Appendix F.4

SURFACE WATER ASSESSMENT

WSP

STORMWATER MANAGEMENT PLAN FOR THE PROPOSED KOMATI SOLAR PV, BESS, AND ASSOCIATED INFRASTRUCTURE

WSP

41103965-358576-1
NOV 2023

CONFIDENTIAL

WSP

STORMWATER MANAGEMENT PLAN FOR THE PROPOSED KOMATI SOLAR PV, BESS, AND ASSOCIATED INFRASTRUCTURE

WSP

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 41103965

OUR REF. NO. 41103965-358576-1

DATE: NOV 2023

WSP

STORMWATER MANAGEMENT PLAN FOR THE PROPOSED KOMATI SOLAR PV, BESS, AND ASSOCIATED INFRASTRUCTURE

WSP

WSP

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

Phone: +27 11 254 4800

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft	Final		
Date	May 2023	Nov 2023		
Prepared by	Sinesipho Vuba	Sinesipho Vuba		
Signature		Vuba, Sinesipho (ZASV05352) 2023.11.20 11:31:28 +02'00'		
Checked by	Eugeshin Naidoo	Eugeshin Naidoo		
Signature		2023.11.20 11:43:45 +02'00'		
Authorised by	Eugeshin Naidoo	Eugeshin Naidoo		
Signature		2023.11.20 11:43:59 +02'00'		
Project number	41103965	41103965		
Report number	41103965-358576-1			
File reference	41103965-358576-1 Komati Solar PV and BESS-SWMP			

CONTENTS

TABLES

FIGURES

APPENDICES

APPENDIX A

DESIGN RAINFALL VALUES FOR KOMATI SOLAR PV AND BESS FACILITIES

APPENDIX B

MODELLING RESULTS FOR THE SOLAR PV SITES

APPENDIX C

SCOPING ASSESSMENT BY WSP

APPENDIX D

HYDROLOGICAL & GEOHYDROLOGICAL BASELINE STUDY BY GHT CONSULTING

APPENDIX E

DOCUMENT LIMITATIONS

Acronyms

BESS	Battery Energy Storage System
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EPASWMM	Environmental Protection Agency Storm Water Management Model
GIS	Geographical Information System
IDF	Intensity Duration Frequency
MAP	Mean Annual Precipitation
MAT	Mean Annual Temperature
OHL	Over Head Lines
PV	Photovoltaic
QC	Quaternary Catchment
SAWS	South African Weather Service
SWMP	Storm Water Management Plan
WMA	Water Management Area
WULA	Water Use License Application

EXECUTIVE SUMMARY

WSP Group Africa (Pty) Ltd (WSP) has been appointed by Eskom Holdings SOC (Ltd) (Eskom) to undertake an Environmental Impact Assessment (EIA) to meet the requirements of both the World Bank Group (WBG) Environmental and Social Framework (ESF) and the EIA requirements under the National Environmental Management Act (Act 107 of 1998) (NEMA), for the proposed 100 MW Solar Photovoltaics (PV) Energy Facility (SEF); 150 MW Battery Energy Storage System (BESS); and associated infrastructure at the Komati Power Station located in the Mpumalanga Province, South Africa. This report documents the Surface Water Specialist Study required for the proposed Komati Power Station Solar Photovoltaic Facility, BESS, and associated infrastructure. The study aims to facilitate the protection of surface water resources and covers the total proposed development area. This report serves to support the Environmental Impact Assessment (EIA) process and has been completed in accordance with Appendix 6 of the EIA regulations for specialist reports. All the stormwater impacts that exist can be managed in a practical and cost-effective manner on site. The moderate rainfall and low gradients of the area suggest that the detailed design should not vary significantly from the surface water management concepts presented in this report. The Stormwater Management Plan (SWMP) was developed considering the findings from the site assessment undertaken as part of this study and presented in this report but should be developed further for the detailed design by conducting a detailed topographic survey and developing the stormwater layout on the information available and infrastructure layout. It is recommended that the Komati Solar PV and BESS be authorized as the surface water impacts are minimal and the predicted level of change is acceptable. To avoid, manage and mitigate surface water impacts, the interventions in the SWMP should be included in the Environmental Management Program (EMPr) for the activity for both the construction and operational phases.

Contact name Eugeshin Naidoo

Contact details +27 11 254 4800 | eugeshin.naidoo@wsp.com

1 INTRODUCTION

1.1 PROJECT BACKGROUND AND DESCRIPTION OF THE ACTIVITY

Eskom is a South African utility that generates, transmits, and distributes electricity and supplies approximately 95 % of the country's electricity. Eskom's 2035 strategy encompasses the journey that Eskom intends to take in response to the changing energy environment and the impact this has towards a sustainable power utility. This strategy is necessitated by the challenges that Eskom faces as a business as well as the global and local shifts occurring in the energy sector particularly with respect to environmental and climate change challenges, difficulties in accessing financing and changes to the macro industry environment significantly altering the energy supply industry. The road to 2035 includes the shutting down of several coal-fired power stations, repurposing, and repowering, delivering new clean generation projects, expanding the Transmission grid, and rolling out micro grid solutions.

Several power stations are reaching the end-of-life. These stations will go into extended cold reserve and are most likely to be fully decommissioned in the future. Eskom is considering a shutdown, dismantling, and repurposing of some of its fleet as it reaches its end-of-life. Komati Power Station, located near Middelburg in the Mpumalanga Province, reached its end-of-life in September 2022. Eskom has developed a Just Energy Transition Project (EJETP) aimed at mitigating the negative social impacts resulting from the shutting down of the plant and to implement projects for the repowering and repurposing related to the Komati Power Station.

WSP Group Africa (Pty) Ltd (WSP) has been appointed by Eskom Holdings SOC (Ltd) (Eskom) to undertake an Environmental Impact Assessment (EIA) to meet the requirements of both the World Bank Group (WBG) Environmental and Social Framework (ESF) and the EIA requirements under the National Environmental Management Act (Act 107 of 1998) (NEMA), for the proposed 100 MW Solar Photovoltaics (PV) Energy Facility (SEF); 150 MW Battery Energy Storage System (BESS); and associated infrastructure at the Komati Power Station located in the Mpumalanga Province, South Africa. The layout of the development area is shown in Figure 1-2.

The SWMP will inform the Environmental Management Programme (EMPr) for the Environmental Impact Assessment (EIA) application to the Department of Forestry, Fisheries, and the Environment (DFFE). This report has been developed in compliance with Appendix 6 of the National Environmental Management Act (NEMA) (Act 107 of 1998) EIA regulations.

1.2 AIMS AND OBJECTIVES

The aim of this report is firstly to protect surface water resources in accordance with the National Water Act (NWA) (Act 36 of 1998) and secondly to minimize impacts to the natural hydrology of the region by the proposed development by applying appropriate environmental management tools (NEMA).

The objective of this report is to develop a conceptual SWMP that protects surface water resources, manages erosion risks, and complies with the relevant regulations and guidelines (listed in Section 3.3) for the construction and operation phases of the Komati Solar PV and BESS.

1.3 SCOPE OF WORK

The scope of work of this project includes the following:

- Review available Geographical Information Systems (GIS) data to identify areas of interest.
- Review the latest Komati Solar PV and BESS layout as supplied by the Client.
- Quantification of stormwater runoff and peak flows.
- Impact Assessment for construction, operation, and decommissioning phases of the project.
- Providing site-specific mitigation measures and any recommendations for the EMPr or conditions to be included in the Environmental Authorisation (EA).
- Verification of site sensitivity.
- Identification of sensitive features on-site and any no-go areas that may be applicable.
- Cumulative Impact Assessment.

The SWMP is a conceptual study at this stage, and a detailed survey and SWMP study will need to be undertaken during the detailed design of the required infrastructure.

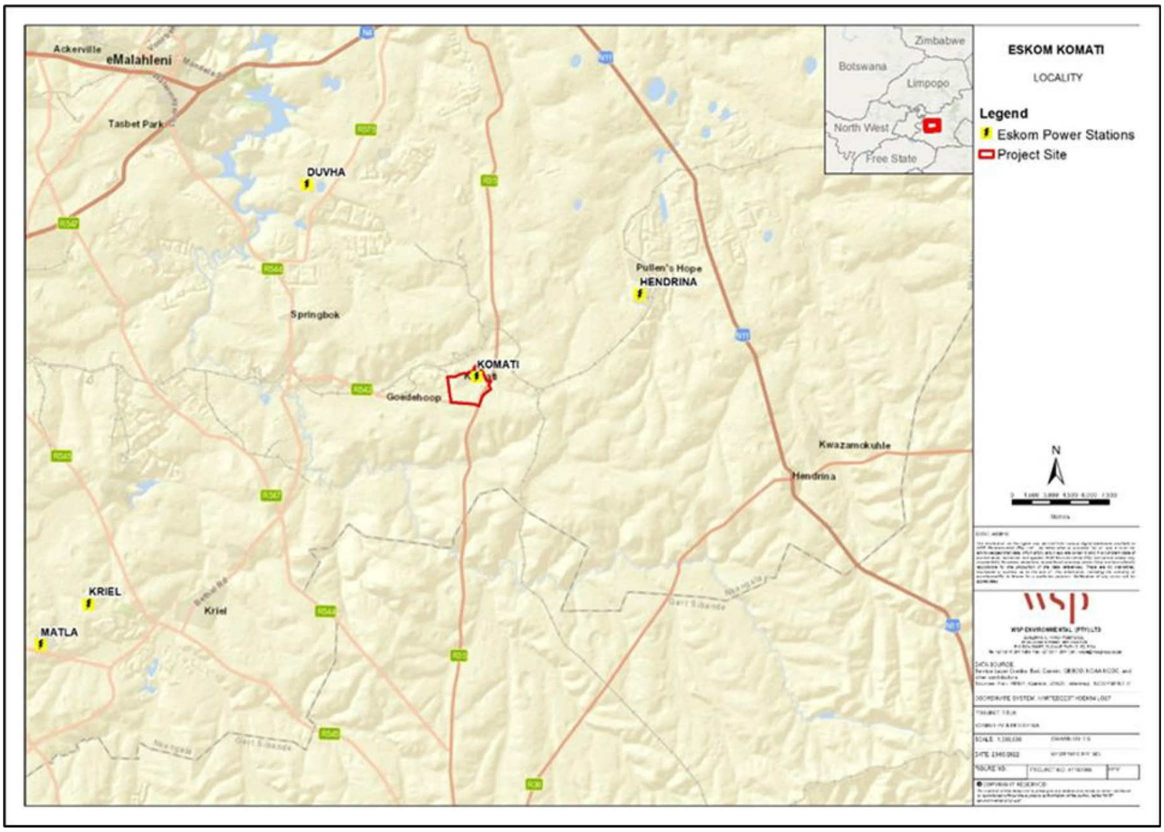


Figure 1-1 – Locality Map

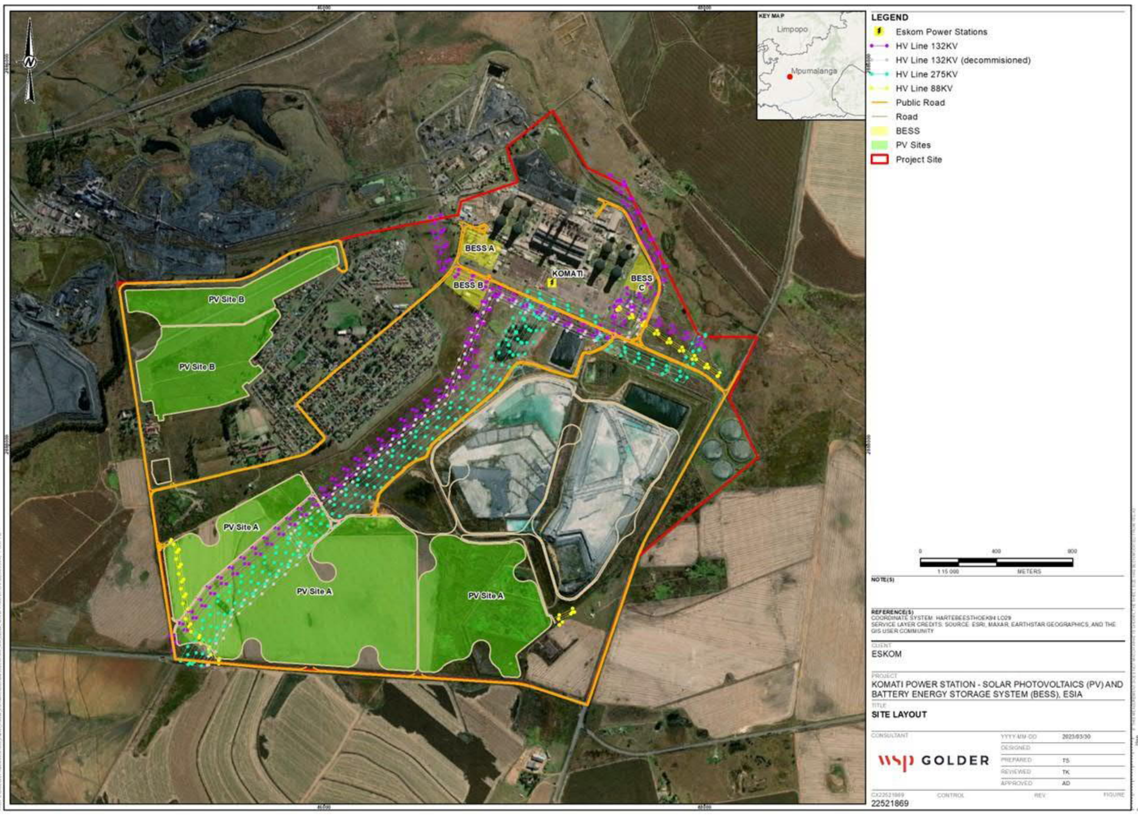


Figure 1-2 - Layout Plan and proposed PV and BESS sites

1.4 ASSUMPTIONS, LIMITATIONS AND EXCLUSIONS

Completion of the project will be based on the following limitations and assumptions:

- Rainfall across the catchments is homogenous temporally and spatially;
- Data obtained from site-specific literature, and previous and other professional investigations will be assumed to be valid and true;
- Publicly available topographical data have been used; and
- Any detailed design and engineering drawings are excluded.

2.0 METHODOLOGY

The following methodology was proposed to meet the scope of work.

2.1 SITE VISIT

At the time of writing this report, a site visit has not been conducted. For the next phase of the project, it is recommended that a site visit be conducted to ground truth and supplement the desktop data gathered for the site. The site visits should be conducted to assess the conditions in the catchment area, as well as on-site drainage, which will inform the site-specific engineering requirements for detailed design.

2.2 INFORMATION GATHERING AND REVIEW

A thorough investigation of all available literature for the site was reviewed. This included the following:

- Meteorological data for the site such as rainfall, runoff and evaporation;
- Academic studies of the hydrology of the site;
- Acquirement of any existing topographical survey data of the site;
- The preliminary layout of the Komati Solar PV and BESS was studied and assessed; and
- National and local legislation applicable to the project was obtained and reviewed.

2.3 HYDROLOGICAL BASELINE ASSESSMENT

The hydrological baseline assessment makes provision for the observations made during the site assessment as well as considering the following aspects:

- Climate and hydrometeorological analysis for the area;
- Delineation of sub-catchments;
- Determination of the Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR) and Mean Annual Evaporation (MAE) from historical rainfall records from South African Weather Stations (SAWS) and the Water Resources Study of South Africa 2012 (Pitman and Bailey, 2015); and
- Calculation of the design rainfall depths for various return periods and event durations.

2.4 STORMWATER MANAGEMENT PLAN

A conceptual stormwater management plan (SWMP) (this document) was developed to manage surface runoff flows from the Solar PV and BESS sites and associated infrastructure. Guidelines and policy for the design of stormwater drainage and stormwater management were obtained from GN704 (1999) and Best Practice G1 (DWAF, 2006). Topographical survey data was used to model the stormwater drainage network.

2.5 REPORTING

The findings of the application of the methodologies provided above are detailed in this report highlighting the key aspects as required in the scope of work.

3.0 SUPPORTING INFORMATION

This section summarises all available information and assumptions upon which the derivation of the SWMP is based. This is done to highlight how the plan was developed: by matching regulations and guidelines to the specific needs of the project in the local natural conditions. The available information is therefore key to understanding the SWMP.

3.1 PROJECT BACKGROUND

Eskom Holdings SOC (Ltd) (Eskom) is proposing the development of a Solar PV, BESS, and associated infrastructure on the Komati Power Station site. The Komati Power Station is situated about 37 km from Middelburg, 43 km from Bethal and 40 km from Witbank, via Vandyksdrift in the Mpumalanga Province of South Africa. The station is in the Steve Tshwete Municipality.

Project Infrastructure

The proposed project will comprise the following key components:

- Solar Energy Facility
- Grid Connection (i.e., powerlines)
- Site Substation and BESS, and
- Associated infrastructure.

These items are summarised in Table 3-1 and discussed in more detail below. The project infrastructure is shown in Figure 1-2. The SEF is intended to evacuate power to the grid. Part of the design development will be to determine the best option to charge the BESS, either with grid power or power generated from PV.

Table 3-1 - Key Project Infrastructure

INFRASTRUCTURE	DESCRIPTION
Solar Energy Facility	▪ Solar Farm A: • Extent: 156 Ha • Buildable Area: 127 Ha • Capacity: Up to 71.5 MW ▪ Solar Farm B: • Extent: 54 Ha • Buildable Area: 50 Ha • Capacity: Up to 28.5 MW ▪ Solar modules will be elevated above the ground, and will be mounted on either fixed tilt systems or tracking system
Grid Connection (i.e. powerlines)	▪ Point of connection of Solar Panels will be to the Komati High Voltage (HV) yard. ▪ Power routed via a medium voltage overhead line (OHL) or underground cabling. ▪ Servitude of powerlines: • Between 36 and 40 m • Area will be approximately 26 ha ▪ Substations: • Each of the Solar Sites will be equipped with collector substations. • Infrastructure associated with the substations includes: o O&M buildings housing the control and communication equipment o Access road infrastructure within the substation sites o Site substations and collector substations ▪ Site Access: • New access roads or tracks may be required to provide access to sections of the powerline route.

INFRASTRUCTURE	DESCRIPTION
	• Access roads will be mostly a two-track gravel road under the OHPL in order to access pylons for construction and maintenance purposes.
Site Substation and BESS	▪ Three BESS facilities. ▪ Footprints: Range from 2 ha up to 6 ha. ▪ BESS capacity: 150 MW with four hours standby time. ▪ Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies are being considered
Associated infrastructure	▪ Access roads; ▪ Perimeter roads; ▪ Below ground electrical cables; ▪ Above ground overhead lines; ▪ Meteorological Station; ▪ Operations and Maintenance (O&M) Building including control room, server room, security equipment room, offices, boardroom, kitchen, and ablution facilities); ▪ Spares Warehouse and Workshop; ▪ Hazardous Chemical Store; ▪ Security Building; ▪ Parking areas and roads; ▪ Temporary laydown areas; ▪ Temporary concrete batching plant ▪ Construction camps and temporary laydown areas; and ▪ Onsite substations.

SOLAR ENERGY FACILITY

The total site area for PV installation is approximately 200-250 hectares to allow for the construction of a PV facility with capacity up to 100 MW. Solar PV modules which convert solar radiation directly into electricity, will occupy a space of up to a total of approximately 720,000 m^2. The solar PV modules will be elevated above the ground and will be mounted on either fixed tilt systems or tracking systems (comprised of galvanised steel and aluminium). The Solar PV modules will be placed in rows in such a way that there is allowance for a perimeter road and security fencing along the boundaries, and O&M access roads in between the PV module rows. Table 3-2 provides a high-level project summary of the proposed facilities. Table 3-3 shows the approximate middle point coordinates of the Solar Facilities.

Table 3-2 - High-level Project Summary – Renewable Energy Facilities

	SOLAR PV SITE A	SOLAR PV SITE B
Extent	156 Ha	54 Ha
Buildable Area	127 Ha	50 Ha
Capacity	71.5 MW	28.5 MW

Table 3-3 - Solar Facilities Approximate Central Coordinates

POINT	LATITUDE	LONGITUDE
PV Site A	26° 6'30.28"S	29°27'37.79"E
PV Site B	26° 5'44.86"S	29°27'13.29"E

GRID CONNECTION

The Solar Facilities will be allocated a point of connection to the Komati High Voltage (HV) yard. Each of the Solar Sites will be equipped with collector substations that will route the power output to the point of connection via a medium voltage overhead line (OHL) or underground cabling. The method and final route to the points of connection will form part of the final designs. The existing Komati points of connection will be used with the existing infrastructure to connect to the Komati 275 kV HV yard. The existing power evacuation infrastructure consists of step-up transformers (140 megavolt Amperes (MVA)), surge arrestors, transmission lines, HV breakers and links to the 275 kV busbar.

SERVITUDE

The registered servitude will likely be between 36 m and 40 m. The length of the transmission will be determined during the design stage. The servitude area will be approximately 26 ha. The servitude is required to ensure safe construction, maintenance, and operation of the powerline.

SUBSTATIONS

On-site substations will be established within the extent of the Solar Site A and Solar Site B. The site itself is very homogenous and there are no significant features in the immediate vicinity of the substation location that might be affected by the development. The following infrastructure is proposed but will be confirmed during the design stage:

- O&M buildings housing the control and communication equipment;
- All the access road infrastructure within the substation sites; and
- Site substations and collector substations to consolidate and distribute power to the connection points.

SITE ACCESS

The project area and surrounding areas are already easily accessible due to existing access roads. New access roads or tracks may be required to provide access to sections of the powerline route. Access roads will be mostly a two-track gravel road under the OHPL in order to access pylons for construction and maintenance purposes. The width of the access roads will be determined during the design phase.

BESS

Eskom proposes to establish three BESS facilities with the existing footprint of the Komati Power Station.

The BESS footprints will range from 2 ha up to 6 ha, depending on design and optimisation of the site and technology selected. The BESS capacity is envisaged to be 150 MW with four hours standby time.

It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or Vanadium Redox flow technologies will be considered as the preferred battery technology however the specific technology will only be determined following Engineering, Procurement, and Construction (EPC) procurement. The main components of the BESS include the batteries, power conversion system and transformer which will all be stored in various rows of containers. The BESS components will arrive on site pre-assembled. Table 3-4 shows the approximate middle point coordinates of the BESS facilities.

The specifics of the technology to be used (i.e., brand and country of origin) will be provided in the EIA.

Table 3-4 - BESS Facilities Approximate Central Coordinates

POINT	LATITUDE	LONGITUDE
BESS Site A	26° 5'14.82"S	29°28'15.73"E
BESS Site B	26° 5'31.37"S	29°28'35.66"E
BESS Site C	26° 5'28.27"S	29°28'7.83"E

ANCILLARY INFRASTRUCTURE

The additional ancillary infrastructure will be confirmed once the Conceptual Design is complete, however, it is anticipated that the following will be applicable:

- Access roads;
- Perimeter roads;
- Below ground electrical cables;
- Above ground overhead lines;
- Meteorological Station;
- Operations and Maintenance (O&M) Building including control room, server room, security equipment room, offices, boardroom, kitchen, and ablution facilities);
- Spares Warehouse and Workshop;
- Hazardous Chemical Store;
- Security Building;
- Parking areas and roads;
- Temporary laydown areas;
- Temporary concrete batching plant;

- Construction camps and temporary laydown areas; and
- Onsite substations.

Project Activities

The construction process will follow industry-standard methods and techniques. Key activities associated with the construction phase are described in Table 3-5.

Table 3-5 - Construction Activities

Activity	Description
Establishment access and internal roads	Internal gravel roads will be developed. The roads will be approximately 8 m wide and may require widening to ensure that it is suitable for use.
Site preparation and establishment	Site establishment will include clearing of vegetation and any bulk earthworks that may be required. The temporary laydown area will be constructed, including establishment of the construction camp (temporary offices, storage containers, concrete batching plant etc). The site laydown areas are expected to occur within the footprint of Site A and Site B. Site establishment will also entail the installation and/or connection of services (sanitation, electricity etc).
Transport of components and equipment to site	All construction material (i.e., PV support structure materials), machinery and equipment (i.e., graders, excavators, trucks, cement mixers etc.) will be transported to site utilising the national, regional and local road network. Large components (such as substation transformers) may be defined as abnormal loads in terms of the Road Traffic Act (No. 29 of 1989). In such cases a permit may be required for the transportation of these loads on public roads.
Establishment of a laydown area on site	Construction materials, machinery and equipment will be kept at relevant laydown and/or storage areas. A laydown area of approximately 2 ha has been proposed for this project. The laydown area will also be utilised for the assembly of the PV panels. The laydown area will limit potential environmental impacts associated with the construction phase by limiting the extent of the activities to one designated area.
Erection of PV Panels	The PV panels will be arranged in arrays. The frames will be fixed onto vertical posts that will be driven into ground utilising the relevant foundation method identified during the geotechnical studies, including potentially employing concrete foundations for the panel frames. PV panels will have a maximum height of 5 m.
Construction of substation and inverters	The facility output voltage will be stepped up from medium voltage to high voltage in the transformer. The medium voltage cables will be run underground in the facility (except where a technical assessment suggest that overhead lines are applicable) to a common point before being fed to the onsite substation.
Establishment of ancillary infrastructure	Ancillary infrastructure will include a workshop, storage areas, office and a temporary laydown area for contractor's equipment.
Rehabilitation	Once all construction is completed on site and all equipment and machinery has been removed from the site, the site will be rehabilitated.

3.2 DESKTOP STUDY OBSERVATIONS

Based on a Desktop study, the solar farm sites, BESS B and BESS C sites are predominantly situated in an open natural field. The BESS A site is located in a build-up area within the footprint of the Komati Power Station. All sites are situated on terrain that appears to be relatively flat.

Except for the BESS A site, no formal stormwater infrastructure is expected, and runoff would be conveyed overland in open earth channels via preferential routes.

Several drains and dams have been constructed around and within the station area. These dams are of importance in terms of preventing water quality degradation and serve as pollution control dams. All polluted surface water runoff is diverted to these reservoirs. Ultimately, all surface water from this area drains into the Olifants River via the Koringspruit.

The soil on the site where the Solar PV will be located is predominantly fine sand with silt. The permeability of the soil on the site area is semi-permeable to permeable.

3.3 LEGISLATION AND GUIDELINES

SWMPs are generally required to support the EMPr and Water Use License Applications (WULA). The following was considered when compiling the SWMP:

- Best Practice Guidelines G1 for Stormwater Management (Department Water Affairs and Forestry (DWAF), 2006);
- Regulation 704 of the National Water Act (Department of Water Affairs and Forestry, 4 June 1999).
- The National Water Act (Act 36 of 1998).
- The World Bank Group (WBG) Environmental and Social Framework (ESF)
  The WBG ESF sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards that are designed to support Borrower's projects, to end extreme poverty and promote shared prosperity.

  The ten Environmental and Social Standards establish the standards that the Borrower and the project will meet through the project life cycle, as follows:

  - Environmental and Social Standard 1: Assessment and Management of Environmental and Social Risks and Impacts.
  - Environmental and Social Standard 2: Labour and Working Conditions.
  - Environmental and Social Standard 3: Resource Efficiency and Pollution Prevention and Management.
  - Environmental and Social Standard 4: Community Health and Safety.
  - Environmental and Social Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement.
  - Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
  - Environmental and Social Standard 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities.
  - Environmental and Social Standard 8: Cultural Heritage.
  - Environmental and Social Standard 9: Financial Intermediaries.
  - Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure

- The World Bank Group Environmental, Health, and Safety General Guidelines.

Municipal regulations, which may introduce specific standards for each municipality, but still adhere to the overall principles of the regulations and guidelines above, should be considered during Detailed Design (if relevant).

3.4 NATURAL CONDITIONS

3.4.1 STUDY SITE AND CLIMATE

Pertinent to this section of the report, is the Scoping Assessment report (included in Appendix C) prepared by WSP in 2022 for the same project. As such, herein, various references are made to this scoping assessment. If the Assessment is unknown to the reader, a recommendation is hereby given to read the Assessment before continuing with this report.

As shown in Figure 3-1, the Komati Power Station occurs within the upper Olifants Water Management Area (WMA), in the B11B quaternary catchment and can be sub-divided into secondary drainage regions compromising of smaller streams and creeks. This catchment receives 687 mm rainfall per year and experiences 1550 mm of evaporation annually. The surface topography of the area is typical of the Mpumalanga Highveld, consisting in the main of a gently undulating plateau. The flood plains of the local streams are at an average elevation of approximately 1595 meters above mean sea level (mamsl). Altitudes vary from ±1650 mamsl at the higher parts south of the ashing facility to ±1595 mamsl which defines the base of the Koringspruit to the north of the Komati Power Station.

The inclusion of a hydrogeology map (Figure 3-1) in this stormwater management report is crucial for understanding the underlying geological conditions and their influence on stormwater runoff and infiltration. This map provides valuable information about the subsurface characteristics, such as soil types, permeability, and groundwater flow patterns, which are essential for designing effective stormwater management strategies. By incorporating the hydrogeology map into our analysis, we can identify areas prone to flooding, determine suitable locations for infiltration systems or detention basins, and make informed decisions regarding stormwater conveyance and retention. The hydrogeology map serves as a valuable tool for ensuring the efficient and sustainable management of stormwater in the project area.

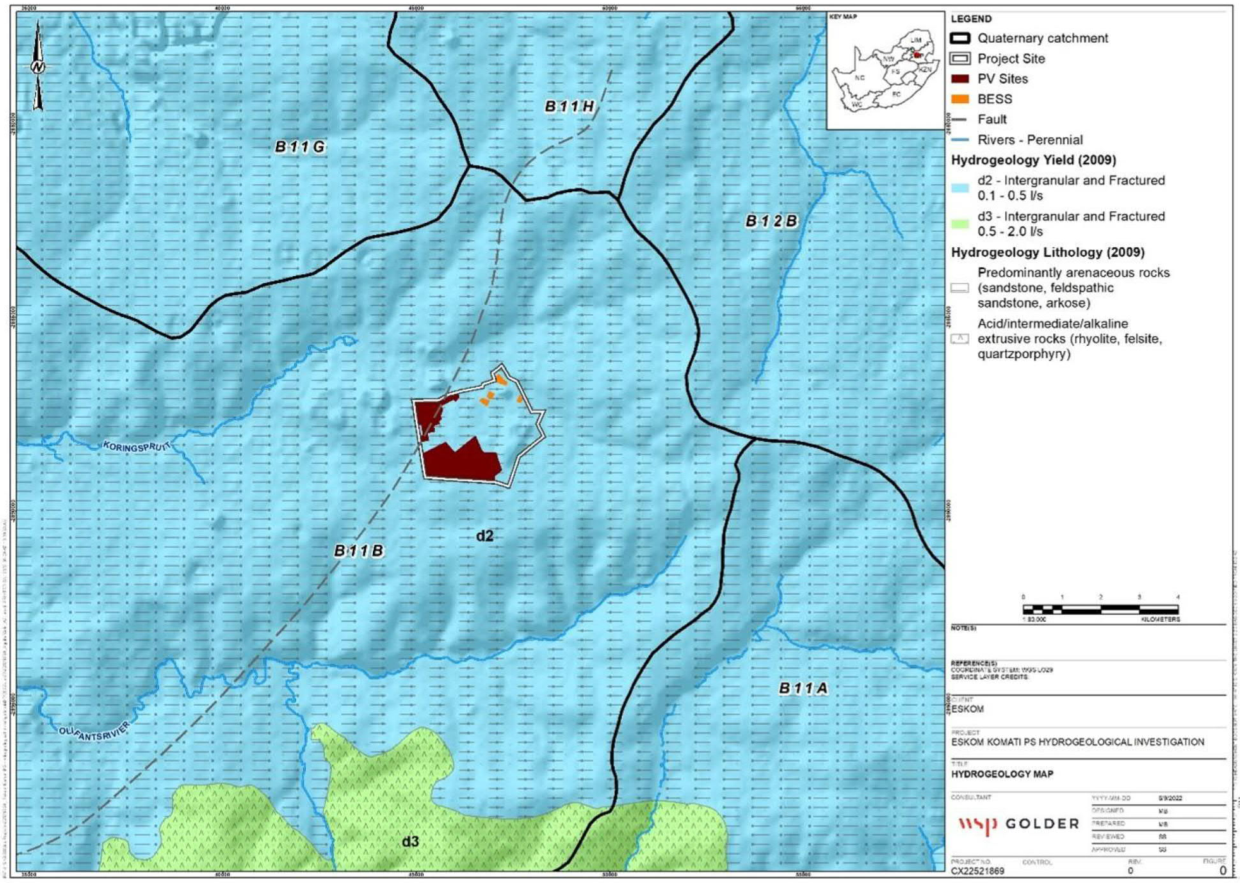


Figure 3-1 - Hydrogeology Map

3.4.2 RAINFALL

An analysis of the rainfall data available for the site was undertaken to determine which dataset would best represent the site rainfall and whether the site should have individual rainfall parameters assigned or if rainfall should be assigned to represent the entire project area.

The three nearest stations to the site were selected and the design rainfall for each rainfall was extracted from Design Rainfall Estimation software by Schulze and Smithers (Smithers & Schulze, 2002). The metadata for each rainfall station is provided in Table 3-6.

The average Mean Annual Precipitation (MAP) for all three weather stations located near the site is 674 mm. Weather Station Vandyksdrift has a higher percentage reliability in terms of measured data. For the purposes of the SWMP, the weather station with the highest reliability of the three was chosen. The final chosen rainfall station is Vandyksdrift, with a MAP of 686 mm and rainfall record of 80 years, which was deemed sufficient. The design rainfall to be used for the site is presented in Table 3-7.

Table 3-6 - Three nearest SAWS to cluster area centroid

Station number	Station Name	Distance (km)	Record period (years)	Period of records	Reliability (%)	MAP (mm)
0478577 W	Vaalkraanz	11.4	80	1920 - 2000	11.7	693
0478546 W	Vandyksdrift	11.8	80	1920 - 2000	59.8	686
0478786 W	Blinkpan (Pol)	2.5	80	1920 - 2000	25	643

According to the WSP Scoping Assessment report, the region experiences rainfall throughout the year, with the majority of the rainfall occurring between October to April. The mean annual rainfall is 693 mm, as observed from the Vandyksdrift rainfall station.

Table 3-7 - Mean Monthly Rainfall observed from Vandyksdrift Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Rainfall (mm)	126	94	79	41	15	6	6	7	26	75	125	133	733

3.4.3 EVAPORATION

According to the WSP Scoping Assessment report, the average S-Class pan potential evaporation, as measured at B1E002 station, is approximately 2 087.9 mm/year. The station is approximately 13 km away from the project site area. The highest average monthly evaporation in the Komati are occurs in November, as shown in Table 3-8.

Table 3-8 - S-Pan Monthly Average Evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
S-Pan evaporation (mm)	200.9	163.5	193.8	161.9	139.3	113.1	120.6	161.2	187.7	199.9	214.8	212.7	2069.4

In comparison to the rainfall (see Figure 3-2) the evaporation is always higher than the rainfall over the course of the year. This indicates that most of the precipitation is evaporated. The evaporation varies throughout the year, with the highest evaporation in the area observed in the months of October to March and the lowest evaporation occurring during the months of October to March.

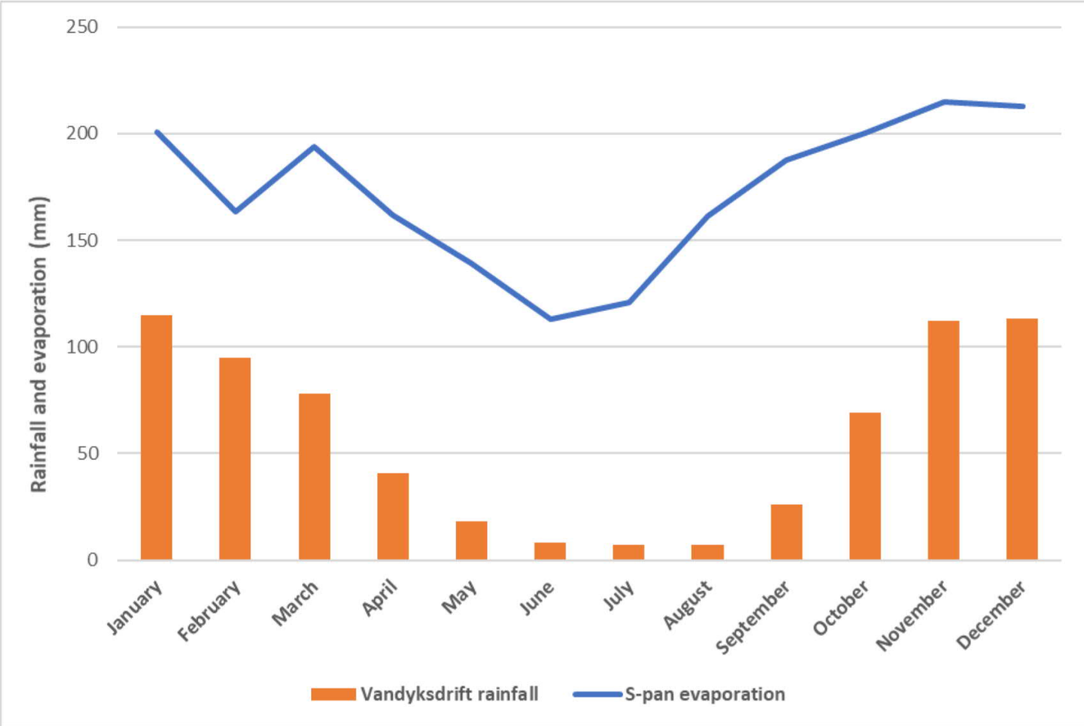


Figure 3-2 - Rainfall and evaporation comparison

3.4.4 TEMPERATURE

According to the Hydrological and Geohydrological Baseline Study Report prepared by GHT Consulting (included in Appendix D), average daily maximum temperatures in the Komati area vary from 27 °C in January to 17 °C in July, but in extreme cases, these may rise to 38 °C and 26 °C, respectively. In comparison, average daily minimums of 13 °C and 0°C can be expected, with temperatures falling to 1 and –13°C, respectively, on unusually cold days. Frost conditions are also common over the 120-day period from May to September.

4.0 STORMWATER MODELLING

The proposed Komati Solar PV project includes Battery Energy Storage System (BESS) facilities. These facilities will have a small footprint ranging from 2 ha to 6 ha, within the Komati Power Station footprint. These facilities are designed to store excess energy generated by the solar PV system for later use. Given their location within watersheds (Figure 1-2), it is crucial to consider their potential impact on water quality.

The BESS facilities will be strategically situated within the project site, taking into account the natural topography and minimising any adverse effects on water quality. By adhering to best management practices and employing appropriate design measures, the project aims to mitigate potential water quality concerns. This includes implementing erosion control measures, sedimentation ponds, and filtration systems to prevent the discharge of sediment and other pollutants into nearby water bodies.

Due to the specific characteristics of the project site and the surrounding watershed areas, localised stormwater management (SWM) interventions are essential to ensure the effectiveness of the stormwater management plan. These interventions can address site-specific challenges and contribute to the overall water quality objectives.

Localised SWM measures may include the installation of vegetated swales, bioretention basins, permeable pavement, and other green infrastructure practices (further SMW measures are discussed in section 6.0). These measures help to intercept and treat stormwater runoff, reducing the potential for pollutants to reach water bodies. The incorporation of localised SWM interventions demonstrates the project's commitment to sustainable stormwater management and its dedication to protecting the quality of water resources in the area.

Considering the small footprint of the BESS facilities, taking into account the minimal stormwater runoff contribution, their integration with existing and proposed stormwater management infrastructure, and the implementation of best management practices, the need for stormwater modeling for the BESS facilities is deemed unnecessary within the scope of this stormwater management plan.

For the BEES facilities, it is recommended to conduct a site assessment and engage in consultations with relevant stakeholders, including local authorities and environmental experts, to confirm the appropriateness and effectiveness of the proposed stormwater management measures within the Komati Power Station footprint as part of the EIA process.

From the above, the remaining focus area was the two proposed Solar PV sites. The PV sites will occupy a significant portion (approximately 40 %) of the Komati Power Station's footprint. Therefore, only the stormwater modelling of these Solar PV sites was considered. The catchment of these sites was modelled in EPA-SWMM 5.2, using the rainfall and runoff data provided below.

4.1 DELINEATION OF SUB-CATCHMENTS

The two catchments draining the area affecting the proposed development is shown on Figure 4-1. The catchment for PV Site A covers an area of 156 ha and the catchment for PV Site B extends over an area of 54 ha. Together, the total area drained is 210 ha.

In adherence to the National Water Act 36 of 1998, GN 704 guidelines, it is crucial to ensure that the proposed development does not encroach upon the floodplain of the Koringspruit. To assess the potential encroachment, a buffer zone of 100 meters from the watercourse has been utilised as a guiding principle. Through a desktop analysis, it has been confirmed that the proposed development remains well outside the designated floodplain (Figure 4-1). Furthermore, the development is bordered by existing roads, and those roads adjacent to the streams are at a higher elevation than the streams, thus mimicking a flood wall, thereby mitigating any adverse impacts on the Koringspruit's hydrological regime and flood risk dynamics. This strategic adherence to the established guidelines underscores the commitment to environmentally responsible practices and safeguards the integrity of the surrounding natural watercourses and floodplain areas.

To delineate the catchments, a Digital Terrain Model (DTM) was created for use in GIS to determine these delineations and characterisation of the catchments.

The delineated catchments are as shown in Figure 4-1 below.

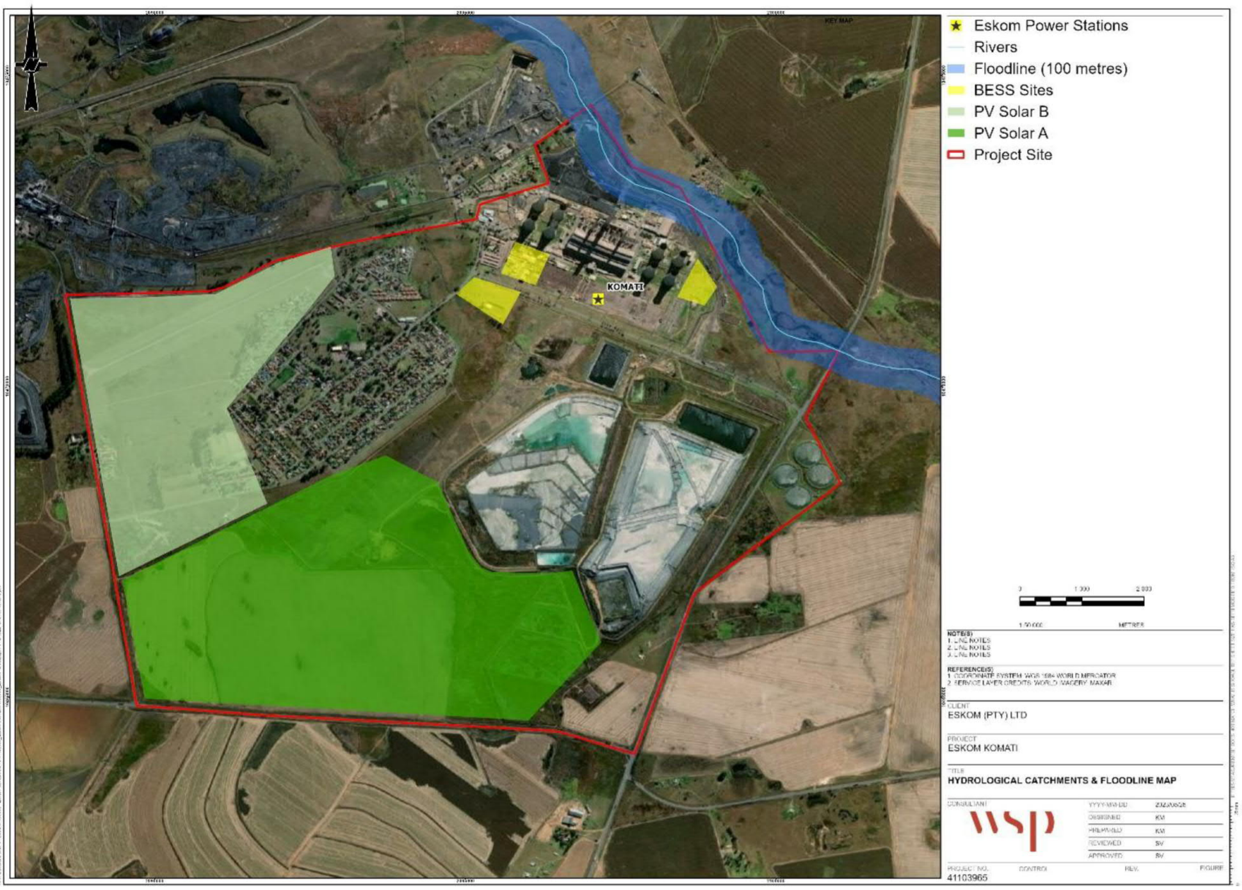


Figure 4-1 - Hydrological Catchments and Floodline Map

4.2 CATCHMENT PARAMETERS

The slope of a catchment is a very important characteristic in the determination of flood peaks. Steep slopes cause faster runoff to shorten the critical duration of flood inducing storms, thus leading to higher rainfall intensities in the runoff formulae. On steep slopes, the vegetation is generally less dense, soil layers are shallower, and there are fewer depressions, all of which cause water to run off more rapidly. The result is that infiltration is reduced, and flood peaks are consequently elevated. For flat catchments such as those encountered on this site, the opposite holds true.

Land use is another critical characteristic as it alters the vegetation present and the degree of soil compaction. Compacted soil is less permeable, and vegetation can slow down stormflows over the land surface. Lastly, the soil type can also be important with some soils allowing quicker infiltration resulting in runoff for each catchment. Detailed geotechnical testing would be required to determine the necessary infiltration parameters for explicit groundwater modelling, but in terms of general hydrological response, it was assumed the soils in the catchments fall into a single broad category.

While the vegetation across both catchments for PV Site A and B appears to be grassland, much of the catchment for PV Site A appears to have been used for agriculture, specifically row cropping.

Even though there are relatively steep zones in the catchment, the majority of aboveground runoff is likely to be in the form of shallow sheet flow and consequently, flow velocities will be relatively low.

Table 4-1**Error! Reference source not found.** presents the conceptual catchment characteristics used in this study.

Table 4-1 - Conceptual Catchment Characteristics

Catchment	Catchment Area (ha)	Permeability (desktop assessment, not lab tested)	Flow type	Vegetation
PV Site A	156 ha	Permeable to Semi-Permeable	Overland Flow	Grasslands and bare row cropping
PV Site B	54 ha	Permeable to Semi-Permeable	Overland Flow	Grasslands

A detailed survey will be required to determine the actual dimensions of drainage paths, but examination of the available topographical information and aerial photography reveals no obvious areas where erosion is taking place.

4.3 DESIGN RAINFALL

The Intensity-duration-frequency (IDF) data was derived from Rainfall Statistics for Design Flood Estimation in South Africa (Smithers & Schulze. 2012) for reference point 26° 6'30.28"S, 29°27'37.79"E for the project site.

The utilisation of 5 and 50-year return periods to assess stormwater modelling impacts is justified based on applicable legislation and guidelines.

The GN 704 guideline stipulates the requirements for water systems in a mine as follows: "design, construct and maintain all water systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with an average period of recurrence of once in 50 years".

The South African National Water Act (Act No. 36 of 1998) and its accompanying regulations, such as the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) and the National Environmental Management: Waste Act (Act No. 59 of 2008), provide guidance on managing stormwater and potential impacts on water resources.

The Guidelines for Human Settlement Planning Sanitation's Guideline (2003) recommends the use of 5 and 50-year return periods as a standard practice for stormwater management. These return periods allow for the assessment of routine storm events and extreme rainfall events that may have significant impacts on the environment and infrastructure. By considering these return periods, the stormwater modelling can evaluate the facility's ability to handle both typical and severe rainfall events, ensuring compliance with the relevant legislation and guidelines.

Additionally, the South African Green Building Council's Green Star SA - Sustainable Precincts Tool provides further support for considering 5 and 50-year return periods in stormwater management. This tool promotes sustainable and resilient design practices, including the assessment of stormwater management measures against different return period scenarios.

Therefore, by incorporating the 5 and 50-year return periods in the stormwater modelling to assess impacts, the report aligns with applicable legislation and guidelines, ensuring comprehensive evaluation of the facility's stormwater management strategies in compliance with environmental regulations and sustainable development principles.

The IDF data is tabulated below for design storm events with return period of 5 and 50 years for various durations:

Table 4-2 - Average Intensity for various design storm durations

Return Period (years)	Design Storm Duration								
	10 min	15 min	30 min	1 hr	2 hr	4 hr	8 hr	12 hr	24 hr
	Average Intensity (mm/hr)								
5	102.0	84.4	54	34.5	22.1	13.18	7.85	5.81	3.46
50	162.6	134.4	86.0	55.0	35.15	20.98	12.50	9.24	5.51

4.4 RUNOFF PARAMETERS

The runoff parameters used are listed below:

- Impervious area roughness coefficient: 0.018
- Pervious area roughness coefficient: 0.050
- Impervious area depression storage: 1 mm
- Pervious area depression storage: 5 mm
- Infiltration method: SCS
- SCS Curve Number (CN): 61

4.5 PRE-DEVELOPMENT RUNOFF

Runoff was computed for both minor (5-year) and major (50-year) design events of various durations up to 24 hours. The peak flows were cross-checked via the Rational Method and found to be reasonable.

The implications of the storm peak flows calculated, and their impact on the SWMP, are discussed in Section 5.0.

The pre-development peak flows are tabulated below.

Table 4-3 - Pre-development peak flows

	5-year Return Period	50-year Return Period
Sub-catchment ID	Peak flow (m^3/s)	Peak flow (m^3/s)
PV Site A	0.08	0.12
PV Site B	0.03	0.05

Due to the relatively permeable nature of the soil, the majority of the rainfall from short-duration events infiltrates events infiltrates into the ground. Only when the soil becomes saturated does significant overland runoff occur. Consequently, longer-duration storms result in the highest peak flows. Saturation happens more quickly for high-order events, which means that peak flows typically occur for shorter-duration design storms compared to low-order events.

For design storm events with a return period of up to 50 years, flow velocities will be low (< 0.19 m/s). Flow depths outside of preferential drainage paths are likely to be shallow. However, where preferential drainage routes converge to form natural earth channels that are more clearly defined, the depth of flow will increase.

A detailed survey will be required to model specific drainage paths accurately and provide more precise flow computations.

4.6 POST-DEVELOPMENT RUNOFF

The primary difference between the pre-development and the post-development scenarios lies in the presence of the solar PV panels and associated infrastructure. While the solar PV panels themselves are impervious, their distributed arrangement with spaces in between and elevation above the natural ground level sets them apart from typical hardened surfaces. Essentially, they do not significantly impede infiltration or obstruct existing flow paths.

This does not apply to the access and internal roads or the site management/plant areas, as they effectively form impervious surfaces and consequently contribute to increased runoff. The increase in impervious area for the post-development scenario was measured using GIS overlays and estimated coverage percentages for the relevant items. However, the estimated catchment surface characteristics need to be re-evaluated during the detailed design stage.

Runoff was computed for both minor (5-year) and major (50-year) design events, considering various durations of up to 24 hours.

The post-development peak flows are tabulated below.

Table 4-4 - Post-development peak flows

	5-year Return Period	50-year Return Period
Sub-catchment ID	**Peak flow (m^3/s)**	**Peak flow (m^3/s)**
PV Site A	0.11	0.17
PV Site B	0.04	0.06

Table 4-5 - Change in maximum peak flow for Site A and B

	50-year return period peak flow (m^3/s)		Change	
Sub-catchment ID	**Pre-development**	**Post-development**	**Peak flow (m^3/s)**	**%**
PV Site A	0.12	0.14	0.02	16.7
PB Site B	0.03	0.04	0.01	33.3

As indicated in Table 4-5, the increase in runoff from the sub-catchments over the pre-development situation is small, both in quantity and percentage (less than 0.02 m3/s and 0.01 m3/s for Site A and B, respectively). This justification supports the exclusion of detention ponds in the stormwater management plan. This conclusion is based on a comprehensive analysis of the site characteristics, hydrological modeling, and the implementation of recommended stormwater measures. Several factors contribute to the limited increase in stormwater runoff. Firstly, both sites have undergone careful design and engineering considerations to minimise impervious surfaces, ensuring a substantial portion of the rainfall infiltrates into the soil. Additionally, advanced stormwater management practices, such as vegetated swales, bio-retention basins, and permeable pavement, effectively promote on-site retention, infiltration, and evapotranspiration. These measures further contribute to the reduction of stormwater volume and peak flows. Furthermore, the geographic locations of the sites are strategically chosen, considering existing natural drainage patterns and topography, which naturally facilitate the conveyance and dispersion of stormwater.

5.0 IMPACT ASSESSMENT

The predicted environmental impacts resulting from the proposed project activities in the scoping phase are listed in Table 5-1, along with their significance ratings before and after mitigation. The mitigation measures are further discussed in section 6.0.

Table 5-1 - Impact assessment summary

Project Name	Eskom Komati Solar PV Surface Water Impact Assessment																		
Impact Assessment																			
CONSTRUCTION																			
Impact number	**Aspect**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Stormwater runoff	Stormwater runoff could, in the case of the temporary construction yards, laydown areas, and offices for the construction workers, potentially come in contact with areas dedicated for the handling of contaminants.	Construction	Negative	Moderate	4	1	3	2	2	**20**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						
Impact 2:	Erosion	Soil stripping, stockpiling, excavations of underground cabling, foundations for the solar PV array mounting structure and construction of stormwater berms may result in loss of soils through erosion, particularly for topsoil stockpiles with unvegetated steep slopes, resulting in increased sedimentation to water resources	Construction	Negative	Moderate	2	2	3	2	4	**36**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
OPERATIONAL																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Flooding	In the operation phase, soil compaction and erosion may occur due to vehicle movement during routine maintenance. This activity will lead to an increase in impervious surfaces. This activity, however, will only occur occasionally and has therefore been considered to be infrequent and negligible.	Operational	Negative	Moderate	3	1	3	2	2	**18**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						
Impact 2:	Stormwater runoff	Stormwater runoff in the vicinity of the substation / control building and solar PV's could come into contact with dedicated areas where hazardous substances are handled such as fuels and oils which could result in contaminated stormwater runoff being discharged downstream. Furthermore, typical activities during maintenance include washing of solar panels with water that includes chemicals. This water could also potentially contaminate nearby watercourses.	Operational	Negative	Moderate	4	1	3	2	2	**20**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						
Impact 3:	Erosion	In the operational phase, the potential impacts due to the additional hardened surfaces include erosion of the surrounding environment. Eroded soil particles carried to downstream water resources can also result in the decrease in quality of nearby watercourses, due to sedimentation.	Operational	Negative	Moderate	2	2	3	2	4	**36**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
DECOMISSIONING																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact 1:	Stormwater runoff	Similarly, to the construction phase, the runoff during the rehabilitation (decommissioning/ closure) phase may contain contaminants. In addition, soil compaction to reshape the landform may cause increased runoff which may still contain higher concentrations of contaminants and sediment.	Decommissioning	Negative	Moderate	4	1	3	2	2	**20**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						

6.0 CONCEPTUAL SWMP

6.1 DESIGN CRITERIA AND PROJECT OBJECTIVES

As per the applicable legislation, guidelines, and standards mentioned in section 3.3, the following measures are recommended to achieve certain objectives based on a philosophy of protecting the receiving environment from hydrological impacts.

- Clean and dirty water should be separated, and it should be ensured that all stormwater structures are designed to keep dirty and clean water separate and can accommodate a defined precipitation event;
- The clean water catchment area should be maximized, and clean water should be routed to a natural watercourse with minimal damage to that watercourse in terms of quantity and frequency of discharge;
- Dirty areas should be minimized, and runoff from these areas contained and neither treated to an acceptable quality to discharge to the environment or removed from the site for disposal; and
- Natural watercourses and the environment should be protected from contamination by dirty areas by ensuring that the dirty water cannot enter the clean water system by spillage or seepage.

In addition to these aims, the following project specific objectives for this SWMP were developed based on the site-specific characteristics:

- Stormwater should be directed such that no water flows in an uncontrolled manner that may jeopardise the safety of personnel or infrastructure, or such that is a nuisance;
- Protection of the soils by preventing erosion is also a key requirement of the SWMP;
- Minimise modification of the natural topography of the area and avoid any modification of the natural watercourses as far as possible;
- Do not impede surface or subsurface water flows unless unavoidable;
- Include a monitoring and inspection system for spills, leaks and erosion and commit to remediation where needed;
- Review and improve the SWMP regularly;
- Ensure no infrastructure, except road crossings, are built within the watercourses; and
- Do not build infrastructure, in particular infrastructure containing potential pollutants, within 100 m of natural drainage lines.

6.2 DELINEATION OF CLEAN AND DIRTY AREAS

The development area is divided into clean and dirty areas as follows:

Dirty areas:

- The workshop where oils and lubricants may be stored and used;
- A chemical storage area will be constructed for the operational phase of the project, which will include proper containment and bunding for all chemicals stored on site;
- Transformers at the substation, as these will contain oil;
- The conservancy tanks, as this will contain sewage; and,
- Vehicle wash bay that has a hard standing surface on which vehicles are washed, generating dirt water which drains to a sump.

Clean areas are deemed to be all areas on the site outside of those stated above as dirty areas.

Requirements for bunding of areas housing potential contaminants are specified in detail in the National Norms and Standards for the Storage of Waste (Notice 926 of 29 November 2012, Department of Environmental Affairs, national Environmental Management: Waste Act 2008, Act No. 29 of 2008). The specification, which will apply to the development area, reads as follows: *"bunds having a capacity which can contain at least 110% of the maximum content of the waste storage facility. Where more than one container or tank is stored, the bund must be capable of storing at least 110% of the largest tank or 25% of the total storage capacity, whichever is greater (in the case of drums the tray or bund size must be at least 25% of total storage capacity)."*

Bunded areas should be sized and sealed to ensure spilled contaminants cannot leak out of the bunded areas.

6.3 SWMP DESIGN PHILOSOPHY

Typical stormwater management interventions for each of these components during both construction, operation and decommission phases are defined in this section.

The SWMP will be guided by Low Impact Design (LID) principles. LID in land development aims to manage stormwater as close to its source as possible by simulating or enhancing natural processes. This is achieved by interception of rainfall on the catchment surface as it lands by enabling natural infiltration into the soil, increasing roughness using vegetation, and aiding soil stability by the establishment of vegetation. LID was selected as a suitable method for several reasons.

Firstly, LID addresses the risk of erosion and downstream sedimentation caused by concentrated flows. Concentrated flow emanating from a catchment has higher velocities and associated streamflow than overland flow. It is desirable to keep peak flow velocity below 1.5 m/s.

Secondly, by reducing concentrated flow, LID minimizes alteration of the pre-development hydrograph of the catchments in terms of peak discharge and duration of runoff.

Lastly, aside from dirty areas defined above, the only water contaminant will be suspended solids from disturbed soil during the construction phase and road runoff during construction and operational phases. The LID interventions specified below will effectively reduce the particle load in the water by settling in temporary sumps during construction, and filtering with vegetation lined channels and dissipaters during operation.

6.4 SITE-SPECIFIC MITIGATION MEASURES AND RECOMMENDATIONS FOR THE EMPR

6.4.1 CONSTRUCTION PHASE

Construction activities could result to erosion from de-vegetated areas, leading to runoff carrying a high silt load and contaminants such as fuel, hydraulic fluids, degreasers, chemicals, and cement. However, due to the gentle slope, sandy soil nature, and low rainfall with high evaporation in the area, limited runoff is expected except for exceptionally high rainfall events. As indicated in Table 5-1 above, the potential surface water impacts during the construction phase have been evaluated as ***moderate to low*** in significance. To further minimise these potential impacts to a ***very low*** significance, the following measures are recommended:

- Construct pollution control systems such as bunded areas, and runoff control systems such as diversion berms and water collection areas such as the process water/evaporation dam first, before undertaking any other activities;
- Construct berms down-gradient of construction areas to collect dirty runoff. Allow silt to settle, examine for contamination with oil and/or hydraulic fluids. Remove contaminated material monthly for remediation or appropriate disposal in accordance with prevailing legislation. Clean silt can be used during re-vegetation of bare areas;
- Place drip trays under vehicles when parked;
- Service vehicles in a workshop, not in the field;
- If in-field refuelling is done from a tanker, it should be done in a designated dirty area and a spill kit and clean-up team must be available on site;
- Spillages should be cleaned up immediately and contaminated soil must either be remediated in situ or disposed of at an appropriately licensed landfill site;
- Potentially contaminating wastes (empty containers for paint, solvents, chemicals, etc.) and cement should be stored in bunded areas until removed by a reputable contractor for disposal at an appropriately licensed site;
- Provision of adequate sanitation facilities in the form of chemical toilets that are serviced regularly; and
- Providing environmental awareness training for workers on site.

6.4.2 OPERATION PHASE

Once operational, the 100 MW Solar Photovoltaics (PV) Energy Facility (SEF), 150 MW Battery Energy Storage System (BESS), and associated infrastructure installation will have a minor impact on water demand, which will be positive. However, during the operational phase, there is a possibility of increased spillage of fuels, lubricants, and other chemicals from the BESS. The installation and operation of the PV plants will result in the creation of relatively small impervious areas (e.g., buildings, roads, and the surfaces of the PV panels). These areas will not have a significant enough footprint to greatly affect the overall infiltration rate on-site. Vehicular movement between the solar panels may disturb the sandy soil surface, but it will not significantly reduce the infiltration rate due to the natural resistance of sandy soils to compaction.

Therefore, localised runoff from these small footprints, with sufficient spaces in for vehicular access for cleaning and maintenance, is unlikely to accumulate and cause erosion or migrate off-site.

As shown in Table 5-1 above, the potential surface water impact during the construction phase has been evaluated as ***moderate to low*** in significance. To further minimise the potential impact to a ***very low*** level of significance, the following measures are recommended:

- Remove settled silt from runoff control berms regularly, examine for contamination with oil and/or hydraulic fluids. Subject contaminated material to remediation or appropriate disposal in accordance with prevailing legislation. Clean silt can be used during re-vegetation of bare areas.
- Place drip trays under vehicles when parked.
- Service vehicles in a workshop, not in the field.
- pillages should be cleaned up immediately and contaminated soil must either be remediated in situ or disposed of at an appropriately licensed landfill site.
- Potentially contaminating wastes (empty containers for paint, solvents, chemicals, etc.) and cement should be stored in bunded areas until removed by a reputable contractor for disposal at an appropriately licensed site.

- Provide environmental awareness training for workers on site.
- Clean-up of spills as soon as they occur.
- Maintenance of any abstraction pumps to prevent spills.
- Maintenance of the BESS to ensure optimal functionality and prevent fire risks.
- Maintenance and quality control of firefighting equipment and systems.
- Mitigations for spillage or leakages will include bunded areas to store chemicals and/or fuel, containerisation of the BESS and cleaning up spills as soon as they occur.

6.4.3 DECOMMISSIONING PHASE

The decommissioning phase will have a shorter duration compared to the construction and operational phases. As indicated in Table 5-1 above, the potential impacts and recommended remediation measures are similar. To minimise the assessed impacts ***low*** to ***very low*** significance, it is recommended that the demolition of containment systems, such as the bunded areas, be carried out after removing all other structures.

These surface water risk management methods associated with proposed activity are recommended to be included in the Environmental Management and Protection Plan (EMPr).

7.0 EROSION AND SEDIMENT TRANSPORT

In general, the main erosion risks on a PV Solar site include channel outlets, roads, road crossings, foundation excavations, and stockpiles. Erosion on roads is not considered a significant risk, provided the roads have no significant camber.

For stockpiles and foundation excavations, it is recommended to place diversion berms or silt fences on the upslope and downslope, respectively. Any topsoil cleared for the development of the PV Plant footprints and hardstand areas should be stockpiled for the decommissioning and rehabilitation of the facility. If possible, the stockpiles should have gentle slopes of 1 in 5 or less to promote revegetation and limit erosion. The stockpile should be bunded until revegetation occurs. Although the gentle slopes require a larger surface area for the stockpile, this approach is considered the lower-impact option as it minimises erosion while disturbing a larger surface area.

8.0 WATER QUALITY

The proposed Eskom Komati Solar PV and BESS project has the potential to impact water quality in the surrounding area. Construction activities, including earthworks and land clearing, have the potential to cause sedimentation and erosion, which could lead to increased turbidity and sedimentation in nearby water bodies. Moreover, the operational phase may involve the use of chemicals, increasing the risk of accidental spills or leaks that could contaminate surface water or groundwater.

To mitigate these potential impacts and ensure the protection of water quality, the following measures are recommended:

- Implement erosion control measures during construction to prevent soil erosion and sedimentation of water bodies.
- Develop and implement a stormwater management plan to manage runoff and prevent contamination.

- Monitor surface water and groundwater quality regularly to detect any potential impacts and take appropriate corrective actions.

Reference is also made to the technical report titled "Komati Power Station Surface and Groundwater Monitoring – Quarter 3", prepared by Applied Chemistry & Microbiology in March 2022.

The technical report presented the following findings and recommendations:

- In general, there is satisfactory compliance, when comparing the water quality with the SANS 241:2015 standards. It was acknowledged that several WUL thresholds are more stringent, therefore the station is unable to attain good compliance status. This is indicated by the high level of conformance to the Drinking Water Quality Standards (SANS 241:2015).
- There is observation of improved surface and groundwater quality on several determinants. This is confirmed by undetected determinants on several sites.
- The above deliberations suggest that there could be good management practices being implemented by the site thus preventing water quality deteriorations.
- In conclusion, monitoring of the surface and groundwater quality should be continued to further detect any abnormalities.

9.0 SWMP MONITORING AND MANAGEMENT

Monitoring and management are key to the success of a SWMP. The following are therefore included as a key aspect of SWMP.

- Frequent inspections until the success of the design and any unexpected problems are resolved/confirmed and maintenance frequency is determined;
- Review of the plan after a few years to improve, where possible, its practicality, cost-effectiveness or efficacy;
- Alerts that do not rely on a full-time environmental management on site (which may not be feasible) including:
  - Automatic alert system for the wastewater conservancy tank (e.g., a float driven switch alert system);
  - Brief, annual refresher training on stormwater protection that should not take more than fifteen minutes for each staff member; and
  - Well placed signs that remind staff members or reporting of incident/issues, as soon as possible and reduce the likelihood that forgetfulness or confusion will prevent reporting.

10.0 SWMP ENGINEERING SPECIFICATIONS

Detailed engineering specifications for a Stormwater Management Plan, describing and illustrating the proposed stormwater control measures, must be prepared by the Civil Engineers during the detailed design phase. These specifications should be based on the underlying principles of this Stormwater Management Plan and should also include erosion control measures. The project design requirements encompass the following:

- Erosion control measures to be implemented before and during the construction period, including the final storm water control measures (post construction) must be indicated within the Final/Updated Storm Water Management Plan.

- All temporary and permanent water management structures or stabilisation methods must be indicated within the inspections until the success of the design and any unexpected problems are resolved/confirmed and maintenance frequency is determined Final/Updated Storm Water Management Plan.
- The drainage system for the development footprint should be designed to specifications that can adequately deal with a 50-year intensity rainfall event or more to ensure sufficient capacity for carrying storm water around and away from the infrastructure.
- Procedures for storm water flow through a site need to take into consideration both normal operating practice and special circumstances. Special circumstances in this case typically include severe rainfall events.
- An on-site Engineer or Environmental Officer is to be responsible for ensuring implementation of the erosion control measures on site during the construction period.

11.0 CUMULATIVE IMPACTS

A cumulative impact assessment is the process of analysing the potential impacts and risks of proposed developments in relation to the effects of other human activities, natural environmental factors, and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time. It also involves proposing specific measures to avoid, reduce, or mitigate such cumulative impacts and risk to the greatest extent possible.

Cumulative impacts may arise from existing and planned facilities during the construction and operation phases of the proposed Komati Solar PV and BESS Facilities. While an individual project may not have a significant negative impact on sensitive resources or receptors, the combined impact of the multiple projects may intensify the potential impacts.

11.1 OTHER RENEWABLE ENERGY PROJECTS IN PROXIMITY TO THE PROPOSED PV AND BESS SITE

Cumulative impacts can be identified by combining the potential environmental implications of the Project with the impacts of past, current, or future projects and activities within the project area.

Several renewable energy developments already exist within the surrounding area, and they have submitted applications for environmental authorisation, some of which have been approved. It is important to note that the approval of an Environmental Authorisation (EA) does not necessarily mean that the project has been developed or implemented.

Table 11-1 and Figure 11-1 present the projects within a 30 km radius of the proposed Komati Solar Facility, as indicated by the SA Renewable Energy EIA Application (REEA) Database.

Table 11-1 - Renewable Energy Projects within 30km of the proposed Komati Solar PV and BESS facility

Project Title	DFFE Reference	Status
Proposed installation of a Solar photovoltaic power plant at ESKOM Duvha power station	14/12/16/3/3/2/759	Approved
Proposed Forzando North Coal Mine photovoltaic solar facility in Emalahleni Local Municipality, Mpumalanga Province	14/12/16/3/3/1/452	In process

Figure 11-1 - Renewable Energy Projects within 30 km of the proposed Komati Solar PV

From a desktop scan, it can be observed that these other renewable energy project sites are similar in nature to the proposed PV Site. Potentially, cumulative impacts may be caused by these various developments, including loss of biodiversity and habitat fragmentation, visual and landscape character impacts, traffic disruptions, impacts to civil aviation, as well as pressures on local facilities, goods, and services. These impacts, in relation to the project, are assessed in separate specialist studies as part of the EIA Report.

11.2 THE PROPOSED PROJECT'S CONTRIBUTION TOWARDS CUMULATIVE IMPACTS

The following is noted in terms of the Project's potential contribution towards cumulative impacts, which are assessed further during on separate specialist studies as part of the EIA Report:

- The construction period may cause traffic-related impacts in terms of the local road network, which will be associated with heavy vehicle construction traffic for the delivery of material, transportation of construction workers and general construction-related traffic. This may compound traffic impacts if other large-scale projects are planned during the same period.
- The clearance of vegetative cover for the Project's development footprint will exacerbate erosion.
- Cumulative impacts with regards to habitat loss and fragmentation.
- There will be an increase in the dust levels during the construction phase, as a result of earthworks, use of haul roads and other gravel roads, stockpiles, material crushing, etc.
- Although the water use associated with the operation of a Solar PV Facility is relatively low, it could contribute towards cumulative impacts on water demand for developments in the area.
- The potential increase in creation of jobs and economic input into local businesses would provide a benefit to local communities.

Since each panel in the proposed Komati Solar PV Facility is separate, there will be no accumulation of runoff, and the rainwater will be routed directly to the ground where it can infiltrate. In practical terms, there will be no significant increase in runoff. Furthermore, if the panels are constructed close to ground level, the runoff from individual panels will not increase the risk of erosion. Consequently, the catchment characteristics will effectively only experience minor changes (as opposed to a site with a large surface area of development), and thus it is not anticipated that the hydrology of the catchment will be significantly altered or pushed beyond an acceptable level of change.

From a hydrological perspective, considering the catchment size of the Komati Solar Facility, low rainfall and suggested mitigation measures, the proposed development will cause a **low negative cumulative impact**.

12.0 NO-GO ALTERNATIVE

The No-Go alternative is the option of not establishing new PV plants and associated BESS at the identified site within the Komati Power Station footprint in Mpumalanga Province, South Africa. Approximately 85 percent or 42,000MW of the nation's electricity in South Africa is generated through coal-fired power stations (International Trade Administration, 2023). Coal combustion in South Africa is the main contributor to carbon dioxide emissions, the primary greenhouse gas linked to climate change.

Solar without storage primarily provides the predictable component of energy generation. Consequently, power must be generated at short notice to maintain the supply-demand balance. Battery storage provides this flexibility. Not utilising BESS technology as part of the No-Go option would prevent the PV plants from taking advantage of surplus energy produced, thus perpetuating an unstable energy generation.

Therefore, there is an emphasis on securing South Africa's future power supply through diversifying power generation sources. Additionally, South Africa needs to invest in a power generation mix, reducing reliance solely on coal-fired power generation, to fulfil its commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (PA) to contribute to global climate change efforts. The country has committed to a 28% reduction in greenhouse gas emissions (GHG) and limiting the global temperature increase to below 1.5 degrees Celsius under the Paris Agreement.

Considering the projected increase in energy demand and growing environmental concerns about fossil fuel-based energy systems, the development of large-scale renewable energy supply schemes such as PV is strategically important for diversifying domestic energy supplies and reducing reliance on energy imports.

Without implementing this project, the use of renewable options for power supply would be compromised in the future, potentially leading to significant negative impacts on environmental and social well-being. Therefore, the No-Go option is not considered a feasible choice for this proposed project.

13.0 CONCLUSION AND RECOMMENDATIONS

A specialist surface water study was conducted by WSP to support the EIA application for the Komati Solar PV and BESS facilities within the Komati Power Station in Mpumalanga, proposed by Eskom Holdings SOC (Ltd). The study determined that the proposed activities during the construction, operational, and decommissioning phases of the Komati Solar PV, BESS, and associated infrastructure would have a minor net impact on hydrology. However, local management of surface runoff is required at the PV plant, BESS facilities, and along the roads. Measures to avoid, manage, and mitigate potential impacts during both the construction and operational phases are specified in Section 6.0 of this report and in the Scoping Assessment prepared by WSP. The study identified that the most significant impacts and risks to surface water resources occur during the construction and operational phases.

Based on these findings, it is recommended to authorize the proposed activity and all associated infrastructure, as it has been determined that the surface water impacts resulting from the activity are minimal and within an acceptable level of change. The summarized impacts are provided below:

- Level of change to runoff regime is minimal, i.e., frequency and magnitude of peak discharges from sub-catchments is not expected to be changed and baseflow is not expected to be impacted.
- As all the proposed infrastructure are located within the Komati Power Station's footprint, it is unlikely that their zone of influence will extend to the watercourses within the site footprint.
- It was found that no PV Solar and BESS sites are positioned within watercourses and therefore no risk of impact to the riverbeds or banks exists.
- The only constituent of concern that may pollute waterways is suspended solids from disturbed soils. These solids can be managed and allowed to settle out of surface runoff prior to release to the environment. Therefore, the resultant impact on surface water quality will be negligible.

In addition to the impacts being minimal, all impacts can be avoided, managed, and mitigated by implementing the Surface Water Management Plan (SWMP) presented in this report. To achieve this, all SWMP interventions should be included in the Environmental Management Program (EMPr).

Is it recommended that the SWMP be developed further during the Detailed Design by:

- Developing a stormwater layout and designs based on the above information and infrastructure layout plan;
- Sizing the culverts or drifts associated with the proposed road crossings such that they can handle at least the 1:20-year flood event, or a minimum of 600 mm diameter or height (for maintenance purposes);
- Developing conceptual designs into detailed designs with sufficient details to support construction; and
- The plan should be incorporated into an environmental specification for use during construction and incorporated into the operation environmental management of the site.

In conclusion:

- The proposed infrastructure is not at risk of flood damage.
- The proposed facility will have an intrinsically low impact on surface water resources;
- The potential stormwater impacts that do not exist can be managed in a practical and cost-effective way; and
- The plan is conceptual, because only a conceptual infrastructure layout was made available at the time of the study – that said, moderate to low rainfall and low flow gradients characteristic of the area suggest that details design should not vary considerably from the concepts presented in this report.

14.0 REFERENCES

Applied Chemistry & Microbiology, 2022, Komati Power Station Surface and Groundwater Monitoring – Quarter 3, Revision 1. Report No. RTD/ACM/21/240-190000008

Bailey, Ak & Pitman, Wv. (2015) Water Resources of South Africa 2012 Study (WR2012). WRC Report K5/2143/1

Department: Forestry, Fisheries and the Environment Republic of South Africa, South Africa's updated draft Nationally Determined Contribution (NDC) launched, 30 March 2021, Virtual conference

Department of Water Affairs and Forestry, 2006. Best Practice Guideline G2: Water and Salt Balances.

Drainage Manual, The South African Roads Agency Limited (SANRAL), 6th edition, 2013

DWA (2010) Department of Water Affairs, Hydrological Information System. http://www.gov.za/Hydrology/ (Accessed 22 May 2023)

GHT Consulting Scientists, 2008. Komati Power Station, Hydrological & Geohydrological Baseline Study

JG Afrika, 2022. Roan Solar PV 1 Facility Stormwater Management Plan

Lynch, SD. 2003: Development of a Raster Database of Annual, Monthly and Daily Rainfall for Southern Africa, WRC Report No. 1156/1/03, Water Research Commission, Pretoria, RSA.

ODOT Hydraulics Manual, 2014.

Schulze, R.E. (2003). Development of a Database of Gridded Daily Temperatures for Southern Africa. University of Natal, Pietermaritzburg, School of Bioresources Engineering and Environmental Hydrology. ACRUcons Report, 41. pp 82.

Smithers, J. C., & Schulze, R. E. (2002). Design Rainfall Estimation Program; Rainfall Statistics for Design Flood Estimation in South Africa. WRC Project K5/1060.

South Africa. (1998). General Notice 704 of the National Water Act (36 of 1998). Pretoria: Department of Water and Forestry.

South African Green Building Council. (2017). Green Star SA - Sustainable Precincts Tool. Retrieved from [https://gbcsa.org.za/wp-content/uploads/2017/12/Sustainable-Precincts_Local-Context-Report_Final_05092017.pdf]

Visual SCS-SA, R.E. Schulze, E.J. Schmidt and J.C. Smithers, University of Natal

Water Research Commission: Water Resources of South Africa, 2012 Study - Resource Centre (waterresourceswr2012.co.za)

WSP, 2022, Scoping Assessment for the Proposed Eskom Komati Solar PV Facility.

Appendix A

DESIGN RAINFALL VALUES FOR KOMATI SOLAR PV AND BESS FACILITIES

```
Design Rainfall in South Africa: Ver 3 (July 2012)

User selection has the following criteria:
Coordinates: Latitude: 26 degrees 7 minutes;  Longitude: 29 degreess 28 minutes
Durations requested: 10 m, 15 m, 30 m, 1 h, 2 h, 4 h, 8 h, 12 h, 24 h
Return Periods requested: 5 yr, 50 yr
Block Size requested: 1 minutes

Data extracted from Daily Rainfall Estimate Database File
The six closest stations are listed

Station Name                SAWS    Distance  Record  Latitude Longitude  MAP Altitude Duration   Return Period (years)
                            Number      (km) (Years)  (°)  (')  (°)  (') (mm)      (m)  (m/h/d)      5        5L        5U        50       50L       50U


Gridded values of all points within the specified block
  Latitude Longitude  MAP Altitude Duration   Return Period (years)
  (°)  (')  (°)  (') (mm)      (m)  (m/h/d)       5       5L       5U       50      50L      50U

   26    6   29   27  699     1621     10 m     17.1     13.5     20.7     27.7     21.4     34.4
                                       15 m     21.2     16.6     25.8     34.4     26.3     43.0
                                       30 m     27.1     21.5     32.6     44.0     34.2     54.3
                                        1 h     34.6     28.0     41.2     56.3     44.5     68.7
                                        2 h     44.3     36.4     52.1     72.0     57.8     86.8
                                        4 h     52.8     42.7     62.7     85.7     67.9    104.5
                                        8 h     62.9     50.2     75.4    102.1     79.8    125.7
                                       12 h     69.6     55.2     84.0    113.2     87.7    140.0
                                       24 h     83.0     64.8    101.0    134.8    103.0    168.4
   26    6   29   28  697     1620     10 m     17.0     13.5     20.6     27.1     21.1     33.3
                                       15 m     21.1     16.6     25.7     33.6     25.9     41.5
                                       30 m     27.0     21.5     32.5     43.0     33.7     52.5
                                        1 h     34.5     28.0     41.1     55.0     43.9     66.4
                                        2 h     44.2     36.4     52.0     70.3     57.1     84.0
                                        4 h     52.6     42.8     62.6     83.8     67.0    101.1
                                        8 h     62.8     50.3     75.3     99.9     78.8    121.8
                                       12 h     69.6     55.3     84.0    110.8     86.6    135.7
                                       24 h     82.9     65.0    101.1    132.0    101.8    163.4
   26    6   29   29  695     1621     10 m     17.1     13.5     20.7     27.2     21.2     33.4
                                       15 m     21.2     16.6     25.8     33.7     26.0     41.6
                                       30 m     27.1     21.6     32.6     43.1     33.9     52.7
                                        1 h     34.7     28.1     41.3     55.2     44.1     66.7
                                        2 h     44.4     36.6     52.2     70.7     57.4     84.4
                                        4 h     53.0     43.1     63.0     84.4     67.5    101.8
                                        8 h     63.3     50.7     75.9    100.7     79.4    122.7
                                       12 h     70.2     55.8     84.7    111.7     87.4    136.9
                                       24 h     83.8     65.6    102.1    133.4    102.8    165.1
   26    7   29   27  694     1609     10 m     17.1     13.5     20.7     27.8     21.4     34.4
                                       15 m     21.2     16.6     25.8     34.4     26.3     43.0
                                       30 m     27.1     21.5     32.6     44.0     34.2     54.3
                                        1 h     34.6     28.0     41.2     56.3     44.5     68.7
                                        2 h     44.3     36.4     52.1     72.0     57.8     86.9
                                        4 h     52.8     42.7     62.7     85.7     67.9    104.5
                                        8 h     62.9     50.2     75.4    102.1     79.8    125.7
                                       12 h     69.6     55.1     84.1    113.2     87.6    140.1
                                       24 h     83.0     64.7    101.1    134.8    102.9    168.6
   26    7   29   28  701     1645     10 m     17.0     13.5     20.6     27.1     21.1     33.3
                                       15 m     21.1     16.6     25.7     33.6     26.0     41.5
                                       30 m     27.0     21.6     32.5     43.0     33.8     52.5
                                        1 h     34.5     28.0     41.1     55.0     43.9     66.4
                                        2 h     44.2     36.5     52.0     70.3     57.1     84.1
                                        4 h     52.7     42.8     62.6     83.9     67.1    101.2
                                        8 h     62.8     50.4     75.4    100.0     78.9    121.9
                                       12 h     69.7     55.4     84.1    110.9     86.7    135.9
                                       24 h     83.1     65.1    101.3    132.3    101.9    163.7
```

Appendix B

MODELLING RESULTS FOR THE SOLAR PV SITES

Pre-Development Results

Summary Results

Topic: Subcatchment Runoff   Click a column header to sort the column.

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
PV_Site_A	33.00	0.00	0.00	26.06	1.48	0.00	1.48	2.31	121.97	0.045
PV_Site_B	33.00	0.00	0.00	26.06	1.55	0.00	1.55	0.84	44.04	0.047

Post-Development Results

Summary Results

Topic: Subcatchment Runoff   Click a column header to sort the column.

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
PV_Site_A	33.00	0.00	0.00	25.92	1.61	0.00	1.62	2.52	133.88	0.049
PV_Site_B	33.00	0.00	0.00	25.92	1.70	0.00	1.70	0.92	48.16	0.051

Appendix C

SCOPING ASSESSMENT BY WSP

DRAFT

REPORT

Scoping Assessment for the proposed Eskom Komati Solar PV facility

WSP Africa

Submitted to:

Megan Govender
Knightsbridge
33 Sloane Street
Bryanston
2191

Submitted by:

Golder Associates Africa (Pty) Ltd.
Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685, South Africa
P.O. Box 6001, Halfway House, 1685

+27 11 254 4800

22521869-352927-1

June 2022

Distribution List

1 eCopy - WSP Africa

1 eCopy - GAA Sharepoint

Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX A
Document Limitations

1.0 INTRODUCTION

Golder Associates Pty Ltd (member of WSP) was appointed by Eskom Holdings SOC (Ltd) to provide a scoping assessment for the proposed Eskom Komati Solar Photovoltaics (PV) project. WSP will carry out an Environmental Impact Assessment (EIA) for the Solar PV project in line with World Bank's Environmental and Social Framework, and the South African Legislations. The purpose of this scoping assessment is to provide a description of the proposed project, including a sufficient level of detail to enable stakeholders to identify relevant issues and concerns.

2.0 PROJECT DESCRIPTION

The Eskom Komati Solar PV project will comprise of the following:

The specifications of the Solar PV and Battery Energy Storage System (BESS) project including aspects of construction and operation are outlined below:

- The total site area for PV installation is approximately 200 to 250 hectares to allow for the construction of a PV facility with capacity up to 100 MW and BESS up to 150 MW.
- Solar PV modules, up to a total of approximately 720,000 m^2, that convert solar radiation directly into electricity. The solar PV modules will be above the ground and will be mounted on either fixed tilt systems or tracking systems (comprised of galvanised steel and aluminium). The Solar PV modules will be placed in rows in such a way that there is allowance for a perimeter road and security fencing along the boundaries, and Operation and Maintenance (O&M) access roads in between the PV module rows.
- Inverter stations, each occupying a footprint of approximately 30 m^2, with up to 100 Inverter stations installed on the identified sites. Each Inverter station will contain an inverter step-up transformer, and switchgear. The Inverter stations will be distributed on the site, located alongside its associated Solar PV module arrays. The Inverter station will perform conversion of Direct Current (DC) to Alternating Current (AC), and step-up the LV voltage of the inverter to the appropriate voltage to allow the electricity to be fed into the appropriate substation / grid Point of Connection (PoC). Inverter stations will connect several arrays of Solar PV modules and will be placed along the internal roads for easy accessibility and maintenance.
- Below ground electrical cables with trenching for connecting PV arrays, Inverter stations, O&M buildings, and Combiner Substations.
- Above ground overhead lines for connecting Combiner Substations to grid PoC.
- Adequately designed foundations and mounting structures that will support the Solar PV modules and Inverter stations.
- Access roads to the Komati PV sites.
- Perimeter roads around the PV sites.
- Internal roads for access to the Inverter stations.
- Internal roads/paths between the Solar PV module rows, to allow access to the Solar PV modules for O&M activities.
- Infrastructure required for the operation and maintenance of the Komati PV installations:
  - Meteorological Station
  - O&M Building – comprising control room, server room, security equipment room, offices, boardroom, kitchen, and ablution facilities (including water supply and sewage infrastructure).

- Spares Warehouse and Workshop.
- Hazardous Chemical Store – approx. 30 m^2.
- Security Building.
- Parking areas and roads.

- Small diameter water supply pipeline from existing supply infrastructure.
- Fire water supply during Construction and Operation.
- Sewage interconnection to existing infrastructure.
- Stormwater channels.
- Perimeter fencing of the Komati PV sites, with access gates.
- Temporary laydown area, occupying a footprint up to approx. 10 hectares. The laydown area will be used during construction and rehabilitated thereafter.
- Temporary concrete batching plant, occupying a footprint up to approx. 1 hectare. The concrete batching plant area will be used during construction and rehabilitated thereafter.
- Temporary site construction office area, occupying a footprint up to approx. 1 hectare. This area will accommodate the offices for construction contractors during construction and rehabilitated thereafter.

3.0 BACKGROUND

Eskom Holdings SOC (Ltd) is a South African utility that generates, transmits and distributes electricity. Eskom supplies about 95 % of the country's electricity. Eskom's 2035 strategy encompasses the journey that Eskom intends to take in response to the changing energy environment and the impact this has towards a sustainable power utility. This strategy is necessitated by the challenges that Eskom faces as a business as well as the global and local shifts occurring in the energy sector particularly with respect to environmental and climate change challenges, difficulties in accessing financing and changes to the macro industry environment significantly altering the energy supply industry (ESI).

The road to 2035, includes the shutting down of a number of coal-fired power stations by 2035, repurposing and repowering, delivering new clean generation projects, expanding the transmission grid, and rolling out micro grid solutions.

Several power stations are reaching the end of life. These stations will go into extended cold reserve and are most likely to be fully decommissioned in the future. Eskom is considering a shutdown, dismantling and repurposing of some of its fleet as it reaches its end of life. Komati Power Station, situated in Mpumalanga will reach its end-of-life expectancy in September 2022.

Eskom is proposing the establishment of a solar electricity generating facility and associated infrastructure as part of its repurposing programme for Komati Power Station. The plan is to install 100 MW of Solar PV and 150 MW of BESS.

4.0 PROJECT LOCATION AND EXTENT

The Komati Power Station is situated about 37 km from Middelburg, 43 km from Bethal and 40 km from Witbank, via Vandyksdrift in the Mpumalanga Province of South Africa. The station is located in the Steve Tshwete Municipality, along the R35 as shown in Figure 1. The GPS coordinates for the power plant is: 26.0896668 S, 29.4655907 E. The station has a total of 9 units, five 100 MW units on the east (Units 1 to 5) and four 125 MW units on the west (Units 6 to 9), with a total installed capacity of 1000 MW. Its units operated on a simple Rankine Cycle without reheat and with a low superheat pressure, resulting in a lower thermodynamic efficiency (efficiency up to 27 %). Komati Units are small and have a higher operating & maintenance cost per megawatt generated compared to modern newer stations. Komati Power Station will reach its end-of-life expectancy in September 2022 when Unit 9 will have reached its Dead Stop Date (DSD). Units 1 to 8 have already reached its DSD.

The parcels of land in Komati for the proposed development is provided in Figure 2. The identified parcels of land are owned by Eskom.

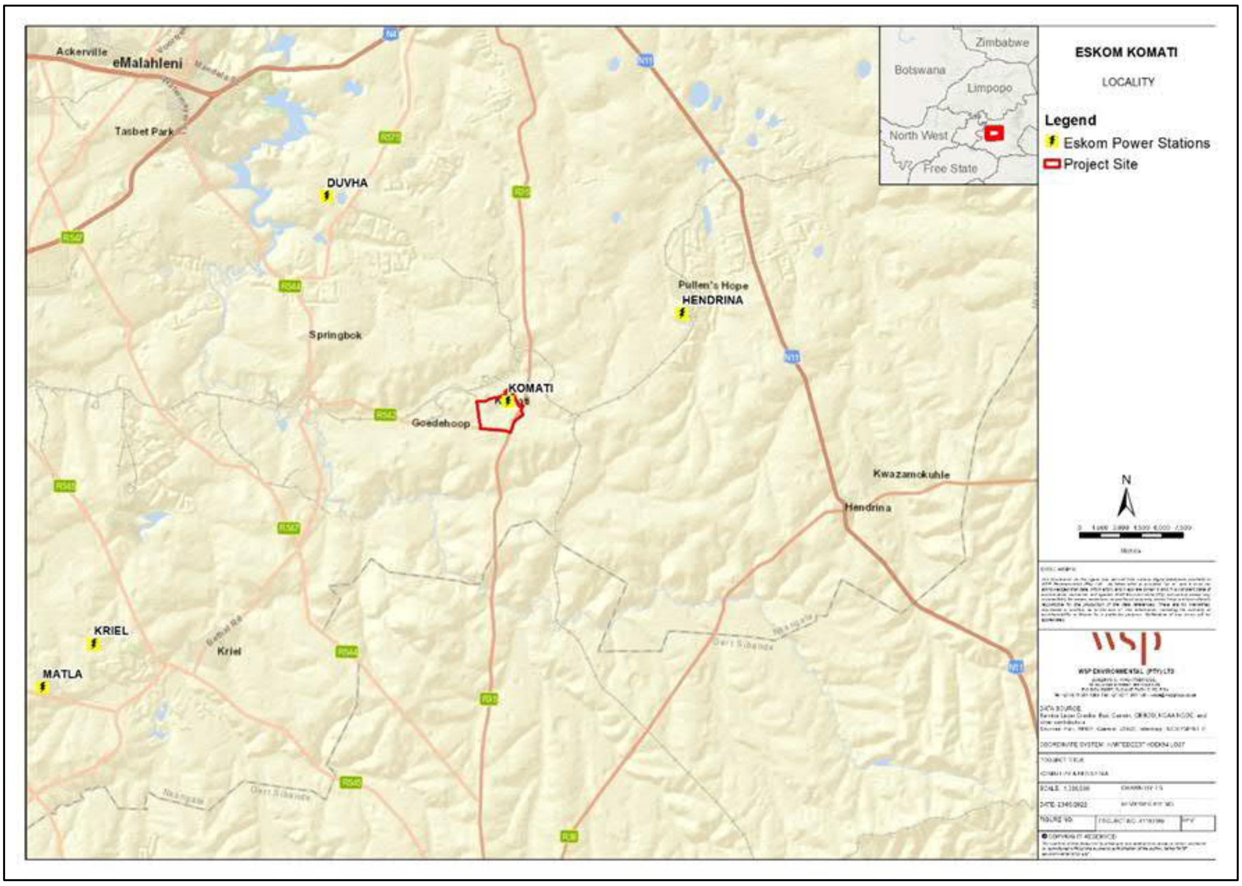


Figure 1: Locality Map

Figure 2: Site layout and proposed PV sites

5.0 APPLICABLE LEGISLATION, GUIDELINES AND STANDARDS

5.1 The World Bank Environmental and Social Framework

The World Bank Environmental and Social Framework sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity.

The ten Environmental and Social Standards establish the standards that the Borrower and the project will meet through the project life cycle, as follows:

- Environmental and Social Standard 1: Assessment and Management of Environmental and Social Risks and Impacts.
- Environmental and Social Standard 2: Labour and Working Conditions.
- Environmental and Social Standard 3: Resource Efficiency and Pollution Prevention and Management.
- Environmental and Social Standard 4: Community Health and Safety.
- Environmental and Social Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement.
- Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- Environmental and Social Standard 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities.

- Environmental and Social Standard 8: Cultural Heritage.
- Environmental and Social Standard 9: Financial Intermediaries.
- Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure.

5.2 The National Water Act (Act 36 of 1998)

Water resources management in South Africa is governed by the National Water Act (Act 36 of 1998) (NWA). The Department of Water and Sanitation (DWS) must, as custodians of water, ensure that resources are used, conserved, protected, developed, managed, and controlled in a sustainable manner for the benefit of all persons and the environment.

5.3 The use of Water for Mining and Related Activities

Government Notice 704 (Government Gazette 20119 of June 1999) (hereafter referred to as GN704), was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. The three main conditions of GN704 applicable to this project are:

- No residue or substance which causes or is likely to cause pollution of a water resource may be used in the construction of any dams, impoundments or embankments or any other infrastructure which may cause pollution of a water resource.
- Clean and dirty water systems must be kept separate and must be designed, constructed, maintained and operated to ensure conveyance of the flow of a 1:50-year recurrence interval storm event. Clean and dirty water systems should therefore not spill into each other more frequently than once in 50-years. Any dirty water dams should also have a minimum freeboard of 0.8 m above the full supply level.
- All dirty water or substances which may cause pollution should be prevented from entering a clean water resource (by spillage, seepage, erosion etc.) and it should be ensured that water used in any process is recycled as far as practicable.

5.4 South African Water Quality Guidelines

The NWA, Section 21 (f) and (g), states that the discharging of water containing waste into a water resource and disposing of waste which may detrimentally impact on a water resource should be prevented. The South African Water Quality Guidelines (SAWQG) are a series of documents published by (Department of Water Affairs) DWA, which forms an integral part of the water quality management strategy to safe keep and maintain the water quality in South Africa. These guidelines are used by the DWA as a primary source of information and decision-support to judge the fitness for use of water and for other water quality management purposes. The content of the SAWQG provides information on the ideal water quality and acceptable concentrations for various constituents of concern.

5.5 National Environmental Management Act

The National Environmental Management Act (NEMA), 1998 (Act No 107 of 1998) covers the control and management of environmental impacts and, *inter alia*, provides a framework for measures that “prevent pollution and ecological degradation; promotes conservation, and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development

6.0 BASELINE OVERVIEW

6.1 Climate

6.1.1 Rainfall

The rainfall data was generated using a rainfall simulator which was sourced through the Design Rainfall Estimation Program (Smithers & Schulze, 2002) and the Daily Rainfall Extraction Utility (Kunz, 2004). Data was sourced for rainfall stations that are within close proximity to the study area. The rainfall stations presented in Table 1 summarize the rainfall data used in the analysis.

Table 1: Metadata for the rainfall stations

Station number	Name	Distance (km)	Record period (years)	Period of records	Reliability (%)	MAP (mm)
0478577 W	Vaalkraanz	11.4	80	1920 - 2000	11.7	693
0478546 W	Vandyksdrift	11.8	80	1920 - 2000	59.8	686
0478786 W	Blinkpan (Pol)	2.5	80	1920 - 2000	25	643

6.1.1.1 Comparison of rainfall stations

The average monthly plot was used to compare the rainfall records as shown in Figure 3. The rainfall records cover the same time periods, and the average monthly rainfall depths for the different stations have a similar pattern. During the wet season, the highest average rainfall was recorded in the month of January. The driest month on average was recorded in the month of July.

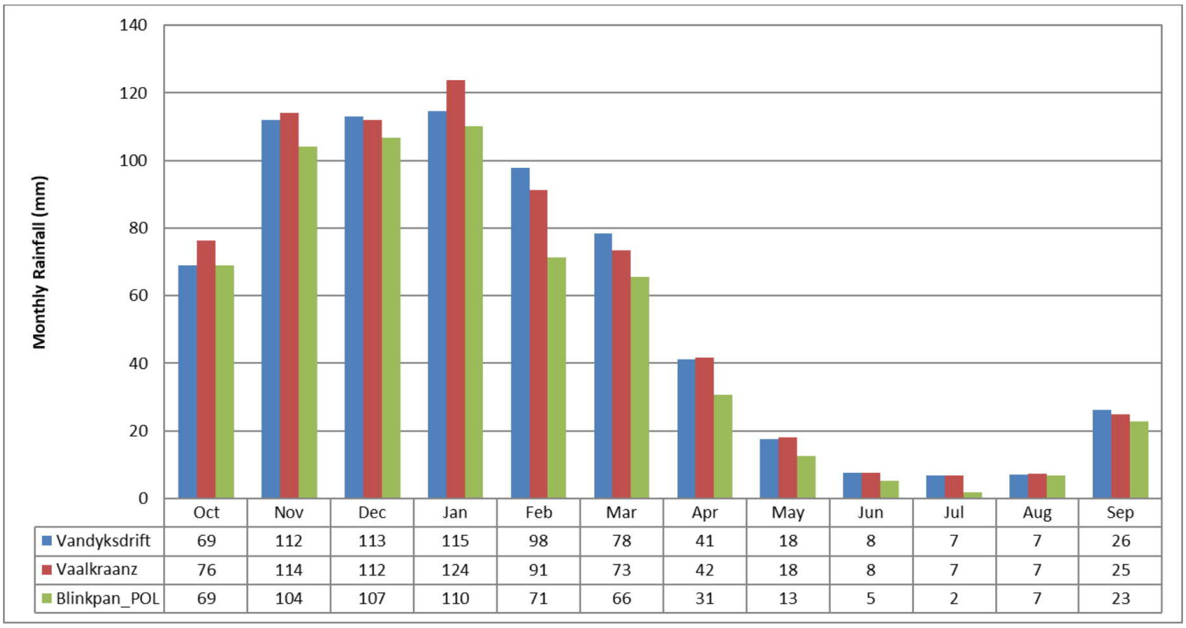


Figure 3: Average monthly rainfall for the stations

The Vandyksdrift, Vaalkraanz and Blinkpan (POL) rainfall stations show a similar increasing trend as observed in Figure 4. The trends are consistent throughout, with no significant changes in slope. Figure 4 shows the total cumulative rainfall over time.

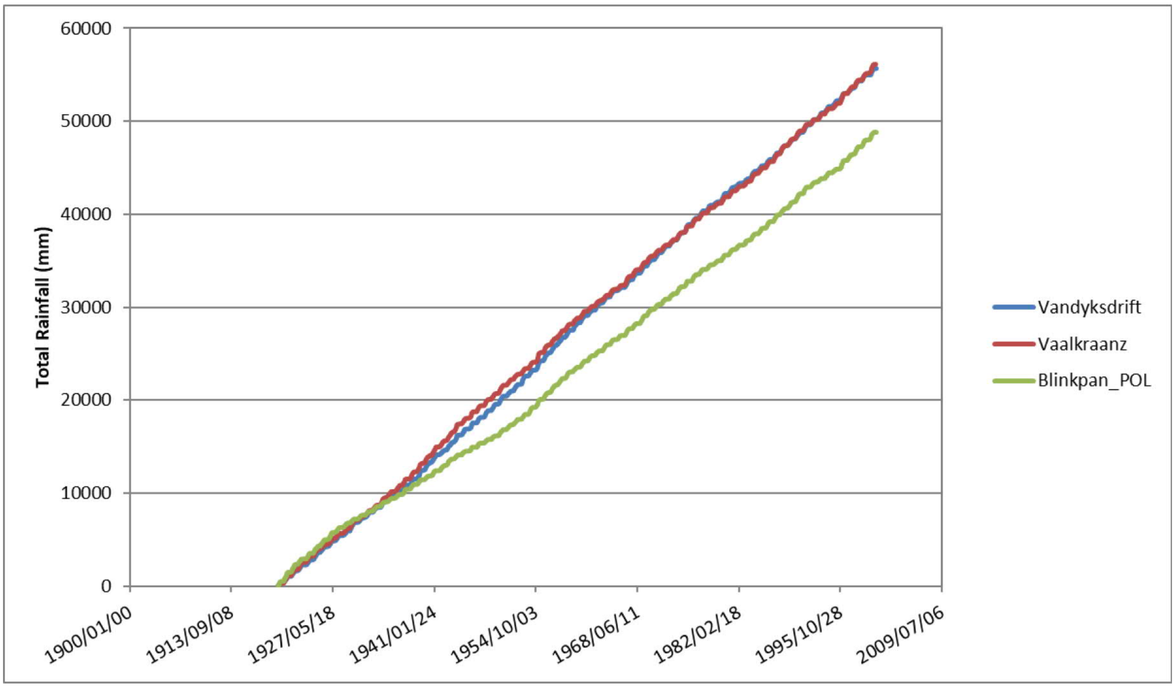


Figure 4: Cumulative rainfall for the stations analyzed

The station 0478546 W Vandyksdrift was chosen as the station that is representative of the study for the following reasons:

- The station is within proximity of the site.
- The station has the highest reliability data set (having the lowest percentage of patched or missing data).
- The station has long duration of recorded data.

6.1.1.2 Vandyksdrift rainfall station

Vandyksdrift rainfall station is situated approximately 12 km from the site with 80-years of recorded data. It has the highest reliability (less patched data) of the analysed stations. The maximum recorded 24-hour rainfall depth is 97 mm, recorded on the 26th of April 1960, as shown in Figure 5. Figure 6 shows the annual rainfall depths. The mean annual precipitation for the station is 693 mm.

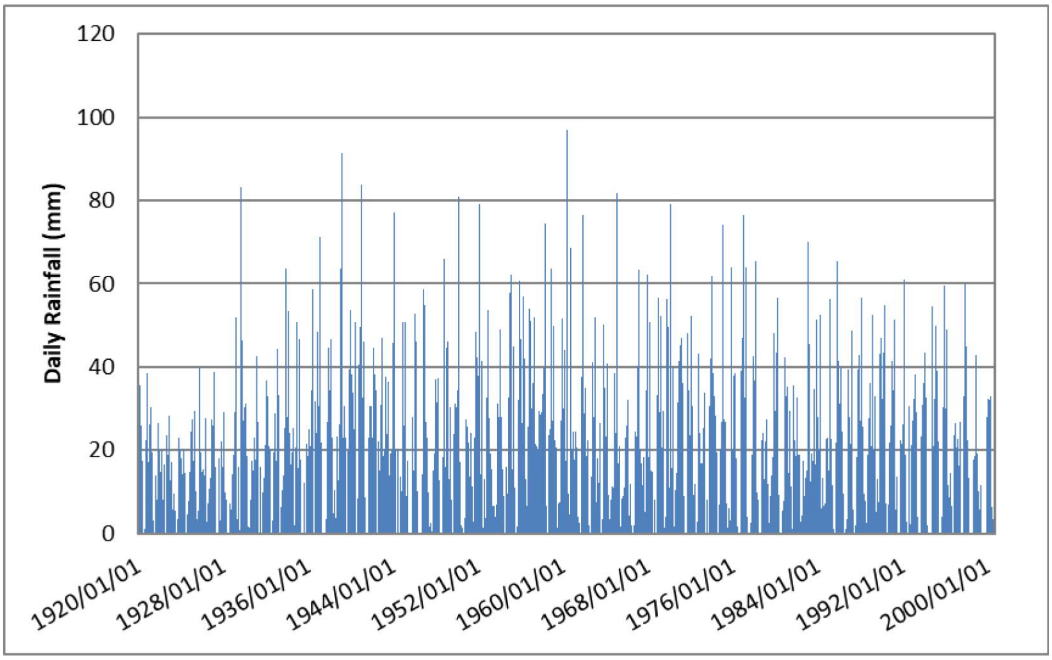


Figure 5: Vandyksdrift weather station daily rainfall

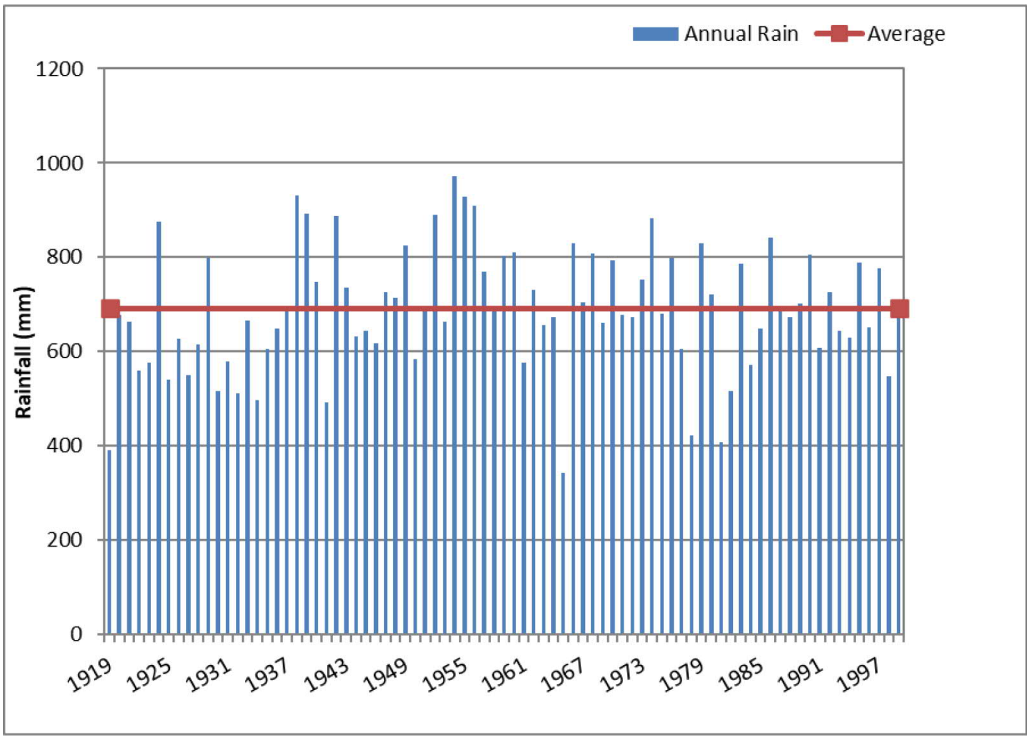


Figure 6: Vandyksdrift weather station annual rainfall readings and mean annual precipitation (MAP)

6.1.1.3 Design rainfall estimation

The 24-hour rainfall depths for several recurrence intervals at the Vandyksdrift station were calculated from the data available. To determine the likely magnitude of storm events, a statistical approach, using chi square statistics method (NIST/SEMATECH e-Handbook of Statistical Methods), was applied to the available recorded daily rainfall depths. This method statistically analyses the maximum daily rainfall depths for each year to determine the different recurrence intervals. The probability distribution with the best fit (R^2=0.993) was found to be the Pearson III distribution (see Figure 5), this was used to estimate the 24-hour storm rainfall depths associated with the various recurrence intervals as summarised in Table 2.

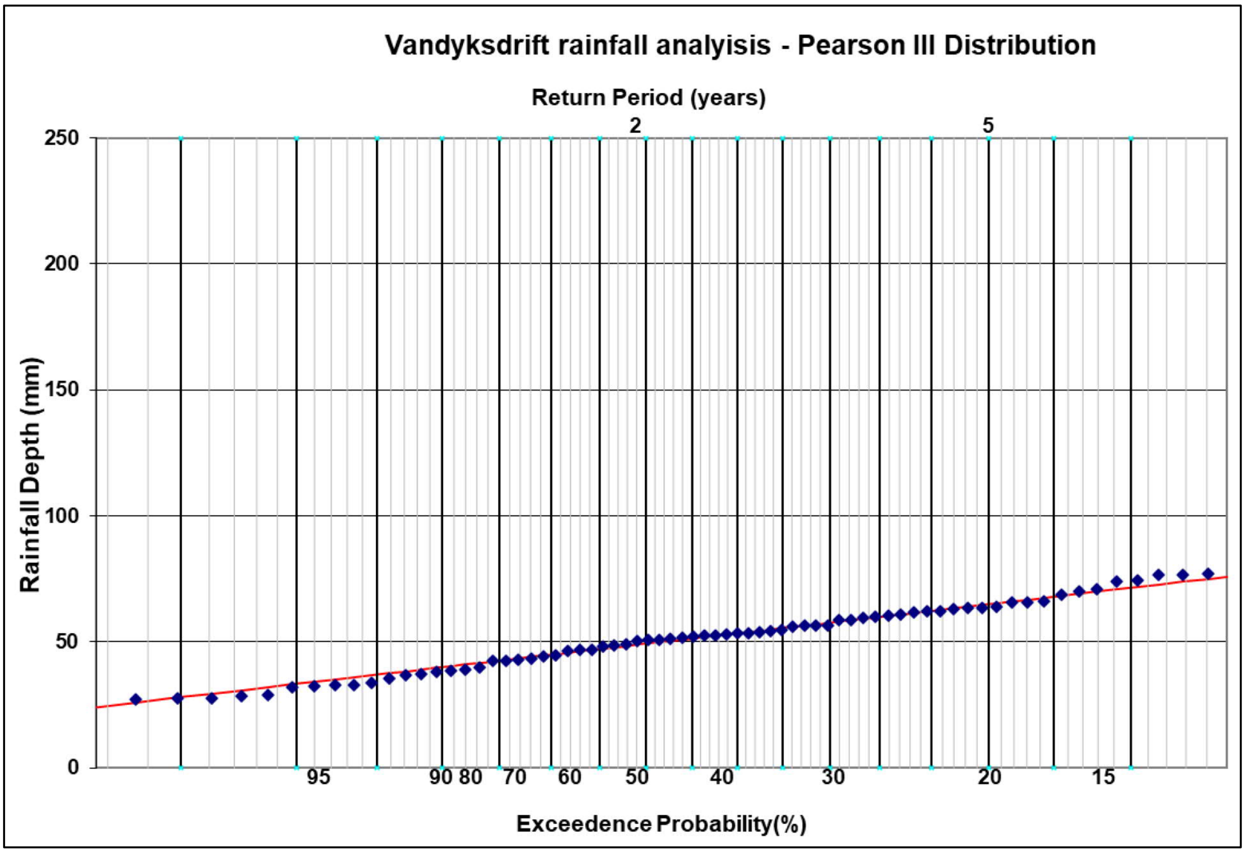


Figure 5 : Vandyksdrift Pearson III distribution

Table 2: Computed 24-hour rainfall depths for various annual recurrence intervals

Return period in years	5	10	20	25	50	100	200	500	100
24-hours Rainfall Depth (mm/d)	68	76	83	85	91	96	101	107	112

6.1.2 Evaporation

The average S-Class pan evaporation is 2087.9 mm/year measured at B1E002 station. The station is approximately 13 km away from the site area. The highest average monthly evaporation occurs in November, as shown in Table 3. Figure 7 plots the monthly average evaporation and the monthly average rainfall readings for the Komati area. From the figure, it is observed that the mean annual evaporation is generally higher than the rainfall throughout the year.

Table 3: Average S-Pan evaporation

Month	S-Pan evaporation (mm/month)
January	200.9
February	163.5
March	193.8

Month	S-Pan evaporation (mm/month)
April	161.9
May	139.3
June	113.1
July	120.6
August	161.2
September	187.7
October	199.9
November	214.8
December	212.7
Total	2069.4

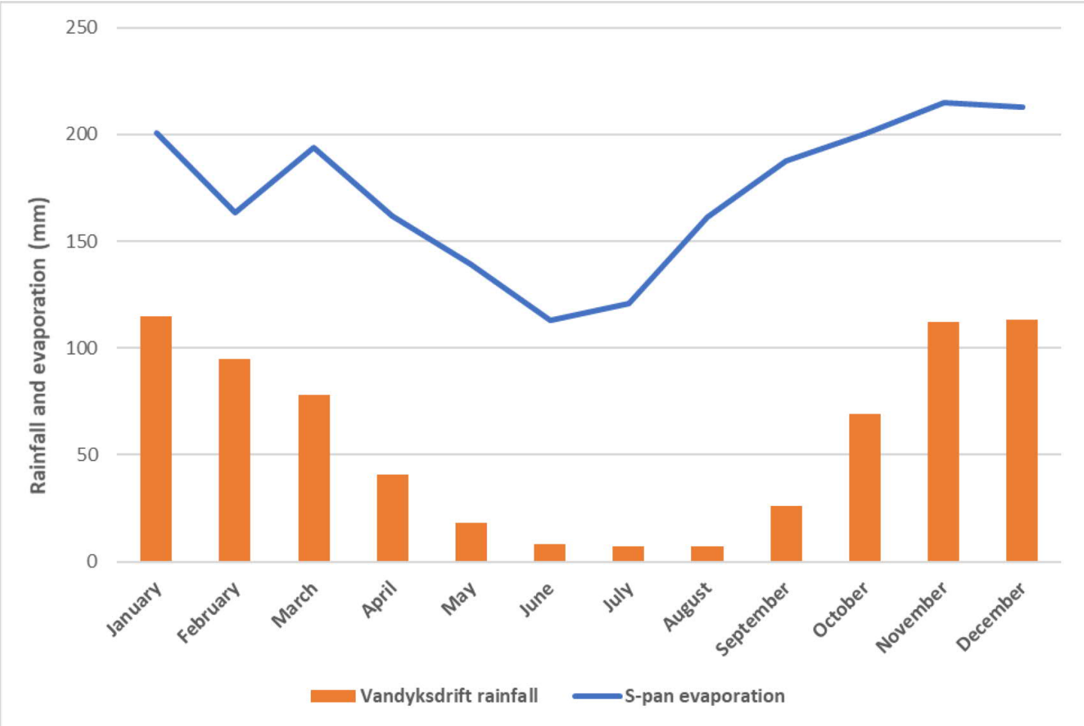


Figure 7: Rainfall and evaporation comparison

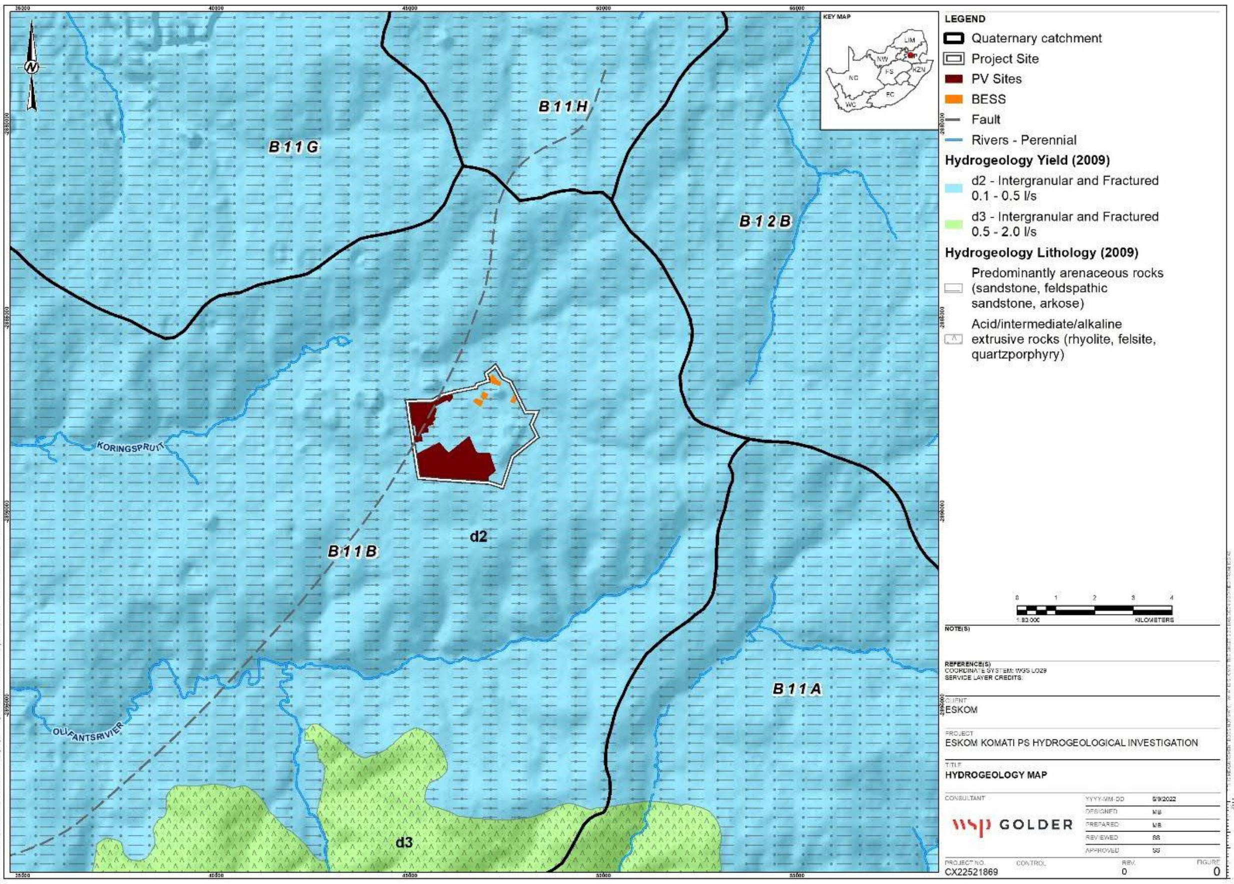
6.2 Temperature

According to GHT Consulting, average daily maximum temperatures in the Komati area vary from 27 °C in January to 17 °C in July, but in extreme cases these may rise to 38 °C and 26 °C, respectively. In comparison, average daily minima of 13 °C and 0°C can be expected, with temperatures falling to 1 and –13°C, respectively, on unusually cold days. Frost conditions are also common over the 120-day period from May to September.

7.0 HYDROLOGICAL DESCRIPTION

7.1 Catchment description

Komati Power Station occurs within the upper Olifants Water Management Area (WMA), in the B11B quaternary catchment and can be sub-divided into secondary drainage regions compromising of smaller streams and creeks. This catchment receives 687 mm rainfall per year and experiences 1550 mm of evaporation annually. The surface topography of the area is typical of the Mpumalanga Highveld, consisting in the main of a gently undulating plateau. The flood plains of the local streams are at an average elevation of approximately 1595 meters above mean sea level (mamsl). Altitudes vary from ±1650 mamsl at the higher parts south of the ashing facility to ±1595 mamsl which defines the base of the Koring Spruit to the north of the Komati Power Station.



8.0 IMPACT ASSESSMENT

Based on the existing information in the area, a preliminary impact assessment was conducted and outlined in the section below. The impacts will be verified by relevant specialists during the EIA Phase. The key issues and concerns for the surface water study have been unpacked in the subsections below.

8.1 Major areas of concern for surface water impact

The following section describes those activities that would have an impact on the surface water resources in the area in which the associated activities are proposed. For the purposes of this scoping impact assessment, the proposed project has been subdivided into the construction, operational, and closure phases. The cumulative impacts will only be included in the EIA phase.

The major activities of concern relating to the surface water resources are:

Construction phase

- Contamination of stormwater runoff
- Erosion at the construction site

Operational phase

- Contamination of stormwater runoff
- Erosion during operation
- Flooding

Closure/decommissioning phase

- Contamination of stormwater runoff

8.2 Impact assessment methodology

The significance of the identified impacts on the various environmental components were determined using the approach outlined below. An impact screening tool has been used in the scoping phase. The screening tool is based on two criterias, namely probability; and, consequence (Table 6), where the latter is based on general consideration to the intensity, extent, an duration.

The scales and descriptors used for scoring probability and consequence are detailed in Table 4 and Table 5 respectively.

Table 4: Significance screening tool

		Consequence scale			
Probability scale		1	2	3	4
	1	Very Low	Very Low	Low	Medium
	2	Very Low	Low	Medium	Medium
	3	Low	Medium	Medium	High
	4	Medium	Medium	High	High

Table 5: Probability scores and descriptors

Score	Descriptor
4	**Definite**: The impact will occur regardless of any prevention measures
3	**Highly Probable**: It is most likely that the impact will occur
2	**Probable**: There is a good possibility that the impact will occur
1	**Improbable**: The possibility of the impact occurring is very low

Table 6: Consequence score descriptions

Score	Negative	Positive
4	Very severe: An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated.	Very beneficial: A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit.

Score	Negative	Positive
3	Severe: A long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming or some combination of these.	Beneficial: A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these.
2	Moderately severe: A medium to long term impacts on the affected system(s) or party (ies) that could be mitigated.	Moderately beneficial: A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way.
1	Negligible: A short to medium term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary.	Negligible: A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.

The nature of the impact must be characterized as to whether the impact is deemed to be positive (+ve) (i.e. beneficial) or negative (-ve) (i.e. harmful) to the receiving environment/receptor. For ease of reference, a colour reference system (Table 7) has been applied according to the nature and significance of the identified impacts.

Table 7: Impact Significance Colour Reference System to indicate the Nature of the impact

Negative Impacts (-ve)	Positive Impacts (+ve)
Negligible	Negligible
Very Low	Very Low
Low	Low
Medium	Medium
High	High

8.3 Construction phase impacts

During the construction phase of the solar PV project, the following activities are anticipated:

- **Site Preparation** - Vegetation and topsoil will be cleared for the footprint of the infrastructure as well as for the access roads to the solar PV site, internal roads and the laydown yard, etc. The topsoil removed will need to be stored for rehabilitation purposes of the site.
- **Transportation of Equipment** - All equipment to site will be transported by means of national, provincial and district roads. This includes but is not limited to, transformers, solar PV modules, inverters, excavators, graders, trucks, compacting equipment, construction material, etc.
- **Site Establishment Works** - The site will have temporary laydown areas and offices for the construction contractors. This will include the contractor's chosen electricity supply infrastructure e.g., use of generators

and fuel storage that will be required to conform to acceptable measures to ensure no harm to the environment. The laydown area will also be used for assembling of solar PV modules and structures. A concrete batching plant may also be required as part of the site establishment works.

- **Construction of the Solar PV Facility** - Trenches would need to be excavated for underground cabling to connect Solar PV arrays, Inverter stations, and Combiner Substations. Foundations for the solar PV array mounting structures and Inverter stations may need to be excavated, with the final extent depending on the geotechnical studies that will be conducted. The geotechnical studies will determine the type of foundations that can be implemented at the PV site. Construction of access, perimeter, and internal gravel roads may require material to be imported from outside the site, from a permitted quarry.
- **Water consumption during construction phase** - The water consumption during the construction phase is estimated as 15,000 kilolitres (total for construction period estimated as 24-months) - The Contractor should in any case be made responsible for securing electricity, water, and any other services during construction.
- **Construction of Electrical Interconnection Line** - Construction and installation of overhead electrical interconnection lines, connecting the Solar PV facilities to the grid PoC.
- **Storage of diesel and oil for construction activities**.

Once all the construction activities are completed the site will be rehabilitated where possible and practical. All temporal structures and facilities will be removed from site and the area rehabilitated.

The associated impacts in the construction phase for the abovementioned activities are described in the following section:

8.3.1 Contamination of stormwater runoff

Stormwater runoff could, in the case of the temporary construction yards, laydown areas, and offices for the construction workers, potentially come in contact with areas dedicated for the handling of contaminants.

The contaminants from areas in which contractor vehicles and equipment are housed, as well as from the areas in which the construction vehicles and equipment are being used, will include hydrocarbons that may be spilled or leaked during use. This could result in contaminated stormwater runoff being discharged downstream. During construction, it is expected that the magnitude of the impact will be **low** and will require mitigation to reduce the risk.

8.3.1.1 Mitigation

The following mitigation measures are proposed:

- Ensure clean-up of hydrocarbon spills from machinery is done immediately, and contaminated soils disposed of to a permitted site.
- After construction, the land must be cleared of debris, surplus materials, and equipment. All parts of the land must be left in a condition as close as possible to that prior to construction.

Should the measures described above be implemented during construction, then the impact significance will reduce to **low – very low**.

8.3.2 Erosion during construction

Soil stripping, stockpiling, excavations of underground cabling, foundations for the solar PV array mounting structure and construction of stormwater berms may result in loss of soils through erosion, particularly for topsoil stockpiles with unvegetated steep slopes, resulting in increased sedimentation to water resources.

The removal or disturbance of vegetation during the construction of roads could result in the concentration of flow and consequently in accelerated erosion along roads where steep slopes dominate, which will result in an increase of suspended solids and sedimentation of the downstream environment. Erosion of the proposed roads is further possible at watercourse crossings due to the concentration of flow. Removal or disturbance of vegetation from areas such as new roads, the construction yards and the substation / control building could also result in erosion due to the soil stability being affected. During construction, it is expected that the magnitude of the impact will be **moderate** and will require mitigation to reduce the risk

8.3.2.1 Mitigation

The following mitigation measures are proposed:

- Avoid clearing during the wet season when short heavy downpours can be expected. This should help to limit erosion.
- Minimize the extent of earthworks.
- Encourage the use of natural flow paths downstream of construction sites.
- The discharge of stormwater should be spread over a wide area to reduce the energy as a result of concentrated flow and return to dispersed flow downstream of the construction site.
- Re-use stockpiled soil within as short a period as possible.

Should the measures described above be implemented during construction, then the impact significance will reduce from **moderate – very low**.

8.4 Operation phase impacts

During the operation phase of the solar PV project, the following activities are anticipated:

- During the life of the Solar PV facility, there will be normal maintenance of all electrical and mechanical components of the plant.
- In addition, there will be periodic cleaning and washing of the solar PV modules. This PV module cleaning will be performed when required, and it is estimated to occur 2-4 times a year.
- The water consumption during operation - estimated water required per year during operation is 10,000 kilolitres (total per year for the design life of plant).

The associated impacts in the operation phase for the abovementioned activities are described in the following section:

8.4.1 Flooding

In the operation phase, soil compaction and erosion may occur due to vehicle movement during routine maintenance. This activity will lead to an increase in impervious surfaces. This activity, however, will only occur occasionally and has therefore been considered to be infrequent and negligible. The impact significance is expected to be **low.**

8.4.1.1 Mitigation

Protect structures such as the solar PV bases and substation / control building from localised flooding by constructing cut-off berms / diverting flow on the uphill side in flood prone areas.

Should the measures described above be implemented during the operation phase, the impact significance will reduce from **low – very low.**

8.4.2 Contamination of stormwater runoff

Stormwater runoff in the vicinity of the substation / control building and solar PV's could come into contact with dedicated areas where hazardous substances are handled such as fuels and oils which could result in contaminated stormwater runoff being discharged downstream. Furthermore, typical activities during maintenance include washing of solar panels with water that includes chemicals. This water could also potentially contaminate nearby watercourses. This PV module cleaning will be performed when required 2 – 4 times a year and has therefore been considered to be infrequent and negligible.

During the operational phase, it is expected that the magnitude of the impact will be **low** and will require mitigation to reduce the risk.

8.4.2.1 Mitigation

- Prevent stormwater runoff to come in contact with dedicated areas where hazardous substances are handled, by diverting flow with berms and cut-off drains to divert stormwater runoff away from the site and discharge diverted stormwater as per pre-development conditions, and good house-keeping.
- Clean solar panels with water that contains no chemicals.

8.4.3 Erosion during operation

In the operational phase, the potential impacts due to the additional hardened surfaces include erosion of the surrounding environment. Eroded soil particles carried to downstream water resources can also result in the decrease in quality of nearby watercourses, due to sedimentation. The impact significance in the operation phase is expected to be **moderate**.

8.4.3.1 Mitigation

In summary, the following mitigation measures are proposed:

- Design stormwater management facilities to comply with regulation GN 704.
- Stormwater infrastructure installed to mitigate possible hydrological impacts must be regularly maintained throughout the lifespan of the infrastructure to ensure its optimum functionality.
- Apply erosion protection measures such as stonepitching downstream of steep roadside channels.

Should the measures described above be implemented during the operation phase, the impact significance will reduce from **moderate – very low**.

8.5 Closure/decommissioning

The aim of the rehabilitation is to bring back the work site to a stabilised condition, as close as possible to pre-construction conditions and to the satisfaction of the landowner. Once all the construction activities are completed the site will be rehabilitated where possible and practical. All temporal structures and facilities will be removed from site and the area rehabilitated. The rehabilitation of the area would entail the following activities:

- Removal of PV modules
- Removal of associated infrastructure
- Land reform

8.5.1 Contamination of stormwater runoff

Similarly, to the construction phase, the runoff during the rehabilitation (decommissioning/ closure) phase may contain contaminants. In addition, soil compaction to reshape the landform may cause increased runoff which may still contain higher concentrations of contaminants and sediment.

The magnitude is therefore rated as low, with a short-term duration, extending to the site. The probability is low with the resultant impact significance of the runoff during rehabilitation expected to be **low**.

8.5.1.1 Mitigation

All pollution control mechanisms are to be in accordance with GN 704, and all necessary pollution control mechanisms must be protected and repaired or established when stockpiles or residue deposits are reclaimed, removed, or rehabilitated so that water pollution is minimized and abated.

Should the measures described above be implemented then the impact significance should be reduced from **low – very low**.

8.6 Impact Assessment summary

The predicted environmental impacts resulting from the proposed project activities in the scoping phase are listed in Table 8, along with their significance ratings before and after mitigation

Table 8: Impact assessment summary

Project Name	Eskom Komati Solar PV Surface Water Impact Assessment																		
Impact Assessment																			
CONSTRUCTION																			
Impact number	**Aspect**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**	**Rating**	**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**	**Rating**
Impact 1:	Stormwater runoff	Stormwater runoff could, in the case of the temporary construction yards, laydown areas, and offices for the construction workers, potentially come in contact with areas dedicated for the handling of contaminants.	Construction	Negative	Moderate	4	1	3	2	2	**20**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						
Impact 2:	Erosion	Soil stripping, stockpiling, excavations of underground cabling, foundations for the solar PV array mounting structure and construction of stormwater berms may result in loss of soils through erosion, particularly for topsoil stockpiles with unvegetated steep slopes, resulting in increased sedimentation to water resources	Construction	Negative	Moderate	2	2	3	2	4	**36**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
OPERATIONAL																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**	
Impact 1:	Flooding	In the operation phase, soil compaction and erosion may occur due to vehicle movement during routine maintenance. This activity will lead to an increase in impervious surfaces. This activity, however, will only occur occasionally and has therefore been considered to be infrequent and negligible.	Operational	Negative	Moderate	3	1	3	2	2	**18**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						
Impact 2:	Stormwater runoff	Stormwater runoff in the vicinity of the substation / control building and solar PV's could come into contact with dedicated areas where hazardous substances are handled such as fuels and oils which could result in contaminated stormwater runoff being discharged downstream. Furthermore, typical activities during maintenance include washing of solar panels with water that includes chemicals. This water could also potentially contaminate nearby watercourses.	Operational	Negative	Moderate	4	1	3	2	2	**20**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						
Impact 3:	Erosion	In the operational phase, the potential impacts due to the additional hardened surfaces include erosion of the surrounding environment. Eroded soil particles carried to downstream water resources can also result in the decrease in quality of nearby watercourses, due to sedimentation.	Operational	Negative	Moderate	2	2	3	2	4	**36**	**N3**	2	1	1	2	2	**12**	**N1**
					Significance	**N3 - Moderate**							**N1 - Very Low**						
DECOMISSIONING																			
Impact number	**Receptor**	**Description**	**Stage**	**Character**	**Ease of Mitigation**	**Pre-Mitigation**							**Post-Mitigation**						
						(M+	**E+**	**R+**	**D)x**	**P=**	**S**		**(M+**	**E+**	**R+**	**D)x**	**P=**	**S**	
Impact 1:	Stormwater runoff	Similarly, to the construction phase, the runoff during the rehabilitation (decommissioning/ closure) phase may contain contaminants. In addition, soil compaction to reshape the landform may cause increased runoff which may still contain higher concentrations of contaminants and sediment.	Decommissioning	Negative	Moderate	4	1	3	2	2	**20**	**N2**	2	1	1	2	2	**12**	**N1**
					Significance	**N2 - Low**							**N1 - Very Low**						

9.0 PLAN FOR EIA PHASE

An in-depth impact assessment will be conducted during the EIA Phase, which will include an assessment of the potential impacts associated with the proposed development on the features present on site and the mitigation measures to be implemented to adequately protect these features. The impacts to be assessed will include:

- Assessment of water quality changes.
- Assessment of hydrology (stormwater management).
- Assessment of the cumulative impacts of the proposed development.

10.0 CONCLUSION AND RECOMMENDATIONS

Due to the nature of the construction activities, it can be concluded that the majority of the surface water impacts would be of a water quality nature. The potential impacts primarily include erosion and stormwater runoff coming in contact with areas dedicated to collection, containment and treatment of hazardous substances such as fuel storage areas as well as localized flooding. Mitigation measures must be put into place to prevent or reduce the impact on the downstream environment.

Stormwater management is required both during and after the construction of the solar PV to prevent damage to property, degradation of the water quality in nearby water resources and negative impacts to the surrounding environment. The impacts during construction phase are temporary, while impacts during operational phase are permanent and could result in a greater cumulative impact, which will be addressed in the EIA phase. Impacts during both these phases should be controlled at the source, to minimize or prevent the long-term and short-term impacts.

11.0 REFERENCES

South Africa. (1998). General Notice 704 of the National Water Act (36 of 1998). Pretoria: Department of Waterand Forestry.

Smithers , J. C., & Schulze, R. E. (2002). Design Rainfall Estimation Program; Rainfall Statistics for Design Flood Estimation in South Africa . WRC Project K5/1060.

The World Bank: https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf

Signature Page

Golder Associates Africa (Pty) Ltd.

Tebatso Menziwa
Candidate Civil Engineer

Eugeshin Naidoo
Senior Civil Engineer

TAM/EN/ck

Reg. No. 2002/007104/07
Directors: RGM Heath, MQ Mokulubete, MC Mazibuko (Mondli Colbert), GYW Ngoma

\\corp.pbwan.net\za\central_data\projects\41100xxx\41103965 - eskom komati pv esia and wula\41 es\01-reports\09-specialists\41103965-358576-1 komati solar pv and bess\appendices\appendix c.docx

APPENDIX A

Document Limitations

WSP GOLDER

golder.com

Appendix D

HYDROLOGICAL & GEOHYDROLOGICAL BASELINE STUDY BY GHT CONSULTING

GHT CONSULTING SCIENTISTS

Komati Power Station

HYDROLOGICAL & GEOHYDROLOGICAL BASELINE STUDY
DECEMBER 2008

for

Eskom

KOMATI POWER STATION

by

GHT CONSULTING SCIENTISTS

PROJECT TEAM
L.J. van Niekerk
S. Staats

Project no.:	149-14-ghd.537	Start Date:	Dec 2008
Current Phase:	Final V1.2	Start Date:	Dec 2008
Report no.:	RVN 537.5/909	Report Date:	July 2009

GHT CONSULTING SCIENTISTS

Geo-Hydro Technologies OFS (Pty)Ltd. Trading as GHT Consulting • Reg. no. 94/05593/07 • VAT no. 493 017 5890

PO Box 32998 Fichardt Park 9317 • http://www.ghtglobal.com • E-Mail: ghtfs@ghtglobal.com
Tel: +27 (0) 51 444 0002 • Fax: +27 (0) 51 444 0088 • Cell: +27 (0) 82 652 2992 +27 (0) 82 656 6996

24 July 2009 Our ref.: RVN 537.5/909

The Manager
Chemical Services
Komati Power Station
Private Bag
Blinkpan
2250

FOR ATTENTION**: **Me. Venessa Naidoo

Dear Madam

It is our pleasure in enclosing two copies of the report RVN 537.5/909 "KOMATI POWER STATION – Baseline Study Final Report V1.2".

We trust that the report will fulfil the expectations of the Power Station and we will supply any additional information if required.

Yours sincerely,

Louis J van Niekerk (Pr.Sci.Nat.)

Copies: 3 copies to Komati Power Station

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

1.1 Background

GHT Consulting Scientists was commissioned to conduct a complete Baseline Study on the Hydrology and Geohydrology of Komati Power Station which will be re-commissioned in the near future.

The Eskom owned Komati Power Station were constructed on the property Komati Power Station 56 to exploit the extensive bituminous coal deposits that occur south of Witbank/Middelburg, Mpumalanga Province. Power generation facilities of this type can have a significant impact on site hydrology if poorly managed, for reasons including:

- Extensive water use and the installation of cut-off drains reducing groundwater levels;
- Disruption of stream flow due to stream diversion construction;
- Acid Mine Drainage (AMD) from cola stockyards and mined areas;
- Seepage from dams containing poor quality effluent;
- Leachate migration from ash dumps.

All of these issues are of concern at the facility. Coal was initially extracted from Blinkpan Colliery to the west and north-west of the power station. The proximity of these workings to the watercourse Koring Spruit required the construction of a stream diversion around the pits. Following the exhaustion of these reserves, the pits were partly backfilled with spoils and overburden, and partially rehabilitated. Unfortunately, as is the case throughout Mpumalanga, mine drainage impacted on background site water quality.

Waste ash generated during coal burning is also of concern. A wet ash disposal system has been employed at the site since its inception, whereby slurry comprised of an ash/make-up water mix is pumped to a dam site for disposal. However, due to the slurry's chemical characteristics and the sheer size of the structures, ash dams and their associated infrastructure have the potential to be a significant point source for pollution.

In order to assess the potential impact of these features on water quality, a good understanding of site hydrology and geohydrology are essential. The site assessment and all the fieldwork for this investigation was done on the 2nd, and 3rd and 4th of December 2008. A map showing the localities of all the sites is presented in Appendix A.

The purpose of the site assessment is first of all to report on the current state of the monitoring network, and secondly to identify pollution sources as well as the target areas that may be impacted upon by these sources. This in turn will then be used to identify any inadequacies of the current monitoring network.

An assessment was also done and the hydro chemical data contained within the water quality database, the data having been collected by laboratory staff as part of a routine monitoring programme. The current Komati Power Station geohydrological database operates on a HydroBase (HydroSolutions, 1996) platform, with approximately eighteen years of historical data (July 1990 to December 2008) for nine groundwater and two surface water-sampling sites. The data base were scrutinised and all unknown / unclear sites and data were removed. All new information that was gathered during this investigation of the old and new sites was entered into the data base. Due to the state of the data base obtained during previous investigations from Komati Power Station the rectification was very time consuming.

While records of sampling depths, major ion concentrations, laboratory pH and Electrical Conductivity (EC) measurements have been maintained, no historical groundwater water level data was entered into the provided database. Water levels were however measured during December 2008 and are included in this report.

This investigation reports on the Baseline Study as well as on the quality of the surface and groundwater at Eskom Komati Power Station as recorded by GHT during the last sample run done in December 2008. It can thus be considered as a continuation of the monitoring programme as well.

A relevant numbering system for these monitoring reports reflecting both the date and the number of the monitoring event were deducted from the number of sample runs undertaken since 1990. This monitoring phase is consequently numbered as follows: December 2008, Phase 39. The previous monitoring report Phase 38 May 2006 was done in September 2006.

1.2 Approach to study

A detailed project of this nature requires the correct desktop planning in advance before conducting the physical fieldwork. The project was therefore divided into four phases or sections, namely:

- A desktop study which includes gathering of data and information;
- A fieldwork investigation;
- Data processing comprising the compilation of GIS MAPS and the capturing of the field information and chemical analyses into the database;
- Evaluating the data and compiling everything into a report format with conclusions and recommendations.

The following different investigations were done as part of the scope of work of this project.

- A description of the physical geography of the area under investigation;
- Hydrocensus survey of the surrounding farms;
- Site assessment of the Komati Power Station area;
- Geophysical investigations
- Hydraulic testing of monitoring boreholes
- EC profiling of monitoring boreholes
- Groundwater numerical model

2 PHYSICAL GEOGRAPHY

2.1 Extent of investigation

This investigation was approximately centred on the area to the north of the Olifants River, south of the Koring Spruit, and west and east of the Middelburg Bethal road.

Komati Power Station is located within a rural area on a gradual slope on the banks of the Koring Spruit approximately 41 km south of the town Middelburg in the Mpumalanga Province of South Africa. The site itself is well developed, due to the presence of the power stations, abandoned mine pits, the existing colliery shafts, the mine offices, and associated infrastructure comprised of stockyards, delivery plant, hostels, and a small town. Prior to development, however, the site was probably a commercial stock and cropping farm similar to those now present along the boundaries of the respective power stations.

2.2 Topography and Surface Drainage

Topographic maps of the area show a recurring block type drainage pattern that seems particularly well developed to the north of the respective power stations, characterized by stream sections orientated southwest-northeast and northwest-southeast. Drainage of this type is often structurally controlled, and thus may provide some insight into the orientation of regional and convergent stresses.

The investigated area is located in the Olifants River catchment and primary drainage region B. Komati Power Station lies within quaternary sub-catchment B11B and can be sub-divided into secondary drainage regions comprised of smaller streams and creeks. The surface topography of the area is typical of the Mpumalanga Highveld, consisting in the main of a gently undulating plateau. The flood plains of the local streams are at an average elevation of approximately 1595 meters above mean sea level (mamsl). Altitudes vary from ±1650 mamsl at the higher parts south of the ashing facility to ±1595 mamsl which defines the base of the Koring Spruit to the north of the Komati Power Station.

The ash stack area is situated between the contour lines of the 1650 – 1615 mamsl. The ashing area has been developed upon gradual slopes and a semi-developed drainage system. The Komati Spruit which originates in this area drains the area west of the ash pile towards the Koring Spruit.

The Power Plant and Coal Stockyard is situated on a topographic flat ±1605 mamsl with a poor drainage pattern. The southeast-northwest orientated Geluk Spruit is another drainage feature of significance and drains the area east and north towards the Koring Spruit. This stream was diverted to prevent ingress into power plant areas, and remains so due to the location the current Komati Power Station.

Several drains and dams have been constructed around the Ashing area, Power Plant area and Coal Stockyard area. These dams are of importance in terms of preventing water quality degradation and serves as pollution control dams. All polluted surface water runoff is diverted to these reservoirs.

Ultimately, all surface water from this area drains into the Olifants River via the Koring Spruit.

Surface run-off from the area is in the order of 5% of the annual rainfall. Groundwater recharge in undisturbed areas is in the order of 3% of the annual rainfall.

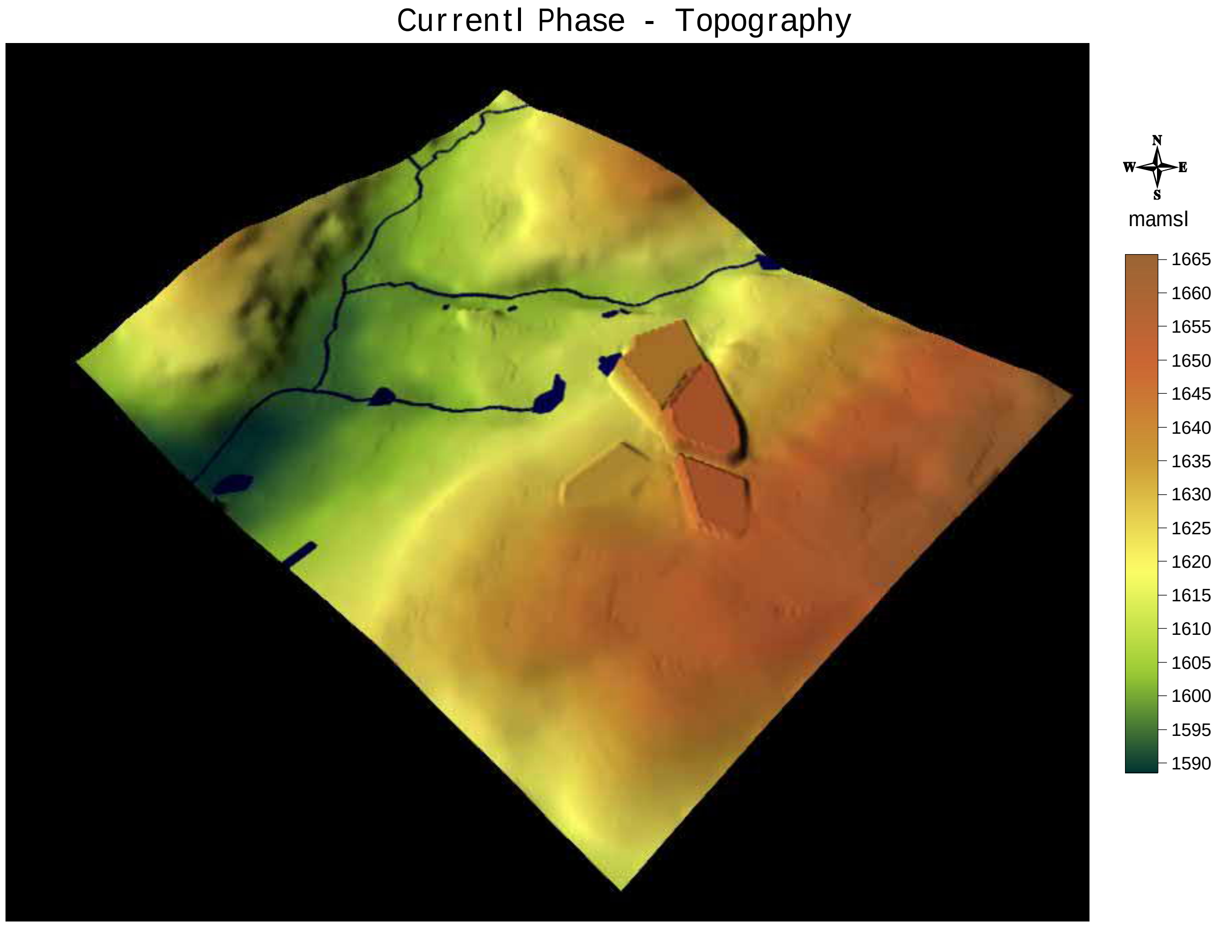


Figure 1. Current Topography of the Komati Power Stations Area.

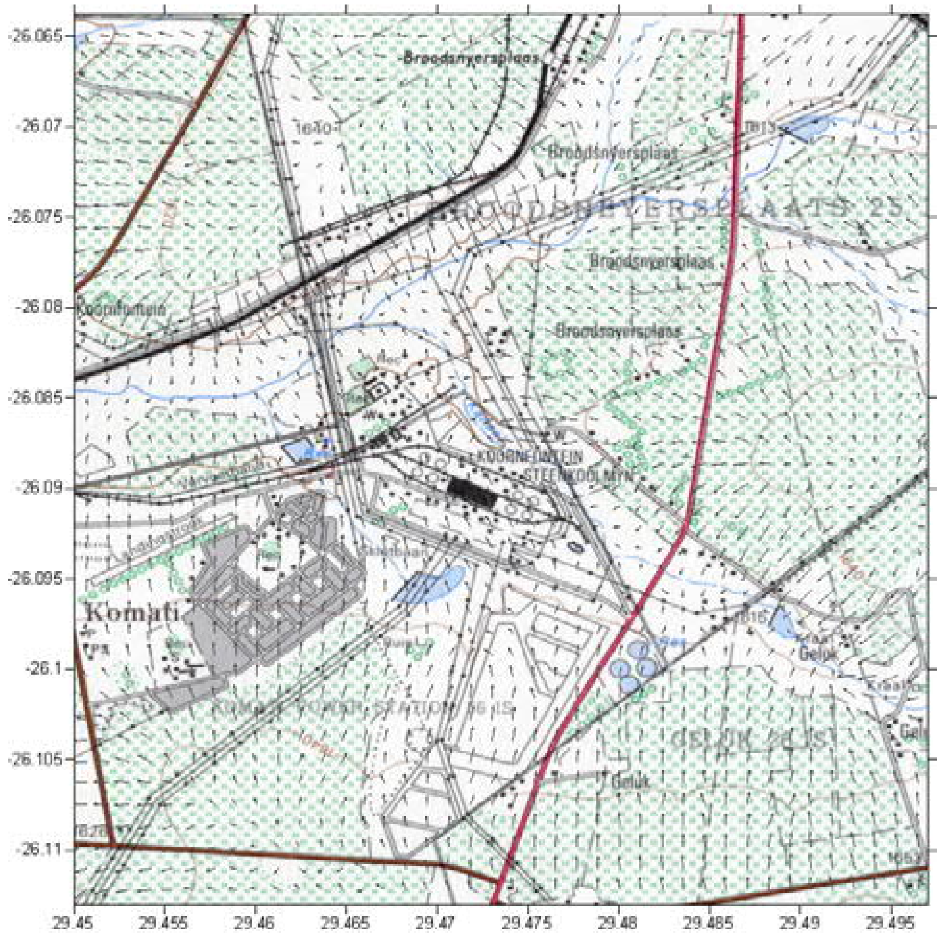


Figure 2. Surface drainage indicating flow directions

2.3 Vegetation

Within the respective power station compounds and surrounds, vegetation is restricted to lawn grasses, small shrubs, and occasional trees, while crops such as maize are grown on adjoining properties. Several pasture species have also been planted with lucerne and other non-native species farmed for commercial purposes.

Reeds are common across the site in areas with a high groundwater table, or where surface water of shallow depth occurs.

2.4 Climate

The project area falls within the highveld climate classification of Viterito (1987), and can thus expect warm, wet summers, and mild, dry winters, with equivalent evaporation depths exceeding precipitation. Regular dust storms can also be expected during periods of prolonged dry weather.

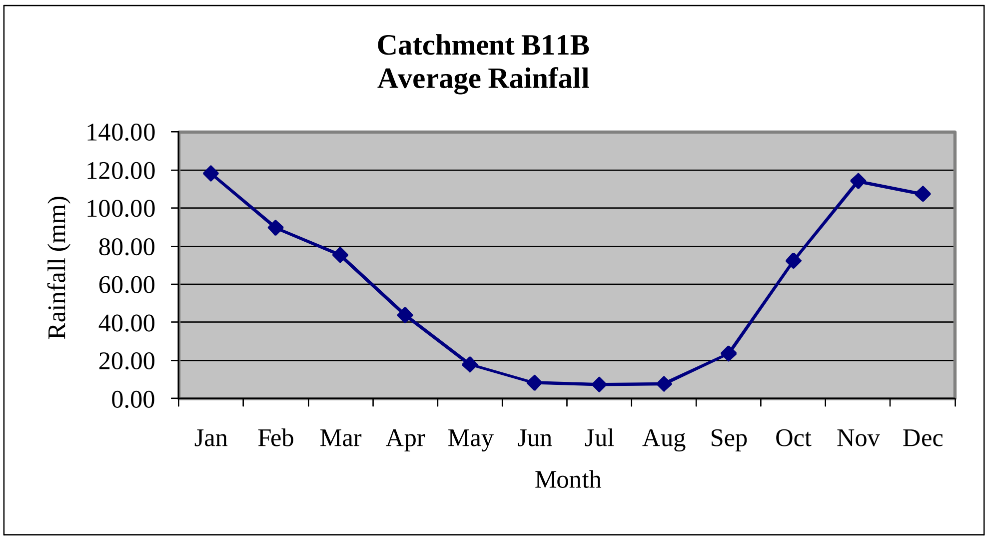
Average daily maximum temperatures vary from 27^{o}C in January to 17^{o}C in July, but in extreme cases these may rise to 38 and 26^{o}C, respectively. In comparison, average daily minima of 13 and 0^{o}C can be expected, with temperatures falling to 1 and –13^{o}C, respectively, on unusually cold days. Frost conditions are also common over the 120-day period from May to September.

Quaternary sub-catchment B11B and Komati Power Station lies within rainfall zone B1A and evaporation zone 4A. To evaluate the local weather conditions, climate data and information from publication Surface Water Resources of South Africa 1990 – WRC Report no. 298/1.1/94 were used.

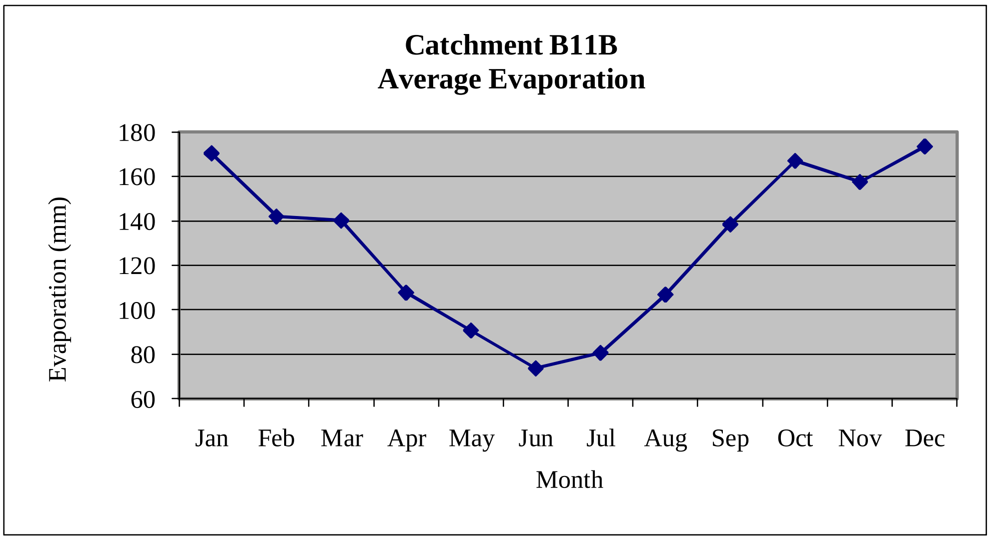
Rainfall is almost exclusively in the form of showers and thunderstorms and falls mainly in the summer months from October to March. The maximum rainfall usually occurs in January. The winter months are usually dry. The mean annual precipitation for Catchment B11B is 687 mm and the mean annual evaporation is 1550 mm. Mean monthly evaporation exceeds the mean monthly precipitation for every month of the year thus a water deficit area.

However water balance analysis undertaken by GHT Consulting at over power station in the area, indicated that while average monthly evaporation exceeds precipitation in all months, consideration of maximum and minimum precipitation values over shorter periods indicated that precipitation surpluses could occur in the months between November and January, and thus recharge through the ash pile could occur.

The average monthly rainfall and evaporation for catchment B11B is summarised and displayed graphically in Figure 3.



Month	Average rainfall Catchment B11B
Jan	118.23
Feb	89.72
Mar	75.43
Apr	43.90
May	18.00
Jun	8.38
Jul	7.49
Aug	7.83
Sep	23.77
Oct	72.41
Nov	114.25
Dec	107.52
MAP	687



Month	Average evaporation Catchment B11B
Jan	170.50
Feb	142.14
Mar	140.28
Apr	107.88
May	90.83
Jun	73.78
Jul	80.76
Aug	106.95
Sep	138.57
Oct	167.09
Nov	157.64
Dec	173.60
MAP	1550

Figure 3. Average rainfall and evaporation for Quaternary sub-catchment B11B

3 SITE ASSESSMENT

The site assessment provides information on the pollution sources and the sufficiency of the monitoring system and the various monitoring sites. This section contains:

- A description of the site assessment to identify contamination sources and impact zones;
- A description of the current state of the water monitoring system and infrastructure at Komati Power Station to identify any problems that may require attention;

3.1 Contaminant Sources and Impact Zones

Various sources of possible contaminants of surface water and groundwater within the four key areas have been identified. These sources were added to the current monitoring system as new sampling and inspection sites in view of the planned re-commissioning of Komati Power Station. Impact zones were also identified through visual inspection, as well as making use of the surface contours, as groundwater generally tends to follow the surface topography. The surface drainage and flow directions are shown in Figure 2.

Four different key areas with possible pollution sources have been identified within the area under investigation, namely:

- The Ashing Area and Domestic Waste Site;
- The Power Station Area;
- The Coal Stockyard Area; and
- The Sewage Plant Area;

These pollution sources impact on groundwater and on three surface drainage regions, namely:

- The groundwater to the north and west of the Ashing area;
- The groundwater to the north and east the of the Power Station Area
- The groundwater to the north, west and east of the Coal Stockyard Area
- A tributary of the Koring Spruit west of the Komati Power Station, henceforth called the Komati Spruit;
- A tributary of the Koring Spruit east of the Komati Power Station, henceforth called the Geluk Spruit.
- The Koring Spruit to the north of the Komati Power Station.

The following tables summarise the sources within each key area, the zone of impact of these sources, current or new monitoring sites and monitoring objective, as well as a description of the monitoring location:

Table 1. Sources of Contaminant and impact zones within the Ashing Area and the Domestic Waste Site.

Group / Area	Source of Possible Env. Hazards	Zone of Possible Impact	No. on map	Site Description	Site Type
Ashing Area & Rehabilitated Domestic Waste Site	Domestic Waste Site	Western Drainage towards Komati Spruit Groundwater migrating north	AB01	Monitoring borehole north and downstream of old rehabilitated domestic waste site.	Borehole
			*AC01	Clean water cut off canal between ash dam and old rehabilitated waste site	Canal
	Ash Dump	Western Drainage towards Komati Spruit Groundwater migrating west and northwest	AB02	Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	Borehole
			AB03	Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	Borehole
			AB04	Monitoring borehole north-west of ash dams and south of dam AP02.	Borehole
			AP01	Pool areas and dams on top of north-western part of ash dams.	Dam
			*AC02	Marshy area south of new ash water return dam AP08	Canal
	Ash Dump & Ash Water Return Dam	Western Drainage towards Komati Spruit Groundwater migrating west	AP08	New ash water return dam.	Dam
			*AP02	Clean water dam where Komati Spruit originates west of ash water return dam.	Dam
			AB05	Monitoring borehole next to Komati Spruit west of power station.	Borehole
	Ash Dump	Northern Drainage towards Geluk Spruit Groundwater migrating north	AB06	Monitoring borehole north and downstream of ash dams.	Borehole
			*AC04	Clean water canal north-eastern corner of ash dam. Sample at culvert underneath sealed road.	Canal
			AC05	Dirty water canal north of ash dam. Sample at culvert underneath sealed road.	Canal
			*AC09	Small canal running parallel with new ash transfer pipes. Sample at culvert underneath sealed road.	Canal
	Ash Dump & Seepage Recovery Dam	Northern Drainage towards Geluk Spruit Groundwater migrating north	AP03	Seepage recovery dam north of ash dam complex & east of power station.	Dam
			AB07	Monitoring borehole north and downstream of seepage recovery dam AP03.	Borehole
	Ash Dump	Groundwater migrating east	AC03	Dirty ash water return canal on eastern side of ash dam.	Canal
			BB21	Hydrocensus Borehole Farm Geluk 26/7	Borehole
			BB22	Hydrocensus Borehole Farm Geluk 26/7	Borehole
			BB23	Hydrocensus Borehole Farm Geluk 26/7	Borehole
	Ash Dump	Groundwater migrating south	BB24	Hydrocensus Borehole Goedehoop 46/3	Borehole
			BB25	Hydrocensus Borehole Goedehoop 46/3	Borehole
			BB27	Hydrocensus Borehole Bultfontein 187/2	Borehole

Table 2. Sources of Contaminant and impact zones within the Coal Stockyard Area.

Group / Area	Source of Possible Env. Hazards	Zone of Possible Impact	No. on map	Site Description	Site Type
Coal Stockyard Area	Coal Stockpile & Coal Settling Dam	Northern Drainage towards Geluk Spruit Groundwater migrating north & northwest	CB09	Monitoring borehole north and downstream of coal stockyard dirty water dam CP06.	Borehole
			CC07	Coal stockyard dirty water run-off canal. Sample at security fence.	Canal
			CP06	Coal stockyard settling pond and dirty water run-off dam.	Dam
			CP07	Old coal stockyard settling and dirty water run-off dam.	Dam

Table 3. Sources of Contaminant and impact zones within the Power Station and Sewage Plant Area.

Group / Area	Source of Possible Env. Hazards	Zone of Possible Impact	No. on map	Site Description	Site Type
Power Station Area	Dirty Water Dams & Oil Skimmers	Northern Drainage towards Geluk Spruit Groundwater migrating north & northwest	PP05	Power station dirty water dams and oil skimmers north of power station.	Dam
			PB08	Monitoring borehole north and downstream of power station dirty water dams PP05.	Borehole
	Run-off from plant area	North-eastern Drainage towards Geluk Spruit	*PC06	North-eastern power station clean water run-off outlet.	Canal
		Western Drainage towards Komati Spruit	*PC08	South-western power station clean water run-off outlet. Sample at culvert underneath sealed road.	Canal
	Raw Water Dam	Artificial recharge to Groundwater	PP04	Raw water dam east of Bethal Middelburg road.	Dam
Sewage Plant Area	Sewage Plant	Northern Drainage towards Komati Spruit Groundwater migrating north	SE01	Purified sewage effluent discharge into natural dam.	Effluent

Table 4. Sources of Contaminant and impact zones within the Geluk-, Komati- and Koring Spruit.

Group / Area	Source of Possible Env. Hazards	Zone of Possible Impact	No. on map	Site Description	Site Type
Geluk Spruit	External Source	Geluk Spruit	*GLR03	Geluk Spruit. Sample at culvert underneath sealed Bethal Middelburg road. Upstream Sample Point	River
	Power Station and Ashing Area	Geluk Spruit	*GLR04	Geluk Spruit. Sample at culvert underneath conveyer. Downstream Sample Point.	River
Komati Spruit	Ash Dump Infrastructure	Komati Spruit	*KMR01	Komati Spruit downstream form dam AP02. Sample at culvert underneath sealed road.	River
	Ash Dump Infrastructure & Township	Komati Spruit	*KMR02	Komati Spruit downstream form dam KMR01. Sample at culvert underneath sealed road.	River
	Ash Dump Infrastructure Township & Sewage Plant	Komati Spruit	*KMR07	Komati Spruit downstream form dam KMR02 and dam receiving purified sewage effluent. Sample at culvert underneath dirt road.	River
Koring Spruit	External Source	Koring Spruit	*KRR05	Koring Spruit upstream of power generation activities. Sample at culvert underneath sealed Bethal Middelburg road.	River
	Power Station and Mining Activities	Koring Spruit	*KRR06	Koring Spruit downstream of KRR05. Sample at culvert underneath sealed road.	River

3.2 Monitoring Survey and Site Assessment

The monitoring sites at Komati Power Station are classified according to their locations relative to the infrastructure and local natural streams. These seven monitoring areas are shown in the location maps of Komati Power Station attached in **Appendix A**. Any major anomalies are noted and recommendations are made to improve the situation with regard to water contamination and environmental impacts at Komati Power Station in order to ensure that the power station adheres to the requirements of the Department of Water Affairs and Forestry (DWA&F) with the intended re-commissioning of the Power Station.

New sites were therefore classified either depending upon the area in which it is located or on the area that it is expected to be impacted upon. A descriptive convention has been adopted for naming the sites, where the first letter is used for the classification of the area of the site and the second letter for classifying the type of site. The first letter is determined as follows:

- **A** for sites from the Ashing Area;
- **P** for sites from the Power Station;
- **C** for sites from the Coal Stockyard Area;
- **S** for sites from the Sewage Plant Area;

- **KM** for sites from the Komati Spruit;
- **GL** for sites from the Geluk Spruit;
- **KR** for sites from the Koring Spruit.

The second letter describes the following:

- **P** for pans and dams;
- **R** for rivers or streams;
- **C** for canals and trenches and
- **E** for effluent and
- **S** for seepage.
- Sites with a * are clean water sites and are supposed not to contain any dirty or contaminated water.

A total of 40 monitoring sites were indentified during Baseline Study and exist currently in and around Komati Power Station. These sites are divided into three different GROUPS and six AREAS. These GROUPS and AREAS are as follows:

- GROUP 1 – 27 Sites: Komati Power Station Monitoring Sites;
  - 17 Sites – Ashing Area
  - 4 Sites – Coal Stockyard Area
  - 6 Sites – Power Station Area
- GROUP 2 – 7 Sites: Natural Water Courses;
  - 2 Sites - Geluk Spruit
  - 3 Sites - Komati Spruit
  - 2 Sites - Koring Spruit
- GROUP 3 – 6 Sites: Private External Users Boreholes;
  - 6 Sites – South and East of Ashing Area.

Descriptions of all the monitoring sites are listed in Table 5 to Table 7. The coordinates of these sites are listed in the tables and can be used to locate all the different sites.

Table 5: GROUP 1 Komati Power Station monitoring sites descriptions.

Group / Area		Number on map	Longitude (°E)	Latitude (°S)	Elevation (mamsl)	Site Description	Site Tipe	Photo No.	Current Condition
GROUP 1 Komati Power Station	Ashing Area	AB01	29.46653	-26.10885	1645	Monitoring borehole north and downstream of old rehabilitated domestic waste site.	Borehole	1	No marker post, lock, pin or cap.
		AB02	29.46809	-26.10053	1626	Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	Borehole	2	No marker post, lock, pin or cap.
		AB03	29.46826	-26.09855	1621	Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	Borehole	3	No marker post, lock, pin or cap. Colapsed to 7.5m
		AB04	29.46831	-26.09615	1613	Monitoring borehole north-west of ash dams and south of dam AP02.	Borehole	4	No marker post, lock, pin or cap.
		AB05	29.46438	-26.08999	1601	Monitoring borehole next to Komati Spruit west of power station.	Borehole	5	No lock, pin or cap. Colapsed to 8.5m
		AB06	29.47715	-26.09551	1615	Monitoring borehole north and downstream of ash dams.	Borehole	6	No marker post. No lock, pin or cap. Borehole is infested with bees.
		AB07	29.47787	-26.09225	1606	Monitoring borehole north and downstream of seepage recovery dam AP03.	Borehole	7	No marker post. No lock, pin or cap. Illegal dumping of building rubble close to AB07.
		*AC01	29.46700	-26.10879	1646	Clean water cut off canal between ash dam and old rehabilitated waste site	Canal	8	Dry. Canal is Overgrown.
		*AC02	29.47291	-26.09678	1615	Marshy area south of new ash water return dam AP08	Canal	9	Flowing slowly. Canal is Overgrown.
		AC03	29.47941	-26.09947	1618	Dirty ash water return canal on eastern side of ash dam.	Canal	10	Flowing slowly. Canal is Overgrown.
		*AC04	29.48020	-26.09685	1615	Clean water canal north-eastern corner of ash dam. Sample at culvert underneath sealed road.	Canal	11	Stagnant. Canal is Overgrown.
		AC05	29.47773	-26.09571	1615	Dirty water canal north of ash dam. Sample at culvert underneath sealed road.	Canal	12	Satisfactory condition. Flowing moderately.
		*AC09	29.47575	-26.09454	1615	Small canal running parallel with new ash transfer pipes. Sample at culvert underneath sealed road.	Canal	13	Satisfactory condition. Flowing slowly.
		AP01	29.47422	-26.09605	1615	Pool areas and dams on top of north-western part of ash dams.	Dam	14	Satisfactory condition.
		*AP02	29.46882	-26.09543	1612	Clean water dam where Komati Spruit originates west of ash water return dam.	Dam	15	Satisfactory condition. Flowing moderately.
		AP03	29.47755	-26.09321	1610	Seepage recovery dam north of ash dam complex & east of power station.	Dam	16	AP03 has recently overflow.
		AP08	29.47353	-26.09493	1615	New ash water return dam.	Dam	17	Satisfactory condition.
	Coal Stockyard Area	CB09	29.47110	-26.08481	1602	Monitoring borehole north and downstream of coal stockyard dirty water dam CP06.	Borehole	18	No marker post, lock, pin or cap.
		CC07	29.47098	-26.08608	1604	Coal stockyard dirty water run-off canal. Sample at security fence.	Canal	19, 20	Canal currently not in a satisfactory condition. Silted up with coal.
		CP06	29.47096	-26.08510	1602	Coal stockyard settling pond and dirty water run-off dam.	Dam	21, 22	Satisfactory condition. Standing water was detected close to CP06
		CP07	29.46977	-26.08558	1603	Old coal stockyard settling and dirty water run-off dam.	Dam	23, 24	Water is seeping from old dams CP07.
	Power Station & Sewage Plant Area	PB08	29.47429	-26.08780	1606	Monitoring borehole north and downstream of power station dirty water dams PP05.	Borehole	25	No marker post, lock, pin or cap. Standing water detected close to CB08.
		*PC06	29.47664	-26.09042	1606	North-eastern power station clean water run-off outlet.	Canal	26	Satisfactory condition. Maintenance work in progress close to PC06.
		*PC08	29.46644	-26.09138	1606	South-western power station clean water run-off outlet. Sample at culvert underneath sealed road.	Canal	27	Satisfactory condition. Flowing slowly.
		SE01	29.46354	-26.08853	1600	Purified sewage effluent discharge into natural dam.	Effluent	28	Satisfactory condition. Flowing moderately.
		PP04	29.48122	-26.09881	1616	Raw water dam east of Bethal Middelburg road.	Dam	29	Satisfactory condition. Seepage visible north of PP04.
		PP05	29.47386	-26.08865	1606	Power station dirty water dams and oil skimmers north of power station.	Dam	30, 31	The oil skimmers are in process of building. Not yet operational.

Photo 1. *AB01*

Photo 2. *AB02*

Photo 3. *AB03*

Photo 4. *AB04*

Photo 5. *AB05*

Photo 6. *AB06*

Photo 7. *AB07*

Photo 8. *AC01*


Photo 9. *AC02*


Photo 10. *AC03.*


Photo 11. *AC04.*


Photo 12. *AC05.*


Photo 13. *AC09.*


Photo 14. *AP01*


Photo 15. *AP02*


Photo 16. *AP03.*

Photo 17. AP08.

Photo 18. CB09

Photo 19. CC07

Photo 20. CC07

Photo 21. CP06

Photo 22. CP06

Photo 23. CP07.

Photo 24. CP07.

Photo 25. PB08.

Photo 26. PC06.

Photo 27. PC08.

Photo 28. SE01.

Photo 29. PP04.

Photo 30. PP05.

Photo 31. PP05.

Table 6: GROUP 2 Natural water courses monitoring sites descriptions.

Group / Area		Number on map	Longitude (°E)	Latitude (°S)	Elevation (mamsl)	Site Description	Site Tipe	Photo No.	Current Condition
GROUP 2 Natural Water Courses	Geluk Spruit	*GLR03	29.48235	-26.09474	1610	Geluk Spruit. Sample at culvert underneath sealed Bethal Middelburg road.	River	32	Flowing slowly. Stream diversion damaged impeding flow.
		*GLR04	29.47170	-26.08500	1603	Geluk Spruit. Sample at culvert underneath conveyer.	River	33	Flowing slowly. Stream diversion damaged impeding flow.
	Komati Spruit	*KMR01	29.46568	-26.09230	1605	Komati Spruit downstream form dam AP02. Sample at culvert underneath sealed road.	River	34	Satisfactory condition. Flowing slowly.
		*KMR02	29.46368	-26.08950	1600	Komati Spruit downstream form dam KMR01. Sample at culvert underneath sealed road.	River	35	Satisfactory condition. Flowing slowly.
		*KMR07	29.46159	-26.08743	1597	Komati Spruit downstream KMR02 & dam receiving purified sewage. Sample culvert underneath road.	River	~	Satisfactory condition. Flowing moderately.
	Koring Spruit	*KRR05	29.48671	-26.07354	1610	Koring Spruit upstream power generation activities. Sample culvert underneath Bethal Middelburg road.	River	36, 37	Satisfactory condition. Flowing moderately.
		*KRR06	29.44499	-26.08252	1582	Koring Spruit downstream of KRR05. Sample at culvert underneath sealed road.	River	38, 39	Satisfactory condition. Flowing moderately.

Photo 32. GLR03.

Photo 33. GLR04.

Photo 34. KMR01.

Photo 35. KMR02.

Photo 36. KRR05.

Photo 37. KRR05.


Photo 38. KRR06.


Photo 39. KRR06.

Table 7: GROUP 3 Private external users boreholes monitoring sites descriptions.

Group / Area		Number on map	Longitude (°E)	Latitude (°S)	Elevation (mamsl)	Site Description	Site Tipe	Photo No.	Current Condition
GROUP 3 Private External Users Boreholes	South and East of Ashing Area	BB21	29.47954	-26.10598	1636	Hydrocensus Borehole Farm Geluk 26/7	Borehole	40	No Equipment
		BB22	29.47907	-26.10586	1635	Hydrocensus Borehole Farm Geluk 26/7	Borehole	41	Good working condition
		BB23	29.47905	-26.10632	1636	Hydrocensus Borehole Farm Geluk 26/7	Borehole	42	Broken
		BB24	29.47125	-26.11574	1655	Hydrocensus Borehole Goedehoop 46/3	Borehole	43	Good working condition
		BB25	29.47127	-26.11574	1655	Hydrocensus Borehole Goedehoop 46/3	Borehole	44	Good working condition
		BB27	29.47912	-26.11710	1660	Hydrocensus Borehole Bultfontein 187/2	Borehole	45	Good working condition


Photo 40. BB21.


Photo 41. BB22.


Photo 42. BB23.


Photo 43. BB24.

Photo 44. BB25.

Photo 45. BB27.

3.3 Hydrocensus Survey and Assessment

This investigates the surface- and groundwater use and possible impacts from power generation activities as well as the general state of equipment installed at these sites. Sites were visited and the following data were recorded at each site: Refer to Table 8 for a summary of the data stipulated below.

- Site coordinates;
- A photograph of the site;
- Casing heights and diameters;
- Type of equipment;
- Diameter of the equipment delivery pipe;
- State of installed equipment (working condition or not);
- Water usage (agricultural, domestic, etc.);
- Measuring of a water level;
- Collecting a sample for chemical analyses;
- Farm detail;
- Farmer / owner detail.

The collected data was entered into a Hydrobase Database with an assigned “Site ID” as well as a designated “Number on Map” for future reference.

3.3.1 Hydrocensus Sites Information

There are at least thirty seven external users boreholes that exist around Komati Power Station on the neighbouring farms as well as nine monitoring boreholes at Komati Power Station (refer to maps in Appendix A). The thirty seven external users boreholes were numbered from BB10 to BB46. The depths of these boreholes varied between 66 m to 11 m with an average depth of 35 m. Six of these boreholes are incorporated into the monitoring system due to its close proximity to the ashing area.

The groundwater monitoring network at Komati Power Station comprises of a total of nine monitoring boreholes installed around the Power Station Area, the Ashing area and the Coal Stockyard Area. The monitoring boreholes have no pizometers installed, but the boreholes are sampled at specific depths. There are seven boreholes installed at the Ashing Area, one in the Coal Stockyard Area and one at the Power Station Area (Refer to maps in Appendix A).

Twenty five (25) surface water monitoring sites which include 7 river sites, 8 dam sites, 9 canals sites and 1 effluent site exist in the vicinity of Komati Power Station of which twenty one (21) sites are sampled as part of the monitoring system. (Refer to maps in Appendix A).

3.3.2 Equipment

The general condition of installed equipment that was encountered during the investigation was found to be good.

A variety of equipment is installed in various boreholes that were inspected. A total of five boreholes are equipped with windmill but none are in a working condition. Three sites were recorded having hand pumps installed. A few sites (four) have mono pumps installed with all four of these pumps in use and in working condition. Submersible pumps were found at sixteen sites with fourteen of the pumps in a working condition.

A total of six boreholes were recorded without any equipment installed.

3.3.3 Groundwater use

Twenty four boreholes are in use with equipment in a working condition. Nineteen of these boreholes are being used for domestic purposes only. A total of seven boreholes are being used for both agricultural stock watering and domestic purposes.

3.3.4 Water levels

Limited access to boreholes because of installed equipment resulted in water levels that were measured at only nineteen boreholes during the hydrocensus. Two boreholes were dry. There is only one set of data available for the water levels of the monitoring boreholes at the Power Station. Groundwater contours with groundwater elevations in meters above mean sea level (mamsl) can be seen in Figure 14.

3.3.5 Sampling sites

Groundwater samples were collected from thirty-six boreholes for analyses. Historical chemical analyses are available for the nine monitoring boreholes of Komati Power Station.

There are twenty one surface water sites that must be sampled as part of the surface water monitoring network of Komati Power Station. Three sites were dry during the time of sampling. Historical analyses are available for some of these sites.

Table 8. Surface and Groundwater sites – Hydrocensus information.

Number on map	Longitude (°E)	Latitude (°S)	Elevation (mamsl)	Site Description	Farm Name	Farmer/ Owner	Site Tipe	Borehole Depth (m)	Casing Hieght (m)	Casing Diameter (mm)	Equipment	Use (Agricultural, Domestic)	Pipe Diameter (mm)	WL Below Colar (mbcl)	Current Condition
AB01	29.46653	-26.10885	1645	Monitoring borehole north and downstream of old rehabilitated domestic waste site.	Komati Power Station 56	Eskom Komati PS	Borehole	35.5	0.340	165	None	Monitoring	~	1.71	No marker post, lock, pin or cap.
AB02	29.46809	-26.10053	1626	Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	Komati Power Station 56	Eskom Komati PS	Borehole	32.5	0.810	165	None	Monitoring	~	2.56	No marker post, lock, pin or cap.
AB03	29.46826	-26.09855	1621	Monitoring borehole downstream and north of small ash dam as well as west of large ash dams.	Komati Power Station 56	Eskom Komati PS	Borehole	7.5	0.340	165	None	Monitoring	~	1.93	No marker post, lock, pin or cap. Colapsed to 7.5m
AB04	29.46831	-26.09615	1613	Monitoring borehole north-west of ash dams and south of dam AP02.	Komati Power Station 56	Eskom Komati PS	Borehole	38.0	0.280	165	None	Monitoring	~	1.54	No marker post, lock, pin or cap.
AB05	29.46438	-26.08999	1601	Monitoring borehole next to Komati Spruit west of power station.	Komati Power Station 56	Eskom Komati PS	Borehole	8.5	0.370	165	None	Monitoring	~	1.05	No lock, pin or cap. Colapsed to 8.5m
AB06	29.47715	-26.09551	1615	Monitoring borehole north and downstream of ash dams.	Komati Power Station 56	Eskom Komati PS	Borehole	37.0	0.300	165	None	Monitoring	~	1.30	No marker post. No lock, pin or cap. Borehole is infested with bees.
AB07	29.47787	-26.09225	1606	Monitoring borehole north and downstream of seepage recovery dam AP03.	Komati Power Station 56	Eskom Komati PS	Borehole	37.0	0.280	165	None	Monitoring	~	2.96	No marker post. No lock, pin or cap. Illegal dumping of building rubble close to AB07.
*AC01	29.46700	-26.10879	1646	Clean water cut off canal between ash dam and old rehabilitated waste site	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Livestock		Dry	Dry. Canal is Overgrown.
*AC02	29.47291	-26.09678	1615	Marshy area south of new ash water return dam AP08	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Livestock		Low	Flowing slowly. Canal is Overgrown.
AC03	29.47941	-26.09947	1618	Dirty ash water return canal on eastern side of ash dam.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Pollution Control		Low	Flowing slowly. Canal is Overgrown.
*AC04	29.48020	-26.09685	1615	Clean water canal north-eastern comer of ash dam. Sample at culvert underneath sealed road.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Livestock		Low	Stagnant. Canal is Overgrown.
AC05	29.47773	-26.09571	1615	Dirty water canal north of ash dam. Sample at culvert underneath sealed road.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Pollution Control		Low	Satisfactory condition. Flowing moderately. Standing water east of AC05, downstream of ash dam.
*AC09	29.47575	-26.09454	1615	Small canal running parallel with new ash transfer pipes. Sample at culvert underneath sealed road.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing slowly.
AP01	29.47422	-26.09605	1615	Pool areas and dams on top of north-western part of ash dams.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		Mod Full	Satisfactory condition.
*AP02	29.46882	-26.09543	1612	Clean water dam where Komati Spruit originates west of ash water return dam.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Livestock		Mod Full	Satisfactory condition. Flowing moderately.
AP03	29.47755	-26.09321	1610	Seepage recovery dam north of ash dam complex & east of power station.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		Very High	AP03 has recently overflow.
AP08	29.47353	-26.09493	1615	New ash water return dam.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		Mod Full	Satisfactory condition.
CB09	29.47110	-26.08481	1602	Monitoring borehole north and downstream of coal stockyard dirty water dam CP06.	Komati Power Station 56	Eskom Komati PS	Borehole	36.5	0.950	165	None	Monitoring	~	1.59	No marker post, lock, pin or cap.
CC07	29.47098	-26.08608	1604	Coal stockyard dirty water run-off canal. Sample at security fence.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Pollution Control		Dry	Canal currently not in a satisfactory condition. Silted up with coal.
CP06	29.47096	-26.08510	1602	Coal stockyard settling pond and dirty water run-off dam.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		High	Satisfactory condition. Standing water was detected close to CP06
CP07	29.46977	-26.08558	1603	Old coal stockyard settling and dirty water run-off dam.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		High	Water is seeping from old dams CP07.
*GLR03	29.48235	-26.09474	1610	Geluk Spruit. Sample at culvert underneath sealed Bethal Middelburg road.	Broodsnyersplaas 25/11	Public Stream	River	~	~	~	~	Monitoring, Livestock		Mod Full	Flowing slowly. Stream diversion damaged impeding flow.
*GLR04	29.47170	-26.08500	1603	Geluk Spruit. Sample at culvert underneath conveyer.	Komati Power Station 56	Public Stream	River	~	~	~	~	Monitoring, Livestock		Low	Flowing slowly. Stream diversion damaged impeding flow.
*KMR01	29.46568	-26.09230	1605	Komati Spruit downstream form dam AP02. Sample at culvert underneath sealed road.	Komati Power Station 56	Public Stream	River	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing slowly.
*KMR02	29.46368	-26.08950	1600	Komati Spruit downstream form dam KMR01. Sample at culvert underneath sealed road.	Komati Power Station 56	Public Stream	River	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing slowly.
*KMR07	29.46159	-26.08743	1597	Komati Spruit downstream form dam KMR02 and dam receiving purified sewage effluent. Sample at culvert underneath dirt road.	Komati Power Station 56	Public Stream	River	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing moderately.
*KRR05	29.48671	-26.07354	1610	Koring Spruit upstream of power generation activities. Sample at culvert underneath sealed Bethal Middelburg road.	Broodsnyersplaas 25/3	Public Stream	River	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing moderately.
*KRR06	29.44499	-26.08252	1582	Koring Spruit downstream of KRR05. Sample at culvert underneath sealed road.	Koornfontein 27/4	Public Stream	River	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing moderately.
PB08	29.47429	-26.08780	1606	Monitoring borehole north and downstream of power station dirty water dams PP05.	Komati Power Station 56	Eskom Komati PS	Borehole	35.5	0.200	165	None	Monitoring	~	3.62	No marker post, lock, pin or cap. Standing water detected close to CB08.
*PC06	29.47664	-26.09042	1606	North-eastern power station clean water run-off outlet.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Livestock		Dry	Satisfactory condition. Maintenance work in progress close to PC06.
*PC08	29.46644	-26.09138	1606	South-western power station clean water run-off outlet. Sample at culvert underneath sealed road.	Komati Power Station 56	Eskom Komati PS	Canal	~	~	~	~	Monitoring, Livestock		Low	Satisfactory condition. Flowing slowly.
SE01	29.46354	-26.08853	1600	Purified sewage effluent discharge into natural dam.	Komati Power Station 56	Eskom Komati PS	Effluent	~	~	~	~	Monitoring, Pollution Control		Mod Full	Satisfactory condition. Flowing moderately.
PP04	29.48122	-26.09881	1616	Raw water dam east of Bethal Middelburg road.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		Mod Full	Satisfactory condition. Seepage visible north of PP04.
PP05	29.47386	-26.08865	1606	Power station dirty water dams and oil skimmers north of power station.	Komati Power Station 56	Eskom Komati PS	Dam	~	~	~	~	Monitoring, Pollution Control		Low	The oil skimmers are in process of building. Not yet operational.

Number on map	Longitude (°E)	Latitude (°S)	Elevation (mamsl)	Site Description	Farm Name	Farmer/ Owner	Site Tipe	Borehole Depth (m)	Casing Hieght (m)	Casing Diameter (mm)	Equipment	Use (Agricultural, Domestic)	Pipe Diameter (mm)	WL Below Colar (mbcl)	Current Condition
BB10	29.42091	-26.04868	1611	Hydrocensus Borehole	Welverdiend 23/2	Engelbreght	Borehole	~	0.200	165	Submersible	Domestic Drink	30	~	Good working condition
BB11	29.45898	-26.06239	1614	Hydrocensus Borehole	Welverdiend 23/10	G.F. Grobler	Borehole	~	0.520	165	Hand pump	Domestic Drink	~	~	Good working condition
BB12	29.46227	-26.06161	1621	Hydrocensus Borehole	Welverdiend 23/10	G.F. Grobler	Borehole	~	0.300	165	Submersible	Domestic Drink	40	~	Broken
BB13	29.44845	-26.06403	1604	Hydrocensus Borehole	Koornfontein 27/6	G.F. Grobler	Borehole	27.2	0.280	120	Submersible	Domestic Drink	40	16.20	Good working condition
BB14	29.48485	-26.05469	1643	Hydrocensus Borehole	Broodsnyersplaas 25/10	Siyavuma Vervoer	Borehole	~	0.000	165	Submersible	Domestic Drink	60	11.80	Good working condition
BB15	29.49044	-26.05852	1629	Hydrocensus Borehole	Broodsnyersplaas 25/28	H De Beer	Borehole	~	0.350	165	Submersible	Domestic Drink	50	~	Good working condition
BB16	29.50683	-26.07076	1642	Hydrocensus Borehole	Broodsnyersplaas 25/1	P Storm	Borehole	~	0.320	165	Hand pump	Domestic Drink	~	~	Good working condition
BB17	29.49821	-26.07593	1639	Hydrocensus Borehole	Broodsnyersplaas 25/5	P Storm	Borehole	66.0	0.000	165	Submersible	Domestic Drink	60	24.00	Good working condition
BB18	29.49867	-26.07736	1642	Hydrocensus Borehole	Broodsnyersplaas 25/5	P Storm	Borehole	85.0	0.000	165	None	~	~	Dry	Dry hole
BB19	29.49741	-26.07693	1639	Hydrocensus Borehole	Broodsnyersplaas 25/5	P Storm	Borehole	~	0.100	165	Hand pump	Domestic Drink	~	~	Good working condition
BB20	29.48213	-26.08393	1622	Hydrocensus Borehole	Broodsnyersplaas 25/3	D Lee	Borehole	26.1	0.100	165	Submersible	Domestic Drink	50	14.10	Good working condition
BB21	29.47954	-26.10598	1636	Hydrocensus Borehole	Geluk 26/7	MCL Dippenaar	Borehole	26.8	0.200	150	None	~	~	2.20	No Equipment
BB22	29.47907	-26.10586	1635	Hydrocensus Borehole	Geluk 26/7	MCL Dippenaar	Borehole	~	0.000	165	Submersible	Domestic Drink	50	~	Good working condition
BB23	29.47905	-26.10632	1636	Hydrocensus Borehole	Geluk 26/7	MCL Dippenaar	Borehole	11.0	0.230	165	Submersible	Domestic Drink	40	4.50	Broken
BB24	29.47125	-26.11574	1655	Hydrocensus Borehole	Goedehoop 46/3	F Schoeman	Borehole	~	0.300	165	Submersible	Domestic Drink	50	15.00	Good working condition
BB25	29.47127	-26.11574	1655	Hydrocensus Borehole	Goedehoop 46/3	F Schoeman	Borehole	26.5	0.300	165	Submersible	Domestic Drink, Livestock	50	20.50	Good working condition
BB26	29.47783	-26.11699	1659	Hydrocensus Borehole	Bultfontein 187/2	K Van Rensburg	Borehole	6.1	0.100	100	None	~	~	Dry	Dry hole
BB27	29.47912	-26.11710	1660	Hydrocensus Borehole	Bultfontein 187/2	K Van Rensburg	Borehole	42.0	0.440	150	Submersible	Domestic Drink, Livestock	50	32.00	Good working condition
BB28	29.50721	-26.11221	1666	Hydrocensus Borehole	Bultfontein 187/11	Van Niekerk	Borehole	~	0.680	165	Mono pump	Domestic Drink	50	~	Good working condition
BB29	29.49529	-26.12859	1629	Hydrocensus Borehole	Bultfontein 187/12	Von Wielligh	Borehole	52.0	0.520	165	Submersible	Domestic Drink, Livestock	50	13.00	Good working condition
BB30	29.50947	-26.13509	1615	Hydrocensus Borehole	Bultfontein 187/6	E Erasmus	Borehole	40.0	0.480	165	None	~	~	8.50	No Equipment
BB31	29.50961	-26.13511	1615	Hydrocensus Borehole	Bultfontein 187/6	E Erasmus	Borehole	~	0.120	165	Mono pump	Domestic Drink	40	~	Good working condition
BB32	29.53378	-26.14317	1651	Hydrocensus Borehole	Hartebeestkuil 185/2	D Van Woutenberg	Borehole	~	0.370	150	None	~	50	5.00	No Equipment
BB33	29.53470	-26.14244	1651	Hydrocensus Borehole	Hartebeestkuil 185/2	D Van Woutenberg	Borehole	8.0	0.360	165	None	~	~	2.00	No Equipment
BB34	29.53840	-26.14023	1646	Hydrocensus Borehole	Hartebeestkuil 185/2	D Van Woutenberg	Borehole	~	0.100	165	Mono pump	Domestic Drink, Livestock	50	~	Good working condition
BB35	29.49518	-26.15330	1604	Hydrocensus Borehole	Wilmansrust 47/3	C.J. Van der Merwe	Borehole	15.0	0.180	150	Submersible	Domestic Drink, Livestock	50	3.00	Works only in dry season
BB36	29.49503	-26.16079	1626	Hydrocensus Borehole	Wilmansrust 47/3	C.J. Van der Merwe	Borehole	32.0	0.170	150	Submersible	Domestic Drink, Livestock	50	18.00	Good working condition
BB37	29.51189	-26.17976	1611	Hydrocensus Borehole	Dunbar 189/2	Proefplaas	Borehole	12.0	0.150	150	Submersible	Domestic Drink	50	3.50	Good working condition
BB38	29.48366	-26.17902	1629	Hydrocensus Borehole	Middelkraal 50/1	BJ Grobler	Borehole	~	0.450	150	Windmill	~	50	~	Not in use for a long time
BB39	29.48336	-26.17877	1629	Hydrocensus Borehole	Middelkraal 50/1	BJ Grobler	Borehole	~	0.300	165	Mono pump	Livestock	50	~	Good working condition
BB40	29.48339	-26.17864	1628	Hydrocensus Borehole	Middelkraal 50/1	BJ Grobler	Borehole	~	0.280	150	Submersible	Domestic Drink, Livestock	40	3.00	Good working condition
BB41	29.47363	-26.16277	1584	Hydrocensus Borehole	Leeufontein 48/3	BJ Grobler	Borehole	~	0.450	165	Windmill	~	40	~	Not in use for a long time
BB42	29.47537	-26.16495	1588	Hydrocensus Borehole	Leeufontein 48/16	BJ Grobler	Borehole	~	0.000	150	Windmill	~	40	~	Not in use for a long time
BB43	29.42195	-26.12209	1619	Hydrocensus Borehole	Goedehoop 46/7	J Harmse	Borehole	15.0	0.300	165	Submersible	Domestic Drink	40	8.00	Good working condition
BB44	29.42193	-26.12198	1619	Hydrocensus Borehole	Goedehoop 46/7	J Harmse	Borehole	55.0	0.100	165	Submersible	Domestic Drink, Livestock	30	5.00	Good working condition
BB45	29.41625	-26.11591	1602	Hydrocensus Borehole	Goedehoop 46/7	J Harmse	Borehole	~	0.300	165	Windmill	~	~	~	Not in use for a long time
BB46	29.42719	-26.11853	1620	Hydrocensus Borehole	Goedehoop 46/7	J Harmse	Borehole	~	0.600	165	Windmill	~	40	~	Not in use for a long time

Number on map	Photo No.	Date	Time	Sample	Sample Depth (m)	pH	EC mS/m	TDS mg/L	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO4 mg/L	C03 mg/L	HCO3 mg/L	F mg/L	NO2-N mg/L	NO3-N mg/L	PO4 mg/L	Fe mg/L	Mn mg/L	B mg/L	Cr mg/L	Anion meq/l	Cation meq/l	Ionbal %
AB01	1	2008-12-03	12:09	Yes	15	7.07	348	2774	362	242	236	30.46	299	1188	1.00	833.00	0.00	0.00	0.00	0.00	4.5800	0.3770	0.0300	0.0076	46.84	48.03	1.25
AB02	2	2008-12-03	14:20	Yes	20	7.11	251	2396	90	281	211	44.94	45	1545	0.00	358.00	0.00	0.00	0.00	0.00	1.6000	1.7650	0.0200	0.0017	39.31	36.49	-3.73
AB03	3	2008-12-03	12:16	Yes	6	6.57	74	435	43	85	25	7.33	41	203	0.00	147.00	0.19	0.00	0.00	0.00	0.5100	0.0051	0.0100	0.0002	7.80	8.38	3.55
AB04	4	2008-12-03	11:00	Yes	19	7.27	235	2092	112	285	165	21.14	66	1237	1.00	404.00	0.00	0.00	4.68	0.00	0.0120	0.0034	0.0500	0.0011	34.59	33.23	-2.00
AB05	5	2008-12-02	14:30	Yes	8.5	7.20	257	1893	374	121	76	7.17	234	879	1.00	398.00	0.00	0.00	2.35	0.00	1.3500	0.0450	0.0300	0.0014	31.62	28.75	-4.75
AB06	6	2008-11-19	13:25	No	~																						
AB07	7	2008-12-03	09:30	Yes	15	6.92	227	1974	145	178	178	10.32	59	1308	0.00	192.00	0.00	0.00	0.00	0.00	1.1200	4.0530	0.0300	0.0004	32.05	30.24	-2.91
*AC01	8	2008-12-03	14:00	No	Surface																						
*AC02	9	2008-12-03	10:45	Yes	Surface	3.14	233	1894	143	306	35	25.14	66	1218	0.00	54.00	0.79	0.00	0.00	0.00	4.2300	3.4850	0.5900	0.0002	27.28	25.11	-4.15
AC03	10	2008-12-03	14:10	Yes	Surface	6.80	83	459	83	48	24	11.86	51	148	0.00	247.00	0.48	0.00	0.00	0.00	0.5600	0.1966	0.1400	0.0001	8.59	8.29	0.75
*AC04	11	2008-12-03	14:26	Yes	Surface	7.39	137	974	87	133	48	10.76	42	418	1.00	346.00	0.79	0.00	0.00	0.00	0.0200	0.0270	0.0900	0.0008	15.62	14.70	-3.02
AC05	12	2008-12-03	14:24	Yes	Surface	7.27	107	719	99	88	22	16.35	49	357	0.00	147.00	0.40	0.00	2.68	0.00	0.0200	0.0026	0.2600	0.0000	11.46	10.95	-2.26
*AC09	13	2008-12-03	14:18	No	Surface																						
AP01	14	2008-12-03	10:32	No	Surface																						
*AP02	15	2008-12-03	11:20	Yes	Surface	7.27	131	965	122	104	27	15.50	40	423	0.00	245.00	0.87	0.00	1.34	0.00	0.0100	0.0001	0.2400	0.0004	14.08	13.13	-3.48
AP03	16	2008-12-03	10:00	Yes	Surface	7.12	114	750	100	86	27	16.58	42	332	0.00	172.00	0.62	0.00	0.00	0.00	0.0200	0.0282	0.2400	0.0010	10.95	11.26	1.38
AP08	17	2008-12-03	10:52	No	Surface																						
CB09	18	2008-12-03	07:40	Yes	31	7.47	69	392	28	64	20	3.48	15	132	0.00	257.00	0.90	0.00	0.47	0.00	12.800	21.260	0.0700	14.740	7.48	6.87	-4.27
CC07	19, 20	2008-12-02	13:00	No	Surface																						
CP06	21, 22	2008-12-03	07:35	Yes	Surface	7.54	66	388	66	42	23	5.89	16	161	0.00	172.00	0.50	0.00	3.80	0.00	0.0020	0.0036	0.1400	0.0008	6.91	6.99	0.60
CP07	23, 24	2008-12-03	07:05	No	Surface																						
*GLR03	32	2008-12-03	10:20	Yes	Surface	7.51	40	193	25	42	12	2.82	13	40	0.00	179.00	0.31	0.00	0.00	0.00	0.2260	0.1365	0.1100	0.0885	4.16	4.17	0.20
*GLR04	33	2008-12-03	07:35	Yes	Surface	7.11	118	771	50	118	46	4.97	18	220	0.00	464.00	0.00	0.00	0.00	0.00	0.0250	0.0274	0.1600	0.0027	12.72	11.96	-3.06
*KMR01	34	2008-12-03	14:11	Yes	Surface	7.15	151	1156	143	132	40	23.24	35	606	0.00	248.00	0.86	0.00	0.00	0.00	0.0056	0.1455	0.4200	0.0966	17.73	16.67	-3.09
*KMR02	35	2008-12-03	14:00	Yes	Surface	7.53	79	485	71	70	18	9.26	30	214	0.00	163.00	0.48	0.00	0.00	0.00	0.0250	0.0239	0.2100	0.0051	8.01	8.33	1.95
*KMR07	~	2008-12-02	12:57	No	Surface																						
*KRR05	36, 37	2008-12-04	09:41	Yes	Surface	7.42	54	272	35	33	29	3.83	27	41	0.00	202.00	0.47	0.00	15.80	0.00	0.0100	0.0004	0.0800	0.0006	6.10	5.66	-3.76
*KRR06	38, 39	2008-12-04	10:22	Yes	Surface	7.38	86	558	68	63	25	6.06	21	254	0.00	174.00	0.60	0.00	3.54	2.24	0.0100	0.0024	0.1400	0.0011	9.03	8.29	-4.24
PB08	25	2008-12-03	08:35	Yes	13	6.65	107	662	122	43	47	3.57	68	261	0.00	275.00	0.87	0.00	0.00	0.00	4.5600	0.2012	0.0400	0.0008	11.92	11.39	-2.27
*PC06	26	2008-12-02	12:40	No	Surface																						
*PC08	27	2008-12-02	14:11	Yes	Surface	6.99	92	574	35	99	39	3.39	29	243	0.00	249.00	0.44	0.00	0.00	0.00	0.0000	0.0000	0.0300	0.0007	10.01	9.79	0.12
SE01	28	2008-12-02	12:50	Yes	Surface	6.57	61	305	57	41	19	7.39	47	63	0.00	179.00	0.19	30.35	0.77	1.52	0.2600	0.0197	0.1500	0.0001	5.64	6.22	4.89
PP04	29	2008-12-02	11:10	No	Surface																						
PP05	30, 31	2008-12-02	12:51	No	Surface																						

Number on map	Photo No.	Date	Time	Sample	Sample Depth (m)	pH	EC mS/m	TDS mg/L	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO4 mg/L	C03 mg/L	HCO3 mg/L	F mg/L	NO2-N mg/L	NO3-N mg/L	PO4 mg/L	Fe mg/L	Mn mg/L	B mg/L	Cr mg/L	Anion meq/l	Cation meq/l	Ionbal %
BB10	46	2008-12-04	14:41	Yes	Tap	7.78	52	229	29	43	20	4.65	21	8	1.00	254.00	0.40	0.00	3.84	0.00	0.0000	0.0000	0.0700	0.0000	5.26	5.14	0.09
BB11	47	2008-12-04	13:31	Yes	Pumped	7.40	75	403	63	59	18	7.62	91	86	0.00	215.00	0.42	0.00	0.00	0.00	0.0200	0.0634	0.0600	0.0000	7.91	7.40	-3.33
BB12	48	2008-12-04	13:46	Yes	Tap	7.90	70	382	44	71	19	3.75	32	61	1.00	280.00	0.56	0.00	0.00	0.00	0.0300	0.0000	0.0500	0.0000	6.82	7.10	1.97
BB13	49	2008-12-04	13:00	Yes	Tap	7.71	51	255	42	41	12	3.34	20	10	1.00	277.00	0.58	0.00	0.00	0.00	0.0000	0.0000	0.0700	0.0001	5.36	4.95	-3.96
BB14	50	2008-12-04	12:00	Yes	Tap	7.82	109	621	41	84	56	3.65	114	103	1.00	253.00	0.00	0.00	21.67	0.00	0.0000	0.0000	0.0500	0.0016	11.10	10.64	-2.10
BB15	51	2008-12-04	11:00	Yes	Dam	7.73	98	576	45	77	48	2.71	52	81	1.00	322.00	0.00	0.00	27.48	0.00	0.0200	0.0000	0.0500	0.0009	10.41	9.84	-2.85
BB16	52	2008-12-03	18:00	Yes	Pumped	7.32	67	353	33	63	27	2.84	82	14	0.00	181.00	0.00	0.94	20.68	0.00	0.5610	1.9110	0.0500	1.3070	7.05	6.91	0.01
BB17	53	2008-12-03	17:00	Yes	Tap	7.79	51	256	25	42	16	3.69	12	7	1.00	263.00	0.37	0.00	0.69	0.00	0.1500	0.1870	0.0700	0.1324	4.88	4.59	-3.14
BB18	54	2008-12-03	17:36	No	~																						
BB19	55	2008-12-03	17:45	Yes	Pumped	7.44	39	156	30	24	10	2.48	9	1	0.00	128.00	0.20	0.00	14.67	0.00	0.1200	0.1994	0.0500	0.0043	3.43	3.40	-0.54
BB20	56	2008-12-04	16:00	Yes	Tap	7.93	53	216	27	45	14	4.98	15	9	1.00	234.00	0.00	0.00	1.39	0.00	0.1500	0.0000	0.0600	0.0001	4.59	4.75	1.73
BB21	57	2008-12-04	08:30	Yes	15	7.39	35	174	20	29	10	3.41	10	5	0.00	126.00	0.22	0.00	11.14	0.00	0.0200	0.0000	0.0500	0.0000	3.26	3.20	-0.95
BB22	58	2008-12-04	08:45	Yes	Tap	7.76	48	226	27	41	14	4.19	13	22	1.00	202.00	0.24	0.00	8.29	0.00	0.0050	0.0053	0.0600	0.0002	4.75	4.47	-3.03
BB23	59	2008-12-04	09:55	No	~																						
BB24	60	2008-12-02	14:40	Yes	Tap	7.58	59	301	26	50	20	15.40	26	7	1.00	256.00	0.53	0.00	14.94	0.00	0.0050	0.0039	0.0800	0.0007	6.20	5.66	-4.53
BB25	61	2008-12-02	15:00	Yes	Krip/Dam	7.42	54	277	45	31	13	12.19	20	8	0.00	255.00	0.35	0.00	0.83	0.00	0.0200	0.0000	0.0900	0.0006	5.01	4.85	0.66
BB26	62	2008-12-03	08:00	No	~																						
BB27	63	2008-12-03	08:15	Yes	Tap	7.18	43	172	23	32	13	9.72	14	2	0.00	198.00	0.35	0.18	0.59	2.17	0.0000	0.0000	0.0700	0.0002	3.76	3.88	1.53
BB28	64	2008-12-04	15:30	Yes	Tap	7.62	43	215	20	33	22	4.19	14	1	0.00	125.00	0.22	0.00	28.23	0.00	0.0000	0.0000	0.0500	0.0003	4.51	4.49	-0.27
BB29	65	2008-12-03	16:00	Yes	Tap	7.60	42	168	24	34	13	3.21	16	11	0.00	174.00	0.25	0.00	0.16	0.00	0.0000	0.0000	0.0600	0.0005	3.57	3.86	3.80
BB30	66	2008-12-03	14:30	Yes	16	7.44	80	399	75	62	23	3.46	112	11	1.00	302.00	0.55	0.00	0.51	0.00	0.0000	0.0000	0.0900	0.0007	8.42	8.37	-0.33
BB31	67	2008-12-03	14:40	Yes	Tap	7.85	55	275	34	46	20	3.17	28	19	1.00	288.00	0.27	0.00	0.00	0.00	0.2900	0.1721	0.0700	0.1193	5.96	5.50	-4.08
BB32	68	2008-12-03	13:00	Yes	12	6.54	57	353	29	33	29	8.21	24	50	0.00	164.00	0.00	0.00	20.89	0.00	0.0100	0.0130	0.0500	0.0000	5.90	5.48	-3.74
BB33	69	2008-12-03	13:15	Yes	6	6.66	56	315	39	33	29	9.99	23	74	0.00	126.00	0.00	0.00	21.70	0.00	0.0100	0.0190	0.0500	0.0000	5.80	6.00	1.77
BB34	70	2008-12-03	13:45	Yes	Dam	7.28	34	158	27	26	6	4.00	7	8	0.00	148.00	0.30	0.00	6.53	0.00	0.0000	0.0000	0.0600	0.0007	3.28	3.12	-2.62
BB35	71	2008-12-03	11:00	Yes	Tap	7.54	87	516	48	63	23	7.23	34	19	0.00	159.00	0.00	0.00	61.82	0.00	0.0200	0.0000	0.0600	0.0000	8.38	7.34	-6.59
BB36	72	2008-12-03	10:30	Yes	Dam	7.46	80	449	48	62	21	7.20	129	20	0.00	140.00	0.00	3.06	19.18	0.00	0.0000	0.0000	0.0600	0.0000	7.72	7.10	-4.21
BB37	73	2008-12-03	12:00	Yes	Tap	7.92	50	207	24	51	12	2.24	10	20	1.00	213.00	0.70	0.00	1.32	0.00	0.0000	0.0000	0.0600	0.0000	4.37	4.64	2.97
BB38	74	2008-12-03	09:30	No	~																						
BB39	75	2008-12-03	09:45	Yes	Dam	8.36	32	163	19	27	11	2.33	9	4	2.00	160.00	0.21	0.00	0.00	0.00	0.0000	0.0000	0.0600	0.0000	3.03	3.20	2.62
BB40	76	2008-12-03	09:50	Yes	Tap	7.37	35	189	18	18	15	3.34	6	4	0.00	141.00	0.25	0.00	6.15	0.00	0.0000	0.0000	0.0600	0.0027	3.02	3.02	0.07
BB41	77	2008-12-03	09:00	No	~																						
BB42	78	2008-12-03	09:10	No	~																						
BB43	79	2008-12-02	13:00	Yes	Dam	6.82	12	56	8	5	3	3.52	4	4	0.00	50.00	0.18	0.00	0.00	1.90	0.0000	0.0000	0.0700	0.0000	1.01	0.93	-3.97
BB44	80	2008-12-02	13:10	Yes	5.1	6.39	22	94	17	11	13	4.13	20	1	0.00	104.00	0.14	0.00	0.00	0.00	0.0050	0.0061	0.0700	0.0006	2.31	2.44	2.89
BB45	81	2008-12-02	13:20	No	~																						
BB46	82	2008-12-02	13:40	No	~																						

Quality of Domestic Water Supplies, DWA&F, Second Edition 1998

Class 0	- **Ideal water quality** - Suitable for lifetime use.
Class 1	- **Good water quality** - Suitable for use, rare instances of negative effects.
Class 2	- **Marginal water quality** - Conditionally acceptable. Negative effects may occur in some sensitive groups
Class 3	- **Poor water quality** - Unsuitable for use without treatment. Chronic effects may occur.
Class 4	- **Dangerous water quality** - Totally unsuitable for use. Acute effects may occur.

South Africa Water Quality Guidelines, Volume 1: Domestic Use, DWA&F, First Edition 1993 & Second Edition 1996

NR	- **Target water quality range** - No risk.
IR	- **Good water quality** - Insignificant risk. Suitable for use, rare instances of negative effects.
LR	- **Marginal water quality** - Allowable low risk. Negative effects may occur in some sensitive groups
HR	- **Poor water quality** - Unsuitable for use without treatment. Chronic effects may occur.


Photo 46. BB10


Photo 47. BB11


Photo 48. BB12


Photo 49. BB13


Photo 50. BB14


Photo 51. BB15

Photo 52. *BB16*

Photo 53. *BB17*

Photo 54. *BB18*

Photo 55. *BB19*

Photo 56. *BB20*

Photo 57. *BB21*

Photo 58. *BB22*

Photo 59. *BB23*


Photo 60. BB24


Photo 61. BB25


Photo 62. BB26


Photo 63. BB27


Photo 64. BB28


Photo 65. BB29


Photo 66. BB30


Photo 67. BB31

Photo 68. BB32

Photo 69. BB33

Photo 70. BB34

Photo 71. BB35

Photo 72. BB36

Photo 73. BB37

Photo 74. BB38

Photo 75. BB39

Photo 76. *BB40*

Photo 77. *BB41*

Photo 78. *BB42*

Photo 79. *BB43*

Photo 80. *BB44*

Photo 81. *BB45*

Photo 82. *BB46*

3.4 Summary of the Site Assessment

A total of 40 monitoring sites were indentified during Baseline Study and exist currently in and around Komati Power Station. These sites are divided into seven areas and can be seen in the locality map, Appendix A. The exact positions for extra groundwater monitoring are not known and were thus not added to these tables or to the locality map.

3.4.1 The Ashing Area and the Domestic Waste Site

- The main contamination sources of this area are the ash dam, the Domestic Waste Site, the ash return water dam, the ash return water canals around the ash dam as well as the pipelines transferring ash and ash water to and from the ash dam.
- These sources impact on groundwater as well as on the Komati and Geluk Spruit.
- Various sampling and inspection points have been identified to monitor surface water impacts from the Ashing Area on both the Komati and Geluk Spruit.
- Inadequate groundwater monitoring has been identified at the eastern and north-western sides of the ash dam.

3.4.2 The Coal Stockyard Area

- The sources of contamination of this area include the coal storage yard and the coal stockyard pollution control dam as well as the settling ponds.
- Various sampling and inspection points have been identified to monitor surface water impacts form the Coal Stockyard Area on the Geluk Spruit.
- Inadequate groundwater monitoring has been identified at the eastern and northern sides of the coal stockyard area.

3.4.3 The Power Station and the Coal Stockyard Area

- The sources of contamination of this area include the fuel depot, the oil skimmers, station drain dams and storage yard, the Power Station run-off outlets and the contractor’s area.
- Various sampling and inspection points have been identified to monitor surface water impacts form the Power Station Area on the Komati and Geluk Spruit, as well as at the raw water reservoir for monitoring artificial recharge to the groundwater.
- There is no groundwater monitoring system in place at the fuel depot. Monitoring of hydrocarbon pollution of groundwater from the oil skimmers and power station drain dams is inadequate.
- Inadequate groundwater monitoring has been identified at the eastern and northern sides of the power station area.

3.4.4 The Sewage Plant Area

- This area can impact on the groundwater as well as on the Komati Spruit.
- A monitoring point has been identified at the final effluent point for surface water quality, overflows, discharge volumes and bacteriological sampling.
- Inadequate groundwater monitoring has been identified downstream of the sewage plant.

3.4.5 The Komati Spruit

- This Spruit can be impacted upon by areas of the Power Station, the Ashing Area and the Sewage Plant.
- New sampling points of the spruit have been identified where it originates at **AP02**, along the spruit at **KMR01** as well as where it leaves Eskom property at **KMR07** in order to establish and quantify the influence of the Power Station and Ashing Area on this spruit.

3.4.6 The Geluk Spruit

- This Spruit can be impacted upon by both the Power Station Area, Coal Stockyard Area and the Ashing Area.
- A new sampling point of the spruit has been identified where it enters Eskom property at **GLR03.** This can be used together with **GLR04** in order to establish and quantify the influence of the Power Station on this spruit.

4 PROPERTIES OF THE ASH DAM, GEOLOGY & GEOHYDROLOGY

4.1 Ash Dam

The Power Stations Operations will produce in excess 50 thousand tons of ash per month. From a 3 : 1 water to solids ratio, it is evident that large volumes of water are released onto the ash dams every month. Figures obtained from Eskom are that 70 - 80% of the water dumped onto the tailings will reach the return water dam. The remaining water will either be absorbed by the tailings, reach the ground-water table by infiltration or be evaporated mainly from the pool area.

According to Stanley (1987), fly ash may be described as a rock floor, comprising 0 - 5% fine sand and 0 - 10% clay fraction, with some 80% of the material falling within the silt classification.

According to van Niekerk (1991) up to a depth of ± 2.0 m, there is vertical movement of moisture, after which the moisture has to move horizontally, either to the centre of a ashing facility or to its side, where it can evaporate, explaining the precipitation of sulphates on the ashing facility surface. It furthermore means that there is no vertical flow past the depth of 2.0 m, hence limiting the influx of oxygen for oxidation of heavy minerals. This also correlates well with the work done on residue dump leaching procedures by James and Mrost (1971). The above-mentioned has the implication that water movement below a depth of 2 m is essentially in the horizontal direction, towards the sides of the ash dam (where it evaporates) or towards the saturated central part (pool area) of the ash dam (where it is intercepted by the drainage system).

It should, however, be stressed that the above-mentioned water movement only applies to parts of the ash dam above the phreatic surface, i.e. the unsaturated part of the slimes dam. If the saturated part of the slimes dam (i.e. the part beneath the phreatic surface) is considered, the situation changes significantly. In this region, there always exists a downward flux, due to the hydraulic gradient between the saturated part of the ash dam and the surrounding ground-water regime, as well as the chemical gradient between the two regimes.

Furthermore, van Niekerk (1991) noted that the stratification of finer and coarser layers in a ash dam is enhanced by their water content. Generally fines tend to retain a larger portion of the available moisture than coarser materials.

The above results were used by van Niekerk (1991) to calculate a possible flux of water through the ash dam. According to van Niekerk (1991) this is difficult to achieve, as the soil moisture characteristics of an ash dam can change significantly towards the centre (pool area) of the ash dam. Two locations were therefore used:

(i) Along the side of the ash dam (wall area), representing the measured data.

(ii) In the centre of the ash dam (pool area), representing a totally saturated area.

An average saturated hydraulic conductivity (K_s) valve of 1 x 10^{-7} m/s was obtained by means of laboratory experiments, as well as Cambell’s formula. This value also compared favourably with values obtained from Steffen, Robertson and Kirsten (1990), as well as values published by James and Mrost (1965) and Mrost and Lloyd (1971). An estimated flux (q) of 1.7 x 10^{-11} m/s was obtained for the wall area (unsaturated area), while a value of 1 x 10^{-7} m/s was obtained for the pool area.

From the above discussions, it is evident that large quantities of contaminated water, depending on the size of the ash dam can seep into the underlying sediments to eventually reach the ground-water table. The amount of water, as well as the rate of infiltration, will furthermore depend on the under-drainage of the ash dam and the hydraulic properties of the underlying sediments respectively.

4.2 Geology

4.2.1 Regional Geology

The site forms part of the Highveld Coalfield and falls within the Carboniferous to early Jurassic aged Karoo Basin, a geological feature that covers much of South Africa. In the Komati area, shales typically define lower and upper levels of the series, with coal measures and associated detrital sediments present between (Truswell, 1977). Two sedimentary units are of interest in this area; the Dwyka Formation, and the Vryheid Formation. The Dwyka Formation is essentially comprised of a succession of glacial deposits characterized by angular to rounded clasts of basement within a silt and clay matrix that were emplaced from the Late Permian, although varved shales, sandstone, and conglomerates typical of a fluvio-glacial environment also occur (Botha et al., 1998). The formation unconformably overlies an undulating basement surface defined by lithologies associated with the Bushveldt Complex in the area.

The younger Vryheid formation is comprised of a succession of sandstones and minor interbeds of siltstone and mudstone to a thickness of ±180 m. Typically, five seams, numbered 1 (youngest) to 5 (oldest) are represented across the Highveld Coalfield, although Seam 1 is often absent. Seam 4, a flat lying to gently undulating unit with a thickness of about 5 m and regional dip of less than 1^o to the southwest, is the seam mostly mined in the area, and typically occurs at a depth of about 30 m in open cut areas. While the entire thickness of the seam is extracted during surface mining, underground operations only exploit the lower two thirds of the unit. The layout of mine operations and subsequent extraction of the coal is influenced by the presence of dolerite sills that tend to displace the coal measures, thereby compartmentalizing the reserves.

The term fracture refers to cracks, fissures, joints and faults, which are caused by geological and environmental processes, such as tectonic activity, secondary stresses, release fractures, shrinkage cracks, weathering, and chemical and thermal influences. Fracturing can also be a function of petrological factors such as mineral composition, internal pressure, and grain size.

From a geohydrological viewpoint, a fractured rock mass can be considered a multi-porous medium, consisting of a matrix intercepted by preferential pathways (i.e. fractures). Fractures can be regarded as conduits of higher hydraulic conductivity within permeable or permeable matrix blocks, most of the storage usually contained within the matrix. It should be appreciated, however, that a rock mass can contain fractures of different scale, and indeed in many cases the hydraulic conductivity of the matrix blocks can be attributed to the presence of micro-fractures. A rock mass comprising only large fractures and some matrix blocks with no micro- fractures can be termed purely fractured rocks. In this case, the domain takes the form of an interconnected network of fractures, and the rock matrix, consisting of fracture-surrounded blocks, is impervious to flow. Where the domain is a porous medium intersected by a network of interconnected fractures, the rock is termed a fractured porous rock, the domain characterized by at least two subsystems, each having a different degree of heterogeneity that is often referred to as the scale effect.

4.2.2 Geophysical Investigations

The geophysical survey was conducted at the western, southern and eastern boundary of the ashing facility. The purpose of the geophysical investigations was to detect and delineate geological features that may be associated with preferential pathways for groundwater migration and contaminant transport. Intrusive magmatic bodies are often associated with baked zones that are usually highly fractured and weathered. Such zones could form preferential pathways along which rapid groundwater flow and contaminant transport can take place. The magnetic method was used during the geophysical survey since this method is often very successful in detecting intrusive magmatic bodies such as dolerite/diabase sills or dykes.

Magnetic data were recorded on 9 traverses. The location of the traverses is as follow:

- Three traverses were recorded west of the Ashing Area.
- One traverses were recorded south of the Ashing Area and
- Five traverses east of the Ashing Area, (Refer to the locality maps in **Appendix A**).

The lengths of the traverses ranged from a few metres to 720 m and the total length of all the traverses was approximately 3.5 km. Data on the traverses were recorded using station spacing of 10 metres, depending on the variability of the data and the detail required. The magnetic profiles are presented in Figure 4 to Figure 12.

The above data could be employed to determine optimal siting positions of boreholes, if necessary. These boreholes could be used as production boreholes to intercept groundwater influx or for grouting of preferred pathways, as well as for monitoring boreholes for future development. These boreholes must be upstream and downstream from the areas under investigations and must be used to conduct permeability tests for the calculation of the hydraulic conductivity of the saturated geological formations. The drilling of additional boreholes is, however, not part of this investigation.

4.2.2.1 Geophysical Survey West of the Ash Dam

Data were recorded on three traverses on the western boundary of the Ash Dam. All three of the traverses have an approximate south/north strike (Traverses 1, 2 and 3).

The anomalies recorded on Traverse 1 and 2 generally had low amplitudes (40 nT) and were observed at only single stations. Most of these anomalies might be due to the presence of metal objects such as poles, pipes and fences. No magnetic anomalies of any significance were recorded on these two traverses.

An anomaly was recorded on Traverse 3 indicating the possible presence of a dolerite sill with a dip in a northwest southeast direction.

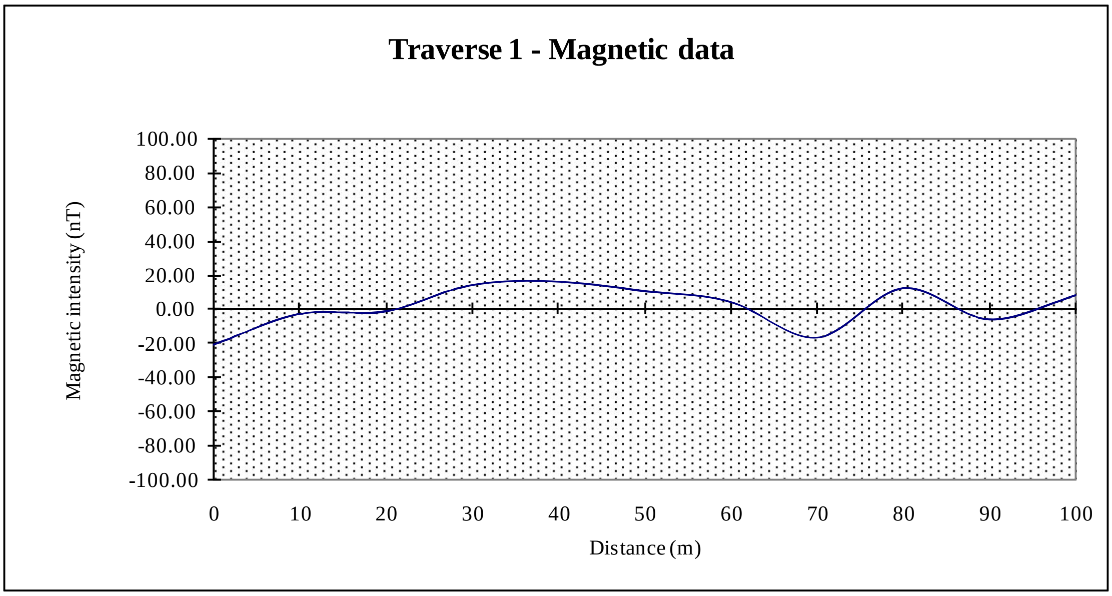


Figure 4. S-N magnetic profile of Traverse 1.

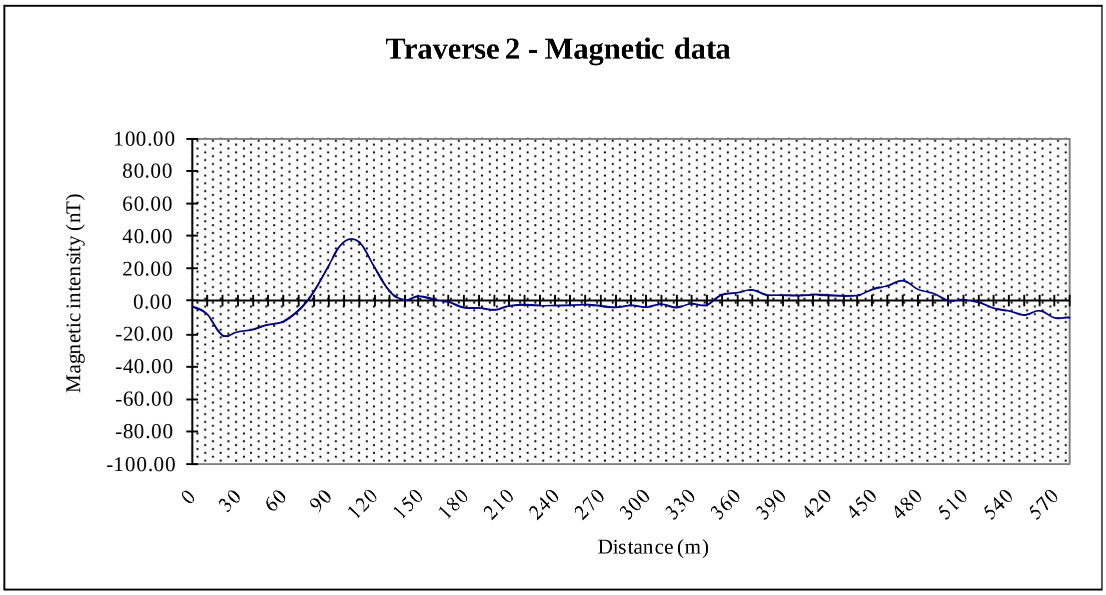


Figure 5. S-N magnetic profile of Traverse 2.

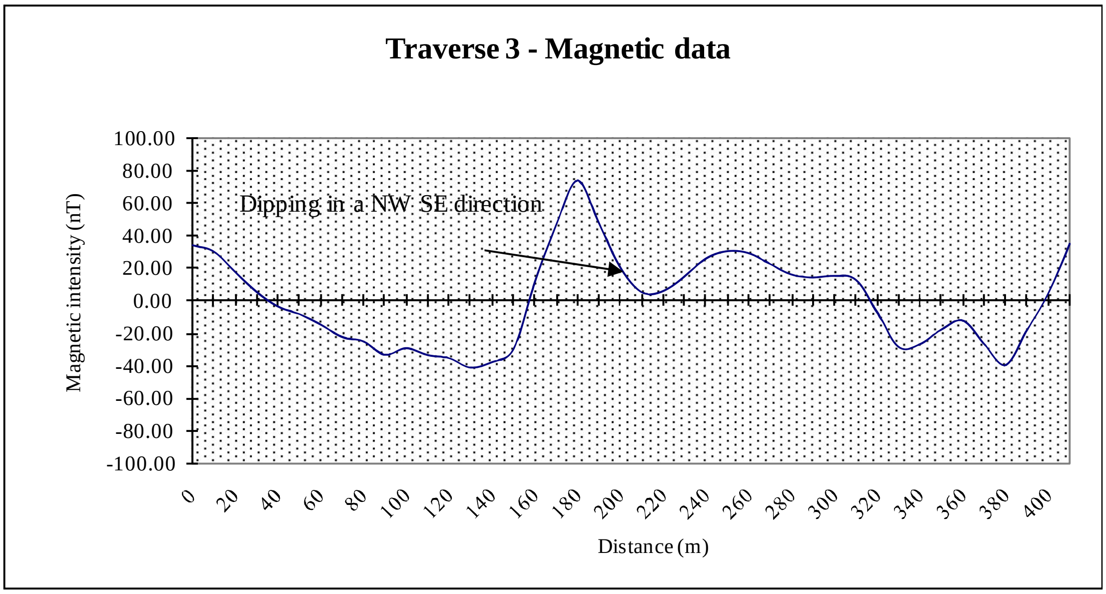


Figure 6. SW-NE magnetic profile of Traverse 3.

4.2.2.2 Geophysical Survey South of the Ash Dam

Data was recorded on one traverses south of the Ash Dam with an approximate west/east strike (Traverses 4). No magnetic anomalies of any significance were recorded on traverse 4.

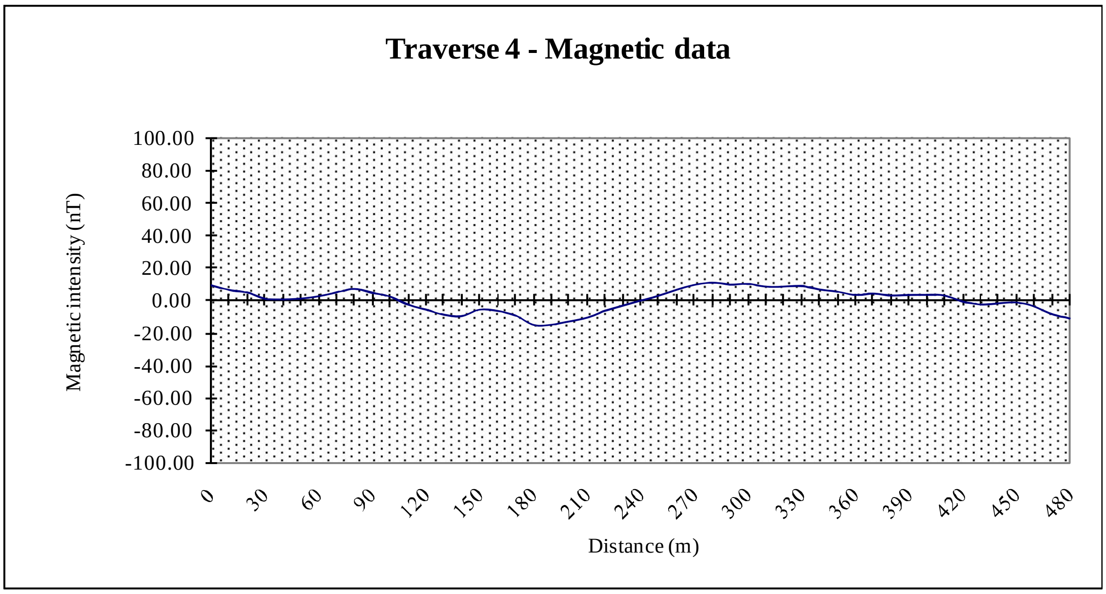


Figure 7. W-E magnetic profile of Traverse 4.

4.2.2.3 Geophysical Survey East of the Ash Dam

Data were recorded on five traverses east of the Ash Dam. Four traverses with an approximate southwest/northeast strike (Traverse 5, 6, 7 and 8) and one with a southeast/northwest strike (Traverse 9).

Anomalies were recorded on two of the traverses namely, Traverses 5 and 9. These anomalies are due to the presence of power lines. No magnetic anomalies of any significance were recorded on the other traverses on the eastern side of the Ash Dam.

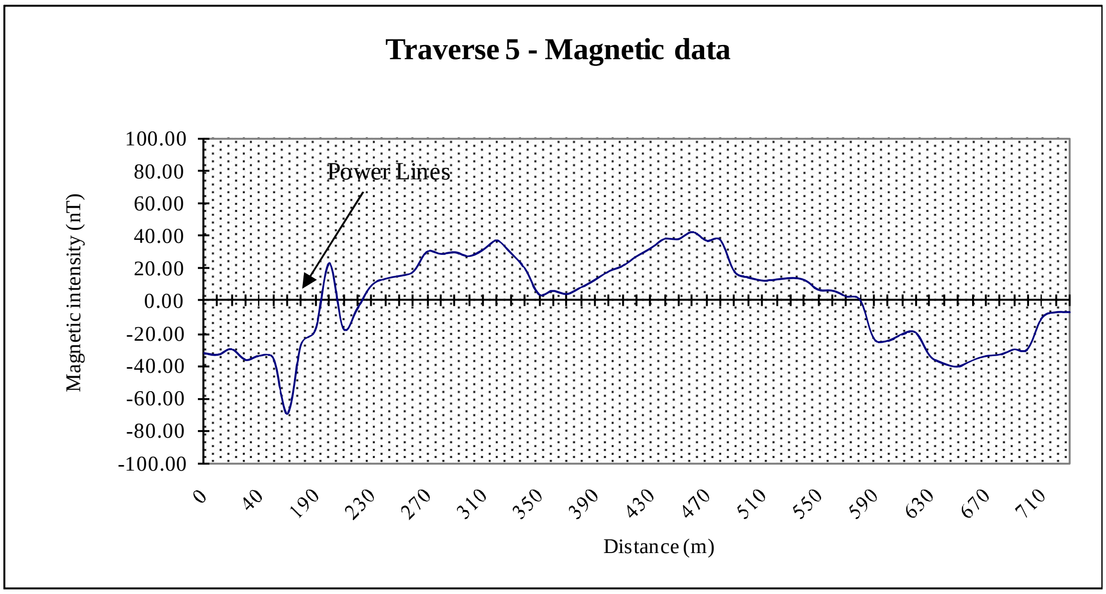


Figure 8. SW-NE magnetic profile of Traverse 5.

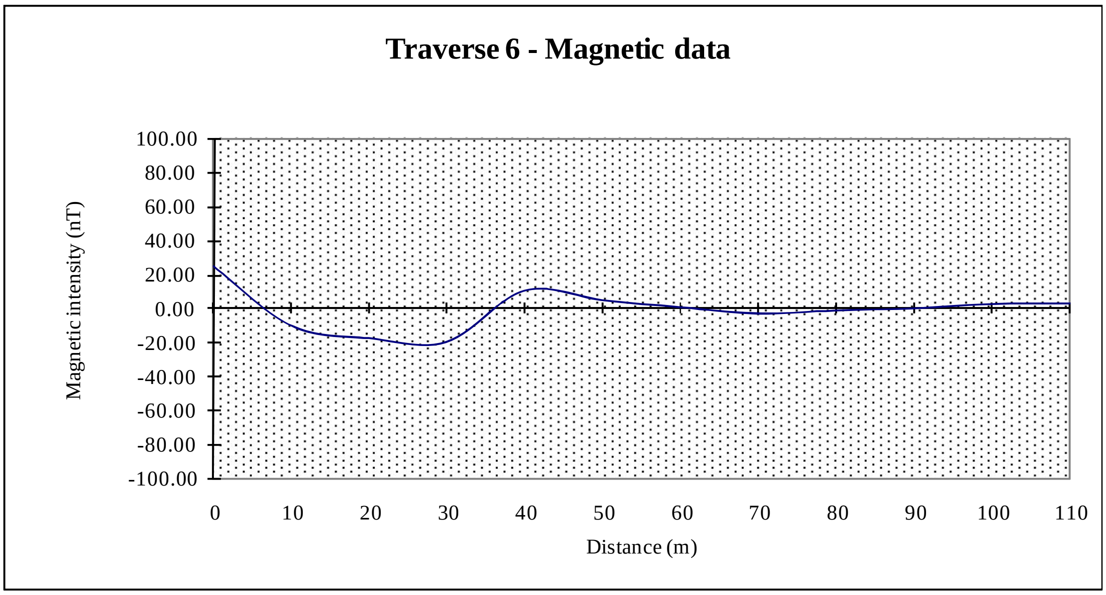


Figure 9. *SW-NE magnetic profile of Traverse 6.*

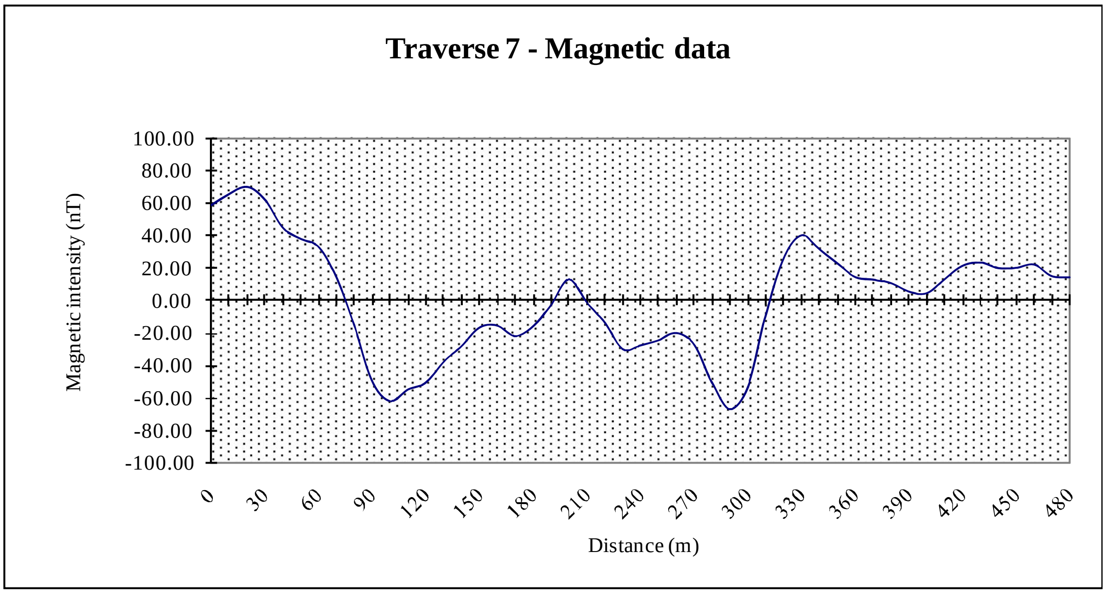


Figure 10. *SW-NE magnetic profile of Traverse 7.*

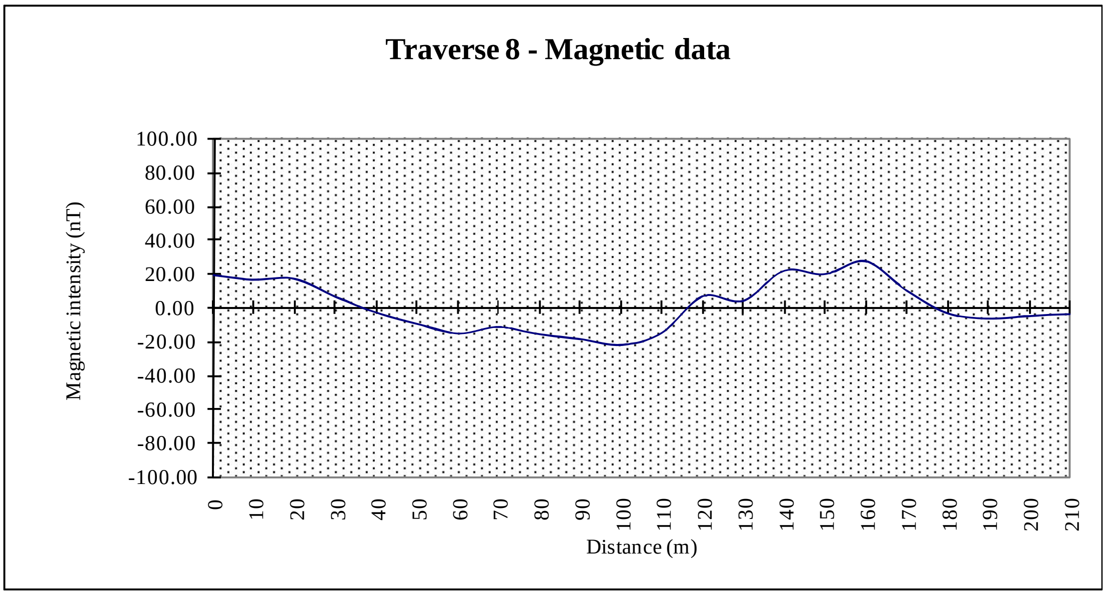


Figure 11. *SW-NE magnetic profile of Traverse 8.*

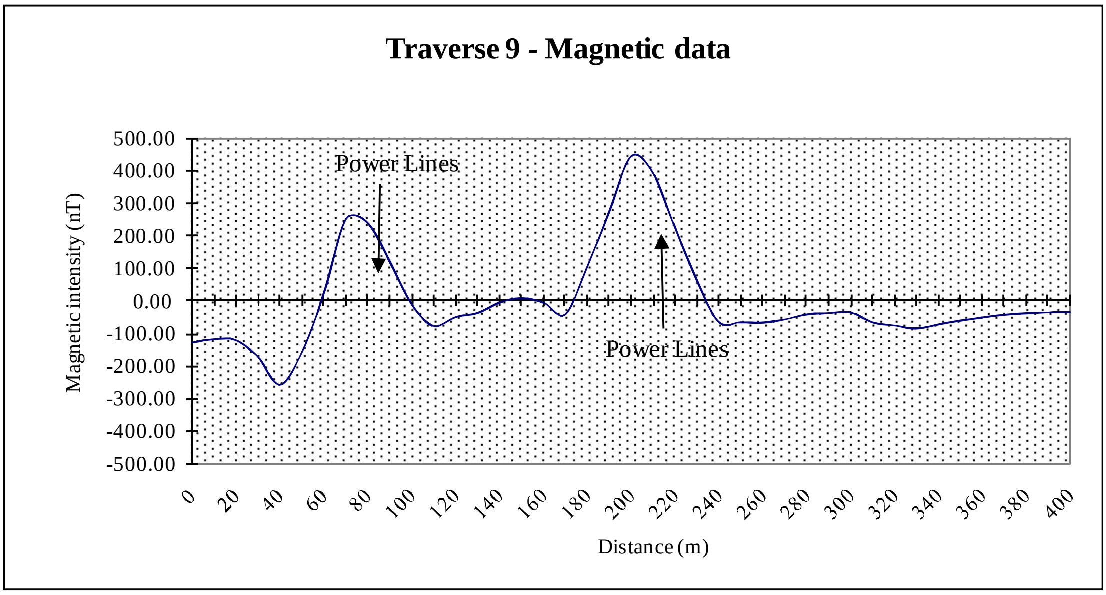


Figure 12. SE-NE magnetic profile of Traverse 9.

4.3 Geohydrology

The main water bearing aquifers in the vicinity of the power station are fractured rock aquifers. The term fracture refers to cracks, fissures, joints and faults, which are caused by (i) geological and environmental processes, e.g. tectonic movement; secondary stresses; release fractures; shrinkage cracks; weathering; chemical action; thermal action and (ii) petrological factors like mineral composition, internal pressure, grain size, etc.

From a hydrogeological point of view, a fractured rock mass can be considered a multi-porous medium, conceptually consisting of two major components: matrix rock blocks and fractures. Fractures serve as higher conductivity conduits for flow if the apertures are large enough, whereas the matrix blocks may be permeable or impermeable, with most of the storage usually contained within the matrix. Actually, a rock mass may contain many fractures of different scales. The permeability of the matrix blocks is in most cases of practical interest a function of the presence of micro-fractures. A rock mass which consists only of large fractures and some matrix blocks with no micro-fissures (or smaller fractures) lead to a term called purely fractured rocks. In this case, the domain takes the form of an interconnected network of fractures and the rock matrix, comprising the blocks surrounded by fractures, is impervious to flow. However, there may still be porosity. In the case where the domain is a porous medium (or a micro-scaled fractured medium) intersected by a network of interconnected fractures, the rock is termed a fractured porous rock and the domain is therefore characterized by at least two subsystems, each having a different scale of inhomogeneity (called scale effect).

4.3.1 Aquifer characteristics

Drilling data and work undertaken during previous investigations suggests that multiple aquifer types are represented at the site. These include:

- Unconfined aquifers present within soil horizons that have developed within colluvial and alluvial environments and the weathered upper levels of Ecca Formation sediments. These aquifers are generally perched on less permeable underlying in situ sediments;
- Unconfined aquifers along the trend of dolerite dykes. These may also act as recharge points for confined aquifers within the Ecca Formation at depth;
- Semi-confined aquifers within the Ecca Formation. These aquifers are commonly confined along essentially horizontal bedding interfaces between different lithologies, but can be locally unconfined along the trend of fractures zones, which allows the aquifers to recharge seasonally. The aquifers can therefore be regarded as a semi-confined, or leaky confined, aquifer on a regional scale if the definition of Fetter (1994) is considered;
- Deeper confined aquifers within basement lithologies.

From a pollution management viewpoint, the presence of a perched shallow aquifer is problematic due to resulting localised decreases in the bearing capacity of site profiles, and the increased potential for pollutant transport. In this instance, shallow aquifers are generally seasonal, which suggests that they either drain quickly (i.e. they are relatively permeable), have a low storage potential, or that stored water can be lost via evapo-transpiration processes. Contaminant movement away from pollution point sources can be reduced, or prevented entirely, through the construction of cut-off trenches and sub-soil drains to the confining layer at the base of the aquifer. This is generally not an option at sites where this layer occurs at significant depths, or when pollutants enter underlying regional aquifers.

While seasonally influenced, the perched aquifer is also artificially recharged by the different structure associated with the power generation activities, the relatively impermeable Karoo sediments which act as aquifer base in some areas of the shallow perched aquifer encouraging lateral migration through the unsaturated zone in these areas. In comparison, recharge to regional aquifers occurs via preferential pathways, such as fractures, dykes, bedding planes and highly weathered bedrock areas. The regional aquifers are therefore classified as fractured rock aquifers. In general, aquifers appear unconfined to semi-confined in character.

The higher water levels observed in the immediate vicinity of the water bearing surface structures are an indication of the artificial recharge from these structures.

The distribution of groundwater levels were inferred from available groundwater level data assuming that the water level is a sub-surface reflection of surface topography using Bayesian interpolation. Subsequently the direction and velocity of groundwater flow were calculated.

Due to the unavailability of pre-operations groundwater data the water levels measured at uninfluenced sites during December 2008 were used for the Bayesian interpolation of groundwater level data for the initial conditions (refer to Figure 13). The same water level data with the exception of the affected areas were used to do Bayesian interpolation for the current ground water level distribution (Figure 14) The elevated topography and groundwater levels associated with the surface structures were incorporated in the current 2008 interpolation.

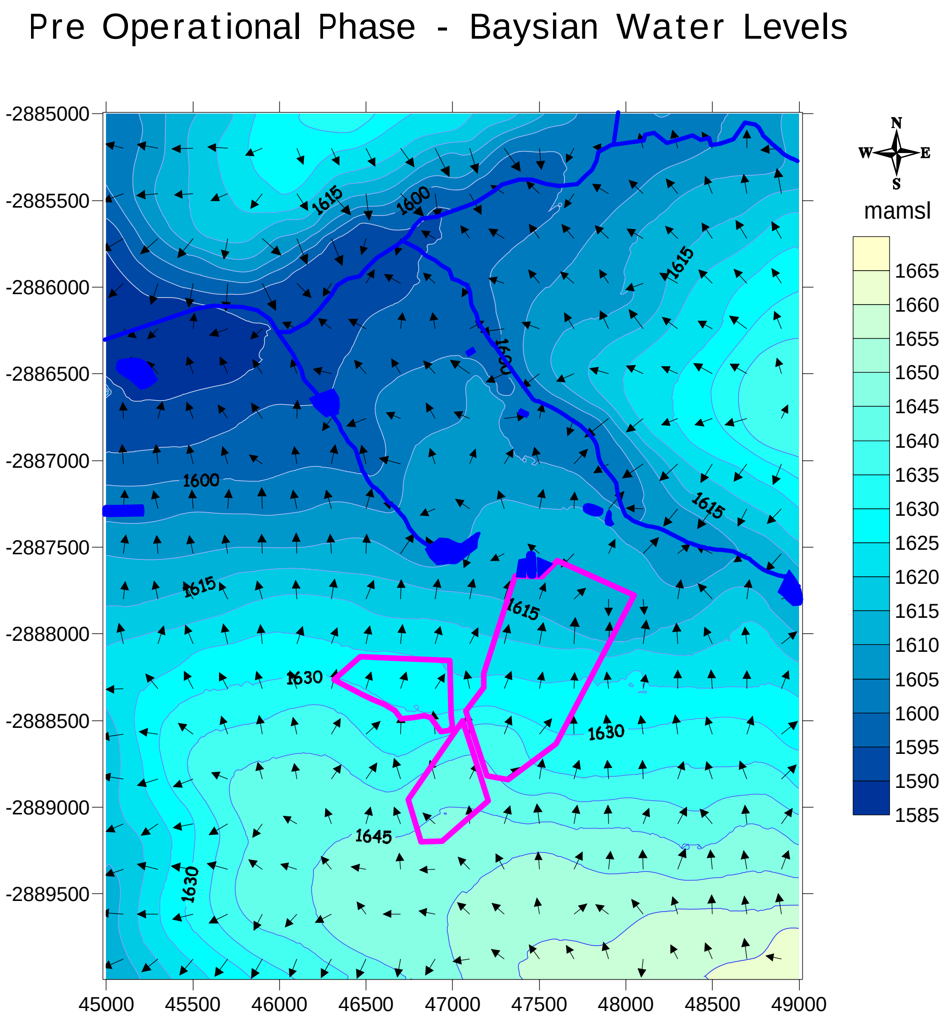


Figure 13. Simulated Pre-Operational Phase groundwater levels and flow directions (Bayesian Interpolation)

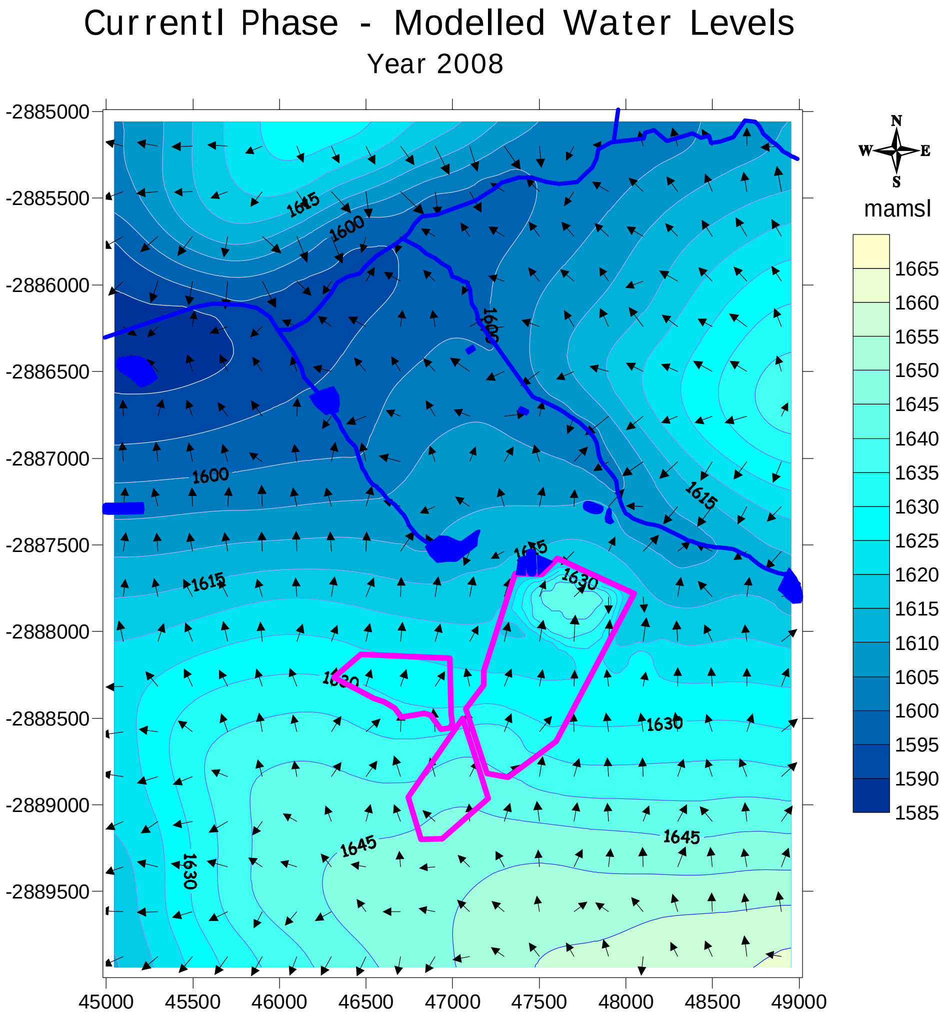


Figure 14. Simulated current (2008) groundwater levels and flow directions (Modelled Water Table))

4.3.2 Factors Controlling Water in Rocks

Permeability of the Aquifer

Permeability is the intrinsic capacity of a rock to transmit fluids. Materials that do not allow water to pass through them are classified as impermeable. Sands and gravel, which have large pore spaces, are highly permeable; clays, on the other hand, are practically impermeable because pore spaces are extremely small and the water contained in them is virtually stationary.

During the execution of permeability tests, also known as "slug tests", a certain volume of water is either added, or removed from, the column water inside the borehole. The rate at which the recovery towards the original rest water level takes place after the addition/removal, is measured. A displacement in the order of 10 cm – 50 cm is considered to be sufficient to enable the investigator to obtain useful results from the exercise. The transmissivity (T) and/or hydraulic conductivity (K) are determined from these measurements. It must, however, be kept in mind that the values obtained from the slug test represent only the aquifer properties in the immediate vicinity around the borehole, since disturbances in the equilibrium conditions are only experienced over small distances from the borehole.

Hydraulic Conductivity (K)

Hydraulic conductivity is defined as the volume of water that will move through a porous medium in unit time under a unit hydraulic gradient through a unit area measured at a right angle to the direction of flow. Hydraulic conductivity has units of Length/Time.

Transmissivity (KD or T)

Transmissivity is the product of the average hydraulic conductivity (*K*) and the saturated thickness of the aquifer (*D*). Consequently, transmissivity is the rate of flow under a unit hydraulic gradient through a cross-section of unit width over the whole saturated thickness of the aquifer. Transmissivity has the units of $Length^2/Time$.

Storativity (S)

The storativity of a saturated confined aquifer of thickness (*D*) is the volume of water released from storage per unit surface area of the aquifer per unit decline in the component of hydraulic head normal to that surface. In a vertical column of unit area extending through the confined aquifer, the storativity *S* equals the volume of water released from the aquifer when the piezometric surface drops over a unit distance. As storativity involves a volume of water per volume of aquifer, it is a dimensionless quantity.

4.3.3 Hydraulic Testing of Monitoring Boreholes

The geological formations permeabilities were determined by conducting falling head tests on eight of the nine current monitoring boreholes. Borehole AB06 were infested by bees and could not be tested. The hydraulic tests on the boreholes were done in order to obtain information on the hydraulic properties of the rock formations in the vicinity of the Ashing Area Power Station Area and the Coal Stockyard Area.

The results of the permeability tests are used to determined fluid/contaminant migration in the rock formations in the vicinity of the boreholes.

The Bouwer-Rice method was used to analyses the permeability tests performed on the Power Station boreholes. The results of the tests are presented in Figure 15 to Figure 22.

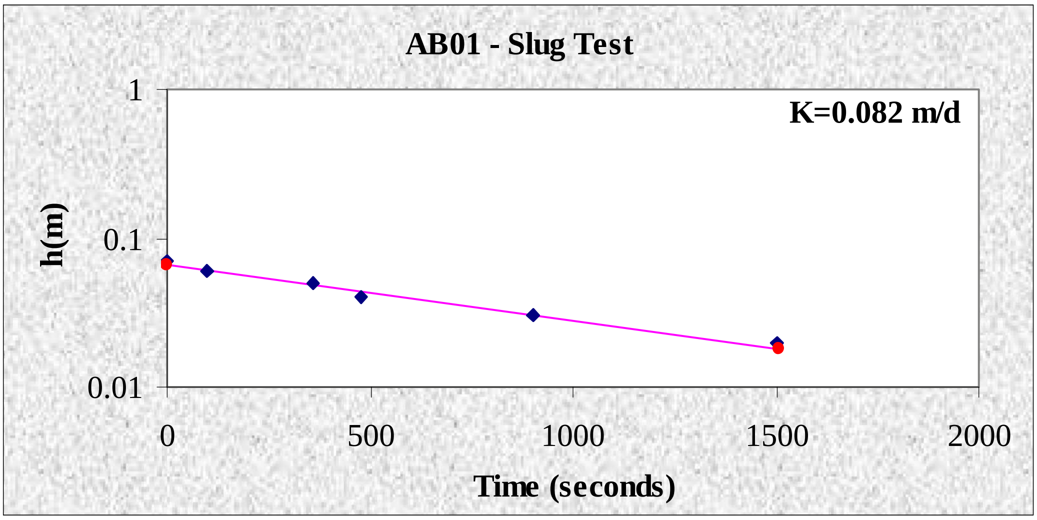


Figure 15. Results of the permeability test performed on AB01.

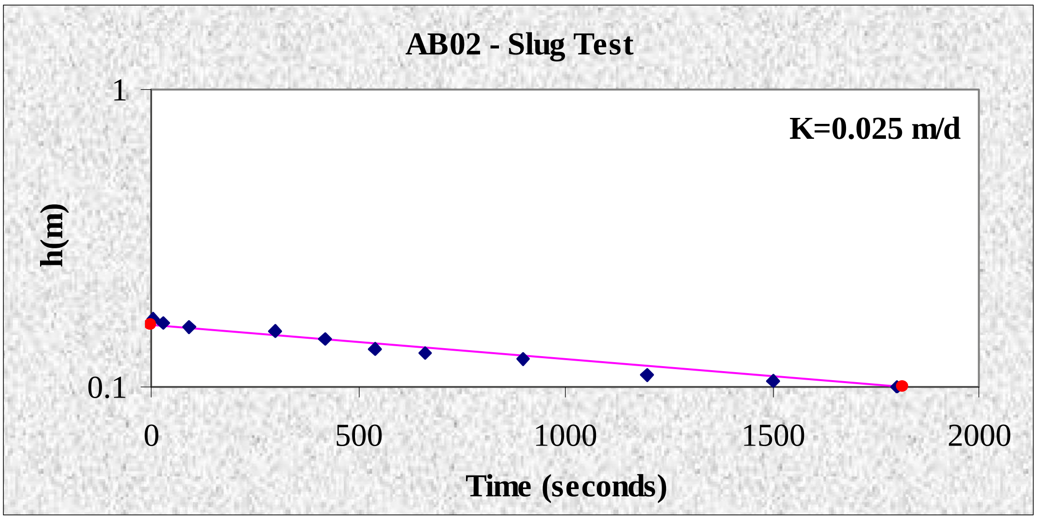


Figure 16. Results of the permeability test performed on AB02.

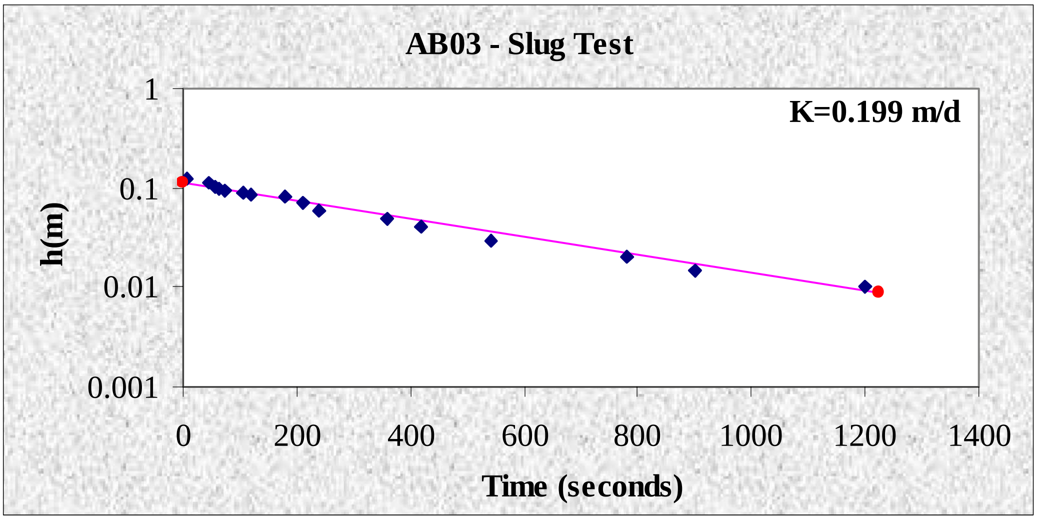


Figure 17. Results of the permeability test performed on AB03

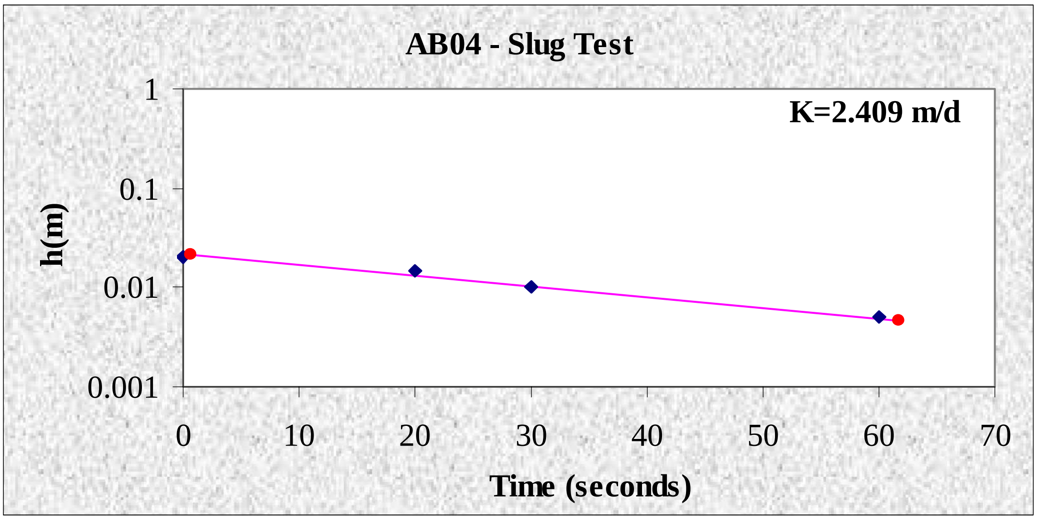


Figure 18. Results of the permeability test performed on AB04.

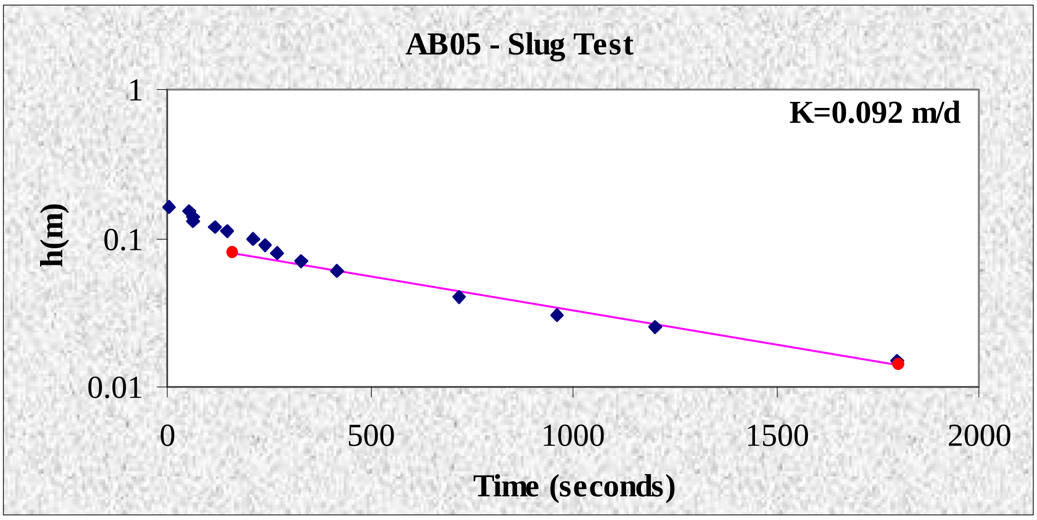


Figure 19. Results of the permeability test performed on AB05.

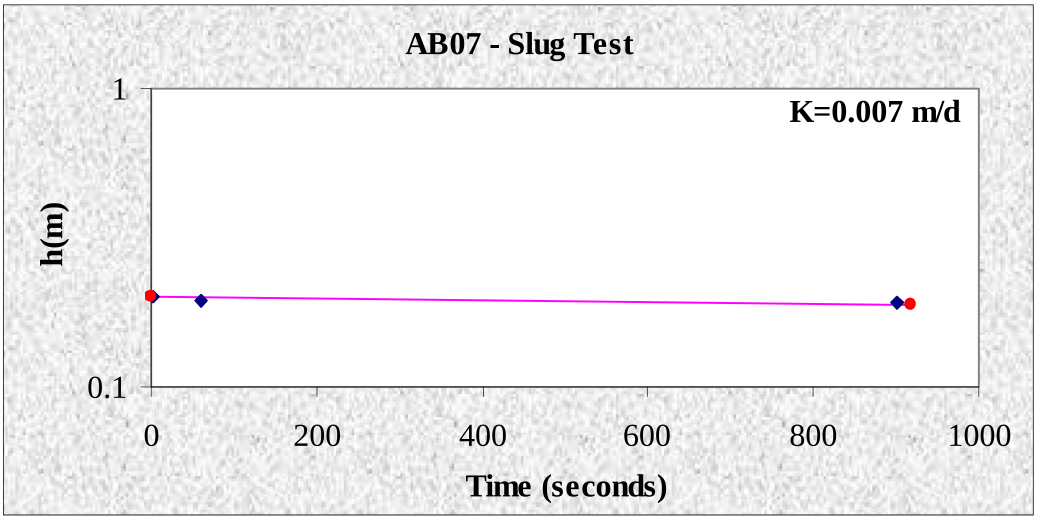


Figure 20. Results of the permeability test performed on AB07.

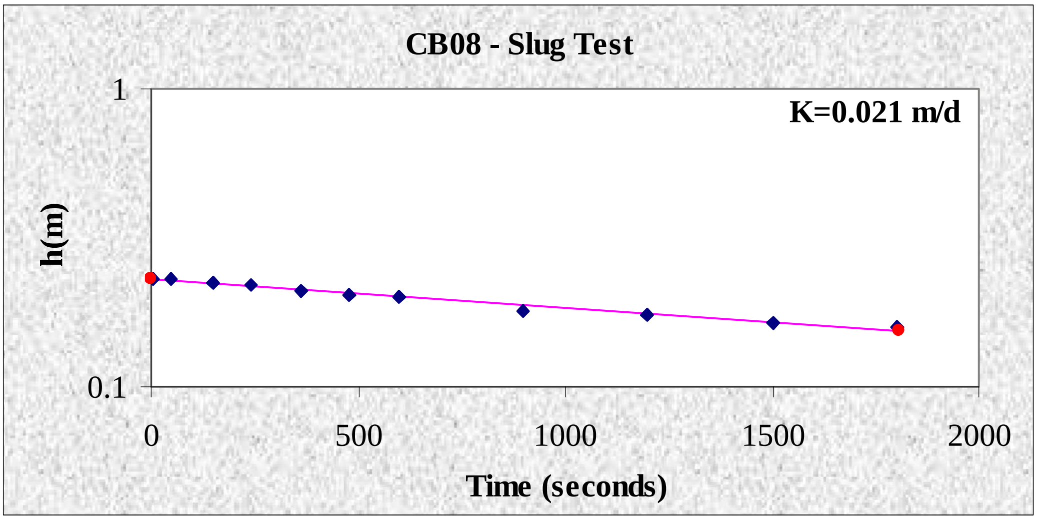


Figure 21. Results of the permeability test performed on CB08.

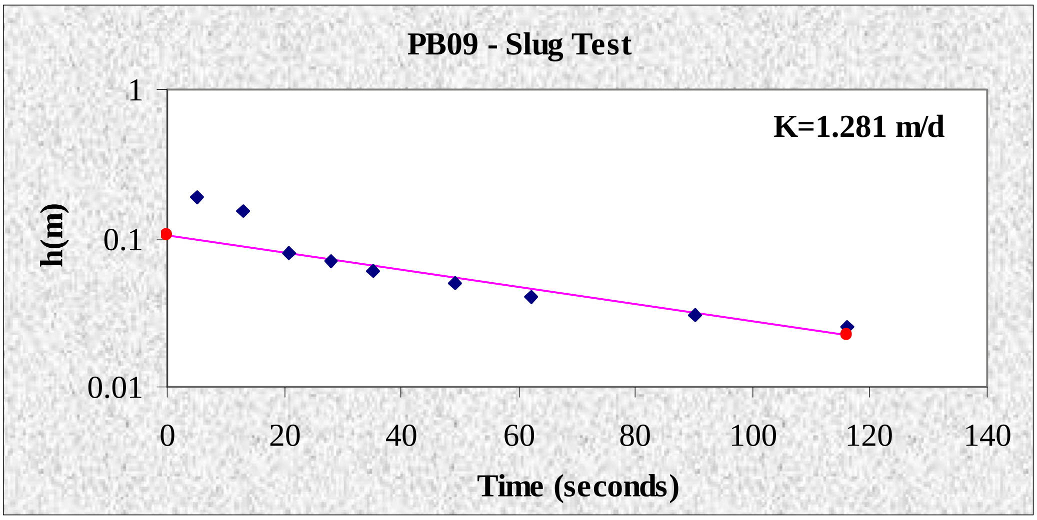


Figure 22. Results of the permeability test performed on PB09.

These observations suggest that the rocks on and in the vicinity of Komati Power Station generally have low permeabilities and hydraulic conductivities. The presence of preferential pathways, such as fractured zones, might be present in the region and may cause marked increases in the hydraulic conductivities. Migration of groundwater and/or contaminants can be expected to be high along such pathways. Permeability tests were not performed during this investigation on boreholes located on the neighbouring farms due to the presence of equipment in the boreholes.

The results of the permeability tests are implemented in the calculation of the flow velocities of the groundwater (which acts as the carrier of pollution [if any] in the geohydrological environment). The calculations are performed as follows:

$$v_s = \frac{K}{n}\frac{\Delta h}{\Delta l}$$

where v_s is Darcy's flow velocity, K is the hydraulic conductivity, $\Delta h/\Delta l$ is the hydraulic gradient, and n is the porosity, assumed to be 30% (0.3). The hydraulic gradient is assumed to equal the local topographic gradient of 0.02 (1:63). The results of the calculations are presented in Table 9.

Table 9. Darcy's flow velocities for the monitoring boreholes

No.	Hydraulic Conductivity *K* (m/d)	n Porosity	Hydraulic Gradient	Flow Velocity (m/y)
AB01	0.082	0.3	0.01	1.1972
AB02	0.025	0.3	0.01	0.3650
AB03	0.199	0.3	0.01	2.9054
AB04	2.409	0.3	0.01	35.1714
AB05	0.092	0.3	0.01	1.3432
AB07	0.007	0.3	0.01	0.1022
CB08	0.021	0.3	0.01	0.3066
PB09	1.281	0.3	0.01	18.7026
Average				**0.7811**

The flow velocities listed in Table 9 suggest that fluid/contaminant migration in the rock formations at Komati Power Station will be slow. However, it must be remembered that the results obtained from permeability tests only represent the characteristics of the aquifer in the immediate vicinity of the boreholes tested. In the presence of preferential pathways these flow velocities may be much higher. The velocity will also be much lower as hydraulic gradient become less in the flat areas.

5 SURFACE- AND GROUNDWATER QUALITY – INORGANIC PARAMETERS

The results of the analyses (as obtained from the submitted database) are presented in this section by various graphical means and observations regarding the contamination status of the surface- and groundwater are made.

Although the concentrations of more than 17 inorganic chemical parameters in the water samples were determined during the chemical analyses, only eight parameters are used as indicators of contamination in the monitoring of the pollution potential in this system. These eight parameters are: the **pH**, the electrical conductivity (**EC**), the major ions **Ca, Na**, **Cl**, **SO_4, K** and **Mg**. The suitability of these parameters to act as *indicator elements* in the evaluation of water contamination was determined by GHT during previous investigations and reports. The additional information on the concentrations of the other elements is required to evaluate the accuracy and reliability of the chemical analyses.

5.1 Chemical Analysis Reliability

The most common way to evaluate the reliability of an analysis is to perform an Ion Balance Calculation. For any water analysis, the total cation and anion concentrations should balance. The difference between these concentrations is referred to as the Ion Balance Error. A negative value indicates that anions predominate in the analysis, whereas a positive value shows that cations are more abundant. For the analysis to be considered reliable, the ion balance error should not be greater than 5% of the total ion concentration. A value greater than this figure indicates that some major constituents have not been analysed for or that there is an analytical error. Some trace elements are not included in the ion balance calculation. However, these may still be important as pollution indicators and may be used to identify point sources of pollution.

5.2 Chemical Data Presentation Formats

The results of the inorganic chemical analyses are presented in various formats in this report. These formats include Data Tables, MMAC plots and Time Graphs. The formats used are not exhaustive and any special requirements could be incorporated if suggested by the client or if shown necessary as the monitoring program progresses. The formats of data presentation used in this report are discussed below.

5.2.1 Data Tables and Water Quality Tables

Data Tables

The results of all the inorganic chemical analyses that have been performed on water samples from Komati Power Station during the current and previous phases of the monitoring program are available in an electronic database for review. A summary of the data tables can be seen in Appendix B.

Water Quality Tables

In these tables the water samples from each monitoring site are classified according to the "South Africa Water Quality Guidelines, Volume 1: Domestic Use, DWA&F, First Edition 1993" and the "South Africa Water Quality Guidelines, Volume 1: Domestic Use, DWA&F, Second Edition 1996", as well as according to the publication "Quality of Domestic Water Supplies, DWA&F, Second Edition 1998". A description of the various classes is given in Table 10.

Table 10. Classification system used to evaluate water quality classes.

Quality of Domestic Water Supplies, DWA&F, Second Edition 1998

Class 0	- **Ideal water quality** - Suitable for lifetime use.
Class 1	- **Good water quality** - Suitable for use, rare instances of negative effects.
Class 2	- **Marginal water quality** - Conditionally acceptable. Negative effects may occur in some sensitive groups
Class 3	- **Poor water quality** - Unsuitable for use without treatment. Chronic effects may occur.
Class 4	- **Dangerous water quality** - Totally unsuitable for use. Acute effects may occur.

South Africa Water Quality Guidelines, Volume 1: Domestic Use, DWA&F, First Edition 1993 & Second Edition 1996

NR	- **Target water quality range** - No risk.
IR	- **Good water quality** - Insignificant risk. Suitable for use, rare instances of negative effects.
LR	- **Marginal water quality** - Allowable low risk. Negative effects may occur in some sensitive groups
HR	- **Poor water quality** - Unsuitable for use without treatment. Chronic effects may occur.

5.2.2 MMAC Plots

Monitoring is undertaken so that changes in water quality over time can be identified. Such changes may be particularly evident in areas affected by surface activities, which could enhance water degradation. For this investigation the evaluation of previous and the current monitoring period has again been condensed and plotted in a format referred to as the Maximum, Minimum, Average and Current plot (MMAC). The results from a number of sample sites can be plotted in a single diagram for comparison.

A diagram of an MMAC plot is shown in the Figure 23 and serves to explain the meaning of each element in the presentation. Instead of only an average value, twice the standard deviation, given as one value above and one value below the average is supplied. The standard deviation allows an idea of the usual range of values measured for the particular constituent at the particular site. A small standard deviation indicates a stable sample, while a large value represents a high variation in values. The maximum and minimum values ever recorded at the site are indicated in these plots by horizontal lines.

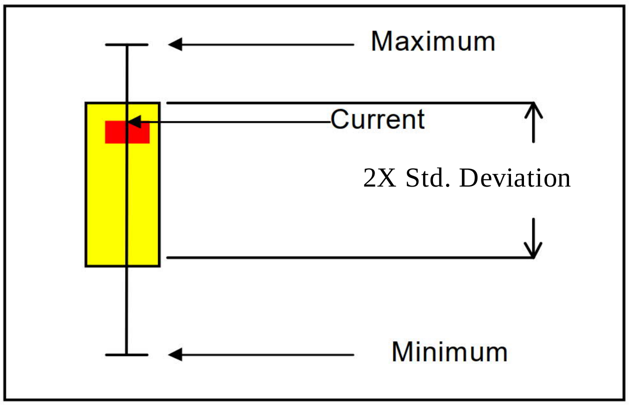


Figure 23. Maximum, Minimum, Average and Current Plot (MMAC)

In this way, a visual comparison may be made between the different sampling points for each monitoring period. At the same time, the history of each sampling point can be assessed. For example, if the red rectangle in the diagram were an actual data point, the current value would be higher than the average. If this is the case for other indicator parameters, and the condition persists through a number of monitoring events, then progressive degradation is indicated.

It must be noted that on the plots included in **Appendix C,** only the sampling sites that were sampled during the last monitoring phase were included. The geohydrological software package ‘WISH’ *(Institute of Groundwater Studies, UOVS, 1999)* was used to evaluate the data. On each of the plots the Department of Water Affairs and Forestry drinking water standard for human consumption is indicated and can be described as follows:

- The Target Water Quality Range (TR) for a particular constituent is indicated by the lower horizontal line on the figures. Concentrations below this value correspond to levels at which the presence of the particular constituent would have no known adverse or anticipated effects on the fitness of the water assuming long-term continuous use. If the quality is within the TR one can immediately concluded that water quality in that particular case is not an issue to the water use concerned. However, if the water quality falls outside the TR it does not mean that the water is unsuitable for a particular use, but rather that the particular situation must be more thoroughly assessed by referencing the comprehensive guidelines.
- The upper horizontal line of the standard indicates the Maximum Allowable Limit (AL). This is the limit above which remedial action should be implemented. It does not mean that the water is unsuitable for a particular use, but rather that the particular situation must be more thoroughly assessed by referencing the comprehensive guidelines.

5.2.3 Time Graphs

Time graphs (refer **Appendix C**) are constructed for the groundwater samples so that temporal changes in concentrations of the indicator elements may be identified. These changes are interpreted to reflect the contamination levels of the groundwater. The temporal trends as observed in the time graphs are summarized in table format in this report.

5.3 Evaluation of Surface- and Groundwater Quality – Inorganic parameters

In this section the results of the chemical analyses of the water samples taken during the current monitoring phase is discussed and related to the results of previous monitoring phases. At the time of the latest sampling event, most of the streams at Komati Power Station were characterized by stagnant water. It is therefore fair to assume that the dilution effect of continuous stream flow was negligibly small during the months preceding the sampling event.

5.3.1 Water Quality Tables

The water quality of the surface- and groundwater at Komati Power Station is summarised in this section in table format. The data in the are colour-coded according to the “South Africa Water Quality Guidelines, Volume 1: Domestic Use, DWA&F, First Edition 1993” and the “South Africa Water Quality Guidelines, Volume 1: Domestic Use, DWA&F, Second Edition 1996”, as well as according to the publication “Quality of Domestic Water Supplies, DWA&F, Second Edition 1998” (see Table 10 and refer to Appendix C).

5.3.1.1 The Ashing Area and Domestic Waste Site

Table 11. Water quality – Ashing Area and Domestic Waste Site.

No.	Date	pH	EC mS/m	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO_4 mg/L	T.Alk mg/L	F mg/L	NO_2-N mg/L	NO_3-N mg/L	PO_4 mg/L	B mg/L
AB01	20081203	7.1	348	362	242	236	30.5	299	1188	684	0.00		0.00	0	
AB02	20081203	7.1	251	90	281	211	44.9	45	1545	294	0.00		0.00	0	
AB03	20081203	6.6	74	43	42	25	7.3	41	203	121	0.19	0.00	0.00	0	0.01
AB05	20081202	7.2	257	374	121	76	7.2	234	879	327	0.00		2.35	0	
AB07	20081203	6.9	227	145	178	178	10.3	59	1308	158	0.00		0.00	0	
AC02	20081203	3.1	233	143	306	35	25.1	66	1318	0	0.79	0.00	0.00	0	0.59
AC03	20081203	6.8	83	73	38	14	11.9	51	148	203	0.48	0.00	0.00	0	0.14
AC04	20081203	7.4	137	87	133	48	10.8	42	478	285	0.79	0.00	0.00	0	0.09
AC05	20081203	7.3	107	99	78	12	16.4	49	387	121	0.40	0.00	2.68	0	0.26
AP02	20081203	7.3	131	112	104	27	15.5	50	523	215	0.87	0.00	1.34	0	0.24
AP03	20081203	7.1	114	100	86	17	16.6	52	392	142	0.62		0.00	0	

5.3.1.2 Power Station and Coal Stockyard area

Table 12. Water quality – Power Station and Coal Stockyard area.

No.	Date	pH	EC mS/m	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO_4 mg/L	T.Alk mg/L	F mg/L	NO_2-N mg/L	NO_3-N mg/L	PO_4 mg/L	B mg/L
PB08	20081203	6.7	107	122	43	27	3.6	68	261	226	0.87		0.00	0	
CB09	20081203	7.5	69	28	64	20	3.5	15	132	212	0.90		0.47	0	
PC08	20081202	7.0	92	25	89	39	3.4	29	263	205	0.44	0.00	0.00	0	0.03
CP06	20081203	7.5	66	56	32	13	5.9	21	171	142	0.50	0.00	3.80	0	0.14

5.3.1.3 Sewage plant area

Table 13. Water quality – Sewage plant area.

No.	Date	pH	EC mS/m	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO_4 mg/L	T.Alk mg/L	F mg/L	NO_2-N mg/L	NO_3-N mg/L	PO_4 mg/L	B mg/L
SPE01	20081202	6.6	61	37	21	9	7.4	47	63	147	0.19	30.35	0.77	1.52	0.15

5.3.1.4 Komati Spruit Area

Table 14. Water quality – Komati Spruit area.

No.	Date	pH	EC mS/m	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO_4 mg/L	T.Alk mg/L	F mg/L	NO_2-N mg/L	NO_3-N mg/L	PO_4 mg/L	B mg/L
KMR01	20081203	7.2	151	133	122	40	23.2	55	646	224	0.86	0.00	0.00	0	0.42
KMR02	20081203	7.5	79	51	50	18	9.3	30	244	135	0.48	0.00	0.00	0	0.21

5.3.1.5 Geluk Spruit Area

Table 15. Water quality – Geluk Spruit area.

No.	Date	pH	EC mS/m	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	Cl mg/L	SO_4 mg/L	T.Alk mg/L	F mg/L	NO_2-N mg/L	NO_3-N mg/L	PO_4 mg/L	B mg/L
GR03	20081203	7.5	40	15	22	12	2.8	13	40	147	0.31	0.00	0.00	0	0.11
GR04	20081203	7.1	118	50	118	46	5.0	18	240	481	0.00	0.00	0.00	0	0.16

5.3.1.6 Discussion

The Ashing Area

The waters from the sites of the Ashing Area can be classified as good to poor water quality due to high concentrations of mainly Mg and SO_4. It can be summarised as follows:

- AB01 (monitoring borehole at domestic waste site), AB02 (monitoring borehole east of new ash dams), AB07 (monitoring borehole below seepage recovery dam) and AC02 (north-western side of ash dam) is classified as dangerous due to the concentrations of Mg and SO_4 and is classed as Class 4 water quality totally unsuitable for human use. Acute effects may occur.
- AB05 (monitoring borehole at dam) can be classified as poor due to the concentrations of SO_4.
- AP02 (clean water dam where Komati Spruit originates west of ash dam) and AC04 (north-eastern corner of ash dam where road crosses over pipelines) can be classifies as marginal due to the concentrations SO_4.

- AB03 (monitoring borehole east of old ash dams), AC03 (dirty water canal on eastern side of ash dam), AC05 (north of ash dam where road crosses over pipelines) and AP03 (seepage recovery dam previously labelled D26) can be classified as good water quality.

Power Station and Coal Stockyard Area

The waters from the Power Station and Coal Stockyard area are classified as ideal to good. It can be summarised as follows:

- CP06 (station drain holding dam at north-western corner of Power Station) can be classified as water with an ideal quality.
- PB08 (monitoring borehole below station drains and oil skimmers), PB09 (monitoring borehole at Lake Fin or new coal stockyard pollution control dams) and PC08 (first bridge south of Power Station where road crosses Komati Spruit) can be classified as good water quality.

Sewage Plant Area

- SE01 (sewage PSE outlet) at the sewage plant can be classified as poor due to the concentrations of NO_2.

Komati Spruit Area

- KMR01 (second bridge south of Power Station where road crosses Komati Spruit) can be classified as poor due to the concentrations of SO_4.

Geluk Spruit Area

- The waters from the Geluk Spruit can be classified as ideal to good.

5.3.2 MMAC Plots and Time Graphs

The observations made from the MMAC plots and Time Graphs are presented in table format in this report. The table headings are as follows:

- AV - The current pollution indicator concentration is above the recorded average;
- HR - The current pollution indicator concentration is the highest on record;
- SD - Sites with high standard deviations in the particular indicator element concentration.
- V - Variable – The indicator element concentration is variable over time;
- S - Stable – The indicator element concentration has remained stable over time;
- D - Decreasing – The indicator element concentration has been decreasing over time.
- I - Increasing – The indicator element concentration has been increasing over time;

The MMAC plots of the chemical analyses of water samples from the various monitoring areas are given in Appendix C.

5.3.2.1 The Ashing Area and Domestic Waste Site

The MMAC plots and temporal trends in the indicator element concentrations of the surface- and groundwater of the Ashing Area are summarised in Table 16.

Table 16. MMAC presentation of the indicator element concentrations of the surface- and groundwater of the Ashing Area.

Sites	Trends PH							Trends EC							Trends Ca							Trends Na							Trends Cl							Trends SO_4							Trends Mg						
	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I
AB01						Y		Y	Y	Y				Y	Y	Y					Y	Y	Y	Y				Y	Y	Y	Y				Y	Y	Y	Y				Y	Y	Y					Y
AB02							Y	Y	Y					Y	Y	Y					Y	Y						Y	Y				Y			Y	Y	Y				Y	Y	Y					Y
AB03						Y				Y			Y				Y			Y							Y							Y				Y			Y							Y	
~~AB04~~																																																	
AB05							Y	Y	Y	Y				Y	Y						Y	Y	Y	Y				Y	Y	Y					Y	Y	Y	Y				Y	Y	Y					Y
~~AB06~~																																																	
AB07							Y	Y		Y				Y	Y		Y				Y	Y						Y	Y				Y			Y		Y				Y	Y						Y
~~AC01~~																																																	
AC02*																																																	
AC03*																																																	
AC04*																																																	
AC05*																																																	
~~AP01~~																																																	
AP02*																																																	
AP03						Y		Y						Y	Y					Y						Y		Y	Y				Y			Y		Y			Y							Y	

Notes: Sites in strikethrough font not sampled during latest monitoring phase
** Sites that are ssampled for the first time*

5.3.2.2 Power Station and Coal Stockyard Area

The MMAC plots and temporal trends in the indicator element concentrations of the surface- and groundwater of the Power Station, Coal Stockyard and the Sewage Plant are summarised in Table 17.

Table 17. MMAC presentation of the indicator element concentrations of the water of the Power Station, Coal Stockyard Area and the Sewage plant Area.

Sites	Trends PH							Trends EC							Trends Ca							Trends Na							Trends Cl							Trends SO_4							Trends Fe						
	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I
PB08					Y		Y			Y		Y	Y						Y	Y						Y		Y					Y	Y		Y				Y	Y							Y	
CB09	Y						Y						Y				Y			Y							Y							Y				Y			Y				Y			Y	
~~PC06~~																																																	
~~CC07~~																																																	
PC08*																																																	
~~PP04~~																																																	
~~PP05~~																																																	
CP06*																																																	
SE01*																																																	

Notes: Sites in strikethrough font not sampled during latest monitoring phase
** Sites that are ssampled for the first time*

5.3.2.3 Komati and Geluk Spruit Area

The MMAC plots and temporal trends in the indicator element concentrations of the surface water of the Komati and Geluk Spruit Area are summarised in Table 18.

Table 18. MMAC presentation of the indicator element concentrations of the water of the Komati and Geluk Spruit Area.

Sites	Trends PH							Trends EC							Trends Ca							Trends Na							Trends Cl							Trends SO_4							Trends Fe						
	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I	AV	HR	SD	V	S	D	I
KMR01*																																																	
KMR02*																																																	
GLR03*																																																	
GLR04*			Y			Y		Y						Y	Y						Y					Y		Y						Y				Y		Y			Y					Y	

Notes: Sites in strikethrough font not sampled during latest monitoring phase
** Sites that are ssampled for the first time*

5.3.2.4 Discussion

Degradation in the water quality at a number of sampling sites is evident.

Ashing Area and Domestic Waste Site

Surface water

Although AP03 forms part of the dirty water system, the quality of the water is good.

Groundwater

Impacts upon the groundwater in the vicinity of the Ash dam, is evident by the large standard deviations observed at AB01, AB02, AB03, AB05 and AB07. Evidence of negative impacts upon the groundwater further north at AB07 is also apparent with concentration of SO_4 and Mg which exceed the groundwater drinking standards.

Of concern is the highest on record concentrations recorded at AB01, AB02 and AB05 for EC, Ca, Na, Cl, SO_4 and Mg.

Power Station, Coal Stockyard Area and Sewage plant Area

Surface water

The surface water sites of the Power Station, Coal Stockyard Area and Sewage plant Area were sampled for the first time.

Groundwater

Stable trends for all the indicator elements were observed at PB08. Large standard deviations with sharp decreasing trends are observed for Ca, SO_4 and Mg at CB09.

Komati and Geluk Spruit Area

Surface water

Variable trends are observed for pH, Ca, Na, Cl and SO_4 at GLR04 (Northern Holding Dam overflow at western corner of Power Station) and large standard deviations of ph, EC, Na and SO_4 which is an indication of negative impacts on the Geluk Spruit.

5.4 EC Profiling of Monitoring Boreholes

Electrical conductivity (EC) profiling was performed on eight of the nine current monitoring boreholes. Borehole AB06 were infested by bees and could not be tested. The aim of the EC profiling was as follows:

- To identify horizons along which preferential contaminant migration may be taking place.
- To determine the depth of the boreholes.

Conductivity measurements of the groundwater were taken every half a metre down the length of the borehole. The data obtained during EC profiling were entered into the existing water quality data base of Komati Power Station.

EC profiling was done on the 2 and 3rd December 2008. Conductivity measurements of the groundwater were taken every half a metre down the length of the borehole. The data obtained during EC profiling were entered into the existing water quality data base of Komati Power Station.

The results of the EC profiling investigations are briefly discussed below:

Monitoring borehole AB01

The EC of the groundwater in borehole AB01 display a gradual increase with depth from 186 mS/m to 212 mS/m.

This borehole is currently sampled at a depth of 15 mbgl. The EC values remain within a very narrow range along the length of the borehole. No preferential pathways for groundwater migration and contaminant migration can be identified. It is recommended that sampling be continued at this depth.

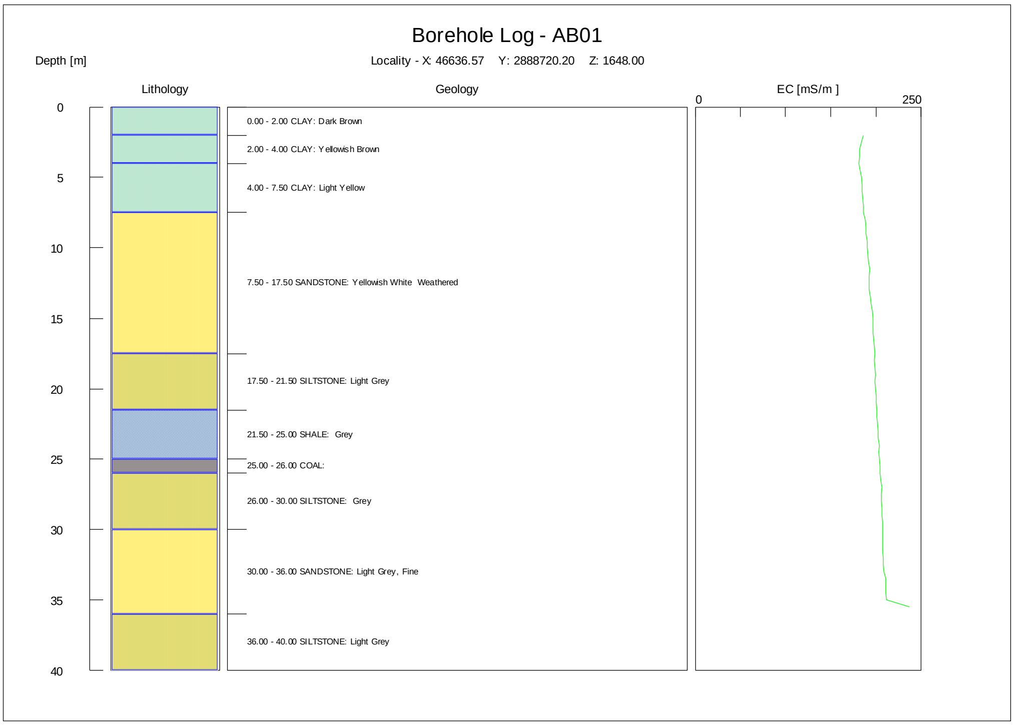


Figure 24. Monitoring borehole AB01.

It should be noted that AB01 was drilled to a depth of 40 metres but has since silted up to a depth of around 35.5 metres.

Monitoring borehole AB02

The EC of the groundwater in borehole AB02 is very constant along the length of the borehole.

This borehole is currently sampled at a depth of 20 mbgl within a sandstone layer. Since the EC values remain within a very narrow range along the length of the borehole and no clear preferential pathways for groundwater migration and contaminant migration can be identified, it is recommended that sampling be continued at this depth.

It should be noted that AB02 was drilled to a depth of 40 metres but has since silted up to a depth of around 32.5 metres.

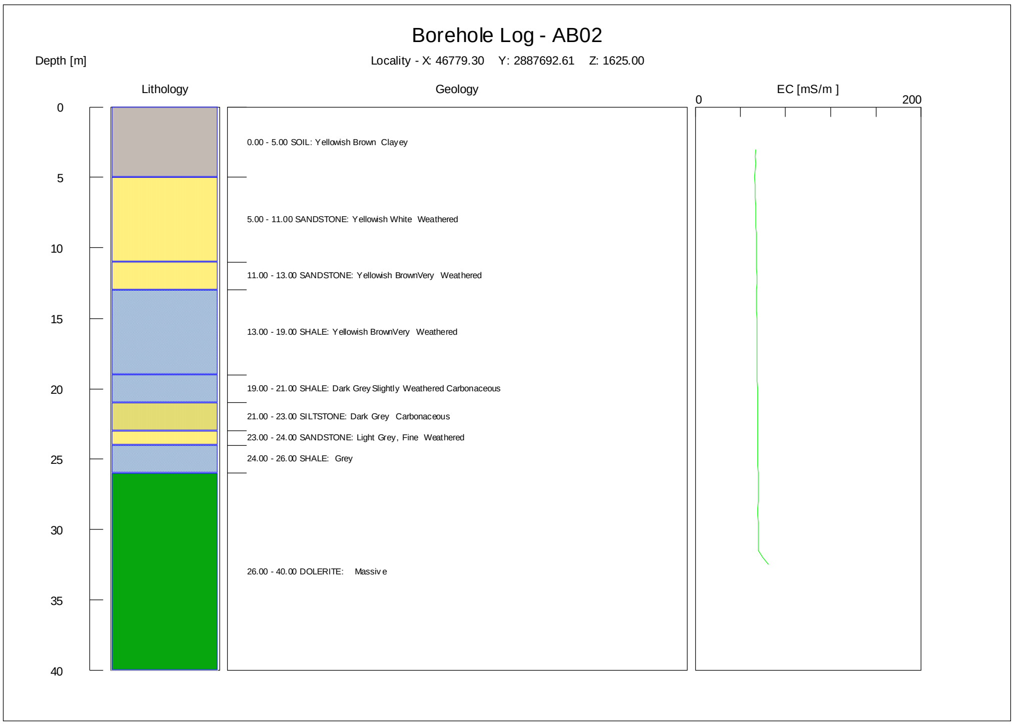


Figure 25. Monitoring borehole AB02.

Monitoring borehole AB03

The EC of the groundwater in borehole AB03 is constant in the borehole.

Borehole AB03 is currently sampled at a depth of 6 mbgl. It is recommended that sampling be continued at this depth.

It should be noted that AB03 was drilled to a depth of 40 metres but has since collapsed or silted up to a depth of around 7.5 metres.

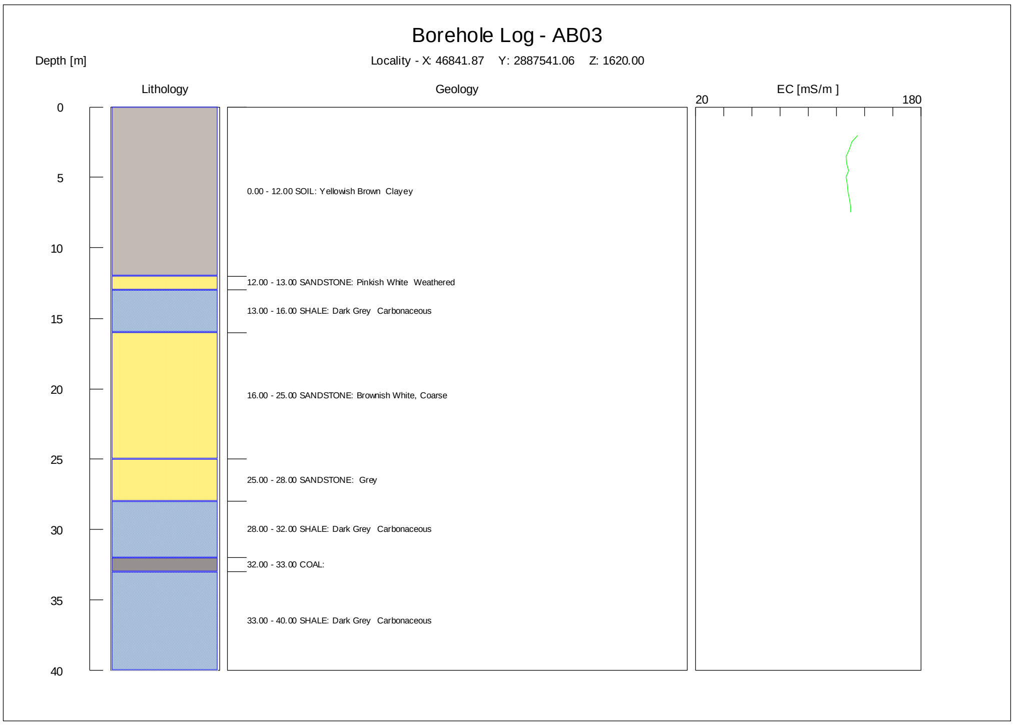


Figure 26. Monitoring borehole AB03.

Monitoring borehole AB04

The EC of the groundwater in borehole AB04 is very constant along the length of the borehole.

This borehole is currently sampled at a depth of 19 mbgl. It is recommended that sampling be continued at this depth.

It should be noted that AB04 was drilled to a depth of 40 metres but has since silted up to a depth of around 38 metres.

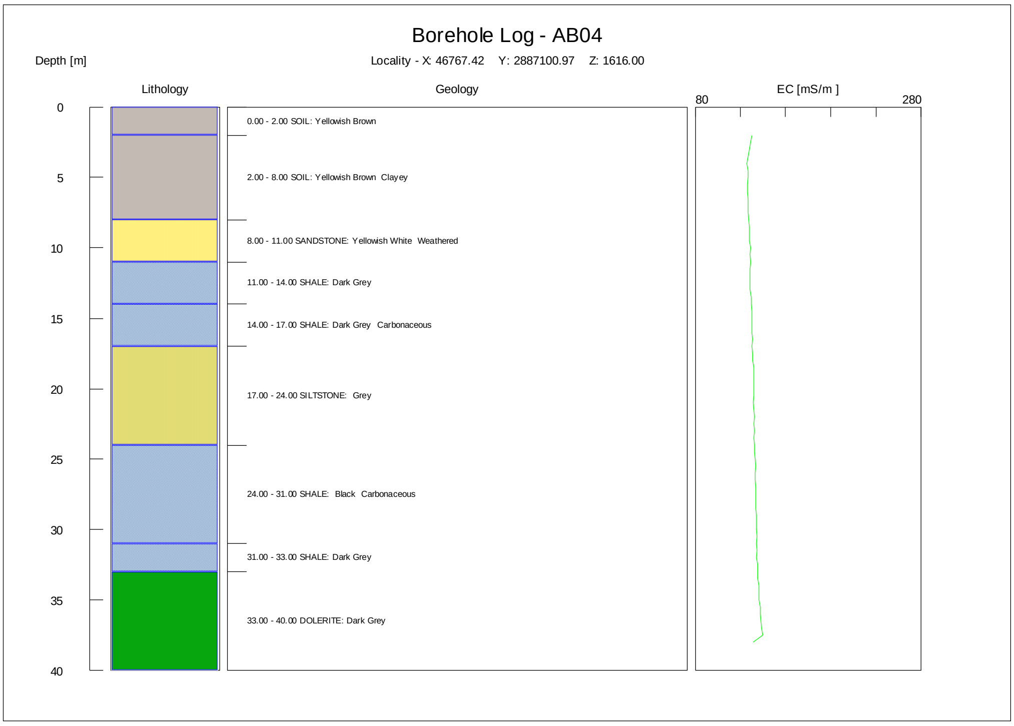


Figure 27. Monitoring borehole AB04.

Monitoring borehole AB05

The EC profiling showed that the groundwater in borehole AB05 displays a gradual increase in the conductivity from a value of around 55.3 mS/m to around 70.9 mS/m at a depth of 3 mbgl. Between 3.5 and 8.5 a further increase in conductivity was measured.

It should be noted that AB05 was drilled to a depth of 40 metres but has since silted up or collapsed to a depth of around 8.5 metres.

This borehole is currently sampled at a depth of 8.5 mbgl within a sandstone layer.

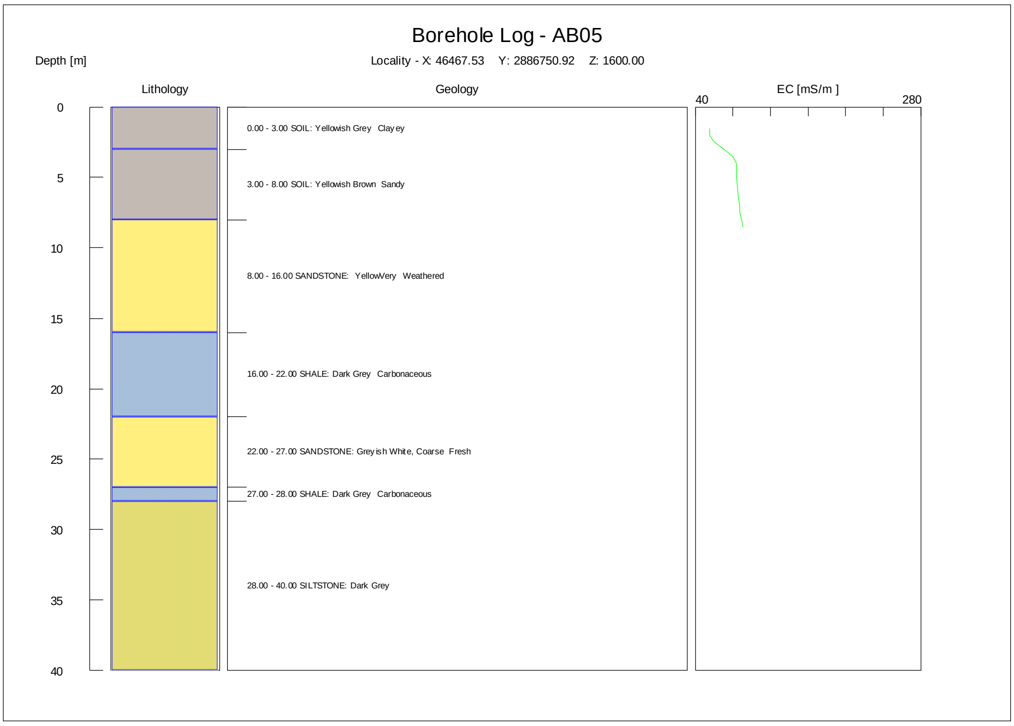


Figure 28. Monitoring borehole AB05.

Monitoring borehole AB07

The EC of the groundwater in borehole AB07 display a gradual increase with depth from 130 mS/m to 138 mS/m.

Since the EC values remain within a very narrow range along the length of the borehole, no clear preferential pathways for groundwater migration and contaminant migration can be identified. This borehole is currently sampled at a depth of 15 mbgl. It is recommended that sampling be continued at this depth.

It should be noted that AB07 was drilled to a depth of 40 metres but has since silted up to a depth of around 37 metres.

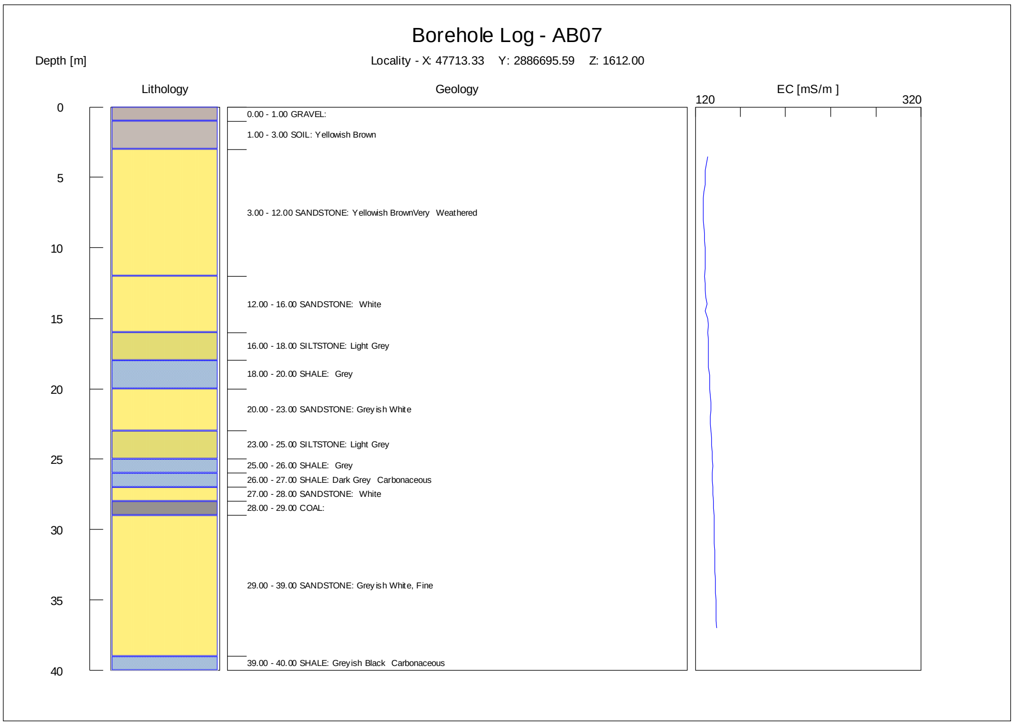


Figure 29. Monitoring borehole AB07.

Monitoring borehole PB08

The EC of the groundwater in borehole PB08 is very constant along the length of the borehole.

This borehole is currently sampled at a depth of 13 mbgl within a sandstone layer. Since the EC values remain within a very narrow range along the length of the borehole and no clear preferential pathways for groundwater migration and contaminant migration can be identified, it is recommended that sampling be continued at this depth.

Borehole PB08 was drilled to a depth of 40 metres but has since silted up to a depth of around 35.5 metres.

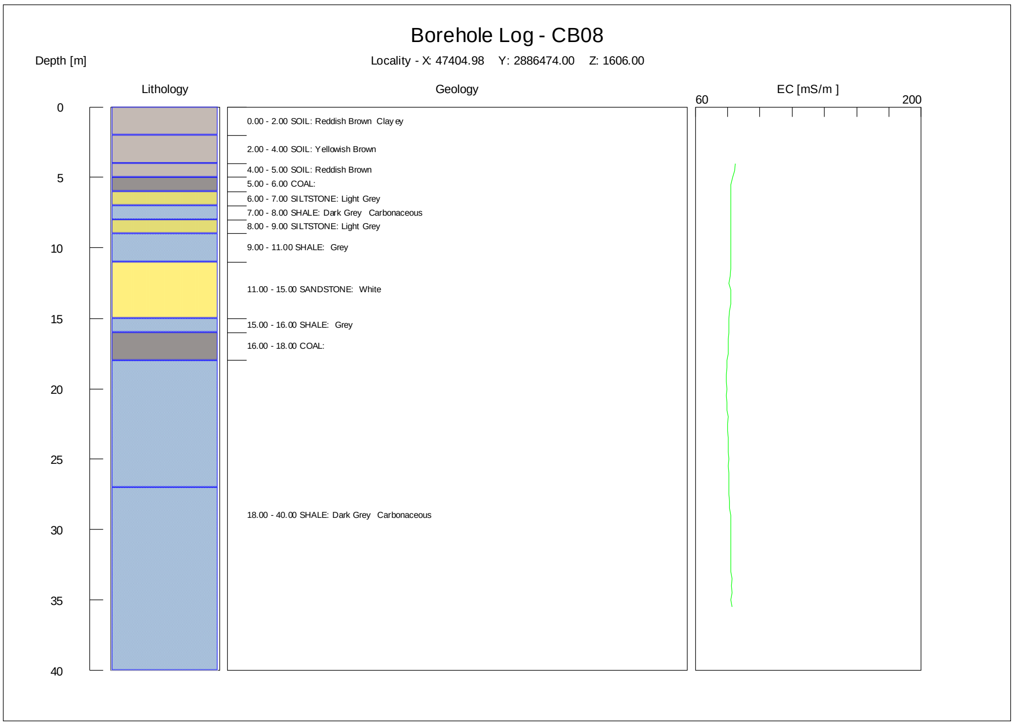


Figure 30. Monitoring borehole PB08.

Monitoring borehole CB09

The EC of the groundwater in borehole CB09 display a gradual increase with depth from 41 mS/m to 55.6 mS/m.

Since the EC values remain within a very narrow range along the length of the borehole, no clear preferential pathways for groundwater migration and contaminant migration can be identified.

This borehole is currently sampled at a depth of 31 mbgl. It is recommended that sampling be continued at this depth.

Borehole CB09 was drilled to a depth of 40 metres but has since silted up to a depth of around 35.5 metres.

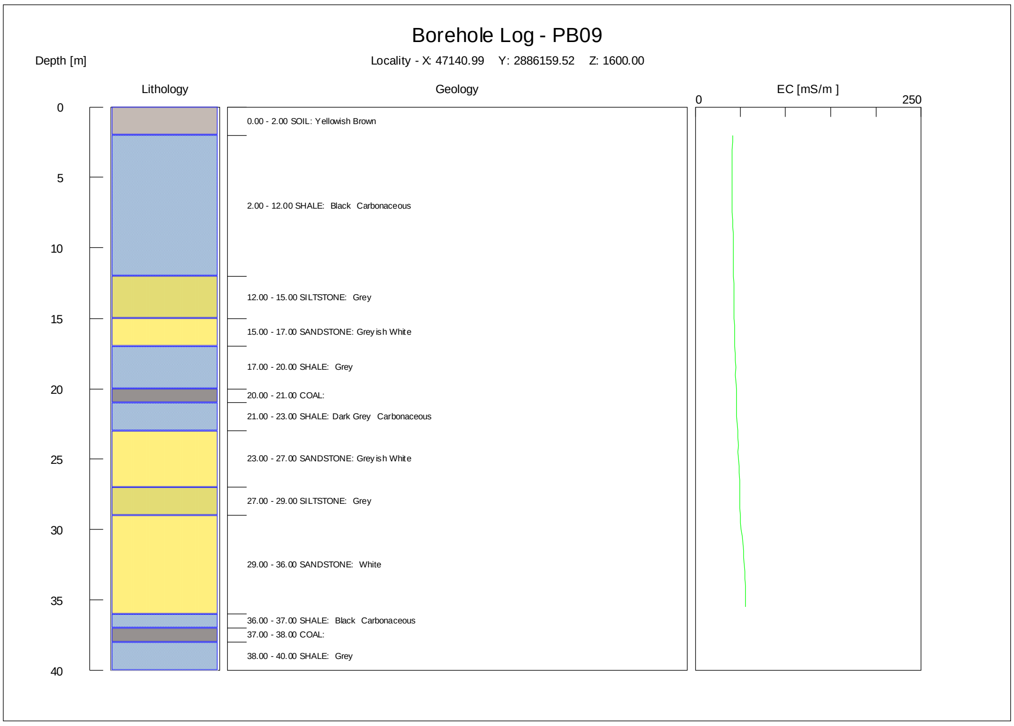


Figure 31. Monitoring borehole CB09.

5.4.1 Discussion

During the latest investigations conducted by GHT Consulting at Komati Power Station, some of the monitoring boreholes of the power station were profiled by means of down-hole electrical conductivity measurements.

During this investigation no preferential pathways were identified in the boreholes along which contaminant transport can take place.

The results of the EC profiling investigations are summarised in Table 19. In Table 19 the drilled and current borehole depths. Also listed are the current and recommended future sampling depths.

Table 19. Results of EC profiling investigations

Borehole #	Drilled depth (m)	Current depth (m)	Current depth of sampling (mbgl)	Recommended depth of sampling (m)
AB01	40	35.5	15	15
AB02	40	32.5	6	6
AB03	40	7.5	19	19
AB04	40	38	8.5	8.5
AB05	40	8.5	20	20
AB07	40	37	15	15
PB08	40	35.5	13	13
CB09	40	36.5	31	31

From Table 19 it can be seen that the current and recommended future sampling depths are identical. It is thus recommended that the boreholes be sampled at the same levels as done in the past.

It is also clear from the data presented in Table 19 that some of the boreholes have been subject to severe silting or have collapsed. Decreased borehole depth is evident at all the boreholes. These boreholes can, however, still serve as monitoring boreholes and it is not deemed necessary to replace them at present.

6 NUMERICAL POLLUTION PLUME MODEL

6.1.1 Groundwater Numerical Model

A groundwater numerical model was also constructed on the limited data currently available. In order to develop a Comprehensive Groundwater Model (CGM), field data is commonly inputted into a predictive model to allow simulations to be developed for given field conditions, the outcomes of this simulations used as a guide during the decision making process. The reliability of these models and consequent understanding of site hydrological behaviour is, however, influenced by the quality and quantity of data available for consideration. Thus, in an ideal case, data should be available for all variations in site conditions, be they geological, chemical, hydrological, or physical. In reality, though, it is either not possible, or cost-effective, to account for all possible variations, particularly where there has been a significant disruption to the natural environment from human activities on a large scale.

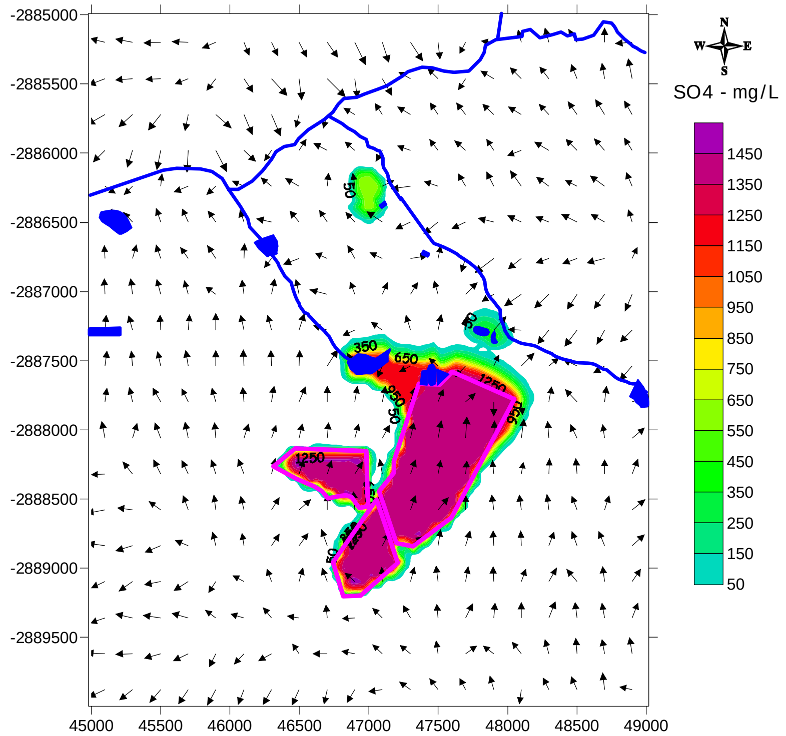
Firstly a Conceptual Model was constructed using historical data as well as data gathered during this investigation. The following shortcomings and data gaps were identified during the construction of the conceptual model:

- Geology, permeabilities and yields from nine boreholes is not enough to construct a representative concept of the area under investigation.
- No historical water level data exist for any boreholes of the area under investigation. Although sufficient chemical data exist for the monitoring boreholes no water levels were recorded in the past. Water levels are more important in the construction of conceptual and numerical models than chemical data. Water levels determined the hydraulic gradient and therefore the flow and spreading of contaminants. Water levels are also used to calibrate and test the integrity of numerical models over time.
- During the drilling of the current monitoring boreholes only certain parameters were recorded and/or entered into the data base.

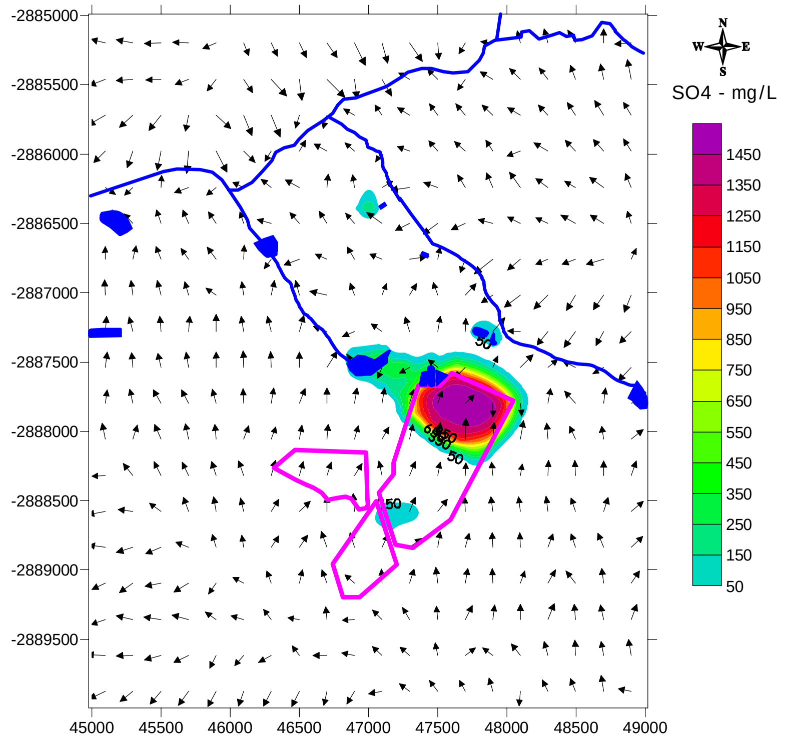
After the construction of the conceptual model a VISUAL MODFLOW numerical model was developed relevant to the aquifer systems at the site and surrounding areas. The groundwater modelling code accommodate the interaction between the two aquifers underlying the site, rainfall recharge and the groundwater influx into surface water systems and pollution sources. Given that model calibration will be done with historical data and during future monitoring phases, MODFLOW, which was developed by the United States Geological Survey, will be used for the modelling exercise.

VISUAL MODFLOW considers 3 dimensional flows for the aquifer system and calibration during future exercises could transfer the current model into fully 3 dimensional simulations.

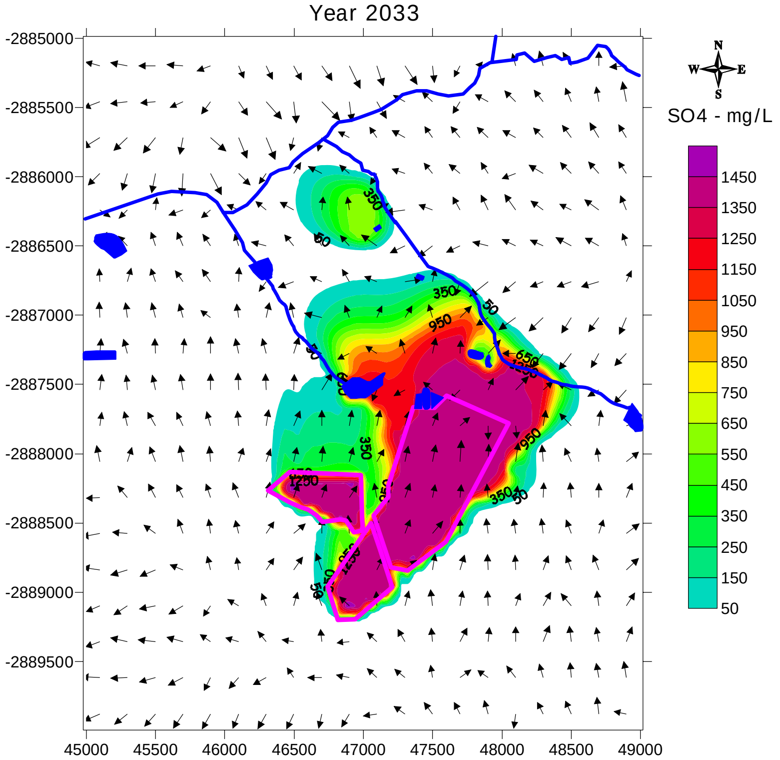
Top Layer Soil & Ash Dump - SO4 Cocentrations
Year 2008



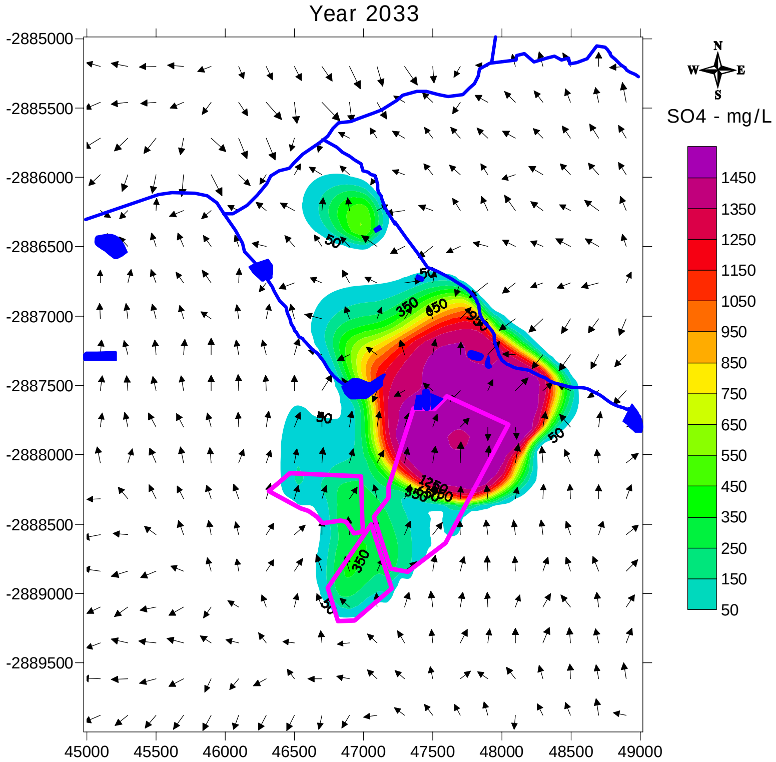
Second Layer Underlying Geology - SO4 Cocentrations
Year 2008



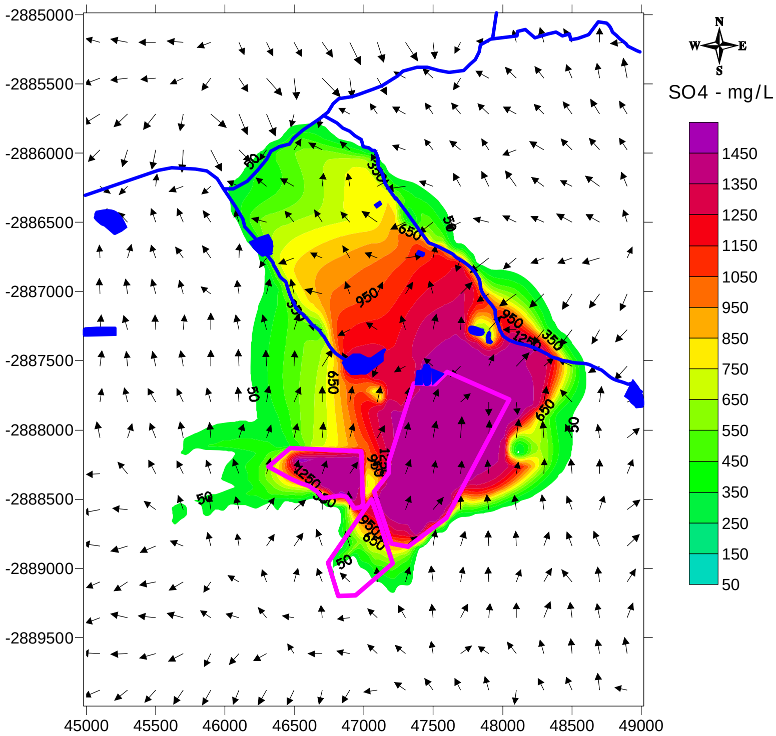
Top Layer Soil & Ash Dump - SO4 Cocentrations



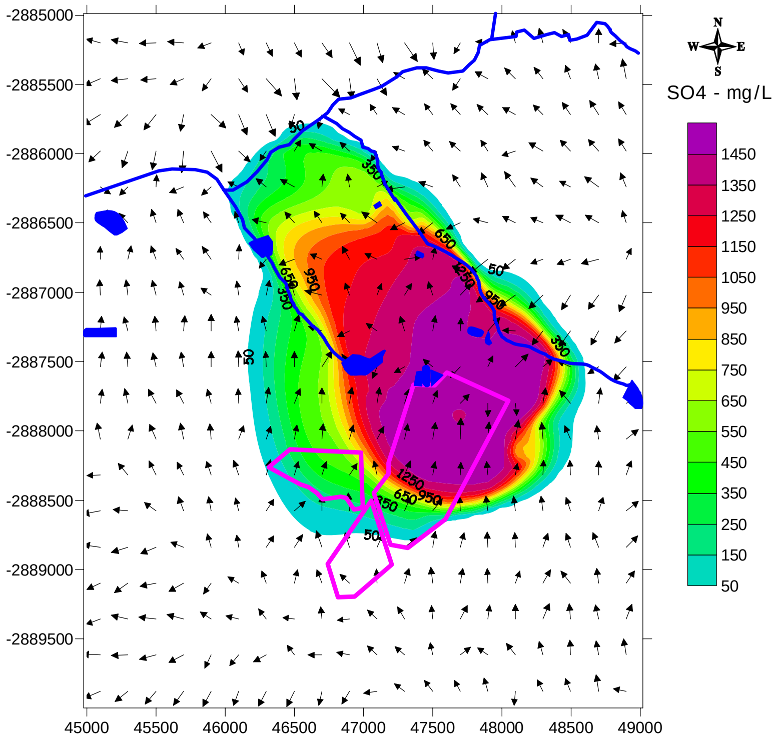
Second Layer Underlying Geology - SO4 Cocentrations



Top Layer Soil & Ash Dump - SO4 Cocentrations
Year 2108



Second Layer Underlying Geology - SO4 Cocentrations
Year 2108



7 CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes findings made during the baseline study undertaken at Eskom Komati Power Station by GHT Consulting Scientists in December 2008. The following conclusions are made on the basis of site observations, monitoring measurements and analyses of laboratory test results as supplied by Komati Power Station:

7.1 Current state and description

The information supplied in the current state and description in the preceding sections is summarised in this section. Additional comments are made about identified problems.

General

- The overall condition of the monitoring boreholes is very good, with a concrete plinth and a well protected frame around the borehole. However, the protected frame around borehole AB06 (monitoring borehole north of old ash dam) needs to be repaired. There is also no cap or locking mechanisms in place at all the boreholes to prevent someone from tampering with the boreholes, or marker posts to be able to easily locate the boreholes.

Ashing Area and Domestic Waste Site

- Sources of contaminants include the ash dam and return water canals and pipelines.
- Seepage problems are evident towards the west of the ash dam.
- Monitoring of surface runoff is inadequate.
- Groundwater monitoring towards the east and north-eastern side of the ash dam is inadequate.
- Various new trenches, canals and pollution control dams are currently been constructed in and around the ashing area.

Power Station Area and Coal Stockyard

- Sources of contaminants include the fuel depot, the oil skimmers and storage area, the power Station outlets and the station drain dams.
- Hydrocarbon pollution of groundwater from the oil skimmers might be inadequate.
- Monitoring of groundwater pollution from the fuel depot is inadequate.
- Monitoring of surface runoff is inadequate.
- Maintenance work is done in the vicinity of PC06. Maintenance work must be finished and the area must be rehabilitated.
- The coal settling ponds must be cleaned and coal and rubbish must be removed.
- The oil skimmers are currently in the process of building. Skimmers are not yet operational. Oils skimmers must be brought up to standard and in a working condition.
- The new CP06 (coal stockyard dam at north-western corner of Power Station) is currently in a satisfactory condition.
- Standing water was detected close to CP06. Water is also seeping from the old part of CP06. This area must be inspected and monitored on a regular basis.
- Old coal settling pond must be cleaned.
- The oil containers are left to stand on open soil in the contractor's area. The drums should be put on bunded hard stands or in the oil sump.

Sewage Plant Area

- The area is clean and neat and seems to be operated properly.
- Monitoring bacteriological pollution of the ground- and surface water is inadequate.

Komati Spruit

- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

Geluk Spruit

- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

7.2 Surface- and Groundwater Quality – Inorganic parameters

Ashing Area and Domestic Waste Site

- Groundwater from this area is classified as marginal to poor and dangerously poor due to high concentrations of Mg, Fe, SO_4 and high EC values indicating detrimental impacts on the groundwater.
- AB01 (monitoring borehole at domestic waste site), AB02 (monitoring borehole east of new ash dams), AB07 (monitoring borehole below seepage recovery dam) and AC02 (north-western side of ash dam) is classified as dangerous due to the concentrations of Mg and SO_4 and is classed as Class 4 water quality totally unsuitable for human use. Acute effects may occur.
- AB05 (monitoring borehole at dam) can be classified as poor due to the concentrations of SO_4.
- AB03 (monitoring borehole east of old ash dams), AC03 (dirty water canal on eastern side of ash dam), AC05 (north of ash dam where road crosses over pipelines) and AP03 can be classified as good water quality.
- The surface water is expected to be contaminated as it is part of the dirty water system and is classified as poor due to high SO_4 and Fe concentrations at the seepage recovery dam **AP03**.
- AP02 (clean water dam where Komati Spruit originates west of ash dam) and AC04 (north-eastern corner of ash dam where road crosses over pipelines) can be classifies as marginal due to the concentrations SO_4.

Power Station and Coal Stockyard Area

The waters from the Power Station and Coal Stockyard area are classified as ideal to good. It can be summarised as follows:

- CP06 (coal stockyard dam at north-western corner of Power Station) can be classified as water with an ideal quality.
- PB08 (monitoring borehole below station drain dams and oil skimmers), CB09 (monitoring borehole at coal stockyard dam) and PC08 (first bridge south of Power Station where road crosses Komati Spruit) can be classified as good water quality.

Sewage Plant Area

- SE01 (sewage PSE outlet) at the sewage plant can be classified as poor due to the concentrations of NO_2.

Komati Spruit Area

- KMR01 (second bridge south of Power Station where road crosses Komati Spruit) can be classified as poor due to the concentrations of SO_4.

Geluk Spruit Area

- The waters from the Geluk Spruit can be classified as ideal to good.

7.3 MMAC Plots and Time Graphs

Interpretation of MMAC plots and time graphs suggests that water quality has deteriorated at a number of sites across Komati Power Station. Water quality deterioration is particularly evident at sites AB01, AB02, AB05 and AB07. These sites have the highest on record concentrations for some of the indicator elements. This observation indicates that ashing facility and power station are still contributing to groundwater contamination.

Variability in some chemical parameter concentrations is observed at most sites. This may reflect the influence of climatic factors on the groundwater quality. During and after heavy rains it is possible that leaching of contaminants into the groundwater may be more pronounced, thereby causing increases in the concentrations of the contaminants. In addition, groundwater level increases during the rainy seasons may cause the water to be exposed to contaminants that would otherwise be too shallow to have a direct impact on the groundwater quality. To obtain more insight in this regard, groundwater level data are required so that these data can be related to the observed chemical parameter concentrations.

Increasing trends in the parameter concentrations show the cumulative effects of contaminant impacts on the surface- and groundwater quality. Water quality degradation over time is especially apparent at sites AB01, AB02, AB05 and AB07.

7.4 EC Profiling

During this investigation no preferential pathways were identified in the boreholes along which contaminant transport can take place. It is recommended that sampling be continued at the depths indicated in Table 19.

The EC profiling investigation showed that some of the boreholes have been subject to severe silting or have collapsed. Decreased borehole depth is evident at all the boreholes. These boreholes can, however, still serve as monitoring boreholes and it is not deemed necessary to replace them at present.

7.5 Recommendations

Ashing Area and Domestic Waste Site

- The seepage towards the west of the ash dam must be contained as it enters the Komati Spruit and eventually ends up in the Koring Spruit towards the north-west of the Power Station.
- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

Power Station Area and Coal Stockyard

- An investigation should be launched at the oil skimmers to determine if groundwater monitoring at P**B08** is adequate for hydrocarbon pollution monitoring from the oil skimmers. An additional borehole should be installed if **B08** is found to be inadequate for this purpose.

- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

Sewage Plant Area

- A monitoring borehole should be installed to monitor bacteriological contamination of groundwater at this area.
- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

Komati Spruit

- Seepage from the ash dam should be intercepted and prevented from entering this spruit.
- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

Geluk Spruit

- Provisions should be made to intercept spillages that may arise from leaking pipes at the eastern side of the Power Station in order to prevent it from entering this spruit.
- A detailed monitoring system which includes all the inadequacies of the system is discussed in detail in Appendix D of this document.

L.J. van Niekerk (Pr.Sci.Nat.) ***S. Staats (Pr.Sci.Nat.)***

Appendix E

DOCUMENT LIMITATIONS

DOCUMENT LIMITATIONS

This document has been provided by WSP Group Africa Pty Ltd ("WSP") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in WSP's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of WSP's Services are as described in WSP's proposal, and are subject to restrictions and limitations. WSP did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by WSP in regard to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry WSP was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. WSP's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed WSP to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by WSP for incomplete or inaccurate data supplied by others.

vii) The Client acknowledges that WSP may have retained sub-consultants affiliated with WSP to provide Services for the benefit of WSP. WSP will be fully responsible to the Client for the Services and work done by all its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from WSP and not WSP's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against WSP's affiliated companies, and their employees, officers and directors.

viii) This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party because of decisions made or actions based on this Document.

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

wsp.com