years until 2039.

The project area falls within the Grassland Biome which is characterised by rich flora and fauna diversity but is under threat due to rapid urbanisation and expansion of mining and industrial activities. The present land use within the project area mainly include underground mining, cultivated land and veld for grazing.

The Kromelmboogspruit and Leeuspruit traverse the project area at Mooikraal and 3 Shaft respectively. A total of three wetlands are present within the project area which are associated with the Kromelmboogspruit and Leeuspruit. These wetlands are all categorised as moderately modified due to the surrounding land uses.

Environmental Impact Statement

The EIA considered potential negative and positive impacts associated with the proposed new activities as well as impacts caused by the current operation, including possible future impacts. These are detailed separately below.

For all potential impacts, mitigation and management measures have been proposed which, if correctly implemented, are likely to reduce the significance of all impacts to minor or negligible significance.

Impacts associated with the Proposed New Activities

The proposed relocation of the primary plant area at 3 Shaft has been proposed as a rectification measure to the existing adverse impacts to the freshwater ecosystem associated with the Leeuspruit. The key potential positive implication associated with the relocation of the primary plant outside of the delineated wetland as well as the proposed upgrade of stormwater management structures at the new site include improved downstream water quality and possible improvement/restoration of ecological integrity and functioning of the affected wetland.

The key negative implications include the loss of topsoil resources, soil erosion and subsequent sedimentation of wetland and river systems from cleared areas as a result of construction site clearance as well as operational and maintenance activities. Nuisance impacts, namely noise disturbance and elevated dust generation may also occur although they are not expected to affect nearby sensitive receptors.

The proposed boreholes to be drilled throughout the Mooikraal Mining Right Area as well as at 3 Shaft and possible future ventilation shafts/ structures to be established will be limited in extent and in some areas over already disturbed footprints such as agricultural fields, therefore are not expected to result in significant additional overall impacts. It is noted that associated access roads will also be established, these access roads will be used to gain access to various boreholes and ventilation structures. These will be maintained along disturbed footprints as far as possible.

Impacts associated with the Current Operational Activities at Mooikraal

The current operational activities at Mooikraal comprise underground mining, conveying of coal via an overland conveyor belt and coal processing and stockpiling at 3 Shaft as well as the operation of various ancillary infrastructure. The key negative implications of this operation include the loss of topsoil resources, soil erosion and compacting resulting from the operation and maintenance of various infrastructure including haul roads.

Undergrounding mining methods may potentially result in surface subsidence, whereby the post mining land capability is significantly impacted upon due to effects on ecological features.

Furthermore, the current operational activities have resulted in impacts to wetlands from the existing conveyor belt, crushing facility and coal bunker at 3 shaft.

In terms of positive implications, the current operations include treated effluent discharge into the Kromelmboogspruit from the Sewage Treatment Plant and continued socio-economic benefits including employment, skills development and improvement of the local socio-economic profile of the area.

Conclusions and recommendations

Mooikraal is an existing operation that provides coal to the Sasol Operations from underground mining sections. The continued operation of Mooikraal, including the coal processing operations at 3 Shaft, is essential to ensuring sufficient coal supply to the Sasol Operations for steam production.

The proposed activities that are subject to this application are planned to ensure better and lawful environmental practices at the operation as well as to optimise the extraction of coal through exploration, monitoring boreholes, as well as additional ventilation structures towards the southern underground reserves.

Various specialist studies were undertaken as part of this Basic Assessment / Regulation 31 Amendment Process with the objective of identifying and assessing anticipated environmental impacts and risks associated with the proposed new activities.

The findings of the impact assessment have shown that the new activities will have impacts on the receiving environment, namely; the loss of topsoil on cleared land; soil erosion and subsequent sedimentation of wetland and river systems. However, due to the current disturbed nature of a large portion of the project area and the extent of the activities, the majority of identified impacts are expected to be of minor or negligible negative significance.

The project will have positive implications as it aims to rectify the current persistent environmental impacts experienced at 3 Shaft. The proposed drilling of numerous exploration, monitoring and rescue boreholes, as well as the establishment of ventilation structures towards the southern underground reserves will also have positive implications as it will allow for mining activities to continue optimally with sufficient monitoring of groundwater to identify impacts as well as health and safety measures.

Based on the assessment of the potential negative and positive impacts associated with the project, it is concluded that the proposed project should be authorised. No long-term negative impacts are expected to arise from the new activities proposed. In fact it is expected that these activities will enhance the existing Mooikraal operation should the proposed mitigation measures be correctly implemented.

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Part A: Scope of Assessment and Basic Assessment / Regulation 31 Amendment Report

1 Introduction

Sasol Mining (Pty) Ltd (hereafter Sasol Mining) owns and operates the Sigma Colliery which consists of two components, namely Sigma Colliery: Mooikraal (hereafter referred to as Mooikraal) and Sigma Colliery: 3 Shaft (hereafter referred to as 3 Shaft) near Sasolburg, Free State Province.

Mooikraal operates under a consolidated Mining Right (inclusive of 3 Shaft) (Reference No. FS 30/5/1/2/2/2/1/221) and approved Environmental Management Programme (EMPr) (Reference No. 30/5/1/2/3/2/1 (221) EM). In addition, Mooikraal has a separate approved Environmental Authorisation (Reference No. EMB/28/14/43) for a 10 and 7 Mega litre per day (Ml/day) water transfer pipeline which are used to transport water between the Kleinvlei ventilation shaft, Mooikraal operations and the Sasolburg Operations.

Mooikraal is an underground coal mine comprising underground mining sections, incline/decline shaft, ventilation shaft infrastructure and various ancillary infrastructure including workshops, water management and electricity supply infrastructure as well as chemical storage areas. The 3 Shaft area is located in Sasolburg, approximately 18 kilometre (km) northeast of Mooikraal which comprises the primary plant area where Run-of-Mine (ROM) coal from Mooikraal and import coal is crushed, coal bunkers and stockpile areas, associated conveyer belts and coal transfer points as well as other ancillary infrastructure including workshops, chemical storage areas, offices and haul roads for import coal transportation.

Mooikraal intends to reconfigure and relocate the existing crusher facility and associated conveyor belt series within the primary plant area at 3 Shaft as it is currently located within a delineated wetland area and resulting in surface water contamination due to the lack of effective stormwater management. In addition, Mooikraal also wishes to amend and consolidate the approved Mooikraal EMPr to include all activities and properties associated with the operations as well as additional activities which are proposed to be undertaken as part of the integrated operation.

Listed Activities in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) (Government Notice No. R. 982 of 4 December 2014 as amended by Government Notice No. R.326 of 7 April 2017) referred to hereinafter as the EIA Regulations, 2014 (as amended) which were promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) have been identified which requires a Basic Assessment Process to be followed. Additionally, the proposed amendment and consolidation of the Mooikraal EMPr constitutes a Regulation 31 Amendment Process in terms of the EIA Regulations, 2014 (as amended). A summary of the activities subject to this application is provided below.

Table 1-1: Summary of activities under application

Basic Assessment Process Activities	Regulation 31 Amendment Activities
▪ Demolition activities at 3 Shaft which includes the demolition of the existing conveyor belt, crushing facility and coal bunker which is currently situated within a wetland; ▪ Relocation/reconstruction of the primary crusher on the coal stockpile area outside of the wetland at 3 Shaft (to remain within the 3 Shaft footprint); ▪ Installation of a new conveyor belt; this belt will join the existing conveyor belt to the relocated crusher on the stockpile. This new conveyor belt will traverse a delineated wetland (to remain within the 3 Shaft footprint); and ▪ Drilling of exploration, monitoring, downcast and rescue boreholes and associated roads within the approved Mooikraal Mining Right Area and 3 Shaft Complex some of which are situated within 500 m of a watercourse.	▪ Amend and consolidate the approved Mooikraal EMPr to incorporate all activities at Mooikraal, Kleinvlei ventilation shaft, 3 Shaft and along both servitudes (conveyor belt and pipelines) as well as all their associated properties. The intention is to ensure one EMPr is utilised for the entire Mooikraal and 3 Shaft operation to ensure effective implementation of the mitigation measures.

Through this application, one consolidated Environmental Authorisation application process is being undertaken to fulfil the requirements of these processes in accordance with the one environmental system.

In accordance with the Regulation 19 (Basic Assessment Process) and Regulation 32 (Regulation 31 Amendment Process) application processes, an application for Environmental Authorisation was submitted to the Department of Mineral Resources (DMR) on 30 November 2018 and the final Basic Assessment and Regulation 31 Report is to be submitted within 90 days of receipt of the application by the DMR. Subsequently, an extension was granted by the DMR ensure the completion of related studies. Figure 1-1 provides a simplified schematic of the Basic Assessment and Regulation 31 Process.

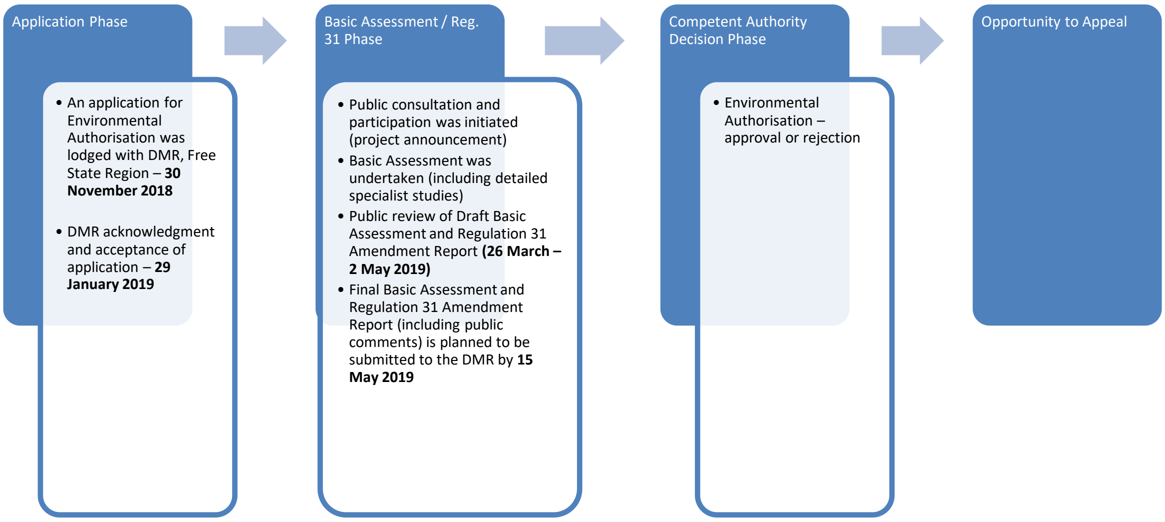


Figure 1-1: Basic Assessment / Regulation 31 Amendment Process

This report constitutes the draft integrated Basic Assessment and Regulation 31 Amendment Report which is submitted to Interested and Affected Parties (I&APs) and relevant authorities for review and comment in terms of the application for Environmental Authorisation under the NEMA EIA Regulations, 2014 (as amended).

2 Item 3: Project Applicant

The details of the project applicant are included in the table below.

Table 2-1: Project applicant details

Project Applicant:	Sasol Mining (Pty) Ltd
Registration number:	1950/038590/07
Responsible Person:	Sigma Colliery: Mooikraal Mine Manager
Contact person:	Lisa Grobler
Physical address:	Sigma Colliery: Mooikraal Farm Saltberry Plain 137, Sasolburg, 1947
Postal address:	P.O. Box 32, Sasolburg, 1947
Telephone:	016 970 6121
Email:	Lisa.Grobler@sasol.com

2.1 Item 3(a)(i): Details of the EAP

Digby Wells and Associates (South Africa) (Pty) Ltd (Digby Wells) has been appointed by Sasol Mining as the independent Environmental Assessment Practitioner (EAP) to conduct the required environmental regulatory process including associated specialist studies and the required Public Participation Process (PPP) for the project.

Table 2-2: Contact details of the EAP

Name of Practitioner:	Digby Wells and Associates (South Africa) (Pty) Ltd Claire Wannenburgh
Telephone:	011 789 9495
Fax:	011 069 6801
Email:	claire.wannenburgh@digbywells.com

2.2 Item 3(a)(ii): Expertise of the EAP

2.2.1 The Qualifications of the EAP

Claire Wannenburgh holds the following qualifications:

- BSc – University of Pretoria; and
- BSc Honours (Environmental Analysis and Management) – University of Pretoria.

Please refer to Appendix 1 for the EAP's curriculum vitae and qualification certificates.

2.2.2 Summary of the EAP's Past Experience

Claire Wannenburgh is a consultant at Digby Wells within the Compliance Department. She holds a BSc (Hons) in Environmental Analysis and Management from the University of Pretoria where she majored in Environmental Impact Assessment, Auditing and Environmental Law. She has six years work experience specifically in legal compliance and environmental management. Claire has managed various Performance Assessments and Water Use Licence (WUL) Audits and has worked as an Environmental Control Officer. She has also managed high profile Environmental Impact Assessments; Basic Assessments; WUL and Permitting Applications; Environmental Management Programme Amendments; Green Star Environmental Management Programmes and Auditing. Claire is also ISO14001 certified as an internal lead auditor.

3 Item 3(b): Description of the Property

The project activities subject to this application are being undertaken at the Mooikraal Mining Right Area (MRA) and the 3 Shaft area. These areas are located the Ngwathe Local Municipality (NLM) with the Fezile Dabi District Municipality (FDDM) in the Free State Province.

The Mooikraal MRA and 3 Shaft Area span over several farm properties which are listed in Appendix 3. Part of this application intends to incorporate all properties listed in Appendix 3 into the approved Mooikraal EMPr. It is noted that the 3 Shaft area does not form part of the Mooikraal MRA.

The regional and local setting of the project area is depicted in Plan 1 and Plan 2 respectively, Appendix 2. Table 3-1 below provides the property details for the activities associated with the activities under application.

Table 3-1: Property details

Farm Name:	Refer to Appendix 3.
Application Area (Ha):	■ Mooikraal MRA (including Kleinvlei ventilation shaft) – 6,720.2 ha; ■ Water Transfer Pipeline within servitude – 7 Ml line: 3.1 km; ■ Conveyor belt and 10 Ml/day water transfer pipeline servitude – 18.4 km; ■ 3 Shaft Area – 39.1 ha.
Magisterial District:	Fezile Dabi District Municipality
Distance and direction from nearest town:	Sasolburg is located approximately 18.6 km south west of Mooikraal and 4 km north west of 3 Shaft.
21 digit Surveyor General Code for each farm portion:	Refer to Appendix 3.

Land Tenure plans for the Mooikraal MRA, conveyor belt and pipeline servitude and 3 Shaft area are attached as Plan 3, Plan 4 and Plan 5 in Appendix 2 respectively.

4 Item 3(c) of Appendix 3: Locality Map

An A3 Locality Map is attached as Plan 2 in Appendix 2 and shown in Figure 4-1 below.

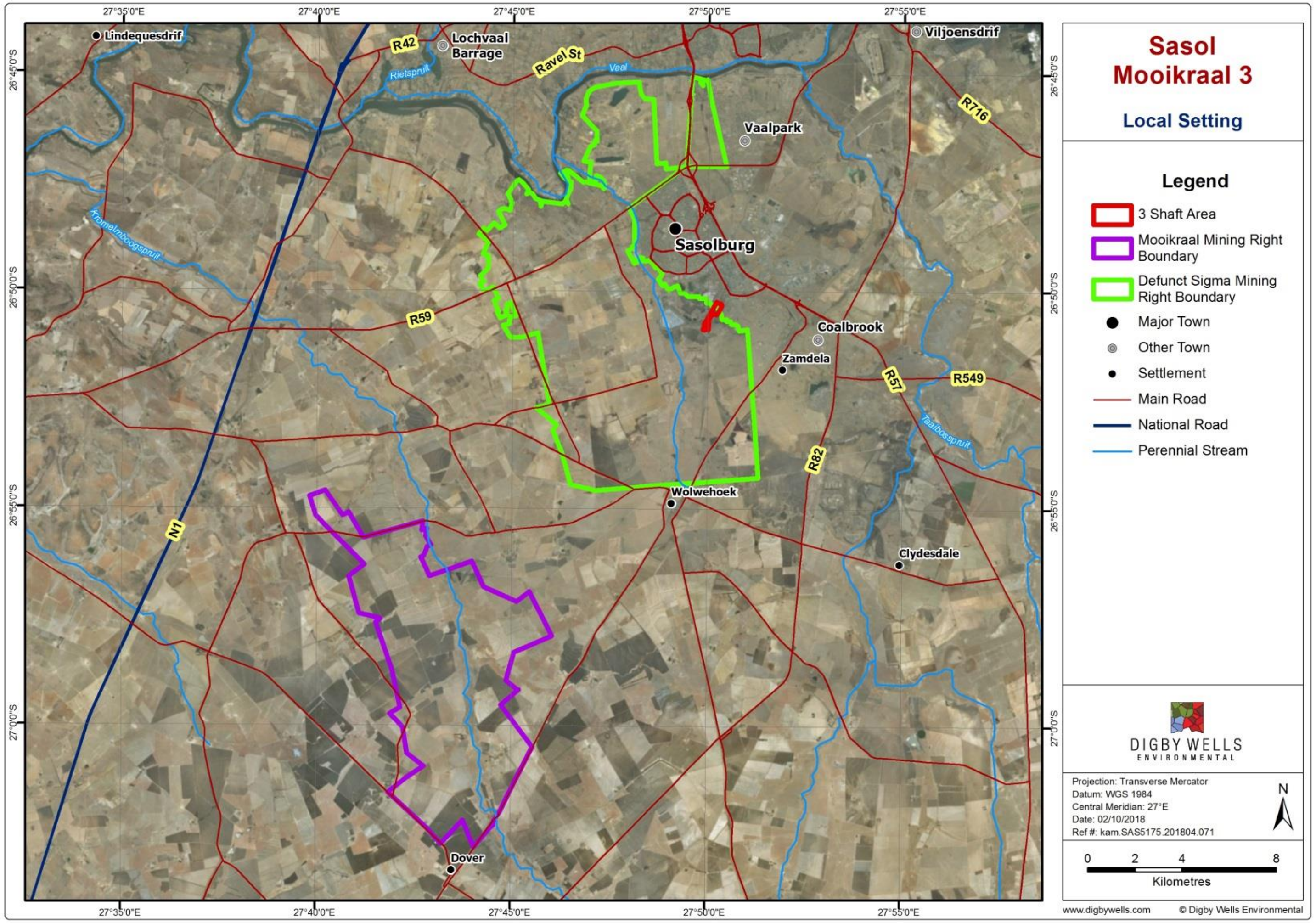


Figure 4-1: Local Setting

5 Item 3(d) of Appendix 3: Description of the Scope of the Proposed Overall Activity

Mooikraal started operations in 2005 and provides a continuous supply of coal to the Sasolburg Operations. Mooikraal extracts its coal from the underground workings which is then brought to surface and stored in a silo. Subsequently the coal is conveyed via an 18 km conveyor belt (MK3 – MK 8 Belt) from Mooikraal to 3 Shaft where the coal is crushed, screened and then stockpiled before it is transported to Sasolburg Operations for further use.

The operational area of 3 Shaft comprises a primary plant area, where coal, which is conveyed via the MK8 Belt as well as import coal transported via haul roads, is crushed and screened prior to being stockpiled at a designated concrete lined stockpile area, located approximately 600 m north-east of the primary plant area. Approximately 1.5 million tonnes per annum (mtpa) of coal from Mooikraal and 200,000 mtpa of imported coal is processed through the primary plant at 3 Shaft.

Table 1-1 in Section 1 above provides a summary of the proposed new activities which are subject to this application. The key activities/infrastructure includes:

- Demolition activities at the 3 Shaft which includes the demolition of the existing conveyor belting, crushing facility and coal bunker which is currently situated within a wetland;
- Relocation of the primary crusher at 3 Shaft (outside of wetland area and to the existing coal stockpile area) and reconfiguration of the associated conveyor belt series;
- Rehabilitation of an affected wetland area at 3 Shaft; and
- Drilling of exploration, monitoring, downcast and rescue boreholes and associated access roads (some of which are located within the vicinity of water resources).

An A3 Infrastructure Layout of the proposed activities at 3 Shaft is attached as Plan 6 in Appendix 2 and shown in Figure 5-1 below. The locations and exact number of the exploration, monitoring and rescue boreholes to be drilled within Mooikraal MRA is still to be determined. Provisional borehole locations have however been determined for the monitoring and exploration boreholes as depicted in Plan 7 and Plan 8, Appendix 2.

As indicated in Section 1 above, Mooikraal has an approved EMPr and a separate Environmental Authorisation for water transfer pipelines associated with the Mooikraal operation. The approved EMPr currently does not include some aspects of the 3 Shaft area as well as some properties associated with linear infrastructure servitudes between Mooikraal and 3 Shaft. Therefore, as part of this application Mooikraal wishes to incorporate the 3 Shaft and linear infrastructure areas and their respective properties as well as consolidate the separate Environmental Authorisation for water transfer pipelines, so as to have one consolidated EMPr applicable to all activities associated with the Mooikraal operation. Further detail pertaining to the proposed activities is provided in Section 5.2.

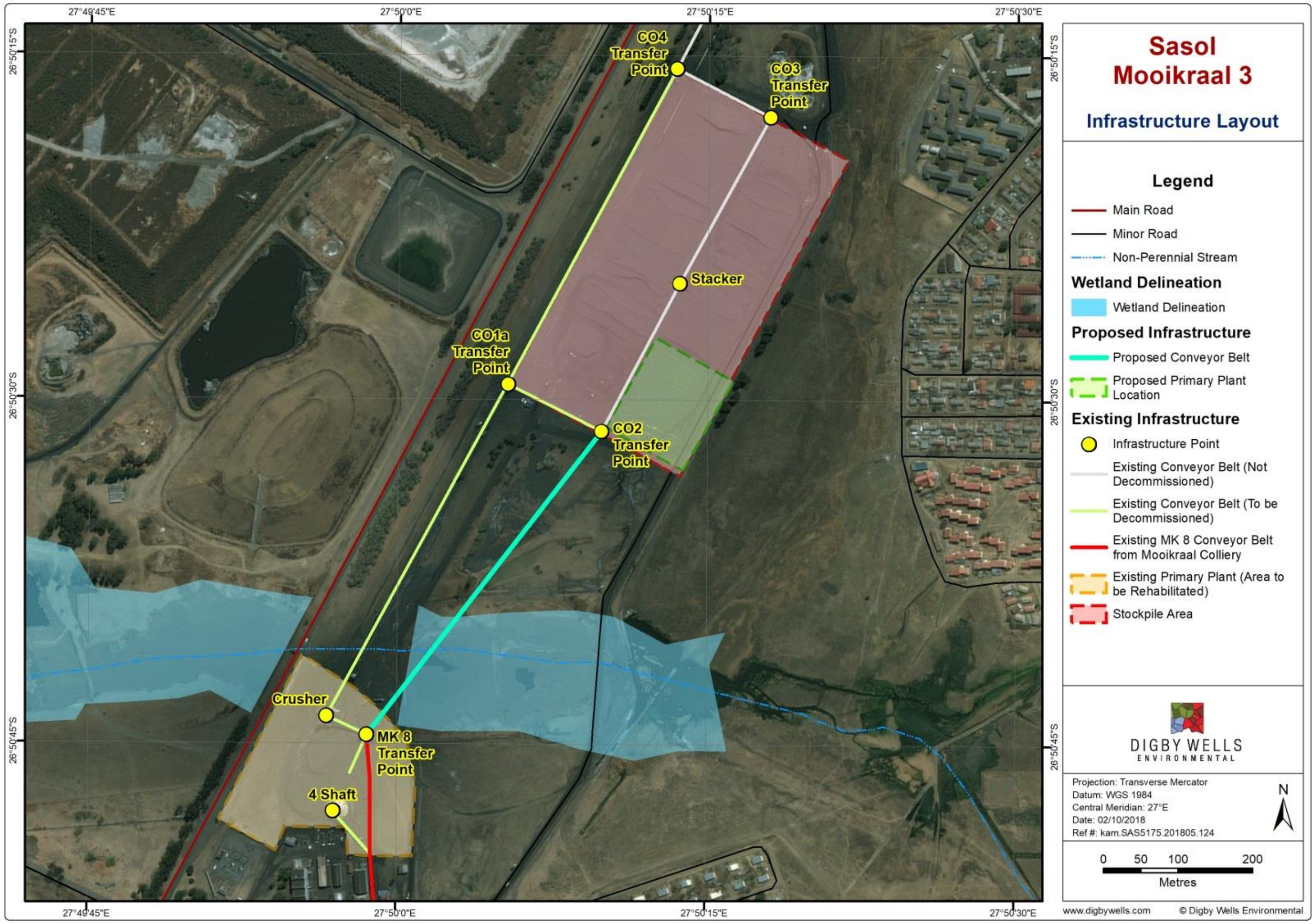


Figure 5-1: Infrastructure Layout (3 Shaft)

5.1 Item 3(d)(i): Listed and Specified Activities

Together with the EIA Regulations, 2014 (as amended), the Minister published Regulations in terms of Sections 24 and 24D of the NEMA for Activities that require Environmental Authorisation prior to their commencement.

Activities identified in Listing Notice 1 (GN R 327) or Listing Notice 3 (GN R 324) requires that a Basic Assessment Process be followed when applying for EA. Activities identified in Listing Notice 2 (GN R 325) require the Scoping EIA Process to be undertaken. It is noted that Mooikraal has previously approved Listed Activities for the operation, as detailed in Table 5-1 and Table 5-2 below.

The proposed new activities at 3 Shaft, namely the relocation and reconfiguration of the primary crusher and associated conveyor belt series as well as the proposed drilling of boreholes within Mooikraal MRA, are activities which fall within the thresholds of Listing Notices 1 and therefore requiring the Basic Assessment Process to be followed. Table 5-3 below details all new activities that will be undertaken as part of this proposed project and the listed actives which are triggered.

Additionally the proposed amendment and consolidation of the Mooikraal EMPr constitutes a Regulation 31 Amendment Process in terms of the EIA Regulations, 2014 (as amended).

Table 5-1: Previously Authorised Listed Activities for Mooikraal (Ref: 30/5/1/2/3/2/1 (221) EM)

Name of Activity (Previously authorised by Approved EMPr)	Corresponding Listed Activities in terms of EIA Regulations, 2014 (as amended by 326 of 07 April 2017)
The construction of a coal silo	Activity 17 of GNR 325 – Listing Notice 2
Conveyor crossings over streams	Activity 17 of GNR 325 – Listing Notice 2
Dirty water storage dams (North Dam Pollution Control Dam (PCD) and South Dam PCD)	Activity 6 of GNR 325 – Listing Notice 2
Ongoing proving of the coal reserves during the life of mine	Activity 17 of GNR 325 – Listing Notice 2
Pumping out of groundwater influxes into the mine	No longer listed under NEMA. Governed under NWA
Access road to the shaft	Activity 24 of GN R 327 – Listing Notice 1
Development of the shaft area of the mine and conveyor infrastructure.	Activity 17 of GNR 325 – Listing Notice 2
The establishment of a coal mine and drilling to define the coal reserve.	Activity 17 of GNR 325 – Listing Notice 2
Kleinvlei vent shaft and downcast	Activity 15 of GNR 325 – Listing Notice 2

Name of Activity (Previously authorised by Approved EMPr)	Corresponding Listed Activities in terms of EIA Regulations, 2014 (as amended by 326 of 07 April 2017)
Borrow pits	Activity 21 of GN R 327 – Listing Notice 1
Waste Rock Dump at Mooikraal	Activity 6 of GNR 325 – Listing Notice 2
Sewage treatment plant	Activity 25 of GNR 325 – Listing Notice 2
Dust suppression at 3 shaft	Activity 6 of GNR 325 – Listing Notice 2

Table 5-2: Previously Authorised Listed Activities for Mooikraal 10 Ml and 7 Ml Pipeline (Ref: EMB/28/14/43)

Name of Activity (Previously authorised by Approved EA)	Corresponding Listed Activities in terms of EIA Regulations, 2014 (as amended by 327 of 07 April 2017)
Construction and operation of the 10 Ml/day and 7 Ml/day pipeline to transfer mine water from Mooikraal to Sasolburg Operations, and to transfer mine water from Kleinvlei to Mooikraal.	• Activity 34 of GN R 327 – Listing Notice 1

Table 5-3: Proposed activities to be undertaken for the proposed project

Name of Activity	Aerial extent of the activity	Listed Activity	Applicable Listing Notice	Waste Management Authorisation
Relocation of the MK9 Conveyer Belt proposed to be constructed over a wetland. *The development of-(ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs-* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse*	650 m	X – 12	GN R 327 – Listing Notice 1	N/A
Relocation of the MK9 Conveyer Belt proposed to be constructed over a wetland. *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.*	650 m	X - 19	GN R 327 – Listing Notice 1	N/A
Demolition of the Crusher, Bunker and Conveyer Belt within a wetland. *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.*	Conveyor Belt – 650 m Crusher Facility – 3.8 ha	X - 19	GN R 327 – Listing Notice 1	N/A
Remediation of the wetland and associated watercourse which has been previously impacted by the operation of 3 Shaft Complex. *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.*	3 Shaft Complex – 39.1 ha	X - 19	GN R 327 – Listing Notice 1	N/A
The Drilling of exploration, monitoring and rescue boreholes (within a wetland areas/in close proximity to a watercourse). *The infilling or depositing of any material of more than 10 cubic metres into, or*	100 m^2 per borehole	X - 19	GN R 327 – Listing Notice 1	N/A

Name of Activity	Aerial extent of the activity	Listed Activity	Applicable Listing Notice	Waste Management Authorisation
the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.				
Drilling of boreholes (monitoring, exploration and emergency) within the Mooikraal MRA which may result in a combined clearance of vegetation. *The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation*	100 m^2 per borehole	X - 27	GN R 327 – Listing Notice 1	N/A
The upgrade of stormwater infrastructure to ensure the separation of clean and dirty water around the 3 Shaft. *The infrastructure may exceed 1000 metres in length however this will be confirmed during the basic assessment process.* *The expansion of infrastructure for the bulk transportation of water or stormwater where the existing infrastructure-* *(i) has an internal diameter of 0,36 metres or more; or* *(i) has a peak throughput of 120 litres per second or more; and* *(a) where the facility or infrastructure is expanded by more than 1 000 metres in length; or* *(b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more.*	3 Shaft Complex – 39.1 ha	X - 45	GN R 327 – Listing Notice 1	N/A
The upgrade of stormwater infrastructure to ensure the separation of clean and dirty water around the 3 Shaft Complex. Sumps and canals will also be constructed to contain the dirty water and ensure no discharge to the environment. *The infrastructure may exceed 1000 metres in length however this will be confirmed during the basic assessment process.* *The expansion and related operation of infrastructure for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes where the existing infrastructure-* *(i) has an internal diameter of 0,36 metres or more; or*	3 Shaft Complex – 39.1 ha	X - 46	GN R 327 – Listing Notice 1	N/A

Name of Activity	Aerial extent of the activity	Listed Activity	Applicable Listing Notice	Waste Management Authorisation
(ii) has a peak throughput of 120 litres per second or more; and *(a) where the facility or infrastructure is expanded by more than 1 000 metres in length; or* *(b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more.*				

5.2 Item 3(d)(ii): Description of the Activities to be undertaken

Mooikraal is located approximately 18 km from the Sigma Defunct Colliery and 18 km southwest of Sasolburg in the Ngwathe Local Municipality. The mine began operation in 2005 and has an approximate Life of Mine (LoM) of 34 years until 2039. The 3 Shaft area has been in operation since 1952 and is located approximately 18 km from Mooikraal within the Metsimaholo Local Municipality. 3 Shaft was originally constructed to crush and stock pile coal from the Sigma Defunct Colliery and is now utilised as the crushing, stockpiling and blending facility for the Mooikraal operation.

As discussed in Section 1 above, this application involves the amendment and consolidation of the approved Mooikraal EMPr with separate authorisations as well as new proposed activities at Mooikraal, therefore all current and proposed activities are relevant to this description and overall assessment. The subsection below provides a description of the existing Mooikraal operation and all associated infrastructure. Subsequently, a description of the new the proposed activities is provided in Section 5.2.2 below.

5.2.1 Current Mooikraal Operation

The current operation at Mooikraal comprises coal extraction of underground mining sections utilising underground bord and pillar mining method, in some areas (not restricted areas such as watercourses, heritage sites, farm dwellings etc.) high extraction mining (rib-pillar extraction) is taking place to optimally mine the reserves. The coal reserves are exploited to a depth of between 80 m – 130 m. Mooikraal accesses the underground workings via an incline/ decline shaft which was constructed utilising the box cut method. The incline/ decline shaft is utilised to allow vehicles, machinery and personnel to both enter and exit the underground workings.

The ROM coal is transported via underground section belts and main belts to surface via the same incline/decline shaft which is used to enter the mine (MK1). The coal passes a crusher and is then stored in a silo. Subsequently the ROM coal is conveyed via an 18 km overland conveyor belt (MK3 – MK7) from Mooikraal to 3 Shaft, where the coal is crushed and stockpiled, before it is transferred to Sasolburg Operations for further industrial use. 3 Shaft was previously undermined as part of the Sigma Defunct Colliery operation. The underground workings have since been flooded. This operation formed part of the Sigma Defunct EMPr and does not form part of the current scope associated with the Mooikraal operation.

The following infrastructure is currently present at Mooikraal:

- Incline shaft;
- Ventilation Shaft (Kleinvlei Shaft) and downcast;
- PCDs (North and South Dams);
- Access roads (including access routes to the rescue and monitoring boreholes);

- Pump station;
- Sumps located at the wash bay, fuel storage, shaft complex and various areas around the mine for stormwater management;
- Explosives magazine;
- Transformers and bunds;
- Clean water channels;
- Waste Rock Dump (WRD);
- Borrow pits;
- Sewage Treatment Plant (STP);
- Waste storage area;
- Workshops (cable, boiler and diesel);
- Lamp room;
- Bulk fuel and oil storage area and bunds;
- Dust suppression storage area and bund;
- Stone dust silo;
- Capital yard;
- Warehouse;
- Material storage yards;
- Conveyor belting, associated drive houses, transformers and substations;
- Coal scanners located on belts;
- 5 Ml/day pipeline from Mooikraal to SSO
- 10 Ml/day pipeline from Mooikraal to SSO;
- 7 Ml/day pipeline from Kleinvlei Shaft to PCDs;
- Electricity pylons located with the existing servitudes;
- Various pipelines (potable and sewerage water);
- Office blocks (including kitchen, security and proto room);
- Various walkways;
- Tuck-shop (where light meals are prepared and sold);
- Change houses;
- Smokers facilities;
- Laundry washing facility;

- Security fencing; and
- Rescue boreholes.

The following infrastructure is present at 3 Shaft Complex:

- Primary plant area – including crusher facility;
- Stockpile area including stacker reclaimer for ROM and imported coal;
- Unpaved haul roads;
- Access roads;
- Security fencing;
- Transformers and substations;
- Conveyor belt and transfer points;
- Coal scanners located on the belts;
- Bulk fuel storage area;
- Wash bay;
- Adult Basic Education Training (ABET) training centre;
- Warehouse;
- Parking area;
- Hazardous chemical storage area;
- Offices (including security and mine closure offices);
- Material handling stores;
- Workshops (diesel and boiler);
- Various pipelines (potable and sewerage);
- Paint spraying booth;
- Waste storage area;
- A cement dam for dust suppression (this dam is fed by the 5 Ml/day pipeline from Mooikraal);
- Contractors storage yard; and
- Dirty water storage dams.

Figure 5-2 below depicts the site layout at Mooikraal. Further detail pertaining to the existing infrastructure and its operation is provided in the subsequent subsections.

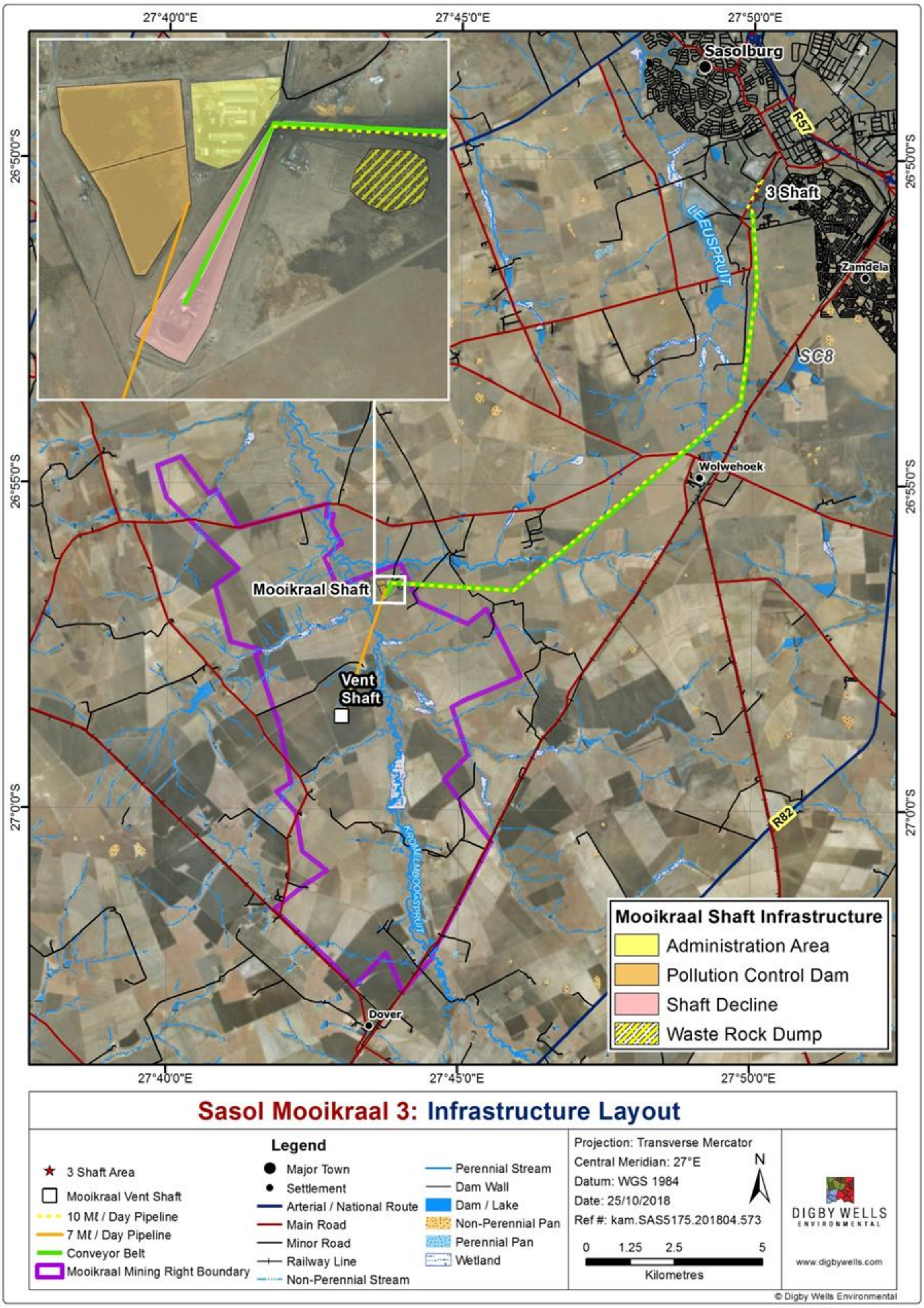


Figure 5-2: Site Layout at Mooikraal

5.2.1.1 Incline Shaft, Silo and Conveyor Belt Area

Borrow pits were constructed in 2005 during the construction phase of the mine and are still located at the mine. An overburden stockpile is located adjacent to the incline shaft, silo and conveyor belt area. This overburden stockpile was developed in 2005 when the incline shaft was constructed (boxcut). The boxcut material (soil and rock) has been stockpiled and will be utilised to backfill the incline/ decline once LOM is reached. The stockpile is located in a designated clean water area with a berm constructed around it. Refer to Figure 5-3 to Figure 5-5.

Figure 5-3: Incline, Silo and Conveyor Belt Area

Figure 5-4: Borrow Pits located behind the Conveyor Belt

Figure 5-5: Overburden Stockpile

5.2.1.2 Kleinvlei Ventilation Shaft and associated Servitudes

Mooikraal has an existing servitude on a portion of the property RE Kleinvlei 66, the remainder of the farm Kleinvlei 66 is utilised for farming activities. This servitude encompasses the Kleinvlei ventilation shaft (Figure 5-6) necessary to provide ventilation to the underground workings. In addition to the ventilation shaft, the following are also present within the servitude:

- Stone dust silo and associated borehole to provide the underground workings with stone dust;
- Dust suppression agent storage facility and the associated bund and boreholes – to provide the underground workings with dust suppression; and

- Substation.

With the progression of mining, it is intended that Mooikraal extend its underground workings towards the southern reserves. It is anticipated that additional ventilation shafts and downcast shafts will be required and established to accommodate this expansion. Where possible none of these ventilation shafts or downcast shafts will take up a total area of more than 1 ha.

Figure 5-6: Kleinvlei ventilation shaft

In addition to this servitude, Mooikraal also has a servitude extending from the ventilation shaft to Mooikraal. This servitude is along the properties detailed in Table 5-4.

Table 5-4: Properties within the servitude from the ventilation shaft to Mooikraal

Farm Name	Portion number	Width	Total Area
Hugenot 291, Parys Rd	R0000	6m	0.45ha
Kleinvlei 66,Parys Rd	00000	6m	0.73ha
Daniels Rust 320, Parys Rd	R0000	6m	1.270ha

This servitude is not fenced in, as it occurs along land utilised for farming purposes.

The following infrastructure occurs within this servitude:

- Underground 7 Ml/day pipeline from the Mooikraal PCDs to the Kleinvlei ventilation shaft; and
- 11 KV electricity supply from Mooikraal to the Kleinvlei ventilation shaft.

5.2.1.3 Servitudes between Mooikraal and 3 Shaft

In addition to the above mentioned servitudes, another servitude runs between Mooikraal and 3 Shaft along the properties detailed in Table 5-5 below. The servitude is surrounded by land utilised for farming activities.

Table 5-5: Properties within the servitude which runs between Mooikraal and 3 Shaft

Farm Name	Portion number	Width	Total Area
Saltberry Plain 422, Parys Rd		33m	5.1004 ha
Zwaneberg 450, Parys Rd	R0000	33m	4.6939 ha
Wolwehoek 1795, Heilbron Rd	00001	33m	3.896 m^2
Wolwehoek 1795, Heilbron Rd	R0000	33m	10.3208 ha
Gysbertshoek 315, Parys Rd	00002	33n	7.4477 ha
Gysbertshoek 315, Parys Rd	R0000	33m	3.272 ha
Gysbert 116, Parys Rd	00000	33m	8.178 m^2
Odin 93, Parys Rd	00001	33m	3.0288 ha
Langverwacht 252	00000	33m	3.9086 ha
Wonderheuvel 417	00000	33m	9.1367 ha

The following infrastructure occurs within this servitude and is shown in Figure 5-7:

- An overland conveyor belt located between Mooikraal and 3 Shaft to transport the ROM coal to the primary plant area at 3 Shaft:
  - The conveyor belt lies on a series of plinths;
  - The servitude area is entirely fenced in with dedicated entrance and exit points;
  - The conveyer belt is cladded for dust suppression;
  - Water sprayers utilising recycled water are installed along the belt to ensure that the coal remains moist and reduces dust generation; and
  - Drive houses/ transfer points - the conveyor belt is equipped with belt turnover units, and scrapers in the drive houses, coal spillages are thus limited to the drive houses (transfer points).
- A 10 Ml/day pipeline (below surface) from Mooikraal PCDs to 3 Shaft and Sasolburg Operations;
- An access and maintenance road (dirt road) constructed along the conveyor belt;
- A 11 KV electricity supply power-line from 3 Shaft to Mooikraal, as well as provision along the overland conveyor belt trajectory (substations and transformers) and electricity pylons); and

- Dirty water management sumps at every drive house to contain dirty stormwater runoff from these structures.

Figure 5-7: Conveyor Belt transporting coal from Mooikraal to 3 Shaft

5.2.1.4 Primary Plant and Conveyor Belt at 3 Shaft

ROM coal from Mooikraal is transported by overland conveyor to 3 Shaft. The coal enters 3 Shaft via MK8 belt, the MK 8 belt splits to either MK9 or MK10 which feeds the 4 Shaft bunker. Ultimately coal enters the crusher via CP4 belt. The crusher crushes and sizes the coal prior to stockpiling the coal on the concrete lined stockpile area.

The crushed coal leaves the crusher and passes through a sieve/ screen and a magnet. The coal enters the stockpile area via CO2 Transfer Point and ultimately is stacked on the stockpile area via a stacker/ reclaimer at CO3 Transfer Point (refer to Figure 5-1).

The ROM coal is handled and blended on the stockpile area manually with front end loaders, the ROM coal is blended with import coal with lower ash content, in order to meet contractual requirements.

Import coal arrives at 3 Shaft in trucks (30 ton trucks) which passes over a weighbridge, and travels along an unpaved haul road, which runs parallel with the perimeter fence, the trucks offload the import coal on the stockpile area.

Various mobile crushers are present on the stockpile area to crush and size the blended coal.

The blended coal (coal at the correct ash percentage) is manually loaded into chutes and bins onto the CS1, CS2 and CO1a and b belts. The blended coal is transported to Sasolburg Operations via CO4 belt at a rate of approximately 7,000 tons/day.

5.2.1.5 Contractors yard at 3 Shaft

A contractor's yard is located within the 3 Shaft and is utilised by a service provider. The area is utilised for parked vehicles and vehicle washing at a wash bay.

5.2.1.6 Water Management

Figure 5-8 below depicts the water reticulation system at both Mooikraal and 3 Shaft. A description of water management at both Mooikraal and 3 Shaft is provided below.

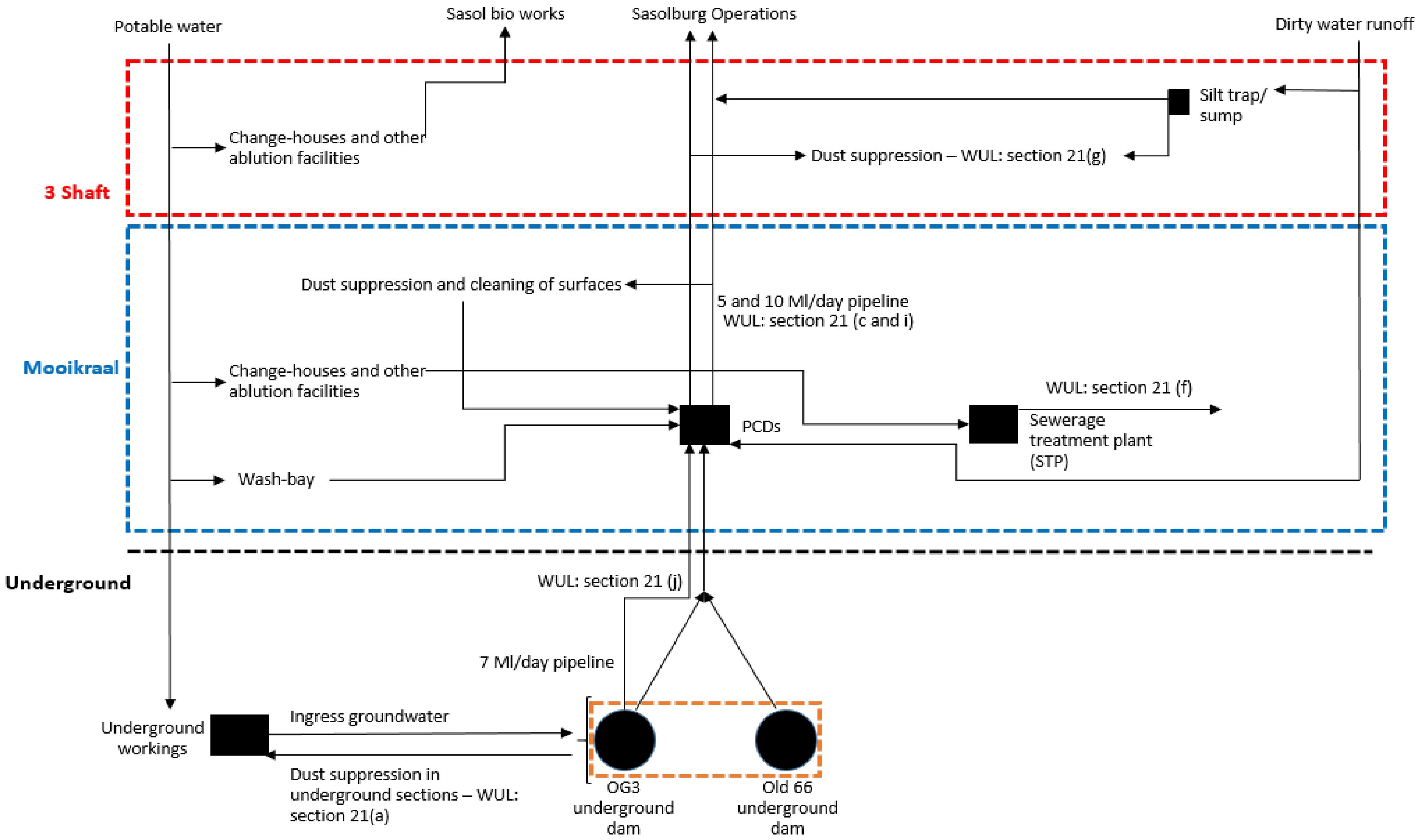


Figure 5-8: Water management schematic representation at Mooikraal and 3 Shaft

5.2.1.6.1 Potable Water

Mooikraal and 3 Shaft both receive potable water from Randwater via a potable water line.

Mooikraal receives potable water from a water line that runs from 3 Shaft, within the conveyor belt servitude. The potable water line enters Mooikraal and is split to provide potable water to various sources, namely offices (kitchen and ablution facilities), laundry washing facility, the wash bay and change houses (showers and ablution facilities). Potable water utilised at the wash bay is for the cleaning of underground machinery and vehicles. Potable water is delivered to the underground workings in water canisters, no pipelines are utilised to distribute potable water to the underground workings.

Potable water at 3 Shaft is utilised at the change houses (showers and ablution facilities) and offices (kitchen and ablution facilities).

5.2.1.6.2 Sewage Water (Effluent)

Mooikraal

All effluent from the change houses, surface ablution facilities and kitchen is pumped to the STP at Mooikraal, via a sewerage network.

The effluent enters the STP through a grid screen at the entrance of the raw sump, the STP operator cleans the grid screen on a daily basis, and the waste that is generated is removed and contained within the drying beds. The raw sump is equipped with a pump and high level and low level float switches, when the effluent level in the raw sump reaches the high level float switch, the pump activates to empty the contents of the raw sump to the aerator tank, and the pump is de-activated when the low level float switch is reached.

The aerator tank circulates and aerates the incoming sewage from the raw sump. The aerator tank contains bio sludge which breaks down the sewerage. As part of the process, the operator determines the volume and age of the bio-sludge on a daily basis.

Similarly, to the raw sump operating mechanism, the aerator tank has high- and low-level float switches. When the level reaches the high float switch, the aerator tank stops circulating and aerating, and allows for a settling period of approximately 1 hour, this is to prevent decant of sludge with the treated water.

After the settling period has been completed, the aerator pump begins to discharge the treated water to the chlorine tank, discharge continues until the low float switch level is reached. The chlorine dosing pump is simultaneously activated upon receipt of the treated water. Two parts per million (2 ppm) of chlorine is dosed into the first chamber of the chlorine tank to treat the water.

The chlorine tank consists of four settling chambers, the overflow weir is situated in the last chamber of the chlorine tank, the treated water leaves the chlorine tank through the overflow weir and is discharged to the receiving environment, as is authorised by Section 21 (f) of the Mooikraal Integrated Water Use Licence (IWUL) (license number: 08/C22K/CIGJFAE/6981; file number: 27/2/2/C1022/12/1, dated 16 January 2018).

Figure 5-9: Chlorine tank

Figure 5-10: Aeration tank

3 Shaft Area

All effluent from the change houses, surface ablution facilities and kitchen is transferred to the municipal sewer system where it is treated.

5.2.1.6.3 Underground Water Management

Underground water management refers to the management of ingress groundwater into the underground workings. This section is only applicable to Mooikraal as no underground mining is taking place at 3 Shaft.

Underground water that ingresses into the underground workings is managed via an underground water reticulation system which involves a complex system of pipelines and storage dams. The underground water storage dams are sealed off by means of seal walls. The water level and water pressure behind the seal walls are monitored on a monthly basis, as the underground seals are maintained to contain a maximum level of water behind the seal wall of 3 m, for safety reasons.

To give effect to the maintenance specifications of the underground seals, volumes of underground water are pumped from the underground water storage compartments to the surface PCDs, namely North and South dams, as is authorised by section 21 (j) of the Mooikraal IWUL (license number: 08/C22K/CIGJFAE/6981; file number: 27/2/2/C1022/12/1, dated 16 January 2018).

The North and South PCDs are clay lined to prevent the potential for dirty water seepage. The South Dam is utilised as a settling dam. Once settled, the water is then allowed to flow naturally to North Dam.

The capacity of the North and South PCDs is 50,985 m^3 and 46,920 m^3 respectively. A 5 Ml/day pipeline was installed during the construction of Mooikraal to transport water from the PCDs to Sasolburg Operations. The 5 Ml/day pipeline is installed along the conveyor belt servitude, and is buried. The purpose of this pipeline was to ensure zero overflow from the PCDs, based on the assumption that approximately 5 Ml/day of underground water would be removed from the underground workings and 5 Ml/day of water would be transported from the PCDs to Sasolburg Operations.

In 2013, the ingress of underground water into the underground workings far exceeded the 5 Ml/day capacity resulting in an imbalance between the volume of water removed from underground and the volume of water transported to Sasolburg Operations via the 5 Ml/day pipeline. Unauthorised overflows of water from the PCDs were experienced.

As part of the management plan to address the PCD overflows, an Environmental Authorisation and WUL process was undertaken to construct two additional pipelines (7 Ml/day and 10 Ml/day). The 7 Ml/day pipeline is utilised to transport underground water from the Kleinvlei ventilation shaft to the South PCD while the 10 Ml/day pipeline is utilised to transport water from the North PCD to Sasolburg Operations.

The 7 Ml/day pipeline is approximately 3 km in length and the 10 Ml/day pipeline is approximately 18.5 km in length. Both pipelines run within existing Sasol Mining servitudes. The 7 Ml/day pipeline is within an existing servitude utilised for power lines while the 10 Ml/day pipeline has been constructed within the existing fenced off overland coal conveyor servitude between Mooikraal and 3 Shaft. The 7 Ml/day pipeline has been buried below the surface, with the exception of the watercourse crossing where it is constructed on surface for 100 m either side of the Kromelmboogspruit. The 10 Ml/day pipeline has been constructed above ground and placed on plinths. The 10 Ml/day pipeline crosses the Leeuspruit, as well as several other watercourses and wetlands, as approved in the issued WUL (Reference Number: 08/C22K/CIGJFAE/6981, dated 16 January 2018) for water uses associated with the Mooikraal operation and 10 Ml/day and 7 Ml/day pipelines.

Figure 5-11 to Figure 5-13 display the existing PCDs and associated pipelines.

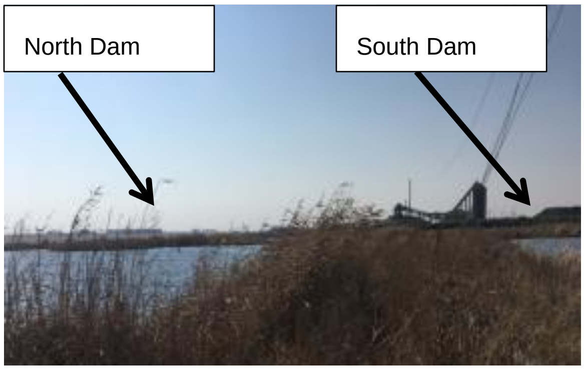


Figure 5-11: PCDs at Mooikraal

Figure 5-12: Existing pump station

Figure 5-13: Constructed Pipelines

5.2.1.6.4 Dust suppression

Dust suppression is undertaken at both Mooikraal and 3 Shaft to manage the level of dust generated from the operations.

Mooikraal

Underground water is used for dust suppression in the underground workings which is authorised by section 21 (a) of the Mooikraal IWUL (license number: 08/C22K/CIGJFAE/6981; file number: 27/2/2/C1022/12/1, dated 16 January 2018). The water is abstracted from the underground water compartments and distributed underground.

Water that is pumped from underground to the PCDs is also utilised for dust suppression along the conveyor belt route to ensure excessive coal dust is not generated while being transported from Mooikraal to 3 Shaft. Additionally the water is also utilised to clean areas around the conveyer belt. Sumps are located along the conveyer belt to contain any excess water generated. The water is also utilised to clean surfaces and workshops at the Mooikraal operation.

3 Shaft

Similarly, underground water is re-used at 3 Shaft for dust suppression. The current 5 Ml/day pipeline when entering 3 Shaft is split to provide 3 Shaft with water for dust suppression, and the remainder water is transported to Sasolburg Operations for use in their process. The 15 Ml/day pipeline will similarly provide water at 3 Shaft for dust suppression, and the remainder will be transported to Sasolburg Operations. It is envisaged that the 15 Ml/day will be the operational pipeline.

Water utilised at 3 Shaft is authorised to be used for dust suppression, at a rate of 20 Ml/day, as per section 21 (g) of the Mooikraal IWUL (license number: 08/C22K/CIGJFAE/6981; file number: 27/2/2/C1022/12/1, dated 16 January 2018).

5.2.1.6.5 Clean and Dirty Water Management

Clean and dirty water separation is implemented at Mooikraal and 3 Shaft. In accordance with GN704 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA), dirty water which is generated is contained and re-used as far as possible while clean water is diverted away from the designated dirty areas as far as possible.

Mooikraal

Water entering dirty water areas (rainfall, cleaning or dust suppression) at Mooikraal is considered dirty water, and is separated from clean water areas through a dirty water management system.

The dirty water management system involves a system of channels and sumps/ silt traps which ultimately divert dirty water to the Mooikraal PCDs. A series of sumps are located at Mooikraal to manage dirty water generated around the shaft complex.

Dirty water management along the incline/decline and conveyor belts, MK 1 and MK2, is managed through a series of sumps, which ultimately pump water to the Mooikraal PCDs.

Two sumps are located near the wash bay and at the fuel, oil storage and workshop area. The sumps separate hydrocarbons from the runoff water prior to entering the PCDs. Dirty water runoff from the diesel workshop is also contained in a sump prior to it entering the PCDs.

Various sumps and channels are used to divert dirty water runoff from the office area and parking lot areas. Figure 5-14 to Figure 5-17 provides an indication of the sumps located at Mooikraal.

Figure 5-14: Sump located at wash bay

Figure 5-15: Oil skimmers located at wash bay

Figure 5-16: Sump located at workshop and oil storage area

Figure 5-17: Sump located at incline shaft

3 Shaft

The 3 Shaft area has been in operation since 1952. The 3 Shaft area is currently used for handling the ROM mined at Mooikraal prior to the coal being transported to the Sasolburg Operations. Coal handling at 3 Shaft involves a series of incoming conveyor belts from Mooikraal, crushing and sizing the incoming ROM coal at the primary plant area. A coal bunker is also located within this area. From the primary plant area, the coal is transported, via conveyor belts, to the coal stockpile area, where the coal is further handled and blended.

In 2016, Mooikraal delineated all wetlands within the project area and it was determined that the primary plant area is located within a delineated wetland area. To implement a comprehensive stormwater management system at 3 Shaft, Mooikraal intends to relocate the primary plant area to the current stockpile area, where a comprehensive dirty water management system as well as dust management system can be implemented, in accordance with GN 704 principles. The bunker (4 shaft bunker) will be demolished.

To relocate the crusher house (primary plant) to the stockpile area, a conveyor belt will be constructed over the delineated wetland, so as to span the shortest distance from MK9 transfer point to the newly constructed crusher.

This corrective action determined is further discussed in Section 5.2.2 below.

5.2.1.7 Waste Management Area

Waste is managed in accordance with the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEMWA) and its associated regulations at both Mooikraal and 3 Shaft.

5.2.1.7.1 Recyclable and Hazardous Waste

Mooikraal

Waste generated at Mooikraal is stored in a designated bunded waste storage area where waste is stored separately according to various waste streams (e.g. general, hazardous and recyclable). All hazardous waste is placed in skips within the bunded area. Mooikraal does not store more than 80 m^3 of hazardous waste, including all hazardous chemical waste (chemical containers), at a given time. Due to the nature of the operation, general waste generated underground is considered hazardous as it is expected to be contaminated with hydrocarbons. Furthermore, Mooikraal does not have the capacity to separate this waste. Hazardous waste is disposed of off-site by a registered waste contractor at a licenced hazardous landfill facility.

The wood waste, scrap metal, used drums and used oil is removed from Mooikraal and taken to Sasol's reclamation yard where it is sold and recycled as far as practicable. The waste storage area at Mooikraal and associated waste streams are shown in Figure 5-18.

Figure 5-18: Waste management area with associated waste streams

3 Shaft

Dedicated waste skips are utilised to dispose of general waste, hazardous waste as well as chemical waste (chemical containers) at 3 Shaft. The storage capacity for general and hazardous waste does not exceed 100 m^3 and 80 m^3 respectively. All fluorescent tubes are stored at 3 Shaft prior to being removed by a service provider for recycling. All waste is disposed of off-site by a registered waste contractor at a licenced landfill facility.

5.2.1.7.2 Sewage Waste (Solid Waste)

A STP is in place at Mooikraal to handle sewage waste. Sludge that is removed from the aeration tanks is allowed to dry in drying beds (Figure 5-19). Once dried, the sludge is disposed of off-site by a registered service provider at a licensed landfill facility. The STP facility does make provision for burning the dried sludge, where a maximum of 10 kg/day of dried sludge may be burned at the STP.

Figure 5-19: STP - Sludge drying beds

5.2.1.7.3 Chemical / Hydrocarbon Waste

Various chemical and hydrocarbon contaminated waste streams is generated at the Mooikraal and 3 Shaft operations as discussed below.

Mooikraal

Diesel and hydraulic oil is stored onsite at Mooikraal in bulk storage tanks. These tanks are stored within a bunded area and on a concrete standing. The oil storage area contains a total of 73 000 litres and has a bund wall capacity to store 150% of the total capacity which amounts to 1,135,000 litres. The diesel tank has a capacity of 23 000 litres, and the bund can contain 110 % of the tanks volume, therefore the size of the bund is 26 400 litres.

An additional bunded area has been constructed to accommodate a storage tank which contains chemical binder utilised for dust suppression. A stone dust silo is also present on Mooikraal which is located at the incline shaft.

All vehicle maintenance is conducted in the diesel workshop, this area has cement flooring and the area around the workshop has been concreted, thus when cleaning the workshop or during rainfall events, the water is captured in a sump area located near the oil storage area (Figure 5-20 and Figure 5-21). The sump is fitted with an oil skimmer and discharged to the PCDs. The oil is stored separately and disposed of accordingly.

Figure 5-20: Fuel and oil storage area

Figure 5-21: Workshop area

Kleinvlei

A storage tank for chemical binders used for dust suppression is stored in a bunded area at the Kleinvlei ventilation shaft. A stone dust silo is also located at the ventilation shaft.

3 Shaft

A diesel storage tank is located at 3 Shaft (Figure 5-22). The diesel storage area is currently not in use and therefore will be decommissioned to concrete level. Any diesel still in the tank will be drained and the diesel contained within the bund removed and recycled or disposed of as hazardous waste.

Figure 5-22: Diesel Storage Facility at 3 Shaft

5.2.2 Proposed Project

Additional activities are proposed within the Mooikraal MRA and 3 Shaft Area as part of this application, namely:

- Demolition activities at the 3 Shaft which includes the demolition of the existing conveyor belting, crushing facility and coal bunker which is currently situated within a wetland;

- Relocation of the primary crusher at 3 Shaft (outside of wetland area and to the existing coal stockpile area) and reconfiguration of the associated conveyor belt series;
- Rehabilitation of affected wetland area at 3 Shaft; and
- Drilling of exploration, monitoring, rescue and downcast boreholes within 500 m of a wetland and associated access roads (some of which are located within the vicinity of water resources).

5.2.2.1 Relocation of Primary Plant at 3 Shaft and Wetland Rehabilitation

As discussed in Section 5.2.1.6.5 above, the existing primary plant area at 3 Shaft is located within a delineated wetland area and the current stormwater management measures have been deemed inadequate to prevent dirty water runoff to the affected water resources and surrounding natural environment. Dirty water runoff (water contaminated with coal) at 3 Shaft Area is currently flowing to the Leeuspruit as a result of the location of the primary plant in a wetland area as well as the absence of dirty water management activities at the stockpile area. The deteriorated water quality of the Leeuspruit has been observed and reported on in the Sigma Defunct Colliery water monitoring report dated January 2018 (Ref No. 2018/03/PJHL).

To rectify these issues, Sasol Mining is proposing to demolish the existing infrastructure of the primary plant area (including crusher and coal bunker), and establish a new primary plant with the latest technology (crusher only) north east of the current primary plant located within the existing stockpile area as shown in Figure 5-1 above. This area is well outside of the wetland area and the 100 meter buffer. Furthermore, the delineated wetland will be rehabilitated. The rehabilitation of the affected wetland will comprise the following, for which an application for Water Authorisation in terms of NWA has been initiated:

- Removal of approximately 300 mm of material from the wetland's natural ground (coal and fine carbonaceous material);
- Infilling of the wetland with clays and soils; and
- Re-vegetation of the wetland with indigenous wetland species. The remediated wetland will thereafter be designated as a clean water area.

Dust suppression will be concentrated on the stockpile area at 3 Shaft, using fogger cannons on the perimeter fence. The water that will be utilised in the fogger cannons will be sourced from a tank/ reservoir with a capacity of 1.6 Ml, which will be filled by the 15 Ml/day pipeline.

This re-location of the primary plant will necessitate the re-alignment of the associated conveyor belt system (existing MK 9 and CP2 belts). Mooikraal proposes to reconstruct the conveyor belt over the shortest distance from the MK 8 transfer point to the relocated primary plant at the CO2 transfer point located at the concrete stockpile area, as shown in Figure 5-1. This conveyor will be the new MK 9 belt and will measure an approximate distance of 650 m from the MK 8 transfer point to CO2 transfer point. The new MK 9 belt will cross the delineated wetland at one section. This crossing is essential to maintaining current operational conditions and the uninterrupted coal supply to the Sasolburg Operations without impacting on production feedstock which would result in down times.

5.2.2.1.1 Proposed Stormwater Management at 3 Shaft

Comprehensive clean and dirty water management activities will be established at and around the stockpile area (which includes the new primary plant), as well as dust management activities to prevent further related pollution.

The proposed dirty water containment system is shown in Figure 5-23 below. The dirty water area is proposed to be kept as small as possible. This will be achieved by reconstructing the infrastructure that is currently located within the delineated wetland to the stockpile area, i.e. the dirty water area. Dirty water will be contained to the dirty water system which will comprise the following:

- Dirty water runoff from the stockpile area will be channelled to a system via V drains running alongside the stockpile area (shown in red and green in Figure 5-23). These V drains have been designed to be 3 m in width and 150 mm deep, capable of accommodating a 1:50 year flood event, and will be concrete lined and reinforced with steel mesh. Water flow through the drains will be gravity fed into a silt trap as depicted in Figure 5-23.
- The silt trap will have a total capacity of 432 m^3 to trap the sediment in the dirty water, with an overflow into an 8.0 m^3 sump (pump chamber). The silt trap is designed to accommodate the maximum rainfall in the area of 120 mm over a period of 24 hours.
- The overflow water in the pump chamber will be pumped at a rate of 288 m^3 per hour via a vertical spindle pump to PCDs at the Sasolburg Operations.
- The pump chamber will start automatically once the high water level is reached and will only stop once the sump reaches the low-level indication. The pump will pump the overflow water, via a High-Density Polyethylene (HDPE) pipeline. The pipeline will have an internal diameter of 200 mm and the maximum length will be 275 m. The pipeline will transfer the overflow water either to the fogger cannon water tank for re-use as dust suppression water on the stockpile, or the pipeline will tie in to the existing 10 Ml/day pipeline utilised to transfer water from Mooikraal to Sasolburg Operations.

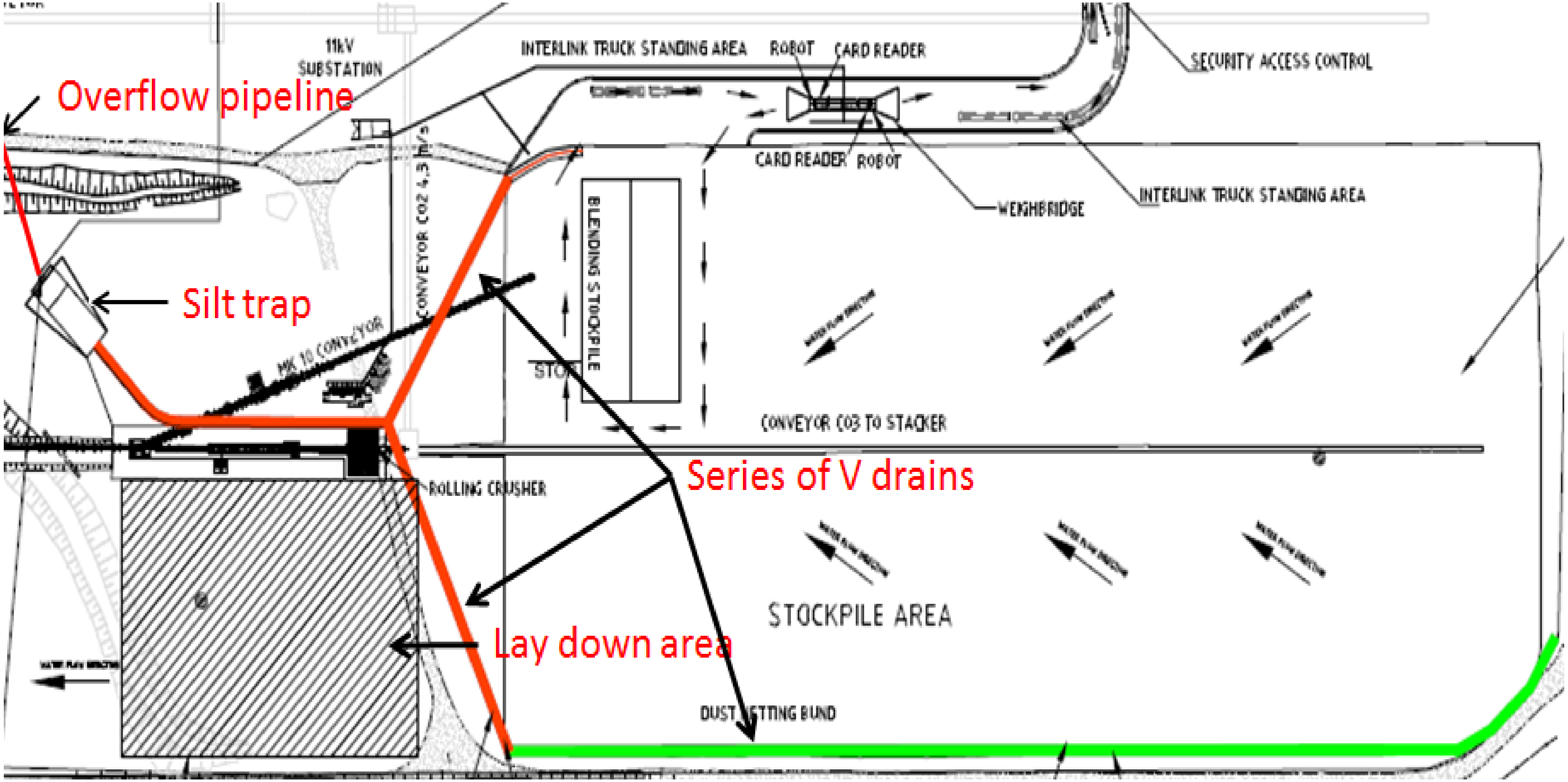


Figure 5-23: Dirt Water Containment System at 3 Shaft

5.2.2.2 Exploration, Rescue, Downcast and Monitoring Boreholes

Mooikraal intends to drill approximately 100 exploration boreholes within the Mooikraal MRA. The total area for each borehole area is planned to be 100 m^2. Some of these boreholes are proposed to be drilled within delineated wetlands, in the vicinity of wetlands (in the 500 m buffer) and/or within 100 m of the Kromelmboogspruit.

Mooikraal is investigating options to further maximise the extraction of coal at Mooikraal towards the southern reserves which necessitates diamond core drilling.

In addition to the exploration boreholes, monitoring, rescue and downcast boreholes will also be drilled in the 500 m buffer and/or within 100 m of the Kromelmboogspruit, and associated access roads will be established. The monitoring boreholes will enable the mine to extend its groundwater monitoring programme within the Mooikraal MRA, as well as to incorporate 3 Shaft into the monitoring network.

The rescue boreholes are intended to be drilled as emergency access points to the underground workings in the event of a disaster, as required by the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA).

5.2.2.3 Additional Ventilation Structures (downcasts and vent shafts)

It is anticipated that as Mooikraal opens up the reserves further south, additional ventilation structures will need to be established. These structures will be established on the Mooikraal MRA, however the exact location of these structures cannot be pre-determined, as the mining layout and specialist studies may vary. It is not anticipated that the ventilation structures if required will be bigger than 1 ha. Downcasts will be drilled into the mine (diameter of approximately 6 m) to provide for underground ventilation as Mooikraal mines the southern reserves.

Vegetation clearance of the area around the downcast will be less than 1 ha, however these downcasts may inevitably be placed within the 500 meter regulated area of wetlands delineated on the Mooikraal MRA. This will however be sited outside the 100 meter buffer/ 1:100 year flood line of the wetland.

5.2.3 Proposed Amendment and Consolidation

The activities associated with the current Mooikraal Operation, as discussed in Section 5.2.1 above, are authorised in terms of the approved EMPr (FS 30/5/1/2/3/2/1 (221) (EM) dated 2016) and Environmental Authorisation (EMB 28/14/43, dated 09 March 2015 as authorised by FSDESTEA).

It has been determined that some properties which are mainly associated with linear infrastructure servitudes and the Kleinvlei ventilation shaft are not included in the approved EMPr. Furthermore, although the EMPr contains some mitigation measures of 3 Shaft, this area has not been adequately addressed/ included in the Mooikraal EMPr.

Through this application, Mooikraal therefore wishes to amend and consolidate the approved Mooikraal EMPr to incorporate all activities at Mooikraal, Kleinvlei ventilation shaft, 3 Shaft and along both servitudes (including the conveyor belt and pipelines trajectory from Mooikraal to 3 Shaft) as well as all their associated properties. This will also include the proposed new activities discussed under Section 5.2.2, subject to approval.

6 Item 3(e): Policy and legislative Context

An application in terms of NEMA for Environmental Authorisation has been submitted to the DMR for Listed Activities provided in Section 5.1 above. Various policy and legislative requirements are applicable to the Environmental Authorisation application and assessment process as detailed in Table 6-1.

Table 6-1: Policy and Legislative Context

Applicable legislation and guidelines used to compile the report	Reference where applied
<u>The Constitution of the Republic of South Africa, 1996 (the Constitution)</u> Under Section 24 of the Constitution it is clearly stated that: *Everyone has the right to* *(a) an environment that is not harmful to their health or well-being; and* *(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -* *(i) Prevent pollution and ecological degradation;* *(ii) Promote conservation; and* *(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*	Sasol Mining is undertaking a consolidated Basic Assessment and Regulation 31 Amendment Process to identify and determine the potential impacts associated with the proposed activities as well as ensure all activities undertaken at Mooikraal are lawfully managed and authorised against one EMPr. Mitigation measures recommended in this report aim to ensure that the potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
<u>National Environmental Management Act, 1998 (Act No 107 of 1998) and EIA Regulations (December 2014)</u> NEMA, as amended, was set in place in accordance with Section 24 of the Constitution. Certain environmental principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The EIA Regulations, Government Notice (GN) Regulation (R) 982 were published on 04 December 2014 and promulgated on 08 December 2014 together with the amended Listing Notices: GN R326, (EIA Regulations) GN R 327 (Listing Notice 1); GN R325 (Listing Notice 2) and GN R324 (Listing Notice 3) of 7 April 2017.	The proposed new activities at Mooikraal are identified to trigger the Listed Activities in the Listing Notices (as amended) and therefore require Environmental Authorisation prior to being undertaken. All identified Listed Activities trigger Listing Notice 1 (GN R 327) which constitutes a Basic Assessment Process. Through this application Mooikraal is also proposing to amend and consolidation the approved Mooikraal EMPr to incorporate the activities subject to Environmental Authorisation as well as an approved separate Environmental Authorisation for pipelines associated with the operation. This has been proposed to ensure effective implementation of the mitigation measures for all activities at Mooikraal under one EMPr. The proposed amendment and consolidation constitute a Regulation 31 Amendment Process. This combined Basic Assessment and Regulation 31 Amendment Process has been duly informed by the requirements of the NEMA and Regulations thereunder.

Applicable legislation and guidelines used to compile the report	Reference where applied
Mineral and Petroleum Resource Development Act. 2002 (Act No. 28 of 2002)(MPRDA) The MPRDA sets out the requirements relating to the development of the nation's mineral and petroleum resources. It also aims to ensure the promotion of economic and social development through exploration and mining related activities. The MPRDA ensures that environmental management principles as set out in the NEMA are applied to all mining operations. The MPRDA serves as a guideline for interpretation, administration and implementation of environmental requirements and ensures that mineral resources are exploited in a sustainable manner to serve both present and future generations.	Mooikraal has an approved mining right FS 30/5/1/2/3/2/2 (221) which permits the mining and extraction of coal within the Mooikraal MRA. No mining activities are currently being undertaken at 3 Shaft and therefore no mining right has been approved for this area. However the operation of the 3 Shaft has been authorised under the approved Mooikraal EMPr. The proposed activities subject to this application are associated with mining-related activities at Mooikraal and 3 Shaft; therefore, the provisions set under the MPRDA will be duly observed.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)(NEMWA) On 29 November 2013, the list of waste management activities published under GN R718 of 3 July 2009 (GN R718) was repealed and replaced with a new list of waste management activities under GN R921 of 29 November 2013. Included in the new list are activities listed under Category A, B and C for which a Waste Management Licence (WML) may be required.	The proposed new activities at Mooikraal will not warrant a WML, however the norms and standards for waste management under the Act will be duly observed.
National Water Act, 1998 (Act No. 36 of 1998) (NWA) The NWA provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA. GN R 704 was published in June 1999 and aims to regulate the use of water for mining and related activities for the protection of water resources and states the following: ▪ Regulation 4: No residue deposit, reservoir or dam may be located within the 1:100 year flood line, or less than a horizontal distance of 100 m from the nearest watercourse. Furthermore, person(s) may not dispose of any substance that may cause water pollution; ▪ Regulation 5: No person(s) may use substances for the construction of a dam or impoundment if that substance will cause water pollution; ▪ Regulation 6 is concerned with the capacity requirements of clean and dirty water systems, and ▪ Regulation 7 details the requirements necessary for the protection of water resources.	An Integrated Water Use Licence Application (IWULA) and an associated Integrated Water and Waste Management Plan (IWWMP) are required in terms of Section 21 of the NWA for the proposed remediation of the affected wetland and conveyor belt crossing over a water resource. The WULA and IWWMP is being applied concurrently with this application for Environmental Authorisation and submitted to the DWS as the decision-making authority.

Applicable legislation and guidelines used to compile the report	Reference where applied
<u>National Noise Control Regulations, R.154 of 1992 (the Noise Regulations) promulgated in terms of Section 25 of the Environmental Conservation Act, 1989 (Act 73 of 1989)</u> The National Noise-Control Regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) (NCRs) form part of the Environmental Conservation Act and these Regulations apply to external noise. The NCRs differentiates between Disturbing Noise levels (which is objective and scientifically measurable which are generally compared to existing ambient noise level) and Noise Nuisance (which is a subjective measure and is defined as noise that "*disturbs or impairs or may disturb or impair the convenience or peace of any person*"). Local Authorities use Controlled Areas to identify areas with high noise levels. Restrictions have been set out for development that occurs in these Controlled Areas. These regulations make provision for guidelines pertaining to noise control and measurements. The regulations make reference to the use of the South African National Standards 10103:2008 (SANS) guidelines for the Measurement and Rating of Environmental Noise with Respect to Land Use, Health, and Annoyance and to Speech Communication. As such, a Noise Impact Assessment in accordance with the NCRs must be undertaken for submission to determine the potential disturbing and nuisance noise levels associated with a particular development.	A Noise Impact Assessment, including modelling, impacts and proposed mitigation measures has been undertaken for this project.
<u>The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA)</u> The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) is the overarching legislation that protects and regulates the management of heritage resources in South Africa. The Act requires that Heritage Resources Agency's in this case the South African Heritage Resources Agency (SAHRA) and Provincial Heritage Resources Authority, be notified as early as possible of any developments that may exceed certain minimum thresholds. This act is enforced through the National Heritage Regulations GN R 548 (2000).	A Heritage Resource Management (HRM) process has been initiated with the SAHRA in accordance with Section 38 of NHRA. However, given that the new activities are proposed over disturbed footprints and the extent of previous assessments undertaken, this therefore negates the need for a Heritage Impact Assessment (HIA). Heritage resources were identified, however no further heritage assessment was deemed necessary. Mitigation measures have been prescribed as a precautionary measure which must be implemented. A request for exemption from further heritage assessment has been submitted to the SAHRA.

Applicable legislation and guidelines used to compile the report	Reference where applied
<u>GN R 1147 (Financial Provisioning Regulations), 2015</u> The Financial Provisioning Regulations prescribe methods for determining the quantum of financial provision for rehabilitation and mechanisms for providing for it. Section 41 (1) of the MPRDA has been repealed and Section 24P of the NEMA, as amended, which provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds.	A rehabilitation plan and closure costing which is aligned with the GN R 1147 has been updated for the Mooikraal MRA and related disturbed area within the project boundaries which is presented in this Report.
<u>National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEMAQA)</u> According to the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEMAQA) the Department of Environmental Affairs (DEA), the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM: AQA. A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM: AQA is the establishment of National Ambient Air Quality Standards (NAAQS) (GN R 1210 of 2009). These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured.	An Air Quality Impact Assessment has been undertaken as part of this process to establish a clear baseline of current air quality in the projects' vicinity, quantify anticipated impacts from the proposed new activities and prescribe mitigation and management measures for the impacts that may be deemed significant.

7 Item 3(f): Need and Desirability of the Proposed Activities

Sasol Mining commenced with its mining operations in Sasolburg at Sigma Colliery in 1952 with the aim of supplying coal to Sasol Operations from both underground and opencast Sigma mining areas. The Sigma Colliery ceased operations in 2006 (now known as the Sigma Defunct Colliery) thereafter Mooikraal took over the supply of coal to the Sasol Operations.

The proposed activities that are subject to this application are planned to ensure better and lawful environmental practices at the operation. In 2016 it was determined that the primary plant area at 3 Shaft is located within a delineated wetland. This infrastructure is historic, dating back to 1952 at the commencement of the Sigma Colliery. Furthermore, the current stormwater management structures have been deemed ineffective at ensuring clean and dirty water separation which has resulted in dirty water runoff into the Leeuspruit.

It is recognised that the current situation at 3 Shaft is a major risk in terms of NEMA, NWA and the MPRDA and further poses a risk to the continuation of the operations. The proposed relocation of the primary plant, upgrade of the stormwater management structures and rehabilitation of the affected delineated wetland at 3 Shaft is aimed to rectify this environmental impact and secure Mooikraal's licence to operate and grow.

In addition, Mooikraal is proposing to drill numerous exploration, monitoring and rescue boreholes, as well as downcasts for ventilation within the Mooikraal MRA with the progression of mining for the purpose of investigating maximised coal extraction through updated geological models, extend the groundwater monitoring programme, establish emergency access point to the underground workings and provide ventilation to the underground workings respectively. These boreholes are essential to ensuring that the mining activities continue optimally with sufficient monitoring of groundwater to identify impacts as well as health and safety measures. Some boreholes are planned within the regulated area of the water resources for which mitigation measures have been prescribed to avoid adverse environmental impacts as far as possible.

Ultimately, the new activities presented in this report have been proposed with the intention to ensure that the Mooikraal Operation can continue to be executed lawfully, reduce environmental risks, promote best environmental practice and provide opportunity for future growth. The continued operation of Mooikraal, including the coal processing operations at 3 Shaft, is essential to ensuring sufficient coal supply to Sasol Operations.

Coal that is supplied to Sasolburg Operations through the Mooikraal Operation is used to produce steam. The steam that is produced by Sasolburg Operations is utilised within its own process, Sasolburg Operations also serves as the only producer and supplier of steam for other industries in Sasolburg, such as NATREF and Omnia. Therefore, the coal supplied to Sasolburg Operations through the Mooikraal Operation will continue to satisfy the existing market as well as continue to contribute towards employment, income generation, skills development and the improvement of the local socio-economic profile of the area.

Through this Basic Assessment Process, the potential impacts associated with the proposed activities have been identified and mitigation measures have been established to avoid adverse environmental impacts. Where impacts are unavoidable, measures to reduce the significance of such impacts have been determined through the specialist investigations which have been undertaken.

With respect to the proposed amendment and consolidation process which forms part of this application, Mooikraal is proposing to have one consolidated EMPr applicable to all activities being undertaken at Mooikraal. This report aims to be relevant to all existing and newly proposed activities at Mooikraal and includes all associated properties. A consolidated EMPr ensures a more efficient tool is utilised for implementation at the Mooikraal and 3 Shaft areas.

8 Item 3(g): Motivation for the Preferred Development Footprint within the Approved Site including a Full Description of the Process followed to reach the Proposed Development Footprint within the Approved Site

All proposed activities are located within the Mooikraal MRA and associated areas including the Kleinvlei vent shaft, conveyor belt/pipeline route and 3 Shaft area. The qualifying criteria when considering the placement of the primary plant relocation site as 3 Shaft were the size requirements for the infrastructure, state of the site, environmental sensitivities as well as the proximity to other associated infrastructure.

The preferred site for the primary plant area is located at the existing concrete lined stockpile area where crushed coal is currently being handled and stored prior to being transported to Sasolburg Operation for further use. This site is characterised as an already disturbed footprint which is preferred as it would not result in further disturbance of the affected wetland at 3 Shaft.

The preferred location/ site is ideal because:

- The area is an already disturbed footprint;
- The area is concrete lined;
- The area is directly adjacent to where crushed coal will be stockpiled, reducing the risks associated with transporting coal to the stockpile area;
- The area will reduce the number of separate dirty water areas, ensuring that the dirty water area footprint is kept as small as possible, which will result in more effective stormwater management at the 3 Shaft Complex;
- The area will allow for the clean water area to be maximised; and
- All dust liberating infrastructure at 3 shaft will be concentrated to one area, allowing for effective dust management via the fogger cannons which are planned to be erected along the 3 Shaft perimeter fence.

The location of the proposed boreholes with associated access roads within the Mooikraal MRA and 3 Shaft area (only water monitoring) has been determined based on the intended use. A large number of boreholes, particularly the exploration boreholes, have been proposed within proximity to water resources. The locations will be determined based on the following:

- For geological/ exploration boreholes, the nature of the location of the coal seam determines the drilling location to obtain the most accurate geological data;
- Rescue and downcast boreholes are situated at areas as designated by the MHSA and Sasol Mining SOPs, as well as various specialist input; and
- Monitoring boreholes are situated based upon geophysical and geological information.

The location of the proposed boreholes will be determined based on the mining activities and strategically suitable areas that avoid sensitive areas as far as possible.

All other existing development footprints associated with the Mooikraal, conveyor belt/pipeline route and 3 Shaft operation have previously been approved and established accordingly. The alternatives presented in subsequent subsections therefore only pertain to proposed new activities at Mooikraal and 3 Shaft.

8.1 Item 3(g)(i): Details of the development footprint alternatives considered

A project alternative is defined as a possible course of action, in place of another, that would meet the same purpose and need (DEAT, 2004). Project alternatives serve to determine the most effective way of meeting the objectives of that project. This is generally done through either enhancing the benefits of an activity and/or mitigating the negative impacts and risks of an activity.

According to the Department of Environmental Affairs (DEA) Criteria for Determining Alternatives in EIA Guideline (2004), there are various types or categories of alternatives, including:

- Activity alternative – consideration of different means to achieve the same project objective;
- Location alternative – alternative project sites in the same geographic area;
- Site layout alternative – consideration of the different options to place project infrastructure;
- Process/design alternative – alternative process/design/equipment;
- Routing alternative – consideration of different routes for linear infrastructure; and
- No-go alternative – the proposed project/activity does not proceed, implying that the current situation or status quo remains.

The above-mentioned categories of alternatives were considered and are detailed in the subsections below.

8.2 Item 2(h)(i): Details of all alternatives considered

8.2.1 Activity Alternatives

Mooikraal and 3 Shaft are existing operations comprising coal extraction and processing activities respectively. No activity alternatives were considered for the relocation of the primary plant as the crushing and screening of extracted coal in an existing and essential part of the Mooikraal operation which is required to continue to satisfy the coal requirements of the Sasolburg Operations. This activity will continue until the end of the LoM.

Furthermore, no activity alternatives were considered for the proposed exploration, monitoring and rescue boreholes as no other means to achieve the activity objectives could be identified.

8.2.2 Location/Site Layout Alternatives

Mooikraal and 3 Shaft are established operations therefore the location of the mine with associated conveyor belt and processing activities remains fixed and will not be relocated or changed.

The preferred site for the relocation of the primary plant at 3 Shaft is characterised as a disturbed footprint located on the existing concrete lined stockpile area. As indicated above, this site is preferred because:

- The area is an already disturbed footprint;
- The area is concrete lined;
- The area is directly adjacent to where crushed coal will be stockpiled, reducing the risks associated with transporting coal to the stockpile area;
- The area will reduce the number of separate dirty water areas, ensuring that the dirty water area footprint is kept as small as possible, which will result in more effective stormwater management at the 3 Shaft Complex;
- The area will allow for the clean water area to be maximised; and
- All dust liberating infrastructure at 3 Shaft will be concentrated to one area, allowing for effective dust management via the fogger cannons which are planned to be erected along the 3 Shaft perimeter fence.

Another alternative site considered is relocating the primary plant to the Mooikraal MRA. This alternative was eliminated because:

- There is insufficient space to accommodate the required infrastructure;

- The relocation of the primary plant to Mooikraal will likely result in the disturbance of natural habitat and the creation of an additional dirty water area; and
- The associated infrastructure, namely the stockpile area and the conveyor belts between Mooikraal, 3 Shaft and Sasolburg Operations already exist.

The location of the proposed boreholes has been determined based on:

- For geological/ exploration boreholes, the nature of the location of the coal seam determines the drilling location to obtain the most accurate geological data;
- Rescue and downcast boreholes are situated at areas as designated by the MHSA and Sasol Mining SOPs, as well as various specialist input; and
- Monitoring boreholes are situated based upon geophysical and geological information.

Therefore no location alternatives for boreholes have been assessed.

8.2.3 Process/Design Alternatives

The existing primary plant at 3 Shaft was deemed to have insufficient stormwater management measures. Furthermore, excessive dust generation from the crushing, screening and stockpiling activities has also been identified for the area. Therefore alternative processes and technologies were considered for stormwater management and dust generation reduction to what is currently in place.

The preferred option for stormwater management at 3 Shaft is to upgrade the structures around the stockpile area with the aim of ensuring dirty water runoff is contained in a dirty water system and that the dirty water area footprint is kept as small as possible. The preferred alternative stormwater management measures includes the installation of V drains on both sides of the stockpile area which direct dirty water runoff, emanating from the stockpile area, through a slit trap to capture sediment. An overflow pump chamber will also be in place as part of the stormwater management system, the water from the overflow chamber will either be directed to the fogger cannon water tank for re-use in the fogger cannons, or will be transferred to the 10 Ml/day pipeline. Ultimately, the remaining water will be pumped to the existing PCD at 3 Shaft.

Two options were considered for dust management at the primary plant and coal stockpile area at 3 Shaft, namely the installation of windbreaks or water fog cannons. The preferred alternative is the installation of a series of fogger cannons on the perimeter fence to mitigate windblown dust from the stockpile area. The fogger cannons have been estimated to have 90% control efficiency on windblown dust from the northwest while the wind breaks would offer 30% control efficiency on windblown dust from the northwest (refer to Air Quality Impact Assessment, Appendix 9).

8.2.4 Routing Alternatives

Two options were considered for the conveyor route associated with the relocation of the primary plant to the stockpile area, namely maintaining the existing conveyor belt route or realign the MK9 belt to go directly from the MK8 transfer point to the CO2 Transfer Point where the new primary plant area will be located (refer to Figure 5-1 above).

Both route options cross the delineated wetland, however, the realignment of the MK9 belt is the preferred for the following reasons:

- It would result in shortest distance to the new primary plant on the stockpile area;
- There will be less transfer points;
- The MK 9 conveyor belt will be designed in a manner to reduce environmental impact, in that the belt that crosses the wetland will be enclosed (gantry) and have pans on either side to capture any coal spillage; and
- The decommissioning of the MK9 belt will also benefit the rehabilitation activities proposed for the current primary plant area within the delineated wetland.

8.2.5 No-go Alternative

The no-go alternative was considered for the new proposed activities as well as the amendment and consolidation of all activities associated with the Mooikraal and 3 Shaft operations. These no-go alternatives are discussed separately below.

8.2.5.1 Proposed New Activities

The no-go alternative entails maintaining the status quo, and as such the dirty water runoff and windblown dust challenges being experienced at 3 Shaft as a result of the location and process/technology associated with the primary plant and stockpile area will persist.

By not implementing the proposed primary plant relocation project, upgrade of the plant technology, implementation of the fogger cannon dust mitigation system and stormwater management structures as well as remediation of the affected wetland, the operation's licence to operate and grow is at risk. This in turn would result in numerous negative environmental and socio-economic implications.

In terms of the proposed boreholes to be drilled, the no-go alternative will hinder Sasol Mining's ability to update the geological models of the area which would ultimately be used to optimise the extraction of coal. This would potentially result in inaccurate estimation and mining methods employed.

For the monitoring boreholes, the no-go alternative would hinder Sasol Mining's ability to extend its groundwater monitoring programme with the progression of mining which may potentially result in insufficient monitoring to meet the objectives of the EMPr.

The rescue and downcast boreholes are essential for ventilation and emergency egress; the no-go option would result in a significant safety risk for the underground workings and non-compliance with the requirements of the MHSA.

8.2.5.2 Amendment and Consolidation of Mooikraal Activities

Through a Regulation 31 Amendment Process, Mooikraal wishes to amend and consolidate the approved Mooikraal EMPr to incorporate all mining related activities undertaken at Mooikraal and 3 Shaft including all associated properties. This includes the 7 Ml/day and 10 Ml/day pipelines which have been approved under a separate authorisation as well as the new activities associated with the Basic Assessment component of this application (refer to Section 5.1 above) should they be approved.

It has been determined that some properties associated with the Mooikraal MRA and conveyor belt/pipeline route are not covered in the approved EMPr and some existing activities are insufficiently addressed/included. The proposed amendment therefore presents an opportunity to reassess the approved Mooikraal EMPr to ensure that all activities and properties associated with the operation in its entirety are adequately covered and mitigation measures are comprehensive.

The consolidation has been deemed a more effective management tool, therefore the no-go option would result in Mooikraal maintaining its current separate authorisations at the operation which inadequately cover the full extent of the operation.

9 Item 3(g)(ii): Details of the Public Participation Process followed

The PPP is undertaken in terms of the regulatory requirements set out in Regulation 44 and 45 of the EIA Regulations, 2014 (as amended) and as required in terms of Chapter 5 of NEMA. The PPP enables stakeholders to partake and submit comments, suggestions or issues of concern. For this Basic Assessment/Regulation 31 Amendment Process, the PPP has been divided into three phases as follows:

- Announcement Phase;
- Basic Assessment/Regulation 31 Amendment Phase; and
- Decision Making Phase.

9.1 Announcement Phase

The project was announced together with availability of the Basic Assessment/Regulation 31 Amendment Report for public comment. The announcement phase included the activities detailed below.

9.1.1 Identification of Stakeholders

Sasol Mining has an existing database of I&APs associated with their mining project and previous regulatory processes. The existing database for the Mooikraal operation was used and updated to ensure that all potentially relevant I&APs will be informed.

Stakeholders were grouped into various categories such as land owners/occupiers, communities, relevant government organisations, non-governmental organisations (NGOs) and business enterprises. The directly affected landowners are listed in Appendix 3 and illustrated on the Land Tenure Map included as Plan 3 to Plan 5, Appendix 2.

Stakeholders were encouraged to register as I&APs throughout the PPP and the stakeholder database was updated throughout the PPP with new stakeholders.

9.1.2 Public Participation Media

Considering the legislative requirements and good practice the following methods have been implemented to make project and information available to stakeholders:

- **Background Information Document (BID):** BIDs were emailed and distributed around the project area. The BID included a project description, information about the required legislation, the competent authorities and details of the appointed EAP. The BID was also accompanied by a registration and comment form for stakeholders to register as I&APs or to submit comments. Information regarding the availability of the Basic Assessment/Regulation 31 Amendment Report was also provided;
- **Newspaper advertisement:** a newspaper advertisement was placed in Southern Ster Newspaper on 26 March 2019. The advertisement included a brief project description, information about the required legislation, the competent authorities, details of the appointed EAP, registration process for I&APs, and information regarding the availability of the Basic Assessment/Regulation 31 Report Amendment for public comment;
- **Site notices:** site notices were put up at various places which contained a brief project description, information about the required legislation, the competent authorities and details of the EAP, registration process for I&APs and information regarding the availability of the Basic Assessment/Regulation 31 Amendment Report for public comment; and
- **SMS:** a SMS was sent to registered I&APs in support of the announcement of availability of the Basic Assessment/Regulation 31 Amendment Report for public comment.

9.2 Basic Assessment Phase

This draft Basic Assessment/Regulation 31 Amendment Report has been made available for a public comment period of 30 days from **26 March 2019 to 2 May 2019** at publically accessible places (Zamdela and Sasolburg Public Libraries), and on the Digby Wells website www.digbywells.com (under Public Documents).

Comments, issues of concern and suggestions received from stakeholders during this public comment period will be captured in a Comments and Response Report (CRR) which will be included into the Final Basic Assessment/Regulation 31 Amendment Report for DMR's appraisal. A public meeting to present the project will be held on 12 April 2019 to present the project findings and provide stakeholder with an additional opportunity to make comments.

9.3 Decision Making Phase

The Final Basic Assessment/Regulation 31 Amendment Report (including the CRR) will be submitted to DMR for appraisal. The DMR, as the competent authority, will issue a decision on the Environmental Authorisation for the proposed project. This decision will be communicated to stakeholders as prescribed under the NEMA legislation. As such, notification to stakeholders will be done by means of a letter sent via email/post and SMS.

9.4 Summary of Public Participation Activities Undertaken

Table 9-1 provides a summary of the PPP activities undertaken thus far, together with referencing materials included in Appendix 4.

Table 9-1: Public Participation Activities

Activity	Details	Reference in Report
Identification of stakeholders	Stakeholder database representing various sectors of society, including directly affected and adjacent landowners, in and around the project area was maintained.	Appendix 4-1: Stakeholder database
Distribution of Notification Letter and BID	A Notification Letter and BID with registration and comment form was emailed and posted to stakeholders on 26 March 2019.	Appendix 4-2: BID
Placing of newspaper advertisement	A newspaper advertisement was placed in the Southern Ster Newspaper on 26 March 2019.	Appendix 4-3: Newspaper Advert
Erecting site notices	English site notices were placed at the boundary of project area, and other public places on 26 March 2019.	Appendix 4-4: Site Notice Report
Announcement of Basic Assessment/ Regulation 31 Amendment Report	Announcement of availability of the Basic Assessment/ Regulation 31 Amendment Report was emailed and posted to stakeholders together with the formal project announcement on 26 March 2019. Copies of this draft BAR are available to stakeholders at: ▪ Zamdela Public Library; and	Appendix 4-5: Announcement Letter

Activity	Details	Reference in Report
	▪ Sasolburg Public Library. The draft report is also available on the Digby Wells website (www.digbywells.com) under Public Documents. ***(30-day comment period for the BAR: 26 March 2019 to 2 May 2019)***	
Consultation with Stakeholders	A public meeting is planned to be held on 12 April 2019 during the public review period. The time and venue will be communicated to stakeholders in due course.	Appendix 4-6: CRR
Announcement of Final BAR	This draft Basic Assessment/Regulation 31 Amendment Report will be updated with all comments received from I&APs and update for submission to the DMR and simultaneously made available to I&APs for comment on the Digby Wells website (www.digbywells.com) under Public Documents.	

9.5 Item 3(g)(iii): Summary of Issues Raised by I&APs

Views, concerns and objections provided by I&APs will be captured in the CRR following this public comment period. No comments on the project have been received to date.

10 Item 3(g)(iv): The Environmental Attributes associated with the Development Footprint Alternatives

This section provides a description of the baseline environment associated with the project area and region (where relevant). The purpose of understanding the environmental baseline conditions relates to the potential of the project to impact on the existing environment, and the potential for existing environmental aspects to influence a proposed development in terms of design, location, technology and layout.

A number of specialist studies were undertaken for this Basic Assessment/Regulation 31 Amendment project are appended to this report and shown in Table 10-1 below.

Table 10-1: Specialist Reports and Associated Appendices

Specialist Study	Appendix
Soil, Land Use and Land Capability Assessment	Appendix 5
Freshwater Assessment (Wetlands and Aquatic Ecology)	Appendix 6
Surface Water Assessment	Appendix 7
Groundwater Assessment	Appendix 8
Air Quality Assessment	Appendix 9
Noise Assessment	Appendix 10
Heritage Assessment	Appendix 11

Socio-economic Assessment	Appendix 12
Rehabilitation Strategy and Implementation Plan (RSIP)	Appendix 13

The subsection below provides the baseline bio-physical and socio-economic environmental conditions currently present on the project site. The information provided in this section has been obtained from the abovementioned specialist reports. Information was also obtained from previous studies undertaken which has been indicated accordingly.

10.1 Regional Climate

The project area occurs within a summer rainfall region with warm summers and moderate dry winters. Climate data used herein originates from the Vereeniging International Weather Station (Station Number 043 87843) from the South African Weather Bureau.

10.1.1 Rainfall

Rainfall records reported are for the periods 1951 – 1984 and 1991-2012 to give long term climatic averages and variability (Digby Wells Environmental, 2014).

Relative to the country's average Mean Annual Precipitation (MAP) of 490 mm (Worldwide Fund for Nature - South Africa, 2016), this area experiences moderately high mean rainfall of approximately 635 mm per annum (i.e. long term average between 1951 – 2012).

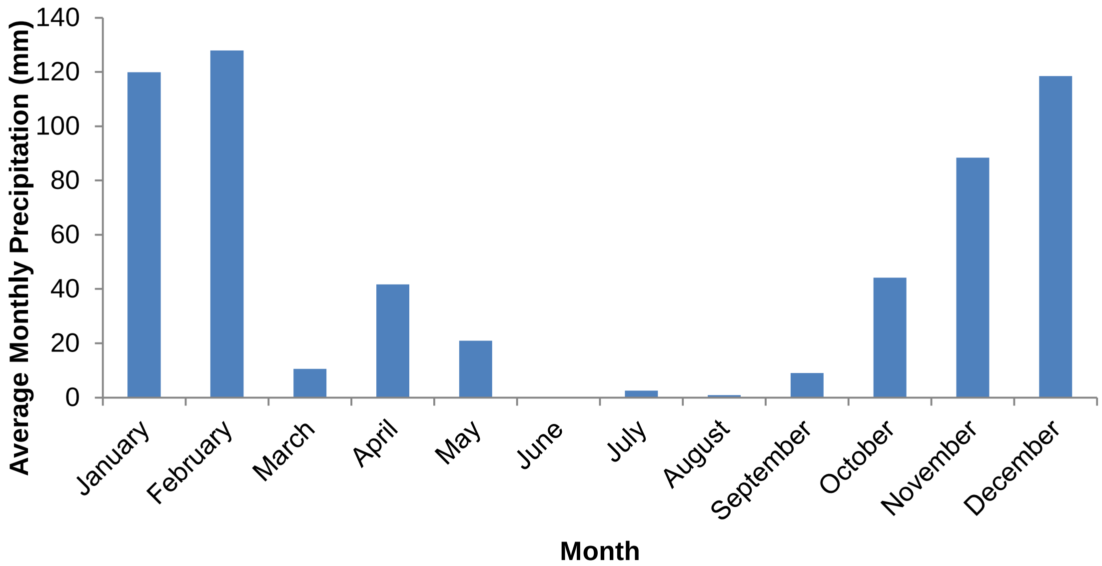


Figure 10-1: Average monthly rainfall for the Sasolburg area

(Source: SA Weather Service. 2017)

10.1.2 Temperature

The project area is located within the Highveld ecoregion (Level II ecoregion 11.03), which has been noted to attain an average temperature range of 12-20°C, a maximum temperature range between 20-32°C during January and a minimum temperature range between -2 to 4°C during July (Kleynhans *et al*., 2007).

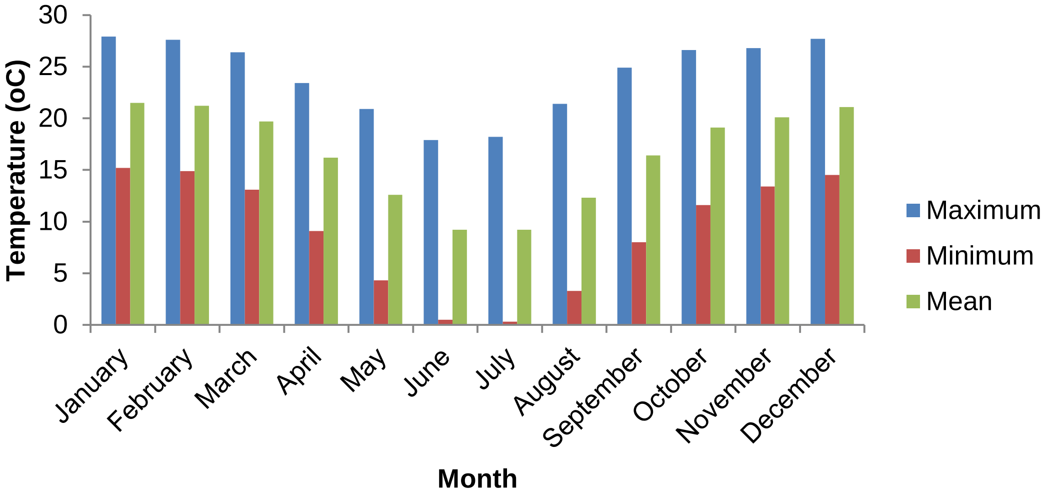


Figure 10-2: Average monthly temperature data for the Sasolburg area

(Source: SA Weather Service. 2017)

10.1.3 Wind

The winds in the region are generally light to moderate except during thunderstorms. Generally, the prevailing wind directions are from the North West during the day and from the east at night. However, it should be noted that the prevailing wind direction typically varies throughout the year. During spring, the prevailing wind direction is north-north east and during autumn the prevailing wind direction is south-east. The prevailing wind direction in summer is east-south east and in winter it is south to south-south east (Neveling, 2012).

10.2 Geology

10.2.1 Regional Geology

Mooikraal and 3 Shaft are situated within the Sasolburg-Vereeniging. This Coal field is located on the Northern edge of the Karoo basin and according to the 1: 250 000 geological map, is predominantly characterized by mudstone and sandstones of the overlying Beaufort Group (Adelaide Subgroup). These sequences are underlain by the Volksrust Formation (Permian Ecca Group), a formation with a thickness of approximately 100 m in the Heilbron area, comprising of blue-grey or black siltstone and shale (Argillaceous rocks) which are found on the surface. The Vryheid Formation, which happens to be the coal-bearing horizon (formation), underlies the Volkrust Formation. The entire coalfield is subdivided into Sigma (which the study area is in), Cornelia, and Coalbrook basins.

10.2.2 Site-specific Geology

The project area is located within the Sigma sub-basin, which is underlain by lava and dolomite as well as metasedimentary rocks of the Ventersdorp and Transvaal supergroups respectively. The above mentioned lavas of the Ventersdorp Supergroup are primarily located in an area in the central part of the sub-basin, whereas the prominent outcrops of Transvaal Supergroup dolomites extend from near the Klip River southwards to Vereeniging and beyond (Nel & Jansen, 1957). Several coal seam nomenclatures exist within this basin, however for the interest of this report we will discuss the number 3 (middle) coal seam, which is mined at a depth of 85-170m at the Mooikraal. This coal seam occurs stratigraphically some 20 m above the No. 2 Seam and ranges in depth below the surface from about 200–500 m. It is approximately less than 3 m thick, and is of poor quality (Stavrakis, 1986).

10.3 Topography and Sensitive Receptors

The topography of Mooikraal varies between 1 480 to 1 500 metres above mean sea level (mamsl). The highest surface elevations are found in the southern and eastern parts of the area and the surface elevations in these areas can go up to 1 500 mamsl. It is characterised by flat boundless plains. The slope is that of a gently sloping surface towards the Vaal River.

The sensitive receptors to the project could include, but are not limited to, residents of Zamdela located east of the 3 Shaft Complex, road users of main roads traversing the project area as well as farmers and businesses occurring within the Mooikraal MRA.

10.4 Soils, Land Use and Land Capability

The Soil and Land Capability Assessment undertaken is appended to this report as Appendix 5. To establish the baseline soils and land capability condition the following methodologies were employed:

- **Desktop Assessment and Literature Review** – existing land type data (Land Type Survey Staff, 1972 - 2006) was used to determine the general soil patterns and terrain types. Other literature consulted included previous environmental assessments undertaken for Mooikraal.
- **Soil sampling and analysis** – a sit visit was conducted where six soil samples were collected within the project area. A chemical analysis was undertaken in an accredited laboratory for indicators of acidity, fertility and texture.
- **Land Capability and Land Use –** the land capability, which is defined as the most sustainable land use under rain-fed conditions, was determined by assessing a combination of soil, terrain and climatic features. The assessment was done in

accordance with the approach adopted by Schoeman *et al*. (2000). Land use was mapped using aerial imagery and then ground-truthed during the site visit.

Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 5.

10.4.1 Land Type and Soil Form

The dominant land type covering the project area is classified as Ca1 and Dc7 which is identified with Arcadia and Avalon Soil Forms, as depicted in Plan 9, Appendix 2. Arcadia soil forms are characterised as soils capable of holding large amounts of water, although are often not available to crops while Avalon soil forms are freely draining and chemically active.

10.4.2 Present Land Use and Land Capability

The present land use within the project area mainly include underground mining, cultivated land and veld for grazing. Plan 10 in Appendix 2 depicts the present land use across the Mooikraal MRA and 3 Shaft area. In terms of land capability the land classes identified within the project area were IV (low to moderate agricultural potential) and V (low agricultural potential).

Although land in Class IV may be used for cultivated areas, there are severe limitations to crop choice and may require more careful management. Class V land capability coincides with the black clayey soils. Although these soils are deeper, they have high clay content and shrink/swell properties, making them very difficult to manage from an agricultural perspective. Land in Class V has little or no erosion hazard but has other limitations such as impractical to ameliorate which limit its use largely to grazing or wildlife.

10.4.3 Soil Chemical and Physical Properties

Six soil samples were analysed from the project area for chemical and physical (soil texture) properties.

The physico-chemical analysis revealed the following general properties of the samples:

- Soil pH – the soil pH has a direct influence plant growth potential and the samples revealed pH levels that range from 4.9 to 6.1 which is considered to be acidic to slightly acidic. Soil pH below 7 may be indicative of the acidic nature of the parent material from which the soil is derived and leaching of nutrients. Lime application would be required to counteract acidity and increase plant growth performance.
- Cations – the levels of the basic cations (Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium (Na)) are determined for agronomic purposes which normally follow the same trend as outlined for soil pH and texture. Ca and Mg levels were found to be generally high and adequate for crop production. Potassium levels were also found to be high and adequate when compared to soil fertility guidelines. The Na levels ranged between 18 and 550 mg/kg. Typically soils with Na levels below 200

mg/kg are considered to not be sodic (represented by five of the six samples) and are acceptable.

- Phosphorus – the samples reveal that phosphorus levels in the project area are very low, according to the Soil Fertility Guidelines (Fertiliser Association of South Africa, 2003), which is limiting on ecosystem functioning and would require Phosphorus fertilisation if considered for agricultural purposes.
- Soil Organic Carbon – the soil organic carbon provides an indication of the organic matter in soil. The samples ranged from 0.1 to 0.9%. Levels below 2% are considered low and would therefore require external nutrient if considered for agricultural purposes.
- Soil Texture – the soil texture of the samples are characterised as clay, sandy clay loam, sandy loam and clay loam. Clayey soils have a slow infiltration rate but a good water retention capacity and these soils are more fertile than sandy soils due to high plant nutrient retention. Three samples within Mooikraal were found to have high clay content and a low to marginal agricultural potential while the reminder, which were collected along the conveyor route and at 3 Shaft were found to be a bit sandy and have a moderate agricultural potential.

10.5 Flora and Fauna

A Flora and Fauna Assessment was conducted for the Mooikraal in 2014 (Digby Wells, 2014). A summary of the regional findings is provided in the subsections below.

10.5.1 Flora Characteristics

10.5.1.1 Regional Vegetation

The project area falls within the Grassland Biome (Mucina and Rutherford, 2012), as depicted in Plan 8, Appendix 2, which is characterised as the second most bio-diverse biome in South Africa. This biome is rich in flora and fauna diversity but is under threat due to rapid urbanisation and expansion of mining and industrial activities.

The project area also occurs in the Central Free State Grassland regional vegetation type, which is characterised by short grassland covering undulating plains (Mucina and Rutherford, 2012). It is considered a ‘Vulnerable’ vegetation type with a conservation target of 24%. In natural condition *Themeda triandra* is dominant, whereas *Eragrostis curvula* and *E. chloromelas* become dominant in more degraded habitats.

Table 10-2 lists a number of other species characteristic of the vegetation type.

Table 10-2: Plant species characteristic of the Central Free State Grassland

Plant form	Species
Graminoids	*Aristida adscensionis (d), A. congesta (d), Cynodon dactylon (d), Eragrostis chloromelas (d), E. curvula (d), E. plana (d), Panicum coloratum (d), Setaria sphacelata (d), Themeda triandra (d), Tragus koelerioides (d), Agrostis lachnantha, Andropogon appendiculatus, Aristida bipartita, A. canescens, Cymbopogon pospischilii, Cynodon transvaalensis, Digitaria argyrograpta, Elionurus muticus, Eragrostis lehmanniana, E. micrantha, E. obtusa, E. racemosa, E. trichophora, Heteropogon contortus, Microchloa caffra, Setaria incrassata, Sporobolus discosporus.*
Herbs	*Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Conyza pinnata, Crabbea acaulis, Geigeria aspera var. aspera, Hermannia depressa, Hibiscus pusillus, Pseudognaphalium luteo-album, Salvia stenophylla, Selago densiflora, Sonchus dregeanus.*
Geophytic Herbs	*Oxalis depressa, Raphionacme dyeri.*
Succulent herbs	*Tripteris aghillana var. integrifolia.*
Low shrubs	*Felicia muricata (d), Anthospermum rigidum subsp. pumilum, Helichrysum dregeanum, Melolobium candicans, Pentzia globosa.*

10.5.1.2 Site Specific Vegetation

A dry season survey was undertaken during the Flora and Fauna Assessment for the Mooikraal in 2014 where a total of 42 plant species were recorded. As shown in Plan 9, Appendix 2, the project area is characterised by three main habitats, namely:

- Wetlands;
- Themeda – Sporobolus dominated Grassland; and
- Transformed areas associated with crop agriculture and mining infrastructure.

10.5.1.2.1 Wetland Areas

Wetland areas were characterised by hydromorphic plant species such as *Juncus effucus* (Soft Rush) and *Cyperus fastigiata*. Wetlands were mostly associated with the Kromelmboogspruit and portions of valley bottom systems had been infringed upon by maize fields. Areas where standing water was present, such as channels and permanent wetlands, had been colonised by *Phragmites australis* (Giant Reed) and *Typha capensis* (Common Bulrush). Figure 10-3 represents examples of the major habitats on site.

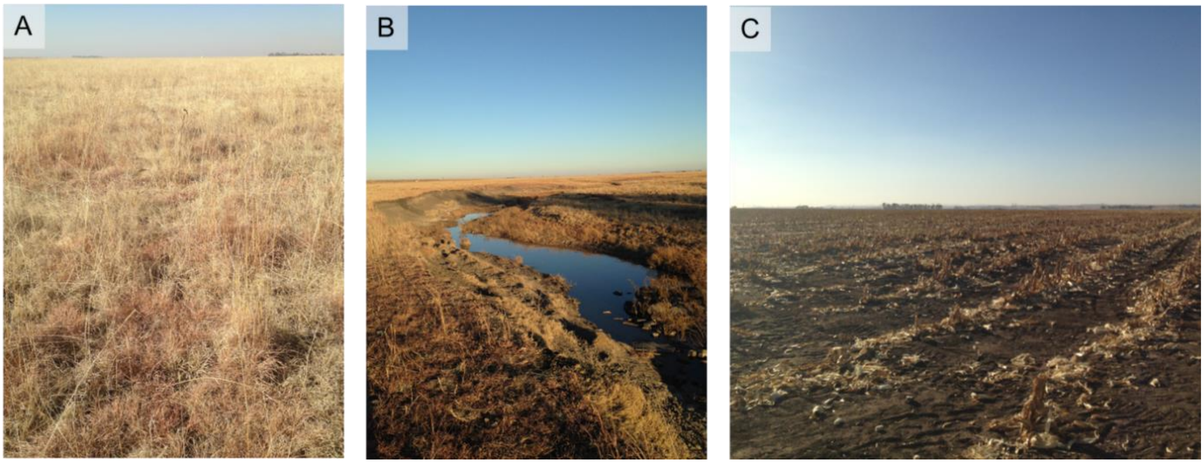


Figure 10-3: Examples of major habitats on site (A: Themeda – Sporobolus dominated Grassland; B: Wetland Areas and Transformed agricultural land)

10.5.1.2.2 Themeda – Sporobolus dominated Grassland

The remaining terrestrial habitat on site has been considerably altered from its reference state of the Central Free State Grassland, with reduced species diversity. Dominant grass species include: *Aristida congesta* subsp. *congesta* (Tassle Three-awn), *Eragrostis chloromelas* (Love Grass), *Heteropogon contortus* (Tussock Grass) *Hyparrhenia hirta* (Common Thatching Grass), *Setaria sphacelata* (Broad-leaf Setaria), *Sporobolus africanus* (African Dropseed) and *Themeda triandra* (Roogras). Charcteristic forbs included: Berkheya setifera (Rasperdisseldoring), *Homeria pallida* (Yellow Tulip), *Erythrina* zeyheri (Plough-breaker), *Senecio* sp. and *Seriphium plumosum* (Bankrupt Bush). Additional grasses and forbs are likely to occur but would only be identified after rains during the summer season.

Grazing potential for the site was regarded as medium to low due to a relative abundance of less palatable species and infestations of the native invasive plant, *S. plumosum* (Bankrupt Bush) had established throughout the site. Alien forbs such as Cosmos bipinnata (Cosmos), *Tagetes minuta* (Khakbibos) and *Verbena brasiliensis* (Brazilian Vervain) were found throughout the *Themeda - sporobolus* – dominated Grassland. Stands of the native invader *Gomphocarpus fruticosus* (Balloon Plant) were found to occur as monospecific patches.

10.5.1.2.3 Species of Special Concern (SSC)

The SSC encompasses all national and international Red Data species, as well as species that are listed under the provincial protected species lists. Table 10-3 lists the plant SSC that are likely to occur, as well as those that were confirmed for the project area. The PRECIS database lists six species for the Quarter Degree Square (QDS) 2625AA in which the study occurs. None of these species were confirmed for Mooikraal and 3 Shaft but this does not imply that they do not in fact occur on site. The nationally declining species, *Crinum bulbispermum* was found in the wetland habitat on site, adjacent to the river (examples of this species are represented in Figure 10-4.

Table 10-3: Plant SCC expected and confirmed on site

Family	Species Name	Common Name	Threat Status[1]	Recorded on site
Amaryllidaceae	*Crinum bulbispermum*	River Lily	Declining	x
Apiaceae	*Alepidea attenuata*	None	NT (Near Threatened)	
Asphodelaceae	*Kniphofia typhoides*	Torch Lily	NT	
	Trachyandra erythrorrhiza	None	NT	
Apocynaceae	*Brachystelma incanum*	None	VU (Vulnerable)	
	Stenostelma umbelluliferum	None	NT	
Fabaceae	*Indigofera hybrida*	None	VU	

Figure 10-4: Example of plant SSC recorded on site – *Crinum bulbispermum*

10.5.1.2.4 Alien Invasive Species

Up to 40% of the plant species identified within the project area were alien plants. A detailed Alien Invader Plant Species (AIPs) Assessment and Management Plan for Mooikraal and 3 Shaft was compiled by Digby Wells in 2018.

The in-field assessment conducted identified the following AIPs category species in accordance with NEMBA:

- Fifteen Category 1b AIPs;
- Seven Category 2 AIPs; and
- Two Category 3 AIPs.

Several other species within the categories listed above as well as Category 1a may also occur.

[1] In accordance with the IUNC Red List of Threatened Species

10.5.2 Faunal Characteristics

Fauna expected to occur on site include assemblages within terrestrial and wetland ecosystems: birds, mammals, reptiles and amphibians. Each of these assemblages occurs within unique habitats, the ecological state of these habitats directly relates to the number of species found within them. As provided above, the main habitats occurring in the project area are grassland and wetland units. Figure 10-5 shows examples of evidence of faunal activity on site.

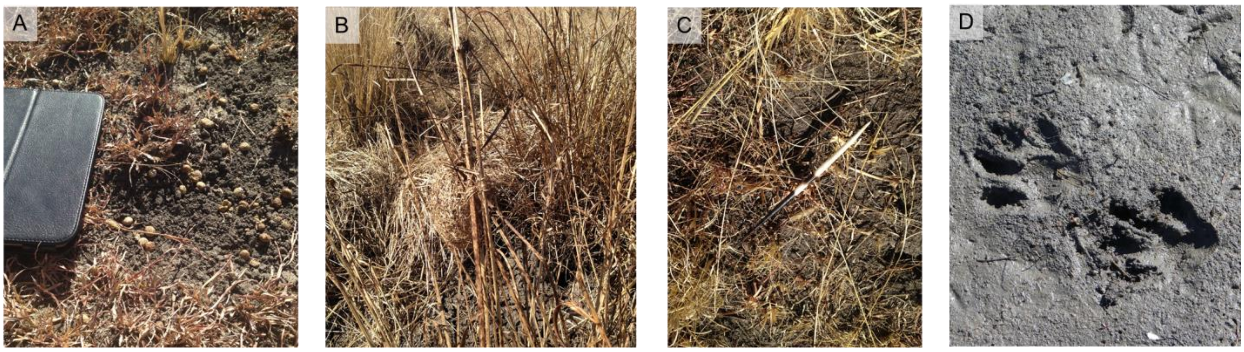


Figure 10-5: Evidence of faunal activity on site: A) potential Common Duiker pellets (*Sylvicapra grimmia*); B) weavers nest; C) Cape Porcupine (*Hystrix africaeaustralis*) quill) and D) Cape Clawless Ottor spoor (Aonyx capensis))

10.5.2.1 Mammals

The project area is largely made up of agricultural fields and secondary grassland. Substantial mammal activity was observed on site with Cape Porcupine (*Hystrix africaeaustralis* and Grey Duiker (*Sylvicapra grimmia*) recorded via quills, spoor and pellets. Marsh Mongoose (*Atilax paludinosus*) was confirmed by spoor and Yellow Mongoose (*Cynictis penicillata*) was confirmed via visual sightings and photographs from one of the motion-sensitive cameras set up on site. Table 10-4 lists mammal species recorded on site and Figure 10-5 and Figure 10-6 represent evidence of faunal activity and motion-sensitive camera results respectively.

Table 10-4: Mammals recorded on site

Species Name	Common Name	Threat Status	Means of Identification
Aonyx capensis	Cape Clawless Otter	Least Concern (LC)	Motion-sensitive camera
Atilax paludinosus	Marsh Mongoose	LC	Spoor
Galerella sanguinea	Slender Mongoose	LC	Motion-sensitive camera
Cynictis penicillata	Yellow Mongoose	LC	Visual sighting, motion sensitive camera
Hystrix africaeaustralis	Cape Porcupine	LC	Recording of quills and active burrows

Species Name	Common Name	Threat Status	Means of Identification
Sylvicapra grimmia	Grey Duiker	LC	Pellets
Xerus inauris	Ground Squirrel	LC	Visual sighting

Figure 10-6: Yellow Mongoose (*Cynictis penicillata*) captured on motion-sensitive camera

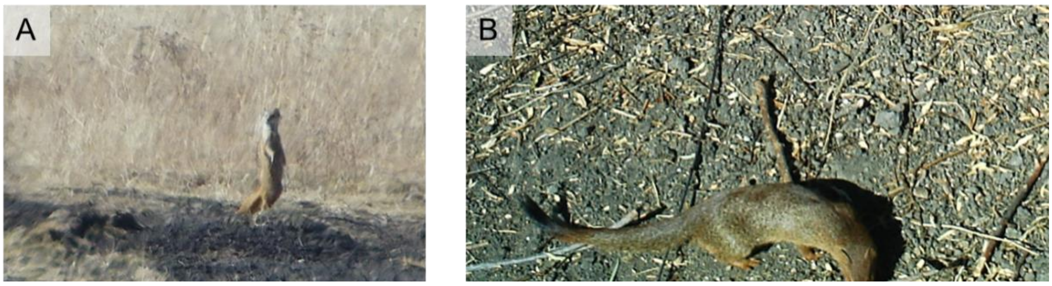


Figure 10-7: Examples of mongoose recorded on site (A: Yellow Mongoose (*Atilax paludinosus*) and B: Slender Mongoose (*Galerella sanguinea*))

10.5.2.2 Avifauna

Birds serve as indicators of biological integrity and environmental health. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds present in that area (The Bird Community Index, 2007). A total of 20 avifaunal regional species were recorded within the project area, as represented in Figure 10-8. Three SSC were recorded, namely: the Vulnerable Blue Crane (Alpochen aegyptiaca), the Near-Threatened and nationally protected Blue Korhaan (Eupodotis caerulescens) and the Vulnerable Grass Owl (Tyto capensis). Exampls of avifauna recorded on site are represented in Figure 10-9.

Figure 10-8: Bird species recorded on site

Species Name	Common Name	National Threat Status	Global Threat Status
Alpochen aegyptiaca	Egyptian Goose	LC	LC
Anthropoides paradiseus	Blue Crane	VU	VU
Ardea melanocephala	Black-headed Heron	LC	LC
Bostrichia hagedash	Hadeda Ibis	LC	LC

Species Name	Common Name	National Threat Status	Global Threat Status
Bubo africanus	Spotted Eagle Owl	LC	LC
Bubulcus ibis	Cattle Egret	LC	LC
Coturnix coturnix	Common Quail	LC	LC
Elanus caeruleus	Black Shouldered Kite	LC	LC
Eremopterix leucotis	Chestnut Backed Finchlark	LC	LC
Eupodotis caerulescens	Blue Korhaan	NT; Protected *	NT
Macronyx capensis	Cape Longclaw	LC	LC
Numida meleagris	Helmuted Guineafowl	LC	LC
Platalea alba	African Spoonbill	LC	LC
Plocepasser mahali	White-browed Sparrow-weaver	LC	LC
Saxicola torquatus	African Stonechat	LC	LC
Streptopelia capicola	Cape Turtle Dove	LC	LC
Threskiornis aethiopicus	African Scacred Ibis	LC	LC
Tyto capensis	African Grass Owl	LC; Protected*	VU
Vanellus armatus	Blacksmith Lapwing	LC	LC
Vanellus coronatus	Crowned Lapwing	LC	LC

Key: * denotes species that are protected according to the National Environmental Management Act (no. 10 of 2004)

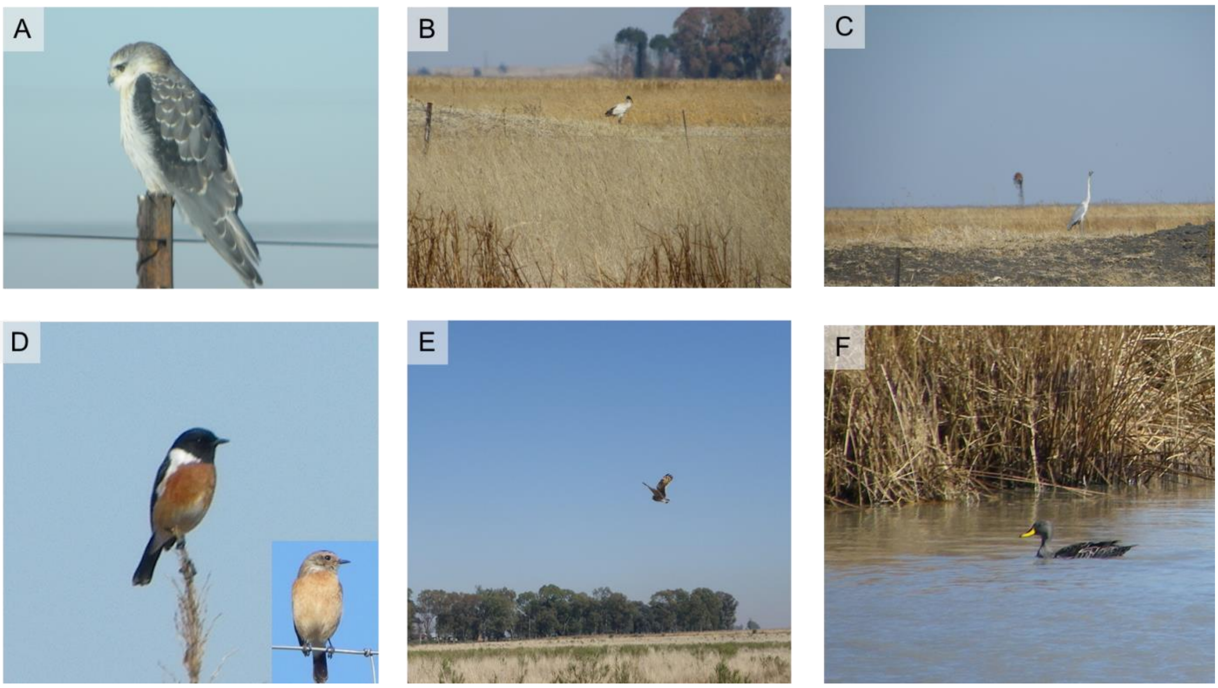


Figure 10-9: Examples of avifauna recorded on site: A) Black-shouldered Kite (*Elanus axillaris*); B) Sacred Ibis (*Threskiornis aethiopicus*); C) Black-headed Heron (*Ardea melanocephala*); D) African Stonechat (*Saxicola rubetra*) male and female (bottom right); E)African Grass Owl (*Tyto capensis*) in flight and F) Yellow-billed Duck (*Anas undulata*)

10.5.2.3 Herpetofauna

The persistence and metapopulation structure of many herpetofauna species is dependent on aquatic environments and terrestrial biotic corridors as well as broadly defined habitat types, in particular; terrestrial, arboreal (tree-living), rupiculous (rock-dwelling), and wetland associated vegetation cover. Due to the timing of the fieldwork, being in winter, there were no frogs or reptiles observed onsite. However, it is likely that there are herpetofauna present on the site and will be observed in the rainy season.

10.5.2.4 Invertebrates

Butterflies are a good indication of the habitats available in a specific area (Woodhall 2005). Although many species are eurytropes (able to use a wide range of habitats) and are widespread and common, South Africa has many stenotrope (specific habitat requirements with populations concentrated in a small area) species which may be very specialised (Woodhall 2005). Butterflies are useful indicators as they are relatively easy to locate and catch, and to identify. It is for this reason that Lepidoptera were used as the primary focus for the invertebrate survey. A single butterfly species was recorded on site, namely the Eyed Pansy (*Junonia orithya madagascariensis*) (Figure 10-10); although additional species may occur.

Large patches of *Gomphocarpus fruticosus* (Milkweed) were recorded on site and are the host plant for Danaus chryssippus (African Monarch). Bee hives were found in abandoned burrows throughout the site and based on the distribution described by Hepburn and Radloff, 1998, the bees can be ascribed the species *Apis mellifera scutellata.*

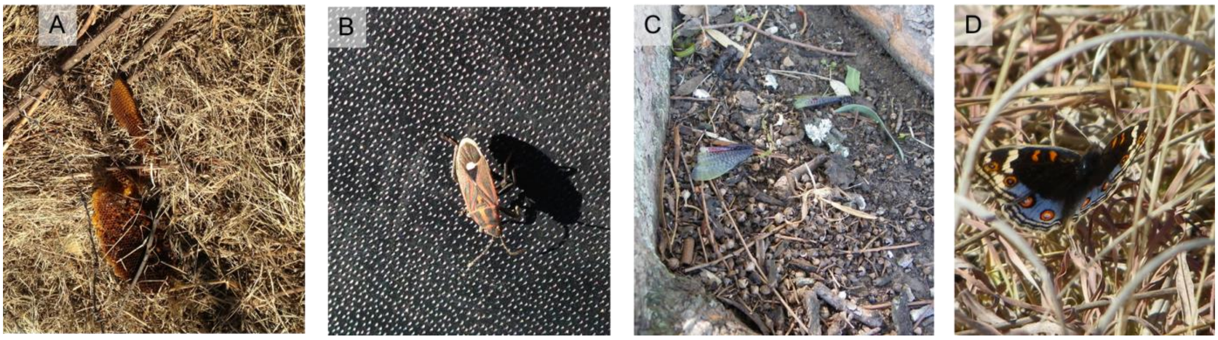


Figure 10-10: Examples of invertebrate species recorded on site: A) Active beehive in an abandoned animal burrow; B) Milkweed Bug (*Spilostethus pandurus*); C) Common Milkweed Locust (*Phymateus morbillosus*) remains; and D) Eyed Pansy (*Junonia orithya madagascariensis*))

10.6 Wetlands

Detailed wetland delineations within the project area were carried out by Digby Wells in 2014 which was utilised in conjunction with an updated baseline wetland assessment conducted in February and September 2018. A Freshwater Impact Assessment comprising the previously delineated wetlands and updated baseline assessment is appended to this report as Appendix 6. The study update aimed to determine the current Present Ecological State

(PES) values and EcoServices. The following methodologies were employed in assessing the wetland systems:

- **Wetland Classification** – the previously delineated wetlands were classified and divided into various Hydro-geomorphic (HGM) units based on their individual characteristics in accordance with the DWAF guidelines (2005). The HGM Unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting.
- **Wetland Integrity Assessment** – the wetland integrity was determined using the WET-Health tool, as prescribed by Kotze *et al*. (2007) to measure the PES of wetlands associated with the project area based on the structure and function of the wetlands. Furthermore, the Ecological Importance and Sensitivity (EIS) was derived using the DWAF, 1999 established methods in conjunction with Rountree and Kotze, (2012).
- Wetland Service Provision (WET-EcoServices) – the Ecoservices in terms various services including but not limited to flood attenuation, stream flow regulation, sediment trapping and maintenance of biodiversity provided by each wetland HGM unit were quantitatively determined and rated utilising the guidelines prescribed by Kotze *et al.* (2009). The scores for each service were then averaged to give an overall score to the wetland.

Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 6.

10.6.1 Wetland Delineation

Detailed wetland delineations were carried out in the project area in 2014 (Digby Wells, 2014). A total of three HGM Units were identified within the project area namely:

- The Kromelmboogspruit floodplain, occupying 344.97 ha;
- The channelled valley bottom wetlands, occupying 188.05 ha; and
- The unchannelled valley bottom wetlands, occupying 341.98 ha.

Evidence of these HGM units as observed on site are shown in Figure 10-11 below and the wetland delineation is depicted Plan 10, Appendix 2.

Figure 10-11: Examples of the HGM units within the project area

(A: Floodplain; B: unchannelled valley bottom; C and D: channelled valley bottom)

The Kromelmboogspruit floodplain is the largest HGM unit which transects the project area and is fed by valley bottom systems in the area. The Kromelmboogspruit floodplain is characterised by typical floodplain wetland features, such as a deep channel, oxbow lakes and levees.

10.6.2 WET-Health

The general features of the identified wetland units within the project area were assessed in terms of impacts to the integrity of these systems. The major impacts identified were related to the following (refer to Figure 10-12 below for examples as observed on site):

- Agricultural practices adjacent to and within wetlands have a large impact on all the wetland systems:
  - Cultivation has resulted in a loss of wetland habitat, increased run-off and erosion, as well as contamination of water due to the application of fertilisers and pesticides. Nutrient loading is usually linked to hydrological alterations, which involves shifts in vegetation patterns and nutrient cycling; and
  - Grazing activities have resulted in overgrazing, trampling and erosion, which has also resulted in a loss of biodiversity within wetlands. In addition, this impact has resulted in impacts on water quality of the Kromelmboogspruit floodplain and channelled valley bottoms associated with the site. These activities cause increased sedimentation of the systems due to exposed substrate. Sedimentation alters the natural hydrological and geomorphological functioning of the wetlands and may have an impact on aquatic life. The impaired water quality may also result from additional loading of phosphates and nitrates.
- Eutrophication of wetlands due to inputs from fertilisers and pesticides increases primary productivity due to increased nutrient availability (Sánchez-Carrillo, 2011). *Azolla filiculoides* (Red Water Fern) is a free-floating weed which typically invades standing water, often as a consequence of eutrophication (Hill et al. 2008). Dense infestations of *A. filiculoides*, a species that spreads via spores in the water, in the lower portion of the Kromelmboogspruit floodplain was observed;

- Damming upstream of the channelled and unchannelled wetlands along the conveyor causes compaction of sediments and reduced flow through the wetlands. The result is shortening and diversion of natural channels as well as the trapping of sediment. Sediment trapped in dams is critical for the maintenance of habitats and physical processes downstream. Furthermore, when the sediment load downstream is not replenished, erosional processes are promoted, and the stream or river may become incised;
- Road crossings reduce vegetation cover, increase compaction thereby increasing runoff and erosion;
- Coal deposits within the channelled and unchannelled valley bottom wetlands in the vicinity of 3 Shaft and the conveyor have altered water quality; and
- Culverts, where roads cross wetlands, also contribute to the negative effects on all wetlands on site. The natural diffuse nature of the water-flow through wetlands is altered, as culverts cause direct flow to occur, reducing the time for infiltration and promoting erosional processes.

Table 10-5 provides a summary of the previous (2014) and current (2018) PES scores assigned to each HGM unit, with examples as observed on site shown subsequently in Figure 10-12. During the initial delineation, all wetlands on site were allocated a PES of moderately modified (Category C), with the exception of unchannelled valley bottoms which were allocated a moderately modified/largely modified status (Category C/D). In 2018 PES has deteriorated slightly within the unchannelled valley bottoms due to the cumulative impacts of roads, agriculture, upstream dams, too few culverts and associated erosion to largely modified (Category D) status. The channelled valley bottoms were allocated a moderately modified (Category C) status, mainly due to the impact of dams and road crossings (to the channelled valley bottoms along the pipeline and conveyor route) as well as agriculture and grazing (to the remainder of the channelled valley bottoms).

The Kromelmboogspruit was also allocated a moderately modified (Category C) status, with the main contributors being agriculture and road crossings, which causes compaction of sediments and reduced flow through the wetland. When the sediment load downstream is not replenished, erosional processes are promoted and the floodplain becomes incised.

Table 10-5: Overall PES score

<table>
<tr><th>HGM Unit</th><th colspan="2">2014</th><th>2018</th></tr>
<tr><td>Kromelmboogspruit Floodplain</td><td colspan="2">C</td><td>C</td></tr>
<tr><td>Unchannelled valley bottom</td><td>C</td><td>D</td><td>D</td></tr>
<tr><td>Channelled valley bottom</td><td colspan="2">C</td><td>C</td></tr>
</table>

Figure 10-12: Impacts to the wetlands within the project area (September 2018)

A: Cattle trampling seen within the Kromelmboogspruit; B: Dumping of rubble in the Kromelmboogspruit; C: Poorly constructed and designed culverts along an unchannelled valley bottom in the vicinity of the conveyor route; D: Pipeline, conveyor and powerline crossings along an unchannelled valley bottom in the vicinity of the conveyor route; E: Coal deposits and invasive species; F: Invasive species, *Azolla filiculoides*) proliferating in the Kromelmboogspruit.

The PES values for each HGM Unit are illustrated in Plan 11, Appendix 2.

10.6.3 WET-EcoServices

One of the dominant EcoServices of the floodplain wetlands (the Kromelmboogspruit) on site is the maintenance of biodiversity, scoring high in 2014 and 2018. The floodplain wetlands on site are centres of biodiversity for flora and fauna and many terrestrial, avifaunal and aquatic fauna depend on floodplain wetlands for crucial stages of their lifecycles (Rogers 1995). In 2018, marsh owls (*Asio capensis*) and secretary birds (*Sagittarius serpentarius*) were identified.

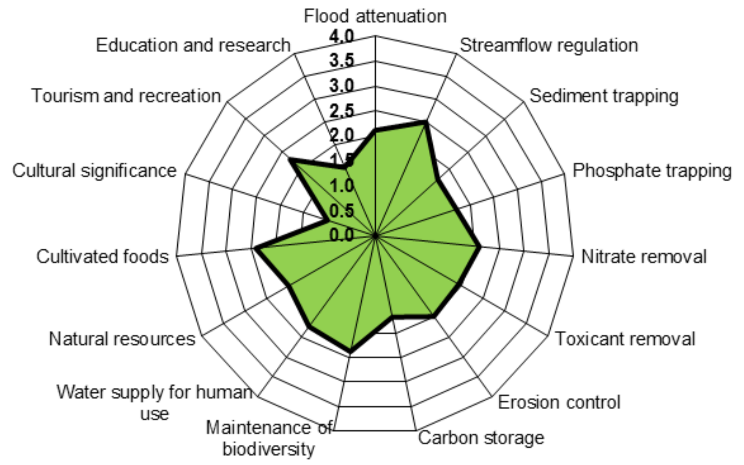
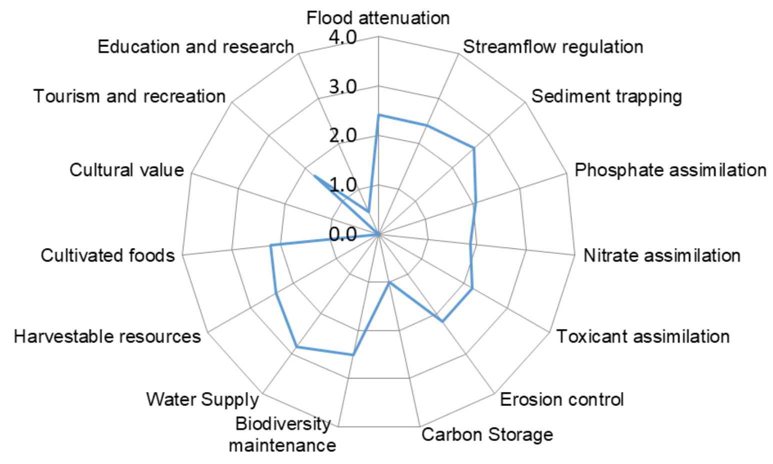
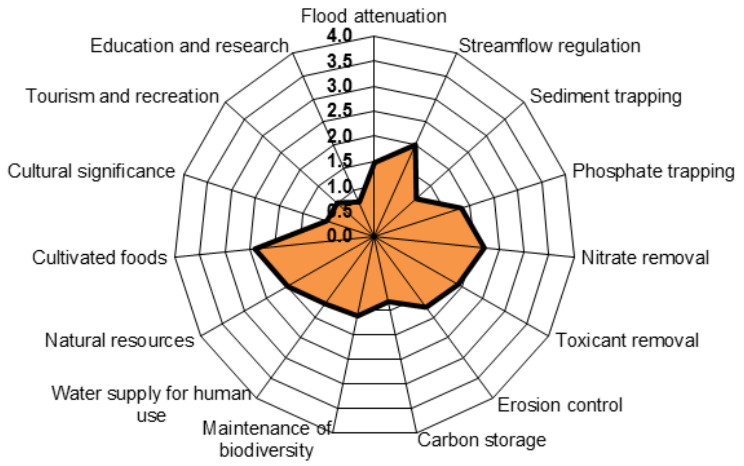
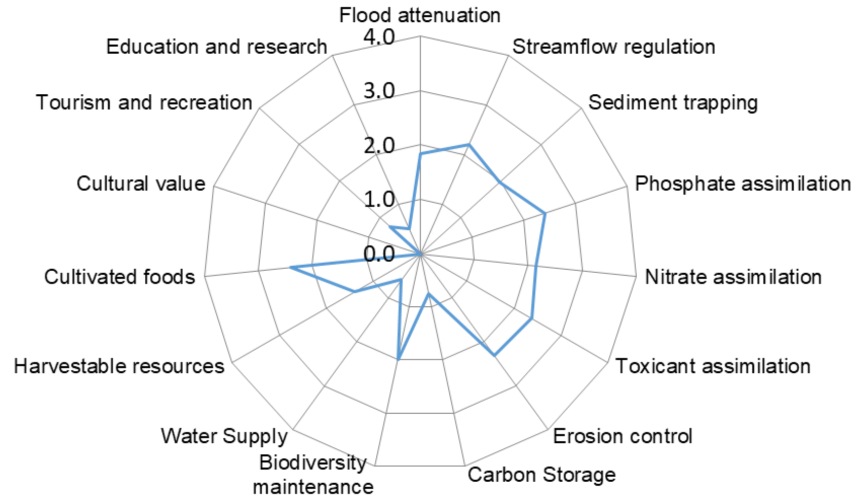
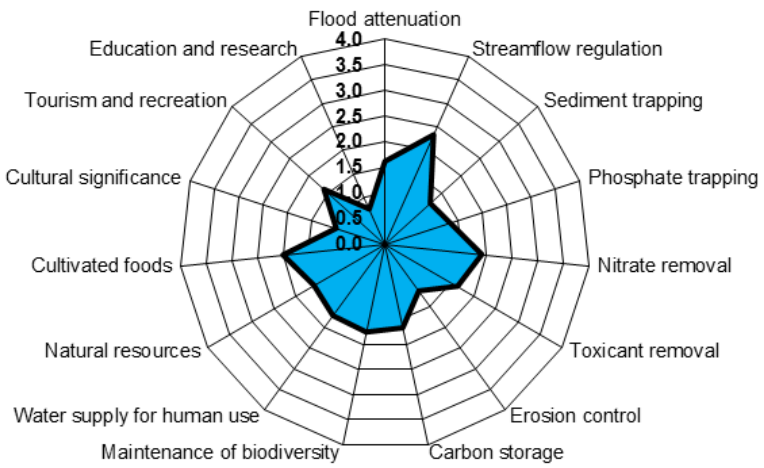
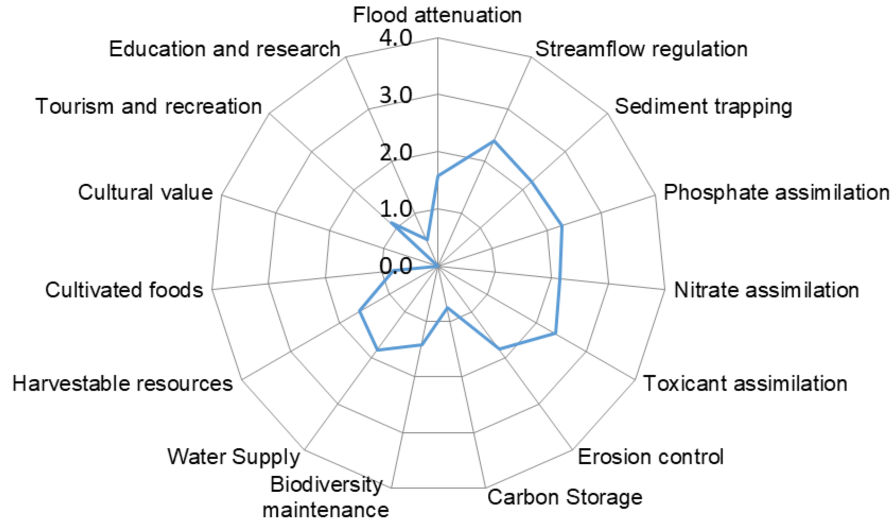
Owing to frosting back of vegetation during the winter months, the amount of plant material that is left to transpire is reduced; and this results in less water being lost to evapotranspiration. The channelled valley bottom wetlands and the Kromelmboogspruit wetlands on site scored high for streamflow regulation in both 2014 and 2018.

Large cultivated areas are located within the unchannelled valley bottoms, which scored highly with regards to providing for cultivated foods. Linked to this is the abstraction of water for watering of cattle and irrigation which also scored highly for the Kromelmboogspruit and channelled valley bottom wetlands in 2014 and 2018.

An additional important function performed by wetlands on site is the regulation of nutrients and toxins that enter into the system via agricultural run-off from maize fields (occupying the majority of the immediate catchment of the Kromelmboogspruit floodplain). Unchannelled wetlands on site scored high for nitrate removal and phosphate assimilation in particular.

Table 10-6 represents the results of the Ecoservices assessment and the EcoServices values for the HGM units are displayed on Plan 12, Appendix 2.

Table 10-6: EcoServices radial plots and high scores for each HGM unit

<table>
<tr><td rowspan="5">Kromelmgoospruit Floodplain</td><td rowspan="5"></td><td>Top EcoServices (2014)</td><td>Scores (2014)</td><td rowspan="5"></td><td>Top EcoServices (2018)</td><td>Scores (2018)</td></tr>
<tr><td>Streamflow regulation</td><td>2.5</td><td>Water Supply for human use</td><td>2.8</td></tr>
<tr><td>Biodiversity maintenance</td><td>2.4</td><td>Sediment trapping</td><td>2.6</td></tr>
<tr><td>Cultivated foods</td><td>2.4</td><td>Biodiversity maintenance</td><td>2.5</td></tr>
<tr><td>Water supply for human use</td><td>2.3</td><td>Streamflow regulation</td><td>2.4</td></tr>
<tr><td rowspan="3">Valley bottom without a Channel</td><td rowspan="3"></td><td>Top EcoServices (2014)</td><td>Scores (2014)</td><td rowspan="3"></td><td>Top EcoServices (2018)</td><td>Scores (2018)</td></tr>
<tr><td>Cultivated foods</td><td>2.4</td><td>Cultivated foods</td><td>2.4</td></tr>
<tr><td>Nitrate removal</td><td>2.2</td><td>Phosphate assimilation</td><td>2.4</td></tr>
<tr><td rowspan="2">Channelled Valley Bottom</td><td rowspan="2"></td><td>Top EcoServices (2014)</td><td>Scores (2014)</td><td rowspan="2"></td><td>Top EcoServices (2018)</td><td>Scores (2018)</td></tr>
<tr><td>Streamflow regulation</td><td>2.3</td><td>Streamflow regulation</td><td>2.4</td></tr>
</table>

10.7 Aquatic Ecology

A Freshwater Impact Assessment which incorporates an Aquatic Biodiversity Assessment is appended to this report as Appendix 6. The aquatic study involved two surveys during the wet and dry season (i.e. February 2018 and September 2018 respectively), in an attempt to quantify the seasonal variation to which aquatic systems are exposed, with special mention of macroinvertebrate assemblages. The locations of the sample points are depicted in Plan 13, Appendix 2. The following methodology was employed for the Assessment:

- **Water Quality** – *in situ* water quality variables were to be taken from eight identified sampling sites (four in relation to the pipeline/conveyor route and 3 Shaft area, labelled SC1, SC2, SC3 and SC4; and four in relation the reminder of the Mooikraal MRA where current underground mining activities occur, labelled KR1, KR2, KT1 and KT2) and were assessed for temperature, conductivity, pH, Dissolved Oxygen concentrations and saturation levels.
- **Integrated Habitat Assessment System (IHAS)** – IHAS was used to measure the variability aquatic macroinvertebrate biotopes available at the time of the survey. The IHAS score is expressed as a categorised percentage that ultimately describes the quantity, quality and diversity of available macroinvertebrate habitat relative to an "ideal" diversity of available habitat.
- **Aquatic Macroinvertebrates** – the aquatic macroinvertebrates assessment included the use of the following associated indices:
  - South Africa Scoring System Version 5 (SASS5) – the SASS5 index was used to assess the status of riverine macroinvertebrates based on the presence of aquatic invertebrates families and their perceived sensitivity to water quality changes. SASS results are expressed both as an index score (SASS Score) and the Average Score per Recorded Taxon (ASPT value).
  - Macroinvertebrates Response Assessment Index (MIRAI) – the MIRAI was used to provide a habitat based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the Bushveld Basin. The results of the MIRAI provide an indication of the baseline ecological category and subsequently assist in determining the PES.
- **Eco-Status** – based on the assessments above, the PES of tributaries considered in the study is determined utilising the River Eco-status Monitoring Programme (REMP) Ecological Classification manual by Kleynhans and Louw (2007).

Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 6.

10.7.1 Aquatic System Characterisation

There are two primary drainage features associated with Mooikraal and 3 Shaft area which are predominantly perennial wetland systems, namely the Kromelmboogspruit, which falls within the Sub-Quaternary-Reach (SQR) C23A-01811 and the Leeuspruit, which falls within the SQR C22K-01812. The Kromelmboogspruit system is fed by a number of non-perennial adjoining tributary wetland systems, some of which are also associated with the conveyor and 10 Ml/day pipeline servitude. Additionally, the current and proposed underground mining activities are largely associated with this system while the proposed 3 Shaft activities are mainly associated with the Leeuspruit system.

10.7.2 *In Situ* Water Quality

The assessment of *in situ* water quality variables is important as aquatic organisms are influenced by the environment in which they live.

Due to the highly dynamic nature of lotic (or flowing) systems, water quality conditions have been known to vary on a temporal scale (e.g. seasonality) and along the longitudinal profile of the watercourse (Dallas and Day, 2004). Table 10-7 provides the *in situ* water quality data obtained at each site assessed during the February and September 2018 field surveys.

Based on the *in situ* water quality variables recorded during the timing of the surveys, the elevated Electrical Conductivity (EC) values and the marginally under-saturated dissolved oxygen values were expected to deter the colonisation and/or inhabitation of these watercourses by sensitive aquatic biota to some extent. However, it should be noted that the inherent wetland nature of these systems was expected to be a major driver of these conditions and as such, aquatic communities inhabiting these systems were expected to be relatively tolerant of these conditions.

Table 10-7: *In situ* water quality variables recorded at each of the sampling sites

Site	Time	Temp. (°C)	pH	EC (µS/cm)	Dissolved Oxygen	
					(mg/ℓ)	(% sat)
WRQO/TWQR*		**-**	**5.50-9.50**	**<1500.0**	**-**	**80-120**
February 2018						
Pipeline/Conveyor Route and 3 Shaft Sampling Points						
SC1	12h25	22.2	7.33	350.0	3.41	**49.8**
SC2	13h30	23.2	8.64	**1 655.0**	6.57	105.6
SC3	16h00	24.6	8.19	489.0	8.04	**130.7**
SC4	Not assessed during the timing of the survey					
Mooikraal MRA Sampling Points						
KR1	10h15	22.7	6.82	126.2	2.04	**32.4**
KR2	10h00	22.8	7.16	155.7	3.45	**56.3**
KT1	15h00	26.8	6.93	136.7	4.17	**72.9**

Site	Time	Temp. (°C)	pH	EC (µS/cm)	Dissolved Oxygen	
					(mg/ℓ)	(% sat)
WRQO/TWQR*		**-**	**5.50-9.50**	**<1500.0**	**-**	**80-120**
KT2	Not applicable					
September 2018						
Pipeline/Conveyor Route and 3 Shaft Sampling Points						
SC1	09h34	15.3	8.98	**1 505.0**	6.75	**64.2**
SC2	10h14	15.9	8.32	**4 600.0**	4.80	**50.0**
SC3	11h35	23.1	8.70	**2 090.0**	6.09	**68.9**
SC4	11h05	19.2	8.38	**1 746.0**	5.44	**57.4**
Mooikraal MRA Sampling Points						
KR1	13h36	24.4	8.27	563.0	6.81	**78.2**
KR2	13h59	20.3	9.41	**1 533.0**	9.41	**106.1**
KT1	10h30	18.2	8.71	433.0	5.93	**62.5**
KT2	Insufficient water for testing					

* Water Resource Quality Objectives (WRQO) stipulated within the approve WUL or Target Water Quality Range (TWQR), as described in (Department of Water Affairs and Forestry, 1996)

Most aquatic systems within South Africa are relatively well-buffered, as a result of dissolved bicarbonate/carbonate ions originating from exposed geological formations and atmospheric deposits, and as such, these systems are expected to exhibit close-to-neutral pH levels (i.e. pH 6-8; Department of Water Affairs and Forestry, 1996; Dallas & Day, 2004). Consequently, despite all pH recordings occurring within the range for the Water Resource Quality Objective (WRQO), the marginally elevated levels observed along the Leeuspruit during the February 2018 survey (i.e. Site SC2 and Site SC3) and all findings during the September 2018 (i.e. all tested sites along the Leeuspruit and Kromelmboogspruit) exceeded the upper expected pH limit of 8 (Department of Water Affairs and Forestry, 1996) and may pose as a potential cause for concern.

However, it is expected that these values would vary on a daily basis depending on rainfall and runoff received from adjacent agricultural areas (i.e. elevated potential nutrient levels). It is also noted that after cursory discussions with the client, a sewerage manhole overflow situated upstream from 3 Shaft might be contributing to the aforementioned pH elevations. For the purposes of this report, and based on the underlying geology of the area, an upper limit of 9.5 has been used.

Each of the EC values recorded during the February 2018 survey were observed to exhibit moderate to high levels with overall recordings from the September 2018 survey exhibiting high levels. These relatively high conductivity findings were, to an extent, expected to occur within the inherent wetland systems. However, the activities occurring at both the local abattoir and tannery located directly upstream of Site SC2 were identified as potential sources of pollution with conductivities highest at Site SC2 at the time of both surveys. This was supported by cursory discussions with the on-site personnel, whom have observed notable changes within the associated section during previous years, as well as the exceedance of the WRQO for EC.

Dissolved oxygen concentrations of 80%-120% saturation are considered to protect all life stages of the vast majority of aquatic organisms that are endemic (or adapted) to inhabiting aerobic warm water habitats (Department of Water Affairs and Forestry, 1996). The notably under-saturated levels observed at a large majority of the monitoring sites during both surveys pose as a potential limiting factor to the colonisation of the indigenous aquatic communities.

It is however, important to note that these oxygen reducing-conditions are to be expected within wetland systems. On the other hand, the marginally elevated saturation levels along the Leeuspruit during the February 2018 survey (i.e. Site SC3) supported the suspicion that this system exhibited mildly eutrophic conditions, especially in light of the elevated pH levels. However, these levels returned to below the guideline saturation percentage of 80 % during the September 2018 survey. This does not preclude the fact that eutrophic interactions may characterise the condition of the stream at this point (e.g. agricultural nutrient runoff or livestock activities).

In relation to the chemical analysis undertaken at Site KR1 and Site KR2 in November 2017 during the water monitoring conducted by the Institute for Groundwater Studies (Institute for Groundwater Studies, 2018), the *in situ* parameters were observed to have marginally decreased in both pH and EC during the timing of the February 2018 survey.

While this may represent a marginal improvement in the on-site conditions, this was most likely attributed to the recent rainfall received prior to the survey and the subsequent ‘flushing’ of the system. In addition, with regards to the conditions observed along the Leeuspruit during the February 2018 survey (i.e. Site SC2 and Site SC3), the *in situ* parameters measured around the Sasol industrial complex exhibited largely comparable values for pH and dissolved oxygen throughout the 2016/17 cycle (Golder Associates, 2017).

Of potential concern was the notable increase in conductivity, which was attributed to upstream industrial activities until further investigation has been undertaken, as mentioned above. The overall conductivity as well as the pH further increased during the timing of the September 2018 survey. However, it is suspected that this is also partially related to the lack of “flushing ability” / flow resulting from the low rainfall received prior to the survey month. Future monitoring will be able to determine if the conditions return to the aforementioned improved state.

10.7.3 Invertebrate Habitat Assessment System

Due to the inherent nature of the valley-bottom and floodplain wetlands within the project area, which is largely derived from the topography of the area, stones as an available biotope were largely absent and the occurrence of hydraulic diversity within these wetlands systems was low. Consequently, each of the assessed sampling sites exhibited poor habitat availability with varying degrees of marginal and aquatic vegetation being the dominant biotope. However, Site KR1 and Site KR2 (associated with the Kromelmboogspruit) were observed to have some stones out of current (SOC) during the September 2018 survey available for sampling as a result of the lower water levels. Thus, the presence of this additional biotope improved the IHAS score in comparison to findings of February 2018. The scores and interpretations from the assessments are provided in Table 10-8.

Table 10-8: Adapted IHAS values obtained within the project area during the February 2018 field survey

Site	Adapted IHAS Value (%)	Description
February 2018		
Pipeline/Conveyor Route and 3 Shaft Sampling Points		
SC1	36	**Poor**
SC2	33	**Poor**
SC3	38	**Poor**
SC4	Not assessed during the timing of the survey	
Mooikraal MRA Sampling Points		
KR1	40	**Poor**
KR2	40	**Poor**
KT1	36	**Poor**
KT2	Not suitable for assessment	
September 2018		
Pipeline/Conveyor Route and 3 Shaft Sampling Points		
SC1	35	**Poor**
SC2	36	**Poor**
SC3	29	**Poor**
SC4	38	**Poor**
Mooikraal MRA Sampling Points		
KR1	29	**Poor**
KR2	40	**Poor**
KT1	27	**Poor**
KT2	Not suitable for assessment	

It should be noted that heavy rainfall was received within the study area directly prior to the February 2018 survey and as such, flows were observed to be notably elevated, which may have had a subsequent impact on the occurrence of macroinvertebrate species sensitive to elevated flow velocities.

10.7.4 Aquatic Macroinvertebrates

Due to the differential sensitivities of aquatic macroinvertebrates, the composition of the aquatic macroinvertebrate community can provide an indication of changes in water quality and other ecological conditions within a watercourse. The use of the SASS has undergone numerous advances, culminating in Version 5 presently being utilised in river health studies along with the application of the MIRAI. However, it should be noted that the application of the SASS5 and MIRAI indices within wetland systems should be interpreted with caution, as these assessment indices were primarily designed to be used exclusively within lotic (or flowing) systems. Nevertheless, for the purpose of standardising the monitoring approach, the SASS5 method was deemed sufficient for assessing changes to the number of aquatic macroinvertebrates families inhabiting these systems.

Based on the derived reference list and distribution, a total of approximately 45 aquatic macroinvertebrate families were to be expected within the study area (Dr C. Thirion, pers. comm., 2017). Of these aquatic macroinvertebrate families, a total of only 27 taxa were collected during the February 2018 survey and a total of 26 taxa collected during the September 2018 survey. The number of taxa at each sampled site ranged from six families at the Site SC3 during the September 2018 survey to 17 at SC2 during the September 2018 survey (Table 10-9).

Accordingly, the corresponding SASS5 scores ranged from a low 17 to a moderate 71 at the same respective sampling sites, while the highest ASPT values was observed at the downstream site along the Kromelmboogspruit (Site KR2) during the September 2018 survey. Only three taxa that were generally regarded as moderately sensitive to water quality impairment (i.e. sensitivity score of 8 and above) were collected during the February 2018 survey, namely Hydrachnellae (Mites), Aeshnidae (Emperor Dragonflies) and Ecnomidae (Caseless Caddisflies; Appendix C). Hydrachnellae and Atyidae (Shrimp) were also sampled during the September 2018 survey which were not collected during the rainy season survey (i.e. February 2018). These serve as an indication that water quality at this point may be regarded as relatively stable over the last year of sampling.

Table 10-9: SASS5 data obtained from within the study area

Site	SASS5 Score	Number of Taxa	ASPT*
	February 2018		
Pipeline/Conveyor Route and 3 Shaft			
SC1	55	15	3.67
SC2	58	15	3.87
SC3	53	13	4.08
SC4	Not assessed during the timing of the survey		
Mineral Rights Area (Mooikraal)			
KR1	40	10	4.00
KR2	24	7	3.43

Site	SASS5 Score	Number of Taxa	ASPT*
KT1	30	9	3.33
KT2	Not Applicable		
September 2018			
Pipeline/Conveyor Route and 3 Shaft			
SC1	48	13	3.69
SC2	71	17	4.18
SC3	18	6	3.00
SC4	33	10	3.30
Mineral Rights Area (Mooikraal)			
KR1	39	9	4.33
KR2	68	15	4.53
KT1	22	7	3.14
KT2	Not Applicable		

* Average Score Per Taxon

Unexpectedly, the lowest macroinvertebrate diversity observed in comparison to other sites at the time of the February 2018 survey was observed within the Mooikraal MRA on the Kromelmboogspruit (i.e. Site KR1, Site KR2 and Site KT1).

However, diversity was also low during the September 2018 survey which may be related to the nature of the systems (i.e. Wetland habitat, which is not regarded as suitable for the application of the SASS5 index). The low dissolved oxygen levels recorded during the February 2018 survey may also have contributed to the lower abundance observed within the main stem Kromelmboogspruit, as diversity seemed to improve when these levels increased along the adjacent Leeuspruit system at the time of the survey.

Dissolved oxygen values increased during the timing of the September 2018 survey along the main stem Kromelmboogspruit, thus most likely resulting in the improved macroinvertebrate scores recorded. In relation to the ASPT values, which are an indication of the general sensitivity of the colonised macroinvertebrate communities, all sites seemed to exhibit a similar overall sensitivity despite the change in abundances and diversity.

10.7.4.1 Invasive Alien Species

One alien species of Gastropoda was confirmed to occur within the study area during both surveys, namely the *Physa acuta* (Acute Bladder Snail). This snail species was accidentally introduced prior to 1956, probably in association with aquatic plants imported through the aquarium trade and/or through the activities of water birds.

These snails have been known to dominate local watercourses throughout the country and as such, samples should be collected to definitively confirm that the Physidae specimens observed are indeed this particular species.

10.7.5 Eco-Status

Although Chutter (1998) originally developed the SASS5 protocol as an indicator of water quality, it has since become clear that the SASS5 approach gives an indication of more than mere water quality, but also a general indication of the current state of the macroinvertebrate community. While SASS5 does not have a particularly strong cause-effect basis for interpretation, as it was developed for application in the broad synoptic assessment required for the old River Health Programme (RHP), the aim of the MIRAI is to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic macroinvertebrate assemblage from the reference condition (Thirion, 2008).

This does not preclude the calculation of SASS5 scores, but encourages the application of MIRAI assessment, even for River Health Programme purposes, as the preferred approach. Accordingly, the SASS5 data obtained was used in the Macro-Invertebrate Response Assessment Index (MIRAI; Thirion, 2008) to determine the PES, (or Ecological Category) of the associated macroinvertebrate assemblage at each site (Table 10-10).

Table 10-10: Results obtained following the application of the MIRAI

Site	REC*	MIRAI Score	Ecological Category	Description
February 2018				
Pipeline/Conveyor Route and 3 Shaft Sampling Points				
SC1	C	35.74	E	Seriously modified
SC2	C	40.21	D	Largely modified
SC3	C	38.94	E	Seriously modified
SC4	C	Not assessed during the timing of the survey		
Mooikraal MRA Sampling Points				
KR1	C	32.63	E	Seriously modified
KR2	C	26.23	E	Seriously modified
KT1	C	23.94	E	Seriously modified
KT2	C	Not suitable for assessment		
September 2018				
Pipeline/Conveyor Route and 3 Shaft Sampling Points				
SC1	C	34.57	E	Seriously modified
SC2	C	49.35	D	Largely modified
SC3	C	15.05	F	Critically modified
SC4	C	31.59	E	Seriously modified
Mooikraal MRA Sampling Points				
KR1	C	25.02	E	Seriously modified
KR2	C	43.19	D	Largely modified
KT1	C	16.43	F	Critically modified
KT2	C	Not suitable for assessment		

* Recommended Ecological Category, as per approved WUL.

In relation to perceived reference conditions (Dr C. Thirion, pers. comm., 2017), it was determined that the ecological conditions of the macroinvertebrate assemblages collected within the project area mainly exhibited largely to seriously modified conditions (i.e. Ecological Category D/E to E). However, findings at Site SC3 and Site KT1 expressed critically modified (Ecological Category F) conditions. This can be attributed to the limited macroinvertebrate habitat available during the timing of the survey as indicated by the low IHAS scores recorded at both sites. Further interrogation of the applied MIRAI indices suggested this and also indicated that the primary driver at each of the other assessed sites was related to the limited available habitat present, which was to be expected within the associated wetland systems.

In relation to these aforementioned conditions, the ecological conditions determined during the 2016/17 biomonitoring cycle at the Sasolburg industrial complex appeared to have marginally deteriorated (i.e. Ecological Category E) along the Leeuspruit (Golder Associates, 2017). Again this was expected to have originated from potential water quality deterioration (i.e. upstream FAD5), as well as poor habitat availability.

10.8 Surface Water

A Surface Water Assessment was conducted for this project and is appended to this report as Appendix 7. Mooikraal has an established Surface Water Monitoring Programme which was utilised to establish the baseline conditions within the project area. The following methodologies were employed in this assessment:

- **Desktop Assessment** – a literature survey was undertaken to gather information on the project area. A desktop assessment of the catchment characteristics (rivers/streams, pans and dams) was conducted using Geographical Information System (GIS) tools.
- **Water Quality Assessment** – no water quality sampling was undertaken. Water quality monitoring data and reports obtained from Mooikraal were utilised for the water quality assessment. Water quality results were benchmarked against the Mooikraal WUL (08/C22K/CIGJFAE/6981) compared to water quality parameters set in the applicable WULs.
- **Floodline Delineations –** the 1:50 year 1:100 year floodlines were delineated using hydraulic modelling in HEC-RAS 5.05 for the Kromelmboogspruit and its tributaries at Mooikraal and the Leeuspruit and its tributaries at all river crossings along the conveyor belt/pipeline route and at 3 Shaft were modelled and mapped.

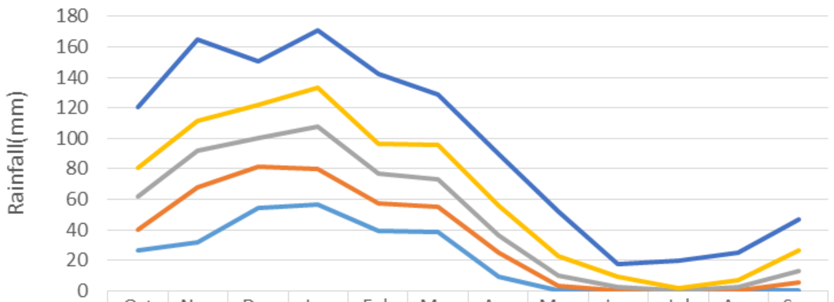
Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 7.

10.8.1 Hydrological Setting

The project area is located in the Vaal Water Management Area 5 (WMA 5), with Mooikraal and 3 Shaft sites falling within quaternary catchments C23B and C22K, respectively. These quaternary catchments lie in the Vaal River catchment with the Mooikraal and 3 Shaft sites located within the Kromelmboogspruit and Leeuspruit sub-catchments respectively. The Kromelmboogspruit and Leeuspruit are perennial tributaries of the Vaal River. The hydrological setting for the project area is depicted in Plan 14, Appendix 2.

10.8.1.1 Hydrometeorology

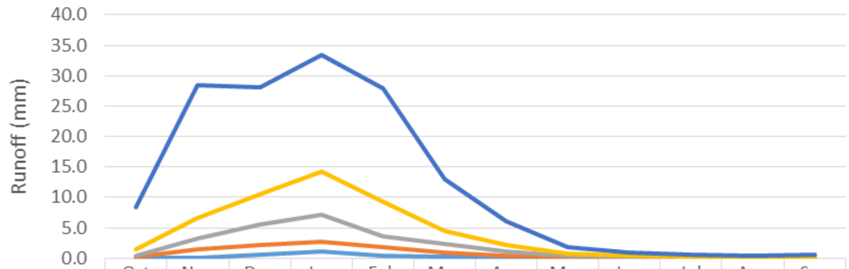
Similar rainfall, runoff and evaporation trends are prevalent within both the C23B and C22K quaternary catchments. The Mean Annual Precipitation (MAP) for C23B and C22K are 619 mm and 644 mm, while the Mean Annual Runoff (MAR) are 35.5 mm and 57.28 mm, respectively. The MAP and MAR within the two quaternaries are likely to be distributed as indicated in Figure 10-13 and Figure 10-14, respectively.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E90	26	32	54	56	40	39	9	0	0	0	0	0
E70	40	68	82	80	58	55	25	3	0	0	0	6
E50	62	92	100	108	77	73	37	10	3	0	2	13
E30	81	111	122	133	97	96	56	23	9	2	7	27
E10	120	165	151	171	142	129	90	52	17	20	25	47

E10 represents a value that cannot be exceeded in 10% of events, etc.

Figure 10-13: Rainfall distribution for the Sasolburg region



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E90	0.1	0.1	0.6	1.1	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
E70	0.2	1.5	2.3	2.8	1.8	0.9	0.4	0.2	0.2	0.2	0.2	0.1
E50	0.5	3.3	5.6	7.1	3.7	2.4	1.2	0.4	0.3	0.3	0.2	0.2
E30	1.4	6.6	10.6	14.2	9.2	4.5	2.1	0.7	0.4	0.3	0.3	0.2
E10	8.4	28.4	28.1	33.4	28.0	12.9	6.1	1.8	0.8	0.5	0.4	0.5

E90 represents a value that cannot be exceeded in 90% of events, etc.

Figure 10-14: Runoff distribution for the Sasolburg region

10.8.1.2 Streamflow Evaluation

A total of nine sub-catchments (SC1 to SC9) were delineated for the Kromelmboogspruit and selected relevant tributaries (refer to Plan 15, Appendix 2). Peak flows calculated using the Rational Method Alternative 3 (RM3), Standard Design Flood (SDF) and the Midgley & Pitman (MIPI) were used to calculate the 1:50-year and 1:100-year peak flows for the delineated catchment at the project area. Catchment characteristics and calculated peak flows are presented in Table 10-11 and Table 10-12, respectively.

Table 10-11: Characteristics of delineated catchments at Mooikraal-3Shaft Collieries

Catchment	AREA	Longest Watercourse (L)	Distance to Centroid (Lc)	Elevation (mamsl)		Slope
	km^2	km	km	10%L	84%L	(m/m)
SC1	509.1	54.25	40.01	1454	1554	0.0024
SC2	34.8	8.381	6.077	1461	1483	0.0035
SC3	33.9	8.499	5.703	1456	1480	0.0038
SC4	77.3	10.361	6.059	1460	1485	0.0032
SC5	51.8	11.323	6.94	1455	1497	0.0049
SC6	6.4	3.741	2.99	1459	1482	0.0079
SC7	7.1	3.459	2.89	1462	1494	0.0123
SC8	11.2	6.298	5.44	1459	1483	0.0051
SC9	9.9	3.627	1.72	1450	1485	0.0129

Table 10-12: Peak flows in the Kromelmboogspruit and selected tributary catchments

Catchment	Method					
	RM3		SDF		MIPI	
	1:50yr	1:100yr	1:50yr	1:100yr	1:50yr	1:100yr
	(m^3/s)					
SC1	420.88	569.86	650.62	823.93	382.44	483.08
SC2	96.82	131.17	176.31	223.28	98.11	123.93
SC3	96.50	130.73	174.91	221.50	97.88	123.64
SC4	185.38	251.19	324.18	410.54	176.79	223.31
SC5	135.17	183.16	238.47	302.00	127.94	161.60
SC6	40.20	54.46	68.28	86.47	37.42	47.27
SC7	45.15	61.19	88.74	112.38	43.09	54.42
SC8	42.07	56.97	77.11	97.65	44.61	56.35
SC9	63.99	86.73	122.96	155.72	62.42	78.85

10.8.2 Water Quality

IGS was appointed by Sasol Mining to conduct continuous bi-annual water monitoring of the Mooikraal MRA and 3 Shaft area. In addition Mooikraal undertakes weekly water quality analysis upstream and downstream of the mine. This section summarises the water quality information based on the latest water quality analysis conducted by IGS (April 2018). The monitoring programme focuses on an integrated approach where all water resources are holistically monitored for potential impacts of mining. The parameters analysed for are displayed in Table 10-13.

Table 10-13: Summary of the parameters/variables analysed for

Water Quality Parameters						
pH	EC	TDS	Ca	Mg	Na	K
P-Alk	M-Alk	Cl	SO_4	NO_3 as N	F	Cd
Al	Fe	Mn	NH_4 as N	Si	Cr	B
Co	Cu	Pb	PO_4	COD	DOC	TOC
Phenols	Turbidity	Suspended Solids				

Nine surface water monitoring sites form part of the monitoring program within the Mooikraal MRA and 3 Shaft area. The monitoring locations depicted in Plan 16, Appendix 2.

10.8.2.1 Kromelmboogspruit

Monitoring points KROM/N and KROM/S (refer to Plan 16, Appendix 2) represent water quality upstream and downstream of the Mooikraal complex along the Kromelmboogspruit. The water quality was compared against the standard limits prescribed in the WUL, as detailed in Table 10-14 below.

Table 10-14: Chemical analysis of the Kromelmboogspruit, February 2018 (IGS, 2018)

SiteName	EC	pH	Ca	Mg	Na	K	PAlk	MAlk	F	Cl	NO2(N)
	mS/m		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
WRQO	<150	5.5 - 9.5	<50	<80	<100	N/S	N/S	N/S	N/S	<150	N/S
KROM/N	11	7.4	7	3	8	5.9	0	39	0.29	5	0.011
KROM/S	8	6.8	4	2	6	6.4	0	23	0.24	5	<0.01
SiteName	NO3(N)	PO4	SO4	Al	Fe	Mn	NH4(N)	TDS	B	Si	Cd
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
WRQO	<40	N/S	<200	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S
KROM/N	0.767	<0.1	7	0.326	0.252	<0.020	0.23	79	<0.040	5.64	<0.003
KROM/S	0.509	<0.1	8	0.521	0.438	<0.020	0.09	57	<0.040	6.18	<0.003
SiteName	Co	Cr	Cu	Pb	Turb	COD	Susp. Solids	Phenol	DOC	TOC	
	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/lO2	mg/L	
WRQO	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	
KROM/N	<0.020	<0.020	0.026	<0.020	661	54	446	<0.010	13	14	
KROM/S	<0.020	<0.020	0.028	<0.020	218	60	110	<0.010	18	19	

WRQO - Water quality limits specified in the Mooikraal WUL Number 08/C22K/CIGJFAE/6981
N/S - Not specified

The latest 2018 water quality for the Kromelmboogspruit as indicated in Figure 10-15 reveals a calcium bicarbonate signature. At times water quality at KOM/N and KROM/S is observably variable and this may be a result of occasional overflows from PCDs into Kromelmboogspruit which was confirmed to have occurred since 2010 (Figure 10-16). The May and November 2018 samples were collected just after heavy rains received in the area and the flow rate in the Kromelmboogspruit was higher than usual, therefore, this explains the similarity in water quality signature of the downstream and upstream sampling points during these periods.

The historic data (Figure 10-16) show that elevated chloride and sodium trends have been observed in the past. Higher levels of sodium and chloride were indicated at the downstream Krom/N. The latest 2018 EC trends for Krom/N have indicated to be directly influenced by the sodium content. Essentially, the decrease in sodium (latest record) revealed a direct decrease in EC.

As mentioned, the water quality of the Kromelmboogspruit indicates that all parameters are well within the prescribed Mooikraal WUL limits.

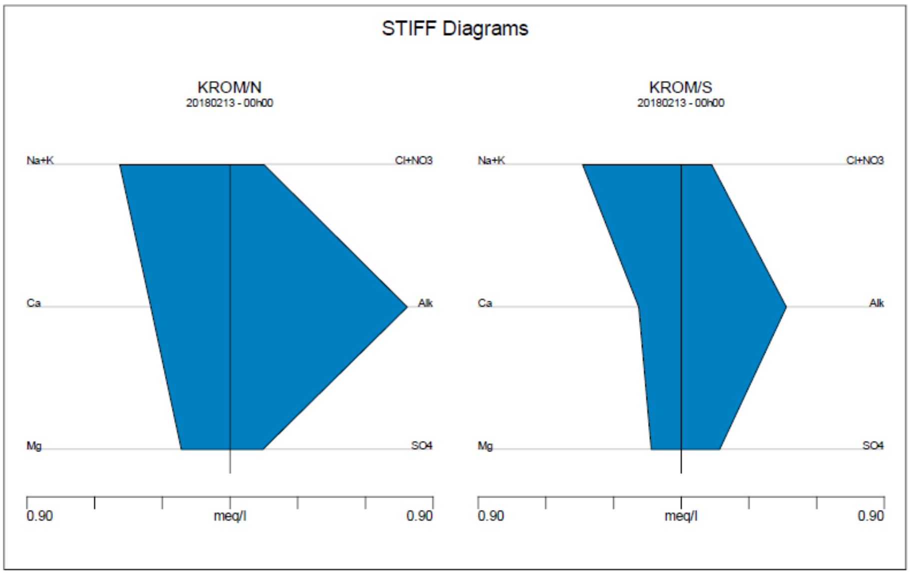


Figure 10-15: Stiff diagrams showing the water quality trends in the Kromelmboogspruit

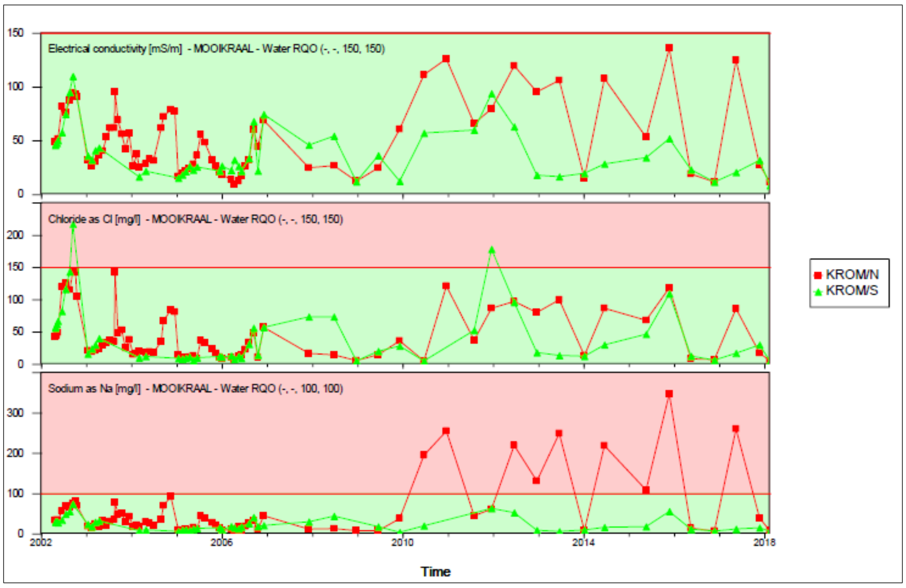


Figure 10-16: Sodium, chloride and EC trends for the Kromelmboogspruit

10.8.2.2 Mooikraal Dirty Surface Water System

The dirty surface water monitoring system consists of three different samples, namely MK-DAM, MK-PIT and MK-SUMP (refer to Plan 16, Appendix 2 and Figure 10-17 below). These dirty water containment facilities are all located within the Mooikraal Complex in proximity to the Kromelmboogspruit and associated tributaries. The sample at the Adit Sump is referred to as MK-Pit, the blended water from the sump and from underground as MK-Sump, and the sample at the dirty water South/ North PCDs as MK-Dams. MK-Sump was inaccessible for the last 2018 sampling run due to excessive weeding.

Figure 10-17: Dirty Surface Water System Monitoring Locations

(A: Adit Sump (MK-Pit); B: Pipe discharging the sump and underground water (MK-Sump); C: Mooikraal South & North PCDs or Dirty Water Dams (MK-Dams))

The latest water quality for the Mooikraal dirty surface water sites is presented in Table 10-15 and Figure 10-18. The water quality in all the samples reflects a strong sodium bicarbonate character. These qualities resemble the underlying geology and are to be expected as the water is pumped directly from underground before its quality is altered. The sump (MK-Pit) has a more calcium-magnesium bicarbonate character. The historic time series trends (Figure 10-19) similarly correspond to the latest qualities, with the exception of a short period in 2012 that showed different chemical signature.

The total alkalinity observed over time from this dam is indicated in Figure 10-20. Since 2010, a sharp increase in total alkalinity has been observed and it levelled off at values just below 400 mg/l. The eventual constant alkalinity, together with an improvement in chloride, has had a huge influence on the EC of the dam which also improved slightly.

Table 10-15: Chemical analysis of dirty surface water dams (IGS, 2018)

SiteName	EC	pH	Ca	Mg	Na	K	PAlk	MAlk	F	Cl	NO2(N)
	mS/m		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
WRQO	<150	5.5 - 9.5	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	<15
MK DAM	117	8.6	26	14	248	3.7	35	391	0.78	90	<0.1
MK PIT	102	8.3	64	50	109	5.3	2	324	0.31	122	<0.1
SiteName	NO3(N)	PO4	SO4	Al	Fe	Mn	NH4(N)	TDS	B	Si	Cd
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
WRQO	<15	<10	N/S	N/S	N/S	N/S	<6	N/S	N/S	N/S	N/S
MK DAM	<0.5	<1	113	0.020	<0.020	<0.020	0.24	884	0.808	6.37	<0.003
MK PIT	<0.5	<1	66	0.030	0.024	<0.020	0.16	739	0.369	15.82	<0.003
SiteName	Co	Cr	Cu	Pb	Turb	COD	Susp. Solids	Phenol	DOC	TOC	
	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/lO2	mg/L	
WRQO	N/S	N/S	N/S	N/S	N/S	<75	<25	N/S	N/S	N/S	
MK DAM	<0.020	<0.020	0.017	<0.020	0.68	49	1	<0.010	4	5	
MK PIT	<0.020	<0.020	0.013	<0.020	2.69	11	7	<0.010	5	6	

WRQO - Water quality limits specified in the Mooikraal WUL Number 08/C22K/CIGJFAE/6981
N/S - Not specified

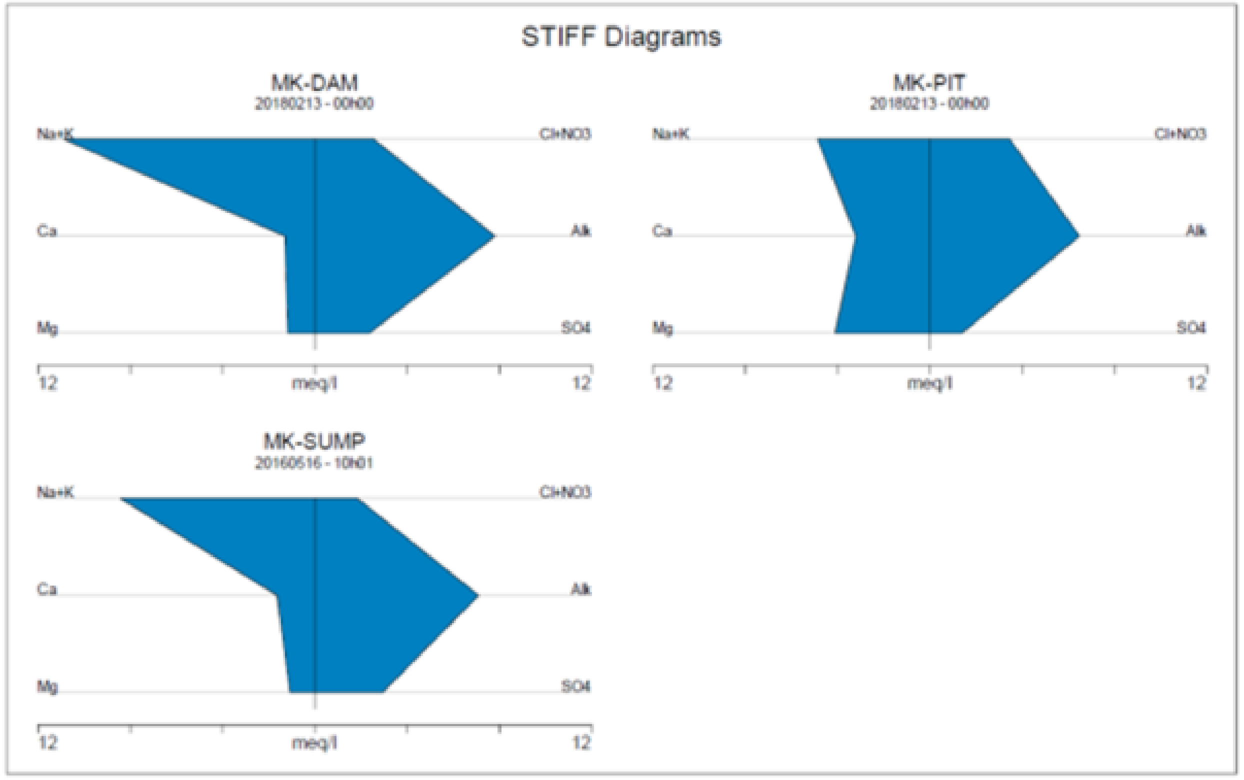


Figure 10-18: Stiff diagrams of the Mooikraal North/South dams, pit and sump

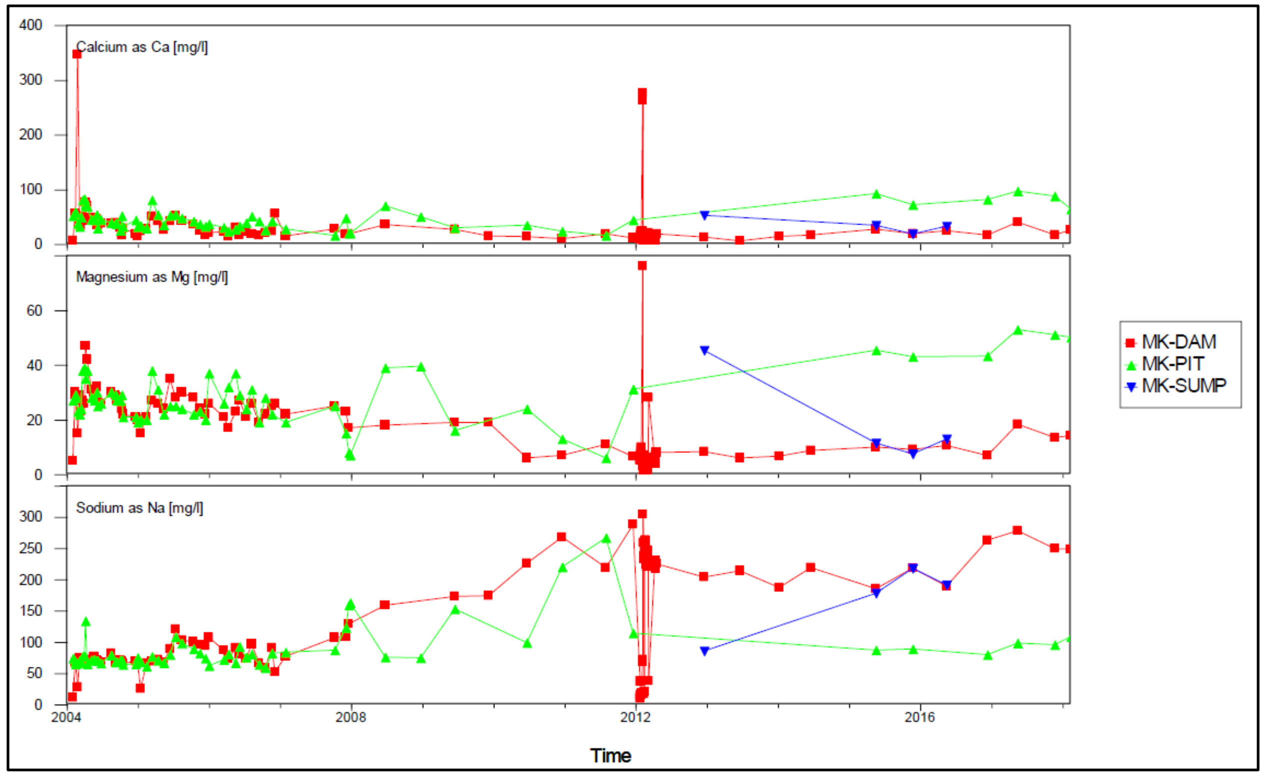


Figure 10-19: Historical time series for Ca, Mg and Na in dirty water areas

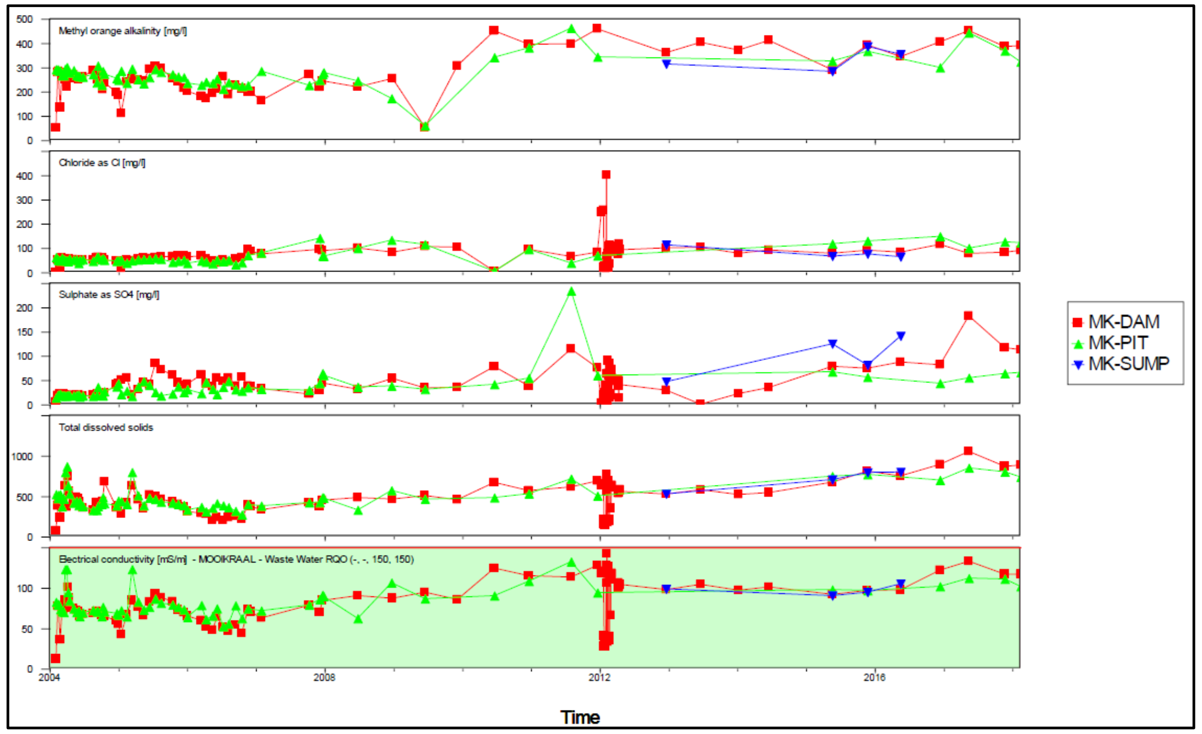


Figure 10-20: Historical time series for alkalinity, chloride, EC, SO_4 and TDS in PCDs

Bacteriological analysis indicates *E. Coli* levels that exceed the limits set in the WUL in the MK-Dam and MK-Pit, as shown in the table below.

Table 10-16: *Dirty Water Dams bacteriological analysis results (February 2018).*

Site Name	Faecal Coliform	E. Coli
	CFU/100ml	CFU/100ml
WUL (08/C22K/CIGJFAE/6981) RQO	<1000	0
MK DAM	201	93
MK PIT	23	4

10.8.2.3 Sewage Treatment Plant

The quality of the treated effluent from the STP is monitored at Mooikraal as required by the WUL. The water quality was benchmarked against the WUL standard limits as indicated in Table 10-17.

From the analysis it is evident that EC, pH, Total Suspended Solids (TSS) and Phosphates (PO_4) are within acceptable WUL limits for the monitoring period from February to June 2018. Ammonia levels are generally within the acceptable WUL limit (6 mg/L) with the exception of two samples in February and April of 2018. The majority of the samples taken show elevated Nitrate (NO_3) above the WUL limit of 15 mg/L. Mooikraal is in the process of investigating options of expanding the STP to address exceedances and operate within limits.

Table 10-17: Treated effluent quality from Mooikraal Sewage Treatment Plant

Date	Free Chlorine (as Cl_2, mg/l)	COD (mg/l)	pH	EC (mS/m)	TSS (mg/l)	Ammonium (as NH^3, mg/l)	Nitrate (as N, mg/l)	Orthophosphate (as P, mg/l)	Faecal Coliform (cfu/100 ml)	Ecoli (cfu/100 ml)
WUL limits	0,25	75	5.5-9.5	70	25	6	15	10	1000,00	0
2018-01-19	0,40	58,00	6,00	54,50	6,00	4,40	25,50	4,67	0,00	0,00
2018-02-20	0,50	30,00	7,47	31,00	2,00	1,90	0,00	0,00	1,00	0,00
2018-03-20	0,30	14,60	6,20	51,80	2,00	0,57	29,00	5,80	0,00	0,00
2018-04-17	0,20	47,00	7,02	60,40	2,00	9,80	23,40	3,90	25,00	0,00
2018-05-15	5,10	22,00	6,78	51,20	2,00	0,16	18,60	2,96	0,00	0,00
2018-06-13	5,00	14,60	6,67	62,30	2,00	0,16	18,90	12,70	0,00	0,00
2018-07-24	2,50	47,00	6,77	45,00	2,80	0,79	18,00	4,20	0,00	0,00
2018-08-21	0,30	14,60	6,45	42,10	2,00	0,16	12,70	4,10	2,00	1,00
2018-09-21	1,10	18,00	5,96	50,00	10,00	0,16	20,50	5,10	0,00	0,00
2018-10-15	5,00	14,60	9,76	249,00	2,00	0,16	12,10	3,40	0,00	0,00
2018-11-20	1,50	75,00	6,01	48,10	2,00	0,22	31,00	5,60	0,00	0,00
2018-12-11	1,20	31,00	6,18	48,00	2,00	0,66	27,00	6,80	0,00	0,00
2019-01-21	1,50	48,00	6,13	52,00	2,00	0,90	37,00	5,02	0,00	0,00
2019-02-18	1,50	76,00	7,09	38,20	2,00	9,40	1,10	3,48	0,00	0,00
	Exceed WUL Limit									

10.8.2.4 Leeuspruit Water Quality

Monitoring points SIG/5 and SIG/6 (refer to Plan 16, Appendix 2) represent water quality upstream and downstream of the 3 Shaft area on a tributary of the Leeuspruit. The water quality was compared against the WUL standard limits.

From the Stiff diagrams shown in Figure 10-21, the water type of both SIG/5 and SIG/6 can be described as sodium-bicarbonate water with SIG/6 (downstream) more enriched with Sulphate (SO_4) than that of SIG/5 (upstream). The change in sulphate concentrations within the Leeuspruit tributary is illustrated in its character that changes from a calcium-bicarbonate water at the upstream point to a sodium-bicarbonate water at the downstream point.

Trend graphs (chemistry against time) for EC, pH, SO_4 and Cl sourced from the bi-annual report (IGS, 2018) are shown in Figure 10-22. Bacteriological analysis results are subsequently presented in Table 10-18. The following conclusions can be made from the trend analysis for EC, pH, SO_4 and Cl assessed on the Leeuspruit water quality:

- SO_4 levels both upstream and downstream of 3 Shaft are within the WUL acceptable limit of 200 mg/L. Point SIG/5 upstream of 3 Shaft has lower SO_4 concentration than the downstream point SIG/6 indicating some influence of activities at the existing 3 Shaft Plant and Crusher.
- Cl and EC are generally within the WUL acceptable limits for all monitoring points from 2007 to 2018.
- All other parameters analysed and compared against WUL limits in January 2018 are within acceptable WUL ranges excluding Na, Manganese (Mn), NO_3, PO_4, TSS, Faecal Coliform and E. Coli.
- Farming activities including use of pesticides and fertilisers in agricultural fields around the Leeuspruit drainage are possible sources of NO_3, PO_4, and TSS in addition to sediments washed-off by runoff at the 3 Shaft area.
- Faecal coliform, E Coli exceed WUL limits within the Leeuspruit tributary which can be explained by contamination from known regular municipal sewage overflows upstream of 3 Shaft.
- Although the Leeuspruit is perennial, flow volumes and rates are generally low with high flows generally associated with high rainfall events. High runoff can cause the increase in TSS observed in the January 2018 results that represent a wet season survey; and
- Mn and Na are naturally occurring elements that are enriched in the soils and geology of the area which is the source of these contaminants (IGS, 2018).

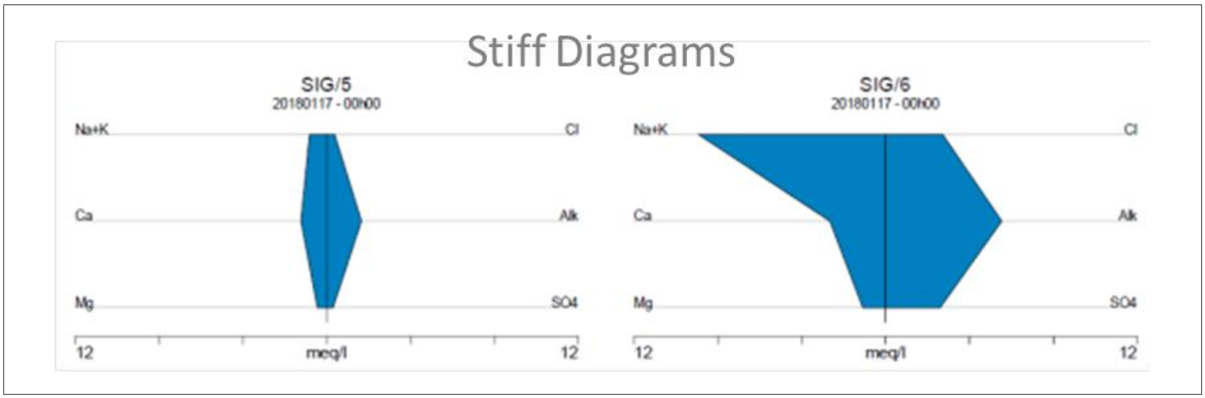


Figure 10-21: Stiff diagrams illustrating the water quality of the Leeuspruit tributary

(IGS, 2018)

Figure 10-22: EC, pH, Cl and SO_4 time graphs for the Leeuspruit tributary (SIG/5 & SIG/6)

(IGS, 2018)

Table 10-18: Leeuspruit bacteriological analysis results (IGS, 2018)

Site Name	Faecal Coliform	E. Coli
	CFU/100 ml	
WUL Limit	<1000	0
SG5	65	45
SG6	1825	1380
WUL (No. 08/C22K/CIGJFAE/6981) Standards Limits		

10.8.3 Floodline Delineations

The 1:50-year and 1:100-year floodlines for the Kromelmboogspruit and its tributaries at Mooikraal and the Leeuspruit and its tributaries at all river crossings along the conveyor belt/pipeline route and at 3 Shaft were modelled and mapped. The general overview of the floodlines can be seen in Plan 17, Appendix 2.

The 7 Ml/day pipeline from the ventilation shaft to the Mooikraal MRA traverses the Kromelmboogspruit at one point, while the 10 Ml/day pipeline from Mooikraal to the 3 Shaft area crosses a tributary of the Kromelmboogspruit once and Leeuspruit tributaries at three points along its length. Floodlines of the Kromelmboogspruit at Mooikraal are presented in Figure 10-23 while those at the Leeuspruit river crossings with the 10 Ml/day pipeline are indicated in Figure 10-24. Enlarged plans of these floodlines are provided in the specialist report, Appendix 7.

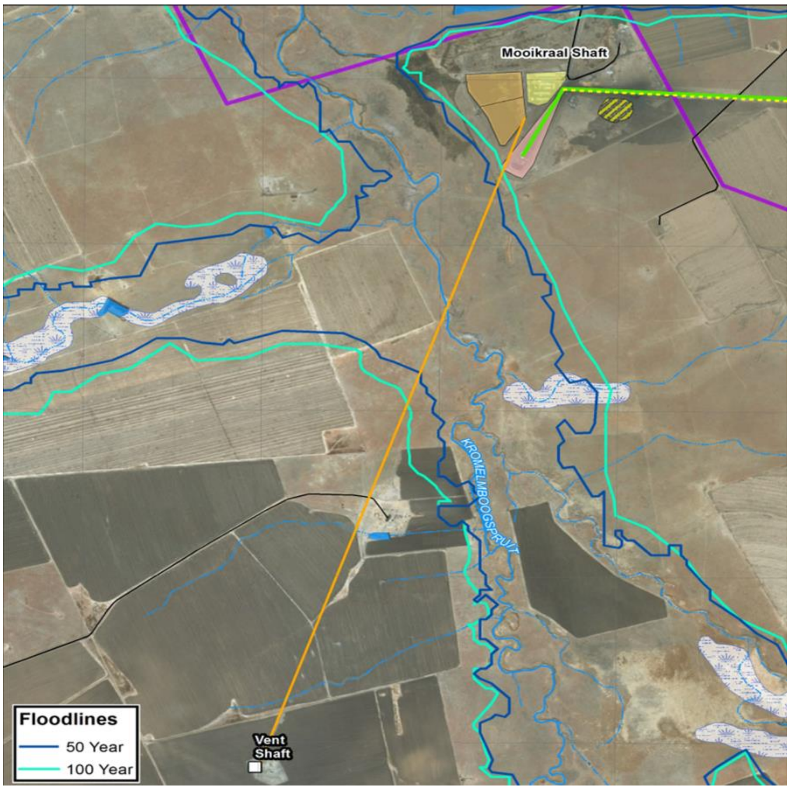


Figure 10-23: Floodlines for the Kromelmboogspruit at Mooikraal =

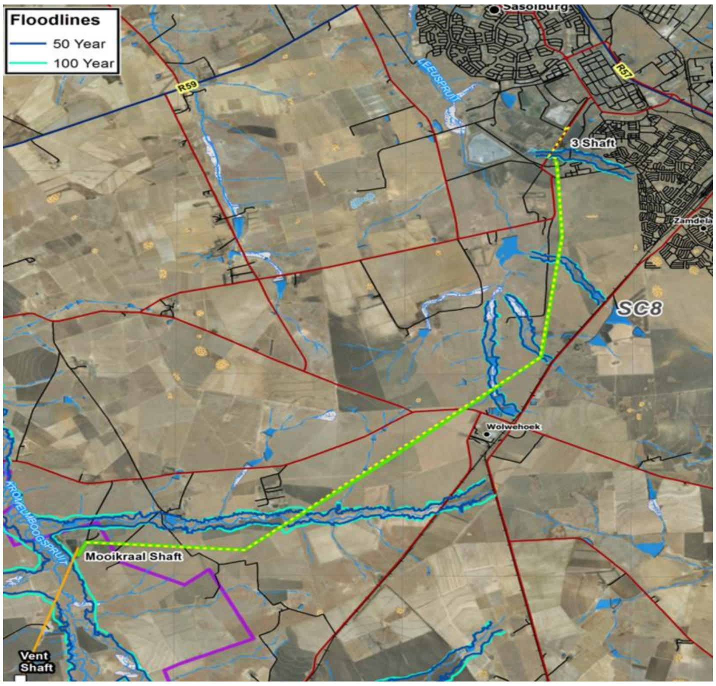


Figure 10-24: Floodlines across the 10 Ml/day pipeline from Mooikraal to 3 Shaft

Pre-development 1:50-year and 1:100-year floodlines on the Leeuspruit tributary at 3 Shaft are presented in Plan 18, Appendix 2.

No infrastructure is located within the 1:100-year floodline at Mooikraal. The existing primary plant area at 3 Shaft falls within the 1:100-year floodline on the Leeuspruit tributary, as shown on Plan 18, Appendix 2. Based on the preferred layout proposed in this application, the proposed site to which the 3 Shaft primary plant area will be relocated is outside the 1:100-year floodline.

The modelled floodlines are for indicative purposes only, and not meant for any engineering designs. They should be used as a general indication of infrastructure placement, if new mining infrastructure is to be constructed at both the Mooikraal and 3 Shaft sites.

10.9 Groundwater

A Groundwater Assessment was conducted for this project and is appended to this report as Appendix 8. Various detailed groundwater assessments have been completed for Mooikraal, including the Mooikraal Groundwater Model (IGS, 2018), Sigma Colliery: Water Monitoring Report for Mooikraal (IGS, 2018) and the Environmental Authorisation applications reports compiled by Sasol Mining and Digby Wells during 2014 for the Mooikraal EMPr and Pipelines Project respectively

The Groundwater Assessment included in this application is therefore based on a collation of information from the abovementioned reports to determine the geological and hydrogeological characteristics of the project area and consequently undertake a groundwater impact assessment.

Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 8 .

10.9.1 Hydrogeological Setting

Mooikraal and 3 Shaft area are underlain by the following aquifers:

- Shallow Aquifer, associated with Quaternary deposits of the Karoo Supergroup i.e. alluvium, colluvium and weathered Karoo rocks;
- Intermediate Aquifer, associated with hard fractured Karoo rocks i.e. sandstone and dolerite of the Karoo Supergroup;
- Deep Aquifer, associated with pre-Karoo rocks i.e. karst aquifer comprised of dolomitic rocks of the Transvaal Supergroup; and
- Mine Aquifer (unnatural groundwater regime) is still being developed as a result of mining; underground mining at Mooikraal and underground mining at Sigma (at the 3 Shaft location).

10.9.2 Groundwater Quality

Groundwater quality trends at Mooikraal are observed from quarterly monitoring results obtained by IGS (2018). The current water levels and quality at 3 Shaft are obtained from newly drilled boreholes (drilled in 2018). Water quality is compared against the Groundwater RQO set in the WUL. The location of the applicable monitoring boreholes is illustrated in Plan 19, Appendix 2.

Groundwater quality limits as per Mooikraal WUL (16/01/2018) are given in the table below.

Table 10-19: Groundwater quality limits as per Mooikraal WUL 08/C22K/CIGJFAE/6981

Parameter (m/L unless otherwise stated)	Limit	Parameter (m/L unless otherwise stated)	Limit
Electrical conductivity (mS/m)	150	Nitrate	10
Sodium	200	Fluoride	1.0
Magnesium	100	Calcium	150
Chloride	200	pH	5.5-9.5
Sulphate	200	-	-

The subsections below provide an assessment of groundwater quality at within the Mooikraal MRA and the 3 Shaft area respectively. The groundwater quality has been divided for each local aquifer discussed in Section 10.9.1 above.

10.9.2.1 Water quality within Mooikraal MRA

10.9.2.1.1 Shallow Aquifer

The monitoring boreholes within this aquifer are listed below (refer to Plan 19, Appendix 2):

- MK002;
- MK007;
- MK008;
- MK029;
- MK030; and
- MK031.

The depths of the boreholes monitoring the shallow aquifer range from 30 to 45 metres below ground level (mbgl).

Water quality trends in the shallow aquifer are presented in Figure 10-25 and Figure 10-26. The following has been observed:

- EC has been observed to deteriorate for MK002 since 2006 while at MK007 EC has improved since operation. The EC of the remaining boreholes has fluctuated throughout operation. However, all boreholes have remained within the prescribed WRQO of (150 mS/m) since operation;
- NO_3 has been observed to be in excess in MK008 since operation, however, drastic improvements have occurred since 2014; fluctuations have occurred since, however. The currently NO_3 concentrations are within the prescribed WUL limits of 10 mg/L;
- Cl and Na are observed to exceed prescribed WUL limits in borehole MK002 since 2009; this is however attributed to the local geology. Cl and Na in MK007 were observed to rise in 2004 and subsequently showed improvement in 2006, and have since remained relatively stable up to date, with slight increases over time; and
- SO_4 was found to fluctuate since the commencement of the operation, with a period of stability between 2006 and 2011. From 2011 trends were observed to fluctuate until stability was reached again in 2015 and has remained constant since. Generally, SO_4 concentrations have remained within prescribed WUL limits for all boreholes throughout operation.

Low SO_4 concentrations are indicative of very minimal or no influence from mining. The shallow aquifer quality has therefore been concluded to be of the natural Karoo groundwater which is characterised by elevated alkalinity and Cl, typical of this area.

Water characterisation according to the Stiff Diagram (Figure 10-27 below) shows that the current water quality within this aquifer is indicative of bicarbonate type water. This type of water is characteristic of recently recharged groundwater.

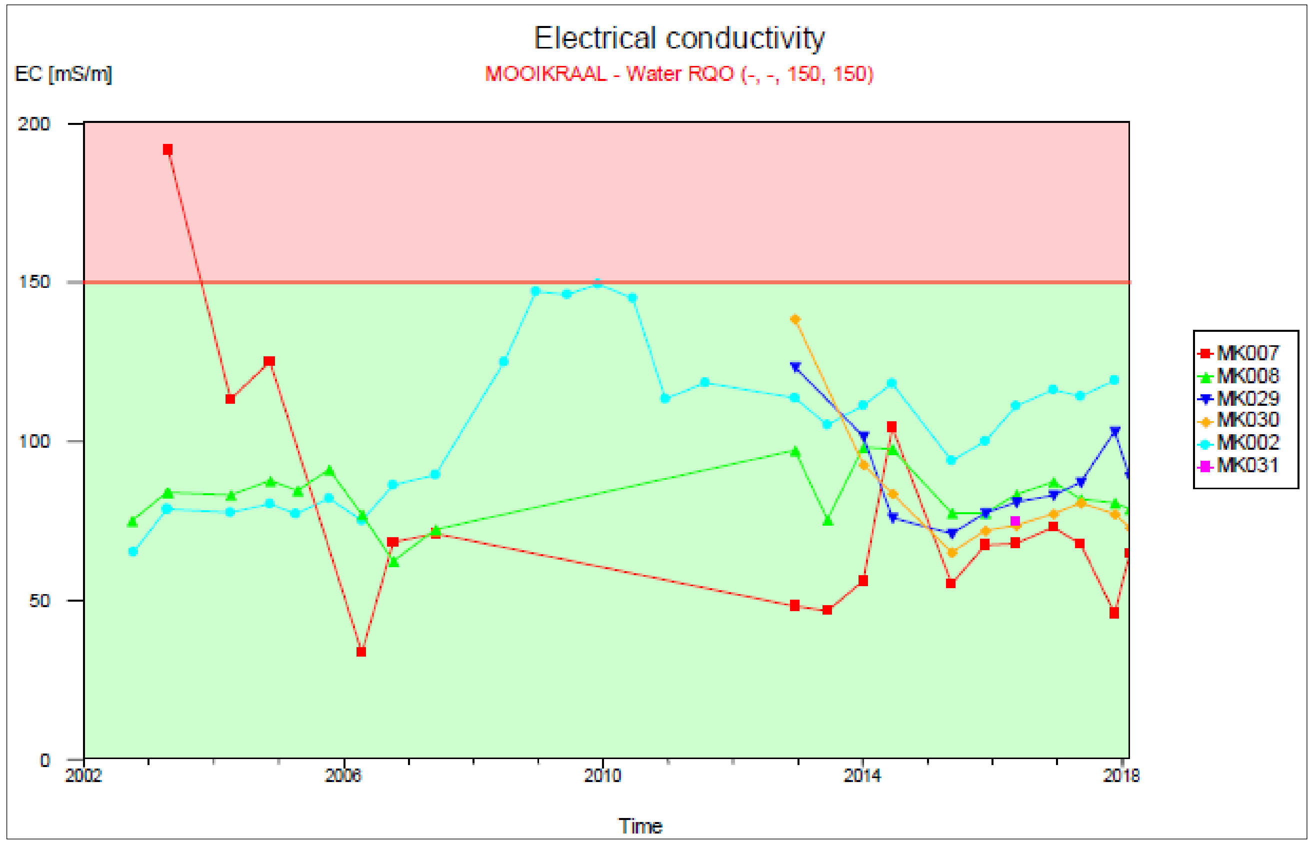


Figure 10-25: EC trends within the shallow aquifer

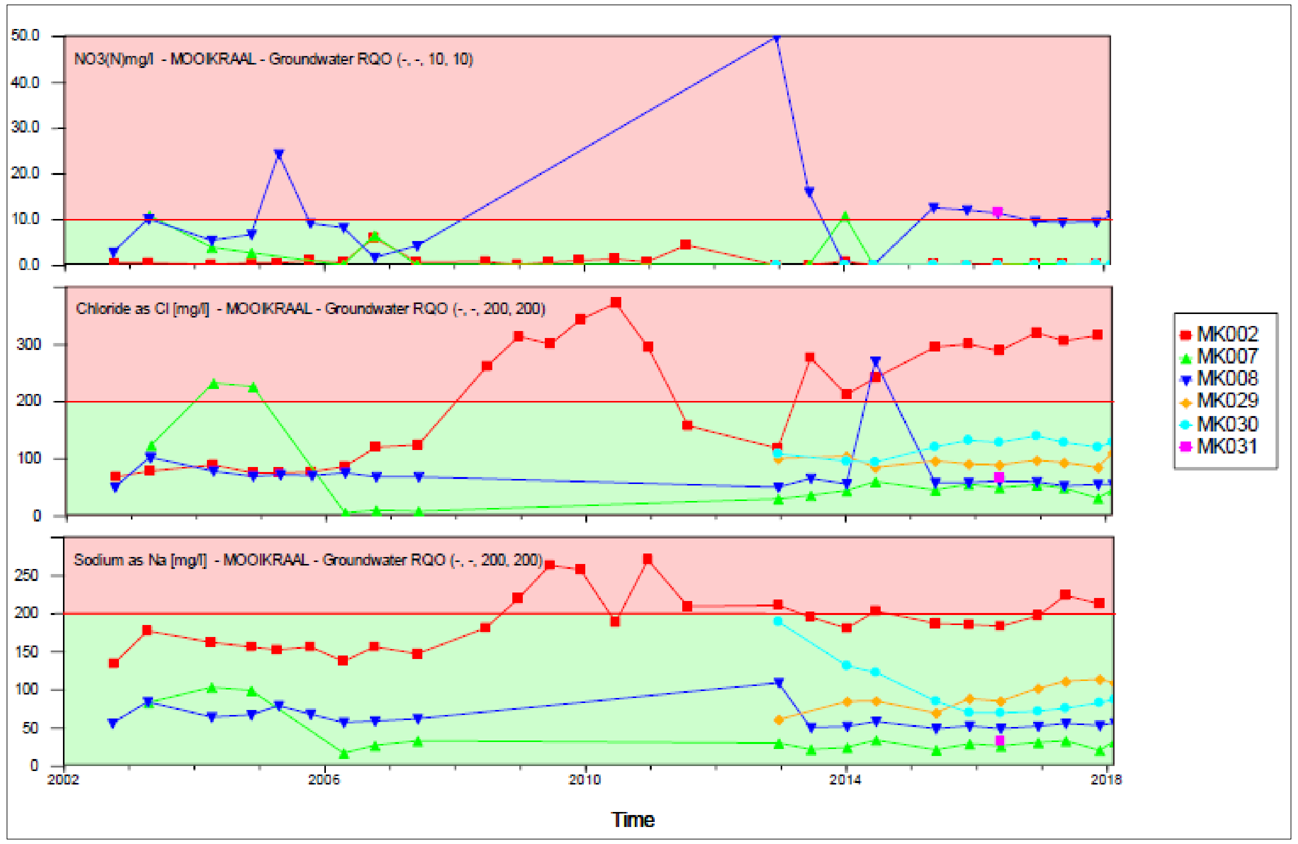


Figure 10-26: NO_3, CL and Na concentration trends within the shallow aquifer

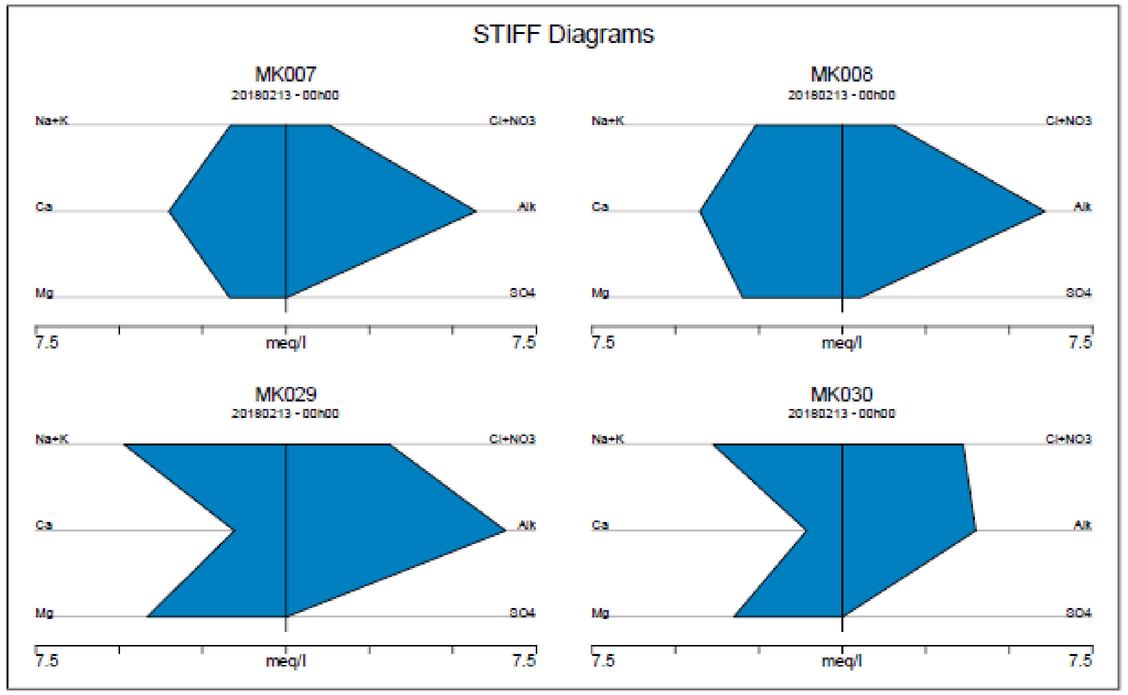


Figure 10-27: Stiff Diagram of the Shallow Aquifer within the Mooikraal Area

10.9.2.1.2 Intermediate Aquifer

The monitoring boreholes within this aquifer are listed below (refer to Plan 19, Appendix 2):

- MK001;
- MK004;
- MK005;
- MK009;
- MK010;
- MK011;
- MK019; and
- MK022

The depths of the boreholes monitoring the intermediate aquifer range from 70 to 108 mbgl.

Water quality trends in the intermediate aquifer are presented in Figure 10-28. The following has been observed:

- EC is observed to fluctuate for all the boreholes, showing relative improvements since 2014. Particularly erratic behaviour is observed for MK005 since 2005; this is attributed to surface water inflows into the borehole which is caused by an absence of a sanitary seal within the borehole. EC has remained within the prescribed WUL limit for all the boreholes since monitoring was initiated (prior to the commencement of operation);
- NO_3 has been found to exceed the prescribed WUL limits in boreholes MK004 (in years 2006, 2011, 2014 and 2016), MK009 (prior to operation till 2007 and again in 2014), and MK010 (2014 and 2015). However, improvements have been observed since then. Generally the NO_3 levels remain below the prescribed WUL limit; and
- Chloride is elevated, however, not in excess of the prescribed WUL limit (with the exception of MK00 in 2009); the elevated concentration is attributed to underlying geology.
- Na was found to be within the prescribed WUL limit with the exception of MK010 (prior operation, showing a distinct rise in concentration in 2013 and drop below the prescribed WUL limit in 2014).

Water characterisation according to the Stiff Diagram (Figure 10-29 below) shows that the dominating cations vary between Mg, Ca and Na. This indicates mixed water with an influence of ion exchange with the host geology. The water is bicarbonate type and is typical of Karoo aquifer waters. Cl is also mostly elevated due to ion exchange with the host geology.

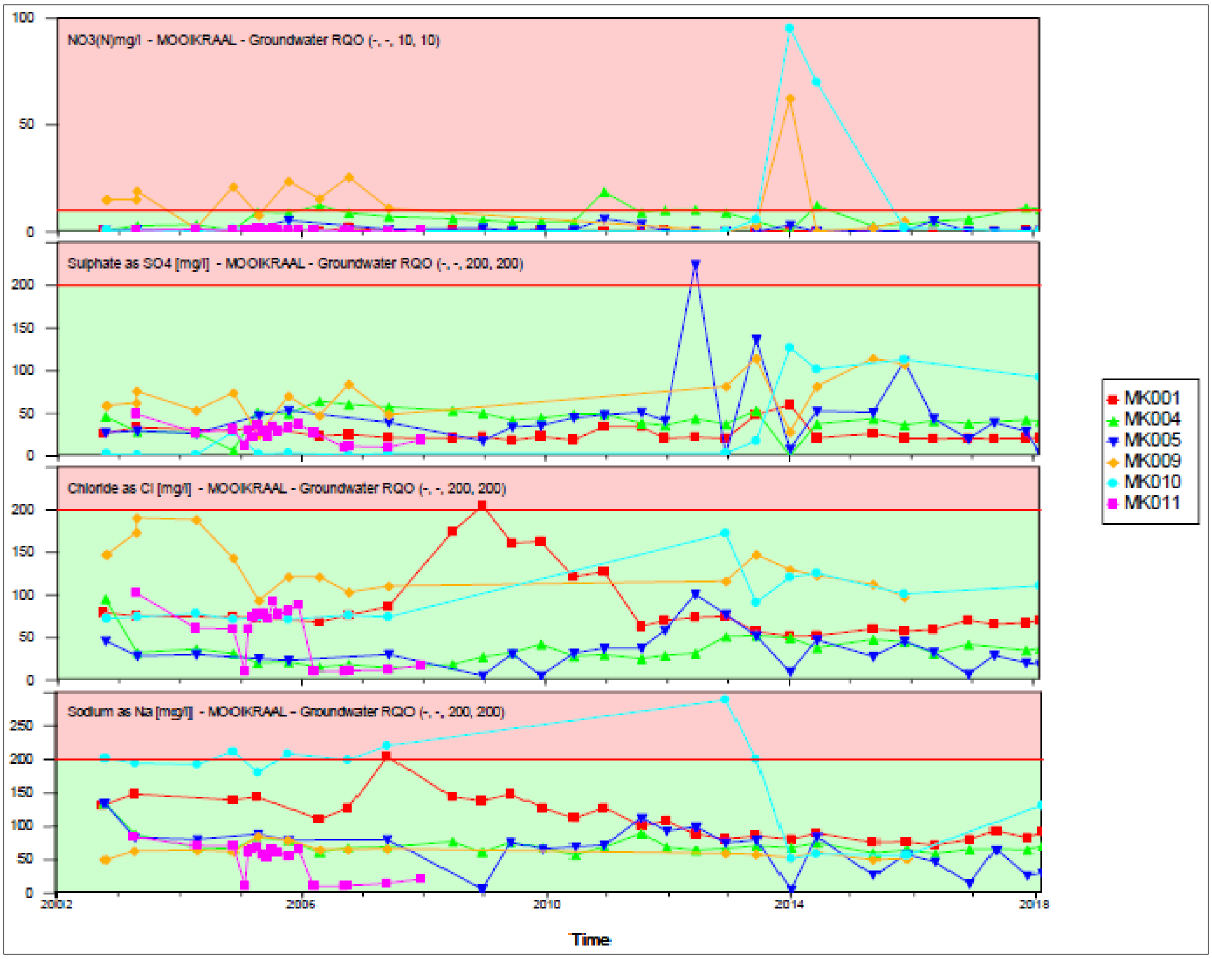


Figure 10-28: No$_3$, SO$_4$, Cl and Na concentration trends within the intermediate aquifer

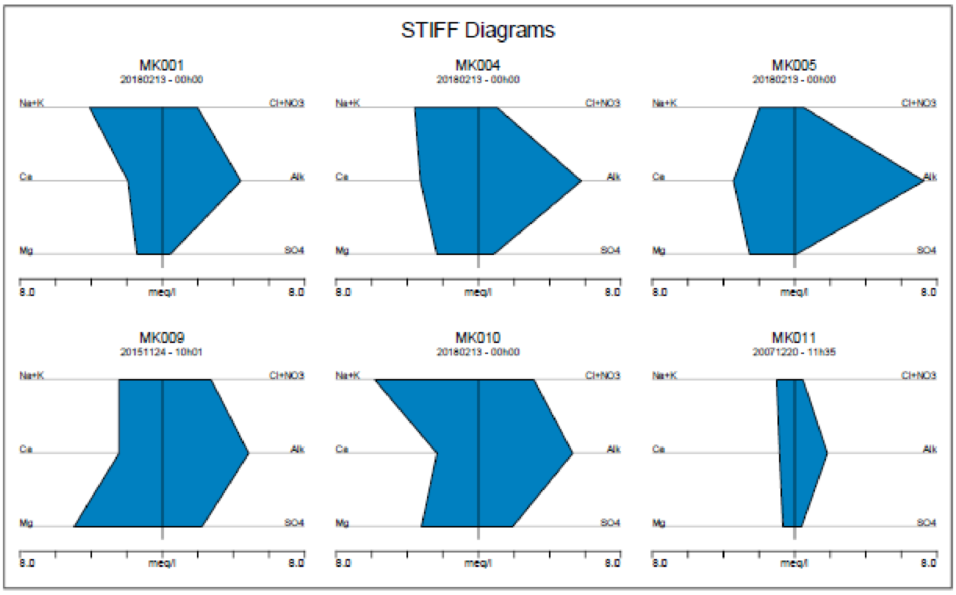


Figure 10-29: Stiff Diagram of the Intermediate Aquifer within the Mooikraal Area

10.9.2.1.3 Deep Aquifer

The monitoring boreholes within this aquifer are listed below (refer to Plan 19, Appendix 2):

- MK012;
- MK013;
- MK015;
- MK017;
- MK018;
- MK021;
- MK023;
- MK024;
- MK025; and
- MK026.

The deep aquifer boreholes range from a depth of 114 to 192 mbgl.

Water quality trends in the deep aquifer are presented in Figure 10-30 and Figure 10-31. The following has been observed:

- EC is observed to be relatively stable, with the exception of MK012 and MK026 which have exceeded the prescribed WUL limit. However, MK026 has been found to be below the prescribed WUL limit since 2015;
- NO_3 has been observed to be in excess in boreholes MK012 and MK023 which initiated during the operation of the mine, drastic improvements have occurred since 2015, however, remain above the prescribed WUL limit;
- Cl exceeded the prescribed WUL limit since 2005 in boreholes MK012 and 2007 in MK026; and
- Na has been found to exceed the WRQO since monitoring commenced in borehole MK026.

Water characterisation according to the Stiff Diagram (Figure 10-32 below) shows mostly calcium/sodium-chloride signatures, indicating the influence of ion exchange with the host geology. It is therefore concluded that there are no mining related influences.

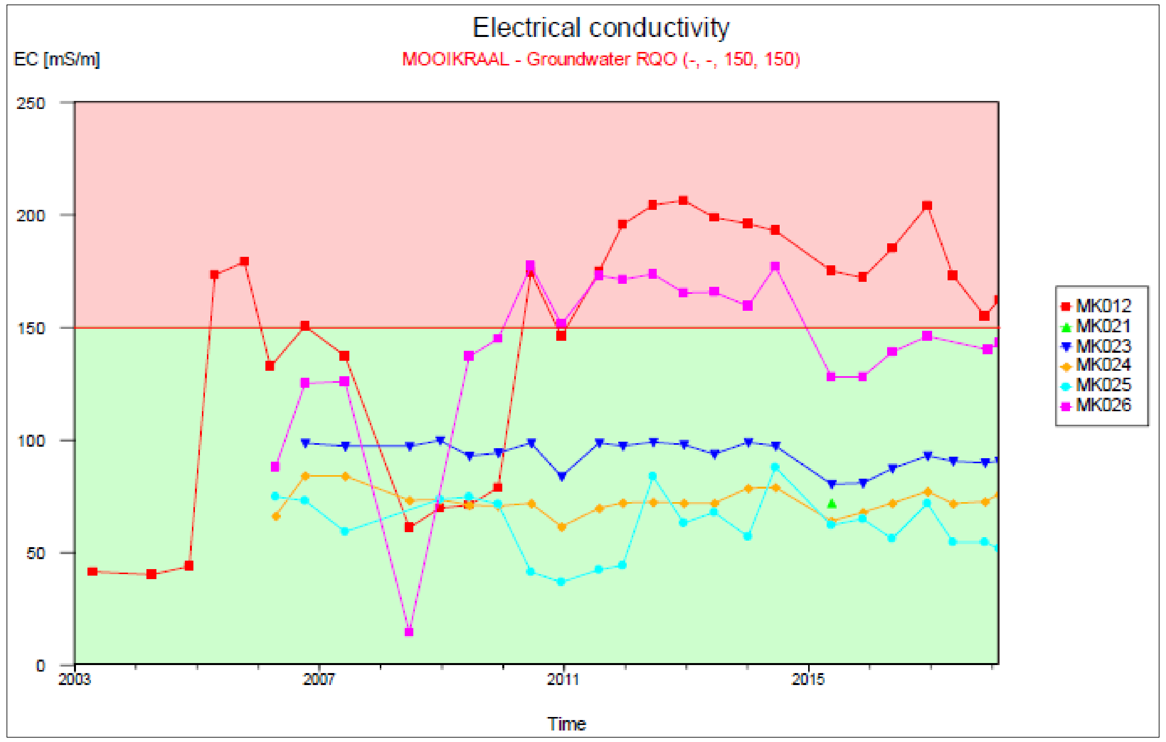


Figure 10-30: EC trends within the deep aquifer

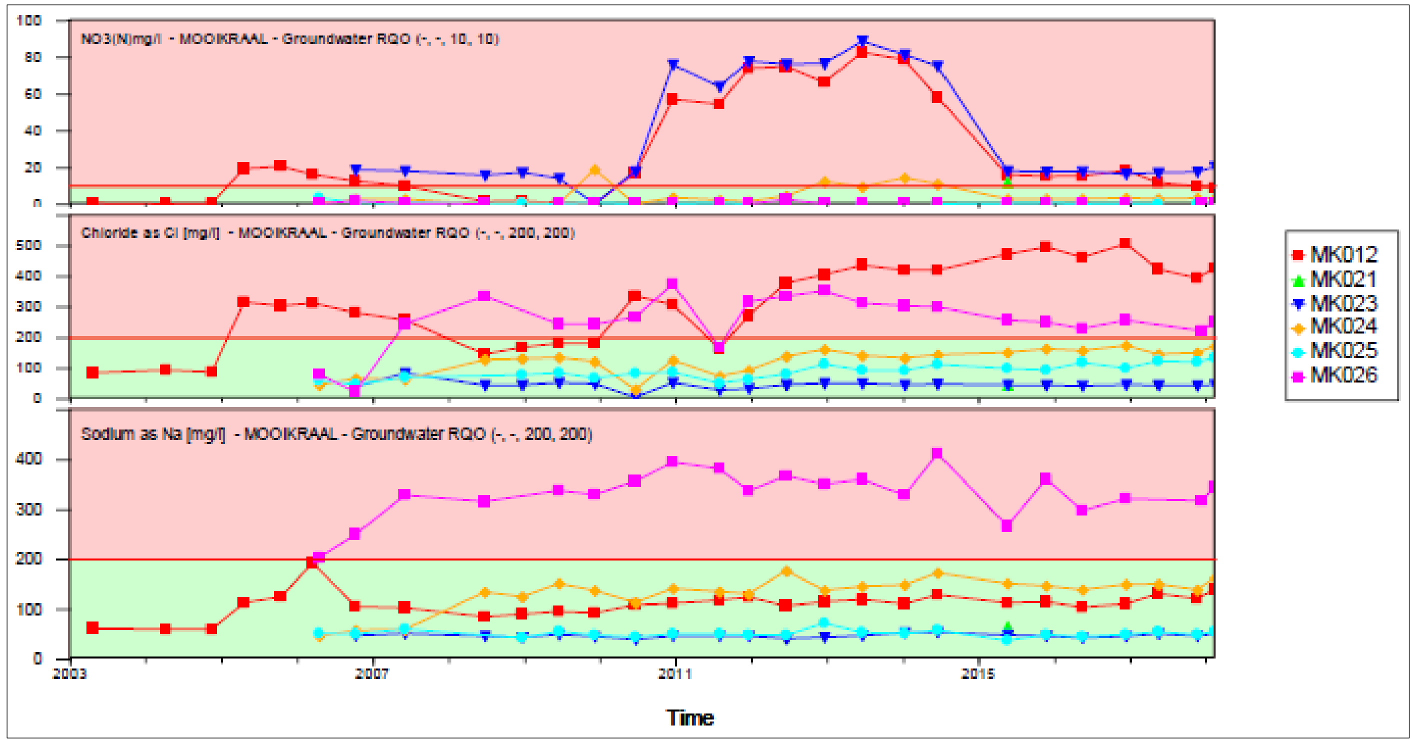


Figure 10-31: NO_3, Cl and Na concentration trends within the deep aquifer

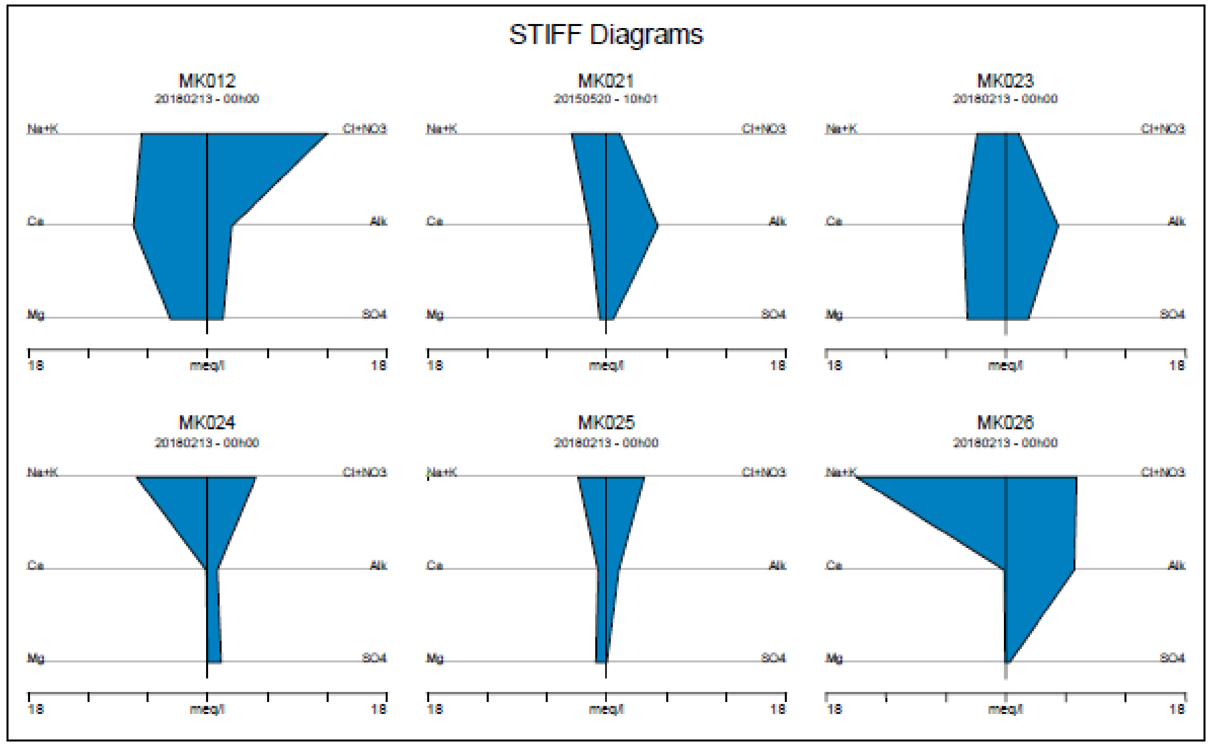


Figure 10-32: Stiff Diagram of the Deep Aquifer within the project area

10.9.2.1.4 Mine Aquifer

The monitoring boreholes within this aquifer are listed below (refer to Plan 19, Appendix 2):

- MK003;
- MK006;
- MK027; and
- MK028

The mine aquifer boreholes range from a depth of 110 to 265 (mbgl).

Water quality trends in the mine aquifer are presented in Figure 10-33 and Figure 10-34. The following has been observed:

- EC has exceeded the prescribed WUL limit in borehole MK006 since the commencement of monitoring in 2002, prior to operation;
- Na has been found to exceed the prescribed WUL since 2002 in borehole MK006. It has also been found to be in excess in MK028 since monitoring was initiated in 2017 therefore pre-mining condition is unknown at that location; and
- All other parameters are within the prescribed WUL showing relative stability.

Water characterisation according to the Stiff Diagram (Figure 10-35 below) shows the groundwater to be sodium-bicarbonate; with MK006 having significantly high concentrations. This indicates the influence of ion exchange between the groundwater and the host geology, and it is concluded to not have any mining related influences.

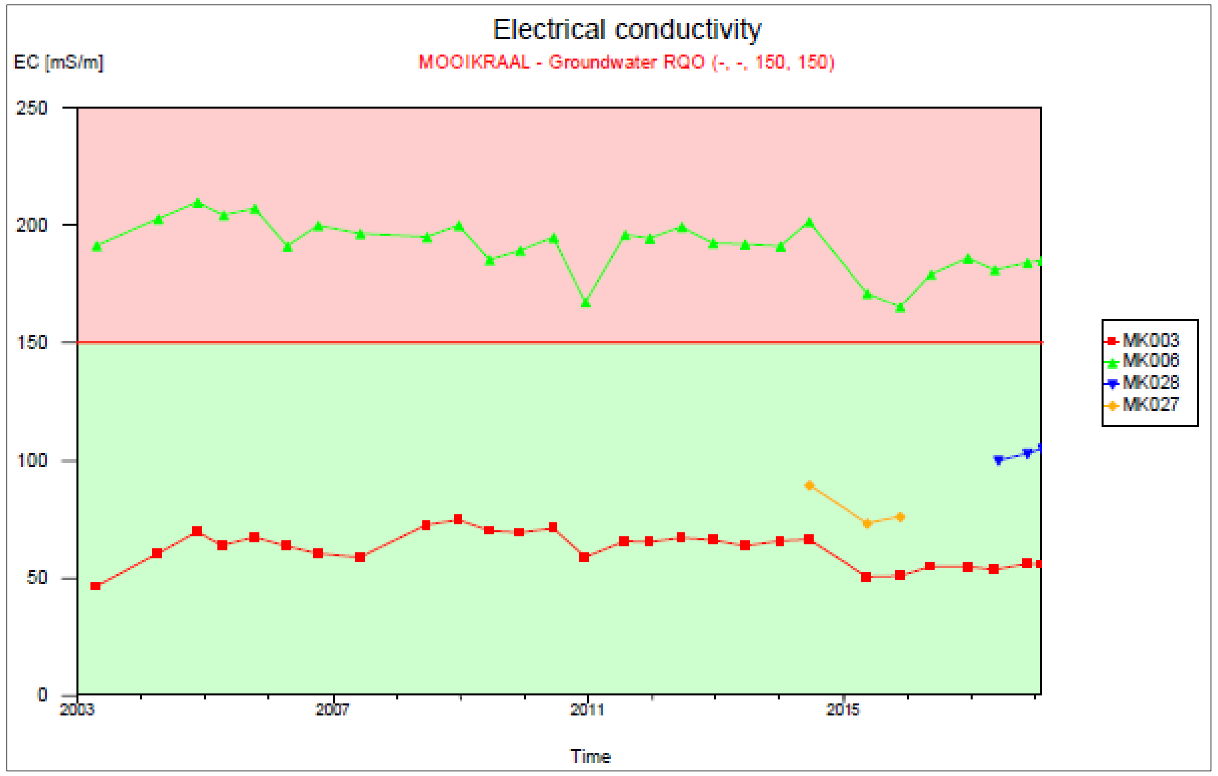


Figure 10-33: Electrical conductivity trends within the mine aquifer

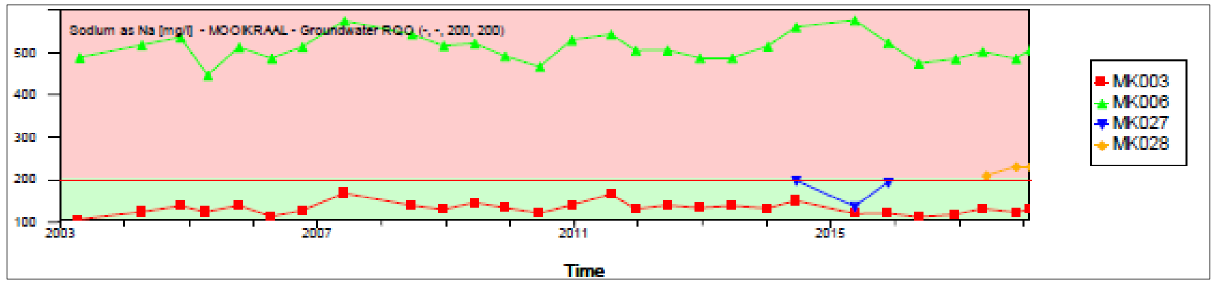


Figure 10-34: Sodium concentration trends within the mine aquifer

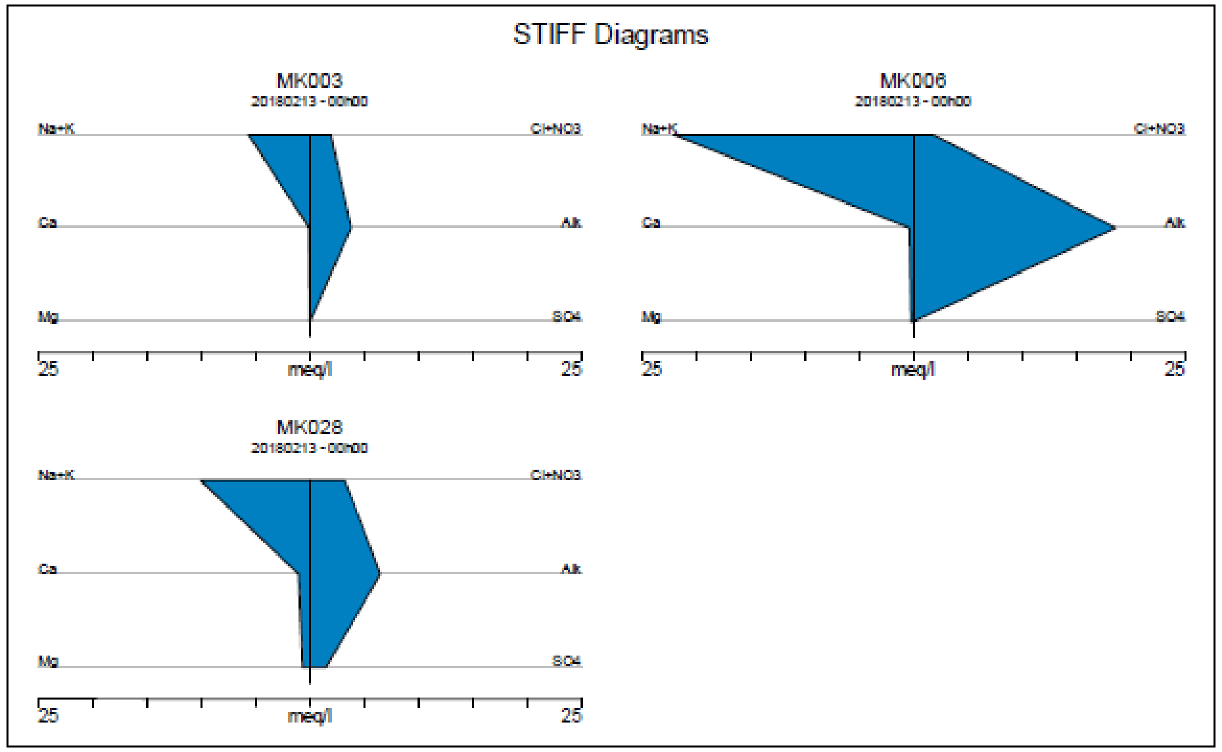


Figure 10-35: Stiff Diagram of the Mine Aquifer within the Mooikraal Area

10.9.2.2 Water quality at 3 Shaft

Shallow and deep boreholes were drilled at 3 Shaft in 2018. The shallow boreholes were drilled to a depth of 49 m while the deep boreholes drilled to a depth of 89 m. These boreholes intercept the shallow and intermediate aquifer respectively.

The comparison of the groundwater quality at 3 Shaft to the prescribed WUL is listed in Table 10-20 and discussed in the subsections below.

Table 10-20: Groundwater quality compared against WRQO

Sample ID		pH	EC (mS/m)	Na (mg/l)	Mg (mg/l)	SO_4 (mg/l)	Cl(mg/l)	$N0_3$ (mg/l)	F (mg/l)	Ca (mg/l)
WRQO	**Date**	**5.5 to 9.5**	**150**	**200**	**100**	**200**	**200**	**10**	**1**	**150**
Shallow Aquifer										
MK034S	25/10/2018	7.88	31.6	27.1696	10.1413	1.7741	2.5994	-0.05	0.9073	29.2604
MK036S	25/10/2018	7.65	54.2	55.5129	14.9851	32.1358	18.2219	2.9985	0.1474	47.0192
MK037S	25/10/2018	7.09	36.5	19.3372	11.4156	4.756	4.5205	1.3127	0.0386	45.4591
Intermediate Aquifer										
MK034D	25/10/2018	9.91	33.6	73.8065	0.096	7.4179	6.3393	0.0625	0.1567	0.4762
MK035D	25/10/2018	7.72	39.1	33.5006	11.8544	4.6795	3.8764	0.5884	0.0352	41.3627
MK036D	25/10/2018	8.78	33.2	72.8309	0.9625	17.8878	5.8689	0.3757	0.1257	2.6423
MK037D	25/10/2018	8.19	30.2	57.249	2.7184	8.6359	5.7722	-0.05	0.0508	8.4472

10.9.2.2.1 Shallow Aquifer

The monitoring boreholes within this aquifer are listed below (refer to Plan 19, Appendix 2):

- MK032S;
- MK034S;
- MK035S;
- MK036S; and
- MK037S.

All parameters were found to be within the prescribed WUL limits therefore currently there are no mining related impacts found within the shallow aquifer (Table 10-20). According to the Stiff Diagram (Figure 10-36 below) the shallow aquifer is characteristic calcium-bicarbonate type water typical of recently recharged groundwater. This is typical of the shallow aquifer as it receives recharge and is also indicative of no influences from mining related impacts.

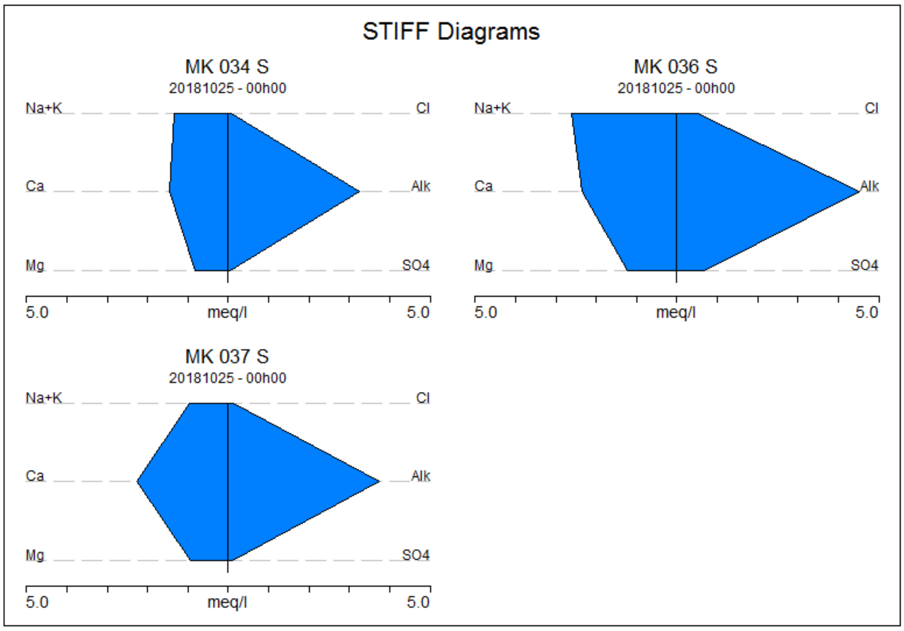


Figure 10-36: Stiff Diagram of the Shallow Aquifer within the 3 Shaft Area

10.9.2.2.2 Intermediate Aquifer

The monitoring boreholes within this aquifer are listed below (refer to Plan 19, Appendix 2):

- MK032D;
- MK034D;
- MK036D; and
- MK037D

As shown in the results of the shallow aquifer, the deep aquifer is found to be within the prescribed WUL limits. This is with the exception of the pH in MK034D (Table 10-20).

According to the Stiff Diagram (Figure 10-37 below), the intermediate aquifer at 3 Shaft is characterised as sodium-bicarbonate type. This type of water is indicative of mixing of long-resident water with recently recharged water, showing no indication of influence from mining related influences. Additionally, the high alkalinity of the water in the intermediate aquifer (ranging between 8.19 and 9.91) is likely a result of the ash backfilling in the mine voids at Sigma Defunct Colliery.

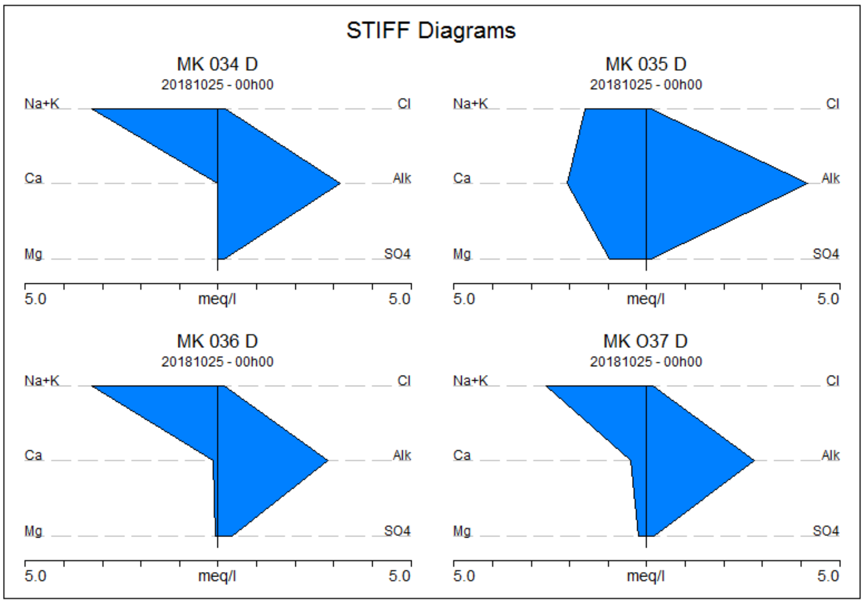


Figure 10-37: Stiff Diagram of the Intermediate Aquifer within the 3 Shaft Area

10.9.3 Groundwater Levels

The subsections below provide an assessment of groundwater levels within the Mooikraal MRA and the 3 Shaft area respectively. The groundwater quality has been divided for each local aquifer discussed in Section 10.9.1 above.

10.9.3.1 Water levels at Mooikraal

10.9.3.1.1 Shallow Aquifer

Between the years 2008 to 2012, MK002 and MK008 water levels declined by approximately 20 and 7 metres respectively (Figure 10-38), whereas the water level in MK007 has increased. It has been observed, however, that since 2013 water levels have been relatively stable, with a distinct rise from 2016 onwards. This was attributed to heavy rainfall events that contributed largely to the groundwater recharge.

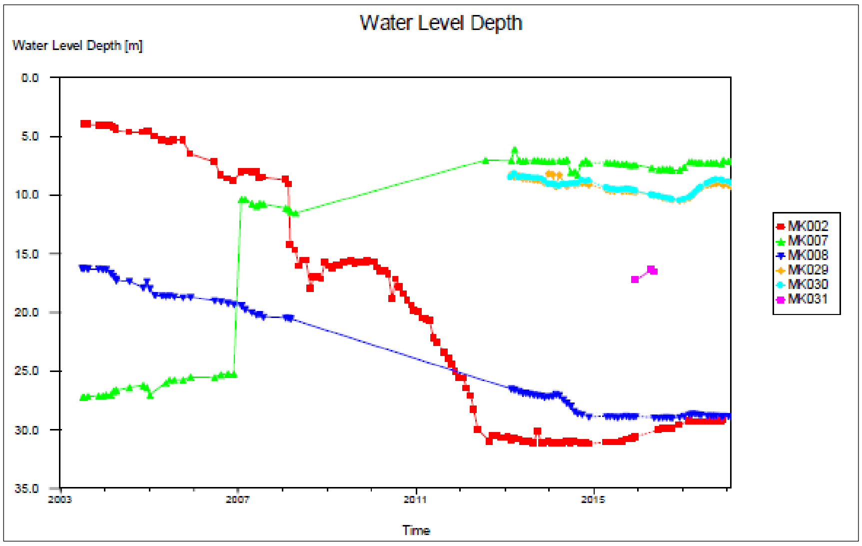


Figure 10-38: Groundwater levels measured at the shallow aquifer

10.9.3.1.2 Intermediate Aquifer

Water level trends at the intermediate aquifer are shown in Figure 10-39. The water level in boreholes MK009, MK011 and MK022 have been observed to fluctuate, however, generally seen as stable. MK022 is a water supply borehole for the adjacent dairy farm and therefore the erratic water level behaviour is due to pumping.

The water levels in MK001 and MK010 indicate a declining trend since 2008. The decline in water level in these boreholes is a result of mine dewatering activities.

The water levels in MK004 and MK005 have been observed to be very erratic.

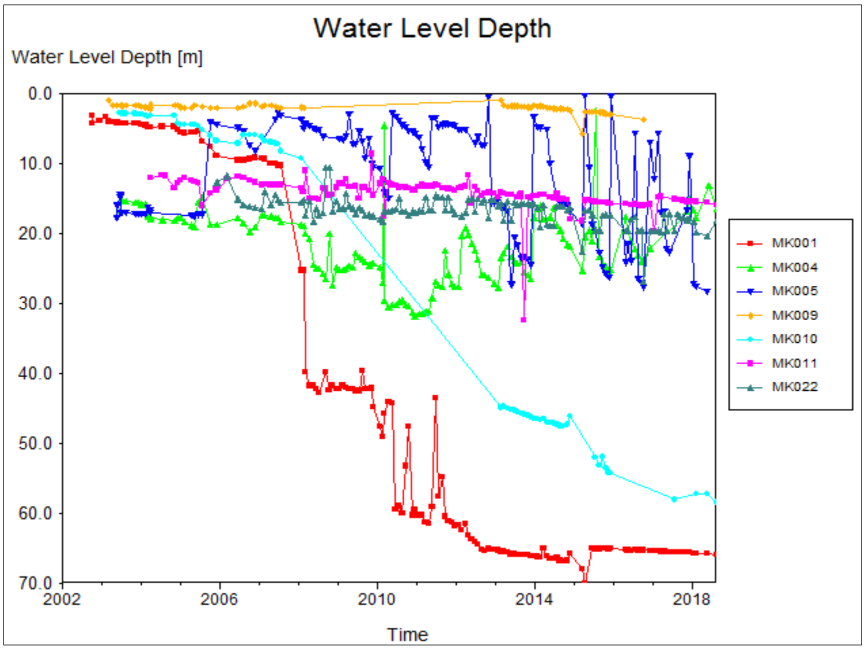


Figure 10-39: Groundwater levels measured at the intermediate aquifer

10.9.3.1.3 Deep Aquifer

The water level trends in the deep aquifer are illustrated in Figure 10-40. The water level of boreholes MK021 and MK025 have been relatively stable since monitoring commenced. MK021 experienced a rise in February 2017.

The overall water levels in boreholes MK023, MK024 and MK026 indicated a declining trend since 2008. These declining trends can be associated with mine dewatering. However, the water levels in boreholes MK024 and MK026 rose approximately 10 m between 2014 and 2015 (from the ranges of approximately 80 to 70 mbgl), and have since relatively stabilised.

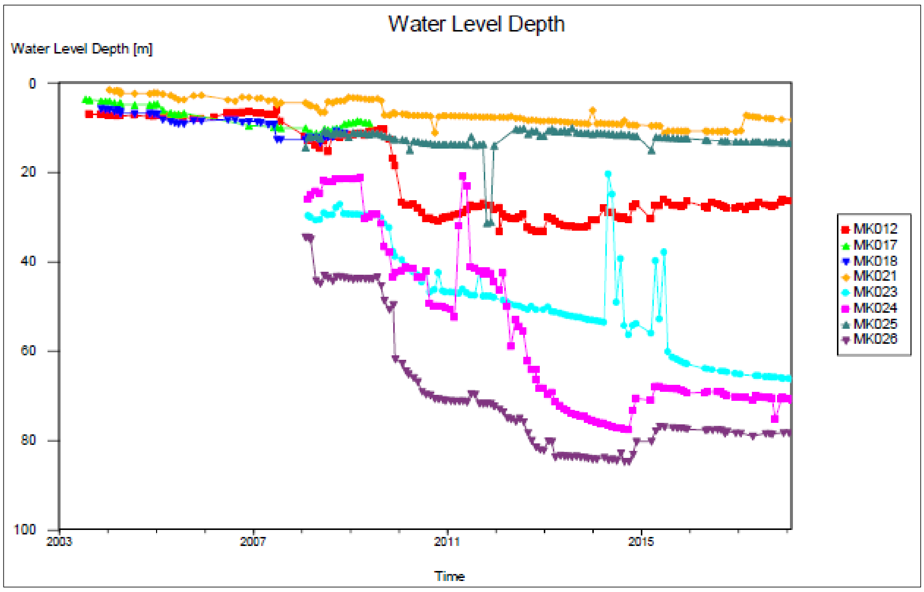


Figure 10-40: Groundwater levels measured at the deep aquifer

10.9.3.1.4 Mine Aquifer

The water level trends in the mine aquifer are illustrated in Figure 10-41. The mined out area where boreholes MK027 and MK028 are located is currently being utilised for water storage. The water levels for MK027 and MK028 have therefore fluctuated only slightly since monitoring at these locations commenced in 2013. This suggests that the water level in the mined out area remains stable.

The water level of borehole MK006 at the western area of the mine indicates a continuous rising trend. The water level of borehole MK003 at the north-eastern area indicated a rising trend until 2008, subsequently the water levels has declined slightly and stabilised since 2012.

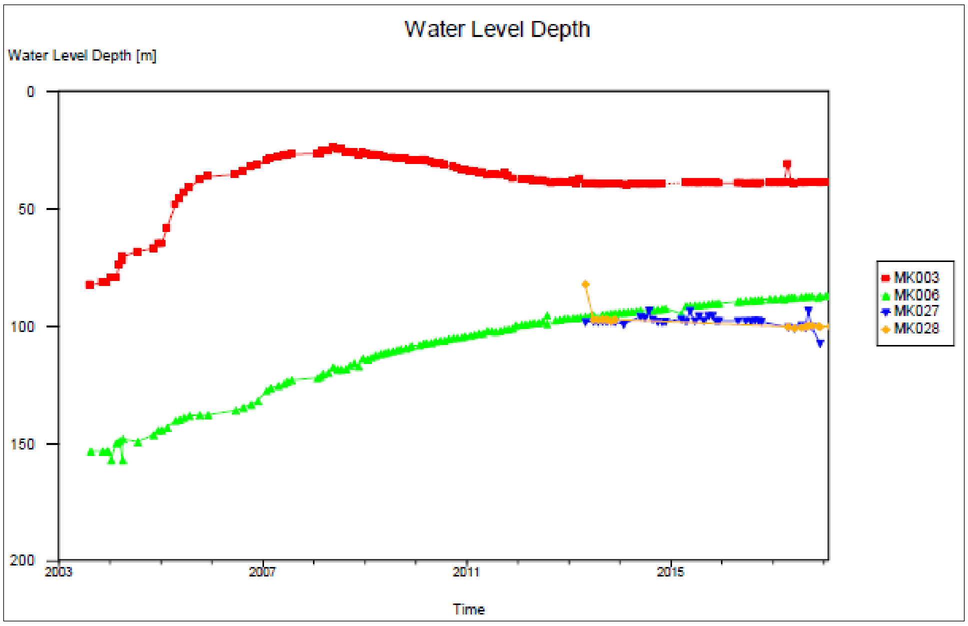


Figure 10-41: Groundwater levels measured at the mine aquifer

10.9.3.2 Water levels at 3 Shaft

10.9.3.2.1 Shallow Aquifer

Groundwater levels measured at the shallow aquifer boreholes are listed below.

Table 10-21: Groundwater levels measured at the shallow aquifer

Borehole ID	Water level (mbgl)
MK034S	31.63
MK035S	No water level measured – found to be muddy
MK036S	24.74
MK037S	4.73

From the water level groundwater flow direction at 3 Shaft is found to be from east to west.

10.9.3.2.2 Intermediate Aquifer

Groundwater levels measured at the intermediate aquifer boreholes are listed below.

Table 10-22: Groundwater levels at the intermediate aquifer

Borehole ID	Water level (mbgl)
MK034D	32.43
MK035D	33.45
MK036D	25.81
MK037D	38.27

10.9.4 Total Concentration Analysis for ROM at Mooikraal

Coal samples at Mooikraal of the ROM coal were obtained and Total Concentration Threshold (TCT) was tested. Total Concentrations were determined by *aqua regia* digestion to provide a measure of the elements in the solid-phase. Although not all elements found in the solid-phase will dissolve, these levels provide the elemental composition of the rocks and can be used as a screening tool to detect constituents which occur in anomalously high concentrations under unfavourable geochemical conditions.

The results are compared to threshold concentrations published in the NEMWA Waste Classification and Management Regulations where the following is applicable:

- TCT0 limits based on screening values for the protection of water resources, as contained in the Framework for the Management of Contaminated Land (DEA, March 2010);
- TCT1 limits derived from land remediation values for commercial/industrial land (DEA, March 2010); and
- TCT2 limits derived by multiplying the TCT1 values by a factor of 4, as used by the Environmental Protection Agency, Australian State of Victoria.

It is important to note that the total concentration values discussed in this section are different from the leachable concentration. Leachable concentrations assessments should be conducted to provide a more accurate prediction on the elements expected to be released from the host rocks.

The samples labelled with the prefix ''SEC'' refer to specific sections underground, whereas the Mooikraal sample represents a composite sample taken along surface belts.

The result of the geochemical analysis at Mooikraal is detailed in Table 10-23 below. The analysis shows that TCT0 threshold values of Barium (Ba), Chromium (Cr), Copper (Cu) and Lead (Pb) are exceeded in majority of the samples. These parameters form part of the quarterly monitoring currently on-going with the exception of Ba, it is recommended to be included as part of analysis going forward.

Table 10-23: TCT comparison threshold concentrations

Parameter	Unit	TCT 0	TCT1	TCT2	Mooikraal	SECT65_A	SECT 65_B	SECT69_C	SECT69_D	SECT69_E	SECT67_F	SECT67_G	SECT 67_H
As, Arsenic	mg/kg	5.8	500	2000	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
B, Boron	mg/kg	150	15000	60000	37.71	24.29	45.11	28.85	74.43	39.33	51.59	36.29	20.41
Ba, Barium	mg/kg	62.5	6250	25000	102.4	114.6	58.09	114.9	107	109	117.2	137.4	185.4
Cd, Cadmium	mg/kg	7.5	260	1040	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
Co, Cobalt	mg/kg	50	5000	20000	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	4.95	4.42	<4.2
Cr (IV), Chromium (IV)	mg/kg	6.5	500	2000	<4.2	5.17	<4.2	9	<4.2	4.415	4.45	<4.2	<4.2
Cu, Copper	mg/kg	16	19500	78000	24.41	12.46	17.02	21.98	8.21	40.96	18.47	15.98	25.78
Mn, Manganese	mg/kg	1000	25000	100000	80.58	52.27	142.8	16.63	88.09	24.49	75.28	45.72	15.14
Mo, Molybdenum	mg/kg	40	1000	4000	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
Ni, Nickel	mg/kg	91	10600	42400	11.94	12.77	10.62	16.78	4.9	<4.2	53.74	29.21	<4.2
Pb, Lead	mg/kg	20	1900	7600	28.8	54.37	42.74	30.93	11.04	40.1	26.4	8.5	15.73
Sb, Antimony	mg/kg	10	75	300	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
Se, Selenium	mg/kg	10	50	200	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2	<4.2
V, Vanadium	mg/kg	150	2680	10720	20.3	6.13	11.34	20.51	15.14	30.42	26.71	5.84	7.732
Zn, Zinc	mg/kg	240	160000	640000	31.92	30.55	59.85	79.18	20.59	23.52	18.4	15.55	24.2

10.9.5 Waste Classification for Waste Rock Dump at Mooikraal

Results of the Total Concentration (TC) and Leachable Concentration (LC) analysis are shown in Table 10-24 and Table 10-25, respectively. The results are compared to threshold concentrations published in the NEMWA Waste Classification and Management Regulations.

10.9.5.1 Total Concentration Results

The analysis shows that:

- TCT0 threshold values of Ba and Cu are exceeded for both samples from the waste rock material; and
- Based on the outcome of the TCT assessment only; more than one element exceeds the TCT0 limits therefore the material according to the regulations is classified as Type 3 waste, requiring a Class C liner.

10.9.5.2 Leachable Concentration Results

The analysis shows that none of the samples leached above the LTC0 threshold. Therefore, based on the LCT results only; the residue from all samples is classified as Type 4, that need to be disposed in an area with a Class D liner.

10.9.5.3 Classification

Both TC and LC analysis are used in conjunction with one another therefore the waste rock material is classified as Type 3 waste, requiring a Class C liner or system performing in a similar way. This is based on the TC analysis outcomes.

The WRD is not lined, as it consists of discard rock that was removed when the box cut was removed to form the Mooikraal adit, the stockpile is not in use, no further deposition of rock occurs.

The WRD has been authorised in the Mooikraal EMP, the intention is to amend the EMP, hereby doing so, Mooikraal has undertaken a waste classification of the discard rock, to inform monitoring and management actions, as well as decommissioning activities. It further stands to reason that other requirements such as a geotechnical investigation and design of pollution barrier system cannot be achieved as the waste rock dump is already in present.

Table 10-24: TCT classification

Parameter	Unit	TCT0	TCT1	TCT2	WRDS1	WRDS2
As, Arsenic	mg/kg	5.8	500	2000	0.800	0.400
B, Boron	mg/kg	150	15000	60000	107	36
Ba, Barium	mg/kg	62.5	6250	25000	144	584
Cd, Cadmium	mg/kg	7.5	260	1040	2.80	4.00
Co, Cobalt	mg/kg	50	5000	20000	<10	<10
Cr total	mg/kg	46000	800000	N/A	108	185
Cu, Copper	mg/kg	16	19500	78000	17	19
Hg, Mercury	mg/kg	0.93	160	640	<0.400	<0.400
Mn, Manganese	mg/kg	1000	25000	100000	137	330
Mo, Molybdenum	mg/kg	40	1000	4000	<10	<10
Ni, Nickel	mg/kg	91	10600	42400	42	<10
Pb, Lead	mg/kg	20	1900	7600	18	14
Sb, Antimony	mg/kg	10	75	300	<0.400	<0.400
Se, Selenium	mg/kg	10	50	200	<0.400	<0.400
V, Vanadium	mg/kg	150	2680	10720	81	15
Zn, Zinc	mg/kg	240	160000	640000	34	65
Cr (IV), Chromium (IV)	mg/kg	n/a	n/a	n/a	<5	<5
F, Fluoride total	mg/kg	n/a	n/a	n/a	196	396
CN total, Cyanide total	mg/kg	n/a	n/a	n/a	<0.5	<0.5

Table 10-25: LCT classification

Parameter	Unit	LCT0	LCT1	LCT2	LCT3	WRDS1	WRDS2
As, Arsenic	mg/l	0.01	0.5	1	4	<0.001	0.003
B, Boron	mg/l	0.5	25	50	200	0.235	0.037
Ba, Barium	mg/l	0.7	35	70	280	0.105	<0.025
Cd, Cadmium	mg/l	0.003	0.15	0.3	1.2	<0.003	<0.003
Co, Cobalt	mg/l	0.5	25	50	200	<0.025	<0.025
Cr total	mg/l	0.1	5	10	40	<0.025	<0.025
Cr (IV), Chromium (IV)	mg/l	0.05	2.5	5	20	<0.010	<0.010
Cu, Copper	mg/l	2	100	200	800	<0.010	<0.010
Hg, Mercury	mg/l	0.006	0.3	0.6	2.4	<0.001	<0.001
Mn, Manganese	mg/l	0.5	25	50	200	<0.025	<0.025
Mo, Molybdenum	mg/l	0.07	3.5	7	28	<0.025	<0.025
Ni, Nickel	mg/l	0.07	3.5	7	28	<0.025	<0.025
Pb, Lead	mg/l	0.01	0.5	1	4	<0.010	<0.010
Sb, Antimony	mg/l	0.02	1	2	8	0.001	<0.001
Se, Selenium	mg/l	0.01	0.5	1	4	<0.001	0.002
V, Vanadium	mg/l	0.2	10	20	80	<0.025	<0.025
Zn, Zinc	mg/l	5	250	500	2000	<0.025	<0.025
Chloride as Cl	mg/l	300	15000	30000	120000	4	<2
Sulfate as SO_4	mg/l	250	12500	25000	100000	35	15
Nitrate as N	mg/l	11	550	1100	4400	<0.1	<0.1
F, Fluoride	mg/l	1.5	75	150	600	0.3	<0.2
CN total, Cyanide total	mg/l	0.07	3.5	7	28	<0.02	<0.02

10.9.6 Numerical Model

A numerical model was developed by IGS (2018) for Mooikraal and the model outcomes are summarized in this Section. The model was developed to predict the potential impact posed by the underground mining and associated activities with regards to groundwater flow, mine inflows and possible decant over the period depicted in Figure 10-42. It is important to note that the groundwater model was conservative with regards to the groundwater flow and contamination plume migration. Therefore the results presented are a worst-case scenario for the potential impacts to the surface water and shallow aquifer.

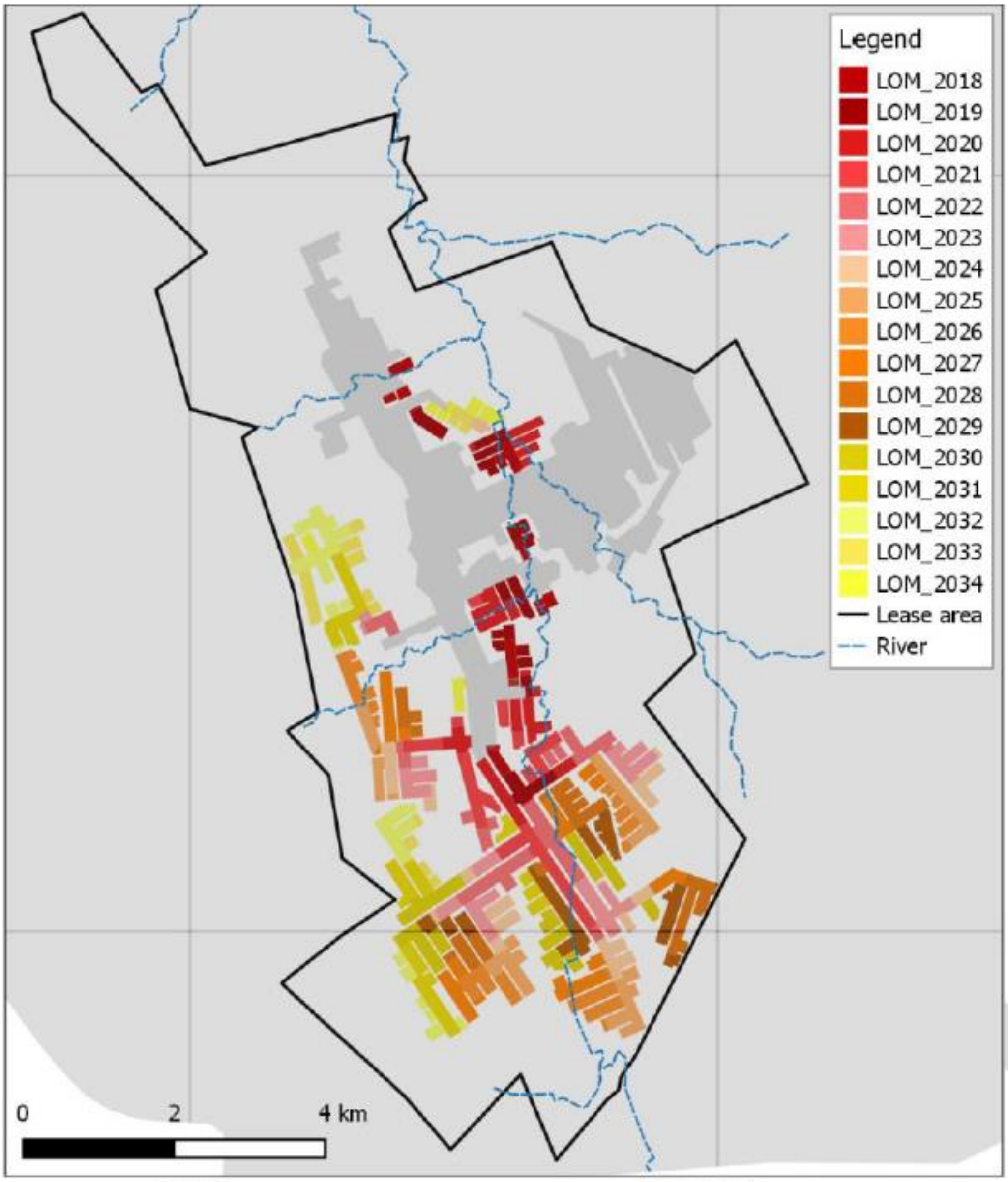


Figure 10-42: Life of Mine (IGS, 2018)

10.9.6.1 Model Setup

The model domain was defined by the western, southern and eastern boundary of the catchment divide of C23B quaternary catchment, while the northern boundary is defined by tributaries flowing towards the Kromelmboogspruit. The hydrostratigraphic units (and the properties) incorporated into the model are those discussed in Section 10.9.1. A simplified image is shown in Figure 10-43.

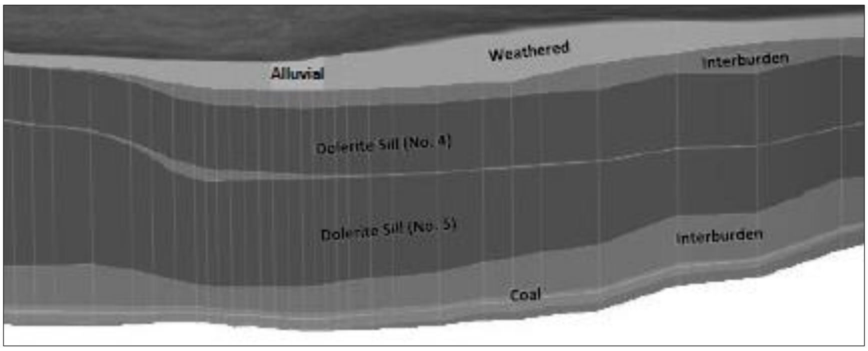


Figure 10-43: Simplified hydrostratigraphic units

10.9.6.2 Model Calibration

Model calibration was conducted to create the best possible representation of site conditions within the constructed numerical model. This task provides for predictive results that are within a reasonable range. Calibration was conducted by altering the aquifer properties (i.e. hydraulic conductivity, porosity, storativity and recharge) in order to achieve good correlation between observed water levels generated within the model and water levels measured on site.

Steady state calibration was conducted using groundwater levels measured during 2002 and 2003, before dewatering commenced. Transient state calibration was conducted using water levels measures and dewatering rates during the operational years from 2004 to date (2018).

10.9.6.3 Model Results

The numerical model was simulated for the operational and post-closure phase of the operation based on the current activities being undertaken at Mooikraal. The results of the model are presented in the Impact Assessment (Section 11.1.5) below.

10.10 Air Quality

An Air Quality Impact Assessment (AQIA) was undertaken by Airshed Planning Professionals (Pty) Ltd specifically to assess air quality associated with activities at the 3 Shaft area. The AQIA is appended to this report as Appendix 9. To establish the background ambient air scenario a desktop assessment was carried out and including the following information:

- Meteorological and ambient air quality data from the nearby Department of Environmental Affairs (DEA) Zamdela ambient monitoring station (located approximately 1.8 km from the project area) for the period 2014 – 2016;
- Applicable legal context and health implications of pollutants, namely: NEMAQA as well as the National Dust Control Regulations, 2013 (NDCR), the National Ambient Air Quality Standards (2009) as well as Standards/Guidelines set by the World Health Organisation (WHO) for Air Quality and health aspects of air pollution; and
- Dust fallout monitoring network monthly monitoring results of three single dust fallout units from the Sasol Sigma Colliery (2017 – 2018).

Further detail pertaining to the methodology of the Assessment as well as the applicable legislation and standards is provided in the specialist report, Appendix 9.

10.10.1 Baseline Results

A total of 33 sensitive receptors were identified in the vicinity of the project (10-by-10 km domain). These receptors include schools, hospitals, clinics and residential areas of Zamdela to the southeast and Sasolburg to the north. Other receptors, namely the ambient monitoring stations, dust fallout sampling point locations were also included.

10.10.1.1 Existing Sources of Emissions

The main sources of emissions in the study area region are petrochemical processes which, according to the Vaal Triangle Priority Area Baseline Study (2007), account for more than 90% of the Sulphur Dioxide (SO_2), Nitrogen Monoxide (NO) and Nitrogen Dioxide (NO_2) in the project area.

For Particulate Matter (PM), mainly PM_{10} emissions, petrochemical processes contribute 70% and mining activities contribute approximately 18% while the remaining contribution comprises secondary sources i.e. domestic fuel burning, fugitive emissions from opencast coal mining, windblown dust from ash dumps and vehicle tailpipe emissions.

Agriculture is also a dominant land use within the area for which PM is the main pollutant of concern. PM emissions derive from windblown dust, burning crop residue and dust entrainment from vehicle movement along dirt roads.

10.10.1.2 Monitored Ambient Concentrations and Dust Fallout Levels

10.10.1.2.1 Ambient Air Monitoring

Figure 10-44 and Figure 10-45 below summarise the PM_{10} concentrations observed at the DEA Zamdela ambient monitoring station for the period 2015 – 2017. The concentrations were measured against the National Ambient Air Quality Standards (NAAQS) which stipulates an average of four daily exceedances of 75 µg/m³ limit value. As shown in Figure 10-44 the daily 99th percentiles for PM_{10} exceed the limit value (75 µg/m³) at Zamdela station for all three years where non-compliance varied between 15% and 30% of the three years assessed.

Figure 10-45 shows the time variation plots of ambient particulate matter (PM10 and PM2.5) concentrations measured at Zamdela station over daily, weekly and annual cycle. Monthly variation of particulate matter shows elevated concentrations during winter months due to the larger contribution from domestic fuel burning, dust from uncovered soil and the lack of the settling influence of rainfall.

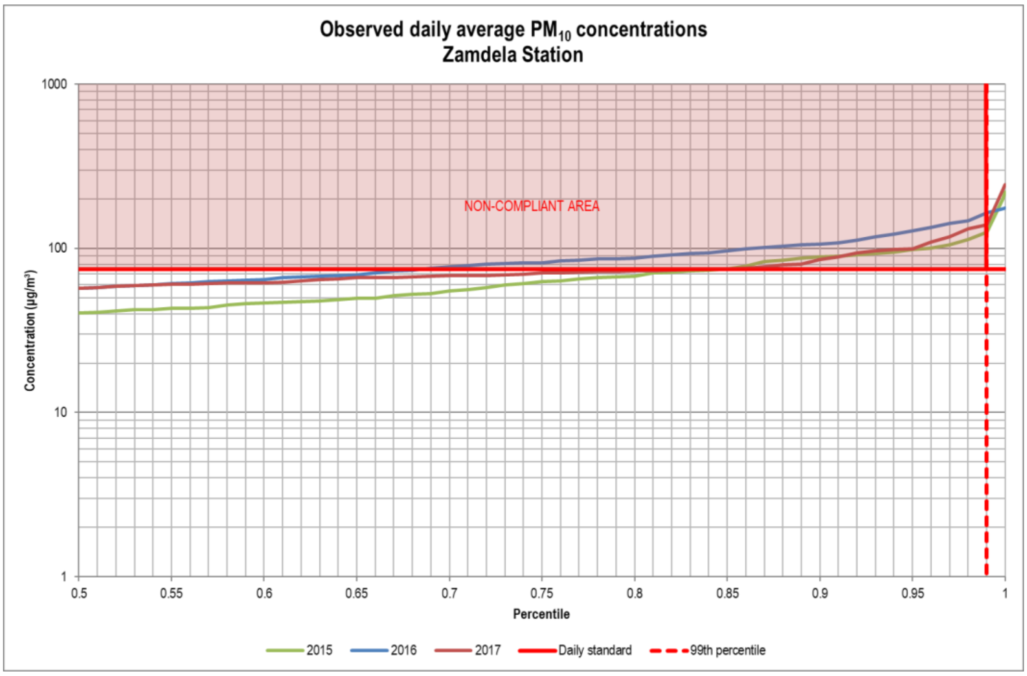


Figure 10-44: Observed daily average PM10 concentrations at Zamdela

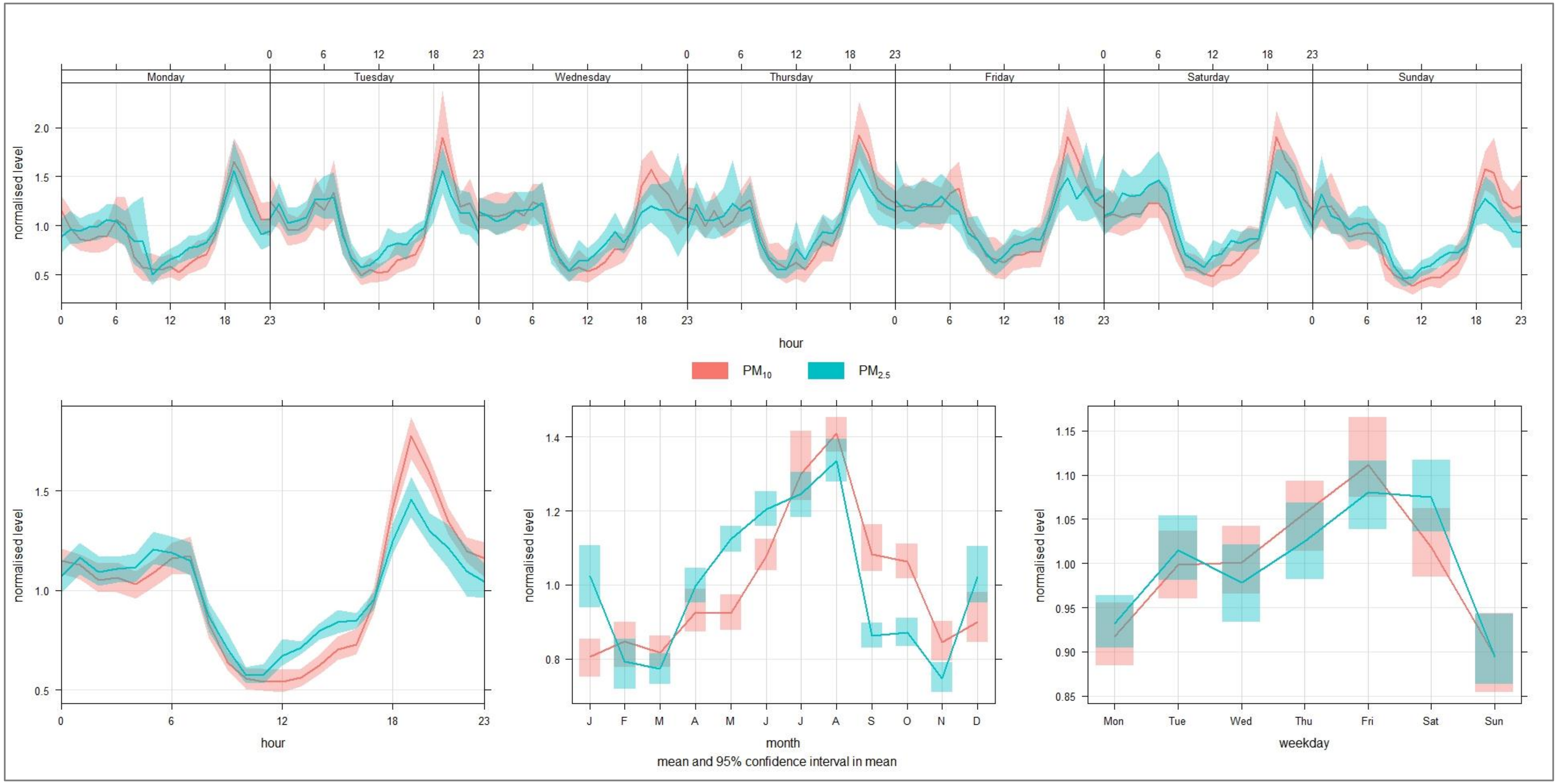


Figure 10-45: Time variation plot of normalised observed PM_{10} and $PM_{2.5}$ concentrations at Zamdela

10.10.1.2.2 Dust Fallout Monitoring

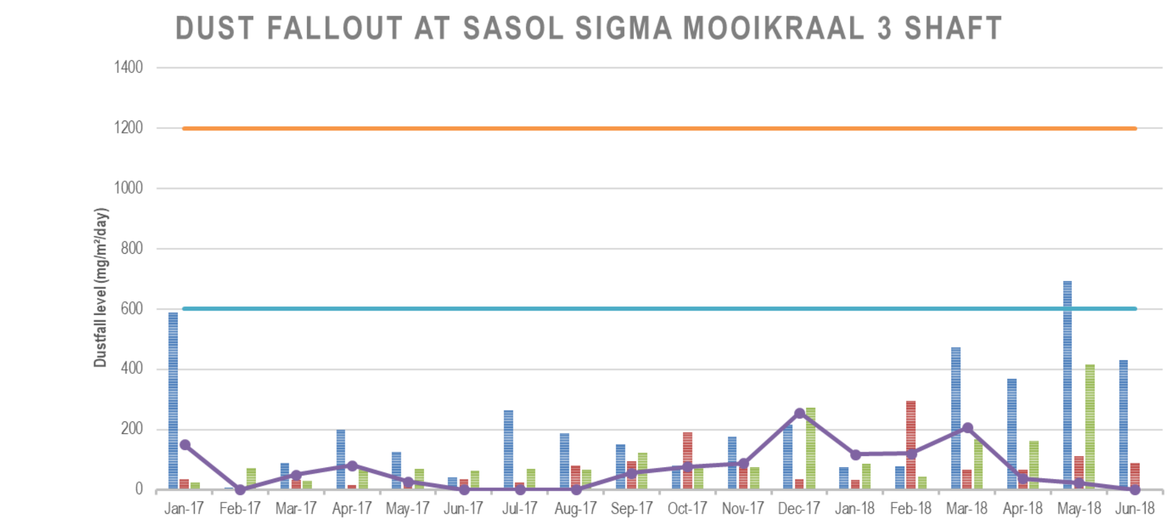
The dust fallout monitoring sites assessed are depicted in the figure below at the 3 Shaft area. Monitoring of these sites has been continuously undertaken since August 2012.

Figure 10-46: Dust fallout sampling sites

As shown in Figure 10-46, the dust fall sampling sites are located in close proximity to the 3 Shaft Complex, with SOS-01 located next to the haul road to the north of the coal stockpile, SOS-02 located 600m southeast from the existing primary plant, and SOS-03 located directly south of the coal stockpile. The closest residential area is the town of Zamdela, located 200m to the east of the project site.

During 1 January 2017 to 30 June 2018, dust fallout rates never exceeded the 1 200 mg/m^2/day limit for non-residential areas at any of the sites, nor the residential limit of 600 mg/m^2/day except during the May 2018 sampling period at SOS-01 (Figure 10-47). Dust fallout rates were low overall, with the highest dust fallout rates measured during the May 2018 sampling period when dust fallout rates were noticeably higher than the other months. The reason for this is not clear. The highest dust fallout rate over the eighteen months is 693 mg/m^2/day collected at SOS-01 during the May 2018 sampling period (the only time it exceeded the residential limit) with the lowest of 6 mg/m^2/day (at SOS-01 and SOS-02) in February 2017. The average dust fallout rate over the eighteen months is 140 mg/m^2/day.

To assess or identify trends in dust fallout rates, a box-and-whisker plot is included in Figure 10-48. A box-and-whisker plot shows the median, the upper quartile (25% of data greater than the median), lower quartile (25% of data less than the median), and the minimum and maximum values. From Figure 10-48 it is apparent that there is an upward trend in the data, and that dust fallout at SOS-01 is consistently higher than the other two sampling sites.



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18
SOS 01	587	6	88	198	126	42	265	187	151	81	175	216	76	77	473	369	693	431
SOS 02	34	6	31	16	35	35	25	80	94	189	74	35	33	294	66	67	110	90
SOS 03	24	72	29	67	70	64	70	67	122	82	75	271	85	43	169	163	415	
Rainfall	150	0	49.5	81	27	0	0	0	56	77	88	256	117	120	207	37.5	23	0
Residential limit	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Industrial limit	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200

Figure 10-47: Sampled dust fallout rates for the period January 2017 to June 2018

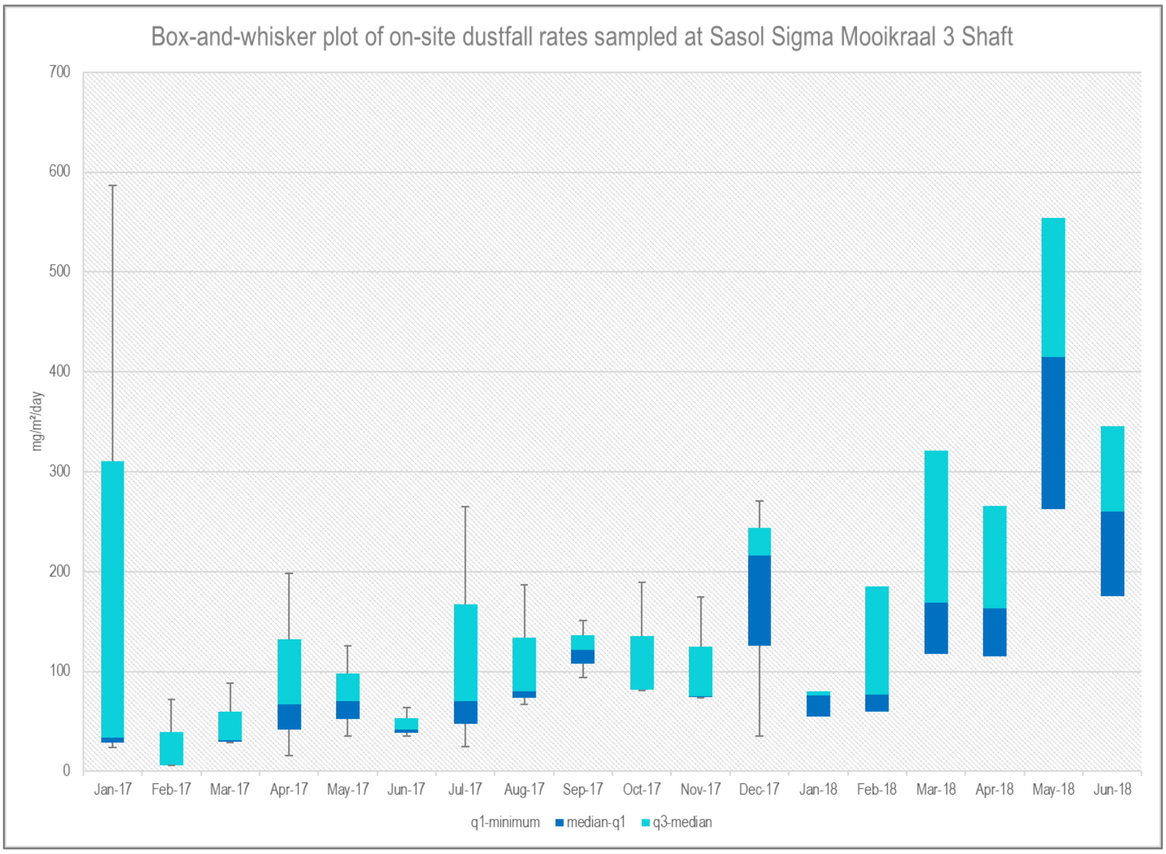


Figure 10-48: Box-and-whisker plot of on-site dust fallout for the period January 2017 to June 2018

10.11 Noise

The Noise Assessment is appended to this report as Appendix 10. To establish the background noise condition the following methodologies were employed:

- **Desktop Assessment** – a literature review and desktop assessment of the applicable Noise Regulations was undertaken. Furthermore, the guidelines provided by SANS 10103:2008 "The measurement and rating of environmental noise with respect to annoyance and to speech communication" were reviewed for the assessment.
- **Fieldwork** – A site visit was undertaken during August 2018, where noise measurements were taken at four sites which were chosen to represent the closest receptors to the proposed project activities. The measurements were taken for a 24-hour period at each location, taking into account the daytime as well as night time noise characteristics
- **Noise Quantification** – Predictive modelling was performed for the proposed mining activities through the use of the modelling software SoundPLAN®. The software

specialises in computer simulations of noise pollution dispersion. Estimates of the cumulative mining noise levels from the study were derived from the noise emissions from all the major noise-generating components and activities of the proposed project.

Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 10.

10.11.1 Baseline Results

The noise meter recording as well as the rating limits according to the SANS 10103:2008 guidelines are presented in Table 10-26. Refer to Plan 20, Appendix 2 for the sample locations.

Table 10-26: Results of the Baseline Noise Measurements

Sample ID	SANS 10103:2008 Guidelines						
	Type of district	Period	Distance from mine (m)	Acceptable rating level dBA	L_{Aeq} dBA	Maximum/Minimum dBA	Date
N1	Urban	Daytime	2000m from Mooikraal	55	56	82/40	27/08/2018
		Night time		45	45	61/27	27/08/2018
N2	Rural	Daytime	1300 from 3 shaft	45	46	78/19	28/08/2018
		Night time		35	46	72/21	28/08/2018
N3	Urban	Daytime	760 from 3 shaft (stockpile handling area)	55	60	89/40	29/08/2018
		Night time		45	53	66/47	29/08/2018
N4	Urban	Daytime	160 from 3 shaft (stockpile handling area)	55	58	77/41	30/08/2018
		Night time		45	58	74/51	30/08/2018
	Indicates current L_{Aeq} levels above either the daytime rating limit or the night time rating limit						

10.11.1.1 Daytime Results

Based on the daytime results, the existing ambient sound levels are above the SANS 10103:2008 guidelines for both districts (rural 45 dBA) and urban (55 dBA).

The average noise level (LAeq) measured at N1 and N2, varied from 46 dBA to 56 dBA where the main sources impacting on the measurements were produced by farm vehicles, mechanical workshop and cattle.

At N3, the average noise level was around 60 dBA and the main source of noise included vehicles and socialising activities while at N4, the average noise level was around 58 dBA where the main source included vehicles and sirens operating at 3 Shaft.

10.11.1.2 Night Time Results

Based on the night time results, the existing ambient sound levels are above SANS 10103:2008 guidelines for rural district (35 dBA) and urban district (45 dBA) respectively.

The average noise level (LAeq) measured at N1 was 45 dBA. The main continuous noise sources were vehicles and cattle. At N2, the average noise level (LAeq) was 46 dBA and is attributed to intermittent noise source mainly coming from 3 Shaft activities and wind gusts.

At N3, the average noise level (LAeq) was 52 dBA, the peaks measured were caused by socialising activities from people living near the school while at N4, the average noise level (LAeq) measured was 58 dBA with vehicles and siren noise coming from 3 Shaft operations.

10.11.1.3 Site Sensitivity

In terms of the current location and infrastructure layout of the proposed amendments, it is not expected that there is any noise sensitive or 'No-Go' areas that would affect the chosen location and layout. The reason for this is that the likely quantified noise levels from the area and linear (conveyor infrastructure) developments of the project will not increase the current measured soundscape due to the decibel scale being logarithmic and cannot just be added as normal arithmetic.

10.12 Heritage

A HRM Process has been undertaken for the proposed project with the specific aim of detailing any identified heritage resources within the specific project area which may be disturbed. The following methodology was employing in the undertaking of the assessment:

- **Desktop Assessment** – information was gathered and reviewed relating to known archaeological and heritage resources within and surrounding the project area. This included a desktop study comprising a review of existing heritage assessments undertaken for Mooikraal and an integration of applicable legislation and regulations.
- **Field survey** - A physical pedestrian survey was conducted in August 2018 and aimed at visually recording the current state of culture landscapes, locating and describing heritage resources falling within the project area.

Due to the disturbed nature of project area and extensive assessments previous conducted, no further heritage assessment in terms of Section 38 of NHRA has been deemed necessary. The HRM Process has therefore been limited to the submission of a Notification of Intent to Develop (NID) and Request for Exemption (RfE) to SARHA (case number 12401). This NID and RfE are appended to this report as Appendix 11.

Heritage resources were identified during the pre-disturbance survey, however no direct interaction with the proposed project activities as discussed in Section 5.2.2 above are envisaged.

The subsections below provide the cultural heritage baseline description applicable to the regional and local study area. Furthermore, a description of the identified heritage resources in relation to the project area is provided.

10.12.1 Archaeological Context

A HRM Process was previously undertaken for the Sasol Mining Sigma Colliery Ash Backfilling Project during March 2014. The subsections below provide a summary of the archaeological baseline included in this process as it is applicable to the local study area of this project.

10.12.1.1 Local Geology and Palaeontological Potential

The lithologies of the Ecca Group in the study area are associated with the Vryheid Formation. The Vryheid Formation consists of sandstone, shale, mudstone and coal, and is renowned for its wealth of plant fossils, specifically the Gondwana *Glossopteris* flora. These fossils have been described from Permian aged rocks (Rubidge, 2008).

Important plant fossil localities have previously found in areas close to Vereeniging. Seward (Fossil floras of Cape Colony, 1903), for example, described impression fossils of the plant *Bothrodendron leslii*. Similarly, Rayner (The Permian Lycopod Cyclodendron Lesilii from South Africa, 1985) also described lycopods such as *Cyclodendron leslii* found close to Vereeniging.

10.12.1.1.1 The Stone Age

Evidence for the three phases of the Stone Age (i.e. Early (ESA), Middle (MSA) and Late (LSA)) has previously been recorded in the Free State Province. The majority of identified Stone Age sites have been limited to lithic scatters dating to the MSA (±250 000 to 20 000 year ago (ka) (CE)) and LSA.

In the local context, the LSA ‘package’ of tools is rock art (Deacon & Deacon, 1999) is applicable. Directly of current operations, the rock engraving site of Leeuwkuil is located. Hollmann (1999) described the sites as being located on a small island in the Vaal River where engravings are concentrated on the south-eastern part of the peninsula. Eland and other antelope dominated the images depicted, which appeared to be in the San hunter-gatherer engraving tradition (Hollman, 1999). Pistorius (2007) discusses the Redan rock engraving site which contains as many as 244 rock engravings depicting animals, geometric designs and in some instances San weapons.

10.12.1.1.2 The Iron Age

Based on Maggs' 1974 settlement distribution map (Maggs, Iron Age Communities of the Southern Highveld, 1976, pp. 38 - 39), no Type V sites have been recorded in the project area, but two 'Vredefort Dome/Type Z' sites are recorded nearby (Van Schalkwyk & Naude, 1996). No additional sites associated with the southern African Iron Age have been identified in the region in any of the reports reviewed for this project. This can be attributed to the reasonably unfavourable natural environment. No sites associated with the southern African Iron Age have been identified in the region in any of the reports reviewed for this project. This can be attributed to the reasonably unfavourable natural environment.

10.12.1.1.3 The Colonial and Historical Period

From the reviewed historical maps, it is evident that that infrastructure development increased in the local study area. Most notable in the 1902-1909 and 1910-1911 maps are the expansion of the railroad and road network (See Figure 10-49 to Figure 10-51).

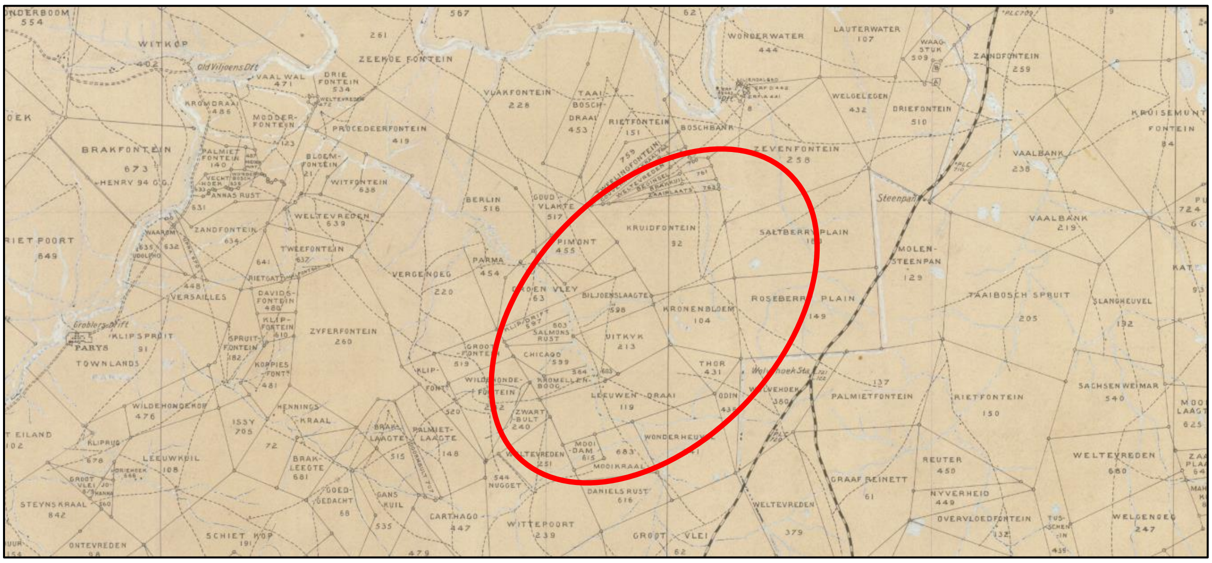


Figure 10-49: Extract from the 1902-1909 Transvaal Degree Sheet. Approximate project area indicated.

Having noted this, no major nodes are established in the local study area. During this time, it would appear that Viljoendrift (Figure 10-50) is the primary node based on the several features evident on the maps such as a post office, court house, railway station, and the Cornelia Coal Mine. The closest area of development in close proximity to the proposed pipelines was the establishment of a railway station, post office and school at Wolwehoek (See Figure 10-50 and Figure 10-51).

Heritage resources associated with the colonial and historical period are limited to built structures and burial grounds. The common agreement amongst the authors is that the identified built structures are of low significance.

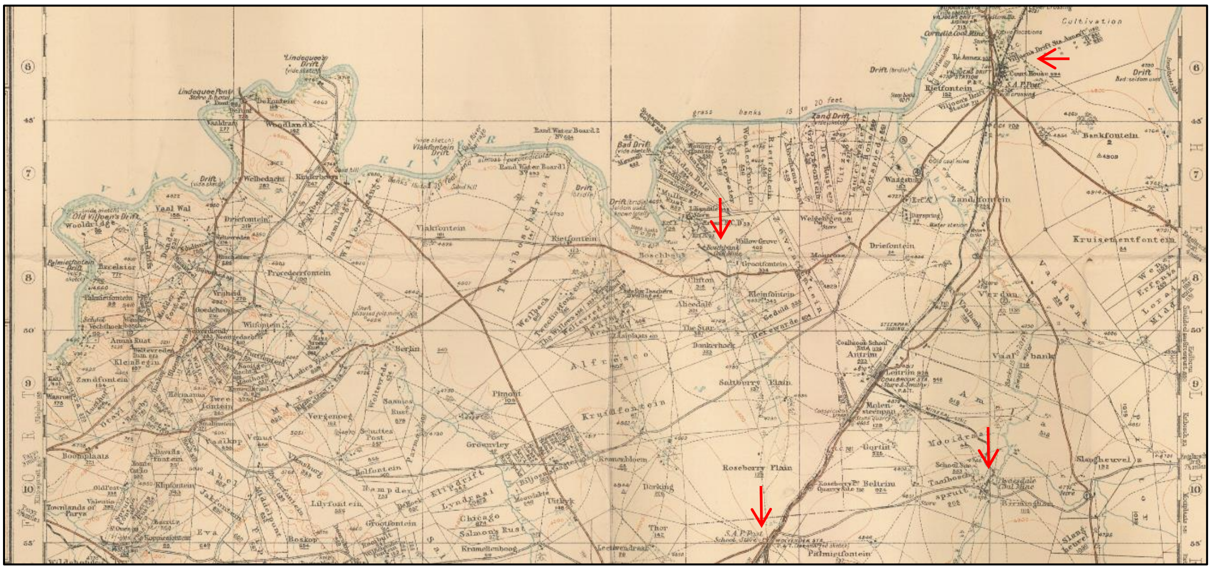


Figure 10-50: Extract from the Free State GSGS 1905-1911 Series. Note Viljoendrifts in the north, established coal mines, and station and school at Wolwehoek

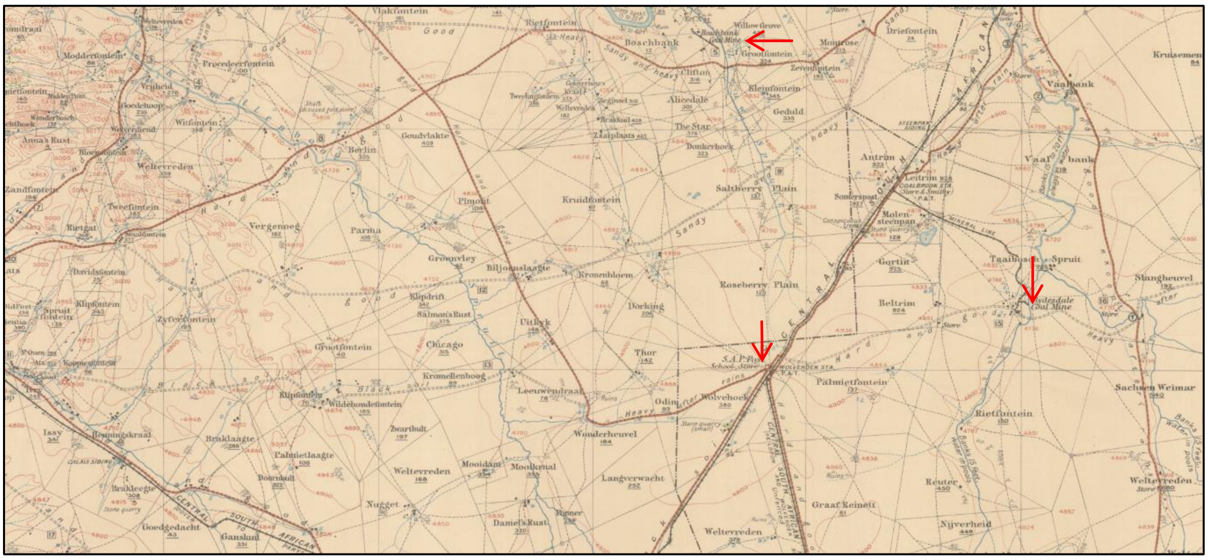


Figure 10-51: Extract from the Transvaal GSGS 1910-1911 Map. Note the expansion of infrastructure and the established mines indicated.

10.12.2 Identified Heritage Resources

The surface was heavily disturbed through animal activity, such as mongoose burrows. Table 10-27 presents a list of the heritage resources identified during the pre-disturbance survey which are illustrated on Plan 21, Appendix 2. Figure 10-52 presents photographs of some of these heritage resources.

Table 10-27: Heritage Resources identified through the pre-disturbance survey

Site Name	Description
STE-001	Rubble in the shape of a polygon, which may represent a historical structure. The rubble is surrounded by very large exotic trees which have been felled, and some glass of an unknown age was noted on site. Graves occur nearby. It is likely this structure was older than 60 years.
BGG-001	Potential unmarked graves or structural remains. A small tree has grown over this heritage resource and so sets of straight, parallel brick lines are visible, with no headstones or other surface indicators visible.
BGG-002	Burial ground demarcated by a rusted and damaged wire fence, which includes a decorative gate. Five graves are visible, of which four have headstones. One grave is a double grave (which appears to be a mother and a daughter, dating to 1921 and belonging to the Scholtz family) and one may be a child grave. Seven exotic trees have been planted in a row along the fence.
BGG-003	Burial ground with a fence running through. This burial ground is very close to BGG-001. In total, this burial ground includes 32 visible graves, but there may be more. On the same side of the fence as BGG-001, nine graves have headstones, which date between 1952 and 1995. The following surnames were legible: Selikane and Nabileyo. Many of the headstones appear to have been painted silver. On the either side of the fence, one grave has a headstone, but this has broken off and is not legible. The other graves are demarcated by stone piles. Grave goods, including enamel mugs, seashells, decorative ceramic items, jars and shells are present.
WF-001	Abandoned werf with many buildings in various states of disrepair, including a barn. Age of the werf is not known.
STE-002 A, B and C	Three of four points where historical drilling took place to establish boreholes. One of these holes has since been closed up. The other two points are in areas that are now cultivated. Mr. Oosthuizen could not remember where the fourth point was.
BGG-004	At least three, but possibly five, graves demarcated by stone and soil piles in an agricultural field near the fence line. These graves have no headstones.
BGG-005	Single grave with a marble headstone and a concrete slab. The headstone has fallen over but is still legible. The surname on the headstone is van der Westhuizen and the date is 1939. This grave is adjacent to foundations of what was a square sub-divided structure approximately 10 m by 10 m.
WF-002	Abandoned werf of unknown age. The werf includes four reservoirs, a barn, grain silo and several outbuildings. The werf is close to the current farm house.
BGG-006	Single grave in a field. The grave had a granite headstone and fittings, but no additional information is available because the field was fenced off.
BGG-007	Burial ground including twelve visible graves. The burial ground is demarcated by a well-kept fence and damaged gate. Two of the graves have granite headstones and

Site Name	Description
	fittings, both of which belong to children of the Els family. These graves are dated to 1929 and 1976. All other graves are demarcated by stone and soil piles and have upright stones as headstones.
STE-003	Abandoned building which appears to be made of sandstone inside a copse of exotic trees. Age of structure is unknown. Corrugated tin roof still present and one electrical fitting. Walls are plastered and painted and are covered in graffiti. Only one outside door remains, all other doors have been removed.
BGG-008	Burial grounds next to the road and next to a field. Not demarcated. Burial ground includes 34 visible burials, but there may be more. Half of these graves have headstones, which include granite or cement. Grave fittings include granite, brick, cement edging or slabs and ceramic tiles. The other graves are demarcated by stone and soil piles. Grave goods include enamel mugs, glasses and bottles. Thirteen graves have fenced off in various ways. The graves date between 1980 and 2002. Legible surnames include: Letoane (three graves fenced off from the other graves), Mofokeng, Tsime, Tsimong, Pani, Podile, Nkuna and Rafube.
WF-003	Werf including the farmhouse, barn, shed, reservoir, dam and windmill. Appears to be historical. The farmhouse appears to have several building phases and may have originally been made of sandstone. The doors, glass and roof is missing, but the wooden lintels remain. The barn and shed have retained their roofs. The shed has since been silted up with sand (animal activity may have contributed, as there is a burrow inside the shed and many porcupine quills around). The barn is being used as storage. The werf is surrounded by large exotic trees, including pine.
WF-004	Abandoned werf, including four reservoirs, a barn (or abattoir), an additional barn (or chicken house) and an outbuilding. The chicken house is in a state of disrepair and the roof is collapsing. The outbuilding connected to the chicken house has lost its roof. The roof is intact on the other barn, which is used for storage (animal feed and tyres). Some of the buildings of this werf are visually similar to WF-003 and may be related.
BGG-009	Burial ground demarcated by a fence. The corners include three large fir trees and the gate. The burial ground includes five visible graves, of which four have headstones. Two headstones are legible and date to 1957 and 1958. These belong to the De Kock and Malan families. The other two headstones are partially visible and read De Kock and Oosthiuzen. No dates were visible.

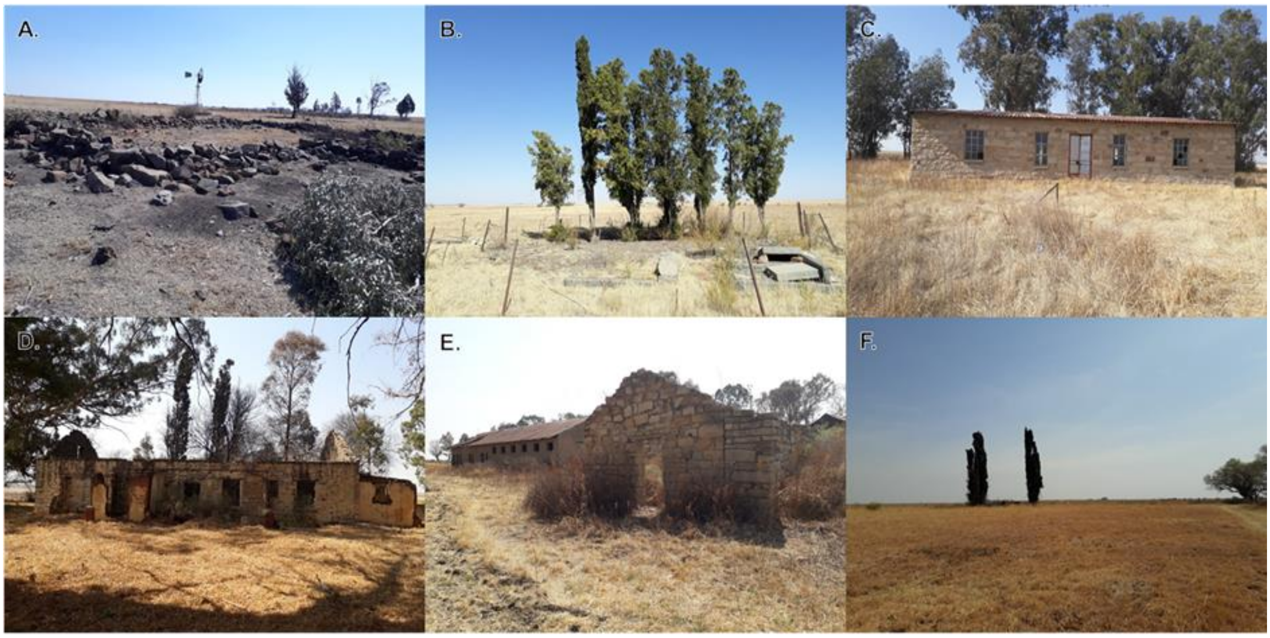


Figure 10-52: Photographs illustrating heritage resources identified in the Project area

A.) STE-001; B.) BGG-002; C.) STE-003; D.) Farmhouse at WF-003; E.) Outbuilding attached to chicken house at WF-004; and F.) Three tall exotics marking BGG-009

During the pre-disturbance survey, the heritage specialist could not access the following farms: Mooikraal 355 (Remainder), MG No. 1, Sub-division 2 of Ailette 351 and Ponner 259. The Project survey manager and draughtsman were aware of heritage resources on these properties and, subsequent to the pre-disturbance survey, provided the localities of these resources. Table 10-28 provides a summary of these heritage resources. Plan 21, Appendix 2 includes these heritage resources, which have been highlighted in red to distinguish these heritage resources from those identified by the heritage specialist.

Table 10-28: Heritage resources identified by Sasol Personnel

Farm	Heritage Resources
Mooikraal 355 (Remainder)	Gravesite 2 and Abandoned Dwelling 2
MG No. 1, Sub-division 2 of Ailette 351	Gravesite 1 and Abandoned Dwelling 1
Ponner 259	No heritage resources identified

10.13 Social

A Social Baseline Profile has been compiled for this project and is appended to this report as Appendix 12. A desktop review was conducted to establish the baseline profile. Information utilised included the following key documents:

- Integrated Development Plans (IDPs) of the local and district municipalities;

- Census 2011 data, reworked according to the new 2016 municipal ward boundary delineations;
- Community Survey 2016 data;
- Previous reports concerning the same project area, specifically the Social Assessment for the proposed Sigma Colliery Ash Backfilling Project completed by Digby Wells in 2013; and
- Available maps and satellite imagery.

Further detail pertaining to the methodology of the Assessment is provided in the specialist report, Appendix 12.

10.13.1 Regional Study Area

The regional study area in this assessment comprises the FDDM, inclusive of the NLM and MLM.

The project area is located within the FDDM. The 3 Shaft area and majority of the conveyor belt / 10 Ml/day pipeline are located in the Metsimaholo Local Municipality (MLM), whereas the Mooikraal (including 7 Ml/day pipeline and ventilation shaft) and a small portion of the conveyor belt / 10 Ml/day pipeline is located in the Ngwathe Local Municipality (NLM).

10.13.1.1 Fezile Dabi District Municipality

The FDDM is one of five district municipalities in the Free State Province and covers an area of about 20 900 km^2. The approximate population of FDDM is 500 000 people which represents just less than a fifth of the Free State province’s total population. It is characterised by 38 different settlements, four of which are farming settlements, 15 formal urban towns, 17 urban townships and two informal urban settlements.

The main economic activities within FDDM is mining and agriculture with a large percentage of South Africa’s grain crops including maize, wheat and sunflowers produce in FDDM. The district municipality is also a major tourist destination as it plays host to South Africa’s 7th World Heritage Site, the Vredefort Dome. It also boasts with an array of nature reserves and the Vaal Dam, which is a main source of water (FDDM IDP, 2017-2022).

10.13.1.2 Metsimaholo Local Municipality

The MLM is located in the north-eastern quadrant of the FDDM and covers an area of about 1 720 km^2. The population size of MLM is estimated at 169 779 people (2018). The average population density is fairly low at 86.7 people per km^2, which is typical of a rural area (although it can be expected that the population density will be higher in towns, such as Sasolburg).

Sasolburg is the most prominent contributor to the local municipality's economy and is the only town in the district where the private sector dominates the public sector, due to the predominant contribution that Sasol operations make to the chemical industry. The economy is also supported by the manufacturing of a vast range of by-products, namely fuels, olefins, waxes, alcohols, tar products, inorganic chemicals, rubber, gases, plastics, fertilizers, etc. as a result of the Vereeniging-Sasolburg Coalfield.

Migration into the municipality is focused towards Sasolburg, Deneysville and Oranjeville (including their lower income residential areas) - presumably due to the existing mining activities and the proximity of these areas to retail, factory, and industrial work opportunities. The migrant population consist of mostly unemployed job-seekers from rural areas in the MLM and neighbouring municipalities. People are also moving from smaller towns in the district into Sasolburg.[2]

Coalfields are regarded as the dominant economic potential for the Sasolburg and Zamdela area, whereas agriculture is more dominant in the Oranjeville/ Metsimaholo and rural areas of the municipality (MLM IDP, 2016/17).

10.13.1.3 Ngwathe Local Municipality

The NLM is situated in the northern part of the FDDM. It covers an area of 7 066 km^2 and is home to an estimated population of 118 193 people (2018). NLM is largely rural in nature, which is evident in the population density of around 17 people per km^2. Major towns in the NLM include Parys, Heilbron, Koppies, Vredefort and Edenville.

Parys is located some 27 km west of the Mooikraal and is the closest town within the NLM to any of the Project infrastructure. The local economy of the NLM has grown at roughly the same rate of the province (3.2% per annum). Key sectors within the NLM include trade and catering, finance and business services, manufacturing, construction, government services and transport. The economic sectors employing the largest number of people are trade and catering, community services, agriculture, government and construction services (NLM IDP, 2017-2022). People in general are still fairly disconnected from economic opportunities – this is due to the geographic layout of the municipality and the subsequent lack of transport.

10.13.2 Local Study Area

The local study area is defined as Sasolburg (MLM Wards 15, 16 and 17)[3], and Zamdela (MLM Wards 2, 8, 9, 10, and 12), as displayed in Plan 22, Appendix 2. The wards have been

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[2] Metsimaholo Local Municipality. (2012). Spatial Development Framework: 2012 / 2013 (newer SDF not yet available).

[3] MLM Ward 7 has been excluded from the baseline profile as it is an industrial zone – the inclusion of this ward data could skew the residential data of the other wards.

combined for each area (i.e. Sasolburg and Zamdela) in the discussions that follow, to give an integrated overview of the area.

10.13.2.1 Population size, growth rate and migration

The MLM has a total population of approximately 169 779 people divided into just over 59 100 households. About 18% of the local municipality's population reside in the informal settlement of Zamdela. This settlement is located close to the employment opportunities offered in both Sasolburg and other areas in the Gauteng Province (such as Vereeniging and Vanderbjilpark). An additional 11% of the MLM's population resides in Sasolburg (see Table 10-29).

Table 10-29: Population size and distribution in the local study area

Area	Total population (individuals)			
	2001	2011	2016	2018 (est.)
MLM		149 107	163,564	169 910
Sasolburg (Wards 15, 16 and 17)	15 141	17 870	-	20 179
Zamdela (Wards 2, 8, 9, 10 and 12)	29 772	30 068	-	30 278

Source: Census 2011 data in Wazimap

The detailed (ward-level) population growth rate and estimate population size for 2018 is reflected in Table 10-30.

Table 10-30: Population size and distribution per ward in the local study area

Area	Total population (individuals)			
	2001	2011	Growth rate pa (%)	2018 (est.)
Sasolburg				
Ward 15	3 654	2 721	-2.6%	2 244
Ward 16	5 496	7 314	3.3%	9 082
Ward 17	5 991	7 835	3.1%	9 610
TOTAL	*15 141*	*17 870*	-	*20 936*
Zamdela				
Ward 2	6 756	6 617	-0.2%	6 524
Ward 8	6 717	6 677	-0.06%	6 649
Ward 9	4 620	5 623	2.2%	8 169
Ward 10	7 902	7 079	-1.0%	6 583
Ward 12	3 777	4 072	0.8%	4 300
TOTAL	***29 772***	***30 068***	**-**	***32 225***

Source: Census 2011 data in Wazimap

10.13.2.2 Demographic characteristics

Of the total population, 71.5% are economically active (i.e. aged between 15 and 64). There is an almost equal split between males and females in both areas, with males in the slight majority in Sasolburg (50.3%) and in Zamdela (51.7%).

Close on two thirds (61.4%) of the Sasolburg population is White, with the remaining third (36.2%) being Black African. The population in Zamdela is almost exclusively Black African (99.6%). The population group distribution for the local study area is reflected in Table 10-31.

Table 10-31: Population group distribution in the local study area

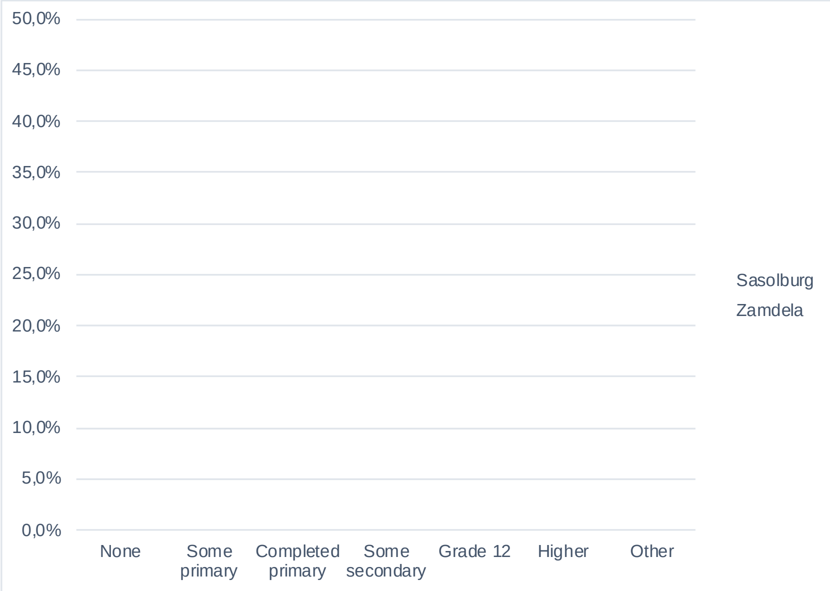
Population group	MLM	Sasolburg	Zamdela
Black African	82%	36.2%	99.6%
Coloured	0.8%	1.8%	0.2%
Indian or Asian	0.3%	0.5%	0.1%
White	16.9%	61.4%	0%
Other	0%	0.2%	0.1%
Total	**100%**	**100%**	**100%**

Source: Census 2011 data in Wazimap

Just over half of the population (59%) in Sasolburg are Afrikaans speaking, followed by Sesotho (21.3%). Most of the population in Zamdela (67.3%) speak Sesotho, followed by isiXhosa and isiZulu.

10.13.2.3 Education

The highest level of education for individuals above the age of 18 is shown in Figure 10-53. This figure shows that individuals resident in Sasolburg are better educated than those in Zamdela, where only 35.7% of individuals have either completed their secondary or tertiary education (compared to 61.7% in Sasolburg). The proportion of the population with either no schooling (5.1%), or only some primary schooling (14.5%) is also much higher in Zamdela than in Sasolburg (0.8% no schooling and 1.6% some primary).



Source: Census 2011 data in Wazimap

Figure 10-53: Education profile of the local study area

10.13.2.4 Employment and income

An overview of the employment profile for the local study area is shown in Figure 10-54. In both Sasolburg and Zamdela, a third of the population (32.6% in Sasolburg and 32.2% in Zamdela) are not economically active (i.e. either aged younger than 15 or older than 65). Just over half (57.2%) of the total population in Sasolburg are employed, with only 40% of the Zamdela population employed. Approximately 25.9% of Zamdela's total population are unemployed.

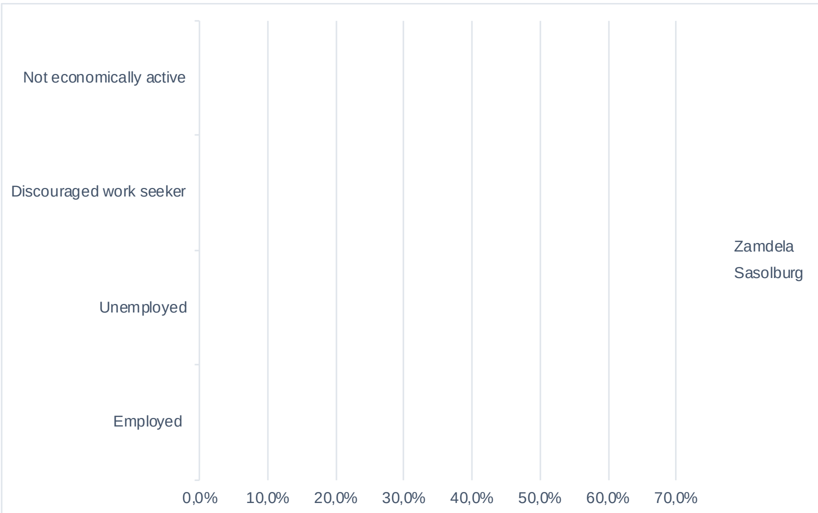


Figure 10-54: Employment profile of the local study area

Source: Census 2011 data in Wazimap

Linked to the employment profile, is the annual household income profile, reflected in Figure 10-55. From this graph it is evident that the majority of households in Sasolburg (58.9%) fall within the middle income bracket (defined as an annual household income of between R 76 801 and R 307 200 for a family of four, whereas the majority of households in Zamdela live in absolute poverty (between R0 and R 19 200 for a family of four) (42.5%) or within the lower middle income bracket (between R 19 201 and R 76 800) (37.4%).

Figure 10-55: Annual household income profile of the local study area

Source: Census 2011 data in Wazimap

10.13.2.5 Access to services

Almost all the households (99.8%) in Sasolburg live in formal dwellings, and have access to electricity, a flush toilet, a refuse removal service and piped-water from a water scheme operated by the municipality or another water services provider.

More than 90% of households in Zamdela have access to electricity, refuse removal and piped water; however, there is more informal housing in Zamdela (approximately 10% of dwellings) than Sasolburg. There is an estimated need for about 15 000 houses in Zamdela. Both Sasolburg and Zamdela are currently constrained for future growth by the undermined areas and by future mining prospecting opportunities located in and around the town. In response to the housing provision backlog, many people often are drawn to settle illegally on private or public property and provide themselves with inadequate, informal and illegal housing in informal or illegal settlements.

Figure 10-56 provides an overview of the municipal services in the local study area.

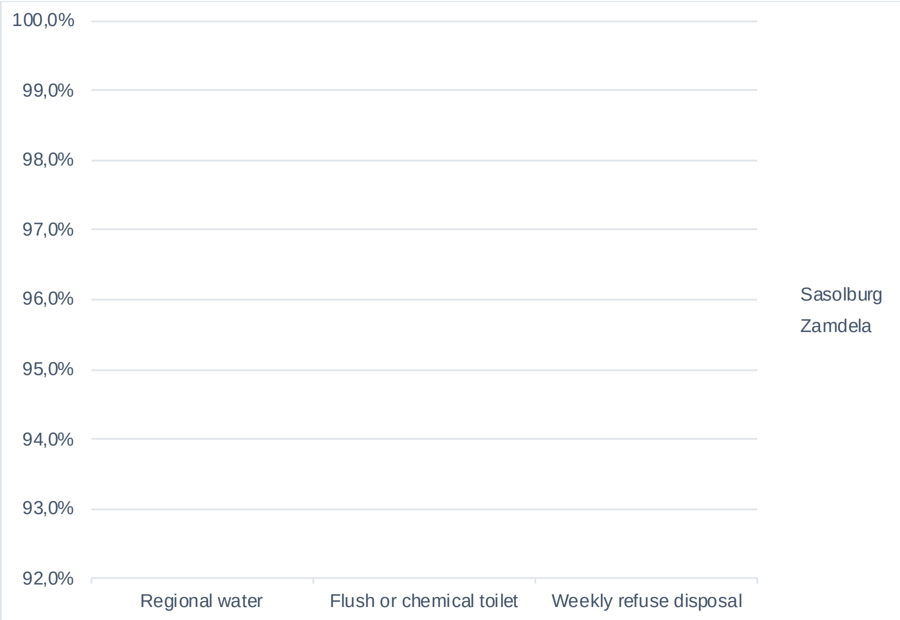


Figure 10-56: Overview of services in the local study area

Source: Census 2011 data in Wazimap

10.13.3 Site-specific study area

The site-specific study area is the area likely to experience impacts related to the physical intrusion by project infrastructure and project-related activities. This study area is defined as the municipal wards in which the proposed project infrastructure is located, namely Ngwathe Ward 7 and Metsimaholo Wards 1, 11 and 14 (refer to Plan 22, Appendix 2).

10.13.3.1 Population size, growth rate and migration

The detailed (ward-level) population growth rate and estimate population size for 2018 for the site-specific study area is reflected in Table 10-32.

Table 10-32: Population size and distribution per ward in the site-specific study area

Area	Total population (individuals)			
	2001	2011	Growth rate pa (%)	2018 (est.)
MLM Ward 1	5 915	17 558	19.7	41 770
MLM Ward 11	5 073	5 110	0.07	5 135
MLM Ward 14	8 598	9 119	0.6	9 501
Ngwathe Ward 7	6 231	10 108	6.2	14 495
TOTAL	***25 821***	***41 895***	**-**	***70 901***

Source: Census 2011 data in Wazimap

The population in MLM Ward 1 more than doubled between 2001 and 2011, giving it an annual population growth rate of 19.7%. Compared to the other wards in the site-specific study area, this is exceptionally high. To account for this rapid population growth in this ward, it has to be assumed that multiple wards were amalgamated between the two censuses, resulting in such a high population count. The 2018 estimate for this ward should therefore be read with caution as it is likely not a true reflection of the current population size.

10.13.3.2 Demographic characteristics

Of the total population, just under two thirds (64.9%) are economically active. As was the case for the local study area, there is an almost equal split between males and females, with males in the slight majority at 50.7%.

The majority of the site-specific study area is Black African (77.4%), followed by White (21.0%). The population group distribution for the local study area is reflected in Table 10-31 above.

Table 10-33: Population group distribution in the site-specific study area

Population group	MLM	MLM Ward 1	MLM Ward 11	MLM Ward 14	Ngwathe Ward 7
Black African	82%	99.1%	99.5%	20.1%	90.8%
Coloured	0.8%	0.4%	0.1%	1.5%	0.9%
Indian or Asian	0.3%	0.1%	0.0%	1.6%	0.4%
White	16.9%	0.3%	0.1%	76.3%	7.3%
Other	0%	0.2%	0.7%	0.1%	0.3%

Source: Census 2011 data in Wazimap

Just over half of the population (54.2%) in the study area speak Sesotho – the exception being Ward 14 where the majority (70.7%) are Afrikaans speaking.

10.13.3.3 Education

The highest level of education for individuals above the age of 18 in the site-specific study area is shown in Figure 10-57. Most of the residents of MLM Ward 14 completed Matric (47.8%) with close on a quarter (22.9%) that completed tertiary education. Ngwathe Ward 7 has the highest percentage of individuals who had no schooling. On average, just over a third (34.6%) of the study area completed Grade 12.

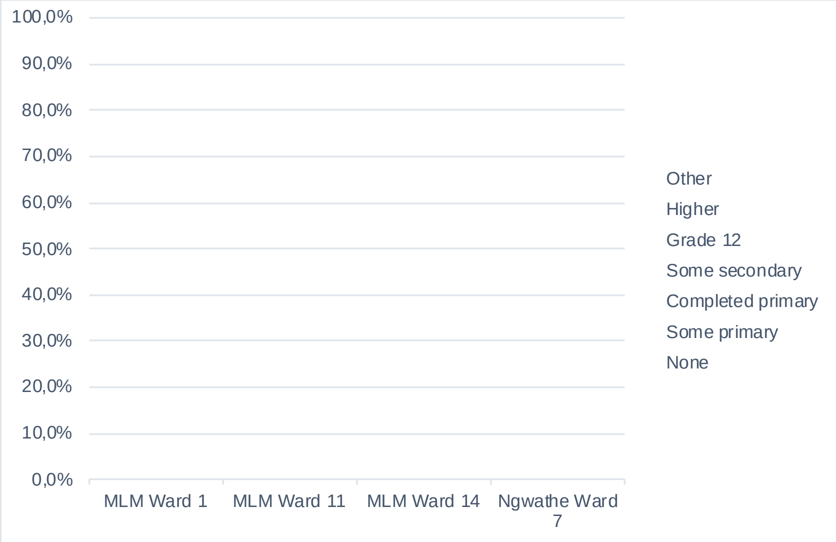


Figure 10-57: Education profile of the site-specific study area

Source: Census 2011 data in Wazimap

10.13.4 Employment and income

An overview of the employment profile for the site-specific study area is shown in Figure 10-58. MLM Ward 14 has the highest employment rate (67.5%) compared to the other three wards that have an average employment rate of around 41.5%. MLM Ward 14 also has a much lower unemployment rate when compared to the other three wards: 3.6% vs an average of 22.5%. Ngwathe Ward 7 has the highest number of discouraged work seekers at 8.3%, followed by MLM Ward 11 with 6% and MLM Ward with 4.2%.

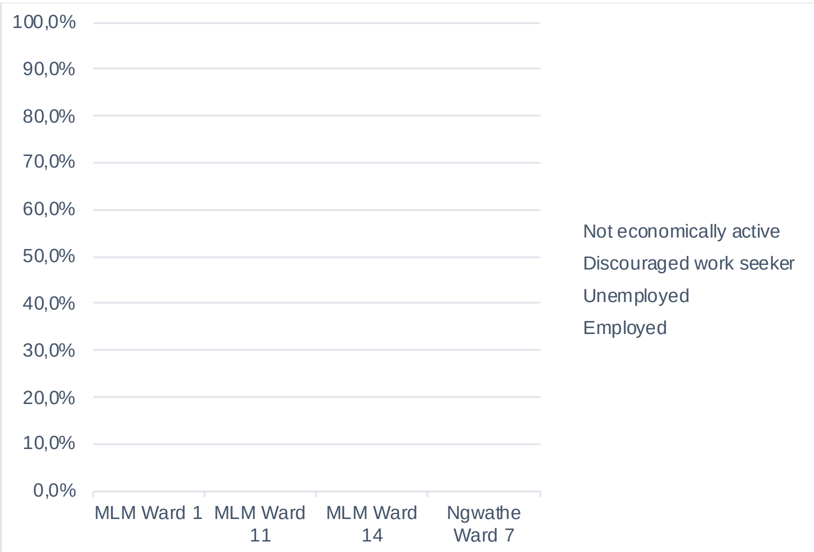


Figure 10-58: Employment profile of the site-specific study area

Source: Census 2011 data in Wazimap

The annual household income profile of the site-specific study area is shown in Figure 10-59. From this figure it is evident that MLM Ward 14 is predominantly a middle income area (58.3% of households) and also has the highest percentage of households in the higher middle income (10.7%) and high income (1.0%) brackets. More than half of the households in MLM Ward 1 (56.8%) and Ngwathe Ward 7 (56.2%) live in absolute poverty, followed by a large percentage of households in the lower middle income bracket (an average of 34.8%). The same holds true for MLM Ward 11, although it has a far lower percentage of households living in absolute poverty (27.2%) and more households in the lower middle income (46.2%) and middle income (26.5%) brackets.

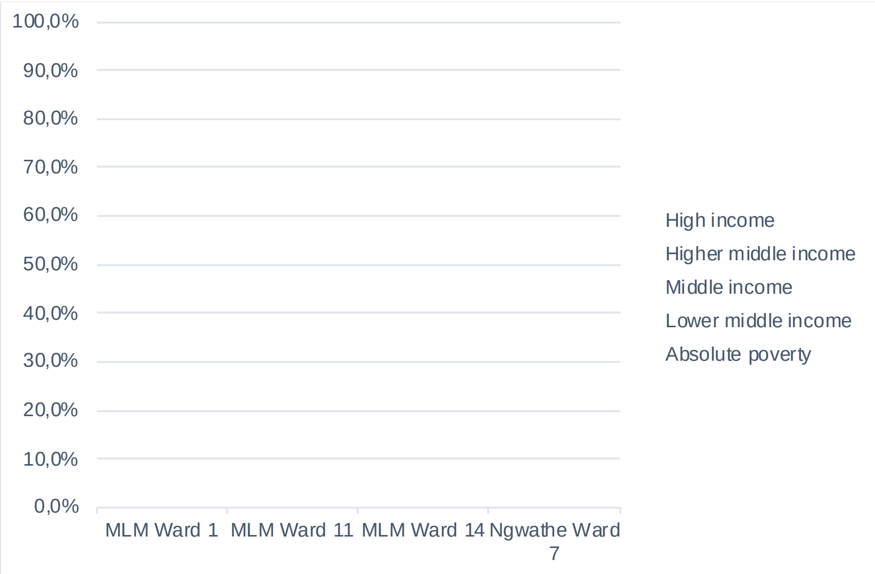


Figure 10-59: Annual household income profile of the site-specific study area

Source: Census 2011 data in Wazimap

10.13.4.1 Access to services

On average, just over a third (35.1%) of households in MLM Ward 1 and Ngwathe Ward 7 live in informal housing. This is in sharp contrast to MLM Wards 11 and 14, where the majority (98.3% on average) are living in formal housing. The housing profile corresponds with the household income profile discussed above – both MLM Ward 1 and Ngwathe Ward 7's households are predominantly living in absolute poverty so it would follow that these two wards would have a large percentage of informal dwellings.

Figure 10-60 provides an overview of the municipal services in the site-specific area. The majority of households in MLM Wards 11 and 14 (99.6% in Ward 11 and 93.8% in Ward 14) have access to municipal services – this includes piped water supplied by a local water scheme, weekly refuse disposal and access to a flush or chemical toilet (i.e. a sanitation service at least RDP level). Although most of MLM Ward 1's households have access to piped water, very few have access to RDP sanitation services (only 4.5%) or weekly refuse disposal (9.8%).

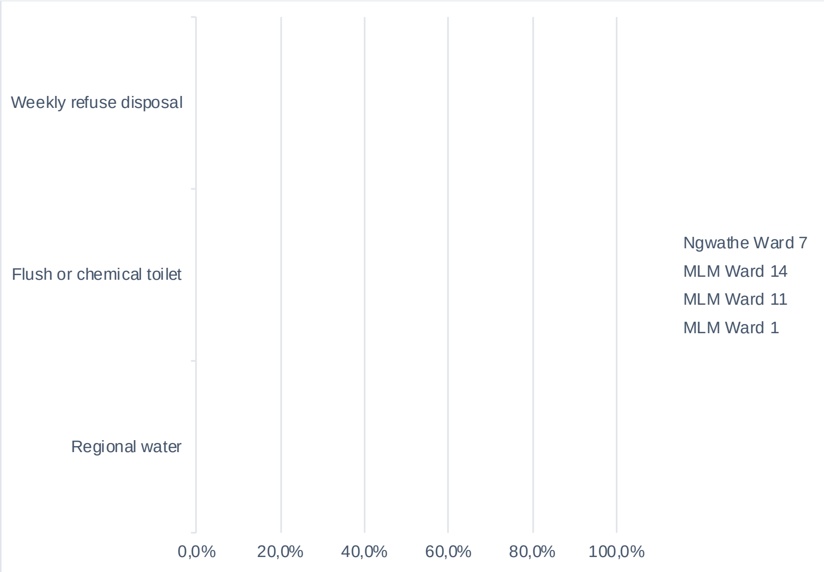


Figure 10-60: Overview of municipal services in the site-specific study area

Source: Census 2011 data in Wazimap

11 Item 3(g)(v): Impacts and Risks Identified including the Nature, Significance, Consequence, Extent, Duration and Probability

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation.

The Impact Assessment provided in Section 11.1 only considers impacts associated with the proposed new activities trigged as indicated in Section 5.2.2.

The potential impacts of activities associated with the Current Mooikraal Operation (discussed in Section 5.2.1 above) were assessed and approved as part of the Mooikraal EMPr (2014) and Basic Assessment process for the 7 Ml/day and 10 Ml/day pipeline Environmental Authorisation application (2014). However, as the mining operation progresses impacts to the various environmental aspects may occur and therefore these impacts have been assessed for the operational and decommissioning phases as shown in Section 11.2. It must be noted that no impacts for the construction of the mine as well as mining activities that have already occurred have been assessed.

The EMPr included as **Part B** of this report includes all activities (current and those now proposed) as part of the Regulation 31 Amendment Process to enable Mooikraal to have one consolidated EMPr to use as a tool against which potential environmental impacts are managed.

The potential impacts identified in this section are informed by the baseline investigations presented in Section 10 above and are a result of both the environment in which the project activity takes place, as well as the activity itself. The potential impacts are discussed per environmental feature/aspect and according to each phase of the project i.e. the Construction, Operational and Decommissioning and Closure Phases.

11.1 Identified New Potential Impacts (3 Shaft)

The subsections below provide the identified potential impacts for the environmental aspects investigated as part of the Regulation 31/Basic Assessment Process for each project phase. Furthermore the significance, extend, duration and probability of the potential impacts are detailed and possible mitigation measures that could applied are provided for each potential impact. It is noted that only direct impacts are assessed in this section, potential risks are detailed in Section 11.3 below.

The proposed activities associated with each project phase for the new proposed activities are summarised in the table below.

Table 11-1: Proposed New Activities

Phase of Project	Activity
Construction phase	■ Demolishing of existing primary plant at 3 Shaft; ■ Construction of new primary crusher facility at the stockpile area at 3 Shaft; ■ Construction of the new MK9 belt (including wetland crossing); ■ Drilling of exploration, rescue and monitoring boreholes; ■ Rehabilitation of affected the affected wetland at 3 Shaft; and ■ Construction of additional ventilation shafts (potential future activity).
Operational phase	■ Operation of infrastructure (raw coal handling and processing as well as stockpiling and conveying of coal product) at new area; ■ Maintenance of primary plant infrastructure at stockpile area; and ■ Storage, handling and disposal of hazardous and non-hazardous waste at stockpile area.
Decommissioning, rehabilitation and closure phase	■ Demolition and removal of all infrastructure; ■ Rehabilitation, including spreading of soil, re-vegetation and profiling or contouring; ■ Storage, handling and disposal of hazardous and non-hazardous waste; and ■ Post-closure monitoring and rehabilitation.

11.1.1 Soils, Land Use and Land Capability

11.1.1.1 Construction Phase

Construction activities will lead to land clearing and disturbance of the soil (mainly associated with the new MK9 conveyor belt, proposed boreholes and possible future ventilation shafts) as well as the potential generation of dust. When soil is removed, the physical properties are changed, and the soils' chemical properties will deteriorate unless properly managed. When organic matter has been removed either by the clearing of an area for development or by erosion; the soils' fertility is reduced, or soil acidity could increase.

Soil compaction is also anticipated as a result of vehicle movement on soil surfaces during the construction phase. Soil compaction reduces infiltration rates and ability for plant roots to penetrate the soil. Land use and land capability loss is anticipated to be restricted to the vicinity of the surface infrastructure.

11.1.1.1.1 Impact Ratings and Mitigation Measures

The construction phase impacts on soil resources are rated in the Table 11-2 and Table 11–3.

Table 11-2: Potential Impacts for the Loss of Soils: Erosion and Compaction

Dimension	Rating	Motivation	Significance
Site clearing and topsoil removal			
Impact Description: Loss of topsoil as a resource: Clearing of vegetation and removal of soil for establishment of surface infrastructure may result in potential changes to the soil chemical and physical properties. Furthermore, soil compaction may occur due to vehicle movement which reduces the vegetation's ability to grow and consequently may also facilitate erosion.			
Prior to Mitigation/Management			
Duration	3	Vegetation and soil will be removed in preparation of plant and conveyor belt, but the impact may be less than 15 years	Minor (negative) - 50
Extent	3	Loss of soil (erosion and compaction) will only occur within project area	
Intensity	4	Vehicles moving on the surface may result in compaction leading to erosion which can be serious but the impact can be reversed.	
Probability	5	By excavating the soil it will certainly impact on the soil and loss of topsoil is certain	
Nature	Negative		

Dimension	Rating	Motivation	Significance
Mitigation/Management Actions			
▪ Only clear vegetation when and where necessary; ▪ Only remove topsoil when and where necessary and stockpile separately. If possible topsoil should only be removed when dry to reduce compaction; ▪ Only utilise designated access routes; ▪ Soil stockpiles should be vegetated, sloped and stockpiled at 3 to 4 m high and protected from erosion, so they are available for use in the rehabilitation process; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and ▪ Ensure proper stormwater management designs are in place.			
Post-Mitigation			
Duration	2	Loss of soil will not be significant with mitigation measures impact will be less.	Negligible (negative) - 32
Extent	3	Loss of soil will be local and extend across the project area.	
Intensity	3	Loss of soil will be reduced if mitigations measures are implemented	
Probability	4	Losses of soil as a resource will probable occur.	
Nature	Negative		

Table 11-3: Potential Impacts associated with Physical Rehabilitation Activities within Existing Wetland at 3 Shaft and Areas Impacted from the Operation of the Existing Conveyor Belt, Crushing Facility and Coal Bunker

Dimension	Rating	Motivation	Significance
Physical rehabilitation activities within the affected wetland at 3 Shaft			
Impact Description: Demolition of the existing primary plant and physical rehabilitation activities within the affected wetland at 3 Shaft resulting in possible soil erosion and soil compaction.			
Prior to Mitigation/Management			
Duration	3	The impact on soils and wetland will continue for few years after soils and wetland been rehabilitated	Moderate (-77)
Extent	3	The impact on soils and wetlands will have an effect on a local scale	

Dimension	Rating	Motivation	Significance
Intensity	5	Erosion and sedimentation is likely to occur due to expose surfaces. Pollutants might migrate and cause impacts on wetlands and their functionality	
Probability	7	Should no mitigation measures be implemented, impacts on soils and wetlands will definitely continue	
Nature	Negative		
Mitigation/Management Actions			
▪ Only clear vegetation when and where necessary; ▪ If possible, topsoil should be removed when the soil is dry, as to reduce compaction; ▪ Only utilise designated access routes; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and ▪ Ensure proper stormwater management designs are in place.			
Post-Mitigation			
Duration	3	The impact on soils and wetland will continue if mitigation measures are not implemented	Minor (-50)
Extent	3	The impact on soils and wetlands will have an effect on a local scale	
Intensity	4	Pollutants might migrate and cause impacts on wetlands and their functionality if mitigation measures are not implemented	
Probability	5	Should no mitigation measures be implemented, impacts on soils and wetlands will definitely continue	
Nature	Negative		

11.1.1.2 Operational Phase

The potential impacts for soil resource are mostly associated with the construction phase based on the activities to be undertaken. Overall the operational phase is expected to have low negative significance on soil resources. The only further or persistence impacts anticipated during the operational phase are soil compaction from vehicle movement linked to maintenance activities and potential soil erosion where soils remain bare.

11.1.1.2.1 Impact Ratings and Mitigation Measures

The potential operational phase impacts on soil resources are rated in Table 11-4 and Table 11-5 below.

Table 11-4: Potential Impacts of Operational Phase on Soils

Dimension	Rating	Motivation	Significance
Activity and Interaction: Maintenance of infrastructure			
Impact Description: Topsoil losses can occur during the operational phase as a result of runoff and wind erosion. Compaction of soils during operational phase will occur due to movement of vehicles.			
Prior to Mitigation/Management			
Duration	5	Roads will be used during this phase for the length of this operation therefore posing an impact on soils if not mitigated accordingly.	Moderate (negative) - 91
Extent	3	Loss of topsoil will only occur within project area	
Intensity	5	Loss of usable topsoil may result in loss of land capability and land use. Soil regeneration takes a very long time.	
Probability	7	Compaction and erosion of soil if mitigations are not implemented will definitely occur	
Nature	Negative		
Mitigation/Management Actions			
▪ Only the designated access routes are to be used to minimise soil compaction; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; ▪ Topsoil stockpiles are to be maintained in a fertile and erosion free state by sampling and analysing annually for macro nutrients and soil pH, and vegetating the stockpiles to reduce erosion; and ▪ Surface infrastructure areas must be rehabilitated following construction in a manner that allows for free drainage where practical.			
Post-Mitigation			
Duration	4	Roads will be used during this phase for the length of this operation therefore posing an impact on soils if not mitigated accordingly	Minor (negative) - 36
Extent	2	With mitigation the impact should be limited to the extent to where the stockpiles will be located.	
Intensity	3	With mitigation this should significantly be reduced.	

Dimension	Rating	Motivation	Significance
Probability	4	With mitigation the likelihood of the impact occurring is limited.	
Nature	Negative		

Table 11-5: Potential Impacts Associated with Drilling of Exploration, Monitoring, downcast and Rescue Boreholes, Raw Coal Handling and Processing

Dimension	Rating	Motivation	Significance
Site clearing and topsoil removal			
Impact Description: Loss of topsoil as a resource: During clearing of vegetation and removal of soil for the preparation of drilling for boreholes.			
Prior to Mitigation/Management			
Duration	3	Vegetation and soil will be removed in preparation of boreholes, but the impact may be less than 15 years	Minor (-50)
Extent	3	Loss of soil (erosion and compaction) will only occur within project area	
Intensity	4	Vehicles moving on the surface may result in compaction leading to erosion which can be serious but the impact can be reversed.	
Probability	5	By excavating the soil it will certainly impact on the soil and loss of topsoil is certain	
Nature	Negative		
Mitigation/Management Actions			
▪ Only the designated access routes are to be used to minimise soil compaction; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and ▪ Topsoil stockpiles are to be maintained in a fertile and erosion free state by sampling and analysing annually for macro nutrients and soil pH, and vegetating the stockpiles to reduce erosion.			
Post-Mitigation			
Duration	2	Loss of soil will not be significant with mitigation measures impact will be less.	Negligible (-32)
Extent	3	Loss of soil will be local and extend across the project area.	

Dimension	Rating	Motivation	Significance
Intensity	3	Loss of soil will be reduced if mitigations measures are implemented	
Probability	4	Losses of soil as a resource will probable occur.	
Nature	Negative		

11.1.1.3 Decommissioning and Rehabilitation Phase

The decommissioning and closure phase will comprise of the removal of the new infrastructure proposed and subsequently rehabilitating disturbed areas. Similarly to the operational phase, the potential impacts on soil resources associated with these activities include soil compaction linked to vehicle movement and soil erosion of bare soils which could result in the loss of topsoil. During rehabilitation, the impacted areas will be rehabilitated as per the rehabilitation guideline (refer to Appendix 13). Rehabilitated areas must be assessed for compaction, contamination and possible erosion, corrected and protected immediately to be deemed successful.

11.1.1.3.1 Impact Ratings

The potential decommissioning and rehabilitation phase impacts on soil resources are rated in Table 11-6.

Table 11-6: Impact Rating during Rehabilitation of Infrastructure Areas

Dimension	Rating	Motivation	Significance
Activity and Interaction: Rehabilitation of infrastructure areas			
Impact Description: Rehabilitation of roads and surface infrastructure areas could cause compaction and erosion if rehabilitation is not done correctly. This could result in poor vegetation establishment which would result in exposed surfaces and increase the risk of erosion.			
Prior to Mitigation/Management			
Duration	5	The impact on soils would likely to occur if mitigations are not implemented	Minor (negative) - 36
Extent	2	Impact will occur on a limited scale	
Intensity	5	The intensity of the impact is serious and might be irreversible if mitigation measures are not implemented leading to chemical and physical degradation of the soil	

Dimension	Rating	Motivation	Significance
Probability	3	Impact will be unlikely to occur, if mitigation measures are not implemented will lead to compaction, erosion and loss of topsoil	
Nature	Negative		
Mitigation/Management Actions			
- Only the designated access routes are to be used to minimise soil compaction; - If erosion occurs, corrective actions must be taken to minimise further erosion from taking place; - Native vegetation must be planted to prevent erosion and encourage self-sustaining development of a productive ecosystem; - Compacted areas are to be ripped to loosen the soil and vegetation cover re-instated; - Ensure proper stormwater management designs are in place; and - Surface inspection on the fully rehabilitated areas must be undertaken to ensure a surface profile that allows good drainage.			
Post-Mitigation			
Duration	2	Impact will be less than a year if rehabilitation measures are implemented correctly	Negligible (negative) - 14
Extent	2	Impact will occur on a limited scale	
Intensity	3	The intensity will be reduced if mitigation measures are implemented	
Probability	2	Impact will be unlikely to occur if mitigation measures are implemented	
Nature	Negative		

11.1.2 Flora and Fauna

No additional impacts are envisaged for Flora and Fauna which are specifically associated with the proposed new activities at Mooikraal/ 3 Shaft area as these mostly occur in already disturbed clear land. It is however noted that the proposed boreholes to be established within the Mooikraal MRA may require land clearing and consequently lead to loss of biodiversity and disturbance of faunal species. Given the limited extent of clearing required for each borehole, the significance of the ecological impact within the context of existing impacts (both mining related and other land uses within the project area) is expected to be minimal. To this end, no updated impact assessment has been undertaken.

11.1.3 Freshwater Ecosystems (Wetlands and Aquatic Ecology)

11.1.3.1 Construction Phase

The proposed construction activities which may have an impact on freshwater ecosystems include site clearing and soil disturbance, crossing of wetland and river areas, vehicular movement as well as storage and dumping of building materials associated with the decommissioning and reconstruction of the various infrastructures within 3 Shaft. The associated impacts include degradation of habitat through the physical removal/direct disturbance of wetland vegetation as well as the deterioration of water quality of associated freshwater ecosystems in the form of sedimentation and increased contaminant/dissolved solids entry as a result of increased runoff.

Further impacts to the ecology of the freshwater ecosystems, include fragmentation of the system, loss of catchment yield, loss of stream connectivity and associated migration routes and loss of habitat provision for aquatic biodiversity maintenance.

11.1.3.1.1 Impact Ratings and Mitigation Measures

The potential impacts of the construction phase activities on freshwater ecology are rated in Table 11-7 to Table 11-9.

Table 11-7: Impact of site access and construction on associated freshwater ecosystem

Dimension	Rating	Motivation	Significance
Activity and Interaction: Site clearance and construction of man-made structures within 3 Shaft wetland habitat and river catchment			
Impact Description: Increased runoff and erosion within associated freshwater ecosystems resulting from cleared vegetation and compaction / disturbance of soils from increased vehicular and machinery activity.			
Prior to Mitigation/Management			
Duration	Long Term (4)	Compaction will reduce the capability of vegetation returning in the long term	Minor (negative) – 45
Extent	Limited (2)	The extent of the impact will likely be limited to the immediate wetland sections associated with the 3 Shaft activities. Further supported by limited flow within the associated wetland system	
Intensity	Moderate (3)	Due to the scale of the proposed site clearance, the intensity to the system is predicted to be moderate	

Probability	Likely (5)	It is likely that the impact will occur as the proposed activities are situated directly in a delineated wetland system	
Nature	Negative		
Mitigation/Management Actions			
- Revegetate the construction footprint and vehicular pathways as soon as possible; - Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate licenced waste facility; - Stormwater should be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of stormwater flow; - As far as practicable, construction should take place during the dry season to minimise runoff; and - Sequential removal of the vegetation should take place (not all vegetation immediately).			
Post-Mitigation			
Duration	Medium Term (3)	Compaction will reduce the capability of vegetation returning in the long term however if the area is ripped and re-vegetated, the duration will be the medium term	Negligible (negative) – 14
Extent	Limited (2)	Runoff will still most likely only impact the immediate wetland sections associated with the construction	
Intensity	Limited (2)	Intensity runoff and erosion is expected to decrease notably if re-vegetation around activities and (or) stormwater management techniques are implemented.	
Probability	Improbable (2)	The likelihood of the impact occurring is reduced if dry seasons are utilised for construction together with stormwater management techniques	
Nature	Negative		

Table 11-8: Impact of the rehabilitation of the affected wetland at 3 Shaft on the freshwater resource

Dimension	Rating	Motivation	Significance
Activity and Interactions: 3 Shaft wetland rehabilitation			
Impact description: Degradation of habitat through the physical removal/direct disturbance of wetland vegetation as well as the deterioration of water quality of associated freshwater ecosystems			

Dimension	Rating	Motivation	Significance
in the form of sedimentation and increased contaminant/dissolved solids entry as a result of increased runoff.			
Prior to Mitigation/Management			
Duration	Medium term (1-5 years) (3)	The impact will continue for a few years after the wetland has been rehabilitated correctly.	Moderate (negative) – 77
Extent	Local (3)	Sedimentation due to exposed surface will result in a degraded habitat and, could result in water quality deterioration which will affect the local watercourses and river reaches.	
Intensity	Serious environmental effects (5)	Due to the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious impacts.	
Probability	Definite (7)	Should no precautionary measures be implemented, further impacts to the watercourses are considered to be definite as the rehabilitation is located within the delineated wetland.	
Nature	Negative		
Mitigation/Management Actions			
▪ A dedicated waste disposal site is to be established; ▪ Waste material removed from the delineated wetland should be loaded manually (using spades) into the skip of the back-actor to limit any impacts on the existing soils; ▪ No material may be dumped or stockpiled within any rivers, tributaries or drainage lines; ▪ Footprint to be kept as small as possible and areas that do not need to be entered should be avoided; ▪ Implement and maintain a suitable Alien Invasive Plant (AIP) control programme to prevent further encroachment because of disturbance to the surrounding terrestrial zones; ▪ Revegetation should ideally take place in the wet season, as far as possible, to promote successful germination; ▪ Permit only essential personnel within the 100m zone of regulation for all freshwater features identified; ▪ No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland or			

Dimension	Rating	Motivation	Significance
instream areas and their associated zones of regulation (notwithstanding those areas to be directly impacted upon as a result of the proposed activities). All vehicles must remain on demarcated roads and within the construction footprint; ▪ Wetlands should be monitored quarterly during construction; ▪ The buffer zone of the wetland area should be clearly demarcated, after rehabilitation has taken place, with stakes positioned in the ground (preferably painted white) and this area should be regarded as 'no-go' for future development; ▪ The support for the proposed new conveyor gantry should cover as small an area as possible and should be located outside of the wetland area; and ▪ The proposed conveyor gantry should be covered.			
Post-Mitigation			
Duration	Medium term (1-5 years) (3)	The impact will continue for a few years after the wetland has been sloped correctly.	Minor (negative) – 70
Extent	Local (3)	Sedimentation due to exposed surface will result in a degraded habitat and, could result in water quality deterioration which will affect the local watercourses and river reaches.	
Intensity	Moderate environmental effects (4)	Due to the already degraded nature of the systems present activities could result in moderate impacts.	
Probability	Definite (7)	Further impacts to the watercourses are considered definite as the rehabilitation it located within the delineated wetland.	
Nature	Negative		

Table 11-9: Impact assessment parameter ratings for the construction phase – generation of waste and use of hazardous products during site access and construction

Dimension	Rating	Motivation	Significance
Activity and Interaction: Waste generation/disposal and the use of hazardous product			
Impact Description: Water and habitat quality deterioration			
Prior to Mitigation/Management			

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	If hazardous products enter the wetland systems, it is suspected that they will be affected in the long term.	Minor (negative) – 40
Extent	Limited (2)	The extent of the impact will likely only impact on the immediate wetland area associated with the construction due to limited flow in the systems	
Intensity	Moderately high 4)	Impacts to biota and flora of the wetland systems is suspected to be high but limited in comparison to river systems	
Probability	Probable (4)	It is probable that contaminant entry will occur as proposed construction is situated directly within a delineated wetland.	
Nature	Negative		
Mitigation/Management Actions			
▪ Stormwater must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of stormwater flow that may carry contaminants from the sites into the associated aquatic systems; ▪ All vehicles must be regularly inspected for leaks; ▪ Re-fuelling must take place at a diesel facility, on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; ▪ All hydrocarbon spills should be immediately cleaned up and treated accordingly; ▪ Ensure correct waste management; and ▪ Ensure correct storage systems are used for the storage of hazardous products when constructing.			
Post-Mitigation			
Duration	Medium Term (3)	The freshwater ecology will already have been affected by the impact but will most likely recover quicker after mitigation	Negligible (negative) – 16
Extent	Limited (2)	The extent of the impact will likely have an impact on the immediate river sections	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	High - (3)	The intensity of the impact will decrease severely if mitigation measures are in place, limiting hazardous substances from entering the aquatic systems	
Probability	Improbable (2)	The likelihood of the impact occurring is reduced by the implementation of the mitigation measure	
Nature	Negative		

11.1.3.2 Operational Phase

The main activities during the operational phase that could result in impacts to the freshwater ecology of the area are associated with conveying coal on the conveyor belt as well as coal handling and stockpiling at 3 Shaft as well as drilling of exploration boreholes. The potential impacts include compaction of soils and hardening of surfaces, loss of catchment yield and surface water recharge, erosion and sedimentation, the potential loss of biodiversity and habitat, loss of natural migration routes for instream fauna and further fragmentation of the systems present.

11.1.3.2.1 Impact Ratings and Mitigation Measures

Table 11-10 to Table 11-12 summarise potential impacts to the freshwater ecology identified during the operational phase.

Table 11-10: Impact of vegetation clearing for proposed boreholes and rescue bays on freshwater resources

Dimension	Rating	Motivation	Significance
Activity and Interactions: Vegetation clearing for boreholes			
Impact description: Vegetation clearing results is a loss of biodiversity and vegetation cover. The bare ground can result in the creation of preferential flow paths over time, which may give rise to erosion and sedimentation, thus affecting the instream ecology and the downstream resources. Vegetation removal can also result in an invasion by AIPs, further altering the natural vegetation profiles of the freshwater resources.			
Prior to Mitigation/Management			
Duration	Beyond Project Life (6)	The impact will remain for some time after the life of the project and is potentially irreversible even with management	Minor (negative) – 72

Dimension	Rating	Motivation	Significance
Extent	Local (3)	Wetland vegetation removal, associated erosion, compaction and sedimentation will result in a degraded habitat and, which will affect the local wetlands.	
Intensity	Moderate environmental effects (3)	Should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Almost certain (6)	Should no precautionary measures be implemented, further impacts to the watercourses are considered almost certain as the refuge bays are located within the delineated wetland.	
Nature	Negative		
Mitigation/Management Actions			
▪ Limit the footprint area of the operational activities to what is essential to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas); ▪ Ensure that no incision and canalisation of the wetland and instream features present takes place; ▪ All erosion noted within the operational footprint should be remedied immediately and included as part of an ongoing rehabilitation plan; ▪ Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction; ▪ Implement and maintain a suitable AIP control programme to prevent further encroachment because of disturbance to the surrounding terrestrial zones; and ▪ No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained.			
Post-Mitigation			
Duration	Beyond Project Life (6)	The impact will remain for some time after the life of the project and is potentially irreversible even with management	Negligible (negative) – 50
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the closure phase.	

Dimension	Rating	Motivation	Significance
Intensity	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the freshwater ecosystems present.	
Probability	Likely (5)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still likely due to the location of the activities in the delineated wetland.	
Nature	Negative		

Table 11-11: Impact assessment parameter ratings for the operational phase – operation of current surface infrastructure at 3 Shaft

Dimension	Rating	Motivation	Significance
Activity and Interactions: Surface operation activities for 3 Shaft			
Impact description: Ongoing contamination of the freshwater resources present are deemed likely based on the large amount of coal at 3 Shaft as well as ingress of hydrocarbons associated with vehicular activity and machinery usage. Additional potential impacts include compaction of soils and hardening of surfaces, loss of catchment yield and surface water recharge, erosion and sedimentation, the potential loss of biodiversity and habitat, loss of natural migration routes for instream fauna and further fragmentation of the systems present.			
Prior to Mitigation/Management			
Duration	Beyond project life (6)	The impacts related to operation of Mooikraal 3 Shaft will continue after the life of the project has been completed.	Minor (negative) – 52
Extent	Local (3)	Erosion, compaction and sedimentation will result in a locally degraded habitat. Hydrocarbon spills and coal contamination will also result in water quality deterioration	
Intensity	Serious medium term environmental	Due to the already degraded nature of the systems present, should no management or mitigation measures	

Dimension	Rating	Motivation	Significance
	effects (4)	be employed, activities could result in serious medium-term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the freshwater ecosystems are considered probable.	
Nature	Negative		
Mitigation/Management Actions			
• Incidents of erosion should be remedied as soon as possible to reduce deterioration of the wetland habitat; • Any coal contamination should be removed to reduce contamination of the water quality. The contaminated material should then be discarded at the correct facility; • Leak detection of the pipelines should be initiated; • Limit the footprint area of the operational activities to what is essential to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas); • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; • No unnecessary crossing of the wetland features, instream areas and their associated buffers, as well as the constructed berms or canals should take place and the substrate conditions of the wetlands, instream areas and downstream stream connectivity must be maintained; • No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads; • All vehicles must be regularly inspected for leaks; • Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil; • All spills should be immediately cleaned up and treated accordingly; • Appropriate sanitary facilities (STP) must be provided for the duration of the operational activities and all waste must be removed to an appropriate licenced waste facility. Treated water discharged to the environment from the STP must comply with the WUL quality standards before it is discharged; • Appropriate stormwater management should be in place; • Monitor all systems for erosion and incision; • Permit only essential personnel within the 100 m zones of regulation for all freshwater features identified; and • Ongoing wetland rehabilitation is necessary during the operational phase as stipulated in the monitoring section.			
Post-Mitigation			
Duration	Beyond project life (6)	The impacts related to operation of Mooikraal 3 Shaft will continue after the life of the project has been	Negligible (negative) – 18

Dimension	Rating	Motivation	Significance
		completed.	
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the operational phase.	
Intensity	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Improbable (2)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are considered improbable.	
Nature	Negative		

Table 11-12: Impact assessment parameter ratings for the operational phase – borehole drilling

Dimension	Rating	Motivation	Significance
Activity and Interaction: Drilling of boreholes			
Impact Description: Water table impacts related to a loss of pressure (immediate) and resultant overflowing, which is likely to be expressed in the decommissioning and closure phases.			
Prior to Mitigation/Management			
Duration	Long Term (4)	Should the boreholes not be sealed, the impacts to the water table and wetlands will be long term in nature.	Minor (negative) – 44
Extent	Local (3)	The quantity of the boreholes results in an impact that will affect local wetlands and water courses.	
Intensity	Serious (4)	Some boreholes are located within wetlands directly, and the water table may be impacted causing water stress to the wetlands which could lead to serious impacts to those systems	

<table>
<tr><th>Dimension</th><th>Rating</th><th>Motivation</th><th>Significance</th></tr>
<tr><td>Probability</td><td>Probable (4)</td><td>Should the boreholes not be sealed, the impact is probable</td><td rowspan="2"></td></tr>
<tr><td>Nature</td><td colspan="2">Negative</td></tr>
<tr><td colspan="4">Mitigation/Management Actions</td></tr>
<tr><td colspan="4">▪ Seal boreholes adequately so there is no loss of pressure to the water table;
▪ Maintain a register of all geological, water monitoring, recue and downcast boreholes
▪ Ensure footprint around borehole is as small as practically possible;
▪ Scarify and reseed area surrounding borehole, unless the borehole is drilled into cultivated land;
▪ Ensure that the boreholes have been sealed correctly after use; and
▪ Ensure that all boreholes and the surrounding area are rehabilitated.</td></tr>
<tr><td colspan="4">Post-Mitigation</td></tr>
<tr><td>Duration</td><td>Short Term (3)</td><td>Should the boreholes be sealed, the impacts to the water table and wetlands will be short term in nature.</td><td rowspan="5">Negligible (negative) – 16</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>The extent of the impact will be limited should the boreholes be sealed</td></tr>
<tr><td>Intensity</td><td>Minor loss (3)</td><td>Water stress to wetlands as a result of changes in pressure to the water table will be minor if the boreholes are sealed</td></tr>
<tr><td>Probability</td><td>Improbable (2)</td><td>If the boreholes are sealed, the impact to the water table and wetlands is improbable as pressure will be restored to the water table</td></tr>
<tr><td>Nature</td><td colspan="2">Negative</td></tr>
</table>

11.1.3.3 Decommissioning and Rehabilitation Phase

Similar to the operational phase, key impacts which are associated with rehabilitation activities include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.

Furthermore, any temporary storage or dumping of decommissioned infrastructure within wetland or river areas, has the potential to result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.

Removal of vegetation and disturbance of soils in the vicinity of the decommissioning footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and alien invasive vegetation species, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the decommissioning footprint.

11.1.3.3.1 Impact Ratings and Mitigation Measures

Table 11-13 and Table 11-14 summarise potential impacts to the freshwater ecology identified during the decommissioning and rehabilitation phase.

Table 11-13: Potential Impacts of decommissioning of Infrastructure

Dimension	**Rating**	**Motivation**	**Significance**
Activity and Interactions: Decommissioning of all infrastructure			
Impact Description: Compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream. Any temporary storage or dumping of decommissioned infrastructure within wetland or river areas, may result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in freshwater resource deterioration.			
Prior to Mitigation/Management			
Duration	Beyond project life (6)	The impact will continue after the decommissioning, rehabilitation and closure phases of the project have been completed.	Minor (negative) – 52
Extent	Local (3)	Erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect the local watercourse and river reaches directly downstream.	
Intensity	Serious medium term environment al effects (4)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium-term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the	

		freshwater ecosystems present are considered probable.	
Nature	Negative		
Mitigation/Management Actions			

- Limit the footprint area of the decommissioning and rehabilitation activities to what is essential;
- Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream;
- No material may be dumped or stockpiled within any wetland areas or within 100m in the vicinity of the proposed decommissioning footprint;
- Re-fuelling must take place at a diesel facility on a sealed and bunded surface area;
- All existing litter and debris should be removed from the freshwater ecosystems and littering should be prohibited on an ongoing basis;
- All spills from machinery should be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities and all waste must be removed to an appropriate licenced waste facility;
- Waste generated from decommissioning activities must be disposed of in accordance with waste regulations; and
- Any coal contamination should be removed and discarded at the correct facility.

Post-Mitigation			
Duration	Beyond project life (6)	The impact will continue after the decommissioning, rehabilitation and closure phases of the project have been completed.	Negligible (negative) – 30
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the freshwater ecosystems present.	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

Table 11-14: Impact rehabilitation of infrastructure areas

Dimension	Rating	Motivation	Significance
Activity and Interactions: Rehabilitation measures and site access			
Impact description: Compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.			
Prior to Mitigation/Management			
Duration	Beyond project life (6)	The impact will continue after the rehabilitation of the project has been completed.	Minor (negative) – 52
Extent	Local (3)	Erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect the local watercourse and river reaches directly downstream.	
Intensity	Serious medium term environmental effects (4)	Due to the sensitivity of the freshwater ecosystems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the freshwater ecosystems present are considered probable.	
Nature	Negative		
Mitigation/Management Actions			
▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled; ▪ Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream; ▪ An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases; ▪ As much vegetation growth as possible should be promoted within the proposed disturbed area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum; ▪ All areas where active erosion is observed should be ripped, re-profiled and seeded with			

Dimension	Rating	Motivation	Significance
indigenous grasses; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint; ▪ All vehicles must be regularly inspected for leaks; ▪ Re-fuelling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; ▪ All existing litter, debris should be removed from the freshwater ecosystems and littering should be prohibited on an ongoing basis; ▪ All spills from machinery should be immediately cleaned up and treated accordingly; ▪ The road servitude and conveyor have affected the integrity of the wetlands resulting in a loss of habitat and downstream surface water recharge. Rehabilitation during the decommissioning and closure phase should focus on the rehabilitation of these areas. Management in this regard would include removal of the structures, re-profiling of the bed and marginal zones to restore the geomorphological and hydrological integrity and ripping and re-seeding with indigenous wetland grass species; ▪ All incidents of erosion should be remedied and AIPs removed, as in the operational phase; and ▪ Any coal contamination should be removed and discarded at the correct facility as in the operational phase.			
Post-Mitigation			
Duration	Beyond project life (6)	The impact will continue after the rehabilitation of the project has been completed.	Negligible (negative) – 30
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the freshwater ecosystems present	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

11.1.4 Surface Water

11.1.4.1 Construction Phase

Land clearing and disturbance of the soil for the establishment of infrastructure may potentially result in sedimentation and siltation of nearby watercourses as a result of soil erosion. This is likely to lead to deteriorated water quality.

The rehabilitation of the affected wetland at 3 Shaft will ultimately have positive effects to the environment and will be beneficial to downstream water users. The rehabilitated wetland will resume its natural functions which include flood attenuation, base flow contribution and subsequent supporting of ecological systems. This will have a positive impact on downstream water users and ecological systems due to sustained water supply and improved water quality within the Leeuspruit.

11.1.4.1.1 Impact Ratings and Mitigation Measures

Table 11-15 to Table 11-17 summarise potential impacts to the surface water identified during the construction phase.

Table 11-15: Impact of site clearance for the establishment of infrastructure

Dimension	Rating	Motivation	Significance
Activity and Interactions: Site clearance for the establishment of infrastructure			
Impact description: Sedimentation and possible siltation of nearby watercourses due to site clearance at 3 Shaft which could result in water quality deterioration.			
Prior to Mitigation/Management			
Duration	5	The impact will likely occur for the duration of the project	Minor (negative) - 40
Intensity	2	This will have minor to medium-term impacts resulting in a reduction in water quality for immediate downstream users and the aquatic life	
Extent	3	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Mitigation/Management Actions			
▪ Site clearance should be restricted to where absolutely necessary; ▪ Following removal of the existing primary plant at 3 Shaft, the area must be rehabilitated and revegetated immediately to reduce chances of erosion and subsequent sedimentation of nearby streams;			

Dimension	Rating	Motivation	Significance
▪ Ensure stormwater management is upgraded and correctly implemented in accordance to GN704 Regulations at the new primary plant area at 3 Shaft to effectively contain dirty water; ▪ Where practical, construction activities should be undertaken during the dry winter periods (May to August) to reduce sedimentation in the Leeuspruit tributary since there will be minimal rainfall; ▪ For any required soil stockpiles, these should be compacted and the slopes should be kept at minimal/low to avoid erosion by high runoff velocity from the stockpile and hence siltation of the streams; and ▪ Dust suppression measures must be undertaken on the cleared areas during construction.			
Post-mitigation			
Duration	2	The impact will likely only occur during the construction phase	Negligible (negative) - 14
Intensity	2	Should the impact occur, it will have minor medium-term impacts resulting in a reduction in water quality for downstream users and the aquatic life	
Extent	3	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	2	If mitigation measures are correctly implemented, it will be rare/improbable for this impact to occur.	

Table 11-16: Impact of rehabilitation of affected wetland at 3 Shaft on the Leeuspruit

Dimension	Rating	Motivation	Significance
Activity and Interaction: Rehabilitation of affected wetland at 3 Shaft			
Impact description: Flood attenuation and toxins filtration leading to improved water quality within the stream.			
Prior to Mitigation/Management			
Duration	7	A very beneficial impact which may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	Major (positive) +119
Intensity	5	Average to intense environmental enhancements which will benefit ecosystems and downstream water users	
Spatial scale	5	The positive impact will extend across the site and to nearby environments	
Probability	7	It is certain/ definite that this impact will occur (there is no mitigation for this impact)	
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
▪ No enhancement measures have been identified for this positive impact. It is noted that water quality monitoring should be monitored following the rehabilitation activities to ensure this positive impact is realised.			

Table 11-17: Impact of the construction of infrastructure on nearby watercourses

Dimension	Rating	Motivation	Significance
Activity and Interaction: Construction of infrastructure			
Impact description: Sedimentation and siltation of nearby watercourses due to reconstruction of infrastructure at 3 Shaft as well as construction of boreholes and possible ventilation shafts in proximity to watercourses.			
Prior to Mitigation/Management			
Duration	3	The impact will likely occur for the duration of the project	Minor (negative) - 36
Intensity	2	This will have minor to medium-term impacts resulting in a reduction in water quality for immediate downstream users and the aquatic life	
Spatial scale	4	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Mitigation/Management Actions			
▪ Site clearance should be restricted to where absolutely necessary; ▪ Ensure stormwater management is upgraded and correctly implemented in accordance to GN704 at all infrastructure areas to effectively contain dirty water; ▪ Where practical, construction activities should be undertaken during the dry winter periods (May to August) to reduce sedimentation in the Leeuspruit tributary since there will be minimal rainfall; ▪ For any required soil stockpiles, these should be compacted and the slopes should be kept at minimal/low to avoid erosion by high runoff velocity from the stockpile and hence siltation of the streams; and ▪ Dust suppression measures must be undertaken on the cleared areas during construction.			
Post-mitigation			
Duration	2	The impact will likely only occur during the construction phase	Negligible (negative) - 14
Intensity	2	Should the impact occur, it will have minor medium-term impacts resulting in a reduction in water quality for downstream users and the aquatic life	

Dimension	Rating	Motivation	Significance
Spatial scale	3	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	2	If mitigation measures are correctly implemented, it will be rare/improbable for this impact to occur.	

11.1.4.2 Operational Phase

Activities during the operational phase that may have potential impacts on the surface water resources include the operation and maintenance of infrastructure which could result in wind and/or runoff erosion leading to sedimentation of nearby water courses. This could consequently result in water quality deterioration. Furthermore, clean and dirty water separation is to be upgraded for the operation of reconstructed infrastructure at 3 Shaft in accordance with the GN704 of the NWA. This may result in a reduction in catchment yield as dirty water is contained, reducing the amount of runoff reporting to the Leeuspruit.

11.1.4.2.1 Impact Ratings and Mitigation Measures

Table 11-18 summarises potential impacts to the surface water identified during the operational phase.

Table 11-18: Impact of operation and maintenance of infrastructure during the operation phase

Dimension	Rating	Motivation	Significance
Activity and Interaction: Operation and maintenance of infrastructure			
Impact description: Surface water quality deterioration from contaminated runoff			
Prior to Mitigation/Management			
Duration	4	The impact will cease after the operational life span of the mines	Minor (negative) - 36
Intensity	3	Moderate, short-term effects which might affect ecosystem functions.	
Spatial scale	2	The impact will be localised, extending only across the site and to nearby environment.	
Probability	4	Without appropriate mitigation, it is probable that this impact will occur	
Mitigation/Management Actions			
- Stormwater management must be implemented and the structures must be maintained in accordance with GN704 to prevent dirty water runoff into nearby watercourses;			

Dimension	Rating	Motivation	Significance
▪ Bare surfaces must be rehabilitated immediately following construction activities to prevent erosion; ▪ Water quality and quantity must be monitored in the Leeuspruit and Kromelmboogspruit verify the effectiveness of the stormwater management structures; ▪ Dust suppression measures must be undertaken as required; and ▪ A maintenance system must be implemented to ensure regular inspections of the conveyor belt and pipelines for spills/leaks.			
Post Mitigation			
Duration	3	The impact will occur for the duration of the project and should be mitigated as recommended	Negligible (negative) - 14
Intensity	2	The impact will have negligible effect with mitigation measures in place.	
Spatial scale	2	The impact spatial extent will be limited to the incident site.	
Probability	2	With mitigation measures in place, it will be rare/improbable for this impact to occur	

11.1.4.3 Decommissioning and Rehabilitation Phase

Activities during the closure phase include dismantling and removal of infrastructure and surface rehabilitation. Removal of infrastructure will expose and disturb the soil and leave it prone to erosion which leads to increased sedimentation and possible siltation of nearby watercourses (Leeuspruit at 3 Shaft).

11.1.4.3.1 Impact Ratings and Mitigation Measures

Table 11-19 summarises potential impacts to the surface water identified during the decommissioning and rehabilitation phase.

Table 11-19: Impact significance rating for the closure and rehabilitation phase

Dimension	Rating	Motivation	Significance
Activity and Interaction: Dismantling and removing infrastructure and surface rehabilitation			
Impact description: Sedimentation and siltation of watercourses leading to deteriorated water quality			
Prior to Mitigation/Management			
Duration	2	The impact will likely occur during the closure phase only	Minor (negative) - 40
Intensity	3	This will have medium-term impacts resulting in a reduction in water quality for immediate downstream users and the aquatic life	

Dimension	Rating	Motivation	Significance
Spatial scale	3	The impacts will be localised, only extending across the site and to nearby settlements	
Probability	5	Without appropriate mitigation, it is probable that this impact will occur	
Mitigation/Management Actions			
▪ Use of accredited contractors for removal or demolition of infrastructure must be adhered to, in order to reduce the risk of waste generation and accidental spillages; ▪ Stormwater management must be implemented and the structures must be maintained in accordance with GN704 until dirty areas are fully rehabilitated; and ▪ Landscape re-profiling must be undertaken on rehabilitated land to allow good drainage. This will ensure improvement of catchment yield close to pre-mining conditions in the surrounding Kromelmboogspruit and Leeuspruit watercourses.			
Post-mitigation			
Duration	2	The impact will likely only occur during the closure phase	Negligible (negative) - 14
Intensity	2	With the recommended mitigation measures in place, the impact intensity will be low.	
Spatial scale	3	The impacts will be localised to the nearby water resources from where the silt is being generated to the immediate downstream	
Probability	2	If the recommended mitigation measures are correctly implemented, it will be rare/improbable for this impact to occur.	

11.1.5 Groundwater

11.1.5.1 Construction Phase

During the construction phase, site clearance (where required) and construction activities are expected to take place above the water table. The local water table ranges from 4.73 to 31.63 mbgl. No impact on the groundwater is expected if the activities take place above the water table. Should there be a need to excavate below the water table, dewatering of the aquifer to lower the water table locally can be considered to ensure that the construction takes place above the groundwater level and the water quality remains the same as prior to construction activities.

The demolition of the infrastructure within the wetland will reduce the risk to the groundwater environment as the potential source of contamination will be gradually depleted throughout this process. This is a positive action with regards to impact to the groundwater environment.

11.1.5.1.1 Impact Ratings and Mitigation Measures

Table 11-20 summarises the potential impact associated with excavation below the table on groundwater.

Table 11-20: Potential impacts of site clearing and construction during the construction phase at 3 Shaft

Dimension	Rating	Motivation	Significance
Activity and Interaction: Site clearing and construction			
Impact Description: Localised dewatering activities if excavation is required below the water table.			
Prior to mitigation/ management			
Duration	Short term: Less than 1 year (2)	Construction activities are expected to be short-lived (i.e. during the construction phase)	Negligible (negative) - 15
Extent	Limited (1)	Site clearing will only occur within and immediately around the project site	
Intensity	Negative (-2)	Any dewatering will have minor environmental significance	
Probability	Unlikely (3)	Dewatering during the construction phase (if any) is unlikely to cause environmental impact considering limited rock permeability, the duration and excavation depth.	
Nature	Negative		
Mitigation/ Management actions			
▪ Restrict construction activities to be limited to areas above the water table; and ▪ If that is not possible, dewatering of the aquifer to locally lower the water table can be considered to ensure that the construction takes place above the groundwater level and the water quality remains the same as prior to construction activities.			
Post- mitigation			
Duration	Short term: Less than 1 year (2)	Any lowering of the water table during the construction phase is expected to be shallow and recover relatively quickly	Negligible (negative) - 8

Dimension	Rating	Motivation	Significance
Extent	Limited (1)	No impacts are expected, however, if they occur they will be reduced to isolated parts of the mine where site clearing is going to take place	
Intensity	Negative (-1)	Considering that the construction phase will be for a short period, the intensity will be minimal	
Probability	Rare (2)	It is unlikely for groundwater impact to occur during the construction phase, especially with the implementation of the above proposed management plan	
Nature	Negative		

11.1.5.2 Operational Phase

The proposed relocation of the primary crushing facilities onto the existing stockpile area may generate contaminating leachate at the new location. As rainwater infiltrates through the coal, metals could be dissolved and leachate may form. The leachate may then seep to the groundwater and migrate by advection within the groundwater environment. However, the stockpile area is lined with cement and groundwater quality has shown no contamination since operation (in the 1950's); therefore the vulnerability of the groundwater environment in this area is not a concern.

Looking at the current groundwater quality at 3 Shaft area (Section 10.9.2.2), no mining related impact thus far have been observed despite the operation of the facility since 1952. However, the location of the monitoring boreholes needs to be reassessed as they are not located in areas within close proximity to the existing plant area and therefore it is with low confidence that 3 Shaft is deemed as an area that is without contamination.

The stockpile area, however, is much less of a risk to the groundwater environment compared to the current primary plant area. This is because the relocation area (stockpile area) is lined with concrete therefore reducing the potential or rate at which leachate may seep into the underlying unsaturated and saturated zone (aquifer).The stormwater management system will also be upgraded reducing the potential impact even further. Due to these factors, the stockpile area is not observed to be a high risk to the groundwater environment.

11.1.5.2.1 Impact Ratings and Mitigation Measures

The significance rating of the potential impacts of groundwater contamination during the operational phase is provided in Table 11-21.

Table 11-21: Potential impacts of groundwater contamination during the operational phase at 3 Shaft

Dimension	Rating	Motivation	Significance
Activity & Interaction: Groundwater contamination as a result of the coal bunker at the primary plant			
Impact Description: A contamination plume may occur due to dissolution of heavy metals when the coal interacts with rainfall in the presence of air, forming a contamination plume which may seep into the local aquifer.			
Prior to mitigation/ management			
Duration	Beyond project life (6)	Groundwater contamination may occur due to dissolution of heavy metals forming a contamination plume which may seep into the local aquifer which may stay beyond the life of the project.	Minor (-60)
Extent	Local (3)	The contamination is likely to be predominantly within the development area with isolated parts of the plume migrating beyond the project area.	
Intensity	Serious (-6)	Groundwater quality deterioration will be predominantly within shallow aquifer and the shallow aquifer is where private borehole (if any) will be located and where surface water bodies receive baseflow. Therefore a serious problem may arise.	
Probability	Likely (4)	Impact to the shallow aquifer is likely to occur should leachate generation and seepage occur.	
Nature	Negative		
Mitigation/ Management actions			
▪ Maintenance of the stockpile area must be undertaken by developing an effective stormwater management system; ▪ Groundwater monitoring must be re-assessed and implemented to assess the time series water level and water quality trends; ▪ Due to the fact that no underground mining occurs at 3 Shaft, all historical groundwater, geological, rescue borehole locations must be retained on a register and the status of the borehole will be recorded; and ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties.			
Post management			
Duration	Project life (5)	Groundwater contamination during the	Negligible

Dimension	Rating	Motivation	Significance
		operation of the primary plant at the new location is likely to be present during the project life	(-27)
Extent	Limited (2)	With the implementation of the above stated mitigation methods, the impact extent can be minimised to the site only	
Intensity	Minor (-2)	If potential impacts are mitigated and identified impacts to receptors are resolved, impacts of the contamination plume is regarded as minor.	
Probability	Unlikely (3)	The impact is unlikely to occur if the above stated mitigation plans are implemented	
Nature	Negative		

11.1.5.3 Decommissioning and Rehabilitation Phase

All infrastructures will be demolished and removed at 3 Shaft during decommissioning therefore no impacts are expected post closure.

11.1.6 Air Quality

A dispersion model was carried out to assess the potential impacts associated with the project activities on ambient air quality. The results of the model and quantification of the potential impact is presented in the subsections below.

11.1.6.1 Construction and Decommissioning Phase

Due to the lack of detailed information and the relatively short duration of most of the activities associated with the construction, decommissioning and rehabilitation as well as the closure and post-closure phases, the assessment of impacts for these phases was only done qualitatively.

During the proposed construction activities, the main pollutant of concern is PM, including $PM_{2.5}$, PM_{10} and dust fallout. The likely sources of these pollutants during construction include demolition activities, and the construction of the construction camp area. Similar impacts can be expected for the decommissioning and rehabilitation phase.

PM_{10}, $PM_{2.5}$ and dust fallout concentrations are associated with potential health impacts due to the size of the particulates being small enough to be inhaled. Nuisance effects are caused by dust fallout (20 µm to 75 µm in diameter) resulting in soiling of materials and visibility reductions.

The following mitigation measures have been proposed for the construction phase:

- Air quality impacts during construction would be reduced through basic control measures such as limiting the speed of haul trucks; limit unnecessary travelling of vehicles on untreated roads; and to apply water sprays on regularly travelled, unpaved sections;
- When haul trucks need to use public roads, the vehicles need to be cleaned of all mud and the material transported must be covered to minimise windblown dust; and
- The access road to the Project also needs to be kept clean to minimise carry-through of mud on to public roads.

11.1.6.2 Operational Phase

With respect to the operational phase, potential atmospheric emissions pollutant sources include windblown dust from the conveyor belts; coal handling, crushing and stockpiling at 3 Shaft; vehicle entrainment on unpaved road surfaces; and wind erosion on bare surfaces.

11.1.6.2.1 Dispersion Model Results

The dispersion model therefore only considered operational activities at the 3 Shaft complex where design mitigation (use of water sprays on haul roads and conveyor transfer points, covering of conveyor transfer points and enclosure of secondary crushing and screening) is applied.

Dispersion modelling was undertaken to determine highest daily and annual average ground level concentrations for the operational phase. Averaging periods were selected to facilitate the comparison of predicted pollutant concentrations to relevant ambient air quality and inhalation health criteria as well as dust fallout regulations. Detailed methodology for the modelling is provided in the specialist report, Appendix 9. The following scenarios were simulated:

- Scenario 1 – representative of the primary plant area in its current position with design mitigation applied;
- Scenario 2, comprising:
  - Scenario 2a – representative of the primary plant area in its new proposed position with design mitigation applied;
  - Scenario 2b – representative of the primary plant area in its new proposed position with design mitigation applied with additional mitigation of windbreaks to control windblown dust (30% efficiency on windblown dust from the northwest); and
  - Scenario 2c – representative of the primary plant area in its new proposed position with design mitigation applied with additional mitigation of fog cannons to control windblown dust (90% control efficiency on windblown dust from the northwest).

PM2.5

The simulated highest daily $PM_{2.5}$ concentrations for Scenario 1 and Scenario 2a are provided in Figure 11-1 and Figure 11-2 respectively. Scenarios 2b and 2c were not modelled for PM2.5, since the hourly emission rates due to windblown dust from the coal stockpile were negligibly low.

The main findings are:

- **Scenario 1:** ***$PM_{2.5}$*** daily Ground Level Concentrations (GLCs), with design mitigation in place, are likely to be in non-compliance with the current and 2030 NAAQSs for an area extending over the crusher area (Figure 11-1). No exceedances are expected at any of the Air Quality Sensitive Receptors (AQSRs). Over an annual average the GLCs are expected to be low and well within the standard.
- **Scenario 2a:** ***$PM_{2.5}$*** daily GLCs show similar impacting areas as with Scenario 1, but with exceedances over the crusher area now closer to Zamdela residential area (Figure 11-2). Compliance with the NAAQS for both daily and annual averages is still expected at all the AQSRs.

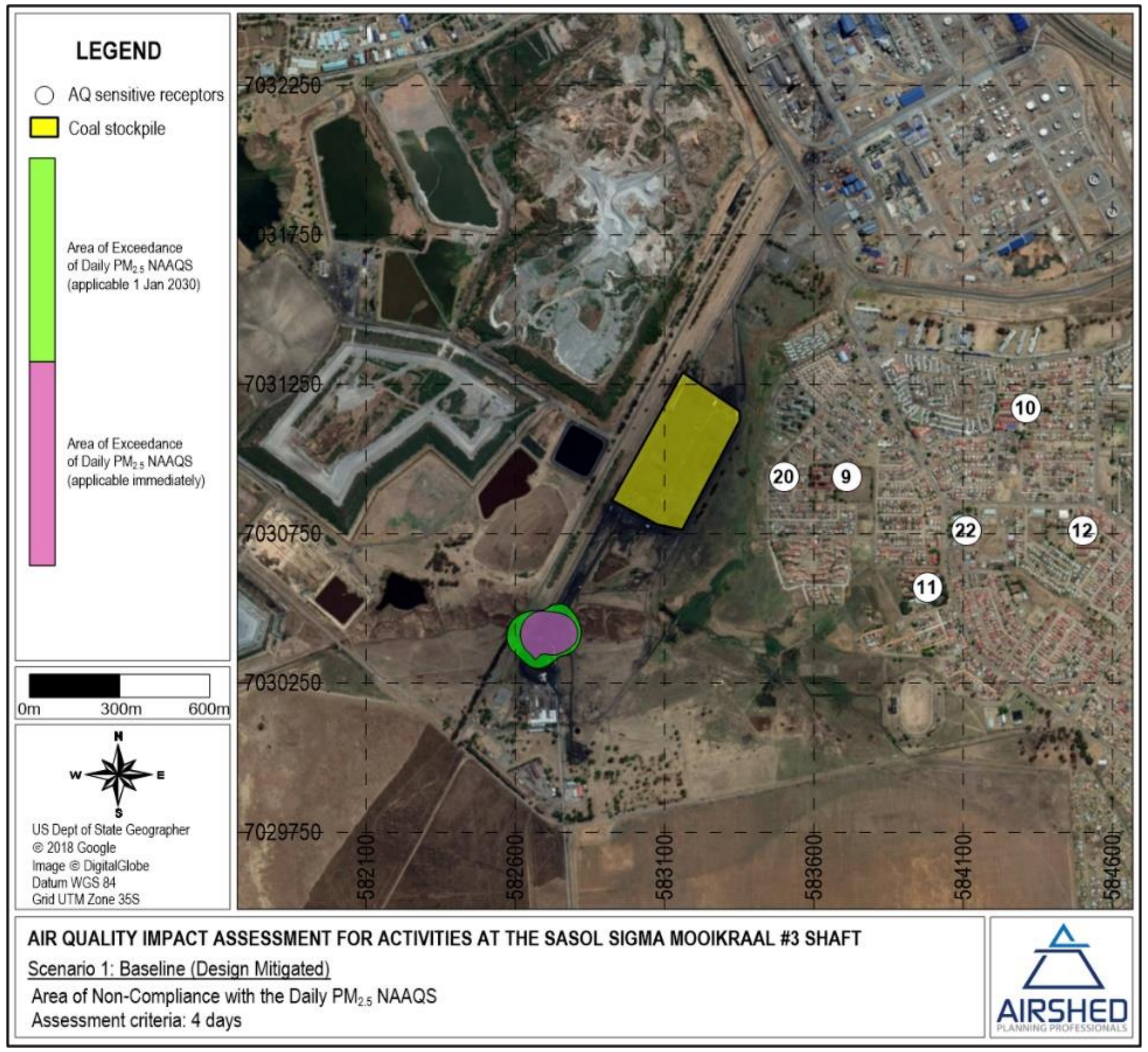


Figure 11-1: Scenario 1 – Area of non-compliance of daily PM2.5 NAAQS due to design mitigated emissions

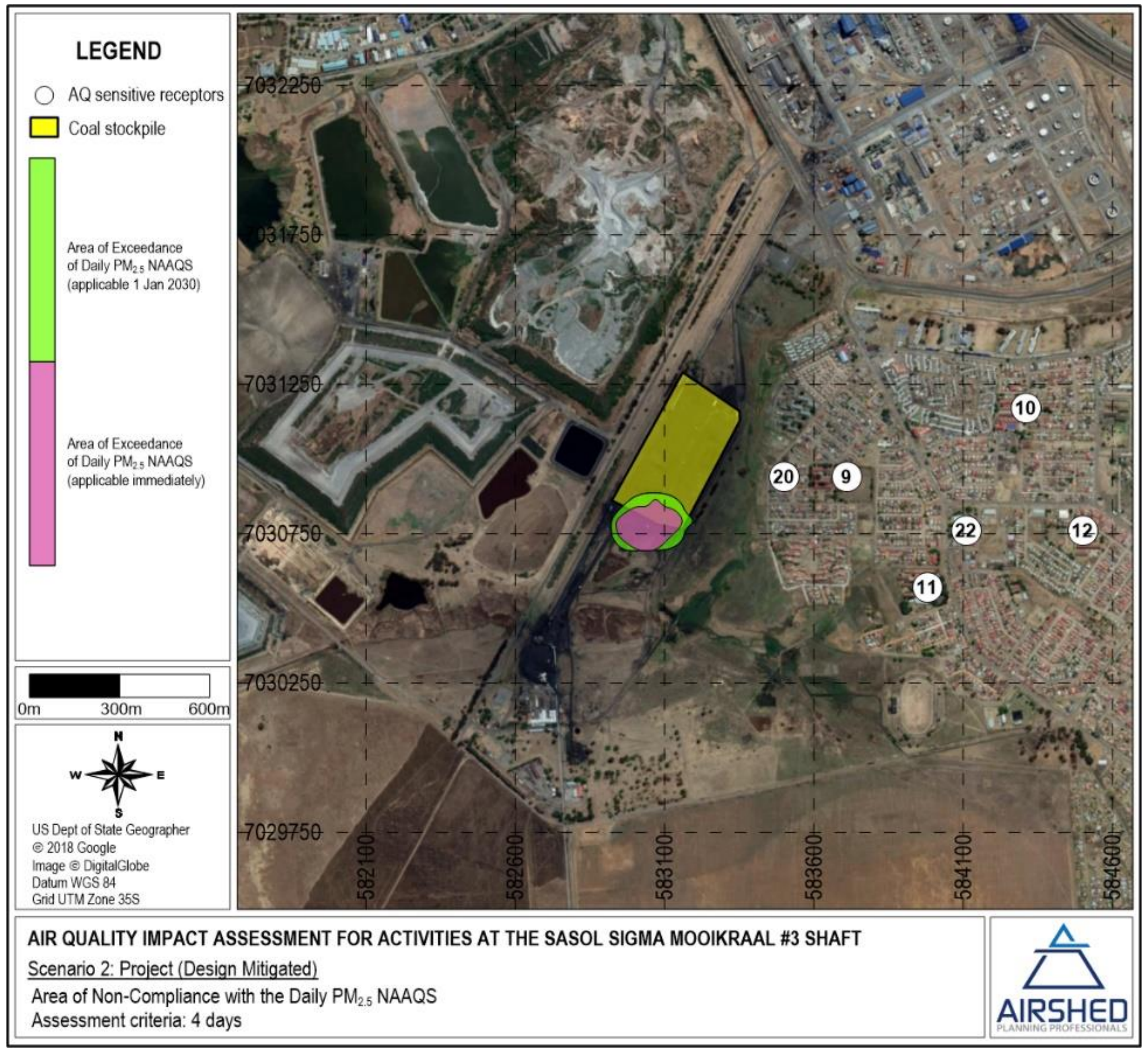


Figure 11-2: Scenario 2 – Area of non-compliance of daily PM2.5 NAAQS due to design mitigated emissions

PM10

The simulated highest daily PM_{10} concentrations for Scenario 1 and Scenarios 2a, 2b and 2c are provided in Figure 11-3 and Figure 11-4 respectively. The main findings are:

- **Scenario 1:** ***PM_{10}*** daily GLCs, with design mitigation in place, are likely to be not comply with the NAAQS for an area extending over the coal stockpile and crusher area. However, over an annual average the GLCs are low and well within the standard.
- **Scenario 2a, b and c:** ***PM_{10}*** daily GLCs show similar impacting areas as with Scenario 1, but with exceedances over the crusher area now closer to Zamdela residential area. A comparison between the impact areas for Scenarios 2a, 2b and 2c reveals only a slight reduction in impacts when additional mitigation in the form of windbreaks and fog cannons are applied. Compliance with the NAAQS for both daily and annual averages are expected at all the AQSRs.

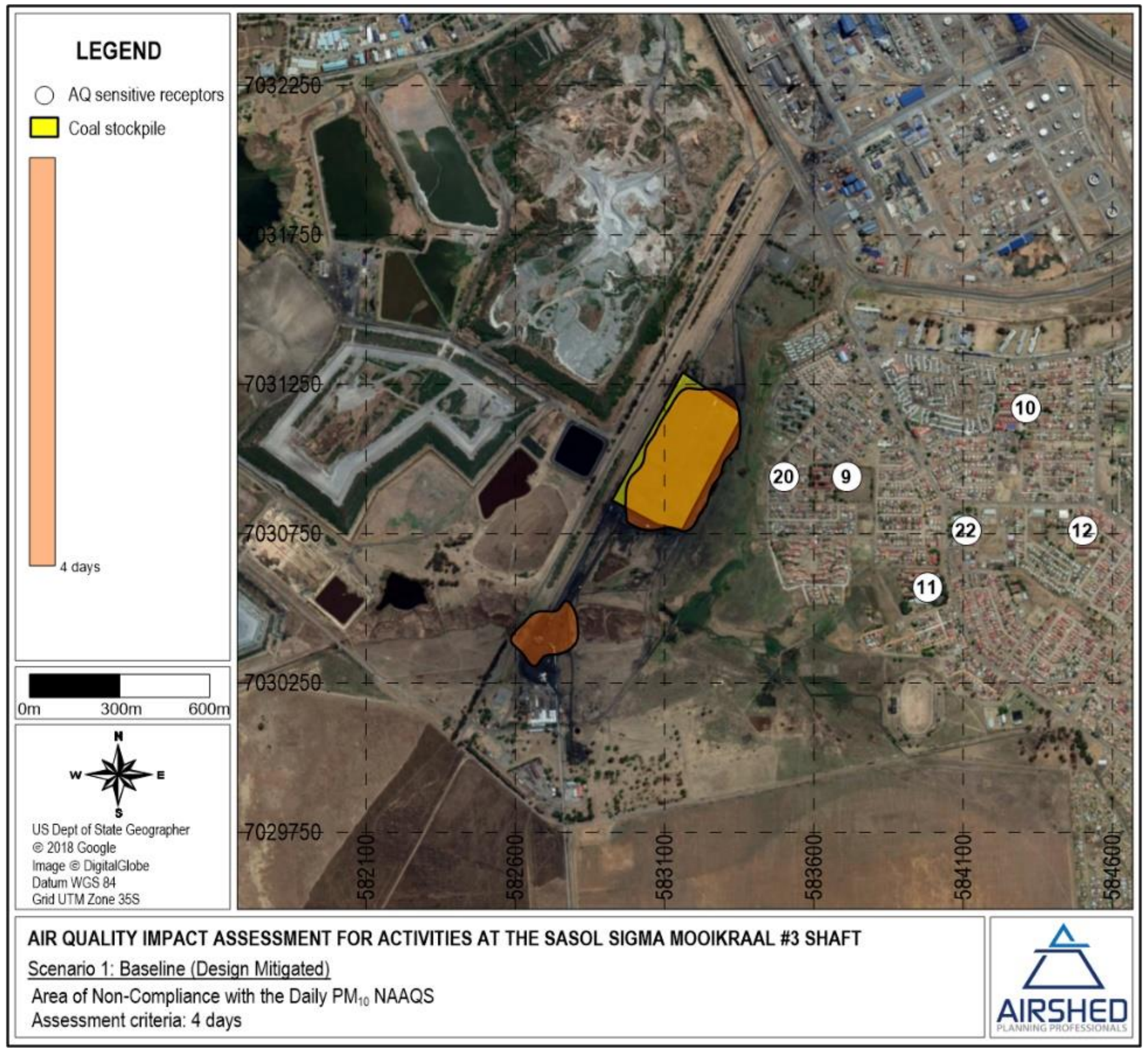


Figure 11-3: Scenario 1 – Area of non-compliance of daily PM10 NAAQS due to design mitigated emissions

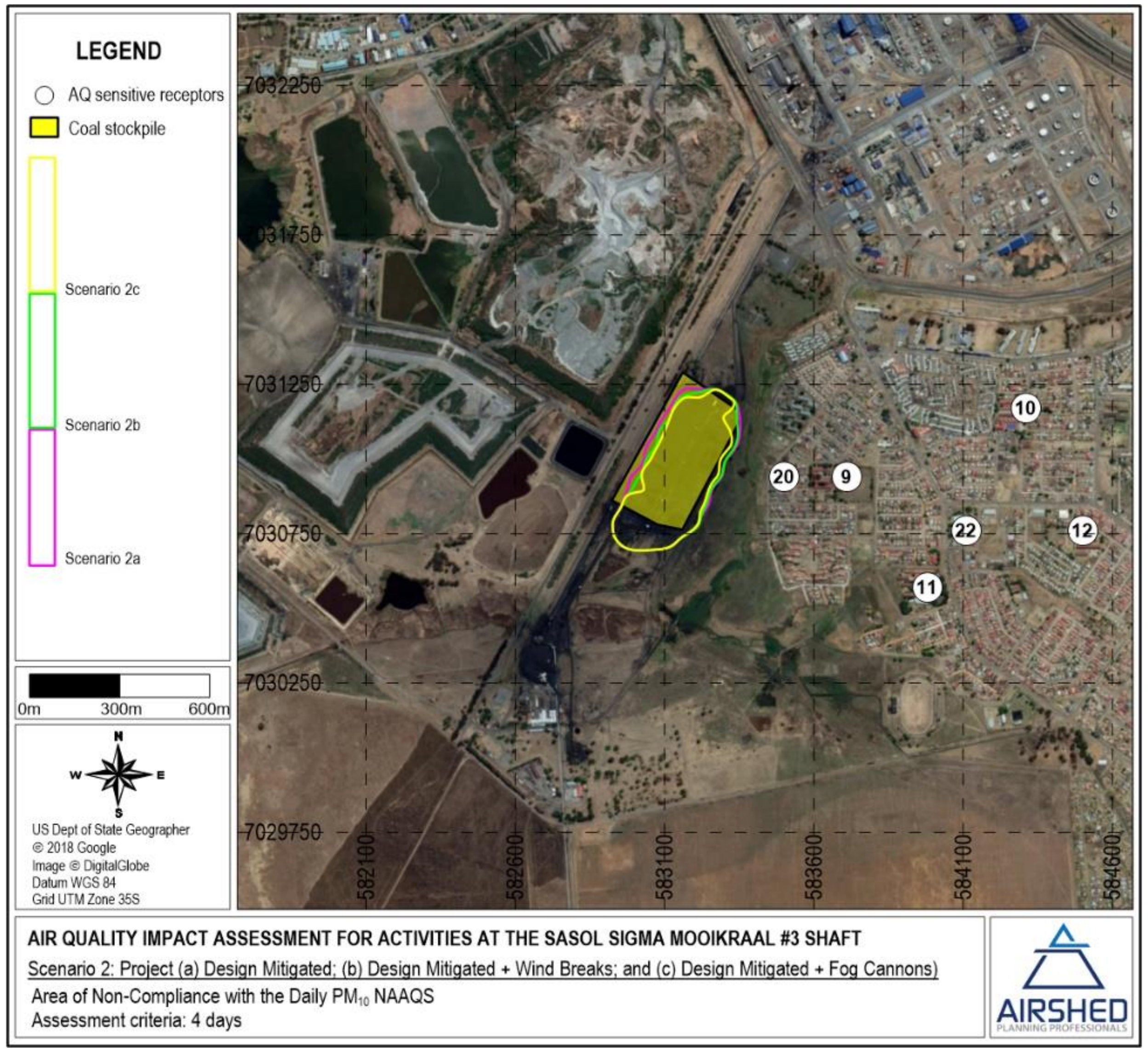


Figure 11-4: Scenario 2 – Area of non-compliance of daily PM_{10} NAAQS due to (a) design mitigated emissions, (b) design mitigated + wind breaks, and (c) design mitigated +fog cannons

Dust Fallout

The simulated maximum daily dust fallout rates for Scenario 1 and Scenarios 2a, 2b and 2c are provided in Figure 11-5 and Figure 11-6 respectively. The main findings are:

- **Scenario 1**: Maximum daily dust fallout rates, with design mitigation in place, are likely to not comply with the NDCR residential limit of 600 $mg/m^2/day$ for the area extending over the coal stockpile and crusher area. However, no exceedances are expected at any of the AQSRs.
- **Scenario 2a, 2b and 2c**: Maximum daily dust fallout rates, with the new crusher and conveyor system in place, show similar impacting areas as for Scenario 1. Very little reduction is expected in the areas of non-compliance between design mitigated activities (Scenario 2a) and Scenarios 2b and c (with additional mitigation in the form of wind breaks and fog cannons respectively). Compliance with the NDCR residential limit (600 $mg/m^2/day$) is however expected at all the AQSRs for all three of the sub-scenarios.

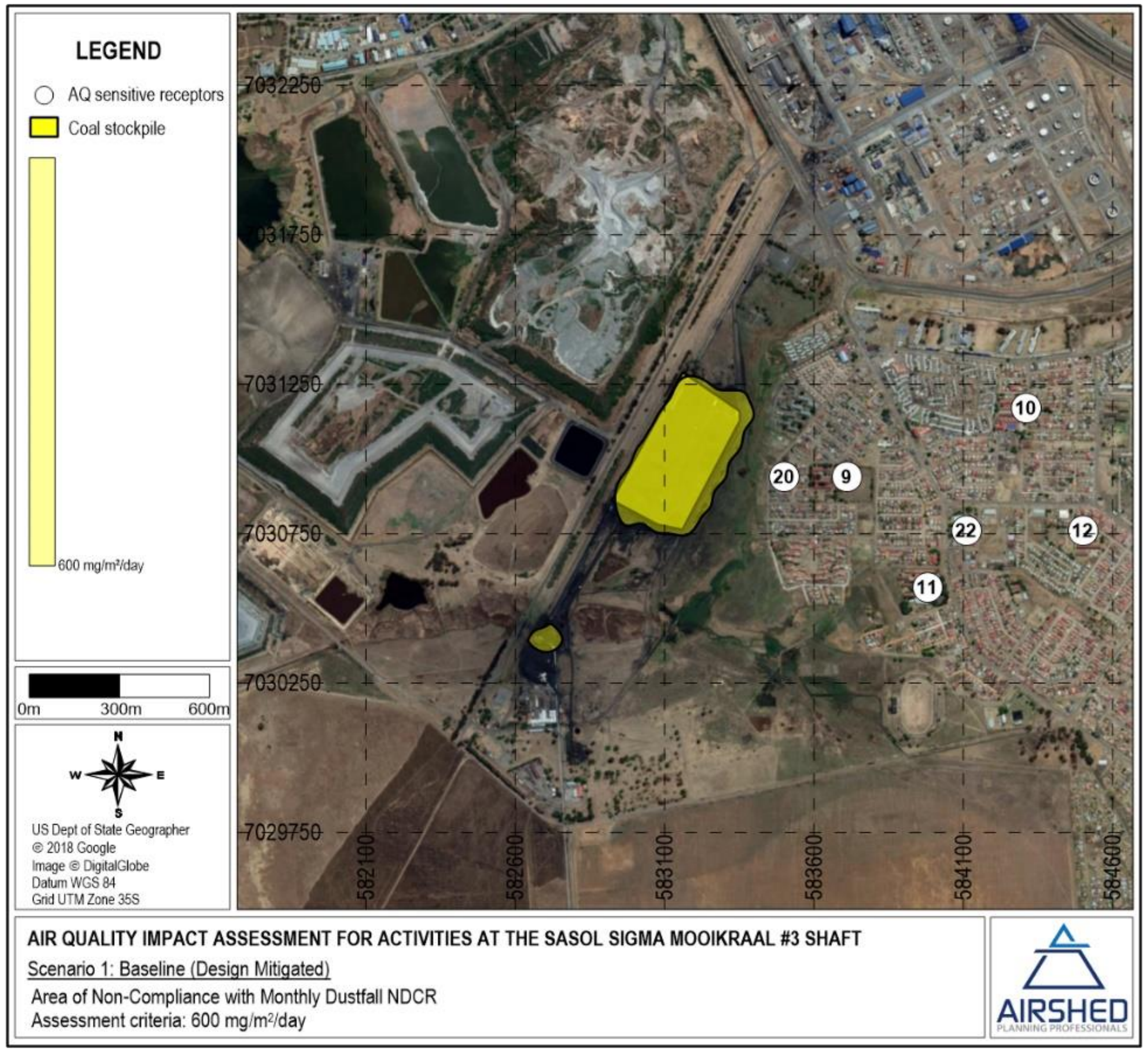


Figure 11-5: Scenario 1 – Simulated dust fallout deposition rates due to due to design mitigated emissions

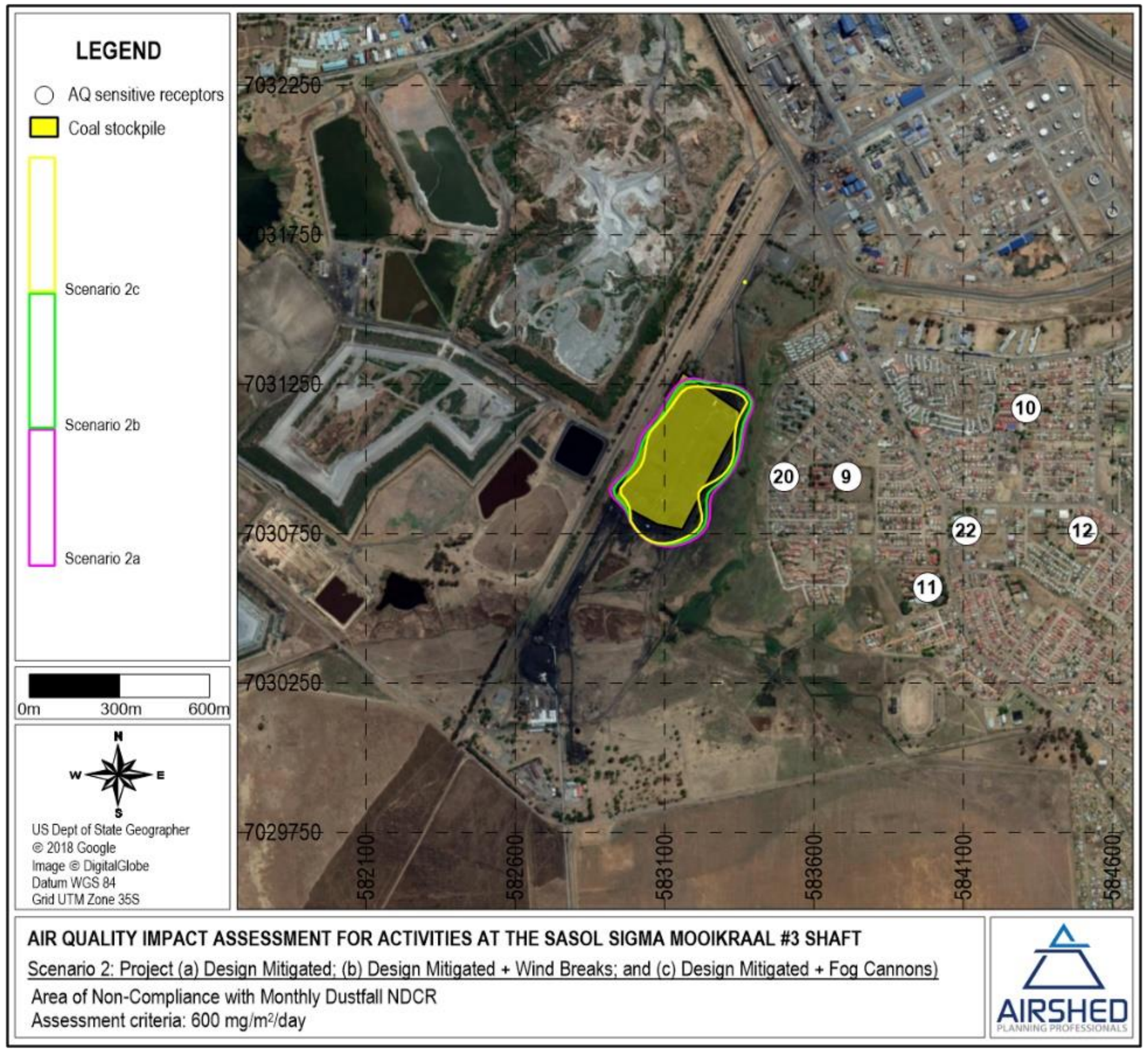


Figure 11-6: Scenario 2 – Simulated dust fallout deposition rates due to design mitigated emissions, (b) design mitigated + wind breaks, and (c) design mitigated +fog cannons

11.1.6.3 Impact Ratings and Mitigation Measures

Table 11-22 to Table 11-24 summarise the potential impact associated with proposed new activities (Scenario 2) at 3 Shaft on air quality during the operational phase.

Table 11-22: Elevated PM_{10} and $PM_{2.5}$ for Scenario 2a, 2b and 2c

Dimension	Rating	Motivation	Significance
Activity and Interaction: Operational activities			
Impact Description: Elevated PM10 and PM2.5 concentrations			
Prior to mitigation/ management			
Duration	Medium term: (4)	Throughout the operational phase.	Negligible (negative) - 30
Extent	Limited (2)	Potential impacts expected to extend beyond the project site.	
Intensity	Negative (-2)	Severity is expected to be minor due to the fact that air quality is expected to remain within standards at AQSRs.	
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by design mitigations.	
Nature	Negative		
Mitigation/ Management actions			
▪ Speed limits must be implemented on haul roads to reduce dust generation; ▪ Application dust suppressant on exposed areas and dirt roads; and ▪ It is recommended that the new MK9 belt be fitted with a roof and covering on one of its sides (as is currently being done).			
Post mitigation/ management			
Duration	Medium term: (4)	Throughout the operational phase.	Negligible (negative) - 27
Extent	Limited (1)	Potential impacts not expected to extend beyond the project site. Air quality is expected to be within standards at AQSRs.	
Intensity	Negative (-2)	Severity is expected to be minor due to the fact that air quality is expected to remain within standards at AQSRs.	
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by design mitigations.	

Dimension	Rating	Motivation	Significance
Nature	Negative		

Table 11-23: Elevated dust fallout for Scenario 2a and 2b

Dimension	Rating	Motivation	Significance
Activity and Interaction: Operational activities			
Impact Description: Dust fallout due to operation of 3 Shaft			
Prior to mitigation/ management			
Duration	Medium term: (4)	Throughout the operational phase.	Negligible (negative) - 30
Extent	Limited (2)	Potential impacts expected to extend beyond the project site.	
Intensity	Negative (-2)	Severity is expected to be minor due to the fact that air quality is expected to remain within standards at AQSRs.	
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by design mitigations.	
Nature	Negative		
Mitigation/ Management actions			
▪ Speed limits must be implemented on haul roads to reduce dust generation; ▪ Application dust suppressant on exposed areas and dirt roads; ▪ It is recommended that the crusher be enclosed, to achieve a control efficiency of up to 90% (as is currently being done); ▪ It is recommended that the new MK9 belt be fitted with a roof and covering on one of its sides (as is currently being done); and ▪ Mitigation of materials transfer points should be done using water sprays at the tip points (and when forming stockpiles using the coal stacker).			
Post mitigation/ management			
Duration	Medium term: (4)	Throughout the operational phase.	Negligible (negative) - 30
Extent	Limited (2)	Potential impacts not expected to extend beyond the project site. Air quality is expected to be within standards at AQSRs.	
Intensity	Negative (-2)	Severity is expected to be minor due to the fact that air quality is expected to remain within standards at AQSRs.	

Dimension	Rating	Motivation	Significance
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by design mitigations.	
Nature	Negative		

Table 11-24: Elevated dust fallout for Scenario 2c

Dimension	Rating	Motivation	Significance
Activity and Interaction: Operational activities			
Impact Description: Dust fallout due to operation of 3 Shaft			
Prior to mitigation/ management			
Duration	Medium term: (4)	Throughout the operational phase.	Negligible (negative) - 30
Extent	Limited (2)	Potential impacts expected to extend beyond the project site.	
Intensity	Negative (-2)	Severity is expected to be minor due to the fact that air quality is expected to remain within standards at AQSRs.	
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by design mitigations.	
Nature	Negative		
Mitigation/ Management actions			
▪ It is recommended that fogger cannons be used to mitigate windblown dust by 90%.			
Post mitigation/ management			
Duration	Medium term: (4)	Throughout the operational phase.	Negligible (negative) - 27
Extent	Limited (1)	Potential impacts not expected to extend beyond the project site. Air quality is expected to be within standards at AQSRs.	
Intensity	Negative (-2)	Severity is expected to be minor due to the fact that air quality is expected to remain within standards at AQSRs.	
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by design mitigations.	
Nature	Negative		

11.1.7 Noise

The Noise Impact Assessment has only been undertaken for the 3 Shaft area as this is the area where the most amount of noise will be generated and where the significant noise impacts will occur.

The results of the predictive modelling are illustrated in Plan 22 to Plan 24 (Appendix 2) for the construction and operational phases. The decommissioning phase was not modelled specifically as it is likely that it would have a similar or lesser impact than the construction phase. A summary of the impacts is indicated in Table 11-25 below.

Table 11-25: Summary of Impacts

<table>
<tr><th rowspan="2">Surrounding area of monitoring locations</th><th colspan="2">Baseline Ambient Noise Levels (refer to table 6-1)</th><th>Construction Phase Predicted Ambient Noise Levels (refer to plan 2)</th><th rowspan="2">Construction noise impacts</th><th colspan="2">Operational Phase predicted ambient noise levels refer to plan 3 and 4)</th><th rowspan="2">Operational noise impacts</th></tr>
<tr><th>Day (dBA)</th><th>Night (dBA)</th><th>Assume only during daytime as assumed to take place (dBA)</th><th>Day (dBA)</th><th>Night (dBA)</th></tr>
<tr><td>N1</td><td>56</td><td>45</td><td><35</td><td rowspan="4">Noise generation as a result of groundwork's (machinery such as haul trucks, front end loaders with reverse sirens)
Noise generation as a result of civil construction activities
Noise generation as a result of material hauling from one area to another for infill and removal
Noise generation as a result of increase in traffic to area
Noise generation as a result of building activities including cement trucks and mixing
Noise generation as a result of demolishing activities</td><td><35</td><td><35</td><td rowspan="4">Noise generation as a result of the current activities occurring at 3 shaft (ambient noise) including trucks for import coal along the haul road (perimeter fence)
Noise generation as a result of drilling activities (for boreholes and piles)
Noise generation as a result of crushing activities located closer to receptors at N4 (Zamdela)
Noise generation as a result of conveyor belt operation which is located closer to receptors (N4 Zamdela)
Noise generation as a result of the operation of the fogger cannons erected on the perimeter fence</td></tr>
<tr><td>N2</td><td>45</td><td>35</td><td><35</td><td><30</td><td>35</td></tr>
<tr><td>N3</td><td>60</td><td>53</td><td>40 – 45</td><td>35 – 40</td><td>45 – 50</td></tr>
<tr><td>N4</td><td>58</td><td>58</td><td>50 – 52</td><td>45 – 47</td><td>55 – 57</td></tr>
</table>

It can be seen when comparing the predicted ambient noise levels during the construction phase and operational phase that there will not be any "disturbing noise", i.e. the ambient sound level was not increased by 7dB.

11.1.7.1 Construction Phase

The demolishing and reconstruction of the primary plant and associated MK9 conveyor belt at 3 Shaft will result in noise disturbance from the construction vehicles and machinery. The noise dispersion model that was run for the construction phase indicates that the expected noise from these activities will not measure above the existing ambient levels at the urban and rural receptors and therefore not impact on the surrounding receptors.

11.1.7.1.1 Impact Ratings and Mitigation Measures

Table 11-26 summarises the rating of the impact significance of noise disturbance during the construction phase.

Table 11-26: Noise disturbance during the Construction Phase

Dimension	Rating	Motivation	Significance
Activity and Interaction: Site clearance and construction of conveyor and crushing facility			
Impact Description: Noise will emanate from the machinery and vehicles operating during the construction activities, however will not impact on any receptors as the noise levels in this area are already high.			
Prior and Post mitigation/ management			
Duration	Short term (2)	Noise will be produced for the duration of construction phase	Negligible (negative) – 21
Extent	Local (3)	It is expected that during construction, noise will extend as far as development site area.	
Intensity	Minor - negative (-2)	It is expected that during construction phase noise will have a minor impact	
Probability	Unlikely (3)	It is unlikely that noise will impact on the surrounding communities.	
Nature	Negative		
Mitigation/ Management action			
▪ No mitigation recommended due to negligible impact			

11.1.7.2 Operational Phase

The operation of the crusher facility, associated conveyor belt and stockpiling area will result in noise disturbance. The operational modelling scenarios that were run for the day and night time (refer to Plan 23 and Plan 24, Appendix 2) indicate that the expected noise will not measure above the current ambient noise levels at the surrounding urban and rural receptors. Furthermore, the relocation of the crusher facility away from the rural receptors towards the south west will likely experience less audible noise from the 3 Shaft complex than the current state.

However, stockpiling activities are currently impacting on the neighbouring urban areas of Zamdela during the day and especially the night time as indicated by the levels measured at N4. It is noted that no complaints from the community have been reported probably due to the community being desensitised by the noise from the coal handling activities having started during the 1950's (roughly the same time as the establishment of the neighbouring areas of Zamdela) and gradually increased in footprint.

11.1.7.2.1 Impact ratings and Mitigation Measures

Table 11-27 below summarises the rating of the impact significance of noise disturbance during the operational phase.

Table 11-27: Noise disturbance during the Operational Phase

Dimension	Rating	Motivation	Significance
Activity and Interaction: Operation of the plant and associated infrastructure as well as stockpiling area at 3 Shaft			
Impact Description: Noise will emanate from the plant and associated infrastructure as well as stockpiling area. The current noise from the stockpiling area is already impacting on the neighbouring urban area of Zamdela.			
Prior mitigation/ management			
Duration	Project life (5)	The existing noise of the stockpiling area is impacting the neighbouring urban areas of Zamdela	Moderate (negative) – 84
Extent	Municipal (4)	The existing noise of the stockpiling area is extending to the neighbouring urban area of Zamdela, but not entire municipal area.	
Intensity	Moderate - negative (-3)	The existing noise of the stockpiling area has a moderate impact on the neighbouring urban area of Zamdela	
Probability	Definite (7)	It is highly likely that noise is impacting on the neighbouring urban area of Zamdela.	
Nature	Negative		
Mitigation/ Management action			
The infrastructure at 3 Shaft has been in operation since 1952 therefore this impact is existing. The following measures are proposed: ▪ If any noise related complaints are received from the existing infrastructure, Mooikraal will investigate the complaint, and put into place actions to address the complaint; and ▪ Should any new structures with noise generating potential be erected, Mooikraal must			

Dimension	Rating	Motivation	Significance
conduct a noise assessment. If it is predicted that new structures will increase noise levels (from the baseline noise level), Mooikraal must investigate noise controls/ abatement to not increase ambient noise levels beyond threshold as per Free State Noise Control Regulations.			

11.1.7.3 Decommissioning Phase

The demolition of infrastructure as well as the decommissioning of all liner structures including roads, pipelines and conveyor belts will result in noise disturbance.

Due to the decommissioning activities using similar or fewer machinery and vehicles than the construction phase, it is expected that the significance of the noise impact during this phase will be similar.

11.1.7.3.1 Impact ratings and Mitigation Measures

Table 11-28 below summarises the rating of the impact significance of noise disturbance during the decommissioning phase.

Table 11-28: Pre-mitigation and post-mitigation significance ratings for impacts on noise during the Decommissioning Phase

Dimension	Rating	Motivation	Significance
Activity and Interaction: Dismantling and removal of the pump stations and pipeline infrastructure			
Impact Description: Noise will emanate from the machinery and vehicles operating during the decommissioning activities.			
Prior and Post mitigation/ management			
Duration	Medium term (3)	Noise will be produced for the duration of the decommissioning phase	Negligible (negative) – 21
Extent	Local (3)	It is expected that during decommissioning noise will extend as far as development site area.	
Intensity	Minimal - negative (-1)	It is expected that during decommissioning noise will have a minimal impact	
Probability	Unlikely (3)	It is unlikely that noise will impact on the surrounding receptors.	
Nature	Negative		
Mitigation/ Management action			
▪ No mitigation recommended due to negligible impact.			

11.1.8 Heritage

A total of 16 tangible heritage resources were identified within the project area (refer to Table 10-27 above). The pre-disturbance survey did not focus on a specified development footprint, but rather a general survey of the areas most affected by project activities. All heritage resources identified are in excess of 100 m of development footprints (including the provisional monitoring and exploration borehole locations identified) therefore no direct impacts to heritage resources from the proposed project activities is envisaged.

11.1.9 Social

The proposed new activities with the Mooikraal MRA and 3 Shaft area are not envisaged to have any additional social impacts. It is noted that the proposed boreholes and possible future ventilation shafts may interact with other surface land uses (i.e. agricultural fields) within the Mooikraal MRA, however, given the limited extent of these activities it is not expected to have a significant social impact. It is recommended that once the localities of these infrastructures are finalised, any possible social impacts be considered and managed accordingly through consultation with relevant stakeholders.

11.2 Identified Existing Impacts (Mooikraal and 3 Shaft))

The following impacts as shown in Table 11-30 have been approved in accordance with the existing 2014 EMPr. These impacts are discussed below to provide an understanding of how the mine may have an impact on certain environmental aspects as it progresses during the operational phase and decommissioning phase.

The existing activities to be undertaken by the Mooikraal and 3 Shaft operations going forward have been summarised in the table below and separated into each phase.

Table 11-29: Existing and Approved Project Activities

Phase of Project	Activity
Operational phase	■ Mining of coal (bord and pillar and high extraction mining method (subsidence)); ■ Conveying of coal via conveyor belt; ■ Water management (ground and surface water) at Mooikraal and 3 Shaft; ■ Waste management at Mooikraal and 3 Shaft; ■ Operation of the Pollution Control Dams at Mooikraal; ■ Operation of the Sewage Treatment Plant at Mooikraal; ■ Operation of the Ventilation shafts and other infrastructure (downcasts); ■ Operation of the Pipelines between Mooikraal and Sasol Operations; ■ Operation of the crusher plant and stockpiling facilities at 3 Shaft; ■ Monitoring of environmental aspects; and ■ WRD.
Decommissioning, rehabilitation and closure phase	■ Decommissioning of all linear structures including roads, pipelines and conveyor belts; ■ Decommissioning of all redundant mining infrastructure as listed in Section 5.2.1 (Mooikraal and 3 Shaft); ■ Decommissioning of activities being undertaken within a water course

Phase of Project	Activity
	(Roads, Pipelines, Conveyor Belts); ■ Backfilling and sealing of Kleinvlei ventilation shaft; ■ Rehabilitation of areas affected by mining including ripping of soil, vegetation establishment, removal of any carbonaceous material; and ■ Rehabilitation of areas where subsidence may have occurred.

Table 11-30: Impact Assessment for Existing Activities

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
Operational Phase	Soil, Land Use and Land Capability	Potential surface subsidence underground mining methods	Subsidence caused by underground mining methods may restrict post mining land capability and agricultural productivity. Surface cracking and subsidence will occur due to large areas that could be affected by high extraction. Due to this land capability will potentially be altered reducing the capability to land with a high degree of limitations for land use.	Moderate (Negative)	▪ Monitoring of undermined areas to assess the effects of subsidence at surface; ▪ Prevent high extraction methods under restricted areas (water courses, farm dwellings, heritage sites etc.) ▪ All subsidence related rehabilitation will be conducted as part of operational rehabilitation, rehabilitation will be informed by a professional; ▪ Rehabilitation of surface cracks, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Areas where vegetation is affected by ponding, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material; ▪ Planning for free drainage of ponded areas where practical; and ▪ All instances of confirmed subsidence due to underground mining will be retained and maintained in a subsidence register.	Minor (Negative)
Operational Phase	Soil, Land Use and Land Capability	Contamination of soil during operational phase	Spillages of hydrocarbons during the operational phase. There is a chance of the machines breaking down or leaking during these activities, hydrocarbon spills at the diesel bay or bulk oil bowser. Coal falling off the conveyor belt can cause contamination to soils and wetlands.	Minor (Negative)	▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities; ▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ All vehicles are to be serviced in a correctly bunded area (workshop); and ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface.	Minor (Negative)
Operational Phase	Soil, Land Use and Land Capability	Soil contamination from WRD	A contamination plume may emanate from the WRD and seep into the soil	Negligible (Negative)	▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained.	Negligible (Negative)
Operational Phase	Fresh Water Resources	Surface operation activities	Ongoing contamination of the freshwater resources present are deemed likely based on the ingress of hydrocarbons associated with increased vehicular activity and coal contamination from the conveyor belt. Additional potential impacts include : ▪ compaction of soils and hardening of surfaces, ▪ loss of catchment yield and surface water recharge, ▪ erosion and sedimentation, ▪ the potential loss of biodiversity and habitat, ▪ loss of natural migration routes for instream fauna and further	Minor (Negative)	▪ Incidents of erosion should be remedied as soon as possible to reduce deterioration of the wetland habitat. Erosion downstream of culverts/crossings is one of the largest impacts and can be addressed with fairly inexpensive energy dissipating measures such as reno mattresses or small concrete structures; ▪ Any coal contamination should be removed to reduce contamination of the water quality. The contaminated material should then be discarded at the correct facility; ▪ Leak detection of the pipelines should be initiated; ▪ Limit the footprint area of the operational activities to what is essential to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas); ▪ All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads; ▪ All vehicles must be regularly inspected for hydrocarbon leaks;	Negligible (Negative)

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
			fragmentation of the systems present.		▪ Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil; ▪ All hydrocarbon spills should be immediately cleaned up and treated accordingly; ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate licenced waste facility; ▪ Permit only essential personnel within the 100 m zones of regulation for all freshwater features identified; and ▪ Ongoing wetland rehabilitation is necessary during the operational phase as stipulated in the monitoring section.	
Operational Phase	Fresh Water Resources	Dewatering	Removal of underground water from the underground mine works may result in a cone of depression near the decline shaft (Mooikraal Groundwater Model, IGS 2018) that could potentially lead to drying out of wetlands in that area leading to fragmentation and habitat degradation.	Minor (Negative)	▪ No mitigation measures	Minor (Negative)
Operational Phase	Fresh Water Resources	Treated effluent being discharged to the Kromelmboogspruit from the STP at Mooikraal	Positive impact pertaining to water quality of the system provided that the water quality complies with the qualities set out in the WUL.	Minor (Positive)	▪ No mitigation actions are required in order to improve the downstream water quality. It is essential that the water being discharged continue to be treated within the limits of the WUL. The established monitoring of discharge quality must be continued in terms of the WUL at monitoring points upstream and downstream from the STP. ▪ Despite the aforementioned, mitigation measures should be in place to limit the potential erosion impacts associated with the discharge of water into a watercourse. Although notable signs of erosion were not observed, some erosion mitigation measures are provided below, should it be noted that erosion is evident. These can be regarded as additional measures to be implemented if notable signs of erosion start to occur and as such have been excluded from the required mitigation measures list. ▪ Armoured outlets utilising naturally occurring rocks can be installed to reduce the intensity of the flow from the pipeline outlet to attempt to limit immediate erosion; ▪ Flow diffusing mechanisms should be implemented (e.g. baffles) to limit any potential erosion and sedimentation likely to be facilitated by the discharge volume of the outfall; and ▪ Should erosion be observed due to the discharge flow, corrective measures must be investigated and implemented accordingly.	Minor (Positive)
Operational Phase	Surface Water	Handling of hydrocarbons (oils, fuels and diesel) during maintenance of pipelines and conveyors and during general mine operations at Mooikraal and 3 Shaft	Surface water quality deterioration from contamination by hydrocarbons (oils, fuels and diesel)	Minor (Negative)	▪ The clean-up and rehabilitation after spillages of coal at the overland conveyor transfer points/drive houses to 3 Shaft and the MK2 conveyor belt to the Silo at Mooikraal should be conducted immediately and appropriately managed to control the spread of the impact to the external environment;	Negligible (negative)

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
Operational Phase	Surface Water	In the event of improper maintenance of PCDs, pipelines and conveyor belts, spillages of mine water and fine coal residues may occur.	The spilt coal residues can wash off into nearby watercourses during rainfall events thereby decreasing the in-stream water quality. Incidental PCD overflows and mine water spillages from pipelines may occur resulting in unauthorised water use (spillage/overflow of mine water to the environment) possibly polluting surface water resources. The probability of PCD overflows is, however, very low due to installed pipelines which transfer surplus PCD water to other functional areas for re-use before PCD freeboard is exceeded.	Negligible (negative)	▪ All mine infrastructure (PCDs, Sewage Treatment Plant, Pipelines, conveyor belts) must be put onto a planned maintenance system to ensure that regular inspections and maintenance is undertaken to prevent spillages at both Mooikraal and 3 Shaft. A job card system will be utilised to request maintenance work. ▪ Monitoring of PCD volumes should be undertaken in order to detect any rise in water levels that may lead to PCD overflows. This is necessary, especially during rainfall events, to ensure that any extra water is quickly transferred through the already installed pipelines away from the PCDs for re-use before any overflows can occur. ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence.	Negligible (negative)
Operational Phase	Surface Water	Surface water contamination	Contamination of surface water resources by leachate from Waste Rock Dump	Negligible (negative)	▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained.	Negligible (negative)
Operational Phase	Surface Water	Operation of the STP	Spillages of sewage effluent from the sewage treatment plant infrastructure or discharges of contaminated effluent not treated to acceptable levels may result in the pollution of surface water resources.	Minor (Negative)	▪ Sewage Treatment infrastructure should regularly be checked and maintained to reduce chances of leakages of contaminated effluent into the natural environment. ▪ Monitoring of treated sewage effluent quality should continue to ensure that all discharges into the Kromelmboogspruit are within acceptable WUL limits. ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence.	Negligible (negative)
Operational Phase	Groundwater	Groundwater removal	As the groundwater is removed from the mine voids, the groundwater resource is depleted in quantity, affecting local aquifers and potentially lowering the water table. A description of the findings from the numerical model is provided in Section 11.2.1 and 11.2.2	Minor (Negative)	▪ Water removed from underground should be stored in the North and South pollution control dams (PCD) and reused for mine processes that are not quality sensitive and are authorised by the WUL. ▪ Excess water shall be pumped away to 3 Shaft (dust suppression) and Sasolburg Operations to prevent any overflows from the PCDs as well as maintain a 800 mm freeboard; ▪ The hydrocensus at Mooikraal is recommended to be updated within the Mooikraal MRA; ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence. ▪ A dewatering network will not be constructed; dry working conditions will be achieved by abstracting groundwater ingress from mine voids during operation, as currently authorised by Mooikraal's approved WUL; ▪ Groundwater monitoring should continue to assess the time series water level and groundwater quality trends as per the approved WUL; and ▪ Numerical modelling should be updated every five years based on groundwater monitoring results as to identify any potential concerns that may rise over the years. ▪ Should any landowner complain of reduced yield/ quality from his borehole due to mining activities, the incident will be investigated by a professional. Upon outcome of the investigation, should it be determined that the landowners borehole has been affected by	Negligible (negative)

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
					mining activities, the WUL, hydrocensus and mining contract will inform the mines decision.	
Operational Phase	Groundwater	Operation of WRD	A contamination plume may emanate from the waste rock dump and seep into the groundwater	Negligible (negative)	▪ The WRD should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation.	Negligible (negative)
Decommissioning and Rehabilitation Phase	Soil, Land Use and Land Capability	Contamination due to WRD	Contamination plume in the groundwater during operation	Negligible (negative)	▪ The waste rock material which will be backfilled into the shaft should be completely flooded; to eliminate exposure to oxygen, this will hinder contamination generating reactions; and ▪ Conduct soil contamination assessments to assess if any remediation is required prior to future land use development.	Negligible (negative)
Decommissioning and Rehabilitation Phase	Soil, Land Use and Land Capability	Rehabilitation of infrastructure areas, roads and subsided areas	Rehabilitation of roads, infrastructure and subsided areas could cause compaction and erosion if rehabilitation is not done correctly. This could result in poor vegetation establishment which would result in exposed surfaces and increase the risk of erosion.	Minor (Negative)	▪ Remove buildings to foundation level. All rubble to be relocated to a specified approved rubble dump or used as backfill / infill material; ▪ Contour slopes to minimise erosion and run-off; ▪ Seal all boreholes (including recue and water monitoring)drilled into the mine as per procedure; ▪ It is assumed that exploration boreholes will be sealed during operational phase ▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All spills from machinery should be immediately cleaned up and treated accordingly and disposed of at an appropriate licenced facility; ▪ Plant native vegetation to prevent erosion and encourage self-sustaining development of a productive ecosystem; ▪ Use waste rock, as stockpiled on Mooikraal, to backfill the incline/ decline shaft ,followed by topsoil to the extent feasible; ▪ Compacted areas are to be ripped to loosen the soil and vegetation cover re-instated; ▪ An inventory of hazardous waste materials stored on site should be compiled, including volumes stored, as well as method of disposal; ▪ The incline/ decline shaft, ventilation shaft as well as downcasts must be sealed as informed by a professional; ▪ Ensure proper stormwater management designs are in place; ▪ Surface inspection on the fully rehabilitated areas must be undertaken to ensure a surface profile that allows good drainage. This will ensure improvement or increased catchment yield on to the surrounding water streams; ▪ Conduct soil contamination assessments to assess if any remediation is required prior to future land use development; and ▪ Only designated access routes are to be used to reduce any unnecessary compaction.	Negligible (negative)
Decommissioning and Rehabilitation Phase	Soil, Land Use and Land Capability	Rehabilitation of wetland areas	Rehabilitation of wetlands and areas impacted from the decommissioning of the existing conveyor belt, crushing facility and coal bunker	Moderate (Negative)		Minor (Negative)
Post Closure	Soil, Land Use and Land Capability	Post closure impact of subsidence on soils	Post closure monitoring and rehabilitation determine the level of success of the rehabilitation. Monitoring will include cracks, erosion and areas of ponding. There is a possibility of loss of land capability if subsidence occurs. A geotechnical assessment and risk assessment will be required and mitigations will need to be	Minor (Negative)	▪ Rehabilitate any erosion as well as damage caused by erosion, the method to be informed by a professional; ▪ Only designated access routes are to be used to reduce any unnecessary compaction. Surface cracks must be effectively rehabilitated by agricultural deep ripping or by a dozer ; ▪ The topsoil should be shaped taking the pre-mining landscape into consideration; ▪ Vehicular movement across rehabilitated areas should be limited where possible while the vegetation is establishing; ▪ The area must be fenced and animals should be kept off the area until the vegetation is self-sustaining;	Negligible (negative)

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
			incorporated to eliminate the risk of subsidence.		▪ Fertilize grassed area with nitrogen containing fertiliser after germination of seeds to promote good growth and development; ▪ Drainage controls such as cut-off trenches and culverts must be used to ensure proper management of water runoff to prevent soil erosion and sedimentation; ▪ Grow indigenous grass to form a vegetative barrier and protect the land from surface erosion; and ▪ Trenching to dewater surface ponds will decrease the extent of surface ponding. Drains need to be checked on a regular basis to ensure that they remain effective.	
Decommissioning and Rehabilitation Phase	Fresh Water Resources	Potential decant	Discharge of decant into freshwater ecosystems may degrade water quality and cause channelisation and associated erosion and sedimentation	Minor (Negative)	▪ Updated groundwater models should be run in order to accurately predict if/where decant will occur and at what volume. ▪ Should it be predicted that decant will occur, a professional will be utilised to determine the best course of action, it must be noted that no decant water must be discharged into watercourses ▪ Comprehensive databases of rescue, groundwater monitoring and geological boreholes must be maintained, ▪ Seal all boreholes drilled into the mine; and ▪ Seal all shafts (mine/ ventilation).	Minor (Negative)
Decommissioning and Rehabilitation Phase	Fresh Water Resources	Decommissioning of all infrastructure	Potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities. Compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream. Any temporary storage or dumping of decommissioned infrastructure within wetland or river areas, has the potential to result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.	Minor (Negative)	▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is essential; ▪ Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream; ▪ No material may be dumped or stockpiled within any wetland areas or within 100m in the vicinity of the proposed decommissioning footprint; ▪ Re-fuelling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; ▪ All existing litter, debris should be removed from the freshwater ecosystems and littering should be prohibited on an ongoing basis; ▪ All spills from machinery should be immediately cleaned up and treated accordingly, the waste should be disposed of to hazardous waste; ▪ Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities and all waste must be removed to an appropriate licenced waste facility ▪ Waste generated from decommissioning activities must be disposed of in accordance with waste regulations; and ▪ Any coal contamination should be removed and discarded at the appropriate facility.	Negligible (negative)
Decommissioning and Rehabilitation Phase	Fresh Water Resources	Rehabilitation measures and site access	Potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities. Compaction of	Minor (Negative)	▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled; ▪ Wherever possible, restrict decommissioning activities to the drier winter months to avoid	Negligible (Negative)

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
			soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.		sedimentation of the freshwater resources further downstream; ▪ An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases; ▪ As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum; ▪ All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint; ▪ All vehicles must be regularly inspected for leaks; ▪ Re-fuelling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; ▪ All existing litter, debris should be removed from the freshwater ecosystems and littering should be prohibited on an ongoing basis; ▪ All spills from machinery should be immediately cleaned up and treated accordingly; ▪ Should the road servitude and overland conveyor have affected the integrity of the wetlands resulting in a loss of habitat and downstream surface water recharge, rehabilitation during the decommissioning and closure phase should focus on the rehabilitation of these areas as informed by a professional. Management in this regard may include removal of the structures, re-profiling of the bed and marginal zones to restore the geomorphological and hydrological integrity and ripping and re-seeding with indigenous wetland grass species. ▪ All incidents of erosion should be remedied and AIPs removed during the operational phase; and ▪ Any coal contamination should be removed and discarded at the correct facility as in the operational phase.	
Decommissioning and Rehabilitation Phase	Surface Water	Removal of infrastructure	Removal of infrastructure will expose and disturb the soil and leave it prone to erosion which leads to increased sedimentation and possible siltation of nearby watercourses (Kromelmboogspruit at Mooikraal and Leeuspruit at 3 Shaft).	Minor (Negative)	▪ Use of accredited contractors for removal or demolition of infrastructure must be adhered to, in order to reduce the risk of waste generation and accidental spillages; ▪ Landscape re-profiling must be undertaken on rehabilitated land to allow good drainage, to ensure improvement of catchment yield close to pre-mining conditions in the surrounding Kromelmboogspruit and Leeuspruit watercourses. this should be informed by a professional.	Negligible (Negative)
Decommissioning and Rehabilitation Phase	Surface Water	Potential decant	Potential surface water pollution from possible decant of contaminated groundwater is envisaged from mine shaft, ventilation shaft and boreholes. The groundwater model outcome, however, predicts a very low probability of decant at the Mooikraal-3 Shaft area (IGS, 2018).	Minor (Negative)	▪ The possibility of contaminated decant can be reduced by sealing-off mine shafts (as informed by a professional) and boreholes drilled into the mine as per Sasol Mining SOPs.	Negligible (Negative)
Decommissioning and Rehabilitation	Groundwater	Groundwater contamination and decant as a result	A contamination plume is likely to originate from the underground mine workings as groundwater recovery commenced and the	Minor (Negative)	▪ All existing boreholes as informed by the registers, with the exception of private water supply boreholes and monitoring boreholes should have been sealed and decommissioned according to Sasol Mining procedure during the operational phase, in order to minimise the chance of decant occurring;	Negligible (Negative)

Phase	Aspect	Activity	Impact Description	Significance Prior to Mitigation	Mitigation Measures	Significance Post Mitigation
Phase		of underground mining	system moved towards filling up the mine voids		▪ All shaft adits, ventilation shafts and down-casts will be sealed and decommissioned as guided by a professional; ▪ Should there be an negative impact to surface water bodies due to decant and base-flow contribution, investigations will occur, and rehabilitation will commence as informed by a professional; ▪ Should there be an negative impact to delineated wetlands, investigations will ensue, and rehabilitation will commence as informed by a professional and ▪ Potential decant should be informed by the numerical model as new data becomes available, should decant be predicted to occur, decant locations should be monitored for decant quality and rate, possible scenarios to manage the decant will be informed by a professional ; ▪ The groundwater monitoring network may be re-assessed and amended to determine the boreholes, to be monitored, necessary to monitor the relevant aquifers sources of contamination and receptors; and ▪ Groundwater monitoring should be conducted to assess the time series water level and water quality trends.	

11.2.1 Groundwater Numerical Model Results – Operational Phase

Modelling of the operational phase was initially simulated from 2004 to 2018 this was done in order to compare model results to observe site conditions over the previous years and calibrating the model according to the best fit of the two measurements. The result of this task is a model of increased accuracy. Future operations were then simulated over a life of mine that extends from 2018 to 2034, showing the impacts of mining to the groundwater environment.

It is noted that the numerical model was conservative and indicated the worst-case scenario.

11.2.1.1 Groundwater Flow

Future groundwater flow predictions simulated between 2018 and 2034 yield the following results:

- The dewatering rate is presented in Figure 11-7 below. The modelling results show that dewatering impacts are observed at depths within the mine and only slightly affected upper shallow water table. This is confirmed by measured groundwater levels within monitoring boreholes that remain stable or are only slightly affected in spite of being located in close proximity of the active mining.
- There are monocline structures within the western parts of Mooikraal. The monocline structures act as preferential flow pathways. These structures were conceptualised to not penetrate the dolerite sills because their formation is understood to have taken place prior the sill intrusions. Thus, the dolerite sills restrict the extent of the drawdown to the immediate area.
- The model simulates the groundwater level above the underground mine (near the decline shaft; where monocline structures that act as vertical preferential pathways are prevalent) falling below the dolerite sill by 2025. This could potentially change the aquifer below the dolerite sill from confined to unconfined, potentially altering the response of the aquifer and the mine inflow rates.

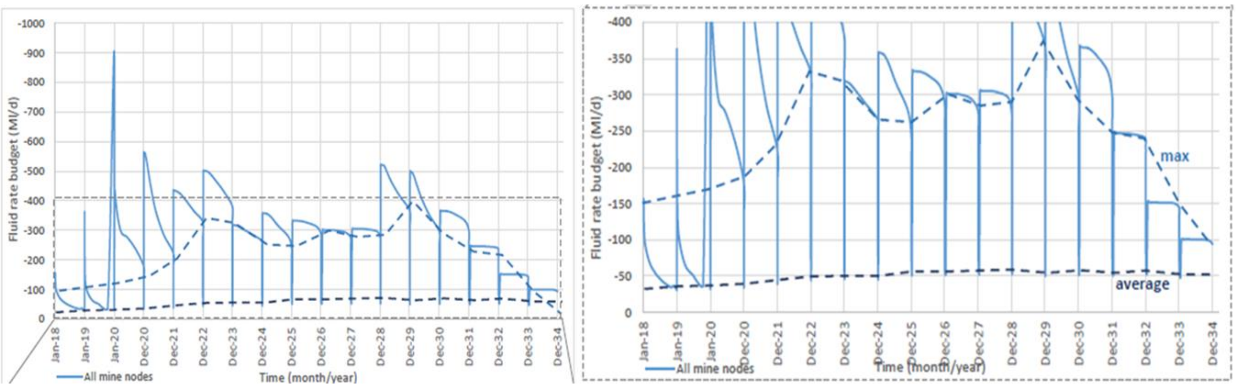


Figure 11-7: Scenario-based simulation of the rate of dewatering for the LOM underground mine voids (2018 – 2034) (IGS, 2018)

11.2.1.2 Impact Description

The results of the numerical model are presented in Section 10.9.5 above. The model simulations indicate minimal impacts from the removal of groundwater. This is due to the presence of the sills which act as aquicludes; restricting impact to the local aquifers in terms of groundwater quantity deterioration. It is also observed in the model that the water levels within the shallow aquifer boreholes are stable throughout the mining activities indicating that the shallow aquifer is insignificantly affected by water removal from the mine void.

However, model simulations predict a notable drop in groundwater level (near the decline shaft where monocline structures are most prevalent) falling below the dolerite sill by 2025.

11.2.2 Groundwater Numerical Model Results – Decommissioning Phase

11.2.2.1 Contamination Plume

The transport of potential contaminants was found to be controlled by the depth of the coal seam, thickness of the overlying dolerite sills and the presence of vertical preferential pathways.

However, at locations where the coal seam is shallow, the dolerite sill is thin and there are vertical preferential pathways such as the decline shaft and monoclines structures. It is at these locations that there is a potential contaminant risk to the shallow aquifer and surface water bodies.

11.2.2.2 Decant

The post-mining model indicated groundwater levels will not fully recover within a 300 year simulation period. The slow recovery, in spite of the underground mine voids being fully flooded, is attributed to the partial depressurisation of the confined aquifer system below the No. 5 dolerite sill. A steady state model was subsequently used to model the fully recovered water levels imposing an equilibrium state and infinite time. The steady state model indicated that the northern boundary of the Mooikraal underground mine is the area where decant is most likely to occur (Figure 11-8) due to the highest hydraulic pressure coupled with the lowest topography. The model estimated a decant rate of 2.5 m^3/d, but this value should be considered only as an initial estimation due to the uncertainty associated with predicting flow rates far into the future based on the current groundwater and climatic conditions.

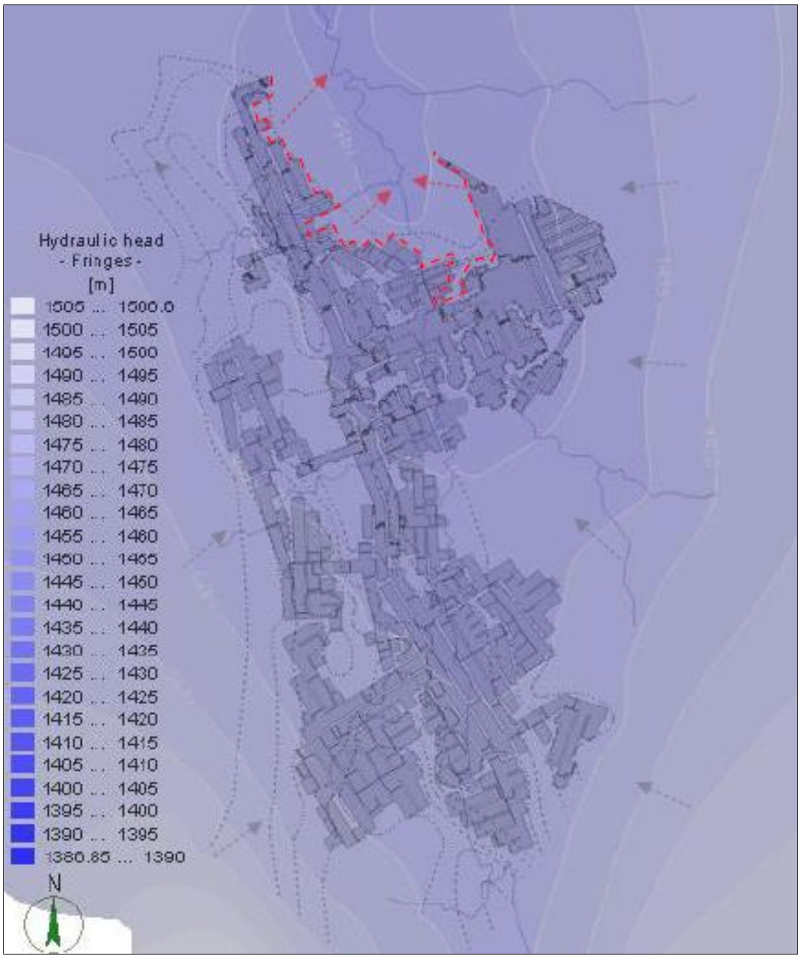


Figure 11-8: Potential decant area (indicated in red)

11.2.2.3 Impact Description

As mining operation at Mooikraal ceases, groundwater removal will also cease. The hydraulic gradient will then drive for the recovery of the local water levels previously affected by removal of water. A contamination plume will be created within the mine voids which will be filling up with groundwater. From model simulations, the contamination plume was found to be limited in extent due to the depth of the coal seam and thickness of the overlying dolerite sills. However, it was observed that at locations where the coal seam is shallower, the dolerite sill is thinner and the presence of vertical preferential pathways (such as the decline shaft and monoclines structures is found), the plume is expected to migrate further introducing a potential contaminant risk to the shallow aquifer and surface water bodies.

The post-mining model indicated that groundwater levels will not fully recover within a 300 year simulation period. The slow recovery is attributed to the partial depressurisation of the confined aquifer system below the No. 5 dolerite sill. Therefore there are uncertainties at this point with regards to the potential of decant. However, for the sake of being conservative in preparation for the worst case scenario; a steady state model was subsequently used to model the fully recovered water levels. The steady state model indicated the northern boundary of the Mooikraal underground mine as the most likely area for decant at an estimated rate of 2.5 m^3/d.

11.3 Unplanned Events and Low Risks

Unplanned events may occur during the project that may have potential impacts which will need mitigation and management. The key risks that will be associated with the Mooikraal operation which could potentially result in contamination of water resources and soil contamination include:

- Spillages of ROM coal from the MK8 and new MK9 conveyor belt route;
- Spillages and leaks/ bursts from pipelines transporting mine affected water between the operations;
- Overflows/ leaks from dirty water containment facilities (silt trap, PCDs and sewage effluent from STP); and
- Hydrocarbon and other hazardous material spillages from vehicles, machinery and storage facilities.

Table 11-31 below is a summary of the identified Project activities that may pose a risk. Not all potential unplanned events may be captured herein and this must therefore be managed by Mooikraal throughout all phases.

Table 11-31: Unplanned Events, Low Risks and their Management Measures

Potential Project Risk (Unplanned Occurrences)	Aspect Potentially Impacted	Mitigation / Management / Monitoring
Spillages of coal material from the conveyor belts	Surface water; Groundwater; Wetlands; Aquatic Ecology; and Soil contamination.	▪ Inspections of the overland conveyor route for any spillages; ▪ Regular maintenance checks and service of the conveyor belt; ▪ Ensure that stormwater management structures are put in place to capture all spills; and ▪ When spillages occur, these must be cleaned up when identified. The coal should be placed back on the conveyor belt or disposed of as hazardous waste.
Hydrocarbon spills from vehicles and heavy machinery, hazardous materials or waste storage facilities.		▪ Hydrocarbons and hazardous materials must be stored in bunded areas; ▪ Refuelling should take place in contained areas; ▪ The Material Safety Data Sheets (MSDS) should be kept on site for reference purposes regarding handling, storage and disposal of hazardous materials; ▪ Ensure that oil traps are well maintained;

Potential Project Risk (Unplanned Occurrences)	Aspect Potentially Impacted	Mitigation / Management / Monitoring
		▪ Vehicles and heavy machinery should be serviced and checked on a regularly basis to prevent leakages and spills; and ▪ Hazardous waste generated onsite must be disposed of at a licenced hazardous waste facility. Safe disposal certificates must be retained for all hazardous waste removed from site.
Spillages/ leaks from pipelines and dirty water containment facilities.		▪ Inspections of the pipelines and water containment facilities must be undertaken for any leaks; ▪ a leak detection system should be implemented to ensure that pipelines are not leaking; ▪ Ensure that stormwater management structures are put in place to capture all spills; and ▪ All accidental discharges of dirty water to the environment that may result in significant pollution should be reported to the competent authority. Action plans should be implemented, including rehabilitation actions.
Contamination of waterbodies utilised by terrestrial fauna.	Surface water; Groundwater; Wetlands; Aquatic Ecology; and Soil contamination.	▪ The incident should be investigated and action plans implemented to address the incident, if necessary an aquatic ecology specialist must investigate the extent of the impact and provide rehabilitation recommendations. ▪ The incident should be captured on internal incident reporting system as per ISO 14001 requirements; and ▪ The incident must be reported on and
Uncontrolled erosion	Surface water; Groundwater; Wetlands; Aquatic Ecology; and Soil contamination.	▪ Erosion control measures must be put in place and provide rehabilitation recommendations.
PCD overflow	Surface water; Groundwater; Wetlands; Aquatic Ecology; and Soil contamination.	▪ The overflow must be stopped as soon as possible ▪ The incident should be reported to the DWS as per WUL license condition and timeframe, ▪ Action plans should be implemented to address the incident ▪ Monitoring of the upstream and downstream water qualities within the watercourse must be implemented

Potential Project Risk (Unplanned Occurrences)	Aspect Potentially Impacted	Mitigation / Management / Monitoring
Failure in the functioning of the clean-dirty water separation and stormwater management plan leading to uncontrolled spilling of polluted from the infrastructure areas	Surface water; Groundwater; Wetlands; Aquatic Ecology; and Soil contamination.	▪ The spilling of the dirty water must be stopped immediately. ▪ Should dirty water enter or have the potential to enter a watercourse, the incident should be reported to DWS as per WUL condition and timeframe; and ▪ The incident should be investigated and action plans implemented to address the incident and rehabilitate the area.
Community expectations and actions	Surface water; Groundwater; Wetlands; Aquatic Ecology; and Soil contamination.	▪ Expectations of communities must be managed by informing them what to expect from the Project in terms of Local Economic Development (LED) and/or community development projects; and ▪ Continuously involve community and municipal structures in the development of any LED or community development projects.
		▪ Establish grievance mechanism which is accessible to aggrieved members of the surrounding communities.

11.4 Cumulative Impacts

Cumulative effects are caused by the accumulation and interaction of multiple stresses affecting the parts and the functions of ecosystems. Of particular concern is the knowledge that ecological systems sometimes change abruptly and unexpectedly in response to apparently small incremental stresses. For purposes of this report, cumulative impacts have been defined as “the changes to the environment caused by an activity in combination with either past, present, and reasonably foreseeable human activities”.

Land uses surrounding the Mooikraal and 3 Shaft project area include mines, agricultural activities, residential areas as well as petrochemical industries. These land uses collectively contribute to adverse impacts to biodiversity cumulatively. The proposed new activities within the Mooikraal MRA and at the 3 Shaft area can be seen to have no discernible negative impact after mitigation measures are implemented, due to the impacted nature of the project area.

The opportunity exists for Mooikraal to contribute to conservation in the region through the remediation of the affected wetland at 3 Shaft which will result in downstream improvements of the Leeuspruit. Conservation of as much of the natural land in the area, and the creation of corridors linking other natural areas, would aid in conservation of ecosystems.

The subsections below generally discuss cumulative impacts associated with the environmental impacts assessed.

11.4.1 Soils, Land Use and Land Capability

The project area and its surroundings consist of mixed land uses ranging from residential areas, mining and its associated infrastructure, industrial and agricultural activities. The land capability of the local area is therefore been greatly impacted. The proposed project is planned over land which can be characterised as mostly disturbed where the land capability has already been impacted. Therefore the establishment of the proposed new activities at Mooikraal are not seen to contribute greatly to cumulative impacts associated with soils, land use and land capability.

11.4.2 Freshwater Resources

The freshwater resources in this area are currently impacted on by extensive mining activities in the area, including current mining at Mooikraal and at Sigma to the north. Road construction, coal conveyors and powerlines associated with mining have caused fragmentation of the systems and coal dust has caused contamination. Mining at Sigma has caused altered topography including subsidence which has resulted in fragmentation of systems. Cultivation and cattle grazing are also large impacts to the area that have resulted in fragmentation and habitat loss of the freshwater ecosystems, in addition to biodiversity loss, nutrient loading and erosion and sedimentation. In addition, other impacts to freshwater resources present in the vicinity of the proposed project include urban settlements and industrial development. The proposed remediation of the affected wetland at 3 Shaft, if correctly implemented, may assist in improving the natural functions and habitat quality of the Leeuspruit freshwater ecosystem. However freshwater ecosystems will continue to be greatly affected by cumulative impacts of the surrounding mixed land uses and consequently downstream adverse impacts.

11.4.3 Surface Water

Cumulative impacts on surface water resources were viewed in the light of similar mining or related operations within the Vaal River Catchment in general, the Kromelmboogspruit and Leeuspruit catchments in particular. Impacts which result from past, present and future activities at the Sasolburg Operations and the Defunct Sigma Colliery are likely to have cumulative impacts on surface water resources adding onto those from operations at 3 Shaft. Carbonaceous materials, sulphate compounds and sewage effluent emanating from the aforementioned facilities (Defunct Sigma Colliery & Sasolburg Operations) are expected to incrementally impact on the Leeuspruit and the Vaal River downstream of 3 Shaft. Based on the above discussion it is clear that cumulative impacts may be significant in this area.

11.4.4 Nuisance Impacts

The mixed land uses of the surrounding area have contributed to existing nuisance impacts (air quality, noise and visual environmental aspects). Air quality within the region is currently impacted on by petrochemical processes as well as mining and agricultural activities resulting in observed exceedances in PM_{10} and $PM_{2.5}$ concentrations. The proposed new activities are not expected to significantly contribute to emissions or dust fallout concentrations if mitigation measures are correctly implemented.

In terms of noise pollution, the project is not expected to contribute to the cumulative impacts or exacerbate current noise levels. This is primarily due to noise propagation not measuring above the rating levels of the surrounding suburban and rural receptors. Furthermore, the cumulative visual impact on the surrounding environment and receptors is low due to the large scale degradation caused by the numerous existing mixed land uses in the project area and surrounds.

12 Item 3(g)(vi): Methodology used in Determining and Ranking the Nature, Significance, Consequence, Extent, Duration and Probability of Potential Environmental Impacts and Risks

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

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

Significance = CONSEQUENCE X PROBABILITY X NATURE

Where

Consequence = intensity + extent + duration

And

Probability = likelihood of an impact occurring

And

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

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 12-1. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this Basic Assessment / Regulation 31 Amendment Report. The significance of an impact is then determined and categorised into one of eight categories (The descriptions of the significance ratings are presented in Table 12-3).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 12-1: Impact assessment parameter ratings

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

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

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

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

Table 12-2: Probability/consequence matrix

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

Consequence

Table 12-3: Significance rating description

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

12.1 Item 3(g)(vii): The Positive and Negative Impacts that the Proposed Activity (in terms of the initial site layout) and Alternatives will have on the Environment and the Community that may be affected

Section 8 above provides an explanation of the site layout, alternatives and aspects that were considered during the finalisation of the layout. The Impact Assessment detailed in Section 11 describes all identified potential impacts associated with the preferred site layout and planned project activities.

12.2 Item 3(g)(viii): The possible Mitigation Measures that could be applied and the level of risk

Mitigation measures for each identified impact have been proposed and are presented with the impact ratings in Section 11.1 above.

12.3 Item 3(g)(ix): Motivation where No Alternatives Sites were considered

The alternatives considered for the project include activity, location process / design, routing alternatives as well as a “No-Go” alternative. These have been detailed in Section 8 above.

12.4 Item 3(g)(x): Statement motivating the Alternative Development Location within the Overall Site

The locations of the proposed new activities associated with this application have been determined based on impacts caused by current activities or based on their intended use. The preferred relocation site for the primary plant at 3 Shaft is located at the existing stockpile area and therefore characterised as an already disturbed footprint which will not result in further disturbance. Furthermore, the location is also ideal as it is directly adjacent to where crushed coal will be stockpiled, reducing the risks associated with transporting coal to the stockpile area and the overall number of dirty water areas.

The location of the proposed boreholes within the Mooikraal MRA has been determined based on the intended use. A large number of boreholes, particularly the exploration boreholes, have been proposed within proximity to water resources. This is due to the nature of the location of the coal which determines the drilling location to obtain the most accurate geological data. The location of the proposed monitoring and rescue boreholes will be determined based on the mining activities and strategically suitable areas that avoid sensitive areas as far as possible.

All other existing development footprints associated with the Mooikraal operation have previously been approved and established accordingly. The alternatives presented in subsequent subsections therefore only pertain to proposed new activities at Mooikraal.

13 Item 3(h): Full Description of the Process undertaken to Identify, Assess and Rank the Impacts and Risks the Activity will impose on the Preferred Site (In respect of the Final Site Layout Plan) through the Life of the Activity

The identification, assessment and ranking of potential new impacts associated with the proposed project were informed by the environmental and technical specialist investigations undertaken. The determined site sensitivities were also considered in the selection of the preferred project site for proposed new activities at Mooikraal. The new impacts associated with the new activities are presented in Table 14-1.

14 Item 3(i): Assessment of each identified potentially significant impact and risk

Table 14-1 presents the potential impacts assessed per project activity and per phase as well as their proposed mitigation / enhancement measures for the proposed new activities subject to the Basic Assessment.

Table 14-1: Assessment of each Identified Impact as per each Activity

Activity	Potential Impact	Aspects Affected	Phase	Significance	Mitigation Type	Significance
1. Demolishing of existing primary plant 2. Construction of new primary plant at stockpile area 3. Drilling of boreholes 4. Construction of additional ventilation shaft (potential future activity)	Site clearance resulting in potential soil erosion, dust generation and soil compaction, and consequently loss of topsoil.	Soil, Land Use and Land Capability	Construction	Minor (negative)	▪ Minimise through site clearing procedures; ▪ Minimise through storm-water management plan; and ▪ Minimise through dust Monitoring Programme.	Negligible (negative)
	Site clearance resulting in soil erosion and soil compaction and consequently adversely impacting water quality of freshwater ecosystems as a result of sedimentation and increased contaminant/dissolved solids entry into wetland and river systems.	Freshwater ecosystems	Construction	Moderate (negative)	▪ Minimise through soil management programme; ▪ Minimise through Stormwater Management Plan; and ▪ Minimise through hazardous chemical and waste management practices.	Minor (negative)
	Site clearance which can result in the spread of AIPs resulting further altering the natural vegetation profiles of freshwater resources.	Biodiversity; and Freshwater ecosystems	Construction	Minor (negative)	▪ Control through Alien Management Plan; and ▪ Control through Rehabilitation Plan	Negligible (negative)
	Site clearance leading to in sedimentation of surface water resources due to increased suspended solids resulting from soil erosion. Consequently this results in water quality deterioration and adverse impacts on aquatic life and downstream water users. Sedimentation and siltation of nearby watercourses due to reconstruction of infrastructure at 3 Shaft as well as construction of boreholes and possible ventilation shafts in proximity to watercourses	Surface Water	Construction	Negligible (negative)	▪ Minimise through Stormwater Management Plan ▪ Control through Dust Management Plan	Negligible (negative)
	Lowering of groundwater table (should excavation take place below the water table)	Groundwater	Construction	Negligible (negative)	▪ Avoid through project designs	Negligible (negative)
	Noise disturbance from construction machinery and vehicles (however not expected to impact any receptors).	Noise	Construction	Negligible (negative)	▪ Avoid through project designs ▪ Avoid through Vehicle and Machinery Maintenance Plan	Negligible (negative)
5. Rehabilitation of affected wetland at 3 Shaft	Rehabilitation of wetland resulting in an improvement of ecological functioning. This is likely to subsequently result in enhanced flood attenuation and toxin filtration wetland functions, leading to improved water quality in the stream.	Surface Water; and Freshwater ecosystems	Construction	Major (positive)	▪ Conduct through water quality monitoring; and ▪ Conduct through post-rehabilitation monitoring (to determine success of rehabilitation efforts)	Major (positive)
6. Operation of infrastructure 7.Maintenance of infrastructure	Operational and maintenance activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Soils, Land Use and Land Capability	Operational	Moderate (negative)	▪ Minimise through Storm-Water Management Plan; and ▪ Minimise through Dust Monitoring Programme.	Minor (negative)
	Operational and maintenance activities resulting in potential ongoing contamination of the freshwater resources	Freshwater ecosystems	Operational	Minor (negative)	▪ Minimise through soil management programme; ▪ Minimise through Stormwater Management Plan; and ▪ Minimise through hazardous chemical and waste management practices	Negligible (negative)

Activity	Potential Impact	Aspects Affected	Phase	Significance	Mitigation Type	Significance
	Drilling boreholes resulting in water table impacts related to a loss of pressure (immediate) and resultant overflowing, which is likely to be expressed in the decommissioning and closure phases.	Freshwater ecosystems; and Groundwater	Operational	Minor (negative)	▪ Avoid through implementation of closure plan for borehole once work is completed.	Negligible (negative)
	Surface water quality deterioration as a result of sedimentation and contaminated runoff entering streams.	Surface Water	Operational	Minor (negative)	▪ Minimise through Stormwater Management Plan; and ▪ Control through Dust Management Plan	Negligible (negative)
	Reduced groundwater quantity as a result of dewatering for underground mining.	Groundwater	Operational		▪ Control through groundwater monitoring programme	
	Elevated dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Air Quality	Construction	Negligible (negative)	▪ Avoid through project designs; and ▪ Minimise through dust management plan.	Negligible (negative)
	Noise disturbance from operational and maintenance activities (however not expected to impact any receptors).	Noise	Operational	Negligible (negative)	▪ Avoid through project designs ▪ Avoid through Vehicle and Machinery Maintenance Plan	Negligible (negative)
8. Demolition and removal of all infrastructure; and 9. Rehabilitation	Soil erosion and soil compaction if rehabilitation is not done correctly.	Soils, Land Use and Land Capability	Decommissioning and rehabilitation	Minor (negative)	▪ Minimise through site clearing procedures; ▪ Minimise through storm-water management plan; and ▪ Minimise through Dust Monitoring Programme.	Negligible (negative)
	Reduced ecological integrity and functioning of wetlands as a result of potential soil compaction, soil erosion and consequent sedimentation of freshwater resources as well as potential encroachment of AIPs as a result of habitat fragmentations.	Freshwater ecosystems	Decommissioning and rehabilitation	Minor (negative)	▪ Minimise through Soil management programme; and ▪ Minimise through Stormwater Management Plan	Negligible (negative)
	Noise disturbance from decommissioning machinery and vehicles (however not expected to impact any receptors).	Noise	Decommissioning and rehabilitation	Negligible (negative)	▪ Avoid through Vehicle and Machinery Maintenance Plan	Negligible (negative)

15 Item 3(j): Summary of specialist reports

Numerous specialist impact assessments were undertaken for the proposed project. Separate specialist reports were compiled and have been attached as appendices to this report (refer to Table 10-1 above). The specialist input included the baseline environment, potential impacts and the recommended mitigation measures. Table 15-1 provides a summary of the key recommendations of the studies.

Table 15-1: Specialist Studies undertake for the Mooikraal and 3 Shaft Project

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
Soils, Land Use and Land Capability Impact Assessment	▪ Runoff must be controlled and managed by use of proper stormwater management facilities; ▪ Hydrocarbon and coal spills are common risks. If they occur the affected areas must be remediate immediately using commercially available emergency clean up kits; ▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained; and ▪ Clearing and removal of soils should preferably be done during dry moths (May to September) to reduce erosion and compaction on soils.	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Soil Specialist, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.
Freshwater Assessment	▪ The proposed project is not expected to result in a direct loss of wetland habitat. Associated impacts such as soil erosion which could subsequently result in sedimentation of wetlands and river systems is however possible. It is therefore imperative that a soil management programme is implemented and maintained to minimise erosion and sedimentation; ▪ The proposed remediation of the affected wetland at 3 Shaft may potentially result in improvements to the ecological integrity and functioning provided by the system and improved water quality. It is highly recommended that ongoing monitoring of the wetlands and aquatic biomonitoring in the vicinity of Mooikraal and 3 Shaft continue t so as to identify emerging trends in terms of improvements or degradation in the ecological integrity and functioning of these systems; ▪ With the exception of the remediation activities, activities within the 100 m zone of regulation for all freshwater features must be avoided as far as possible. If it is absolutely unavoidable that any wetlands areas present will be affected, disturbance must be minimised and suitably rehabilitated; and ▪ Where practical, high rainfall periods (i.e. usually December to March) should be avoided during construction and decommissioning to possibly avoid increased surface runoff.	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Ecologist, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.
Surface Water Impact Assessment	▪ The modelled floodlines are for indicative purposes only, and not meant for any engineering designs. They should be used as a general indication of infrastructure placement, if new mining infrastructure is to be constructed at both the Mooikraal and 3 Shaft sites. ▪ The stormwater management plan at 3 Shaft should be implemented to include the proposed relocation of the Primary Plant and Crusher facilities as per the DWS GN704 regulation. Construction should be undertaken during the dry winter period to reduce sedimentation in the Leeuspruit tributary since there will be minimal to no occurrence of rainfall. Site preparation for the proposed 3 Shaft Primary Plant and Crusher should be confined to the existing 3 Shaft footprint area to minimise disturbance of soils and the probability of sedimentation and siltation of the Leeuspruit tributary. ▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained. ▪ All storage areas for oils, fuels, paints and other chemicals should be appropriately bunded and spill kits should be in place, construction workers should be trained in the use of spill kits, to contain and immediately clean up any potential leakages or spills during the construction.	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Hydrologist, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
	▪ Water quality monitoring 3 Shaft should continue fortnightly upstream (SG/5 and SG/6) and downstream of 3 Shaft on the Leeuspruit tributary during the construction of the primary plant and crusher.		
Groundwater Assessment	▪ Mooikraal: ▪ The hydrocensus previously conducted (and not completed) at Mooikraal is recommended to be updated within a 3 km radius of the project boundary; ▪ X-Ray Diffraction (XRD), acid base accounting and leachable concentration investigations of the coal seam at Mooikraal are recommended.; ▪ A dewatering network will not be constructed; dry working conditions will be achieved by abstracting groundwater ingress from mine voids during operation; ▪ Water removed from underground that is found to be contaminated should be stored in the North and South pollution control dams (PCD) and reused for mine processes that are not quality sensitive. Excess water shall be pumped away to the Sasol Sasolburg Operations to prevent any spillages from the PCDs; ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties. The hydrocensus, WUL and mining contracts will be used to guide the corrective actions; ▪ Should there be an impact to wetlands, ongoing wetland rehabilitation should be conducted according to the Freshwater Impact Assessment Report (Digby, 2018); ▪ Groundwater monitoring should continue to assess the time series water level and groundwater quality trends as per the approved WUL; and ▪ Numerical modelling should be updated every five years based on groundwater monitoring results as to identify any potential concerns that may rise over the years. ▪ 3 Shaft: ▪ Two monitoring boreholes at 3 Shaft are recommended to be drilled downstream (in addition to the existing) of the current location of the primary plant area, one in the shallow, and one in the intermediate aquifer. These boreholes will serve to acquire groundwater samples in order to quantify the presence or absence of contamination in the existing primary plant vicinity with better accuracy; ▪ A hydrocensus is recommended to be conducted within a 1 km radius of the 3 Shaft area; ▪ Maintenance of the stockpile area must be undertaken by developing an effective stormwater management system; ▪ Groundwater monitoring must be implemented to assess the time series water level and water quality trends; ▪ Due to the fact that no underground mining occurs at 3 shaft, all historical groundwater, geological, rescue borehole locations must be retained on a register and the status of the borehole will be recorded; and ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties. The hydrocensus, WUL and mining contracts will be used to guide the corrective actions; ▪ The following recommendations are made during the decommissioning and post-closure phase: ▪ All existing boreholes as informed by the registers, with the exception of private water supply boreholes and monitoring boreholes should have been sealed and decommissioned according to Sasol Mining procedure during the operational phase, in order to minimise the chance of decant occurring; ▪ All shaft adits, ventilation shafts and down-casts will be sealed and decommissioned as guided by a	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Hydrogeologist as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
	professional; ▪ Should there be an negative impact to surface water bodies due to decant and base-flow contribution, investigations will occur, and rehabilitation will commence as informed by a professional; ▪ Should there be an negative impact to delineated wetlands, investigations will ensue, and rehabilitation will commence as informed by a professional and ongoing wetland rehabilitation should be conducted according to the Freshwater Impact Assessment Report (Digby, 2018); ▪ Potential decant should be informed by the numerical model as new data becomes available, should investigated further and if decant be predicted to occur, decant locations should be monitored for decant quality and rate; ▪ The groundwater monitoring network may be re-assessed and amended to determine the boreholes, to be monitored, necessary to monitor the relevant aquifers sources of contamination and receptors; and ▪ Groundwater monitoring should be conducted to assess the time series water level and water quality trends.		
Air Quality Assessment	▪ The implementation of dust controls for the management of dust sources, such as the onsite coal stockpile, as well as the crusher and unpaved haul roads must be done. These include use of fogger cannons, covering the side and top of the conveyor system (cladding) and other dust control measures such as enforcing speed limits on haul roads; ▪ Continuous monitoring of dust fallout must be conducted as part of the project's dust monitoring plan.	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Air Quality Specialist, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.
Noise Impact Assessment	The predictive model generated to quantify the expected noise levels associated with the new proposed activities show that there will be a negligible impact and noise disturbance to any nearby receptors. It is however established that the stockpiling area is currently impacting on the ambient noise levels at the neighbouring urban area of Zamdela as indicated by the measured levels at location N4. It is noted that no complaints from the community have been reported probably due to the community being desensitised by the noise from the coal handling activities having started during the 1950's (roughly the same time as the establishment of the neighbouring areas of Zamdela) and gradually increased in footprint. It is recommended that if any noise related complaints are received from the existing infrastructure, Mooikraal investigate the complaint, and put into place actions to address excessive noise.	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Noise Specialist, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.
Heritage Assessment	The Mooikraal EMPr (2014) does not consider heritage resources. Consequently, no heritage monitoring plans or mitigation measures are stipulated. It is therefore recommended that the measures prescribed under Section 0 and 7 be implemented throughout the project area with respect to both existing and the proposed new activities.	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Heritage Specialist, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.
Rehabilitation, Decommissioning and Financial Provision Assessment	The following is recommended to assist Mooikraal in successfully carrying out all activities within the project: ▪ Regular water monitoring should take place to determine possible changes in water quality and quantity of water resources; ▪ Invasive alien plants should be removed on an ongoing basis; and	X - All recommendations have been considered and included in this report.	Mitigation and management measures included in this report were recommended by the Closure and Rehabilitation Specialist, as well as the monitoring programmes. This includes

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations that have been included in the EIA report	Reference to applicable section of report where specialist recommendations have been included
	▪ Monitoring and maintenance of the rehabilitated areas should take place on an annual basis for at least 2 years post-closure.		the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations provided in Part B Sections 0 and 7 and the monitoring provided in Section 9.

16 Item 3(k): Environmental Impact Statement

16.1 Item 3(k)(i): Summary of the Key Findings of the Environmental Impact Assessment

Mooikraal and 3 Shaft are existing interdependent operations that provide coal to the Sasolburg Operations. New activities are being proposed at the operations which are the primary focus of the Impact Assessment presented in Section 11.1.

As a result of existing adverse impacts to water resources at the 3 Shaft area which are due to the location of the primary coal crushing plant facility and inadequate stormwater management structures, a relocation and wetland remediation project is proposed. The proposed relocation of the primary plant to the existing stockpile area at 3 Shaft as well as remediation of the affected wetland will reduce adverse impacts to the Leeuspruit freshwater ecosystem and potentially also result in improved ecological integrity and functioning of the system.

However some negative impacts are to be expected with undertaking these activities as they will require direct environmental disturbance, although this will be limited in extent. The most significant negative impacts identified are associated with site clearing during the construction phase and general operational and maintenance activities during the operational phase which may result in soil erosion, soil compaction, topsoil loss and subsequent sedimentation of watercourses leading to water quality deterioration. Similarly proposed new activities within the Mooikraal MRA, namely the establishment of several boreholes and possible additional ventilation shafts in future, may result in similar impacts to freshwater ecosystems associated with the Kromelmboogspruit.

The current operational activities at Mooikraal comprise underground mining, conveying of coal via an overland conveyor belt and coal processing and stockpiling at 3 Shaft as well as the operation of various ancillary infrastructure. The applicable impacts associated with the current operational activities are presented in Section 11.2. The key negative implications of this operation include the loss of topsoil resources, soil erosion and compacting resulting from the operation and maintenance of various infrastructure including haul roads. Undergrounding mining may potentially result in surface subsidence from the collapsed underground mine roof which in turn results in a damage of ecological features, significantly impacting the post-mining land capability. Furthermore, the current operational activities have resulted in impacts to wetlands from the existing conveyor belt, crushing facility and coal bunker.

In terms of positive implications, the current operations include clean water discharge into the Kromelmboogspruit from the STP and continued socioeconomic benefits including employment, skills development and improvement of the local socioeconomic profile of the area.

16.2 Item 3(k)(ii): Final Site Map

The final proposed infrastructure layout plan for the proposed relocation activities at 3 Shaft is provided in Plan 3, Appendix 2.

The exact localities of boreholes which are proposed to be drilled within the Mooikraal MRA has yet to be finalised as these will be determined with progression of mining as and when required, and based on the intended use. Provisional locations specifically associated with monitoring and exploration boreholes have been established as illustrated on Plan 7 and Plan 8, Appendix 2.

16.3 Item 3(k)(iii): Summary of the Positive and Negative Implications and Risks of the Proposed Activity and Identified Alternatives

The proposed relocation of the primary plant area at 3 Shaft has been proposed as a rectification measure to the existing adverse impacts to the freshwater ecosystem associated with the Leeuspruit. The key potential implication associated with the relocation of the primary plant outside of the delineated wetland as well as the proposed upgrade of stormwater structure at the new site (stockpile area) include improved downstream water quality and possible improvement/restoration of ecological integrity and functioning of the affected wetland.

The key negative implications include the loss of topsoil resources, soil erosion and subsequent sedimentation of wetland and river systems from cleared areas as a result of construction site clearance as well as operational and maintenance activities. Nuisance impacts, namely noise disturbance and elevated dust generation may also occur although they are not expected to affect nearby sensitive receptors.

The current operational activities may also result in the loss of topsoil resources, soil erosion and compacting from the operation and maintenance of various infrastructure including haul roads. Undergrounding mining may potentially result in surface subsidence from collapsed underground mine roof which in turn results in a damage of ecological features, significantly impacting the post-mining land capability. Furthermore, the discharge of decant into freshwater systems is possible which would result in the deterioration of water quality and cause channelisation and associated erosion and sedimentation. In terms of positive implications, the current operations include clean water discharge into the Kromelmboogspruit from the STP and continued socioeconomic benefits including employment, skills development and improvement of the local socioeconomic profile of the area.

Hydrocarbon and other hazardous material spillages from vehicles, machinery and storage facilities; spillages of ROM coal off the conveyor belts; spillages/leaks from pipelines; and overflows from dirty water containment facilities have been identified as key potential risks for the Mooikraal and 3 Shaft operations.

In terms of alternatives, the relocation of the primary plant at 3 Shaft and associated conveyor belt has been deemed the most feasible option to manage the current persistent environmental impacts associated with the current location which will likely have an overall positive implication. The preferred alternative for the new MK9 belt route does cross the delineated wetland increasing the severity of impacts associated with the risk of spillages of ROM coal, however this is still deemed the most effective route.

The proposed boreholes to be drilled throughout the Mooikraal MRA will be limited in extent and in some areas over already disturbed footprints, therefore are not expected to result in significant additional overall impact. The final localities of the proposed boreholes within the Mooikraal MRA will be determined based on the intended use, therefore no alternatives have been considered.

Mitigation and management measures have been proposed for each identified impact associated with the proposed new activities. Should these be correctly implemented the significance of all impacts can be reduced to negligible significance.

17 Item 3(l): Proposed Impact Management Objectives and the Impact Management Outcomes for Inclusion in the EMPR

The EMPr seeks to achieve a required end state and describes how activities that have, or could have, an adverse impact on the environment and surrounding communities will be mitigated, controlled and monitored. The key objectives of the EMP therefore are:

- To minimise the extent of an impact during the life of the project;
- To ensure appropriate restoration of areas affected by the project; and
- To prevent long term environmental degradation.

18 Item 3(m): Final Proposed Alternatives

The alternatives considered and motivations for the preferred alternatives are detailed in Section 8 above.

Ultimately, the relocation of the primary plant at 3 Shaft has been deemed the most feasible activity alternative to negate the persistent adverse environmental impacts resulting from the current facility location and operation. The new site at the existing stockpile area is deemed the most preferred location alternative as it is an already disturbed footprint, reducing the potential for several impacts associated with undisturbed footprint options.

In terms of the proposed boreholes, no activity alternatives were considered for the proposed exploration, monitoring and rescue boreholes as no other means to achieve the activity objectives could be identified. Furthermore, no location alternatives could be considered as the final strategic determination of their localities will be based on the intended use.

19 Item 3(n): Aspects for Inclusion as Conditions of Authorisation

The EAP recommends the following conditions for the DMR to consider for inclusion into the Authorisation:

- The mitigation/enhancement measures contained in the attached specialist reports and EMPr which consider the entire Mooikraal operation must be adhered to;
- An independent Environmental Control Officer (ECO) must be appointed for construction phase of the proposed new activities at 3 Shaft to conduct environmental inspections on a monthly basis;
- A WUL must be obtained prior to operations; and
- The current monitoring programmes for the Mooikraal operation must be continued to ensure that environmental aspects are managed responsibly.

The specialist studies and impact assessment have been based on the proposed preferred site layout for new proposed activities associated with the Mooikraal operation. Should there be any changes to the project description or site layout plan as provided, the adequacy and accuracy of the work may be affected and additional studies may be required to assess the impacts of these proposed changes.

20 Item 3(o): Description of any Assumptions, Uncertainties and Gaps in Knowledge

The following general assumptions are applicable to this Basic Assessment / Regulation 31 Amendment study:

- Any impacts associated with project activities for which the Mooikraal EMPr and the Environmental Authorisation for pipelines has already been authorised are assumed to have been adequately assessed. The EMPr included in Part B of this report does however account for all activities applicable to the Mooikraal and 3 Shaft operations to ensure one EMPr is utilised for effective implementation of the mitigation measures;
- The areas surveyed for various studies conducted were based on the preliminary infrastructure layout presented by Sasol Mining;
- The findings presented are based on professional experience, supported by a literature review, and extrapolated from the data collected at the time of field surveys conducted. Field surveys for all studies were limited to one season surveys; and
- Representative sampling methods were employed for the studies conducted and therefore the possibility of gaps in the data gathered exists.

Table 20-1 below presents the assumptions, uncertainties, limitations and knowledge gaps to the various specialist studies undertaken, where relevant.

Table 20-1: Specialist Studies Assumptions, Uncertainties and Gaps

Specialist Study	Assumptions, uncertainties and gaps
Soils, Land Use and Land Capability	▪ The information provided in this report is based on information gathered from the site visit undertaken in July 2018 and information reviewed from previous studies; and ▪ A total of six soil samples were collected and analysed.
Freshwater Assessment	▪ The wetland impact assessment is based on a previous delineation completed by Digby Wells in 2014 and a baseline wetland assessment completed by Digby Wells in 2018; ▪ The composition of freshwater resources in the study area prior to major disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available; ▪ In order to obtain a comprehensive understanding of the dynamics of the aquatic biota present within a watercourse (e.g. migratory pathways, seasonal prevalence, breeding cycles, etc.), studies should include investigations conducted during different seasons, over a number of years and through extensive sampling efforts. Given the time constraints of the baseline assessment, such long-term research was not feasible and could not be conducted. Consequently, the findings presented are based on professional experience, supported by a literature review, and extrapolated from the data collected at the time of the wet and dry season field surveys; ▪ Only a single site visit during the September 2018 survey was undertaken for the assessment of the aquatic conditions at the downstream site from 3 Shaft (i.e. Site SC4). Therefore, established baseline conditions at this site, especially the macroinvertebrate assemblage are based on a single season survey only and some seasonal variation in the future is anticipated; and ▪ Although the selected assessment index (i.e. SASS5) is not specifically designed and/or recommended for use in wetland systems (Chutter, 1998; Dickens and Graham, 2002), it was considered a valuable source of data in terms of species sensitivity and composition within the study area. For the purposes of this study, application was limited to the channelled systems that exhibited some evidence of riverine elements (e.g. flowing systems).
Surface Water	▪ The existing stormwater management plan (SWMP) and water quality reports for Mooikraal and 3 Shaft were utilised for the surface water impact assessment; ▪ No water quality sampling was undertaken for this study by Digby Wells for the purpose of this specialist study. Water quality data and reports obtained from Mooikraal were, therefore, considered as representative of current conditions at the Mooikraal and 3 Shaft project site; and ▪ Baseline hydrological assessment, floodlines, water balance and surface

Specialist Study	Assumptions, uncertainties and gaps
	water impact assessment were undertaken as components of the scope of the current study.
Air Quality	▪ No onsite meteorological data was available therefore data from the DEA Zamdela ambient monitoring station (approximately 1.75 km away) was used; ▪ Gaseous emissions from vehicle exhaust and other auxiliary equipment were not quantified as the impacts from these sources are usually localized and unlikely to exceed health screening limits outside the project area; and ▪ Information required for the calculation of emissions from fugitive dust sources for the facility's operations were provided. The assumption was made that this information is accurate.
Noise	▪ Only the new proposed activities at 3 Shaft has been modelled. No noise modelling was undertaken at Mooikraal as it is an underground mine and therefore not likely to impact significantly on the surrounding environment; ▪ It is assumed that during the relocation of the crushing facility, the stockpiling activities will temporarily be halted; ▪ The construction phase is assumed to be carried out during daytime hours (06:00-22:00), therefore only a daytime scenario was modelled for the construction phase and the subsequent impact of the construction phase refers only to the daytime; ▪ The resulting noise contours represent worst case LAeq at any receiver located 360 degrees in the horizontal plane around the noise sources. The noise modelling software is limited to calculating the downwind conditions in all directions; and ▪ The decommissioning phase was not modelled specifically as it is likely that it would produce similar results than that of the construction phase because of similar vehicle and machinery involved.
Heritage	▪ It is assumed the previously recorded heritage resources are accurate and true; ▪ Digby Wells assumes the historical structures are older than 60 years and are therefore generally protected. Should Sasol foresee any alteration or direct disturbance of these structures, the age must be verified prior to these activities and a Section 34 Permit Application process must be followed if required; and ▪ Access could not be gained to the properties RE of the farm Mooikraal 355, MG 1 and sub-division 2 of the farm Ailette 351 and the farm Ponner 259. It is assumed that previously recorded heritage resources are accurate and true.

21 Item 3(p): Reasoned Opinion as to whether the Proposed Activity should or should not be authorised

21.1 Item 3(p)(i): Reasons why the activity should be authorised or not

Mooikraal is an existing operation that provides coal to the Sasol Operations from underground operations. The proposed activities that are subject to this application are planned to ensure better and lawful environmental practices at the operation as well as to enable the optimisation of the extraction of coal through exploration and monitoring boreholes.

Various specialist studies were undertaken as part of this Environmental Authorisation process with the objective of identifying and weighing anticipated impacts and risks associated with the proposed new activities. The findings of the impact assessment have shown that the new activities will have impacts on the receiving environment, namely; the loss of topsoil on cleared land; soil erosion and subsequent sedimentation of wetland and river systems. Due to the current disturbed nature of a large portion of the project area and the extent of the activities, the majority of identified impacts are expected to be of minor or negligible negative significance.

The project will have positive implications as it aims to rectify the current persistent environmental impacts experienced at 3 Shaft. The proposed drilling of numerous exploration, monitoring and rescue boreholes will also have positive implications as it will allow for mining activities to continue optimally with sufficient monitoring of groundwater to identify impacts as well as health and safety measures.

Based on the assessment of the potential negative and positive impacts associated with the project, it is concluded that the proposed project should be authorised. No long-term negative impacts are expected to arise from the new activities proposed. In fact it is expected that these activities will enhance the existing Mooikraal operation should the proposed mitigation measures be correctly implemented.

21.2 Item 3(p)(ii): Conditions that must be included in the authorisation

21.2.1 Specific conditions to be included into the compilation and approval of EMPR

The conditions provided in Section 21.2 above are applicable for inclusion into the EMPr.

21.2.2 Rehabilitation Requirements

A RSIP has been compiled for the Mooikraal operation and is appended to this report as Appendix 13. The intent of the RSIP is to provide a vision, objectives, targets and criteria for final rehabilitation. Closure and rehabilitation is a continuous series of activities that begin at the commencement of the project and construction, and end with achievement of long-term site stability and the establishment of a self-sustaining ecosystem. Table 21-1 summarises the overall rehabilitation actions / requirements for the Mooikraal operation.

Table 21-1: Summary of Rehabilitation and Closure Actions / Requirements

Target Area	Main Actions
■ Infrastructure and Plant Area	■ Infrastructure such as the offices, administration buildings and workshops must be removed, unless legally transferred or sold to another party; ■ If complete infrastructure removal is chosen, all infrastructure should be demolished to 1m below surface and the demolition rubble must be used as backfill / infill material or removed and taken to the nearest licenced waste facility or utilised as backfill for the shaft area, if contaminated; ■ If contamination in the soil is discovered around stockpiled areas, this soil should be removed by 300 mm and disposed of in the appropriate licenced waste disposal facility; ■ The footprint should be ripped 300 mm to alleviate compaction; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ Infrastructure	■ All salvageable equipment and plant is to be removed as the mine is decommissioned; ■ All tanks, pipes and sumps containing hydrocarbons or any other fluids to be flushed or emptied prior to removal once underground mine is sealed off. These tanks should be disposed of at an appropriate licenced waste facility or reuse and recycled if clean; ■ All power and water services to be disconnected and certified as safe. Where practicable cabling containing copper is to be brought to surface; ■ Surface openings (downcasts, ventilation shafts, incline etc.) will be sealed as guided by civil engineers; ■ Box cuts and inclines will be backfilled with the overburden material and demolished rubble if not contaminated; and ■ The seals between the underground workings and the backfill or surface, will be engineered to withstand potential pressure exerted on the seal from water as the workings fill during groundwater rebound.
■ Waste Rock Dump and Product Stockpiles	■ All stockpiled product must be removed; ■ If contamination in the soil is discovered around stockpiled areas, this soil must be removed and disposed of in an appropriately lined licenced waste disposal facility; ■ Use waste rock material in rehabilitation efforts (envirobund, in-filling, back-filling etc.); ■ Rehabilitated areas must be contoured to be free draining where practical and roughly emulate the surrounding surface topography; ■ Rip the waste dump footprint areas to alleviate compaction; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ Roads and Parking areas and other paved surfaces (incl. concrete slabs and bricks)	■ Mine roads that are not needed for closure and post-closure uses at the site (e.g. security and monitoring) will be closed and rehabilitated; ■ Removal of all signage, fencing, shade structures, traffic barriers, etc.; ■ All 'hard top' surfaces to be ripped and bitumen/concrete removed along with any culverts and concrete structures; ■ All concrete lined drainage channels and sumps will be broken up and removed; ■ All potentially contaminated soils are to be identified 'and demarcated for later remediation; ■ All haul roads that have been treated with saline dust suppression water need to be treated as “sealed” roads with the upper surface ripped and removed areas as per waste classification; ■ Establish vegetation establishment to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; ■ All concrete slabs and brick material will be broken up and used as backfill /infill material at Mooikraal; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ Conveyor and Pipeline Route	■ All power and water services to be disconnected and certified as safe prior to commencement of any demolition works; ■ Electrical, water and other services that are more than 1 m below ground surface will remain; ■ Conveyor belting to be removed, cut up and disposed of offsite or reused at other operations; ■ Salvageable equipment will be removed and transported offsite prior to the commencement of demolition; ■ Concrete material will be broken up and used as backfill / infill material at Mooikraal; ■ All concrete below 1 m depth will remain underground with the invert of all structures broken/sealed to prevent possible ingress and ponding of water; ■ All excavations resulting from demolition of the conveyor plinths will be left in a safe manner; ■ Rehabilitated areas must be contoured to be free draining where practical and roughly emulate the surrounding surface topography. The natural topography of the wetland crossing the servitude should be re-instated to ensure that the flow connectivity is restored, this will be informed by a professional; ■ Rip the servitude road and conveyor footprint to reduce compaction; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion;

Target Area	Main Actions
	■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ Mooikraal Silo	■ If complete infrastructure removal is chosen, all infrastructure should be demolished to 1 m below surface and the demolition rubble removed and used as infill at Mooikraal. ■ If contamination is discovered, this soil should be removed and disposed of in the appropriate waste disposal facility. ■ Rehabilitated areas must be shaped to be free draining where practical and roughly emulate the surrounding surface topography. ■ Rip disturbed area, place 300 mm topsoil to reduce compaction. ■ Establish vegetation cover. ■ Remove alien invasive vegetation.
■ PCDs and Water Pipelines	■ De-silt pollution control dams; ■ Conduct a contamination assessment on the PCD's to determine the appropriate rehabilitation measures to be adopted, if sediment is contaminated it may be required that the sediment is removed and disposed of at a registered facility and/or investigate options for in situ rehabilitation; ■ Doze the dam walls; ■ Concrete of the dam overflow to be broken up and used as infill material at Mooikraal; wire mesh at the overflow to be removed and disposed of; ■ Remove supporting plinths for pipeline as well as foundations; piping and other associated infrastructure to be removed; ■ Pump station to be decommissioned, infrastructure removed, concrete slab to be demolished and used as infill material at Mooikraal; ■ Remaining structures should be demolished to 1 m below surface and the demolition rubble removed and any re-usable items should be removed from the site; ■ Soil should be tested for contamination; ■ If contamination is discovered, this contaminated soil should be removed and disposed of in the appropriate waste disposal facility; ■ The footprints of dams must be ripped to 200 mm; ■ Appropriate topsoil should be replaced to a minimum thickness of 300 mm on the rehabilitated areas; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ Sewage Treatment Plants	■ All infrastructure should be demolished to 1m below surface and the demolition rubble removed and used as backfill/infill material. ■ If contamination is discovered, this soil should be removed and disposed of in the appropriate waste disposal facility. ■ Rehabilitated areas must be shaped to be free draining where practical and roughly emulate the surrounding surface topography. ■ Rip disturbed area, place150 mm topsoil to reduce compaction. ■ Establish vegetation cover. ■ Remove alien invasive vegetation.
■ Fencing	■ Service roads providing access to the fences will be rehabilitated; ■ Fencing and walls will be demolished as sections are rehabilitated/closed to ensure access control and monitoring of rehabilitation measures; ■ Monitor and maintain vegetation establishment; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ Coal Stockpile Area and Crusher Plant at 3 Shaft	■ All coal product will be removed from the stockpile area; ■ All infrastructure will be removed (mining and dust suppression infrastructure) ■ The delineated wetland area will be demarcated, with appropriate signage, to prevent any disturbance or unauthorised activity within the regulated area, ■ The conveyor belt spanning the wetland will be removed, as well as associated infrastructure, foundations, and terraces – these actions will be informed by a professional, ■ The stockpile area access roads traversing the wetland will be rehabilitated as informed by a professional; ■ All applicable authorisations will be applied for prior to commencement of any activities within the regulated area of the wetland ■ Cement stockpile pad will be demolished, a contamination assessment of the rubble will determine the disposal of the rubble; ■ Soil containing coal duff will be removed to a depth of 300 mm unless it is noted that the level of coal duff is deeper, a contamination assessment of the soil-coal duff will be undertaken to determine the appropriate means of disposal. ■ Dirty water management structures will be demolished, a contamination assessment of the soil-coal duff will be undertaken to determine the appropriate means of disposal. ■ The area will be contoured to reduce the likelihood of ponding occurring on surface and to blend in with the surrounding topography; ■ The area should be ripped to 500mm to reduce compaction; ■ Appropriate topsoil should be replaced to a minimum thickness of 300mm on the rehabilitated areas; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion;

Target Area	Main Actions
	■ Any remaining dumps should be rehabbed in situ if an excess of material is discovered. ■ Monitor required aspects according to monitoring programme provided in this report.
■ Substation	■ Remove generator and sub-station and associated infrastructure from site; ■ Demolish concrete bund area and conduct a contamination assessment of the rubble to determine the appropriate means of disposal of material; ■ A contamination assessment of the substation footprint must be carried out and corrective actions, as determined by a professional, must be undertaken to address any contamination present. Once the site has been cleared of all infrastructure and rubble and no contamination is present, the area should be contoured to create a gently sloping, free-draining topography where practical; ■ Topsoil should be replaced over the area and ripped to 200 mm to reduce compaction, thereafter establish successful vegetation cover; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to guidelines stipulated in specialist reports appended to the EIA.
■ Diesel Storage Tanks	■ Remove diesel tanks (by owner) and associated infrastructure from site (it is assumed that all potential contamination is removed during operations). ■ Thereafter, demolish concrete bund wall and dispose of contaminated material at a licenced hazardous waste facility. ■ Once the site has been cleared of all infrastructure and rubble and no contamination is present, the exposed area should be reshaped to create a gently sloping, free-draining topography where practical. ■ Monitor and maintain vegetation establishment. ■ Remove alien invasive vegetation.
■ Disturbed areas	■ Contamination assessments must be undertaken in areas where hazardous material was handled to determine if there is any contamination of soils. If contamination in the soil is discovered, this soil must be removed and disposed of in the appropriate waste disposal facility; ■ Rehabilitated areas must be contoured to be free draining where practical and roughly emulate the surrounding surface topography; ■ Rip footprint areas to alleviate compaction; ■ Establish vegetation to ensure a sustainable cover and to prevent erosion; ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion; ■ Remove alien invasive vegetation; and ■ Monitor required aspects according to monitoring programme provided in this report.
■ 3 Shaft Wetland	■ All rehabilitation actions within the wetland regulated area will be informed by a professional, ■ All applicable authorisations will be applied for prior to commencement of any activities within the regulated area of the wetland; ■ During decommissioning of the 3 shaft area, the wetland area will be demarcated and appropriate signage will be erected, to prevent any unauthorised activities and disturbance within the area ■ A dedicated waste disposal is to be established for the inert demolition waste from the conveyor. Steel and any other material of salvage value to be sold and removed from site; ■ Removal of the disused road crossing the wetland; ■ All coal and fine carbonaceous material up to 300mm from the natural ground should be removed from the wetland and stockpiled. Stockpiled waste should be collected with a back-actor, parked on a safe place on the edge of the infilled areas. The remaining 300mm of waste material should be loaded manually (using spades) into the skip of the back-actor to limit any impacts on the existing soils; ■ Subsoil is to be levelled according to surrounding wetland landscape to promote functional hydrology. This includes infilling of the channel that was dug. Wetland soils that can be preserved from the excavated areas associated with the site should be levelled over the area and manually compacted. Patches of Phragmites that don’t need to be levelled should be left in place to assist with colonisation and provide a refuge for biota; ■ Revegetation should ideally take place in the wet season, as far as possible, to promote successful germination. The specialist report lists plant species that would be suitable for revegetation. Many of these species (if not all of them) can be found on site and seed can be harvested manually; ■ Wetland area to be monitored monthly, for a year after the rehabilitation actions are completed to ensure that erosion and alien plant invasion are kept under control and remedied;
■ Kleinvlei Ventilation Shaft, Downcast Shafts and Adit	■ Remove all ventilation shaft related infrastructure; ■ Seal all shaft as guided by a civil engineer; ■ Appropriate topsoil should be replaced to a minimum of 300 mm thick in all rehabilitated areas. This must be included in the monitoring programme; ■ Topsoil should be fertilised and ripped to 200 mm to reduce compaction. The fertiliser requirements can only be determined once a fertility assessment is carried out at the proposed project area; ■ Remove alien invasive plants; and ■ Prevent access of people/machinery/vehicles/grazing animals on newly rehabilitated land to allow regeneration of vegetation and reduce erosion.

22 Item 3(q): Period for which the Environmental Authorisation is required

The approved LOM for the Mooikraal operation is 21 years (until 2039). The consolidated Environmental Authorisation should be aligned to this LOM.

23 Item 3(r): Undertaking

Please refer to Part B, Section 13 for the complete undertaking applicable to both the EIA and EMP sections of this report.

24 Item 3(s): Financial Provision

The Financial Provisioning Assessment for the Mooikraal Operation is updated annually, the last update was conducted by Jones and Wagner (last update: in March 2018. The area of responsibility assessment was divided into three areas, namely Sigma No. 3 Shaft, Old Sigma Coal Handling (primary plant area at 3 Shaft) and Mooikraal Shaft, referred to as Mooikraal operations.

The estimated closure cost required for the rehabilitation and closure of the Mooikraal operation is **R 114,612,971.00 (incl. VAT)**. A detailed closure cost breakdown is provided in Table 24-1 below.

Table 24-1: Summary of FY2018 Cost Estimation (Jones and Wagner, 2018)

	01 - Dismantling of processing plant and related structures	02(A) - Demolition of steel buildings and structures	02(B) - Demolition of reinforced concrete buildings and structures	02(C) - Demolition of brick office buildings and structures	03 - Rehabilitation of access roads	07 - Sealing of shafts, adits and inclines	08(A) - Rehabilitation of overburden and spoils	10 - General surface rehabilitation, including grassing of all denuded areas	12 - Fencing	13 - Water management (separating clean and dirty water, managing polluted water and managing the impact on groundwater, including treatment, when required)	15 - Miscellaneous items	pg - P&G	Grand Total
MKR - Mooikraal	7,572,526	5,150,211	10,935,870	3,762,036	903,783	4,277,969	32,678,361	19,808,709	816,055	9,138,490	466,801	19,102,162	114,612,971
MKR1 - Sigma No 3 shaft		1,729,702	73,066	2,441,709	238,774			4,234,937	439,003	80,098	3,344	1,848,126	11,088,759
MKR2 - Mooikraal	5,553,846	2,610,239	1,112,144	1,166,689	665,009	4,277,969	32,678,361	6,045,729	221,734	3,922,049	254,181	11,701,590	70,209,540
MKR3 - Old Sigma Coal Handling	2,018,680	810,270	9,750,660	153,638				9,528,043	155,317	5,136,343	209,275	5,552,445	33,314,672
Grand Total	**7,572,526**	**5,150,211**	**10,935,870**	**3,762,036**	**903,783**	**4,277,969**	**32,678,361**	**19,808,709**	**816,055**	**9,138,490**	**466,801**	**19,102,162**	**114,612,971**

24.1 Item 3(s)(i): Explain how the aforesaid amount was derived

The financial liability cost update was calculated in alignment with Financial Provisioning Regulations, 2015 (GN R 1147). The following assumptions are applicable to the updated (March 2018) closure cost model calculated:

- Sigma 3 Shaft:
  - Topsoil will be purchased, assumed 10 km transport, covering 50% of the area with a layer 250 mm thick;
  - All alien invader trees will be removed;
  - All fencing will be removed, with exception of fencing around the remaining buildings and stores;
  - The cost of demolishing of the overland conveyor and rehabilitation of the conveyor route is included in the Mooikraal costing;
  - Dumping sites for building rubble are approximately 22 km from 3 Shaft; and
  - Crushing of building rubble is included in costing rates.
- Mooikraal Shaft:
  - Adequate topsoil is available on the site in fills and embankments, with exception of the coal discard dump area and the adit;
  - All fencing will be removed;
  - The asphalt access road, fencing and drainage structures will be demolished;
  - All the earth dams will be demolished and the surface areas rehabilitated; and
  - Cost of rehabilitation of river crossings along the overland conveyor has not been included in the costing due to unknown design requirements.
- Coal Handling Plant
  - The cost of demolishing the overland conveyor is that of Mooikraal, up to the transfer point; and
  - The coal stacker is movable equipment and is excluded from costing.

24.2 Item 3(s)(ii): Confirm that this amount can be provided for from operating expenditure

Sasol Mining has made provision for closure as legally required. A liability assessment update will continue to be undertaken annually to ensure the financial provision is in line with the closure cost.

25 Item 3(t): Deviations from the Approved Scoping Report and Plan of Study

25.1 Item 3(t)(i): Deviations from the methodology used in determining the significance of potential environmental impacts and risks

Not applicable.

25.2 Item 3(t)(ii): Motivation for the deviation

Not applicable.

26 Item 3(u): Other Information required by the Competent Authority

Not applicable.

26.1 Item 3(u)(i)(1): Impact on the socio-economic conditions of any directly affected person

The proposed new projects at Mooikraal and 3 Shaft are not expected to have any additional direct socio-economic impacts. The new activities have been proposed to ensure better and lawful environmental practices at the operation which in turn will ensure the continuation of the operation. In terms of socio-economic considerations, this will result in continued job security and other secondary socio-economic benefits related to the operation.

It is noted that people within the vicinity of the project may experience some nuisance impacts (visual, noise and dust) however based on these have been deemed negligible.

26.2 Item 3(u)(i)(2): Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

A total of 16 tangible heritage resources were identified within the project area. All heritage resources identified are in excess of 100 m of development footprints (including the provisional monitoring and exploration borehole locations identified) therefore no direct impacts to heritage resources from the proposed project activities is envisaged.

In line with the provisions set out under the NHRA, a NID and RfE based on the findings of the pre-disturbance survey, was submitted to SARHA. The NID is appended to this report as Appendix 11.

27 Item 3(v): Other matters required in terms of Sections 24(4)(a) and (b) of the Act

Not applicable.

Part B: Environmental Management Programme Report

1 Item 1(a): Details of the EAP

Digby Wells and Associates South Africa (Pty) Ltd (Digby Wells) has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment/ Regulation 31 Amendment Process. The details of the EAP are provided in below.

Table 1-1: Contact Details of the EAP

Name of Practitioner:	Claire Wannenburgh
Telephone:	011 789 9495
Fax:	011 069 6801
Postal Address	Private Bag X10046, Randburg, 2125, South Africa
Email:	claire.wannenburgh@digbywells.com

2 Item 1(b): Description of the aspects of the activity

This EMPr has been compiled as a tool which will be utilised to manage and mitigate as far as possible against any potential adverse environmental impacts associated with each phase of the Mooikraal and 3 Shaft operation. The EMPr therefore considers current activities, as discussed in Section 5.2.1 (Part A above) as well as proposed new activities as discussed in Section 5.2.2 (Part A above) to ensure effective implementation of the mitigation measures for the operation in its entirety.

It is noted that the majority of activities are existing, therefore construction phase activities relate to the proposed new activities only.

The project activities included in the EMPr are detailed in Table 2-1 below.

Table 2-1: Project Activities

Construction Phase	Operational Phase	Decommissioning Phase	Post-Closure Phase
▪ Establishment of the contractors camp ▪ Site clearance, topsoil removal and stockpiling; ▪ Demolition of existing conveyor belt and primary plant which is situated in a wetland at 3 Shaft; ▪ Reconstruction of primary plant within the stockpile area (including upgraded stormwater structures); ▪ Construction of MK9 conveyor belt at 3 Shaft; ▪ Construction of ventilation shafts within Mooikraal MRA (possible future activity); ▪ Storage and handling of hazardous products (including fuel, chemicals and oil) and waste from the construction camp at 3 Shaft; and ▪ Remediation of affected wetland at 3 Shaft.	▪ Underground mining of coal (bord-and-pillar and high extraction); ▪ Conveying coal via overland conveyor belt [MK1-MK7 (approx. 18 km) and MK9 (approx. 650 m)] and operation of water transfer pipeline (underground 7 Ml/day; overland 10 Ml/day; various potable water and sewage pipelines); ▪ Operational and maintenance of infrastructure (incl. incline shaft, Kleinvlei ventilation shaft, downcasts, STP, haul roads, primary crusher plant, machinery and overburden stockpile); ▪ Maintenance of the stormwater management infrastructure including dirty water channels, PCDs and silt traps and the clean water berms and trenches ▪ Dirty water storage in the North and South PCDs; ▪ Operation of the STP ▪ Operation of the crusher plant at 3 Shaft; ▪ Stockpiling of ROM and crushed coal at 3 Shaft; ▪ Storage and handling of hazardous products (including fuel, chemicals and oil) and waste; ▪ Operation of contractors yard at 3 Shaft, haul roads,	▪ Demolition and removal of infrastructure (incl. transporting materials) (redundant and linear); ▪ Backfilling and sealing of shafts; ▪ Decommissioning of infrastructure within any water course or wetland ▪ Storage, handling and treatment of hazardous products (incl. fuel, explosives and oil and waste); ▪ Rehabilitation (including spreading of soil, re-vegetation and profiling/contouring); and ▪ Remediation of areas where subsidence has occurred	▪ Post-closure monitoring

Construction Phase	Operational Phase	Decommissioning Phase	Post-Closure Phase
	change houses, surface ablution facilities and kitchens; and ▪ Drilling of monitoring, exploration and rescue boreholes; ▪ Alien invasive management in all disturbed areas for areas under control of Mooikraal.		

3 Item 1(c): Composite Map

The Composite Map is attached as Plan 28, Appendix 2.

4 Item 1(d): Description of Impact management objectives including management statements

4.1 Item 1(d)(i): Determination of closure objectives

Closure and rehabilitation is a continuous series of activities that begin with planning prior to the project's design and construction, and end with achievement of long-term site stability and the establishment of a self-sustaining ecosystem. Not only will the implementation of this concept result in a more satisfactory environmental outcome, but it will also reduce the financial burden of closure and rehabilitation.

The overarching objective with respect to closure is to rehabilitate the land use to sustain grazing of domestic animals. This post-mining land use is aligned and compliments the surrounding land use. Based on this determined post-mining land use, the following points outline the main objectives for rehabilitation and closure of the Mooikraal operation:

- To comply with all applicable legislation at the time of final rehabilitation and closure;
- To monitor the success of rehabilitation actions to ensure post-mining land use is sustainable;
- To ensure that the post mining land use is physically stable in that it does not pose a hazard to public health and safety;
- To ensure that the post mining land use is environmentally stable, in that adverse environmental risks have been identified and mitigated;
- To constructively consult with all relevant I&APs and ensure the post-mining land uses is agreed upon and any grievances are addressed.

Ultimately the closure of the operation should result in the land being ceded for other productive and sustainable land uses. This comprises ensuring that the land is physically and environmentally stable to sustain the agreed upon post-mining land use. Progressive meaning consultation with stakeholders regarding the closure objectives is crucial to ensuring the determined post-mining land use is agreed upon and relevant to the surrounding socio-economic needs which in turn ensures its sustainability.

4.2 Item 1(d)(ii): The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity

Mooikraal has established Environmental Response Plans/Procedures which are implemented in event of unintended environmental damage or pollution. These plans/procedures are aimed at rapidly and effectively managing emergency situations that may arise at the mine.

Figure 4-1 provides a general overview of the Emergency Response Procedure.

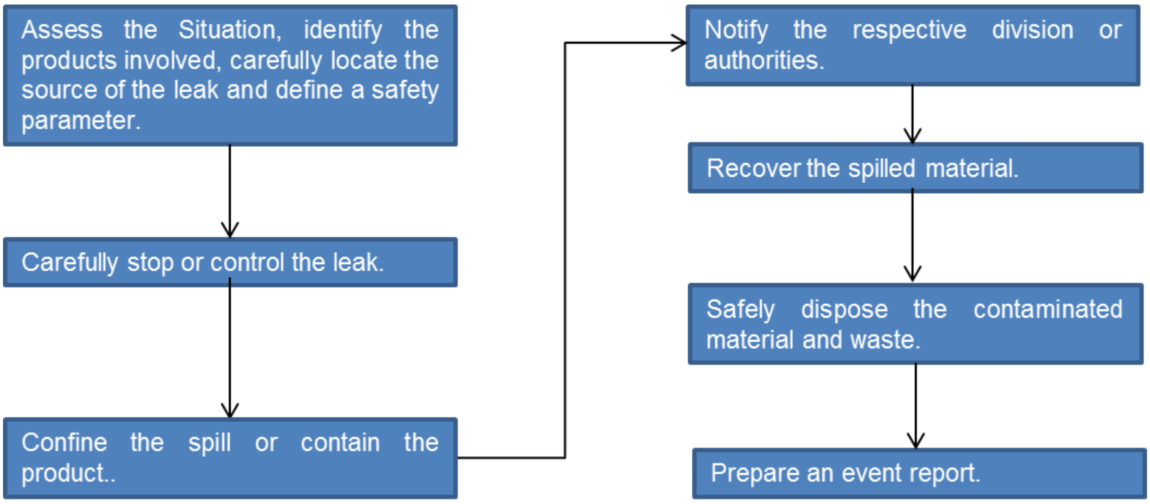


Figure 4-1: Emergency response procedure overview

4.3 Item 1(d)(iii): Potential risk of Acid Mine Drainage

The post-mining model (based on the numerical model developed by IGS, 2018) indicated groundwater levels will not fully recover within a 300 year simulation period. The slow recovery, in spite of the underground mine voids being fully flooded, is attributed to the partial depressurisation of the confined aquifer system below the No. 5 dolerite sill. Therefore, there are uncertainties at this point with regards to the potential of decant. However, for the sake of being conservative in preparation for the worst case scenario, a steady state model was subsequently used to model the fully recovered water levels imposing an equilibrium state and infinite time. The steady state model indicated the northern boundary of the Mooikraal underground mine as the most likely area for decant at an estimated rate of 2.5 m^3/d. The decant rate should be considered only as an initial estimation due to the uncertainty associated with predicting flow.

In the event that decant occurs, it is anticipated that this decant will be acid forming (acid mine draining, AMD). Therefore long-term passive water treatment options will need to be investigated to prevent untreated AMD decant water from entering the catchment.

4.4 Item 1(d)(iv): Steps taken to investigate, assess, and evaluate the impact of acid mine drainage

The acid generating potential for Mooikraal is unknown. X-Ray Diffraction (XRD), acid base accounting and leachable concentration investigations of the coal seam at Mooikraal have been recommended to assess any potential of acid mine water forming. (refer to Groundwater Assessment, Appendix 8).

4.5 Item i(d)(v): Engineering or mine design solutions to be implemented to avoid or remedy acid mine drainage

The acid generating potential for Mooikraal is unknown. XRD, acid base accounting and leachable concentration investigations of the coal seam at Mooikraal have been recommended to assess any potential of acid mine water forming. (refer to Groundwater Assessment, Appendix 8).

4.6 Item 1(d)(vi): Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage

The acid generating potential for Mooikraal is unknown. XRD, acid base accounting and leachable concentration investigations of the coal seam at Mooikraal have been recommended to assess any potential of acid mine water forming. (refer to Groundwater Assessment, Appendix 8).

4.7 Item 1(d)(vii): Volumes and rate of water use required for the mining, trenching or bulk sampling operation

Water is required for use throughout the operation which is sourced from the underground workings. Underground water that ingresses into the underground workings is pumped from the underground water storage compartments to the North and South PCDs at Mooikraal. Potable water required for both Mooikraal and 3 Shaft are satisfied by Randwater via a potable water line.

The updated Water Balance for the Mooikraal and 3 Shaft operations is presented in the subsection below.

4.7.1 Water Balance

The water balance with process flow for Mooikraal-3 Shaft is indicated in Figure 4-2 while the DWS format of the water balance is presented in Table 4-1.

The water balance shows that runoff from dirty areas is captured in the South and North PCDs (MK dirty water dams). The dust suppression volume for Mooikraal is indicated to be 964 569 m^3/annum while that for 3 Shaft is indicated to be 493 339 m^3/annum constituting groundwater from the OG3 and Old 66 pits and rainfall. A treated sewage effluent volume of 25 000 m^3/annum from the STP (Cl2 Tank) is discharged to the natural environment.

The total dust suppression volume of 1 457 908 m^3/annum for Mooikraal and 3 Shaft falls within the WUL limit of 7 440 000 m^3/annum. The volume of treated effluent (25 000 m^3/annum) that is discharged to the natural environment complies with the 30 000 m^3/annum stipulated by the WUL requirements.

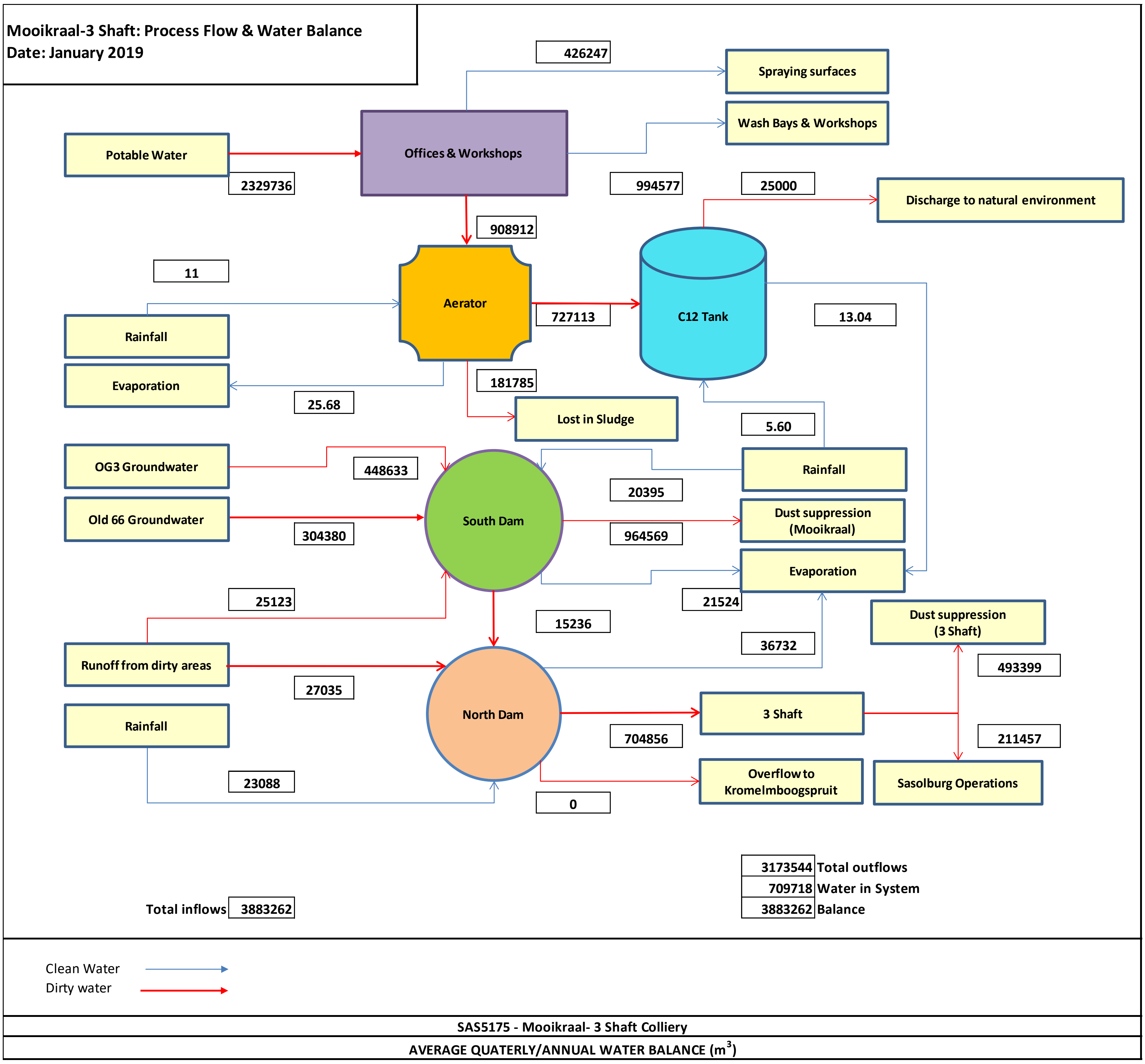


Figure 4-2: Water balance with PFD for the Mooikraal-3 Shaft

Table 4-1: DWS format water balance for the Mooikraal-3 Shaft

Mooikraal - 3 Shaft Water Balance (m^3)					
Facility Name	**Water In**		**Water Out**		**Balance**
	Water Circuit/stream	**Quantity**	**Water Circuit/stream**	**Quantity**	
Offices & Workshops			Spraying Surfaces	426,247	
	Potable Water	2,329,736	Wash Bays & Workshops	994,577	
			Aerator	908,912	
	Total	**2,329,736**		**2,329,736**	**0.00**
Aerator	Rainfall	11	C12 Tank	727,113	
	Offices & Workshop	908,912	Lost in Sludge	181,785	
			Evaporation	25.68	
			Water in storage	0.00	
	Total	**908,923**		**908,923**	**0.00**
C12 Tank	Rainfall	5.6	Discharge to Natural Environment	25,000.0	
	Aerator	727,112.8	Evaporation	13.0	
			Water in storage	702,105	
	Total	**727,118**		**727,118**	**0.00**
South Dam	Rainfall	20,395	North Dam	15,236	
	Runoff from Dirty Water Areas	25,123	Dust suppression at Mooikraal	964,569	
	OG3	448,633	Evaporation & Other losses	160,142	
	Old 66	304,380	Water in storage	46,920	
	Make-up	388,337			
	Total	**1,186,867**		**1,186,867**	**0.00**
North Dam			Evaporation	36,732	
	Rainfall	23,088	Overflow to Kromelmboogspruit	0.00	
	South Dam	15,236	Infrachem at 3 Shaft	704,856	
	Runoff from Dirty Water Areas	27,035	Water in Storage	836	
	Make-up	677,066			
	Total	**742,425**		**742,425**	**0.00**
3 Shaft					
			Sasolburg	211,457	
	North Dam (Mooikraal)	704,856	Dust suppression at 3 Shaft	493,399	
	Total	**704,856**		**704,856**	**0.00**

4.8 Item 1(d)(viii): Has a water use licence has been applied for

Mooikraal has an authorised WUL namely: 08/C22K/CIGJFAE/6981 (dated 16 January 2018) for water uses associated with the Mooikraal operation and 10 Ml/day and 7 Ml/day pipelines.

An application for WUL for Section 21 Water Uses associated with the proposed new activities, namely wetland crossing for the new MK9 belt and drilling boreholes in proximity to water resources is being applied for from DWS as per NWA requirements.

DIGBY WELLS ENVIRONMENTAL

5 Item 1(d)(ix): Impacts to be mitigated in their respective phases

The proposed mitigation measures and its compliance with the relevant standards are presented in Table 5-1. It is noted that the mitigation measures presented below is applicable to the Mooikraal operation, 3 Shaft Operation as well as the conveyor belt, servitudes, pipelines and associated haul roads.

Table 5-1: Impacts to be mitigated

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
CONSTRUCTION PHASE							
1. Site clearance, topsoil removal and stockpiling; 2. Demolition of existing conveyor belt and primary plant which is situated in a wetland at 3 Shaft; 3. Reconstruction of primary plant at stockpile area (including upgraded stormwater structures); 4. Construction of MK9 conveyor belt at 3 Shaft; 5. Construction of ventilation shafts within Mooikraal MRA (possible future activity);	Soil, Land Use and Land Capability	Site clearance resulting in potential soil erosion, dust generation and soil compaction, and consequently loss of topsoil.	Construction	3 Shaft (39ha) Conveyor route (650m)	▪ Limit vegetation clearance to a footprint as small as possible, ie: only when and where necessary; ▪ Only remove topsoil when and where necessary ; ▪ Topsoil should be removed when the soil is dry; ▪ Should soils be stripped for the construction of ventilation shafts and or structures, the soil should be stripped and stockpiled separately for rehabilitation; ▪ Prevent any hydrocarbon spills from heavy machinery and construction vehicles from occurring; ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, if applicable, reported to the appropriate authorities; ▪ All vehicles are to be serviced at a workshop; ▪ Drip trays should be placed under vehicles leaking hydrocarbons; ▪ Berms will be placed around construction areas, so as to keep clean water from entering the construction area, as well as prevent water being released from the construction area that is high in suspended solids. ▪ Any topsoil removed should be vegetated and stockpiled to a maximum height of 3 to 4 m for protection against erosion should it be stockpiled for a period longer than 12 months; ▪ Only the designated access routes are to be used to avoid unnecessary soil compaction; and ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion.	Chamber of Mines Guidelines	Design and Construction Phase
	Flora and Fauna	Direct loss of floral species/vegetation types and biodiversity	Construction	3 Shaft (39ha) Conveyor route (650m)	▪ The construction area shall be demarcated to prevent unauthorised entry the construction area; ▪ Limit site clearing of natural environment to the designated project areas by clearly demarcating the construction areas and restricting access to adjacent areas; ▪ Revegetate open and disturbed areas once construction is complete to limit erosion and aid with water infiltration and flood attenuation; ▪ Avoid sensitive landscapes such as riparian and wetland areas that were encountered on site that are not already impacted by the mining operation; ▪ Alien vegetation should be removed in the correct way and timeously before it starts flowering. An Alien Invasive Management plan should be compiled and implemented.	NEMA; and NEMBA.	Construction Phase
	Freshwater ecosystems	Site clearance resulting in soil erosion and soil compaction and consequently adversely impacting water quality of freshwater ecosystems as a result of sedimentation and increased	Construction	Local	▪ Ensure that a soil management programme is implemented and maintained to minimise erosion and consequent sedimentation of freshwater resources; ▪ Sequential removal of the vegetation should take place (not all vegetation immediately). ▪ Limit the footprint area of the construction activities to the immediate construction area to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ Revegetate the construction footprint and vehicular pathways once the construction is completed; ▪ Clean stormwater should be diverted away from construction areas by berms;	Section 19 of the NWA NEM:BA NEMA	Design and construction phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
		contaminant/dissolved solids entry into wetland and river systems.			▪ Construction method statements must be developed and implemented for the construction of the conveyor crossing at the wetland; and ▪ The proposed conveyor gantry should be fully covered.		
	Surface Water	Siltation of surface water resources due to increased suspended solids resulting from soil erosion.	Construction	Local	▪ Clearing of vegetation and excavation should be limited as far as possible; ▪ Site preparation for the new 3 Shaft Primary Plant and Crusher should be confined to stockpile minimal area to minimise disturbance of soils and the probability of sedimentation and siltation of the Leeuspruit tributary; ▪ Rehabilitation and revegetation of the disturbed 3 Shaft site after removal of the Primary Plant and Crusher, and the decommissioning of the coal bunker should be undertaken to reduce chances of soil erosion and subsequent sedimentation in nearby streams; ▪ For any required soil stockpiles, these should be compacted and the slopes should be kept at minimal/low to avoid erosion; ▪ Dust suppression measures must be implemented on the cleared areas during construction; ▪ No water should be abstracted from the stream for construction purposes without the necessary water authorisation in place.	NWA	Design and construction phase
	Groundwater	Lowering of groundwater table.	Construction	Local	▪ Restrict construction activities to areas above the water table; ▪ If that is not possible, dewatering of the aquifer to locally lower the water table can be considered to ensure that the construction takes place above the groundwater level and the water quality remains the same as prior to construction activities; and ▪ Hydrocarbon spillages shall be managed and clean up within 24 hours of incident occurring, waste to be disposed of to hazardous waste bins.	NWA	Design and construction phase
	Air Quality	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Construction	Local	▪ Where practical, construction activities should be limited to non-windy days (wind speed < 5.4 m/s,); ▪ Monitoring of dust fallout must continue during the construction phase as per dust monitoring network at 3 shaft ▪ Speed limits must be enforced on haul roads . It is recommended these be set at 30 km/h; and ▪ Construction machinery and vehicles must be switched off when not in use.	NEMAQA	Design and construction phase
	Noise	Noise disturbance from construction machinery and vehicles (however will not impact on any receptors).	Construction	Local	▪ Construction activities should be restricted to daylight hours (7h00 – 16h00); and ▪ Machinery and vehicles must be switched off when not in use.	National Noise Control Regulations	Construction Phase
	Visual	Visual intrusion caused by construction activities.	Construction	Local	▪ Disturbance of the natural environment must be limited to the designated project areas; ▪ Apply dust suppression techniques to limit dust generated from the topsoil spoils; if topsoil is stockpiled; and ▪ Avoid construction activities at night, limit construction activities to 7h00 – 16h00.	NEMA	Construction Phase
	Heritage	Direct disturbance of heritage resources (however not expected – proposed activities in excess 100 m from identified heritage	Construction	3 Shaft (39ha) Conveyor route (650m) Mooikraal MRA	▪ A 50 m no-go buffer zone should be implemented around all identified heritage resources; ▪ Clearly demarcate the established "unauthorised zone" buffer and place visible signage; ▪ A Chance Finds Protocol (CFP) and Fossil Finds Protocol (FFP) must be developed by a professional for implementation prior to the commencement of construction activities; and	NHRA	Design and Construction Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
		resources)		6700ha	▪ Immediately inform SAHRA of any newly-identified heritage resources identified and enlist the services of a qualified and accredited heritage practitioner to assess the find and recommend appropriate management and/or mitigation measures as per CFP and FFP).		
	Social	Potential employment opportunity and income generation	Construction	3 Shaft (39ha) Conveyor route (650 m)	▪ Procurement procedures should favour the use of local service provides as far as possible.	NEMA	Construction Phase
6. Storage and handling of hazardous products (including fuel, chemicals and oil) and waste at construction camp at 3 Shaft.	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Potential contamination of soils and water resources as a result of hazardous substance spillages	Construction	3 Shaft (39ha) Conveyor route (650 m)	▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities; ▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ All vehicles are to be serviced in a correctly bunded area (workshop); ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface; ▪ All hydrocarbon spills should be immediately cleaned up and treated accordingly, the waste shall be disposed of to a licenced hazardous waste facility; ▪ MSDS's should be kept on site for reference purposes regarding handling, storage and disposal of materials; ▪ Vehicles and heavy machinery should be serviced and checked on a regularly basis to prevent leakages and spills; and ▪ Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate licenced waste facility. ▪ Safe waste disposal certificates must be obtained and made available on request.	NEMA	Construction Phase
7. Remediation of contaminated wetland at 3 Shaft;	Soils; Surface Water; and Freshwater ecosystems	Possible improvement of ecological functioning and consequent flood attenuation and toxin filtration wetland functions, leading to improved water quality in the stream.	Construction	Local	▪ Water quality should be monitored throughout and post rehabilitation activities of the wetland to determine the success of rehabilitation efforts; ▪ Ensure that no incision and canalisation of the wetland and instream features present takes place; ▪ Actively rehabilitate, re-slope, and re-vegetate disturbed areas once all contaminated material is removed from the affected wetland; ▪ All soils compacted because of construction activities should be ripped/scarified (<300mm) and profiled (see the Soil Specialist Report for more information); ▪ Implement and maintain a suitable Alien Invasive Plant (AIP) control programme to prevent further encroachment because of disturbance to the surrounding terrestrial zones; ▪ Permit only essential personnel within the 100m buffer zone of the wetlands; ▪ No material removed from the wetland may be dumped or stockpiled within 100m from any watercourse or within the 1:100 year floodline or whichever is the greatest; ▪ All vehicles must remain on demarcated roads ~~-~~within the wetland when contaminated material is removed from the wetland; ▪ All erosion noted within the wetland should be remedied immediately and included as part of an ongoing rehabilitation plan; ▪ Contaminated material should be removed from the delineated wetland manually (using spades) and loaded into a skip to limit any impacts on the existing soils; ▪ Waste material removed from the delineated wetland should be loaded manually	NWA NEMA	Construction Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
					(using spades) into the skip of the back-actor to limit any impacts on the existing soils. This waste shall be disposed of to an appropriate licenced facility; ▪ The footprint should be kept as small as possible and no go areas that do not need to be entered shall be demarcated to prevent unauthorised entry; ▪ Revegetation of the rehabilitated wetland should ideally take place in the wet season to promote successful germination; ▪ The buffer zone of the wetland area should be clearly demarcated, after remediated has taken place, with stakes positioned in the ground (preferably painted white) and this area should be regarded as 'no-go' for future development; and ▪ Wetlands should be monitored quarterly by a professional during construction to prevent the deterioration of the PES.		
OPERATIONAL PHASE							
8. Underground mining of coal (bord-and-pillar and high extraction);	Groundwater	Groundwater and surface water depletion, contamination and possible decant	Operational	Local	▪ Water removed from underground should be stored in the North and South PCD and reused for mine processes that are not quality sensitive and are authorised by the WUL. Excess water shall be pumped away to 3 Shaft for dust suppression and Sasolburg Operations to prevent any overflows from the PCDs, as well as maintain an 800 mm freeboard in the PCDs; ▪ Excess water shall be pumped away to 3 Shaft (dust suppression) and Sasolburg Operations to prevent any overflows from the PCDs as well as maintain a 800 mm freeboard; ▪ The hydrocensus at Mooikraal is recommended to be updated within the Mooikraal MRA; ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence; ▪ A dewatering network will not be constructed; dry working conditions will be achieved by abstracting groundwater ingress from mine voids during operation, as currently authorised by Mooikraal's approved WUL; ▪ Groundwater monitoring should continue to assess the time series water level and groundwater quality trends as per the approved WUL; ▪ Numerical modelling should be updated every five years based on groundwater monitoring results as to identify any potential concerns that may rise over the years; and ▪ Should any landowner complain of reduced yield/ quality from his borehole due to mining activities, the incident will be investigated by a professional. Upon outcome of the investigation, should it be determined that the landowners borehole has been affected by mining activities, the WUL, hydrocensus and mining contract will inform the mines decision.	NWA	Operational Phase
	Freshwater ecosystems	Direct disturbance of wetlands due to subsidence	Operational	Local	▪ High extraction methods may not be permitted below wetlands and water courses or within the regulated buffer zone of 500m unless it is authorised by a WUL; ▪ Subsidence monitoring beneath all watercourses shall be undertaken throughout the operational phase on an annual basis; ▪ Should subsidence occur below wetlands and water course the necessary mitigation measures shall be taken to rehabilitate and the area, as informed by a professional ▪ Ongoing monitoring of the delineated wetlands for hydrological and geomorphic changes shall be conducted.	NWA	Operational Phase
	Heritage	Direct disturbance of heritage resources due to	Operational	Local	▪ No high-extraction mining must take place underneath the identified heritage resources; and ▪ Only bord-and-pillar methodologies should be undertaken below heritage resources.	NHRA NEMA	Design and Throughout

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
		subsidence					Operational Phase
	Soils, Land Use and Land Capability Geology	Subsidence may restrict post mining land capability and agricultural productivity. Land capability will potentially be altered reducing the capability of the land with a high degree of limitations for land use.	Operational	Local	▪ Monitoring of undermined areas to assess the effects of subsidence at surface; ▪ Prevent high extraction methods under restricted areas (water courses, farm dwellings, heritage sites etc.) ▪ All subsidence related rehabilitation will be conducted as part of operational rehabilitation, rehabilitation will be informed by a professional; ▪ Rehabilitation of surface cracks, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Areas where vegetation is affected by ponding, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material; ▪ Planning for free drainage of ponded areas where practical; and ▪ All instances of confirmed subsidence due to underground mining will be retained and maintained in a subsidence register.	Chamber of Mines Guidelines NEMA NWA	Throughout Operational, decommissioning and post closure Phase
9. Conveying coal via overland conveyor belts and operation of water transfer pipelines (5 Ml, 7 Ml and 10 Ml as well as other water pipelines);	Soils; Air Quality; Surface Water; Groundwater; and Freshwater ecosystems	Spillage of coal from the conveyor belt and spillage/leaks of mine affected water from transfer pipelines resulting in contamination of soils and water resources	Operational	MK3-MK7 (18.4 km) MK9 (650 m)	*Pipelines*: ▪ All pipelines shall be put onto planned maintenance to prevent any leakages of mine water into the environment; ▪ Maintenance and inspections of pipelines must be conducted on a regular basis to check for leakages; ▪ When spillages occur, these must be contained to the immediate area and rectified as soon as possible, especially when water is entering any watercourse when identified. The coal should be placed back on the conveyor belt or disposed of as hazardous waste; ▪ Vehicles utilised for the monitoring and maintenance of the 5 and 10 Ml/day pipeline must be restricted to the existing service road; *Conveyors* ▪ The clean-up and rehabilitation after spillages of coal at the overland conveyor transfer points/drive houses to 3 Shaft and the MK2 conveyor belt to the Silo at Mooikraal should be conducted immediately and appropriately managed to control the spread of the impact to the external environment; ▪ The conveyor crossing the wetland at 3 shaft should be closed to prevent any spillages into any watercourse; ▪ Regular inspections of the conveyor route for any spillages must be undertaken; ▪ All conveyors shall be put onto planned maintenance for regular maintenance checks and service of the conveyor belt; ▪ Ensure that stormwater management structures are put in place to capture all spills; ▪ Quarterly monitoring at crossing must be ongoing to detect any impacts; ▪ The conveyor be fitted with a roof and cladding.	Chamber of Mines Guidelines NEMA NWA	Throughout Operational Phase
10. Operation and maintenance of infrastructure at Mooikraal (incl. incline shaft, Kleinvlei ventilation shaft, haul roads,	Soils, Land Use and Land Capability	Operational and maintenance activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Operational	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Areas that are prone to erosion must be identified and the necessary mitigation measures must be implemented; ▪ Erosion must be controlled by appropriate erosion control techniques; ▪ If erosion occurs, appropriate corrective actions must be investigated and implemented to minimise any further erosion from taking place; ▪ Ensure proper stormwater management designs are in place; ▪ Overburden stockpiles should be vegetated and inspected regularly for erosion; and ▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be	Chamber of Mines Guidelines	Throughout Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
machinery and WRD. As well as operation of infrastructure at 3 Shaft					placed around the facility to ensure dirty water is contained.		
	Fauna and Flora	Direct loss of floral species/vegetation types and biodiversity	Operational	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Strict speed limits (recommended 30 km/h) at infrastructure areas must be implemented on site to avoid roadkill of faunal species; ▪ Any form of hunting, poaching, snaring or trapping will be prohibited at areas under the control of the operation (Mooikraal and 3 Shaft); ▪ Should any animals be found on areas under the control of Mooikraal, they should be relocated to suitable habitats outside the operational areas. ▪ Killing of animals must be prohibited, on areas under Mooikraal control; ▪ Only the existing access routes must be used to avoid unnecessary disturbance of natural habitats; ▪ Removal of AIPs on areas under control of Mooikraal (Mooikraal and 3 Shaft), specifically with a focus on water-loving species such as. Eucalyptus species, which will aid in rehabilitation. These trees utilise large amounts of water and therefore impact on the hydrology of wetlands. A co-ordinated AIP removal programme should be run annually; ▪ Disturbed areas must be revegetated with indigenous species as soon as possible; ▪ Signage advising of areas where faunal species may occur must be erected; and – Noise disturbance must be limited as far as possible.	NEMBA	Throughout Operational Phase
	Freshwater ecosystems	Ongoing contamination of the freshwater resources present are deemed likely based on the ingress of hydrocarbons associated with increased vehicular activity and coal contamination from the conveyor belt. Additional potential impacts include : ▪ compaction of soils and hardening of surfaces, ▪ loss of catchment yield and surface water recharge, ▪ erosion and sedimentation, ▪ the potential loss of biodiversity and habitat, ▪ loss of natural migration routes for instream fauna and further fragmentation of the systems present.	Operational	Local	▪ Incidents of erosion should be remedied as soon as possible to reduce deterioration of the wetland habitat. Erosion downstream of culverts/crossings is one of the largest impacts and can be addressed with fairly inexpensive energy dissipating measures such as reno mattresses or small concrete structures; ▪ Any coal contamination should be removed to reduce contamination of the water quality. The contaminated material should then be discarded at the correct facility; ▪ Leak detection of the pipelines should be initiated; ▪ Limit the footprint area of the operational activities to what is essential to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas); ▪ All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads; ▪ All vehicles must be regularly inspected for hydrocarbon leaks; ▪ Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil; ▪ All hydrocarbon spills should be immediately cleaned up and treated accordingly; ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate licenced waste facility; ▪ Permit only essential personnel within the 100 m zones of regulation for all freshwater features identified; and ▪ Ongoing wetland rehabilitation is necessary during the operational phase as stipulated in the monitoring section.	NWA	Operational Phase
	Surface Water	Surface water quality deterioration as a result of	Operational	Local	▪ All Stormwater management infrastructure shall be put onto planned maintenance schedule to ensure that all infrastructure will have the necessary capacity to manage the 1:50 year storm event.	NWA	Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
		sedimentation and contaminated runoff entering streams.			▪ Stormwater management to separate clean and dirty stormwater must be implemented and the structures must be maintained in accordance with GN704 to prevent dirty water runoff entering into nearby watercourses; ▪ All mine infrastructure (PCDs, Sewage Treatment Plant, Pipelines, conveyor belts) must be put onto a planned maintenance system to ensure that regular inspections and maintenance is undertaken to prevent spillages at both Mooikraal and 3 Shaft. ▪ Management and maintenance measures must be implemented to ensure that all berms, channels and containment structures are kept in good working order to prevent accidental discharges of dirty water to the environment; ▪ Water quality must be monitored in the Leeuspruit and Kromelmboogspruit to verify the effectiveness of the stormwater management structures; ▪ The mine will implement measures to minimise its dirty water make at Mooikraal and 3 Shaft that need to be handled in the water balance e.g. dirty areas at the plant will be kept to the minimum. Any water that is generated from the stockpile areas at 3 Shaft will be contained within the silt trap and then pumped either to the fogger cannon tank for re-use in the fogger cannons, or to Sasolburg Operations. The water balance must be updated on an annual basis to reflect the current situation; ▪ Underground machinery and vehicles are to be washed, serviced and repaired in a dedicated workshop on surface with the necessary pollution control measures in place such as dedicated wash bays with oil separators and a facility to contain the recycled oil; ▪ Clean and dirty water separation at both Mooikraal and 3 Shaft must be implemented. Clean water must be directed away from the stockpile area to the environment while dirty water is directed to containment facilities; ▪ A spill response plan will be implemented and employees trained accordingly to react efficiently to address any spillage where dirty water is discharged to the environment. ▪ Dust suppression measures must be undertaken as required and as authorised by the WUL; ▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained; and ▪ A maintenance programme must be implemented to ensure regular inspections of machinery and infrastructure.		
	Air Quality	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Operational	Local	▪ Dust suppressants and binders may be used on haul roads; ▪ Fogger cannons will be erected on the perimeter fence at 3 Shaft to minimize windblown dust from 3 shaft activities being blown to the community. ▪ Monitoring of dust fallout must continue as per dust fallout monitoring network ▪ Speed limits must be enforced on travelling and haul roads. Machinery and vehicles must be switched off when not in use.	NEMAQA	Operational Phase
	Noise	Noise disturbance from operational and maintenance activities (however not expected to impact any receptors).	Operational	Local	▪ All machinery shall be put onto planned maintenance to ensure optimum working operations and prevent excessive nuisance noise generation ▪ Machinery and vehicles must be switched off when not in use; ▪ Noise suppressant mechanisms such as exhaust mufflers must be considered for machinery where excessive noise is experienced; and ▪ Machinery and vehicles must services regularly to ensure they perform optimally.	National Noise Control Regulations	Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
	Visual	Impact on surrounding land users due to increased lighting	Operational	Local	▪ The current lighting layout will continue at 3 Shaft and Mooikraal, should there be any complaints due to lighting, the layout may be re-evaluated.	NEMA	Operational Phase
	Groundwater	A contamination plume may emanate from the waste rock dump and seep into the groundwater, deteriorating groundwater quality	Operational	Local	▪ The WRD should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. ▪ XRD, acid base accounting and leachable concentration investigations of the coal seam at Mooikraal are recommended, to be kept on file to assess any potential of acid mine water forming.	NEMA	Operational Phase
11. Dirty water storage in the North and South PCDs, underground water storage dams and at STP;	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Possible overflows/leaks of mine affected water from PCDs and STP resulting in contamination of soils and water resources	Operational	>1ha	▪ All mine infrastructure (PCDs, STP, Pipelines, conveyor belts) must be put onto a planned maintenance system to ensure that regular inspections and maintenance is undertaken to prevent spillages at both Mooikraal and 3 Shaft. A job card system will be utilised to request maintenance work ▪ Monitoring of PCD volumes should be undertaken in order to detect any rise in water levels that may lead to PCD overflows. This is necessary, especially during rainfall events, to ensure that any extra water is quickly transferred through the already installed pipelines away from the PCDs for re-use before any overflows can occur. ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence. ▪ Two boreholes (one in the shallow, and one in the intermediate aquifer) are drilled downstream of the PCDs to determine any possible leaks (mine water signature in the quality), these boreholes must continue to be analysed as per the WUL requirements to determine any possible leak or seepage of the PCDs; ▪ Any maintenance work on the PCDs will be carried out as required; ▪ PCDs must be maintained and operated with a 0.8 m freeboard and able to contain a 1:100 year flood event; ▪ Continuous monitoring of water levels (volumes of water removed from underground, as well volumes of water pumped in the 5 and 15 Ml/day pipelines) must be conducted to prevent overflow from the dams into the Kromelmboogspruit; ▪ Water stored in the PCDs shall be transferred to 3 Shaft and Sasolburg Operations to prevent overflow of the PCDs; ▪ Underground water storage dams must be monitored for water level and pressure behind the seal walls; ▪ Ensure that stormwater management structures are put in place in all dirty areas to capture all dirty water and divert this water to PCDs; ▪ Clean-up and rehabilitation of any areas affected by spillages; ▪ If overflow from the PCDs should occur, Mooikraal will conduct water quality monitoring downstream of the PCDs and notify the competent authority, should there be a negative impact to surface water bodies, downstream users will be notified and rehabilitation measures will be informed by a professional; ▪ The STP infrastructure should regularly be inspected and maintained to ensure the optimum operation of the STP to provide a treated effluent that complies with the water qualities set out in the WUL; ▪ Monitoring of treated sewage effluent quality should continue to ensure that all	Chamber of Mines Guidelines NEMA NWA	Throughout Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
					discharges into the Kromelmboogspruit are within acceptable WUL limits. ▪ Monthly monitoring of treated sewage effluent quality must be conducted to ensure that all discharges into the Kromelmboogspruit are within acceptable WUL limits.		
12. Operation and water discharge from the STP	Freshwater ecosystems	Erosion of the water course from water discharged from the STP (If applicable)	Operational	>1ha	Despite the aforementioned, mitigation measures should be in place to limit the potential erosion impacts associated with the discharge of water into a watercourse. Although notable signs of erosion were not observed, some erosion mitigation measures are provided below. These can be regarded as additional measures to be implemented if notable signs of erosion start to occur and as such have been excluded from the required mitigation measures list. ▪ Armoured outlets utilising naturally occurring rocks can be installed to reduce the intensity of the flow from the pipeline outlet to attempt to limit immediate erosion; ▪ Flow diffusing mechanisms should be implemented (e.g. baffles) to limit any potential erosion and sedimentation likely to be facilitated by the discharge volume of the outfall; and ▪ Should erosion be observed due to the discharge flow, corrective measures must be investigated and implemented accordingly.	Chamber of Mines Guidelines NEMA NWA	Throughout Operational Phase
13. Operation of crusher plant, stockpiling of ROM and crushed coal at 3 Shaft;	Groundwater	Groundwater contamination	Operational	3 Shaft (39ha)	▪ Two monitoring boreholes at 3 Shaft are recommended to be drilled downstream (in addition to the existing) of the current location of the primary plant area, one in the shallow, and one in the intermediate aquifer. These boreholes will serve to acquire groundwater samples in order to quantify the presence or absence of contamination in the existing primary plant vicinity with better accuracy; ▪ A hydrocensus is recommended to be conducted within a 1 km radius of the Mooikraal and 3 Shaft area; ▪ Stormwater management principles must be implemented at the stockpile area; ▪ Groundwater monitoring must be implemented to assess the time series water level and water quality trends; ▪ Due to the fact that no underground mining occurs at 3 shaft, all historical groundwater, geological, rescue borehole locations must be retained on a register and the status of the borehole will be recorded; and ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties	Chamber of Mines Guidelines NEMA NWA	Throughout Operational Phase
	Soils, land use and land capability	Soil contamination as a result runoff emanating from stockpile facilities	Operational	3 Shaft (39ha)	▪ All operations shall be contained to the existing stockpiling area. No new areas shall be disturbed as a result of the stockpiling of ROM at the existing stockpiling areas; ▪ No ROM shall be stockpiled outside the existing stockpiling areas and outside any dirty stormwater management infrastructure; ▪ If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; and ▪ Only the designated access routes are to be used to reduce any unnecessary compaction.	Chamber of Mines Guidelines	Throughout Operational Phase
	Surface Water; and Freshwater ecosystem	Contamination due to runoff emanating from stockpile facilities resulting in reduced ecological integrity and functioning of freshwater	Operational	Local	▪ The stormwater management infrastructure at 3 Shaft should be upgraded to include the proposed new Primary Plant, and conveyor belt facilities so that dirty water from these areas is contained within the dirty water area for re-use. Construction of the proposed cut-off trenches at the Stockpile area should be implemented to separate dirty runoff from the clean environment. Dirty water may not be permitted to be discharged to the environment; ▪ Surface water monitoring around the 3 Shaft area must be undertaken in accordance with the WUL, as well as water monitoring plan;	NWA	Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
		ecosystems			▪ Where coal contamination is found outside the designated dirty water areas, this must be cleaned up immediately, the area must be rehabilitated, and measures implemented to prevent; ▪ Dust management programme must continue; ▪ The wetland must be monitored on a regular basis to ensure no residual impact to the wetland and watercourse is realised; and if contamination of degradation of the wetland or river is detected remediation measures must be implemented as informed by a professional; ▪ If possible, if coal is imported, truck loads should be covered; particularly in dry and windy seasons; and ▪ Berms must be maintained at the perimeter of the coal handling area as a buffer between the coal handling area and the sensitive receiving environment.		
	Groundwater	Groundwater contamination as a result of seepage from stockpile facilities	Operational	Local	▪ The WRD at Mooikraal and the coal stockpile area at 3 Shaft should be managed to minimise infiltration of contaminants to the groundwater; ▪ The WRD must be vegetated to minimise rainfall infiltration and prevent the mobilisation of dissolved metals; ▪ Groundwater monitoring must be continue to detect any impacts from the stockpile facilities; and ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties.	NWA	Operational Phase
	Air Quality	Dust generation from stockpile facilities	Operational	Local	▪ In controlling dust from the crushing and screening operations, it is recommended that the crusher be enclosed, to achieve a control efficiency of up to 90%; ▪ Mitigation of materials transfer points should be done using water sprays at the tip points (and when forming stockpiles using the coal stacker). This should result in a 50% control efficiency; ▪ In minimizing windblown dust from stockpile areas, it is recommended that fogger cannons be used to mitigate windblown dust by 90%; and ▪ The drop heights when trucks are off loading coal and at tipping points should be minimised.	NEMAQA	Operational Phase
	Noise	Noise disturbance from the operation of 3 Shaft	Operational	Local	▪ If any noise related complaints are received from the existing infrastructure, Mooikraal will investigate the complaint, and put into place actions to address the complaint; and ▪ Should any new structure with noise generating potential be erected, Mooikraal must conduct a noise assessment. If it is predicted that new structures will increase noise levels (from the baseline noise level), Mooikraal must investigate noise controls/ abatement to not increase ambient noise levels beyond threshold as per Free State Noise Control Regulations	Free State Noise Control Regulations	Operational Phase
14. Storage and handling of hazardous products (including fuel, chemicals and oil) and waste; and 15. Operation of contractors yard, haul roads, change houses, wash bays, surface ablution	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Potential contamination of soils and water resources as a result of hazardous substance spillages	Operational	Mooikraal MRA (6700ha) 3 Shaft (39ha)	*Storage of hazardous substances* ▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities; ▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ All vehicles are to be serviced in a correctly bunded area (workshop); and ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface.	NEMA	Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
facilities and kitchens (Mooikraal and 3 Shaft)					*Sanitation provided during operational activities* ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities; *Waste management* ▪ All waste must be temporarily stored separately on a concrete standing in a designated waste storage area. No waste may be permitted to be stored outside the designated waste storage area; ▪ At 3 Shaft, waste must be disposed of as general, hazardous and recyclable waste (fluorescent tubes etc.); at Mooikraal waste will be designated as co-contaminated waste (hazardous waste) and recyclable waste (steel, drums, wood etc) ▪ Waste must be stored in waste skips as far as practicable, on a cement/ concrete surface ▪ Waste storage will comply with For the storage of general waste, no more than 100 m3 will be stored, for hazardous waste, no more than 80 m3 will be stored ▪ In storing the above mentioned volumes of waste, Mooikraal and 3 Shaft will not trigger the NEM:WA: list of waste management activities that have, or likely to have detrimental effect on the environment (GNR 921, dated 29 November 2013) as well as the National norms and standards for the storage of waste (GNR 926, dated 29 November 2013) ▪ Appropriate signage must be placed around the waste and hydrocarbon storage area; ▪ Waste must be recycled as far as possible. if it cannot be recycled it must be removed by an approved service provider and disposed of at an appropriate licenced waste facility; ▪ Hazardous waste generated onsite must be disposed of at an appropriate licenced hazardous waste facility. Safe disposal certificates must be retained for all hazardous waste removed from site. *Washbays and workshops* ▪ The sumps at the wash bay and diesel workshop must be equipped with oil skimming devices to remove oil and grease from the wash down water; ▪ Oil that is removed from the sumps must be recycled ▪ An emergency spillage response plan should be in place and accessible to the responsible t monitoring team; ▪ A spill response kit must be available at all times. Should a spillage occur the incident must be reported, and cleaned, reference to the spillage response plan. Actions should be taken to prevent re-occurrence of the spill. ▪ Material used for clean-up, as well as any contaminated soil must be disposed of to hazardous waste ▪ Ensure that oil traps and skimmers are well maintained; and ▪ All employees must be trained and made aware of the procedure for dealing with spills and leaks on site.		
16. Drilling of monitoring, exploration, downcast and rescue boreholes	Soils, land use and Land Capability	Drilling activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Operational	Approx. 100 m^2 per borehole	▪ Only clear vegetation when and where necessary. Keep footprint as small as possible and if practicable less than 25 m x 25 m; ▪ Only remove topsoil when and where necessary ; ▪ Only the designated access routes are to be used to avoid unnecessary soil compaction; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion where; and ▪ Active rehabilitation, of disturbed areas immediately after construction.	Chamber of Mines Guidelines	Operational Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
	Flora and Fauna	Direct loss of floral species/vegetation types and biodiversity	Operational	Approx. 100 m^2 per borehole	▪ Limit vegetation clearance to the designated project areas (approximately 25mx 25m); and ▪ Allow natural vegetation to re-establish as far as possible.	NEMA; and NEMBA.	Operational Phase
	Freshwater ecosystems; Groundwater	Drilled boreholes resulting in water table impacts related to a loss of pressure (immediate) and resultant overflowing, which is likely to be experienced in the decommissioning and closure phases.	Operational	Approx. 100 m^2 per borehole	▪ Groundwater monitoring must be undertaken; ▪ Existing access routes shall be used as far as possible; ▪ No unnecessary crossing of the wetland features and their associated buffers should take place; ▪ Boreholes and rescue bays should be drilled to cause as little harm to the surrounding environment as possible; and ▪ Following use, boreholes must be adequately sealed so there is no loss of pressure to water table and to prevent the boreholes from overflowing.	NWA	Operational Phase
	Heritage	Direct disturbance of heritage resources	Operational	Approx. 100 m^2 per borehole	▪ A 50 m no-go buffer zone should be implemented around all identified heritage resources at the proposed borehole sites; ▪ Immediately inform SAHRA of any newly-identified heritage resources identified and enlist the services of a qualified and accredited heritage practitioner to assess the find and recommend appropriate management and/or mitigation measures.	NHRA	Operational Phase
	Groundwater	Impact to groundwater	Operational	Approx. 100 m^2 per borehole	▪ All groundwater monitoring, geological, downcast and rescue borehole locations must be retained on a register; ▪ Geological/ exploration boreholes will be sealed and decommissioned during the operational phase, according to the Sasol Mining procedure and the register will reflect the status of the borehole; and ▪ Rescue boreholes that are no longer required/ in use will be sealed and decommissioned as per Sasol Mining Procedure, and the register will reflect the status of the borehole; ▪ Downcast boreholes must be sealed upon decommissioning of Mooikraal as per Sasol Mining procedure	NWA	Operational Phase
DECOMMISSIONING AND REHABILITATION PHASE							
17. Demolition and removal of infrastructure (incl. transporting materials); and 18. Rehabilitation (including replacement of soil, re-vegetation and profiling/contouring).	Soils, Land Use and Land Capability	Soil erosion and soil compaction if rehabilitation is not done correctly.	Decommissioning and Rehabilitation	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Remove buildings to foundation level. All rubble to be relocated to a specified approved rubble dump or used as backfill / infill material; ▪ Contour slopes to minimise erosion and run-off; ▪ Seal all boreholes (including recue and water monitoring)drilled into the mine as per procedure; ▪ It is assumed that exploration boreholes will be sealed during operational phase ▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All spills from machinery should be immediately cleaned up and treated accordingly and disposed of at an appropriate licenced facility; ▪ Plant native vegetation to prevent erosion and encourage self-sustaining development of a productive ecosystem; ▪ Use waste rock, as stockpiled on Mooikraal, to backfill the incline/ decline shaft followed by topsoil to the extent feasible; ▪ Compacted areas are to be ripped (<300mm) to loosen the soil and vegetation cover re-instated; ▪ An inventory of hazardous waste materials stored on site should be compiled,	Chamber of Mines Guidelines	Decommissioning and Rehabilitation Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
					including volumes stored, as well as method of disposal; ▪ The incline/ decline shaft, ventilation shaft as well as downcasts must be sealed as informed by a professional; ▪ Ensure proper stormwater management designs are in place; ▪ Surface inspection on the fully rehabilitated areas must be undertaken to ensure a surface profile that allows good drainage. This will ensure improvement or increased catchment yield on to the surrounding water streams; ▪ Only designated access routes are to be used to reduce any unnecessary compaction; ▪ All PCDs, once no longer in use, must be emptied of water. This water can either be pumped underground or pumped to Sasolburg Operations (via the 5 and 15 Ml/day pipeline). A contaminated land assessment must be done to determine whether the soil remaining in the dam is contaminated. If found to be contaminated the contaminated soil should be removed and disposed of to an appropriate licenced facility and the PCD backfilled and rehabilitated / revegetated. If the soil is found not to be contaminated, this soil can be utilised for rehabilitation; ▪ Small amounts of fertiliser will be added to accommodate a low nutrient status of the soils where necessary in accordance with the post closure land use; ▪ Soils will be replaced in the disturbed areas (shaft and plant sites) to the same depth as that before mining commenced at least 400 mm (250 mm topsoil and 150 mm subsoils) to sustain post mining land use; ▪ The waste rock material which will be backfilled into the shaft should be completely flooded; to eliminate exposure to oxygen, this will hinder contamination generating reactions; and ▪ Conduct soil contamination assessments (as per NEMWA part 8) to assess if any remediation is required prior to future land use specifically in areas where soil contamination would be expected such as the waste storage areas, Incline shaft, along the conveyor belt and at 3 Shaft (crusher and stockpile area).		
	Fauna and Flora	Loss of fauna and flora species	Decommissioning and Rehabilitation	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Plant native/indigenous species to the area to prevent erosion and encourage self-sustaining development of a productive ecosystem; ▪ As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum; ▪ All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses; ▪ It is expected that once revegetation occurs, some alien invasive species and pioneer species will establish in the newly rehabilitated areas. Alien invasive species must be removed from the rehabilitation areas and replaced with indigenous vegetation. An alien invasive management plan must be implemented and monitored for a period of three years until the majority of the alien invasive species have been removed.	NEMA	Decommissioning and Rehabilitation Phase
	Surface Water	Surface water quality deterioration as a result of sedimentation and contaminated runoff entering streams.	Decommissioning and Rehabilitation	Local	▪ Use of accredited contractors for removal or demolition of infrastructure must be adhered to, in order to reduce the risk of waste generation and accidental spillages; ▪ Ensure surface water monitoring is undertaken until closure is reached ▪ All sludge from the STP drying beds must be removed and disposed of at an approved waste disposal facility; ▪ The bioreactor and settling tanks must be emptied, the sludge removed and appropriately disposed of; ▪ Stormwater management must be implemented and the structures must be maintained in accordance with GN704 until dirty areas are fully rehabilitated; and ▪ Landscape re-profiling must be undertaken to emulate natural drainage to the surrounding Kromelmboogspruit and Leeuspruit watercourses.	NWA	Decommissioning and Rehabilitation Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
	Freshwater ecosystems	Reduced ecological integrity and functioning of freshwater ecosystems as a result of potential soil compaction, soil erosion and consequent sedimentation of freshwater resources as well as potential encroachment of alien invasive plant species as a result of habitat fragmentations.	Decommissioning and Rehabilitation	Local	▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled; ▪ Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream; ▪ An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases; ▪ As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum; ▪ All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint; ▪ All vehicles must be regularly inspected for leaks; ▪ Re-fuelling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; ▪ All existing litter, debris should be removed from the freshwater ecosystems and littering should be prohibited on an ongoing basis; ▪ All spills from machinery should be immediately cleaned up and treated accordingly; ▪ Should the road servitude and overland conveyor have affected the integrity of the wetlands resulting in a loss of habitat and downstream surface water recharge, rehabilitation during the decommissioning and closure phase should focus on the rehabilitation of these areas as informed by a professional. Management in this regard may include removal of the structures, re-profiling of the bed and marginal zones to restore the geomorphological and hydrological integrity and ripping and re-seeding with indigenous wetland grass species. ▪ All incidents of erosion should be remedied and AIPs removed during the operational phase; and ▪ Any coal contamination should be removed and discarded at the correct facility as in the operational phase.	NWA	Decommissioning and Rehabilitation Phase
	Air Quality	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Decommissioning and Rehabilitation	Local	▪ The dismantling area disturbed must be kept to a minimum; ▪ Drop heights when offloading must be minimised; ▪ Limit demolition activities to non-windy days; ▪ Dust monitoring must continue to be undertaken until closure is reached or until it is proven that no further impact from the mine on the generation of dust is expected; ▪ Use of dust suppressant on dirt roads and exposed areas; and ▪ Rehabilitated landscape should be vegetated with native/ indigenous vegetation.	NEMAQA	Decommissioning and Rehabilitation Phase
	Noise	Noise disturbance from operational and maintenance activities (however not expected to impact any receptors).	Decommissioning and Rehabilitation	Local	▪ Decommissioning activities should be restricted to daylight hours; and ▪ Machinery and vehicles must be switched off when not in use.	National Noise Control Regulations	Decommissioning and Rehabilitation Phase
19. Storage, handling and	Soils;	Potential contamination of soils and water resources	Decommissioning and	Mooikraal MRA	▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental	NEMA	Decommissioning and

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
treatment of hazardous products (incl. fuel, explosives and oil and waste)	Surface Water; Groundwater; and Freshwater ecosystems	as a result of hazardous substance spillages	Rehabilitation	(6700ha) 3 Shaft (39ha)	hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities; ▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ Vehicles and heavy machinery should be serviced and checked on a regularly basis to prevent leakages and spills. Vehicles are to be serviced in a correctly bunded area (workshop); ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface; ▪ MSDS's should be kept on site for reference purposes regarding handling, storage and disposal of materials; ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities; ▪ All waste must be temporarily stored separately; ▪ All waste removed from site must be recorded. All hazardous waste must have safe disposal certificates; ▪ Waste must be recycled as far as possible. If it cannot be recycled it must be disposed of at an appropriate licenced waste facility.		Rehabilitation Phase
20. Decant (Mooikraal)	Groundwater	A contamination plume is likely to originate from the underground mine workings as groundwater recovery commenced and the system moved towards filling up the mine voids	Decommissioning and Rehabilitation	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ All existing boreholes as informed by the registers, with the exception of private water supply boreholes and monitoring boreholes should have been sealed and decommissioned according to Sasol Mining procedure during the operational phase, in order to minimise the chance of decant occurring; ▪ All shaft adits, ventilation shafts and down-casts will be sealed and decommissioned as guided by a professional; ▪ Should there be an negative impact to surface water bodies due to decant and base-flow contribution, investigations will occur, and rehabilitation will commence as informed by a professional; ▪ Should there be an negative impact to delineated wetlands, investigations will ensue, and rehabilitation will commence as informed by a professional and ▪ Potential decant should be informed by the numerical model as new data becomes available, should decant be predicted to occur, decant locations should be monitored for decant quality and rate, possible scenarios to manage the decant will be informed by a professional ; ▪ The groundwater monitoring network may be re-assessed and amended to determine the boreholes, to be monitored, necessary to monitor the relevant aquifers sources of contamination and receptors; and ▪ Groundwater monitoring should be conducted to assess the time series water level and water quality trends.	NWA	Decommissioning and Rehabilitation Phase
	Wetlands Surface Water	Discharge of decant into freshwater ecosystems may degrade water quality and cause channelisation and associated erosion and sedimentation.	Decommissioning and Rehabilitation	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Groundwater monitoring must be undertaken until closure is reached; ▪ Updated groundwater models should be run in order to accurately predict if/where decant will occur and at what volume. ▪ Should it be predicted that decant will occur, a professional will be utilised to determine the best course of action, it must be noted that no decant water must be discharged into watercourses ▪ Comprehensive databases of rescue, groundwater monitoring and geological boreholes must be maintained, ▪ Seal all boreholes drilled into the mine; and ▪ The possibility of contaminated decant can be reduced by sealing-off mine shafts (as informed by a professional) and boreholes drilled into the mine as per Sasol Mining procedures.	NWA	Decommissioning and Rehabilitation Phase

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
21. Subsidence	Soil, Land use and land capability Surface Water Fauna and Flora Wetlands	Impact on various environmental aspects due to subsidence	Decommissioning and Rehabilitation	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Rehabilitation of surface cracks (subsidence), caused by surface subsidence due to underground mining where significant risks to the environment and health and safety have been identified, must be rehabilitated; ▪ Areas where vegetation is affected by ponding, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Trenching to dewater surface ponds will decrease the extent of surface ponding. Drains need to be checked on a regular basis to ensure that they remain effective; ▪ Lidar subsidence monitoring should be undertaken throughout the operational phase on an annual basis; ▪ Should subsidence occur below wetlands and water course the impact shall be mitigated immediately, as informed by a professional, and the necessary actions taken to remediate this, ongoing monitoring and wetland rehabilitation of hydrological and geomorphic changes must be conducted; ▪ Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material. Should ash backfilling be utilised various environmental authorisations must be awarded prior to this being undertaken; ▪ The area undergoing rehabilitation will be fenced and all animals prevented from entering the area until vegetation is sustainable; ▪ Newly seeded/planted areas will be protected against compaction and erosion; ▪ A monitoring programme will be initiated to monitor the rehabilitation of disturbed areas specifically focusing on erosion, AIP establishment, indigenous vegetation establishment and compaction.	NEMA NWA Chamber of Mines Guidelines	Decommissioning and Rehabilitation Phase
POST-CLOSURE PHASE							
22. Post-closure monitoring.	Soils, Land Use and Land Capability; and Flora and Fauna	Unsuccessful revegetation resulting in soil erosion on bare surfaces	Post closure	Mooikraal MRA (6700ha) 3 Shaft (39ha)	▪ Rehabilitate any erosion as well as damage caused by erosion, the method to be informed by a professional; ▪ Only designated access routes are to be used to reduce any unnecessary compaction. Surface cracks must be effectively rehabilitated by agricultural deep ripping or by a dozer ; ▪ The topsoil should be shaped taking the pre-mining landscape into consideration; ▪ Vehicular movement across rehabilitated areas should be limited where possible while the vegetation is establishing; ▪ The area must be fenced and animals should be kept off the area until the vegetation is self-sustaining; ▪ Fertilize grassed area with nitrogen containing fertiliser after germination of seeds to promote good growth and development; ▪ Drainage controls such as cut-off trenches and culverts must be used to ensure proper management of water runoff to prevent soil erosion and sedimentation; ▪ Grow indigenous grass to form a vegetative barrier and protect the land from surface erosion; and ▪ Trenching to dewater surface ponds will decrease the extent of surface ponding. Drains need to be checked on a regular basis to ensure that they remain effective.	Chamber of Mines Guidelines NEMBA	Post Closure
	Surface Water and Freshwater ecosystems	Potential surface water and freshwater ecosystem pollution from possible decant of contaminated groundwater	Post closure	Local	▪ Possible decant and seepage should continually be monitored after mine activities have ceased until such point in time that an equilibrium is reached and the necessary proof is available that no decant will occur from the underground mine; ▪ Water quality and wetland monitoring should continue post rehabilitation in accordance with the closure plan to detect any latent impacts; and ▪ The numerical model must be updated to incorporate new data, this model should inform potential decant, should decant be predicted or observed, a professional will guide mitigation and rehabilitation actions.	NWA	Post Closure

Activity	Aspect Affected	Impact Description	Phase	Size and scale of disturbance	Mitigation Type	Compliance with standards	Time period for implementation
	Groundwater	Potential groundwater contamination and decant	Post closure	Local	▪ All existing boreholes as informed by the registers, with the exception of private water supply boreholes and monitoring boreholes should have been sealed and decommissioned according to Sasol Mining procedure during the operational phase, in order to minimise the chance of decant occurring; ▪ All shaft adits, ventilation shafts and down-casts will be sealed and decommissioned as guided by a professional; ▪ The numerical model must be updated to incorporate new data, this model should inform potential decant, should decant be predicted or observed, a professional will guide mitigation and rehabilitation actions. ▪ The groundwater monitoring network may be re-assessed and amended to determine the boreholes, to be monitored, necessary to monitor the relevant aquifers sources of contamination and receptors; and ▪ Groundwater monitoring should be conducted to assess the time series water level and water quality trends.	NWA	Post Closure
	Socio-economic	Mine closure resulting in job losses and other incomes (local goods and services supplied to the operation)	Post closure	Regional	▪ Attempts will be made to place the existing labour force on other projects where appropriate; ▪ The workforce will be trained and their skills developed during the operational phase, particularly in the area of basic literacy, basic numeracy and basic business skills, which will enhance future employment opportunities outside the mine; ▪ Employees will receive counselling to prepare for the closure of the mine; ▪ The development and growth of SMMEs will be supported in local settlements and ongoing skills development programmes will be available to the labour force; ▪ Ensure the development of an efficient collaboration between Mooikraal and the various stakeholders concerned or interested in a better implementation of the proposed measures for the mitigation of negative impacts and the improvement of positive ones; and ▪ Ensure the good coexistence between the mine and other stakeholders through an effective communication mechanism that can inform all stakeholders on the life of the mine.	-	Closure and Post Closure

6 Item 1(e): Impact Management Outcomes

A description of the objectives and outcomes of the EMP is outlined in Table 6-1.

Table 6-1: Objectives and outcomes of the EMP

Activity	Potential Impact	Aspect Affected	Phase	Mitigation Type	Standard to be Achieved
CONSTRUCTION PHASE					
1. Site clearance, topsoil removal and stockpiling; 2. Demolition of existing conveyor belt and primary plant which is situated in a wetland at 3 Shaft; 3. Reconstruction of primary plant at stockpile area (including upgraded stormwater structures); 4. Construction of MK9 conveyor belt at 3 Shaft; 5. Construction of ventilation shafts within Mooikraal MRA (possible future activity);	Site clearance resulting in potential soil erosion, dust generation and soil compaction, and consequently loss of topsoil.	Soil, Land Use and Land Capability	Construction	▪ Minimise through site clearing procedures; ▪ Minimise through storm-water management plan; and ▪ Minimise through dust Monitoring Programme.	To prevent the loss of top soil as a resource
	Direct loss of floral species/vegetation types and biodiversity	Flora and Fauna	Construction	▪ Control through Alien Management Plan; and ▪ Control through Rehabilitation Plan	To minimise disturbance of natural habitats To minimise the loss of Red Data plant species
	Site clearance resulting in soil erosion and soil compaction and consequently adversely impacting water quality of freshwater ecosystems as a result of sedimentation and increased contaminant/dissolved solids entry into wetland and river systems.	Freshwater ecosystems	Construction	▪ Minimise through soil management programme; ▪ Minimise through Stormwater Management Plan; and ▪ Minimise through hazardous chemical and waste management practices.	To prevent unnecessary impacts on wetlands To prevent loss of aquatic habitats
	Siltation of surface water resources due to increased suspended solids resulting from soil erosion.	Surface Water	Construction	▪ Minimise through Stormwater Management Plan ▪ Control through Dust Management Plan	To prevent siltation of surface water resources
	Lowering of groundwater table.	Groundwater	Construction	▪ Avoid through project designs	To prevent excavation below the water table
	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Air Quality	Construction	▪ Minimise through Stormwater Management Plan; ▪ Control through Dust Management Plan; and ▪ Control through groundwater monitoring programme	To prevent elevated levels of dust fallout
	Noise disturbance from construction machinery and vehicles (however will not impact on any receptors).	Noise	Construction	▪ Avoid through Vehicle and Machinery Maintenance Plan	To prevent increase from background noise levels

Activity	Potential Impact	Aspect Affected	Phase	Mitigation Type	Standard to be Achieved
	Visual intrusion caused by construction activities.	Visual	Construction	▪ Minimise through project designs; and ▪ Control through Dust Management Plan	To minimise the negative visual impacts caused by construction activities
	Direct disturbance of heritage resources (however not expected – proposed activities in excess 100 m from identified heritage resources)	Heritage	Construction	▪ Avoid through establishment of 50 m no-go buffer zone ▪ Minimise through CFP and FFP	To avoid disturbance of heritage resources
	Potential employment opportunity and income generation	Social	Construction	▪ Mooikraal Social and labour plan, Sasol preferential procurement	To adhere to the approved SLP
6. Storage and handling of hazardous products (including fuel, chemicals and oil) and waste at construction camp at 3 Shaft.	Potential contamination of soils and water resources as a result of hazardous substance spillages	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Construction	▪ Minimise through Stormwater Management Plan; ▪ Avoid through Vehicle and Machinery Maintenance Plan; and ▪ Minimise through spill response plan	To avoid spillages of hazardous substance into the natural environment
7. Remediation of affected wetland at 3 Shaft;	Possible improvement of ecological functioning and consequent flood attenuation and toxin filtration wetland functions, leading to improved water quality in the stream.	Soils; Surface Water; and Freshwater ecosystems	Construction	▪ Enhance through water quality monitoring; and ▪ Enhance through post-rehabilitation monitoring (to determine success of rehabilitation efforts)	To restore ecological functions of wetland at 3 Shaft
OPERATIONAL PHASE					
8. Underground mining of coal (bord-and-pillar and high extraction);	Groundwater and surface water depletion, contamination and possible decant	Groundwater	Operational	▪ Control through groundwater and surface water monitoring programmes	To avoid water quality deterioration due to mining activities
	Direct loss of wetlands due to subsidence	Freshwater ecosystems	Operational	▪ Control through freshwater ecosystem monitoring and rehabilitation	To avoid direct disturbance of freshwater ecosystems due to subsidence cause by underground mining
	Direct disturbance of heritage resources due to subsidence	Heritage	Operational	▪ Control through mine scheduling, and placement of restriction lines around heritage resources on survey plans, to prevent high extraction planned under restricted areas.	To avoid direct disturbance of heritage resources due to subsidence
	Subsidence may restrict post mining land capability and agricultural productivity. Land capability will potentially be altered reducing the capability of the land with a high degree of limitations for land use.	Soils, Land Use and Land Capability Geology	Operational	▪ Control through Rehabilitation Plan; and ▪ Enhance through post-rehabilitation monitoring	To avoid surface subsidence due to underground mining
9. Conveying coal via overland conveyor belts and operation of water transfer pipelines;	Spillage of coal off the conveyor belt and spillage/leaks of mine affected water from transfer pipelines resulting in contamination of soils and water resources	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Operational	▪ Minimise through Stormwater Management Plan; ▪ Minimise through spill response plan ▪ Minimise through groundwater water monitoring programmes	To avoid spillages of hazardous substance into the natural environment

Activity	Potential Impact	Aspect Affected	Phase	Mitigation Type	Standard to be Achieved
10.Operation and maintenance of infrastructure (incl. incline shaft, Kleinvlei ventilation shaft, STP, haul roads, primary crusher plant (3 Shaft), machinery and WRD (Mooikraal));	Operational and maintenance activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Soil, Land Use and Land Capability	Operational	▪ Minimise through soil management programme; ▪ Minimise through storm-water management plan; and ▪ Minimise through dust Monitoring Programme.	Soil Management in terms of the Chamber of Mines Guidelines for Rehabilitation; and
	Direct loss of floral species/vegetation types and biodiversity	Flora and Fauna	Operational	▪ Control through Alien Management Plan; and ▪ Control through Rehabilitation Plan	To minimise disturbance of natural habitats
	Reduced ecological integrity and functioning of freshwater ecosystems as a result of potential soil compaction, soil erosion and consequent sedimentation of freshwater resources as well as potential encroachment of alien invasive plant species as a result of habitat fragmentations.	Freshwater ecosystems	Operational	▪ Minimise through soil management programme; ▪ Minimise through Stormwater Management Plan; and ▪ Minimise through hazardous chemical and waste management practices	To prevent unnecessary impacts on wetlands To prevent loss of aquatic habitats
	Surface water quality deterioration as a result of sedimentation and contaminated runoff entering streams.	Surface Water	Operational	▪ Minimise through Stormwater Management Plan; and ▪ Control through Dust Management Plan	To prevent siltation of surface water resources
	Elevated levels of dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Air Quality	Operational	▪ Avoid through project designs; and ▪ Minimise through dust management plan.	To prevent elevated levels of dust fallout
	Increase of noise from background levels, as per Free State Noise Regulations from operational and maintenance activities (however not expected to impact any receptors).	Noise	Operational	▪ Avoid through project designs ▪ Avoid through Vehicle and Machinery Maintenance Plan	To minimise noise levels increasing 7dB from background level
	Impact on surrounding land users due to increased lighting	Visual	Operational	▪ Avoid through infrastructure designs	To minimise visual intrusion to nearby receptors
11. Dirty water storage in the North and South PCDs and at STP;	Possible overflows/leaks of from PCDs and STP resulting in contamination of soils and water resources	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Operational	▪ Avoid through water level monitoring in containment facilities; ▪ Minimise through water quality monitoring programmes	To avoid spillages from the PCDs and untreated STP effluent into the natural environment
12. Operation of STP and water discharge	Erosion of the water course from water discharged from the STP	Freshwater ecosystems; Surface Water	Operational	▪ Minimise through Stormwater Management Plan; and ▪ Avoid through project designs	To avoid erosion caused by water discharge from the STP

Activity	Potential Impact	Aspect Affected	Phase	Mitigation Type	Standard to be Achieved
13. Stockpiling of ROM and crushed coal at 3 Shaft;	Soil contamination as a result runoff emanating from stockpile facilities	Soils, land use and land capability	Operational	▪ Minimise through Stormwater Management Plan	To avoid dirty water runoff to soils from stockpile areas
	Contamination due to runoff emanating from stockpile facilities resulting in reduced ecological integrity and functioning of freshwater ecosystems	Surface Water; and Freshwater ecosystem	Operational	▪ Minimise through Stormwater Management Plan ▪ Minimise through wetland assessment monitoring	To avoid impacts to freshwater ecosystems as a result of dirty water runoff from stockpile areas
	Groundwater contamination as a result of seepage from stockpile facilities	Groundwater	Operational	▪ Minimise through Stormwater Management Plan ▪ Minimise through water quality monitoring	To avoid impacts to groundwater as a result of contamination from stockpile areas
	Dust generation from stockpile facilities	Air Quality	Operational	▪ Control through Dust Management Plan	To avoid excess dust generation emanating from stockpile areas
	Noise disturbance from the operation of 3 Shaft	Noise	Operational	▪ Control through operational hours	To avoid and increase in ambient noise levels (more than 7 dB from background levels)
14. Storage and handling of hazardous products (including fuel, chemicals and oil) and waste; and 15. Operation of contractors yard at 3 Shaft, haul roads, change houses, surface ablution facilities and kitchens	Potential contamination of soils and water resources as a result of hazardous substance spillages	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Operational	▪ Minimise through Stormwater Management Plan; ▪ Avoid through Vehicle and Machinery Maintenance Plan; and ▪ Minimise through spill response plan	To avoid spillages of hazardous substance into the natural environment
16. Drilling of monitoring, exploration and rescue boreholes	Drilling activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Soil, Land Use and Land Capability	Operational	▪ Minimise through soil management programme; ▪ Minimise through storm-water management plan; and ▪ Minimise through dust Monitoring Programme.	Soil Management in terms of the Chamber of Mines Guidelines for Rehabilitation; and
	Direct loss of floral species/vegetation types and biodiversity	Flora and Fauna	Operational	▪ Control through Alien Management Plan; and ▪ Control through Rehabilitation Plan	To minimise disturbance of natural habitats

Activity	Potential Impact	Aspect Affected	Phase	Mitigation Type	Standard to be Achieved
	Drilled boreholes resulting in water table impacts related to a loss of pressure (immediate) and resultant overflowing, which is likely to be experienced in the decommissioning and closure phases.	Freshwater ecosystems; Groundwater	Operational	▪ Control through sealing of boreholes once boreholes are not in use; and ▪ Control through borehole register	To avoid post-closure impacts
	Direct disturbance of heritage resources	Heritage	Operational	▪ Avoid through establishment of 50 m no-go buffer zone ▪ Minimise through CFP and FFP	To avoid direct disturbance of heritage resources due to subsidence
DECOMMISSIONING AND REHABILITATION PHASE					
17. Demolition and removal of infrastructure (incl. transporting materials); and 18. Rehabilitation (including replacement of soil, re-vegetation and profiling/contouring).	Soil erosion and soil compaction if rehabilitation is not done correctly.	Soils, Land Use and Land Capability	Decommissioning and Rehabilitation	▪ Minimise through site clearing philosophy; ▪ Minimise through storm-water management plan; and ▪ Minimise through Dust Monitoring Programme.	Soil Management in terms of the Chamber of Mines Guidelines for Rehabilitation; and
	Loss of fauna and flora species	Flora and Fauna	Operational	▪ Control through Alien Management Plan; and ▪ Control through Rehabilitation Plan	To minimise disturbance of natural habitats
	Surface water quality deterioration as a result of sedimentation and contaminated runoff entering streams.	Surface Water	Decommissioning and Rehabilitation	▪ Minimise through Stormwater Management Plan; and ▪ Control through Dust Management Plan	To prevent siltation of surface water resources
	Reduced ecological integrity and functioning of freshwater ecosystems as a result of potential soil compaction, soil erosion and consequent sedimentation of freshwater resources as well as potential encroachment of alien invasive plant species as a result of habitat fragmentations.	Freshwater ecosystems	Decommissioning and Rehabilitation	▪ Minimise through soil management programme; ▪ Minimise through Stormwater Management Plan; and ▪ Minimise through hazardous chemical and waste management practices	To prevent unnecessary impacts on wetlands To prevent loss of aquatic habitats
	Elevated levels of dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Air Quality	Decommissioning and Rehabilitation	▪ Avoid through project designs; and ▪ Minimise through dust management plan.	To prevent elevated levels of dust fallout
	Noise disturbance from operational and maintenance activities (however not expected to impact any receptors).	Noise	Decommissioning and Rehabilitation	▪ Avoid through project designs ▪ Avoid through Vehicle and Machinery Maintenance Plan	To avoid increasing the ambient noise levels by 7 dB from background levels
19. Storage, handling and treatment of hazardous products (incl. fuel, explosives and oil and waste)	Potential contamination of soils and water resources as a result of hazardous substance spillages	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Decommissioning and Rehabilitation	▪ Minimise through Stormwater Management Plan; ▪ Avoid through Vehicle and Machinery Maintenance Plan; and ▪ Minimise through spill response plan	To avoid spillages of hazardous substance into the natural environment
20. Decant (Mooikraal)	A contamination plume may originate from the underground mine workings as groundwater recovery commenced and the system moved towards filling up the mine voids	Groundwater	Decommissioning and Rehabilitation	▪ Control through groundwater monitoring programme ▪ Control through numerical model update	To avoid contamination of watercourses as a result of decant

Activity	Potential Impact	Aspect Affected	Phase	Mitigation Type	Standard to be Achieved
	Discharge of decant into freshwater ecosystems may degrade water quality and cause channelisation and associated erosion and sedimentation.	Wetlands Surface Water	Decommissioning and Rehabilitation	▪ Control through freshwater ecosystems and surface water monitoring programmes ▪ Control through numerical model update	To avoid contamination of watercourses as a result of decant
21. Subsidence	Impact on various environmental aspects due to subsidence	Soil, Land use and land capability; Surface Water; Fauna and Flora; and Wetlands	Decommissioning and Rehabilitation	▪ Avoid through subsidence monitoring programme	To avoid environmental disturbance due to subsidence
POST-CLOSURE PHASE					
22. Post-closure monitoring.	Unsuccessful revegetation resulting in soil erosion on bare surfaces	Soils, Land Use and Land Capability; and Flora and Fauna	Post closure	▪ Minimise through correct implementation of rehabilitation plan	To avoid bare surfaces and soil compaction which leads to persistent soil erosion
	Potential surface water and freshwater ecosystem pollution from possible decant of contaminated groundwater	Surface Water and Freshwater ecosystems	Post closure	▪ Minimise through post closure monitoring programme	To avoid water quality deterioration
	Potential groundwater contamination and decant	Groundwater	Post closure	▪ Minimise through post closure monitoring programme	To avoid water quality deterioration
	Mine closure resulting in job losses and other incomes (local goods and services supplied to the operation)	Socio-economic	Post closure	▪ Avoid through implementation of social closure plan and SLP (during operations)	To avoid local community collapse due to closure of the mine

7 Item 1(f): Impact Management Actions

A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs 5and 0 (Part B) will be achieved in Table 7-1.

Table 7-1: Impact management actions

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
CONSTRUCTION PHASE					
1. Site clearance, topsoil removal and stockpiling; 2. Demolition of existing conveyor belt and primary plant which is situated in a wetland at 3 Shaft; 3. Reconstruction of primary plant at stockpile area (including upgraded stormwater structures); 4. Construction of MK9 conveyor belt at 3 Shaft; 5. Construction of ventilation shafts within Mooikraal MRA (possible future activity);	Soil, Land Use and Land Capability	Site clearance resulting in potential soil erosion, dust generation and soil compaction, and consequently loss of topsoil.	Construction	▪ Limit vegetation clearance to a footprint as small as possible, ie: only when and where necessary; ▪ Only remove topsoil when and where necessary ; ▪ Topsoil should be removed when the soil is dry; ▪ Should soils be stripped for the construction of ventilation shafts and or structures, the soil should be stripped and stockpiled separately for rehabilitation; ▪ Prevent any hydrocarbon spills from heavy machinery and construction vehicles from occurring; ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, if applicable, reported to the appropriate authorities; ▪ All vehicles are to be serviced at a workshop; ▪ Drip trays should be placed under vehicles leaking hydrocarbons; ▪ Berms will be placed around construction areas, so as to keep clean water from entering the construction area, as well as prevent water being released from the construction area that is high in suspended solids. ▪ Any topsoil removed should be vegetated and stockpiled to a maximum height of 3 to 4 m for protection against erosion should it be stockpiled for a period longer than 12 months; ▪ Only the designated access routes are to be used to avoid unnecessary soil compaction; and ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion.	Chamber of Mines Guidelines
	Flora and Fauna	Direct loss of floral species/vegetation types and biodiversity	Construction	▪ The construction area shall be demarcated to prevent unauthorised entry the construction area; ▪ Limit site clearing of natural environment to the designated project areas by clearly demarcating the construction areas and restricting access to adjacent areas; ▪ Revegetate open and disturbed areas once construction is complete to limit erosion and aid with water infiltration and flood attenuation; ▪ Avoid sensitive landscapes such as riparian and wetland areas that were encountered on site that are not already impacted by the mining operation; ▪ Alien vegetation should be removed in the correct way and timeously before it starts flowering. An Alien Invasive Management plan should be compiled and implemented.	NEMA; and NEMBA.
	Freshwater ecosystems	Site clearance resulting in soil erosion and soil compaction and consequently adversely impacting water quality of freshwater ecosystems as a result of sedimentation and increased contaminant/dissolved solids entry into wetland and river systems.	Construction	▪ Ensure that a soil management programme is implemented and maintained to minimise erosion and consequent sedimentation of freshwater resources; ▪ Sequential removal of the vegetation should take place (not all vegetation immediately). ▪ Limit the footprint area of the construction activities to the immediate construction area to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ Revegetate the construction footprint and vehicular pathways once the construction is completed; ▪ Clean stormwater should be diverted away from construction areas by berms; ▪ Construction method statements must be developed and implemented for the construction of the conveyor crossing at the wetland; and ▪ The proposed conveyor gantry should be fully covered.	Section 19 of the NWA NEM:BA NEMA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
	Surface Water	Siltation of surface water resources due to increased suspended solids resulting from soil erosion.	Construction	▪ Clearing of vegetation and excavation should be limited as far as possible; ▪ Site preparation for the new 3 Shaft Primary Plant and Crusher should be confined to stockpile minimal area to minimise disturbance of soils and the probability of sedimentation and siltation of the Leeuspruit tributary; ▪ Rehabilitation and revegetation of the disturbed 3 Shaft site after removal of the Primary Plant and Crusher, and the decommissioning of the coal bunker should be undertaken to reduce chances of soil erosion and subsequent sedimentation in nearby streams; ▪ For any required soil stockpiles, these should be compacted and the slopes should be kept at minimal/low to avoid erosion; ▪ Dust suppression measures must be implemented on the cleared areas during construction; ▪ No water should be abstracted from the stream for construction purposes without the necessary water authorisation in place.	NWA
	Groundwater	Lowering of groundwater table.	Construction	▪ Restrict construction activities to areas above the water table; ▪ If that is not possible, dewatering of the aquifer to locally lower the water table can be considered to ensure that the construction takes place above the groundwater level and the water quality remains the same as prior to construction activities; and ▪ Hydrocarbon spillages shall be managed and clean up within 24 hours of incident occurring, waste to be disposed of to hazardous waste bins.	NWA
	Air Quality	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Construction	▪ Where practical, construction activities should be limited to non-windy days (wind speed ≥ 5.4 m/s, this implies wind speeds < 5.4 m/s); ▪ Monitoring of dust fallout must continue during the construction phase as per dust monitoring network at 3 shaft ▪ Speed limits must be enforced on haul roads . It is recommended these be set at 30 km/h; and ▪ Construction machinery and vehicles must be switched off when not in use.	NEMAQA
	Noise	Noise disturbance from construction machinery and vehicles (however will not impact on any receptors).	Construction	▪ Construction activities should be restricted to daylight hours (7h00 – 16h00); and ▪ Machinery and vehicles must be switched off when not in use.	National Noise Control Regulations
	Visual	Visual intrusion caused by construction activities.	Construction	▪ Disturbance of the natural environment must be limited to the designated project areas; ▪ Apply dust suppression techniques to limit dust generated from the topsoil spoils; if topsoil is stockpiled; and ▪ Avoid construction activities at night, limit construction activities to 7h00 – 16h00.	NEMA
	Heritage	Direct disturbance of heritage resources (however not expected – proposed activities in excess 100 m from identified heritage resources)	Construction	▪ A 50 m no-go buffer zone should be implemented around all identified heritage resources; ▪ Clearly demarcate the established "unauthorised zone" buffer and place visible signage; ▪ A Chance Finds Protocol (CFP) and Fossil Finds Protocol (FFP) must be developed by a professional for implementation prior to the commencement of construction activities; and ▪ Immediately inform SAHRA of any newly-identified heritage resources identified and enlist the services of a qualified and accredited heritage practitioner to assess the find and recommend appropriate management and/or mitigation measures as per CFP and FFP).	NHRA
	Social	Potential employment opportunity and income generation	Construction	▪ Procurement procedures should favour the use of local service provides as far as possible.	NEMA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
6. Storage and handling of hazardous products (including fuel, chemicals and oil) and waste at construction camp at 3 Shaft.	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Potential contamination of soils and water resources as a result of hazardous substance spillages	Construction	▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities; ▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ All vehicles are to be serviced in a correctly bunded area (workshop); ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface; ▪ All hydrocarbon spills should be immediately cleaned up and treated accordingly, the waste shall be disposed of to a licenced hazardous waste facility; ▪ MSDS's should be kept on site for reference purposes regarding handling, storage and disposal of materials; ▪ Vehicles and heavy machinery should be serviced and checked on a regularly basis to prevent leakages and spills; and ▪ Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate licenced waste facility. ▪ Safe waste disposal certificates must be obtained and made available on request.	NEMA
7. Remediation of contaminated wetland at 3 Shaft;	Soils; Surface Water; and Freshwater ecosystems	Possible improvement of ecological functioning and consequent flood attenuation and toxin filtration wetland functions, leading to improved water quality in the stream.	Construction	▪ Water quality should be monitored throughout and post rehabilitation activities of the wetland to determine the success of rehabilitation efforts; ▪ Ensure that no incision and canalisation of the wetland and instream features present takes place; ▪ Actively rehabilitate, re-slope, and re-vegetate disturbed areas once all contaminated material is removed from the affected wetland; ▪ All soils compacted because of construction activities should be ripped/scarified (<300mm) and profiled (see the Soil Specialist Report for more information); ▪ Implement and maintain a suitable Alien Invasive Plant (AIP) control programme to prevent further encroachment because of disturbance to the surrounding terrestrial zones; ▪ Permit only essential personnel within the 100m buffer zone of the wetlands; ▪ No material removed from the wetland may be dumped or stockpiled within 100m from any watercourse or within the 1:100 year floodline or whichever is the greatest; ▪ All vehicles must remain on demarcated roads ~~-~~ within the wetland when contaminated material is removed from the wetland; ▪ All erosion noted within the wetland should be remedied immediately and included as part of an ongoing rehabilitation plan; ▪ Contaminated material should be removed from the delineated wetland manually (using spades) and loaded into a skip to limit any impacts on the existing soils; ▪ Waste material removed from the delineated wetland should be loaded manually (using spades) into the skip of the back-actor to limit any impacts on the existing soils. This waste shall be disposed of to an appropriate licenced facility; ▪ The footprint should be kept as small as possible and no go areas that do not need to be entered shall be demarcated to prevent unauthorised entry; ▪ Revegetation of the rehabilitated wetland should ideally take place in the wet season to promote successful germination; ▪ The buffer zone of the wetland area should be clearly demarcated, after remediated has taken place, with stakes positioned in the ground (preferably painted white) and this area should be regarded as 'no-go' for future development; and ▪ Wetlands should be monitored quarterly by a professional during construction to prevent the deterioration of the PES.	NWA NEMA
OPERATIONAL PHASE					
8. Underground mining of coal (bord-and-pillar	Groundwater	Groundwater and surface water depletion, contamination	Operational	▪ Water removed from underground should be stored in the North and South PCD and reused for mine processes that are not quality sensitive and are authorised by the WUL. Excess water shall be pumped away to 3 Shaft for dust suppression and Sasolburg Operations to prevent any overflows from the	NWA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
and high extraction);		and possible decant		PCDs, as well as maintain an 800 mm freeboard in the PCDs; ▪ Excess water shall be pumped away to 3 Shaft (dust suppression) and Sasolburg Operations to prevent any overflows from the PCDs as well as maintain a 800 mm freeboard; ▪ The hydrocensus at Mooikraal is recommended to be updated within the Mooikraal MRA; ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence; ▪ A dewatering network will not be constructed; dry working conditions will be achieved by abstracting groundwater ingress from mine voids during operation, as currently authorised by Mooikraal's approved WUL; ▪ Groundwater monitoring should continue to assess the time series water level and groundwater quality trends as per the approved WUL; ▪ Numerical modelling should be updated every five years based on groundwater monitoring results as to identify any potential concerns that may rise over the years; and ▪ Should any landowner complain of reduced yield/ quality from his borehole due to mining activities, the incident will be investigated by a professional. Upon outcome of the investigation, should it be determined that the landowners borehole has been affected by mining activities, the WUL, hydrocensus and mining contract will inform the mines decision.	
	Freshwater ecosystems	Direct disturbance of wetlands due to subsidence	Operational	▪ High extraction methods may not be permitted below wetlands and water courses or within the regulated buffer zone of 500m unless it is authorised by a WUL; ▪ Subsidence monitoring beneath all watercourses shall be undertaken throughout the operational phase on an annual basis; ▪ Should subsidence occur below wetlands and water course the necessary mitigation measures shall be taken to rehabilitate and the area, as informed by a professional ▪ Ongoing monitoring of the delineated wetlands for hydrological and geomorphic changes shall be conducted.	NWA
	Heritage	Direct disturbance of heritage resources due to subsidence	Operational	▪ No high-extraction mining must take place underneath the identified heritage resources; and ▪ Only bord-and-pillar methodologies should be undertaken below heritage resources.	NHRA NEMA
	Soils, Land Use and Land Capability Geology	Subsidence may restrict post mining land capability and agricultural productivity. Land capability will potentially be altered reducing the capability of the land with a high degree of limitations for land use.	Operational	▪ Monitoring of undermined areas to assess the effects of subsidence at surface; ▪ Prevent high extraction methods under restricted areas (water courses, farm dwellings, heritage sites etc.) ▪ All subsidence related rehabilitation will be conducted as part of operational rehabilitation, rehabilitation will be informed by a professional; ▪ Rehabilitation of surface cracks, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Areas where vegetation is affected by ponding, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material; ▪ Planning for free drainage of ponded areas where practical; and ▪ All instances of confirmed subsidence due to underground mining will be retained and maintained in a subsidence register.	Chamber of Mines Guidelines NEMA NWA
9. Conveying coal via overland conveyor belts and operation of water transfer pipelines (5 Ml, 7 Ml and 10 Ml as well as other water pipelines);	Soils; Air Quality; Surface Water; Groundwater; and Freshwater ecosystems	Spillage of coal from the conveyor belt and spillage/leaks of mine affected water from transfer pipelines resulting in contamination of soils and water resources	Operational	*Pipelines*: ▪ All pipelines shall be put onto planned maintenance to prevent any leakages of mine water into the environment; ▪ Maintenance and inspections of pipelines must be conducted on a regular basis to check for leakages; ▪ When spillages occur, these must be contained to the immediate area and rectified as soon as possible, especially when water is entering any watercourse when identified. The coal should be placed back on the conveyor belt or disposed of as hazardous waste; ▪ Vehicles utilised for the monitoring and maintenance of the 5 and 10 Ml/day pipeline must be restricted	Chamber of Mines Guidelines NEMA NWA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
				to the existing service road; *Conveyors* ▪ The clean-up and rehabilitation after spillages of coal at the overland conveyor transfer points/drive houses to 3 Shaft and the MK2 conveyor belt to the Silo at Mooikraal should be conducted immediately and appropriately managed to control the spread of the impact to the external environment; ▪ The conveyor crossing the wetland at 3 shaft should be closed to prevent any spillages into any watercourse; ▪ Regular inspections of the conveyor route for any spillages must be undertaken; ▪ All conveyors shall be put onto planned maintenance for regular maintenance checks and service of the conveyor belt; ▪ Ensure that stormwater management structures are put in place to capture all spills; ▪ Quarterly monitoring at crossing must be ongoing to detect any impacts; ▪ The conveyor be fitted with a roof and cladding.	
10. Operation and maintenance of infrastructure at Mooikraal (incl. incline shaft, Kleinvlei ventilation shaft, haul roads, machinery and WRD. As well as operation of infrastructure at 3 Shaft	Soils, Land Use and Land Capability	Operational and maintenance activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Operational	▪ Areas that are prone to erosion must be identified and the necessary mitigation measures must be implemented; ▪ Erosion must be controlled by appropriate erosion control techniques; ▪ If erosion occurs, appropriate corrective actions must be investigated and implemented to minimise any further erosion from taking place; ▪ Ensure proper stormwater management designs are in place; ▪ Overburden stockpiles should be vegetated and inspected regularly for erosion; and ▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained.	Chamber of Mines Guidelines
	Fauna and Flora	Direct loss of floral species/vegetation types and biodiversity	Operational	▪ Strict speed limits (recommended 30 km/h) at infrastructure areas must be implemented on site to avoid roadkill of faunal species; ▪ Any form of hunting, poaching, snaring or trapping will be prohibited at areas under the control of the operation (Mooikraal and 3 Shaft); ▪ Should any animals be found on areas under the control of Mooikraal, they should be relocated to suitable habitats outside the operational areas. ▪ Killing of animals must be prohibited at areas under the control of the operation (Mooikraal and 3 Shaft); ▪ Only the existing access routes must be used to avoid unnecessary disturbance of natural habitats; ▪ Removal of AIPs on areas under control of Mooikraal (Mooikraal and 3 Shaft), specifically with a focus on water-loving species such as. Eucalyptus species, which will aid in rehabilitation. These trees utilise large amounts of water and therefore impact on the hydrology of wetlands. A co-ordinated AIP removal programme should be run annually; ▪ Disturbed areas must be revegetated with indigenous species as soon as possible; ▪ Signage advising of areas where faunal species may occur must be erected; and –Noise disturbance must be limited as far as possible.	NEMBA
	Freshwater ecosystems	Ongoing contamination of the freshwater resources present are deemed likely based on the ingress of hydrocarbons associated with increased vehicular activity and coal contamination from the conveyor belt. Additional potential impacts include : ▪ compaction of soils and hardening of surfaces, ▪ loss of catchment yield and	Operational	▪ Incidents of erosion should be remedied as soon as possible to reduce deterioration of the wetland habitat. Erosion downstream of culverts/crossings is one of the largest impacts and can be addressed with fairly inexpensive energy dissipating measures such as reno mattresses or small concrete structures; ▪ Any coal contamination should be removed to reduce contamination of the water quality. The contaminated material should then be discarded at the correct facility; ▪ Leak detection of the pipelines should be initiated; ▪ Limit the footprint area of the operational activities to what is essential to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas); ▪ All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads; ▪ All vehicles must be regularly inspected for hydrocarbon leaks; ▪ Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress	NWA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
		surface water recharge, ▪ erosion and sedimentation, ▪ the potential loss of biodiversity and habitat, ▪ loss of natural migration routes for instream fauna and further fragmentation of the systems present.		of hydrocarbons into topsoil; ▪ All hydrocarbon spills should be immediately cleaned up and treated accordingly; ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate licensed waste facility; ▪ Permit only essential personnel within the 100 m zones of regulation for all freshwater features identified; and ▪ Ongoing wetland rehabilitation is necessary during the operational phase as stipulated in the monitoring section.	
	Surface Water	Surface water quality deterioration as a result of sedimentation and contaminated runoff entering streams.	Operational	▪ All Stormwater management infrastructure shall be put onto planned maintenance schedule to ensure that all infrastructure will have the necessary capacity to manage the 1:50 year storm event. ▪ Stormwater management to separate clean and dirty stormwater must be implemented and the structures must be maintained in accordance with GN704 to prevent dirty water runoff entering into nearby watercourses; ▪ All mine infrastructure (PCDs, Sewage Treatment Plant, Pipelines, conveyor belts) must be put onto a planned maintenance system to ensure that regular inspections and maintenance is undertaken to prevent spillages at both Mooikraal and 3 Shaft. ▪ Management and maintenance measures must be implemented to ensure that all berms, channels and containment structures are kept in good working order to prevent accidental discharges of dirty water to the environment; ▪ Water quality must be monitored in the Leeuspruit and Kromelmboogspruit to verify the effectiveness of the stormwater management structures; ▪ The mine will implement measures to minimise its dirty water make at Mooikraal and 3 Shaft that need to be handled in the water balance e.g. dirty areas at the plant will be kept to the minimum. Any water that is generated from the stockpile areas at 3 Shaft will be contained within the silt trap and then pumped either to the fogger cannon tank for re-use in the fogger cannons, or to Sasolburg Operations. The water balance must be updated on an annual basis to reflect the current situation; ▪ Underground machinery and vehicles are to be washed, serviced and repaired in a dedicated workshop on surface with the necessary pollution control measures in place such as dedicated wash bays with oil separators and a facility to contain the recycled oil; ▪ Clean and dirty water separation at both Mooikraal and 3 Shaft must be implemented. Clean water must be directed away from the stockpile area to the environment while dirty water is directed to containment facilities; ▪ A spill response plan will be implemented and employees trained accordingly to react efficiently to address any spillage where dirty water is discharged to the environment. ▪ Dust suppression measures must be undertaken as required and as authorised by the WUL; ▪ The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained; and ▪ A maintenance programme must be implemented to ensure regular inspections of machinery and infrastructure.	NWA
	Air Quality	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Operational	▪ Dust suppressants and binders may be used on haul roads; ▪ Fogger cannons will be erected on the perimeter fence at 3 Shaft to minimize windblown dust from 3 shaft activities being blown to the community. ▪ Monitoring of dust fallout must continue as per dust fallout monitoring network ▪ Speed limits must be enforced on travelling and haul roads. Machinery and vehicles must be switched off when not in use.	NEMAQA
	Noise	Noise disturbance from operational and maintenance activities (however not expected to impact any	Operational	▪ All machinery shall be put onto planned maintenance to ensure optimum working operations and prevent excessive nuisance noise generation ▪ Machinery and vehicles must be switched off when not in use; ▪ Noise suppressant mechanisms such as exhaust mufflers must be considered for machinery where excessive noise is experienced; and	National Noise Control Regulations

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
		receptors).		▪ Machinery and vehicles must services regularly to ensure they perform optimally.	
	Visual	Impact on surrounding land users due to increased lighting	Operational	▪ The current lighting layout will continue at 3 Shaft and Mooikraal, should there be any complaints due to lighting, the layout may be re-evaluated.	NEMA
	Groundwater	A contamination plume may emanate from the waste rock dump and seep into the groundwater, deteriorating groundwater quality	Operational	▪ The WRD should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. ▪ XRD, acid base accounting and leachable concentration investigations of the coal seam at Mooikraal are recommended, to be kept on file to assess any potential of acid mine water forming.	NEMA
11. Dirty water storage in the North and South PCDs, underground water storage dams and at STP;	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Possible overflows/leaks of mine affected water from PCDs and STP resulting in contamination of soils and water resources	Operational	▪ All mine infrastructure (PCDs, STP, Pipelines, conveyor belts) must be put onto a planned maintenance system to ensure that regular inspections and maintenance is undertaken to prevent spillages at both Mooikraal and 3 Shaft. A job card system will be utilised to request maintenance work ▪ Monitoring of PCD volumes should be undertaken in order to detect any rise in water levels that may lead to PCD overflows. This is necessary, especially during rainfall events, to ensure that any extra water is quickly transferred through the already installed pipelines away from the PCDs for re-use before any overflows can occur. ▪ Incidents of potential impact to surface water bodies will be reported to the DWS (within timeframes as stipulated by the WUL), investigated and appropriate action plans (and rehabilitation if necessary) will be implemented and communicated to DWS. Upstream and downstream quality monitoring will commence. ▪ Two boreholes (one in the shallow, and one in the intermediate aquifer) are drilled downstream of the PCDs to determine any possible leaks (mine water signature in the quality), these boreholes must continue to be analysed as per the WUL requirements to determine any possible leak or seepage of the PCDs. ▪ Any maintenance work on the PCDs will be carried out as required; ▪ PCDs must be maintained and operated with a 0.8 m freeboard and able to contain a 1:100 year flood event; ▪ Continuous monitoring of water levels (volumes of water removed from underground, as well volumes of water pumped in the 5 and 15 Ml/day pipelines) must be conducted to prevent overflow from the dams into the Kromelmboogspruit; ▪ Water stored in the PCDs shall be transferred to 3 Shaft and Sasolburg Operations to prevent overflow of the PCDs; ▪ Underground water storage dams must be monitored for water level and pressure behind the seal walls; ▪ Ensure that stormwater management structures are put in place in all dirty areas to capture all dirty water and divert this water to PCDs; ▪ Clean-up and rehabilitation of any areas affected by spillages; ▪ If overflow from the PCDs should occur, Mooikraal will conduct water quality monitoring downstream of the PCDs and notify the competent authority, should there be a negative impact to surface water bodies, downstream users will be notified and rehabilitation measures will be informed by a professional; ▪ The STP infrastructure should regularly be inspected and maintained to ensure the optimum operation of the STP to provide a treated effluent that complies with the water qualities set out in the WUL; ▪ Monitoring of treated sewage effluent quality should continue to ensure that all discharges into the Kromelmboogspruit are within acceptable WUL limits. ▪ Monthly monitoring of treated sewage effluent quality must be conducted to ensure that all discharges into the Kromelmboogspruit are within acceptable WUL limits.	Chamber of Mines Guidelines NEMA NWA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
12. Operation and water discharge from the STP	Freshwater ecosystems	Erosion of the water course from water discharged from the STP (If applicable)	Operational	Despite the aforementioned, mitigation measures should be in place to limit the potential erosion impacts associated with the discharge of water into a watercourse. Although notable signs of erosion were not observed, some erosion mitigation measures are provided below. These can be regarded as additional measures to be implemented if notable signs of erosion start to occur and as such have been excluded from the required mitigation measures list. ▪ Armoured outlets utilising naturally occurring rocks can be installed to reduce the intensity of the flow from the pipeline outlet to attempt to limit immediate erosion; ▪ Flow diffusing mechanisms should be implemented (e.g. baffles) to limit any potential erosion and sedimentation likely to be facilitated by the discharge volume of the outfall; and ▪ Should erosion be observed due to the discharge flow, corrective measures must be investigated and implemented accordingly.	Chamber of Mines Guidelines NEMA NWA
13. Operation of crusher plant, stockpiling of ROM and crushed coal at 3 Shaft;	Groundwater	Groundwater contamination	Operational	▪ Two monitoring boreholes at 3 Shaft are recommended to be drilled downstream (in addition to the existing) of the current location of the primary plant area, one in the shallow, and one in the intermediate aquifer. These boreholes will serve to acquire groundwater samples in order to quantify the presence or absence of contamination in the existing primary plant vicinity with better accuracy; ▪ A hydrocensus is recommended to be conducted within a 1 km radius of the Mooikraal and 3 Shaft area; ▪ Stormwater management principles must be implemented at the stockpile area; ▪ Groundwater monitoring must be implemented to assess the time series water level and water quality trends; ▪ Due to the fact that no underground mining occurs at 3 shaft, all historical groundwater, geological, rescue borehole locations must be retained on a register and the status of the borehole will be recorded; and ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties.	Chamber of Mines Guidelines NEMA NWA
	Soils, land use and land capability	Soil contamination as a result runoff emanating from stockpile facilities	Operational	▪ All operations shall be contained to the existing stockpiling area. No new areas shall be disturbed as a result of the stockpiling of ROM at the existing stockpiling areas; ▪ No ROM shall be stockpiled outside the existing stockpiling areas and outside any dirty stormwater management infrastructure; ▪ If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; and ▪ Only the designated access routes are to be used to reduce any unnecessary compaction.	Chamber of Mines Guidelines
	Surface Water; and Freshwater ecosystem	Contamination due to runoff emanating from stockpile facilities resulting in reduced ecological integrity and functioning of freshwater ecosystems	Operational	▪ The stormwater management infrastructure at 3 Shaft should be upgraded to include the proposed new Primary Plant, and conveyor belt facilities so that dirty water from these areas is contained within the dirty water area for re-use. Construction of the proposed cut-off trenches at the Stockpile area should be implemented to separate dirty runoff from the clean environment. Dirty water may not be permitted to be discharged to the environment; ▪ Surface water monitoring around the 3 Shaft area must be undertaken in accordance with the WUL, as well as water monitoring plan; ▪ Where coal contamination is found outside the designated dirty water areas, this must be cleaned up immediately, the area must be rehabilitated, and measures implemented to prevent; ▪ Dust management programme must continue; ▪ The wetland must be monitored on a regular basis to ensure no residual impact to the wetland and watercourse is realised; and if contamination of degradation of the wetland or river is detected remediation measures must be implemented as informed by a professional; ▪ If possible, if coal is imported, truck loads should be covered; particularly in dry and windy seasons; and ▪ Berms must be maintained at the perimeter of the coal handling area as a buffer between the coal handling area and the sensitive receiving environment.	NWA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
	Groundwater	Groundwater contamination as a result of seepage from stockpile facilities	Operational	▪ The WRD at Mooikraal and the coal stockpile area at 3 Shaft should be managed to minimise infiltration of contaminants to the groundwater; ▪ The WRD must be vegetated to minimise rainfall infiltration and prevent the mobilisation of dissolved metals; ▪ Groundwater monitoring must be continue to detect any impacts from the stockpile facilities; and ▪ Should any landowner report a reduced yield/ quality from his borehole, the cause of the impact will be investigated by the mine. If there is reasonable cause to believe that the impact is mining related, suitable corrective action will be agreed between the parties.	NWA
	Air Quality	Dust generation from stockpile facilities	Operational	▪ In controlling dust from the crushing and screening operations, it is recommended that the crusher be enclosed, to achieve a control efficiency of up to 90%; ▪ Mitigation of materials transfer points should be done using water sprays at the tip points (and when forming stockpiles using the coal stacker). This should result in a 50% control efficiency; ▪ In minimizing windblown dust from stockpile areas, it is recommended that fogger cannons be used to mitigate windblown dust by 90%; and ▪ The drop heights when trucks are off loading coal and at tipping points should be minimised.	NEMAQA
	Noise	Noise disturbance from the operation of 3 Shaft	Operational	▪ If any noise related complaints are received from the existing infrastructure, Mooikraal will investigate the complaint, and put into place actions to address the complaint; and ▪ Should any new structure with noise generating potential be erected, Mooikraal must conduct a noise assessment. If it is predicted that new structures will increase noise levels (from the baseline noise level), Mooikraal must investigate noise controls/ abatement to not increase ambient noise levels beyond threshold as per Free State Noise Control Regulations	Free State Noise Control Regulations
14. Storage and handling of hazardous products (including fuel, chemicals and oil) and waste; and 15. Operation of contractors yard, haul roads, change houses, wash bays, surface ablution facilities and kitchens (Mooikraal and 3 Shaft)	Soils; Surface Water; Groundwater; and Freshwater ecosystems	Potential contamination of soils and water resources as a result of hazardous substance spillages	Operational	*Storage of hazardous substances* ▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities; ▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ All vehicles are to be serviced in a correctly bunded area (workshop); and ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface. *Sanitation provided during operational activities* ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities; *Waste management* ▪ All waste must be temporarily stored separately on a concrete standing in a designated waste storage area. No waste may be permitted to be stored outside the designated waste storage area; ▪ At 3 Shaft, waste must be disposed of as general, hazardous and recyclable waste (fluorescent tubes etc.); at Mooikraal waste will be designated as co-contaminated waste (hazardous waste) and recyclable waste (steel, drums, wood etc) ▪ Waste must be stored in waste skips as far as practicable, on a cement/ concrete surface ▪ Waste storage will comply with For the storage of general waste, no more than 100 m3 will be stored, for hazardous waste, no more than 80 m3 will be stored ▪ In storing the above mentioned volumes of waste, Mooikraal and 3 Shaft will not trigger the NEM:WA: list of waste management activities that have, or likely to have detrimental effect on the environment (GNR 921, dated 29 November 2013) as well as the National norms and standards for the storage of waste (GNR 926, dated 29 November 2013) ▪ Appropriate signage must be placed around the waste and hydrocarbon storage area; ▪ Waste must be recycled as far as possible. if it cannot be recycled it must be removed by an approved service provider and disposed of at an appropriate licenced waste facility; ▪ Hazardous waste generated onsite must be disposed of at an appropriate licenced hazardous waste facility. Safe disposal certificates must be retained for all hazardous waste removed from site. *Washbays and workshops* ▪ The sumps at the wash bay and diesel workshop must be equipped with oil skimming devices to remove	NEMA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
				oil and grease from the wash down water; ▪ Oil that is removed from the sumps must be recycled ▪ An emergency spillage response plan should be in place and accessible to the responsible t monitoring team; ▪ A spill response kit must be available at all times. Should a spillage occur the incident must be reported, and cleaned, reference to the spillage response plan. Actions should be taken to prevent re-occurrence of the spill. ▪ Material used for clean-up, as well as any contaminated soil must be disposed of to hazardous waste ▪ Ensure that oil traps and skimmers are well maintained; and ▪ All employees must be trained and made aware of the procedure for dealing with spills and leaks on site.	
16. Drilling of monitoring, exploration, downcast and rescue boreholes	Soils, land use and Land Capability	Drilling activities resulting in soil erosion and soil compaction, and consequently loss of topsoil.	Operational	▪ Only clear vegetation when and where necessary. Keep footprint as small as possible and if practicable less than 25 m x 25 m; ▪ Only remove topsoil when and where necessary ; ▪ Only the designated access routes are to be used to avoid unnecessary soil compaction; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion where; and ▪ Active rehabilitation, of disturbed areas immediately after construction.	Chamber of Mines Guidelines
	Flora and Fauna	Direct loss of floral species/vegetation types and biodiversity	Operational	▪ Limit vegetation clearance to the designated project areas (approximately 25mx 25m); and ▪ Allow natural vegetation to re-establish as far as possible.	NEMA; and NEMBA.
	Freshwater ecosystems; Groundwater	Drilled boreholes resulting in water table impacts related to a loss of pressure (immediate) and resultant overflowing, which is likely to be experienced in the decommissioning and closure phases.	Operational	▪ Groundwater monitoring must be undertaken; ▪ Existing access routes shall be used as far as possible; ▪ No unnecessary crossing of the wetland features and their associated buffers should take place; ▪ Boreholes and rescue bays should be drilled to cause as little harm to the surrounding environment as possible; and ▪ Following use, boreholes must be adequately sealed so there is no loss of pressure to water table and to prevent the boreholes from overflowing.	NWA
	Heritage	Direct disturbance of heritage resources	Operational	▪ A 50 m no-go buffer zone should be implemented around all identified heritage resources at the proposed borehole sites; ▪ Immediately inform SAHRA of any newly-identified heritage resources identified and enlist the services of a qualified and accredited heritage practitioner to assess the find and recommend appropriate management and/or mitigation measures.	NHRA
	Groundwater	Impact to groundwater	Operational	▪ All groundwater monitoring, geological, downcast and rescue borehole locations must be retained on a register; ▪ Geological/ exploration boreholes will be sealed and decommissioned during the operational phase, according to the Sasol Mining procedure and the register will reflect the status of the borehole; and ▪ Rescue boreholes that are no longer required/ in use will be sealed and decommissioned as per Sasol Mining Procedure, and the register will reflect the status of the borehole; ▪ Downcast boreholes must be sealed upon decommissioning of Mooikraal as per Sasol Mining procedure	NWA
DECOMMISSIONING AND REHABILITATION PHASE					
17. Demolition and removal of infrastructure (incl. transporting materials); and	Soils, Land Use and Land Capability	Soil erosion and soil compaction if rehabilitation is not done correctly.	Decommissioning and Rehabilitation	▪ Remove buildings to foundation level. All rubble to be relocated to a specified approved rubble dump or used as backfill / infill material; ▪ Contour slopes to minimise erosion and run-off; ▪ Seal all boreholes (including recue and water monitoring)drilled into the mine as per procedure; ▪ It is assumed that exploration boreholes will be sealed during operational phase	Chamber of Mines Guidelines

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
18. Rehabilitation (including replacement of soil, re-vegetation and profiling/contouring).				▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All spills from machinery should be immediately cleaned up and treated accordingly and disposed of at an appropriate licenced facility; ▪ Plant native vegetation to prevent erosion and encourage self-sustaining development of a productive ecosystem; ▪ Use waste rock, as stockpiled on Mooikraal, to backfill the incline/ decline shaft followed by topsoil to the extent feasible; ▪ Compacted areas are to be ripped (<300mm) to loosen the soil and vegetation cover re-instated; ▪ An inventory of hazardous waste materials stored on site should be compiled, including volumes stored, as well as method of disposal; ▪ The incline/ decline shaft, ventilation shaft as well as downcasts must be sealed as informed by a professional; ▪ Ensure proper stormwater management designs are in place; ▪ Surface inspection on the fully rehabilitated areas must be undertaken to ensure a surface profile that allows good drainage. This will ensure improvement or increased catchment yield on to the surrounding water streams; ▪ Only designated access routes are to be used to reduce any unnecessary compaction; ▪ All PCDs, once no longer in use, must be emptied of water. This water can either be pumped underground or pumped to Sasolburg Operations (via the 5 and 15 Ml/day pipeline). A contaminated land assessment must be done to determine whether the soil remaining in the dam is contaminated. If found to be contaminated the contaminated soil should be removed and disposed of to an appropriate licenced facility and the PCD backfilled and rehabilitated / revegetated. If the soil is found not to be contaminated, this soil can be utilised for rehabilitation; ▪ Small amounts of fertiliser will be added to accommodate a low nutrient status of the soils where necessary in accordance with the post closure land use; ▪ Soils will be replaced in the disturbed areas (shaft and plant sites) to the same depth as that before mining commenced at least 400 mm (250 mm topsoil and 150 mm subsoils) to sustain post mining land use; ▪ The waste rock material which will be backfilled into the shaft should be completely flooded; to eliminate exposure to oxygen, this will hinder contamination generating reactions; and ▪ Conduct soil contamination assessments (as per NEMWA part 8) to assess if any remediation is required prior to future land use specifically in areas where soil contamination would be expected such as the waste storage areas, Incline shaft, along the conveyor belt and at 3 Shaft (crusher and stockpile area).	
	Fauna and Flora	Loss of fauna and flora species	Decommissioning and Rehabilitation	▪ Plant native/indigenous species to the area to prevent erosion and encourage self-sustaining development of a productive ecosystem; ▪ As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum; ▪ All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses; ▪ It is expected that once revegetation occurs, some alien invasive species and pioneer species will establish in the newly rehabilitated areas. Alien invasive species must be removed from the rehabilitation areas and replaced with indigenous vegetation. An alien invasive management plan must be implemented and monitored for a period of three years until the majority of the alien invasive species have been removed.	NEMA
	Surface Water	Surface water quality deterioration as a result of sedimentation and contaminated runoff entering streams.	Decommissioning and Rehabilitation	▪ Use of accredited contractors for removal or demolition of infrastructure must be adhered to, in order to reduce the risk of waste generation and accidental spillages; ▪ Ensure surface water monitoring is undertaken until closure is reached ▪ All sludge from the STP drying beds must be removed and disposed of at an approved waste disposal facility; ▪ The bioreactor and settling tanks must be emptied, the sludge removed and appropriately disposed of; ▪ Stormwater management must be implemented and the structures must be maintained in accordance	NWA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
				with GN704 until dirty areas are fully rehabilitated; and ▪ Landscape re-profiling must be undertaken to emulate natural drainage to the surrounding Kromelmboogspruit and Leeuspruit watercourses.	
	Freshwater ecosystems	Reduced ecological integrity and functioning of freshwater ecosystems as a result of potential soil compaction, soil erosion and consequent sedimentation of freshwater resources as well as potential encroachment of alien invasive plant species as a result of habitat fragmentations.	Decommissioning and Rehabilitation	▪ Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled; ▪ Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream; ▪ An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases; ▪ As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum; ▪ All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses; ▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint; ▪ All vehicles must be regularly inspected for leaks; ▪ Re-fuelling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; ▪ All existing litter, debris should be removed from the freshwater ecosystems and littering should be prohibited on an ongoing basis; ▪ All spills from machinery should be immediately cleaned up and treated accordingly; ▪ Should the road servitude and overland conveyor have affected the integrity of the wetlands resulting in a loss of habitat and downstream surface water recharge, rehabilitation during the decommissioning and closure phase should focus on the rehabilitation of these areas as informed by a professional. Management in this regard may include removal of the structures, re-profiling of the bed and marginal zones to restore the geomorphological and hydrological integrity and ripping and re-seeding with indigenous wetland grass species. ▪ All incidents of erosion should be remedied and AIPs removed during the operational phase; and ▪ Any coal contamination should be removed and discarded at the correct facility as in the operational phase.	NWA
	Air Quality	Elevated levels of PM10, PM2.5 and dust fallout resulting from site clearance and construction activities (however not expected to impact any AQSRs).	Decommissioning and Rehabilitation	▪ The dismantling area disturbed must be kept to a minimum; ▪ Drop heights when offloading must be minimised; ▪ Limit demolition activities to non-windy days; ▪ Dust monitoring must continue to be undertaken until closure is reached or until it is proven that no further impact from the mine on the generation of dust is expected; ▪ Use of dust suppressant on dirt roads and exposed areas; and ▪ Rehabilitated landscape should be vegetated with native/ indigenous vegetation.	NEMAQA
	Noise	Noise disturbance from operational and maintenance activities (however not expected to impact any receptors).	Decommissioning and Rehabilitation	▪ Decommissioning activities should be restricted to daylight hours; and ▪ Machinery and vehicles must be switched off when not in use.	National Noise Control Regulations
19. Storage, handling and treatment of hazardous products (incl. fuel, explosives	Soils; Surface Water; Groundwater; and	Potential contamination of soils and water resources as a result of hazardous substance	Decommissioning and Rehabilitation	▪ Prevent any hydrocarbon spills occurring; ▪ Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages ▪ If a hydrocarbon spill occurs it is to be cleaned up immediately and, the material picked up and disposed of to the hazardous waste bins ▪ if applicable the spill will be reported to the appropriate authorities;	NEMA

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
and oil and waste)	Freshwater ecosystems	spillages		▪ Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring; ▪ Vehicles and heavy machinery should be serviced and checked on a regularly basis to prevent leakages and spills. Vehicles are to be serviced in a correctly bunded area (workshop); ▪ Filling of machinery or vehicles with diesel or hydraulic oil will take place on a lined surface; ▪ MSDS's should be kept on site for reference purposes regarding handling, storage and disposal of materials; ▪ Appropriate sanitary facilities must be provided for the duration of the operational activities; ▪ All waste must be temporarily stored separately; ▪ All waste removed from site must be recorded. All hazardous waste must have safe disposal certificates; ▪ Waste must be recycled as far as possible. If it cannot be recycled it must be disposed of at an appropriate licenced waste facility.	
20. Decant (Mooikraal)	Groundwater	A contamination plume is likely to originate from the underground mine workings as groundwater recovery commenced and the system moved towards filling up the mine voids	Decommissioning and Rehabilitation	▪ All existing boreholes as informed by the registers, with the exception of private water supply boreholes and monitoring boreholes should have been sealed and decommissioned according to Sasol Mining procedure during the operational phase, in order to minimise the chance of decant occurring; ▪ All shaft adits, ventilation shafts and down-casts will be sealed and decommissioned as guided by a professional; ▪ Should there be an negative impact to surface water bodies due to decant and base-flow contribution, investigations will occur, and rehabilitation will commence as informed by a professional; ▪ Should there be an negative impact to delineated wetlands, investigations will ensue, and rehabilitation will commence as informed by a professional and ▪ Potential decant should be informed by the numerical model as new data becomes available, should decant be predicted to occur, decant locations should be monitored for decant quality and rate, possible scenarios to manage the decant will be informed by a professional ; ▪ The groundwater monitoring network may be re-assessed and amended to determine the boreholes, to be monitored, necessary to monitor the relevant aquifers sources of contamination and receptors; and ▪ Groundwater monitoring should be conducted to assess the time series water level and water quality trends.	NWA
	Wetlands Surface Water	Discharge of decant into freshwater ecosystems may degrade water quality and cause channelisation and associated erosion and sedimentation.	Decommissioning and Rehabilitation	▪ Groundwater monitoring must be undertaken until closure is reached; ▪ Updated groundwater models should be run in order to accurately predict if/where decant will occur and at what volume. ▪ Should it be predicted that decant will occur, a professional will be utilised to determine the best course of action, it must be noted that no decant water must be discharged into watercourses ▪ Comprehensive databases of rescue, groundwater monitoring and geological boreholes must be maintained, ▪ Seal all boreholes drilled into the mine; and ▪ The possibility of contaminated decant can be reduced by sealing-off mine shafts (as informed by a professional) and boreholes drilled into the mine as per Sasol Mining procedures.	NWA
21. Subsidence	Soil, Land use and land capability Surface Water Fauna and Flora Wetlands	Impact on various environmental aspects due to subsidence	Decommissioning and Rehabilitation	▪ Rehabilitation of surface cracks (subsidence), caused by surface subsidence due to underground mining where significant risks to the environment and health and safety have been identified, must be rehabilitated; ▪ Areas where vegetation is affected by ponding, caused by surface subsidence due to underground mining, must be rehabilitated once identified; ▪ Trenching to dewater surface ponds will decrease the extent of surface ponding. Drains need to be checked on a regular basis to ensure that they remain effective; ▪ Lidar subsidence monitoring should be undertaken throughout the operational phase on an annual basis; ▪ Should subsidence occur below wetlands and water course the impact shall be mitigated immediately, as informed by a professional, and the necessary actions taken to remediate this, ongoing monitoring and wetland rehabilitation of hydrological and geomorphic changes must be conducted; ▪ Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material. Should ash backfilling be utilised various environmental authorisations must be awarded prior to this being undertaken; ▪ The area undergoing rehabilitation will be fenced and all animals prevented from entering the area until	NEMA NWA Chamber of Mines Guidelines

Activity	Aspect Affected	Impact Description	Phase	Mitigation Type	Compliance with standards
				vegetation is sustainable; ▪ Newly seeded/planted areas will be protected against compaction and erosion; ▪ A monitoring programme will be initiated to monitor the rehabilitation of disturbed areas specifically focusing on erosion, AIP establishment, indigenous vegetation establishment and compaction.	
POST-CLOSURE PHASE					
22. Post-closure monitoring.	Soils, Land Use and Land Capability; and Flora and Fauna	Unsuccessful revegetation resulting in soil erosion on bare surfaces	Post closure	▪ Rehabilitate any erosion as well as damage caused by erosion, the method to be informed by a professional; ▪ Only designated access routes are to be used to reduce any unnecessary compaction. Surface cracks must be effectively rehabilitated by agricultural deep ripping or by a dozer ; ▪ The topsoil should be shaped taking the pre-mining landscape into consideration; ▪ Vehicular movement across rehabilitated areas should be limited where possible while the vegetation is establishing; ▪ The area must be fenced and animals should be kept off the area until the vegetation is self-sustaining; ▪ Fertilize grassed area with nitrogen containing fertiliser after germination of seeds to promote good growth and development; ▪ Drainage controls such as cut-off trenches and culverts must be used to ensure proper management of water runoff to prevent soil erosion and sedimentation; ▪ Grow indigenous grass to form a vegetative barrier and protect the land from surface erosion; and ▪ Trenching to dewater surface ponds will decrease the extent of surface ponding. Drains need to be checked on a regular basis to ensure that they remain effective.	Chamber of Mines Guidelines NEMBA
	Surface Water and Freshwater ecosystems	Potential surface water and freshwater ecosystem pollution from possible decant of contaminated groundwater	Post closure	▪ Possible decant and seepage should continually be monitored after mine activities have ceased until such point in time that an equilibrium is reached and the necessary proof is available that no decant will occur from the underground mine; ▪ Water quality and wetland monitoring should continue post rehabilitation in accordance with the closure plan to detect any latent impacts; and ▪ The numerical model must be updated to incorporate new data, this model should inform potential decant, should decant be predicted or observed, a professional will guide mitigation and rehabilitation actions.	NWA
	Groundwater	Potential groundwater contamination and decant	Post closure	▪ All existing boreholes as informed by the registers, with the exception of private water supply boreholes and monitoring boreholes should have been sealed and decommissioned according to Sasol Mining procedure during the operational phase, in order to minimise the chance of decant occurring; ▪ All shaft adits, ventilation shafts and down-casts will be sealed and decommissioned as guided by a professional; ▪ The numerical model must be updated to incorporate new data, this model should inform potential decant, should decant be predicted or observed, a professional will guide mitigation and rehabilitation actions. ▪ The groundwater monitoring network may be re-assessed and amended to determine the boreholes, to be monitored, necessary to monitor the relevant aquifers sources of contamination and receptors; and ▪ Groundwater monitoring should be conducted to assess the time series water level and water quality trends.	NWA
	Socio-economic	Mine closure resulting in job losses and other incomes (local goods and services supplied to the operation)	Post closure	▪ Attempts will be made to place the existing labour force on other projects where appropriate; ▪ The workforce will be trained and their skills developed during the operational phase, particularly in the area of basic literacy, basic numeracy and basic business skills, which will enhance future employment opportunities outside the mine; ▪ Employees will receive counselling to prepare for the closure of the mine; ▪ The development and growth of SMMEs will be supported in local settlements and ongoing skills development programmes will be available to the labour force; ▪ Ensure the development of an efficient collaboration between Mooikraal and the various stakeholders concerned or interested in a better implementation of the proposed measures for the mitigation of negative impacts and the improvement of positive ones; and ▪ Ensure the good coexistence between the mine and other stakeholders through an effective communication mechanism that can inform all stakeholders on the life of the mine.	-

8 Financial Provision

8.1 Item (i)(1): Determination of the amount of Financial Provision

Financial Provisioning Assessments for the Mooikraal Operation (including 3 Shaft) are conducted annually, the last update was conducted by Jones and Wagner in March 2018

The area of responsibility assessment was divided into three areas, namely Sigma No. 3 Shaft, Old Sigma Coal Handling (primary plant area at 3 Shaft) and Mooikraal Shaft (remaining infrastructure).

The financial liability cost update was calculated in alignment with Financial Provisioning Regulations, 2015 (GN R 1147).

8.1.1 Item (i)(1)(a): Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under Regulation 22 (2) (d) as described in 2.4 herein

The rehabilitation and closure objectives have been set out in Section 4.1 (Part B) above. The overarching objective for closure is to ensure that impacted land is rehabilitated in a manner that allows it to be ceded for other sustainable land uses.

8.1.2 Item (i)(1)(b): Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties

The Rehabilitation and Closure Plan (RCP) was made available for public review and comment together with this Draft Basic Assessment and Regulation 31 Amendment Report (please refer to Appendix 13). All comments received that pertain to the RCP will be recorded in the final report.

8.1.3 Item (i)(1)(c): Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure

A summary of the rehabilitation plan is presented in Section 21.2.2 (Part A) above. Please refer to Appendix 13 for the complete RCP associated with the project.

8.1.4 Item (i)(1)(d): Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives

The RCP has been compiled in support of the primary closure objectives which are to remove unwanted infrastructure and rehabilitate the land to a suitable sustainable land use which provides a safe and stable environment for surrounding receptors.

8.1.5 Item (i)(1)(e): Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline

The estimated closure cost required for the rehabilitation and closure of the Mooikraal operation is **R 114,612,971.00 (incl. VAT)**. A detailed closure cost breakdown is provided in Table 24-1 (Part A) above.

8.1.6 Item (i)(1)(f): Confirm that the financial provision will be provided as determined

Sasol Mining has made provision for closure as legally required. A liability assessment update will continue to be undertaken annually to ensure the financial provision is in line with the closure cost.

9 Monitoring compliance with and performance assessment

Mooikraal will be responsible for the implementation of all monitoring, mitigation and management measures, as well as compliance with the EMP. Mooikraal has an established monitoring programme that is implemented at the operations.

This programme will be expanded to include aspects associated with the proposed new activities. The specific recommended environmental monitoring for the identified impacts associated with the entire operation are detailed below and subsequently summarised in Table 9-5 below.

The following environmental aspects are monitored:

- Soils;
- Biodiversity;
- Surface Water;
- Groundwater;
- Wetlands;
- Aquatic Ecology;
- Air Quality;
- Noise; and
- Cultural Heritage.

9.1 Item 1(g): Monitoring of impact management actions

9.1.1 Soils

Soil monitoring includes the following aspects:

- The location of soil types that can be stripped and stockpiled together;
- Stripping depths of different soil types;
- The location, dimensions and volumes of planned stockpiles for different soil types; and

- Soil erosion.

The following maintenance is required with respect to these aspects:

- Repair any damage caused by erosion; and
- If soil is contaminated, it is treated by means of in-situ bio-remediation.

9.1.2 Biodiversity

Flora and Fauna monitoring includes the following aspects:

- The impacts on vegetation structure and health;
- Impacts on faunal populations and numbers;
- Red Data Listed fauna and flora species (should it be recorded going forward);
- The establishment of alien plant species; and
- The success of revegetation and other rehabilitation activities.

9.1.3 Surface Water

Monitoring is currently being conducted at Mooikraal and 3 Shaft. However, the monitoring plan provides a surface water monitoring programme which includes the proposed relocation of the 3 Shaft Primary Plant and the upgrading of the stormwater management system. Surface water monitoring should continue at Mooikraal (Upstream and Downstream of Mooikraal on Kromelmboogspruit; in all dirty water dams and sumps; at the discharge point of treated sewage effluent from the STP) and at 3 Shaft (Upstream and Downstream of 3 Shaft on Leeuspruit tributary and in the dirty water PCD). Monitoring frequencies specific to different phases of the project are described in this monitoring plan. All water quality results should be benchmarked to the Mooikraal WUL (No. 08/C22K/CIGJFAE/6981) to determine any impact on the quality of water (positive/negative).

The surface water monitoring plan is summarised in Table 9-1.

Table 9-1: Surface Water Monitoring Plan

WUL condition number		Monitoring Point	Parameters	Sampling method	Monitoring points	Method of analysis	Frequency of Sampling	Reporting to DWS	Responsible Person
Mooikraal Monitoring (Kromelmboogspruit)									
no condition		Surface Water Upstream and Downstream of Mooikraal - Kromelmboogspruit	EC	grab sample	refer to monitoring plan	Electrode	Monthly during Operation & Monthly for 3 years after Closure of mine	Annual report	Environmental Practitioner
			pH			Electrode			
			TDS			Gravimetric			
			NH_3			Spectrophotometric			
			Na			Spectrophotometric			
			COD			Spectrophotometric			
			SO_4			chromatography			
			Ca			Spectrophotometric			
			Mg			Spectrophotometric			
			Cl			chromatography			
			NO_2/NO_3			chromatography			
			PO4			chromatography			
			F			chromatography			
Sewage treatment plant - effluent (only Mooikraal)									
Appendix V Section 21 (f)	2.1	Quality of sewage effluent discharged to Kromelmboogspruit	pH	grab sample	refer to monitoring plan	Electrode	Weekly	6 monthly - bi-annual water report	Environmental Practitioner
			EC			Electrode			
			Suspended solids			Gravimetric			
			NO_2/ NO_3			chromatography			
			NH3			Spectrophotometric			
			COD			Spectrophotometric			
			E. coli			membrane filtration			
			Faecal coliforms			membrane filtration			
			free Cl_2			Electrode			
			PO4			chromatography			
3 Shaft Monitoring (Leeuspruit tributary)									
no condition		Surface Water Upstream and Downstream of 3 Shaft - tributary of Leeuspruit)	EC	grab sample	refer to monitoring plan	Electrode	Fortnightly during construction of Primary Plant, Crusher; Monthly during Operation; Monthly for 3 years after mine Closure	Annual report	Environmental Practitioner
			pH			Electrode			
			TDS			Gravimetric			
			NH_3			Spectrophotometric			
			Na			Spectrophotometric			
			COD			Spectrophotometric			
			SO_4			chromatography			
			Ca			Spectrophotometric			
			Mg			Spectrophotometric			
			Cl			chromatography			
			NO_2/NO_3			chromatography			
			PO4			chromatography			
			F			chromatography			
Dirty Water Dams at Mooikraal and 3 Shaft									
no condition		South & North Dams; Sumps (Mooikraal); PCD at 3 Shaft	EC	grab sample	refer to monitoring plan	Electrode	Monthly	no requirement to report currently	Environmental Practitioner
			pH			Electrode			
			TDS			Gravimetric			
			NH_3			Spectrophotometric			
			Na			Spectrophotometric			
			COD			Spectrophotometric			
			SO_4			chromatography			
			Ca			Spectrophotometric			
			Mg			Spectrophotometric			
			Cl			chromatography			
			NO_2/NO_3			chromatography			
			PO4			chromatography			
			F			chromatography			
Water Volumes (Mooikraal and 3 shaft)									
Appendix II section 21 (a)	2 & 7.1	volume	Volume of water used underground for dust suppression	flowmeter readings	refer to monitoring plan	125 652 m^3/ annum	daily, recorded on the last day of the month	6 monthly - bi-annual water report	Environmental Practitioner
Appendix V Section 21 (f)	3.1.1	volume	volume of water containing waste discharged to the Kromelmboogspruit	flowmeter readings		30 000 m^3/annum	metered on a daily basis at the discharge point	6 monthly - bi-annual water report	
Appendix VI section 21 (g)	2.1	volume	volume of water for dust suppression at 3 shaft	flowmeter readings		7 444 000 m^3/annum	daily, recorded on the last day of the month	6 monthly - bi-annual water report	
Appendix VI section 21 (g)	2.1	volume	volume of water entering the North and South dam	flowmeter readings		9 524 000 m^3/annum	volume of water as per section 21 (j) will confer to the dam volumes	6 monthly - bi-annual water report	
Appendix VII section 21 (j)	1	volume	Volume of water removed from underground at Mooikraal Mine (property portion 2 of)Mooikraal 356	flowmeter readings		9 524 000 m^3/annum	metered and recorded on a daily basis	6 monthly - bi-annual water report	
Appendix VII section 21 (j)	1	volume	volume of water removed from underground at vent shaft (property Kleinvlei 66)	flowmeter readings		2 604 000 m^3/annum	metered and recorded on a daily basis	6 monthly - bi-annual water report	
		volume	potable water received from Randwater	flowmeter readings			monthly	annually as WCWD plan	

9.1.3.1 Proposed Surface Water Monitoring Points

Surface water monitoring should continue within the Kromelmboogspruit (Upstream & Downstream), Sewage Treatment Plant treated effluent and in the North and South PCDs (MK-Dams) and MK- Sump at Mooikraal and within the Leeuspruit tributary (Upstream & Downstream) at 3 Shaft and in PCD (refer to Plan 19, Appendix 2). Coordinates of the surface water monitoring points are presented in Table 9-2.

Table 9-2: Surface water monitoring points at Mooikraal – 3 Shaft

Area	Site ID	Comments	Coordinates	
			Latitude	Longitude
Mooikraal	MK-DAMS	South PCD	-25.0341333	29.57283333
		North PCD	-25.918097	29.5855778
Mooikraal	MK-PIT	Decline Shaft Pit	-26.946196°	27.728363°
Mooikraal	MK-SUMP	Dirty runoff enters MK- Dam at the South PCD end	-26.943833°	27.728728°
Mooikraal	KROM/N	Kromelmboogspruit downstream of the Mooikraal Shaft	-26.922308°	27.712806°
Mooikraal	KROM/S	Kromelmboogspruit upstream of the Mooikraal Shaft	-27.034387°	27.743567°
Mooikraal	STP	Sewage Treatment Plant treated effluent	-	-
3 Shaft	SG/5	Downstream of Zamdela and upstream of 3 Shaft on Leeuspruit tributary	-26.849165°	27.844471°
3 Shaft	SG/6	Downstream of 3 Shaft on Leeuspruit tributary	-26.845097°	27.829692°
3 Shaft	Zamdela to Sigma	Upstream of 3 Shaft	-	-
3 Shaft	Sigma to Pepler	Downstream of 3 shaft	-	-

9.1.4 Groundwater

Current groundwater monitoring network for Mooikraal is seen as sufficient and should be maintained. The newly drilled boreholes at 3 Shaft are recommended to form part of the current ongoing monitoring plan. Furthermore, two additional boreholes are proposed to be included in the monitoring network, namely downstream of the existing plant (one borehole at the shallow aquifer and another at the intermediate aquifer).

9.1.4.1 Water Level

Groundwater levels are recommended to be recorded on a quarterly basis, in order to continue to detect any changes or monitor trends in groundwater elevation and flow direction.

9.1.4.2 Water Sampling and Preservation

When sampling, the following procedures are proposed:

- One litre plastic bottles with a cap are required for the sampling exercises;
- Collected samples must be stored in cooler box or fridge while on site; and
- Sample bottles should be marked clearly with the borehole name, date of sampling and the sampler's name and submitted to a laboratory that analyses in accordance with the methods prescribed by the South African Bureau of Standards in terms of the Standards Act, Act 30 of 1982.

9.1.4.3 Sampling Frequency

Groundwater migrates at a relatively slow rate and drastic changes in the groundwater quality rarely encountered, unless a groundwater preferential flow path is present in the vicinity of a contamination plume. Quarterly monitoring is recommended; in accordance to the WUL guidelines additionally it has been observed sufficient over the years of monitoring groundwater level and quality trends.

Samples should be collected by using Water Research Commission (WRC), 2007, Groundwater Sampling: A Comprehensive Guide for Sampling Methods and submitted to a laboratory that analyses in accordance with the methods prescribed by the South African Bureau of Standards in terms of the Standards Act, Act 30 of 1982.

It is suggested that quarterly samples be collected, extending up to two years post closure and based on the result trends it can be adjusted until a sustainable situation is reached and after it has been signed off by the authorities.

9.1.4.4 Parameters to be Monitored

Should be informed by the authorised water use license, additional suggested parameters include:

- TDS, EC, pH, Alkalinity, Chemical Oxygen Demand;
- Major ions i.e. Ca, Mg, Na, K, SO_4, NH_3, NO_3, NO_2, PO_4, F, Cl; and
- Minor and trace metals, including As, Al, B, Co, Cr, Zn, Cd, Cu, Pb, Fe, Ni, Mn.

9.1.5 Wetlands

Wetland monitoring to be conducted by an independent suitably qualified wetland specialist. The timing of such monitoring audits should be as follows:

- Quarterly during the construction phase;
- Bi- annually during the operational phase;
- Quarterly during decommissioning and rehabilitation phase;
- Annually for a minimum of three years after closure and rehabilitation.

It is highly recommended that ongoing monitoring of the wetlands in the vicinity of the Mooikraal and 3 Shaft continue so as to identify any emerging trends in terms of improvements or degradations in the ecological integrity and functioning of these systems. This data should be compared to the results obtained in both this and historical studies so as to guide the management process going forward.

9.1.6 Aquatic Ecology

Aquatic biomonitoring should continue as per the aquatic methodology currently implemented at the sites depicted in Plan 16, Appendix A. The monitoring programme objectives are set out in Table 9-3 below.

Table 9-3: Aquatic Ecology Monitoring Objectives

Location	Monitoring objectives	Frequency of monitoring	Parameters to be monitored
Current sites used in this study.	Overall PES.	Bi-annual (dry and wet season)	Standard River Ecosystem Monitoring Programme (Ecostatus) methods.
Current sites used in this study.	Determine if water quality deterioration is occurring.	Bi-annual	SASS5 scores should not decrease as and be related to mining activities.
Site used in this study and the surface water assessment.	Determine if water quality deterioration is occurring.	Monthly	Standard water quality monitoring, as per the surface water specialist report.
Current sites used in this study.	Determine if water/habitat quality deterioration is occurring.	Bi-annual	Monitor for presence of fish.

9.1.7 Air Quality

The existing dust fallout monitoring network should remain in place with monthly dust fallout collection conducted throughout the remaining LOM. This will not only provide air quality trends, but also provide an indication of dust fallout increases, if any, due to the mining activities.

Monthly dust fallout reporting should continue, providing information on:

- Monthly dust fallout rates compared to the applicable dust fallout limits, as per National Dust Control Regulations (GNR 827 dated 1 November 2013) (as listed in Table 9-4 and illustrated in Figure 10-46 above); and
- Temporal and spatial dust fallout trends to indicate potential source contributions (3 Shaft).

Table 9-4: Dust Fallout Monitoring Points

Site	Longitude	Latitude	Elevation (m)	NDCR Classification	Applicable Limit
3 Shaft					
SOS 01	27.83868	-26.8355	1486	Non-Residential	1 200 mg/m²-day
SOS 02	27.83351	-26.8518	1478	Non-Residential	1 200 mg/m²-day
SOS 03	27.83663	-26.8427	1476	Non-Residential	1 200 mg/m²-day
Mooikraal Area					
SMK 01	27.726142	-26.940630	2.26	Non-Residential	1 200 mg/m²-day
SMK 02	27.732917	-26.945000	2.31	Non-Residential	1 200 mg/m²-day
SMK 03	27.727528	-26.945111	2.30	Non-Residential	1 200 mg/m²-day
SMK 04	27.734579	-26.940363	2.23	Non-Residential	1 200 mg/m²-day
SMK 05	27.729600	-26.940004	2.30	Non-Residential	1 200 mg/m²-day
SMK 06	27.726194	-26.944000	2.31	Non-Residential	1 200 mg/m²-day
SMK 07	27.736640	-26.942014	2.70	Non-Residential	1 200 mg/m²-day
SMK 08	27.729667	-26.946500	2.37	Non-Residential	1 200 mg/m²-day

9.1.8 Heritage

Project specific CFPs and FFPs must be developed for the project. The purpose of the CFPs and FFPs are to establish procedures that aim to minimise damage to any heritage resources that may be accidentally exposed during the course of activities.

The CFPs and FFPs must clearly describe the type of heritage resources that may occur within the site specific project area, the protocol to follow in the event of accidental exposure of previously unidentified heritage resources, and the appropriate management measures and reporting structures to be adhered to. The CFP and FFP at a minimum should include the following:

- Definitions as defined by Section 2 and 38(1) of the NHRA;
- Procedures that detail the following:
- How to spot a chance find;
- Steps to be undertaken when a chance find is made;
- Internal reporting structures;

- Recording of chance finds; and
- Legal processes and requirements.

9.2 Item 1(h): Monitoring and reporting frequency

Table 9-5 below discusses the monitoring and reporting frequency in detail.

9.3 Item 1(i): Responsible persons

The roles and responsibilities associated with the monitoring programme are set out in Table 9-5 below.

9.4 Item 1(j): Time period for implementing impact management actions

Table 9-5 below captures the time period for implementing impact management actions.

9.5 Item 1(k): Mechanism for monitoring compliance

Table 9-5 sets out the monitoring and management programme of environmental impacts for the Mooikraal operation.

Table 9-5: Monitoring and Management of Environmental Impacts

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
All activities throughout the project	Flora and Fauna	Vegetation clearing at the project area must be monitored to ensure no unnecessary disturbance is taking place. This should be done on a monthly basis during the construction phase.	ECO	Monthly
		The encroachment of alien invasive plant species should be monitored within the project area on a monthly basis and appropriate corrective measures must be undertaken on a monthly basis.	ECO	Monthly
		Annual monitoring of general biodiversity and ensuring sustainable populations of both fauna and flora persist until closure. This includes impacts on vegetation structure and health; impacts on faunal populations and numbers; and Red Data Listed fauna and flora species (should it be recorded going forward).	Terrestrial Ecologist	Annually
	Soil erosion	Daily site inspection will be undertaken by the site manager to ensure that all soil erosion mitigation measures are in place and implemented adequately.	Site Manager	Daily
	Surface Water	Water quality and quantity should be monitored monthly The specific monitoring elements are discussed in Section 9.1.3 above.	Qualified Aquatic Ecologist	Monthly
	Groundwater	Groundwater level and groundwater quality should be monitored on a quarterly basis at the established boreholes as discussed in Section 9.1.4.	Geohydrologist	Quarterly
	Wetlands	Ongoing monitoring of the wetlands in the vicinity of the Mooikraal and 3 Shaft continue so as to identify any emerging trends in terms of improvements or degradations in the ecological integrity and functioning of these systems. This data should be compared to the results obtained in both this and historical studies so as to guide the management process going forward.	Qualified Aquatic Ecologist	Quarterly during the construction phase; Bi- annually during the operational phase; Quarterly during decommissioning and rehabilitation phase; and Annually for a minimum of three years after closure and rehabilitation.
	Aquatic Ecology	Bi-annual aquatic monitoring must be undertaken at the established monitoring points to enable the detection of potential negative impacts brought about by the project. This programme should include the following aspects: ○ Water Quality; ○ Toxicity Testing; ○ Habitat Quality; and ○ Macroinvertebrate assemblages.	Qualified Aquatic Ecologist	Bi-annually
	Dust, visual and noise	Dust fallout must be undertaken as prescribed in Section 9.1.7 above. Dust suppression must be implemented and a dust monitoring network must be established outside of the construction area. Furthermore, heavy machinery and vehicles must be maintained and serviced regularly and, if possible, a silencing system should be fitted. The project activities must only take place during daylight hours.	Environmental Practitioner	Dust monitoring monthly As and when required

Source Activity	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
	Use of hydrocarbons	Daily inspections of machinery must be undertaken and spill trays will be placed under the machinery to collect any hydrocarbon leaks and spillages in the event it is required. Should spillages occur, the soil must be cleared and disposed of to hazardous waste.	Site manager	Daily
	Ablution facilities	The contents of the chemical toilets must be emptied on a regular basis, at least weekly, to prevent spillages	Site manager	Weekly
	Domestic waste	Bins will be placed at various places around the project area to collect the domestic waste and will be disposed of at a registered waste handling facility.	Site manager	Weekly

10 Item 1(l): Indicate the frequency of the submission of the performance assessment report

In accordance with the NEMA EIA Regulations (2014), as amended, an external independent Environmental Audit will be undertaken every year. The Environmental Audit Report will be submitted to the DMR and other relevant authorities where required.

11 Item 1(m): Environmental Awareness Plan

11.1 Item 1(m)(1): Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work

The purpose of an Environmental Awareness Plan is to outline the methodology that will be used to inform employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with to avoid contamination or the degradation of the environment.

The environmental awareness plan is primarily a tool to introduce and describe the requirements of the range of environmental and social plans for the proposed project during the life of the project.

The environmental awareness plan ensures that training needs are identified and appropriate training is provided. The environmental awareness plan should communicate, as adopted from ISO 14001:2015):

- Importance of conformance with the environmental policy, procedures and other requirements of good environmental management;
- The significant environmental impacts and risks of an individual's work activities and the environmental benefits of improved performance;
- Individual's roles and responsibilities in achieving the aims and objectives of the environmental policy; and
- The potential consequences of not complying with environmental procedures.
- The objective of this Environmental Awareness Plan is to:
- Inform employees and contractors of any environmental risks which may result from their work; and
- Inform employees and contractors of the manner in which the identified possible risks must be dealt with to prevent degradation of the environment.

In general, the purpose of implementing an Environmental Awareness Plan is to optimise the awareness of those partaking in all project activities which have the potential to impact negatively on the environment and in doing so, promote the global goal of sustainable development.

Mooikraal has established methods of environmental awareness training of its employees and contractors. Health, Safety and Environmental training will be carried out and applicable for all personnel partaking in the project as well as any other activities at Mooikraal to achieve the objectives set out above.

11.2 Item 1(m)(2): Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment

The established procedures at Mooikraal for the internal communication between the various levels and functions of the organisation, and receiving, documenting and responding to relevant communication from I&APs remain applicable, as per clause 7 4 of ISO 14001:2015.

Communication is a management responsibility. All line supervisors are responsible for effective communication within their own sections. Environmental risks will continue to be dealt with through training and communication to ensure minimal degradation of the environment.

12 Item 1(n): Specific information required by the Competent Authority

The financial provision for the environmental rehabilitation and closure requirements of mining operations is governed by NEMA, as amended, which provides in Section 24P that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision will continue to be reviewed annually.

13 Item 2: Undertaking

The EAP herewith confirms:-

(a) the correctness of the information provided in the reports

(b) the inclusion of comments and inputs from stakeholders and I&APs ;

(c) the inclusion of inputs and recommendations from the specialist reports where relevant; and

(d) the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed.

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Appendix 1: EAP Qualifications and CV

Appendix 2: Plans

Appendix 3: Mining Boundary Properties

Appendix 4: Public Participation Material

Appendix 5: Soils, Land Use and Land Capability Assessment

Appendix 6: Freshwater Assessment

Appendix 7: Surface Water Assessment

Appendix 8: Groundwater Assessment

Appendix 9: Air Quality Assessment

Appendix 10: Noise Assessment

Appendix 11: Heritage Assessment (NID & RfE)

Appendix 12: Social Impact Assessment

Appendix 13: Rehabilitation Strategy and Implementation Plan