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NEAS REF: DEA/EIA/0001413/2012

APPLICATION FOR AN INTEGRATED ENVIRONMENTAL AUTHORISATION AND WASTE MANAGEMENT LICENCE IN TERMS OF THE:
NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT 107 OF 1998) AS AMENDED AND THE ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2010; AND

NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008 (ACT 59 OF 2008) AND GOVERNMENT NOTICE 718 OF 2009

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

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INTEGRATED WASTE MANAGEMENT LICENCE APPLICATION FOR THE KUSILE COAL FIRED POWER STATION

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT

(Ref. No. 14/12/16/3/3/3/51)

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LIST OF ABBREVIATION

ADDD	Ash/gypsum Dump Dirty Water Dam
BID	Background Information Document
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DWA	Department of Water Affairs
EA	Environmental Authorisation
EAD	Emergency Ash/gypsum co-disposal facility
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act, 1989 (Act of 73 1989)
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
IDP	Integrated Development Plan
FGD	Flue Gas Desulphurisation
ISP	Internal Strategic Perspective
GN	Government Notice
HDPE	High Density Polyethylene
I&APs	Interested and Affected Parties
IAIA	International Association for Impact Assessment
IRR	Issues and Responses Report
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEMWA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
NWA	National Water Act, 1998 (Act 36 of 1998)
NPV	Net Present Value
PPP	Public Participation Process
RN	Registration Number
SDD	Station Dirty Water Dam
SDD ST	Station Dirty Water Dam Settling Tank
UNFCCC	United Nations Framework Convention on Climate Change
WML	Waste Management Licence
WMLA	Waste Management Licence Application
WULA	Water Use Licence Application

LIST OF UNITS

ha	hectares
km	kilometres
MW	Megawatts
ℓ/s	litres per second
m	metres
mamsl	metres above mean sea level
mm	millimetres
m^3	cubic metres
%	percentage
m^3/a	cubic metres per annum
mm/a	millimetres per annum

1. INTRODUCTION

1.1. BACKGROUND

In 2006 Eskom Holdings initiated an Environmental Impact Assessment (EIA), undertaken by Ninham Shand (Pty) Ltd, for the construction of a 4 800 MW Kusile Coal-Fired Power Station and associated infrastructure in the Witbank area. The power station covers approximately 2 500 ha of land on the Farm Hartebeesfontein 537 JR and the Farm Klipfontein 566 JR. The power station precinct includes the power station building, administration buildings (administrative, medical, maintenance, services) and the high voltage yard. The associated infrastructure applied for during the EIA included a water treatment works, a wastewater treatment works, access roads, railway line, water supply pipelines, a coal stockyard, an ash disposal facility, a coal and ash conveyor system and water storage facilities.

Ninham Shand concluded that the proposed development would not conflict with the principles of the Environmental Conservation Act (ECA), 1989 (Act No. 73 of 1989), that the Public Participation Process (PPP) was undertaken as per relevant regulations and the issues of the Interested and Affected Parties (I&APs) were adequately addressed. Ninham Shand therefore recommended that the proposed development should be authorised subject to the implementation and enforcement of the recommendations and mitigation measures contained in the EIA Report and Environmental Management Programme (EMPr) (Please refer to **Appendix A** for a copy of the EIA Report).

In June 2007, the Department of Environmental Affairs (DEA) issued a positive Environmental Authorisation (EA) (Ref: 12/12/20/807) for the construction of the Kusile Coal Fired Power Station and Associated Infrastructure in the Witbank Area, Mpumalanga Province (Please refer to **Appendix B** for a copy of the EA). This June 2007 EA was appealed and a revised EA was issued in March 2008 under the ECA.

In terms of this EA, Eskom can construct the power station and operate ash disposal systems. The EA also states that Kusile Power Station will have Flue Gas Desulphurisation (FGD) technology to minimize particulate and SO_2 emissions. As a result of FGD technology, gypsum shall be produced as a by-product during operation of the power station.

At the time of the EIA, Eskom's intention was to dispose of ash only at the ash disposal facility and initiated an investigation to determine existing potential

opportunities in the market which would result in the use of gypsum. Although the possibility of gypsum being generated through the FGD process and the commercial value related to it was discussed in the final EIA Report, the disposal of gypsum on the ash/gypsum co-disposal facility was not included. The co-disposal of gypsum with ash is therefore not authorised.

Since gypsum is considered to be a hazardous waste (classified as a medium hazardous waste), a Waste Management Licence (WML) must be applied for to co-dispose ash and gypsum as a listed activity 9, Category B of GN718 and the construction of the facility (Ash/gypsum dump, the Ash/gypsum co-disposal facility Dirty Water Dam (ADDD), the Station Dirty Water Dam (SDD) and the station dirty dam settling tanks (SDD ST)) will trigger activity 11, Category B of GN 718.

In addition to the hazardous waste that will be disposed of at Kusile, general waste including rock spoils (the concrete rock spoil and K3 spoils) produced during construction will also be temporarily stored on site.

The construction of the ADDD within a wetland will trigger activities 11 and 18 of GN R544. **Table 1-1** and **Table 1-2** give a summary of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA) activities that will be triggered as a result of the various waste activities at Kusile.

Table 1-1: Summary of NEMA Listed Activities being applied for

Number and date of the relevant notice:	**Activity No (s) (in terms of the relevant or notice) :**	**Description of each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):**
Government Gazette R544 2 August 2010	**11**	The construction of the Ash/gypsum co-disposal facility Dirty Water Dam (ADDD) and settling dams within a wetland.
	18	Removing soil located in a wetland for the construction of a waste management facility and depositing ash/gypsum waste material exceeding 5 m^3 into the wetland for storage purposes using a waste management facility.

Table 1-2: Summary of NEMWA Listed Activities being applied for

No. & Date Of The Relevant Notice:	Activity Numbers (As Listed In The Waste Management Activity List) :	Description of Listed Activity
Government Notice 718 of 3 July 2009	**Category A 3 (1)**	The temporary storage of silty soils and degradable rock which is not suitable for use as general backfill within the project (classified as general waste) at the K 3 spoil stockpile that has the capacity to store in excess of 100 m^3.
		The temporary storage of construction waste (mainly concrete, unusable soil, rebar and unwanted material, classified as general waste) at the Concrete spoil stockpile that has the capacity to store in excess of 100 m^3 .
Government Notice 718 of 3 July 2009	**Category B (9)**	The co-disposal and storage of ash and gypsum which has been classified as a moderate hazardous waste to land.
		The disposal of the belt filter press sludge (gypsum) from the FGD process to land.
	Category B (11)	The construction of a hazardous waste facility (Ash/Gypsum Dump) and its associated dams (Ash/gypsum co-disposal facility Dirty Water Dam, Station Dirty Water Dam and Station Dirty Water Dam Settling Tank).

The March 2008 Environmental Authorisation granted Kusile Power Station permission to construct a number of waste related facilities (**DEA Ref: 12/12/20/807**). In May 2010, Kusile Power Station was also granted a waste management licence (**DEA Ref: 12/9/11/L193/6**) (**Appendix C**) for additional waste activities. The authorised waste activities are summarised in **Table 1-3**.

Table 1-3: Summary of Authorised Waste Activities at Kusile

No.	Activity	Comments

No.	Activity	Comments
1.	Sewage treatment works	The Sewage Treatment Works were authorised in terms of the 2008 Environmental Authorisation (**DEA Ref: 12/12/20/807**).
2.	Coal Stockyard Pollution Control Dam (PCD)	The Coal Stockyard PCD was authorised in terms of the 2008 Environmental Authorisation (**DEA Ref: 12/12/20/807**).
3.	Potable Raw Water Treatment (Brine)	The Potable Raw Water Treatment (brine) was authorised in terms of the 2008 Environmental Authorisation, which authorised water and waste water treatment facilities (**DEA Ref: 12/12/20/807**).
4.	Water Treatment Plant	The Water Treatment Plant was authorised in terms of the 2008 Environmental Authorisation, which authorised water and waste water treatment facilities (**DEA Ref: 12/12/20/807).**
5.	Effluent Neutralisation Plant	The Effluent Neutralisation Plant was authorised in terms of the 2008 Environmental Authorisation, which authorised water and waste water treatment facilities (**DEA Ref: 12/12/20/807).**
6.	Holding Recycling Dams and De-gritting Sumps	The Holding Recycling Dams and De-gritting Sumps were authorised in terms of the 2008 Environmental Authorisation, which authorised water and waste water treatment facilities (**DEA Ref: 12/12/20/807**).
7.	Temporary Demineralisation Plant	The Temporary Demineralisation Plant was authorised in terms of the 2008 Environmental Authorisation, which authorised water and waste water treatment facilities (**DEA Ref: 12/12/20/807**).
8.	Radial Stacker	The Radial Stacker was authorised in terms of the 2008 Environmental Authorisation, which authorised ash disposal facility (**DEA Ref: 12/12/20/807**).

No.	Activity	Comments
9.	Emergency Ash/gypsum co-disposal facility (EAD)	The EAD was authorised in terms of the 2008 Environmental Authorisation, which authorised ash disposal facility (**DEA Ref: 12/12/20/807**).
10.	Hazardous Waste during construction	The hazardous waste produced during construction was authorised in terms of the waste licence (**DEA Ref: 12/9/11/L193/6**).
11.	General Waste during construction	General waste produced during construction was authorised in terms of the waste licence (**DEA Ref: 12/9/11/L193/6**).

In addition to the activities in **Table 1-1** and **Table 1-2**, Eskom is also looking to consolidate all waste activities into one licence and is requesting that the Department includes the abovementioned activities (**Table 1-3**), which were applied for and authorised prior to the promulgation of the NEMWA, in the Licence.

1.2. PROJECT TEAM

The environmental assessment has been undertaken by Ndomupei Dhemba and Deon Esterhuizen, and specialist input from René von Gruenewaldt from Airshed (air quality) Dr Manda Hinsch from SRK (Surface Water Quality and Hydrology), Dr Johann du Preez from MDA (Ecology), Ms Kylie Farrell from Golder (Aquatic Ecology) and Ms Claudia Brites from GCS (Hydrogeology).

Deon Esterhuizen is a certified Professional Natural Scientist (Registration Number: 400154/09) with a MSc in Environmental Management with 20 years of experience in water related projects, which include water quality management, registration and licencing of water users, completion of Environmental Impact Assessments in support of the issuing of Record of Decisions, development of a management guide for domestic water use, project management, and implementation of the Resource Directed Measures as required by the Department of Water Affairs.

Ndomupei Dhemba is a GIS and Remote Sensing specialist with a Masters degree in GIS and remote sensing for environmental management. She is a registered Natural Scientist with the SACNASP (Registration Number: 400045/14). She has eight years of experience in natural resources management including resource inventorying and auditing, biodiversity assessment and spatial planning, GIS and remote sensing, as well as environmental management. Ndomupei has also

undertaken environmental assessments for projects in Tanzania, Botswana and South Africa. She also assisted with the applications for amendments to authorisation on the Gautrain.

The qualifications for each specialist are provided in **Chapter 9**.

1.3. PURPOSE OF THIS STUDY

Environment Impact Assessment (EIA) is defined as the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made (IAIA, 1999). The aim of the EIA is to prevent substantial damage to the environment. The objectives of this study are:

- To comply with the requirements of National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated Regulations;
- To identify the most important issues that must be considered during impact assessment;
- To ensure that environmental considerations are explicitly addressed and incorporated into the project;
- To anticipate and avoid or minimize the adverse significant effects of the proposed project;
- To identify procedures and methods for the follow-up (monitoring and mitigation) in the operation of the ash/gypsum co-disposal facility;
- To promote sustainable development and optimize resource use and management opportunities; and
- To enable the competent authority to make a decision and set conditions that must be adhere to.

1.4. THE OBJECTIVES OF THIS REPORT

This EIA report was compiled with the aim to document the EIA process. The draft EIA report will be made available to stakeholders for their comments. All comments received will be considered and incorporated into a final EIA report that will be submitted to the authority for decision making.

1.5. STRUCTURE OF THIS REPORT

The structure of this report was designed with the aim to meet the requirements of the EIA Regulations R. No. 385 of 2006 as captured in Regulation 32(2). **Chapter 2** presents the project desirability. **Chapter 3** provides a brief overview of the project locality. The description of the project is presented in **Chapter 4** and **Chapter 5**. The

legislations and guidelines that we used to complete this EIA project are listed in **Chapter 6**. **Chapter 7** provides a description of the receiving environment.. The key issues that were identified during the scoping phase are presented in **Chapter 8**. The summary of specialists' studies is given in **Chapter 9**, and it contains the following information:

- Details and expertise of each specialist;
- Declaration of independence;
- Terms of Reference (ToRs) for specialists' studies;
- The consultation process;
- Summary of findings; and
- Recommendations by specialists.

The assessment of the existing Environmental Management Plan and Wetland Management Plan is included in **Chapter 10**. **Chapter 11** contains the impact assessment methodology that was employed in this project and the results of the impact assessment and the proposed mitigation measures. The Public Participation Process (PPP) is presented in **Chapter 12**. **Chapter 13** presents the environmental statement, whilst the conclusion and recommendations of the Environmental Assessment Practitioner (EAP) are presented in **Chapter 14**. Finally, the cited literature is listed in **Chapter 15**.

2. PROJECT DESIRABILITY

Eskom is the primary supplier of electricity in South Africa, providing approximately 95% of the electricity consumed. The decision to expand Eskom's electricity generation capacity was based on national policy and informed by on-going strategic planning undertaken by the national Department of Minerals and Energy (DME), the National Energy Regulator of South Africa (NERSA) and Eskom.

According to the white paper that was published by the Department of Energy, the objectives for the further development of the energy sector are as follows:

- Increased access to affordable energy services;
- Improved energy governance;
- Stimulating economic development;
- Managing energy-related environmental and health impacts; and
- Securing supply through diversity.

Studies conducted have shown that the demand for electricity in South Africa far outweighs the supply. The Kusile Power Station is a response by Eskom towards meeting the growing electricity demand. The ash/gypsum co-disposal facility and associated infrastructure form an integral part of the Power Station, without which the power station cannot function.

In addition to contributing significantly to the electricity grid of South Africa, Kusile Power Station will also make significant economic contributions at local, regional and national levels. Socio-economic studies conducted by Urban-econ during the 2006 EIA for the power station showed that during the construction phase, 55 560 employed person-years were expected to be created. This included direct jobs, i.e. construction workers and supporting services, as well as indirect jobs, i.e. jobs created within businesses that support companies directly involved in construction of and supply of material to the power station. The 55 560 employed person-years correlated with approximately 3 670 new direct jobs and 3 275 indirect employment opportunities created during the whole construction period (Urban-econ), 2006.

Urban-econ determined that operational expenditure of R 2.06 billion per annum would lead to an increase in new business sales by an additional R 7.06 billion per annum. This included direct as well as indirect spin-offs. Approximately R 2.3 billion of new business sales was expected to be generated as a result of direct effects (Urban-econ, 2006).

It was anticipated that 800 jobs would be created by the power station directly. At the same time, the operation of the power station by means of the multiplier effect was determined to create an additional 5 430 jobs. These jobs would be formed mainly in the trade, mining and transportation sectors. Thus, through direct and flow on effects the operating power station was determined to create 6 230 sustainable jobs. It was expected that the value-added would increase by R 2.67 billion per annum, of which R 1.18 billion would be generated directly by the operations of the power station (Urban-econ, 2006).

3. LOCATION OF PROJECT

The Kusile Project is located on approximately 2 500 ha on the farms of Hartbeestfontein 537 JR and Klipfontein 566 JR within the Mpumalanga Province.

The Kusile Project falls within the jurisdiction of the Delmas Local Municipality which is in the Mpumalanga Province. The largest town within a 30 km radius of the Kusile Project site is Emalahleni. The smaller town of Kungwini lays approximately 20 km north-west of the site.

Figure 3-1 shows the Kusile Project location. **Figure 2-2** and **Figure 2-3** show the current Project Layout Plan

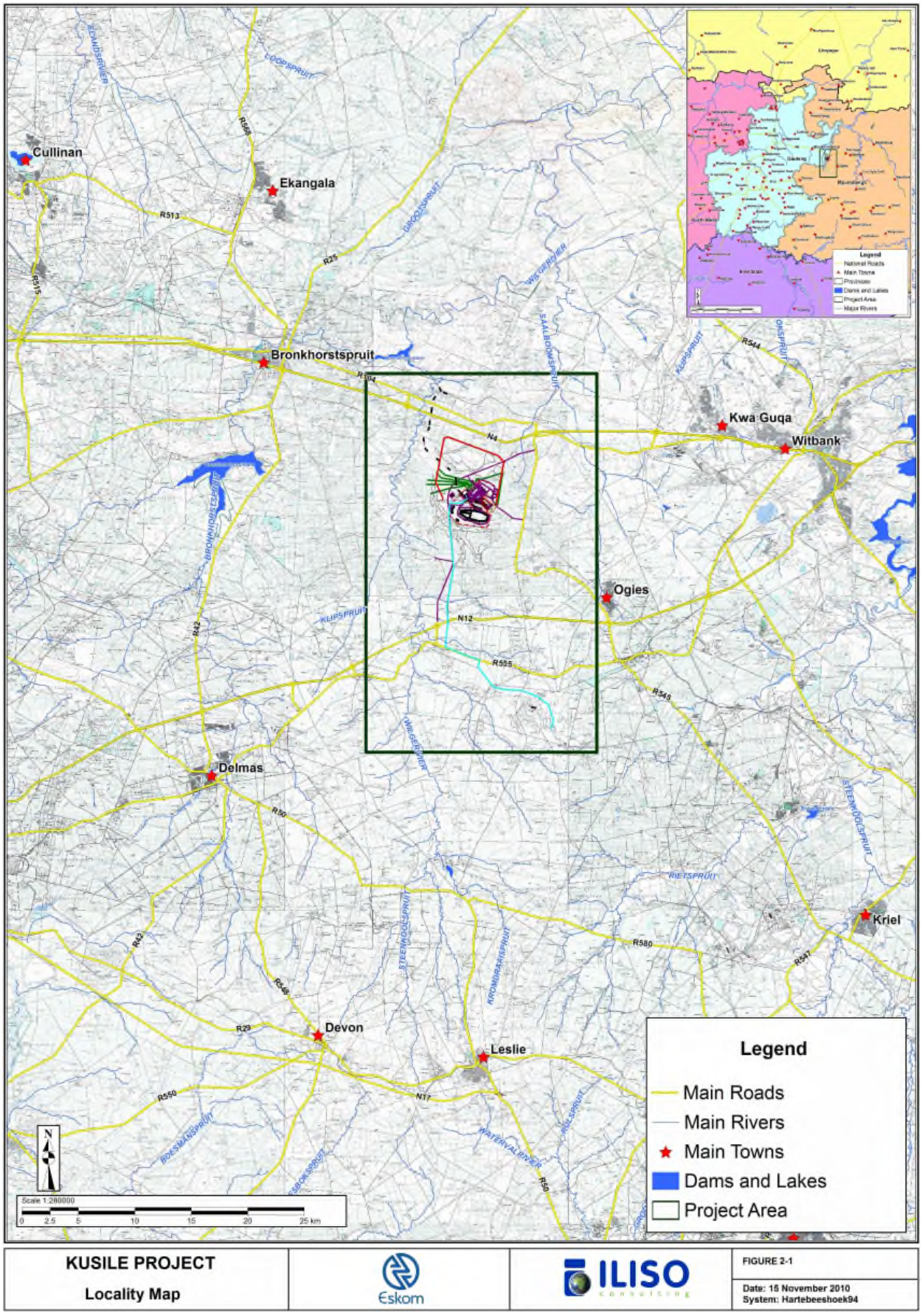

Figure 3-1: Kusile Project Location

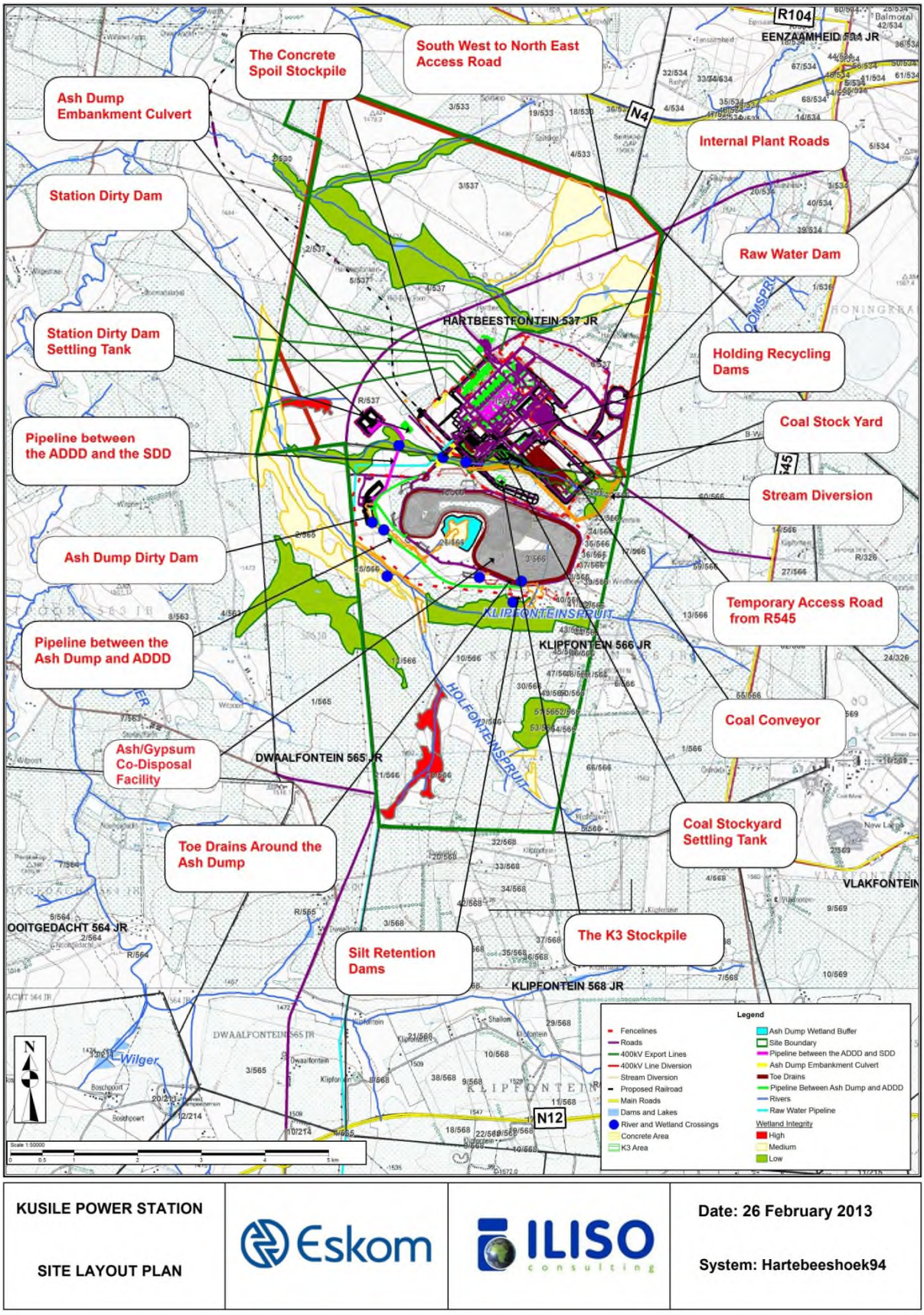

Figure 3-2: Kusile Site Layout Plan

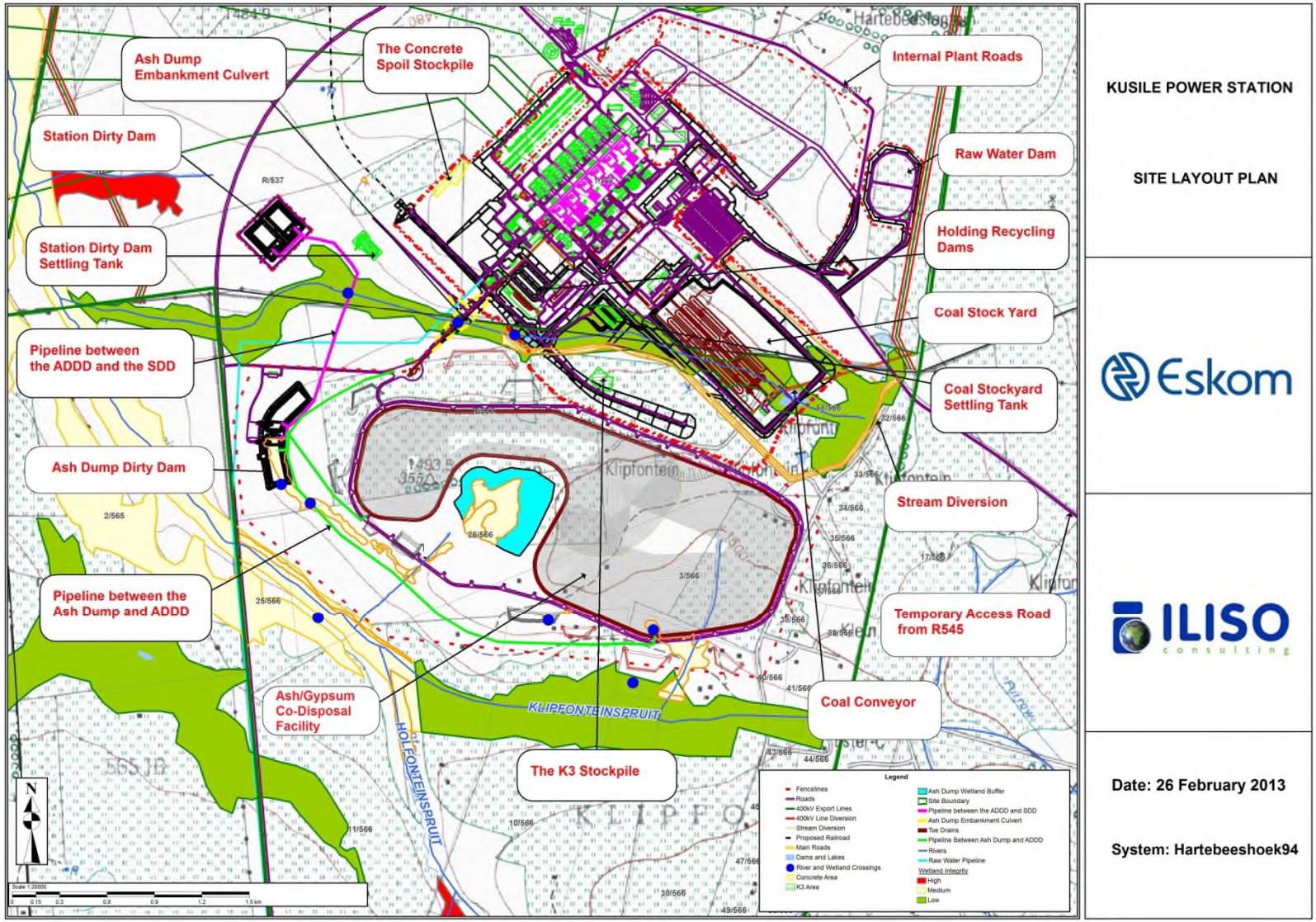

Figure 3-3: Kusile Site Layout Plan

3.1. PROJECT DESCRIPTION

The Kusile Project entails the construction of the following:

Power Station Precinct:

i) Power station buildings
ii) Administration buildings (control buildings, medical, security, etc);
iii) High voltage yard

Associated Infrastructure:

i) Coal stock yard
ii) Coal and ash conveyors
iii) Water supply pipelines (temporary and permanent)
iv) Water and waste water treatment facilities
v) Ash disposal system
vi) Access roads (including haul roads)
vii) Dams for water storage
viii) Railway siding and/or line for sorbent supply

This integrated waste management licence application is applicable to the following:

- The ash/gypsum disposal facility and the ADDD;
- The SDD and the SDD ST; and
- Concrete and K3 Stockpile Areas.

All the design Reports are attached in **Appendix D**.

3.2. ASH/GYPSUM CO-DISPOSAL PROCESS

Above ground ash disposal will be used. The ash produced through the combustion of the coal will be removed from the bottom of the boiler (boiler bottom ash) and the fly ash removed from the top of the boiler together with the flue gas (via electrostatic precipitators or bag filters) and sent to an ash/gypsum dump.

The Flue Gas Desulphurisation (FGD) process that will be used to reduce sulphur emissions will also result in filter cake/gypsum which will be transported via a conveyer belt to the ash/gypsum disposal facility.

3.3. ASH/GYPSUM ASH/GYPSUM CO-DISPOSAL FACILITY

The ash/gypsum ash/gypsum co-disposal facility will be located to the south of the power station, on high ground between two drainage paths. Construction of the facility will entail:

- Excavate and construct the dirty water concrete channels in 1 000 m lengths at a time.
- Backfill trenches after completion of each section.
- Construct perimeter road bed and balance of culvert crossings over 1 000 m lengths at a time.
- Excavate and form clean water drains in 1 000 m sections together with culverts and culvert discharge trenches to silt retention dams.
- Topsoil removal and foundation preparation in 0.25 km squared sections of the phase one footprint to receive the liner sandwich installation (also installed in 0.25 km squared sections).
- Deliver, spread and tip the 300 mm G5 protection layer over the installed liner as soon as each 0.25 km squared section is complete.
- Form toe wall to each liner panel section, including drainage pipes at 75 m intervals for storm water discharge to the silt retention dams.

The disposal of ash/ gypsum is to be undertaken as follows:

Place the ash/gypsum onto the ash/gypsum disposal facility for the first 4 years of power station operation by a load and haul operation. The ash and gypsum will be delivered by conveyer to a radial stacker near the ash/gypsum disposal facility, for subsequent loading, hauling and placement into paddocks of approximate size 200 m by 200 m, developed in 2 m lifts, spread initially over the ash/gypsum disposal facility 5-year half-footprint, to full design height on the ash/gypsum disposal facility, and then similarly over the second half of the footprint.

3.4. ASH/GYPSUM CO-DISPOSAL MODELLING

The power station comprises six boiler units which will be commissioned one every eight months, starting December 2014. The full power station ash/gypsum output will thus only be effective in the 4th year of operation. In years 6 to 60 of operation, only gypsum will be placed at significantly reduced tonnages onto the ash/gypsum disposal facility by the same, but smaller, load and haul operation.

3.5. ASH/GYPSUM ASH/GYPSUM CO-DISPOSAL FACILITY FLOOD HYDROLOGY

The ash/gypsum load and haul deposition system will enable the disposal facility operators to place the ash/gypsum disposal facility in such a manner as to be free draining in shape, with minimisation of any depression that will collect and retain stormwater run-off.

Temporary artificial channels will be constructed on the exposed ash surfaces to lead stormwater down the faces to the dirty water collection channels in a controlled manner thereby preventing erosion. Irrigation of the exposed ash surfaces will take place to achieve dust control. Irrigation water volumes will be restricted as far as possible to limit any seepage potential arising from the irrigation waters.

3.6. ASH/GYPSUM DISPOSAL FACILITY STABILITY

Exposed surfaces will be finally shaped at 1:5 on the side slopes and at 1:200 on the top surfaces and rehabilitated as soon as practically possible by placement of selected topsoil and vegetation cover. These areas will be irrigated to promote and sustain the vegetation.

3.7. ASH/GYPSUM CO-DISPOSAL FACILITY DIRTY WATER DAM

The dirty water collection channels will be routed to the ADDD, which is located northwest of the disposal facility. The liners for the ADDD were designed in conjunction with the DWA, taking the gypsum into account to ensure no or minimal seepage. The ADDD will also have concrete lined sections at the low end of the ADDD for equipment access and removal of accumulated solids. The water stored in the ADDD will be used for dust suppression. In case of excessive stormwater in the ADDD, manual controls will allow gravity flow to the station dirty dam contingent on water quality. The outlet pipe in the ADDD will be elevated above operation volume levels to minimize the conveyance of solids to the SDD. Note that a 50 year, 8 day storm event can be stored in the ADDD for the worst case dirty area of the ash/gypsum disposal facility and that the ADDD is comprised of two 50 % cells so that one cell can remain in service while the other cell is being maintained.

3.8. RADIAL STACKER

The Radial Stacker will be located adjacent to the 10-year ash/gypsum dump. Ash and gypsum will be delivered by conveyor to a radial stacker near the ash/gypsum disposal facility, for subsequent loading, hauling and placement into paddocks of approximated size 200 m by 200 m, developed in 2 m lifts. The ash and gypsum will

be spread initially over the ash/gypsum disposal facility 5-year half-footprint, to full design height on the ash/gypsum disposal facility, and then similarly over the second half of the footprint.

For the radial stacker operation, the combined waste product from the overland conveyors will be stacked in a kidney shaped pile by a radial stacker machine adjacent to the ash/gypsum disposal facility. The kidney shaped pile will be reclaimed by mobile equipment and loaded into trucks which will drive into the ash/gypsum disposal facility and dump the waste product. The radial stacker area will be large enough to accommodate the pile from the radial stacker and to also accommodate multiple trucks and mobile equipment working on the pile simultaneously. The radial stacker area will have a concrete slab with a liner under it and will be fed by one of the overland link ash conveyors. The other overland link ash conveyor will discharge directly onto a concrete slab, also lined, and create a conical shaped pile just North of the radial stacker. This conical shaped pile will be much smaller than the kidney shaped pile but will be used if the conveyor to the radial stacker is disabled or separation of the ash and FGD dewatered solids is required. The liners for the radial stacker were designed in accordance with the requirements of the DWA.

Should there be a problem with the radial stacker or the 10-year ash/gypsum disposal facility, the handling system will convey the waste products to an emergency ash/gypsum disposal facility (EAD) area.

3.9. EMERGENCY ASH/GYPSUM CO-DISPOSAL FACILITY (EAD) AREA

The Emergency Ash/gypsum co-disposal facility (EAD) will consist of a concrete lined area of approximately 1.4 ha, sloped to fall with a concrete trapezoidal drain on two adjacent sides and a concrete rectangular channel drain on the other two sides that joins the trapezoidal drain. The EAD will be used occasionally for the temporary storage of quenched ash for periods of up to 24 hours, before being removed for permanent disposal on the appropriately licensed waste disposal facility. The EAD therefore does not represent the same level of environmental risk as the permanent ash disposal facility.

The purpose of the EAD is to have a place to stack waste product should both the overland link ash conveyors become disabled. The EAD is sized to provide 24 hours storage of bottom ash and FGD dewatered solids for all 6 units running at full

capacity. The fly ash will be stored in the fly ash silos for up to 24 hours in case of an emergency. The EAD will have a large concrete slab on which the pile will be stacked. Underneath the concrete will be a liner which will be designed in accordance with the DWA Minimum Requirements for Waste Disposal by Landfill, and will be subject to DWA approval. The concrete slab is designed to contain and drain the EAD area and direct run off to a sump located on the North West corner of the slab. After an emergency and once the overland link ash conveyors are operational again the bottom ash will be reclaimed and loaded onto the overland link ash conveyors and taken to the ash/gypsum ash/gypsum co-disposal facility.

3.10. STATION DIRTY DAM

All potentially contaminated water on the Kusile Power Station will be managed in a closed system. The SDD are two equal capacity, lined, temporary holding dams that act as a collection point for all polluted storm-water and wash-down water on the Kusile site, before it is pumped to the Holding/Recycle Dams (HRD).

The SDD will receive inflows from two distinct sources:

1) Coal Stockyard Settling Tanks (CSY ST): The CSY ST will receive inflows from the Coal Stockyard (CSY), EAD, limestone processing area, and a number of grit sumps. Clarified water leaving the CSY ST will travel via gravity pipeline to the SDD.
2) Station Dirty Dams Settling Tanks (SDD ST): The SDD ST will receive inflows from the station terrace area. Clarified water leaving the SDD ST will travel via gravity pipeline to the SDD.

The SDD will receive gravity discharges of dirty water from the rest of the Kusile Power Station. The SDD will also receive water from the ADDD. It will be the furthest downstream dirty water structure on the site and therefore is required to be down-gradient from the power station. The natural contours of the site slope downwards to the north-west, towards the non-perennial tributary of the Klipfonteinspruit. The SDD will be optimally located approximately 1 km north-west of the power station's north-west fence corner. The selected position avoids surrounding wetlands and the 1:100 year flood line of the natural stream. The SDD elevation will range from 1 441 meters above sea level (masl) at the sump of Compartment No. 2 to 1 454 masl at the crest of Compartment No. 1.

To prevent contamination to the underlying soil, the SDD is required to be a fully contained structure. The liners for the SDD will be designed in accordance with the

DWA Minimum Requirements for Waste Disposal by Landfill (1998)", and will be subject to DWA approval.

3.11. STATION DIRTY DAM SETTLING TANK

The SDD ST will be located to the north-west of the main power block, and south-east of the SDD. This position is down-gradient of the power station terrace and in close proximity to the SDD. The SDD ST will receive gravity discharges of dirty water from the power station terrace. The two compartments of the settling tank will be partially excavated into the natural ground and partially built in a fill terrace. The terrace elevation was carefully planned in conjunction with the inlet and outlet pipe hydraulic requirements.

The SDD ST will consist of two equal capacity concrete basins that clarify contaminated water from the power station terrace before it travels by gravity pipeline to the SDD. The SDD ST will transmit dirty water inflows from the main power station terrace via a pipeline, to the SDD.

The SDD ST is designed:

- To pass all of the dirty water runoff from its inflow sources for the 1:50 year, peak instantaneous storm event.
- With an emergency spillway to accommodate larger events.
- With two equal capacity compartments which can each pass 6.55 m^3 /s. The water enters each compartment of the SDD ST via four sluice gates (1.75 m^2). The two compartments will allow for occasional maintenance and inspection access (preferably during the dry season) without interrupting the functionality of the SDD ST under normal circumstances.

3.12. FLUE GAS DESULPHURISATION WASTEWATER TREATMENT PLANT

The FGD process will result in the production of an FGD wastewater/brine stream which has significantly high concentrations of chlorides, magnesium, calcium, and heavy metals. This wastewater cannot be directly re-used elsewhere in the station. As Kusile Power Station is to be a zero-liquid effluent discharge site, this wastewater will require specialised treatment. Kusile Power Station will employ a three step process of 1) Pre-treatment, 2) Evaporation/Concentration, and 3) Crystallisation to treat this wastewater. This will produce a clean water stream that can be reused, which allows the power station to reduce its raw water intake by up to 3%. Wastes will be generated in the pre-treatment step and crystallization step. This waste will be

in solid form and will consist of the gypsum that will be disposed of at the ash/gypsum disposal facility. The initial plan was to dispose of the salts from the FGD Sludge at the Holfontein Disposal Facility. However due to the costs, the salts will now be disposed of on-site. The site for the disposal of salts from the FGD Sludge will be identified and applied for in a separate application. The flow diagram for the FGD Wastewater treatment plant is attached as **Appendix E**.

3.13. SPOIL AREAS

Two separate spoil areas have been developed at Kusile as follows:

- The Concrete Spoil Stockpile which is a mixture of waste containing mostly concrete, unusable soil , rebar (re-enforcing steel) and rubbish; and
- The K3 stockpile which will comprise of silty soils and degradable rock which is not suitable for use as general backfill within the project.

These spoil areas will be temporary. The concrete will be disposed of offsite and the remaining K3 will be spread out and grass will be planted on top.

4. AMOUNTS OF WASTE TO BE DISPOSED OF

It is expected that the ash/gypsum dump will handle approximately 3 600 tonnes of ash and gypsum per day within the first four years, and 21 600 tonnes of ash and gypsum per day at year 5. For the next 55 years (year 6-60), only gypsum will be disposed of at the facility. The amounts of gypsum to be handled at the ash/gypsum dump will be 2 783.52 tonnes per day. It is expected that an additional 72 tonnes of gypsum per day will be produced from the FGD as belt filter press sludge.

The rock spoils to be stored daily at Kusile are estimated to be 75 tonnes at the concrete spoil area and 500 tonnes at the K3 spoil area. **Table 4-1** provides a summary of all the waste sites that are being applied for and the total amounts of waste expected to be disposed of at each site.

Table 4-1: Summary of Waste Sites being applied for

Waste Site	Size of facility for a waste management activity	Area where the waste management activity takes place	Classification of facility in terms of climatic water balance	Type of Facility	The quantity of waste received
Ash/Gypsum ash/gypsum co-disposal facility	The footprint of the ash/gypsum ash/gypsum co-disposal facility is approximately 250 ha	The ash/gypsum ash/gypsum co-disposal facility will be located on Farm Klipfontein 566JR (Coordinates: 25º 56' 13.05"S, 28º 55' 11.49"E).	The ash/gypsum ash/gypsum co-disposal facility is classified as B^+ (water excess).	Ash is classified as non-hazardous waste and gypsum is classified as a moderate hazardous waste according to the DWA Minimum Standards Classification, therefore, the mixture is classified as a moderate hazardous waste. The co-disposal of ash and gypsum will require a class H:h (LB^+) waste disposal facility.	The total waste storage for the Ash/gypsum disposal facility will be 84 423 000 m^3.
Ash/gypsum co-disposal facility Dirty Water Dam	The ADDD will be approximately 7.01 ha.	The ADDD will be located on Farm Klipfontein 566JR (Coordinates: 25º 55' 54.17"S, 28º 53' 50.35"E).	The ADDD is classified as B^+ (water excess).	The dirty water collection channels from the Ash/gypsum dump will be routed to the ADDD. The ADDD is therefore classified as a hazardous waste disposal facility. .	The total waste storage volume of the ADDD will be 227 410 m^3
Station Dirty Water Dam	The footprint of the SDD is approximately 5.615 ha.	The Station Dirty Dam will be located on Farm Hartbeestfontein 537JR (Coordinates: 25º 55' 12.82"S, 28º 53' 50.48"E).	The Station Dirty Water Dam is classified as B^+ (water excess).	The Station Dirty Water Dam is classified as a hazardous waste facility.	The design storage capacity of each dam with the sloping floors is 181 890 m^3.
Station Dirty Dam Settling Tank	The footprint of the Station Dirty Dam Settling Tank is approximately 0.8 ha.	The Station Dirty Dam Settling Tank will be located on Farm Hartbeestfontein	The Station Dirty Dam Settling Tank is classified as B^+ (water excess).	The Station Dirty Water Dam Settling Tank is classified as a hazardous waste facility.	The waste storage volume of the Station Dirty Dam Settling Tank will be 7 975 m^3.

Waste Site	Size of facility for a waste management activity	Area where the waste management activity takes place	Classification of facility in terms of climatic water balance	Type of Facility	The quantity of waste received
		537JR (Coordinates: 25º 55' 12.82"S, 28º 53' 50.48"E).			
Rock Stockpile Areas	The footprint of the Concrete Spoil Stockpile will be approximately 9.6 ha and the K3 stockpile will be approximately 4.84 ha.	The concrete spoil stockpile will be located on Farm Hartbeestfontein 537JR (Coordinates: 25º 55' 2.15" S and 28º 54' 30.33" E) and the K3 spoil area will be located on Farm Klipfontein 566JR (Coordinates: 25º 55' 43.46" S and 28º 55' 4.32" E).	The rock stockpile is classified as B^-.	The rock stockpile is classified as General Waste. It will primarily consist of silty soils and degradable rock not suitable for use as general backfill.	The total waste storage volume of the concrete spoil stockpile and K3 stockpile will be approximately 229 500 m^3 and 750 000 m^3 respectively

5. POTENTIAL ALTERNATIVES

An initial site selection study was undertaken by Eskom with the objective of describing the planning process that has resulted in the geographical area in question being identified for the purpose, as well as initially screening the five potential sites within the geographical area and identifying the two preferred sites that were the subject of the 2006 EIA.

Detailed assessments were undertaken for a number of specialist fields including groundwater, terrestrial ecology, and aquatic fauna and flora.

In essence the overall recommendations which were made during the EIA Phase were that there is no clear distinction between the two sites as their environmental impacts are similar. The preferred site had the following advantages:

- The geology of the preferred site is such that it is unlikely to allow the rapid distribution of pollutants through the groundwater, specifically related to the disposal of ash;
- The preferred site supports a smaller area of high integrity wetlands and offers less wetland services than the alternative site;
- There are fewer sensitive noise receptors that are likely to be affected by a direct dry cooled power station at the preferred site;
- There is less land that is cultivated on the preferred site, especially with respect to irrigated land; and
- The net income per hectare at the preferred site is in excess of 20% lower than the net income per hectare on the alternative site.

While the differences are marginal, it was concluded that the establishment of a coal fired power station on the preferred site is likely to have fewer negative impacts on the biophysical and socio-economic environments. A further conclusion was that it would be important to consider technical, financial and other factors in deciding on which site to pursue.

The specific location of the power station, coal stockyard, above-ground ash/gypsum dump, road access and raw water pipeline corridors as initially identified on the preferred site were refined, to avoid impacting on high integrity wetlands. The ash/gypsum dump design was also further refined to avoid impacting on any wetlands and a buffer around the wetland has been included in order to preserve and protect the wetland. According to the wetland delineation studies, unless the ash/gypsum co-

disposal is relocated the impacts associated with the loss of wetlands and their function was unavoidable. However relocating the ash/gypsum co-disposal facility and associated dams to another site will impact on grasslands, which have higher biodiversity than wetlands (higher negative impact).

6. LEGISLATION AND GUIDELINES

6.1. NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008 (ACT NO. 59 OF 2008)

The Department of Environmental Affairs (DEA) published a List of Waste Management Activities as contained in a Schedule of the NEMWA in the Government Notice GN. No. 718 of 3 July 2009. The Schedule contains a list of waste management activities which have, or are likely to have a detrimental effect on the environment in terms of Section 19(1) of the NEMWA. The co-disposal of ash and gypsum will require a WML for the following listed activities:

i) *3 (1) the storage, including temporary storage of general waste at a facility that has a capacity to store in excess of 100 m^3 of general waste at any one time, excluding the storage of waste in lagoons:* the temporary storage of the concrete and K3 spoil at Kusile.

ii) *4(9) The disposal of any quantity of hazardous waste to land-* The co-disposal and storage of approximately 84 423 000 m^3 of ash and gypsum waste, which has been classified as a moderate hazardous waste to land.

iii) *4(11) The construction of facilities listed in Category B of the Schedule 1* – The construction of a hazardous waste facility for the co-disposal and storage of ash and gypsum..

The application for the integrated waste management licence requires an EIA as stipulated in the EIA Regulations made under Section 24(5) of NEMA.

6.2. NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998)

The construction of the disposal facility (ash/gypsum dump, ADDD, SDD and SDD ST) and the disposal of the ash and gypsum will be carried out in accordance with the environmental management principles as set out in Section 2 of NEMA, and summarised below:

- Environmental management at Kusile will place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interest equitably;
- The disturbance of ecosystem and loss of biodiversity will be avoided, where this is not possible, the disturbance will be minimised and remedied;
- The pollution and degradation of water resources will be avoided;
- The produced ash and gypsum will be disposed of in a responsible manner;
- The environmental management will be integrated in acknowledgement that all elements of the environment are linked and interrelated;

- The social, economic and environmental impacts will be evaluated and the decisions will be in line with the evaluation process; and
- Work of the site will comply with the Occupational Health and Safety Act, 1993 (Act No. 83 of 1993) (OHSA).

In addition, the application for the WML will comply with the EIA Regulations No. R. 543 of 2010. **Table 1-4** presents how Part 3 of the Chapter 3 of the EIA Regulations (2010) shows where and how compliance was achieved in this report.

6.3. NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The disposal of ash and gypsum into the wetland is defined in Section 21 of the NWA as follows:

21(g) disposing waste or water containing in a manner that may detrimentally impact on the water resource.

A Water Use Licence Application (WULA) was submitted to the Department of Water Affairs (DWA) to comply with Section 40(1) of the NWA. The Section 21 (g) licence was issued by the DWA on 12 April 2011 (**Appendix F**). According to the Section 21 (g) licence the following is authorised:

6.3.1. Storage and Disposal of Water Containing Waste

The Licensee is authorised to operate and maintain the various pollution control facilities, for the purpose of collection, containment and re-use as specified in the Licence.

The Licensee is authorised to irrigate ash/gypsum dumps to suppress dust utilising 246 010 m^3/a. The irrigation water will be supplied from the ash/gypsum dirty water dam which will be supplemented from the holding/recycling dam when the need arise.

6.3.2. Coal Storage Yard

The Licensee is authorised to operate 852 000 m^3 of coal storage yard on the farm Hartbeestfontein 537JR, in accordance with provisions made in the Report.

6.3.3. Ash and Gypsum Ash/gypsum co-disposal facility

The Licensee is authorised to dispose of a maximum volume of 4 921 295 tons/a of ash/gypsum into the ash/gypsum dump on the farm Hartbeestfontein 537JR in accordance with the provisions made in the Report.

6.3.4. Emergency Ashing Area

The Licensee is authorised to operate 13 975 m^3 emergency ashing area on the farm Hartbeestfontein 537JR in accordance with the provisions made in the Report.

6.3.5. Station Dirty Dam

The Licensee is authorised to dispose of 284 510 m^3/a of dirty water into the station dirty dam.

6.3.6. Temporary Stockpiling Course Ash

The Licensee is authorised to operate 13 975 m^3 temporary stockpiling course ash facility on the farm Hartbeestfontein 537JR in accordance with the provisions made in the Report.

6.3.7. Station Recycle/Holding Dam

The Licensee is authorised to dispose a maximum volume of 78 400 m^3 of water containing waste in the Station Recycle/Holding Dam on the farm Hartbeestfontein 537JR in accordance with the provisions made in the Report.

6.3.8. Pollution Control Dams

The Licensee is authorised to operate the following control dams in accordance with the provisions made in the Report;

- *The station two dirty dam settling facility (2 x 184 453 m^3) situated on farm Hartbeestfontein 566, Portion 0.*
- *The Coal Stockyard/limestone building settling facility (4 977 m^3) situated on farm Hartbeestfontein 566, Portion 1.*
- *The two holding/recycle dams (2 x 35 623 m^3) situated on farm Hartbeestfontein 566, Portion 1.*

6.4. THE KYOTO PROTOCOL

The United Nations Framework Convention on Climate Change (UNFCCC) and the subsequent Kyoto Protocol is an attempt to address global warming. South Africa ratified the Convention on 29 August 1997. The Kyoto Protocol was adopted at a Conference of the Parties to the UNFCCC in Kyoto, Japan in December 1997. The conference resulted in a consensus decision to adopt a protocol under which industrialised countries will reduce their combined greenhouses gas emissions by at least 5% compared to 1990 levels in the period 2008 to 2012.

In developing the Kyoto Protocol, the need to promote sustainable development was recognised. This means implementing policies and measures to, among others, enhance energy efficiency, protect and enhance sinks and reservoirs of greenhouse gases, promote sustainable forms of agriculture, increase the usage of new and renewable forms of energy and of advanced, innovative and environmentally sound technologies. The Kyoto Protocol is a legally binding instrument. In response, South African policies are starting to place emphasis on cleaner technology and production, and a shift to sustainable development.

Eskom works closely with the DEA to realise the strategic objectives, principles and proposals of the national Climate Change Response Strategy. The strategy is a broad framework for formulating, implementing and regularly updating national and, where appropriate, regional programmes to mitigate climate change

6.5. GUIDELINE DOCUMENTS

The following guideline documents were considered in the compilation of this report:

- General Notice 654 of 29 June 2010, National Environmental Management Act (107/1998): Publication of Implementation Guidelines: For general public comments. Government Gazette 33333.
- DEA (2002): Scoping, Integrated Environmental Management, Information Series 2, Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2002): Stakeholder Engagement, Integrated Environmental Management, Information Series 3, Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2002): Specialist Studies, Integrated Environmental Management, Information Series 4, Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2002): Impact Significance, Integrated Environmental Management, Information Series 5, Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2002): Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2002): Criteria for Determining Alternatives in EIA, Integrated Environmental Management, Information Series 11, Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2006): General Guide to the EIA Regulations (Guideline 3), Department of Environmental Affairs and Tourism, Pretoria.
- DEA (2006): Public Participation (Guideline 4) in support of the EIA Regulations, Department of Environmental Affairs and Tourism, Pretoria.

- DEA (2006): Assessment of alternatives and impacts (Guideline 5) in support of the EIA Regulations, Department of Environmental Affairs and Tourism, Pretoria.
- IAIA in cooperation with Institute of Environmental Assessment (1999): Principles of EIA Best Practice. www.iaia.org.

7. DESCRIPTION OF THE RECEIVING ENVIRONMENT

This section provides a description of the project area's climate and baseline environment and conditions.

7.1. CATCHMENT

The site falls within the B20F water quaternary catchment and the larger Wilge River catchment in the Upper Olifants sub-area of the Olifants Water Management Area.

7.2. CLIMATE

7.2.1. Regional Climate

The project area displays the warm summers and cold winters typical of the Highveld climate. The average summer and winter daytime temperatures are 25 ^{0}C and 20 ^{0}C, respectively. Rainfall occurs mainly as thunderstorms and drought conditions occur in approximately 12 % of all years. The Environmental Potential Atlas for Mpumalanga and Gauteng places rainfall at site as ranging between 621 mm and 750 mm per year. The prevailing wind direction is north-west during the summer and east during winter. Winds are usually light to moderate. The Mean Annual Evaporation in the area is 707 mm/a (1 532 mm/a – S Pan).

7.2.2. Rainfall

Rainfall is strongly seasonal with most rain occurring in the summer period (October to April). The maximum rainfall occurs during the November to January period. Whereas summer months receive about 80 % of the rainfall, winter months are normally dry.

The area experiences an average rainfall of 682 mm per annum. The majority of summer rain falls in early to mid-summer, November, December and January. The driest months fall in mid-winter, June to August, when less than 10 mm of rain falls on average.

7.3. SOIL AND LAND CAPABILITY

The University of the Free State conducted an agricultural impact study to provide input to the Environmental Impact Assessment during September 2006. The main findings with regard to soil potential and land capability include (Jordan, 2006):

- Based on on-site inspection, satellite imagery as well as data received from individual farmers, 27 % of land was cultivated for dry land purposes;
- The land use patterns showed livestock farm activities on site;
- The site was noted to have a few good quality farm dwellings and sheds, with livestock handling facilities on nearly all farms and one irrigation system; and

- Farmers at the site indicated their average yields for the past three years as between 3.5 and 5 tons per ha.

The average gross margin revenue for the Kusile site was calculated to be R 749 per hectare. Total loss in gross agricultural production was calculated to be R 289 million (Jordan, 2006). The net present value (NPV) at a discount rate of 10 % was calculated to be R 70.7million, while the loss in total net income was determined to be R 150 million. The NPV of net income calculated at a discount rate of 10% per annum was calculated to be R 36.6 million (Jordan, 2006).

7.4. TOPOGRAPHY

The surface topography consists of a gently undulating plateau of the Highveld region with gently sloped hills. The highest point is of the site lies at a height of 1 520 meters above mean sea level (mamsl) on the eastern section of the site. The lowest point on the site is at a height of 1 440 mamsl on the western section of the site.

7.5. GEOLOGY

The site is underlain by geology of the Karoo Sequence and Pretoria Group with diabase intrusions. A large part of the Kusile Power Station Site is underlain by the Dwyka and Ecca Formations of the Karoo Sequence and the Rayton Formation of the Pretoria Group. The Karoo Sequence overlies the Pretoria Group. Diabase sills intrude the Rayton as well as the Dwyka Formation in the investigated site area.

7.6. SURFACE WATER HYDROLOGY

The site falls into the Quaternary Catchment B20F which forms part of the larger upper Olifants River Catchment. The Upper Olifants River Catchment is defined as the drainage area upstream of Loskop Dam. The catchment has three major sub-drainage areas associated with the Olifants River, viz. the Klein-Olifants River, Wilge River and the Klipspruit. The main surface dams in the catchment include Loskop Dam, Witbank Dam, Bronkhorstspruit Dam and Middelburg Dam.

The Klipfonteinspruit and Holfonteinspruit flows through the site, along with unnamed tributaries of these rivers. All of these watercourses are perennial and are fed by groundwater and eventually flow into the Wilge River. The Wilge River flows in a northerly direction and drains into the Olifants River. There are also various small farm dams on the site as shown on the figure below.

7.7. SENSITIVE AREAS

Ecosun conducted an ecological assessment to provide input into the Environmental Impact Assessment. This included the identification and assessment of the integrity of wetlands on the Kusile site.

Ecosun identified six different wetland types (Ecosun, 2006):

- Channelled valley bottom;
- Hillslope feeding a watercourse;
- Hillslope not feeding a watercourse;
- Non channelled valley bottom;
- Floodplain; and
- Depression wetlands.

Ecosun classified these wetlands in terms of high, medium and low ecological integrity, and determined that the general integrity of these wetlands could be regarded as impaired with only two wetland sections of high integrity.

7.8. GROUNDWATER

The site is underlain by geology of the Karoo Sequence and Pretoria Group with diabase intrusions. Hydrogeologically, the site is composed of two layers: the upper unconfined aquifer that extends to a depth of 30 m, followed by a 70 m thick confined/unconfined aquifer.

A good correlation (97.6 %) between the topography and groundwater elevation indicates that the top aquifer is indeed unconfined.

The groundwater depth ranges from -0.35 (artesian) to 25 m with an average of 8 m. The regional groundwater flow is directed from south-east to the north-west. However, on a local scale the flow could be directed differently but is primarily directed to the streams as the source of these streams is a combination of rainfall and groundwater base flow.

8. KEY ISSUES IDENTIFIED IN THE SCOPING PHASE

The following potential issues were identified by the EIA team and will be considered in the assessment phase:

- Groundwater Quality;
- Surface Water Quality;
- Air Quality;
- Aquatic Ecology; and
- Terrestrial Ecology

8.1. GROUNDWATER QUALITY

According to the specialist studies that were conducted in 2006 for the whole Kusile project, above-ground co-disposal of ash is expected to have an impact on groundwater. The study found that the study area is underlain by younger Dwyka Group tillite and Karoo sediments and the hydrogeology on the majority of the site comprises a non-aquifer system, with very low yielding boreholes and limited groundwater potential. There is little or no groundwater use occurring within the site; however, persistent contamination can have an impact on the groundwater users with time. It was concluded that groundwater can be impacted on by the proposed power station and infrastructure; causing elevated groundwater levels and altering hydrochemistry. An initial risk assessment identified that sources of artificial recharge, such as an unlined ash/gypsum dump or dirty water dams, require risk reduction measures.

8.2. SURFACE WATER QUALITY

The position of the ash/gypsum disposal facility (ash/gypsum dump, ADDD, SDD and SDD ST) makes the wetlands and water resources susceptible to pollution during construction and operation. Sources of pollution include dust generated during construction activities, sediments, leaked hydrocarbons, litter and construction materials. Indirect impacts associated with an above ground ash/gypsum dump on the water quality include the impacts of dust blown from the dump increasing sediment levels of water resources and thereby impacting on the turbidity of the resource.

A Specialist Wetland Offset Report will be submitted to DEA as part of the 60-year Ash/gypsum co-disposal facility EIA process. With the sensitivity surrounding the transformation of wetlands within the Kusile footprint as well as the DWA's initial

discussion regarding offsets, Eskom staff and the Environmental Assessment Practitioner (EAP), Zitholele, have authorised a Wetland Offset Report to be included as an additional specialist report for the 60 Year Ash/gypsum co-disposal facility EIA process. The Wetland Offset Report will be conducted by Prime Africa Consultants and will identify possible wetland areas, which are suitable for offset consideration. The study will make use of the current delineation and classification study and will be based on the Guideline for Wetland Offset developed by SANBI.

Sebata compiled a Wetland Management Plan as part of the application for environmental authorisation that was submitted and approved by the DEA on 5 April 2013 for construction within wetlands and crossing of rivers and wetlands at the Kusile Power Station. This Wetland Management Plan included the wetland affected by the ADDD and was submitted to and approved by the DEA. The Wetland Management Plan and the 2006 EMPr have been included as **Appendix G**.

The surface water specialist will also conduct a 1:100 year floodline determination and mapping process as requested by the DWA.

8.3. AIR QUALITY

The ash/gypsum to be disposed of at the ash/gypsum dump may present dust nuances. There are some measures in place to mitigate against the generation of dust which include:

- Additional storage of water for dust control and irrigation over the active disposal area and the rehabilitation establishment zone is provided in the ADDD for 72 hours.
- The maximum 72 hr dust suppression and irrigation volume is approximately 2 562 m^3. The maximum pumping capacity from the ADDD is 37 ℓ/s.
- Based on the maximum pumping capacity, the operating storage was set at 6 480 m^3, which is equivalent to 72 hrs of pumping at 25 ℓ/s.
- The dust control and irrigation storage volumes are based on 1 mm/day of equivalent rainfall.
  (1 mm/day is equivalent to 0.5 x the average annual daily rainfall at Kusile Site).
- The dust suppression for the paddocks will be performed by the sprinkler system and will need to cover the following areas simultaneously (at maximum):
  - Two paddocks. The paddocks will typically be 200 m x 200 m in length and width and will increase in height by 1 m intervals. The paddocks at the edge

of the dump will typically be 100 m x 400 m in width and length and will increase in height by 1 m intervals. All paddocks are considered to have a footprint area of approximately 40 000 square meters.

- All active side slopes (sprinklers to be placed along the crests of the side slopes diameter widths apart attached to drag lines enabling the sprinklers to be moved vertically along the side slopes).
- A 300 m x 30 m area for irrigation to assist rehabilitation.

- The dust suppression system will have the capacity to fill the trucks/bowsers at the same time as covering the above areas with the sprinklers

Dust suppression of the disposal facility at finished height will be controlled by a 100 mm permeable blanket layer of gravel, followed by topsoiling and grassing. Rehabilitation establishment will take three years, developed progressively as each section of the dump is finalised

8.4. AQUATIC ECOLOGY

The ash/gypsum disposal facility will be constructed around medium integrity wetlands and is therefore expected to have an impact on aquatic ecology. The position of the ash/gypsum dump makes the wetlands and water resources susceptible to pollution during construction. Sources of pollution include dust generated during construction activities, sediments, leaked hydrocarbons, litter and construction materials. Indirect impacts associated with an above ground ash/gypsum dump on the aquatic ecological environment include the impacts of dust blown from the dump increasing sediment levels of aquatic systems, resulting in loss of habitat due to smothering, increased turbidity, decreased photosynthesis and physiological stress on organisms.

8.5. TERRESTRIAL ECOLOGY

The project site is mostly disturbed through agricultural activities, with little natural vegetation remaining. There are however a range of protected species occurring on the project site, including six protected plant species and one red data bird species. During the construction phase, it is possible that the contractor may remove more vegetation cover than is required to establish the power station and its associated infrastructure, with the potential to impact on the identified protected plant species, with knock-on effects for the animals that utilise that habitat.Kusile appointed an Ecologist to conduct a search and rescue of protected species at the construction sites.

8.6. CONSTRUCTION RELATED IMPACTS

Construction can be a noise and dust producing activity which may cause a nuisance to people living in the vicinity. These impacts, however, can be mitigated and managed to acceptable levels, with a post mitigation impact that is not significant. No specialist studies will be undertaken, but all the mitigation measures necessary to maintain acceptable levels of noise and dust were included in the 2006 EMPr for the construction phase

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9. SPECIALIST STUDIES

Specialist studies identified during the Scoping Phase were conducted as follows:

- Groundwater (GCS Consulting (Pty) Ltd);
- Air Quality (Airshed Planning Professionals (Pty) Ltd);
- Surface Water, Hydrology and Floodline Determination (SRK Consulting (Pty) Ltd);
- Terrestrial Ecology (MDA Consulting (Pty) Ltd); and
- Aquatic Ecology (Golder Associates (Pty) Ltd.

All the specialist reports are attached as **Appendix H**.

9.1. AIR QUALITY

The Air Quality impact assessment was conducted by **Ms René von Gruenewaldt** from Planning Professionals (Pty) Ltd (Airshed).

Name: Ms René von Gruenewaldt
Employer: Airshed Planning Professionals (Pty) Ltd
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Fax: 011 805 7010
E-mail: renee@airshed.co.za
Address: 480 Smuts Drive, Halfway Gardens, Midrand, 1682

9.1.1. Expertise of the Specialist

René von Gruenewaldt is an Air Quality Scientist with more than eleven (11) years of experience. She is a registered Professional Natural Scientist (Registration Number 400304/07). She has developed technical and specialist skills in various modelling packages including the industrial source complex models. She has a good understanding of the laws and regulations associated with ambient air quality and emission limits in South Africa and various other African countries, as well as the World Bank Guidelines, European Community Limits and World Health Organisation.

9.1.2. Declaration of Independence

Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialized services as stipulated in the terms of reference. A signed declaration of independence is attached together with the air quality specialist report in **Appendix H**.

9.1.3. Approach and Methodology

A quantitative assessment was undertaken based on the evaluation of existing windblown dust from ash/gypsum co-disposal facility studies (Burger, 1994), together with the dispersion potential of the site and magnitude of predicted impacts from the proposed activities.

The study considered environmental regulations and guidelines governing the emissions and impact of the co-disposal operations prior to identification of potential impacts and sensitive receptors. These included:

- The National Ambient Air Quality Standards;
- The National Regulations for dust deposition; and
- The Highveld Airshed Priority Air Quality Management Plan.

The study focused on the assessment of the effect of particulate matter on vegetation, animals and susceptible human receptors, particularly whether or not the project would result in an increased life-time cancer risk.

In modelling the projected impacts to air quality in the vicinity, meteorological data from the Kendal monitoring station for the period January 2009 to October 2012 was used. The modelling of the impact to air quality included four scenarios, with respect to windblown dust emissions from the disposal facility: (1) unmitigated emissions; (2) mitigation through re-vegetation (to 80% of the facility area); (3) mitigation through wetting (maintaining the moisture content to 5%); and, (4) mitigation through both re-vegetation and wetting.

9.1.4. Assumptions and Limitations

The limitations and assumptions made during the study were as follows:

- An ash sample was acquired from Kendal Power Station. It is assumed that the particle size distribution and elemental composition will be similar to that from Kusile, when operational.
- Meteorological data was acquired from Eskom for the Kendal Power Station, for January 2009 to October 2012. Due to the proximity between Kusile and Kendal, it was assumed that the meteorological data are representative of the site.
- The end-of-life, worst-case, area footprint for each ash disposal facility alternative was used in the model.
- Increased life-time cancer risk was calculated at the identified sensitive receptors for arsenic, nickel and chromium.

- The gypsum material co-disposed of on the disposal facility is expected to provide a crust when mixed with water.

9.1.5. Findings

9.1.5.1. Air Quality Baseline Evaluation

Existing Sources of Emissions near Kusile Power Station

The identified sources of emissions close to the Kusile Power Station were as follows:

- Wind-blow Dust from the Kendal Ash/gypsum co-disposal facility;
- Materials handling operations associated with mining and power station activities in the area, which includes the transfer of coal by means of tipping, loading and off-loading of trucks;
- Industrial Emissions within the Mpumalanga region including emissions from coal combustion by power generation, metallurgical and petrochemical industries;
- Vehicle Exhaust Emissions;
- Biomass Burning;
- Fugitive Dust Emissions from Mining; and
- Other Fugitive Dust Sources such as vehicle entrained dust from local paved and unpaved roads, wind erosion from open areas and dust generated by agricultural activities (e.g. tilling) and mining.

Ambient Air Quality near Kusile Ash/gypsum co-disposal facility

The Project is located in the vicinity of the Emahaleni Hot Spot (HPA, 2011) which has poor ambient air quality as a result of emissions from power generation, metallurgical manufacturing processes, open-cast coal mining and residential fuel burning; where industrial processes dominate the source contribution (HPA, 2011). Dispersion modelling projected exceedances of the daily PM_{10} limit for more than 12 days across the Emahaleni Hot Spot (HPA. 2011). Monitored daily PM_{10} concentrations within the Hot Spot, at Witbank and Greendale High School show regular exceedances of the daily limit, between 2008 and 2012 (**Figure 9-1**). The HPA Air Quality Management Plan (2011) reported exceedance of the annual limit, for 2008 / 2009, at one of the two monitoring stations in Witbank with an annual averages ~83 $\mu g.m^{-3}$ for Witbank 2.

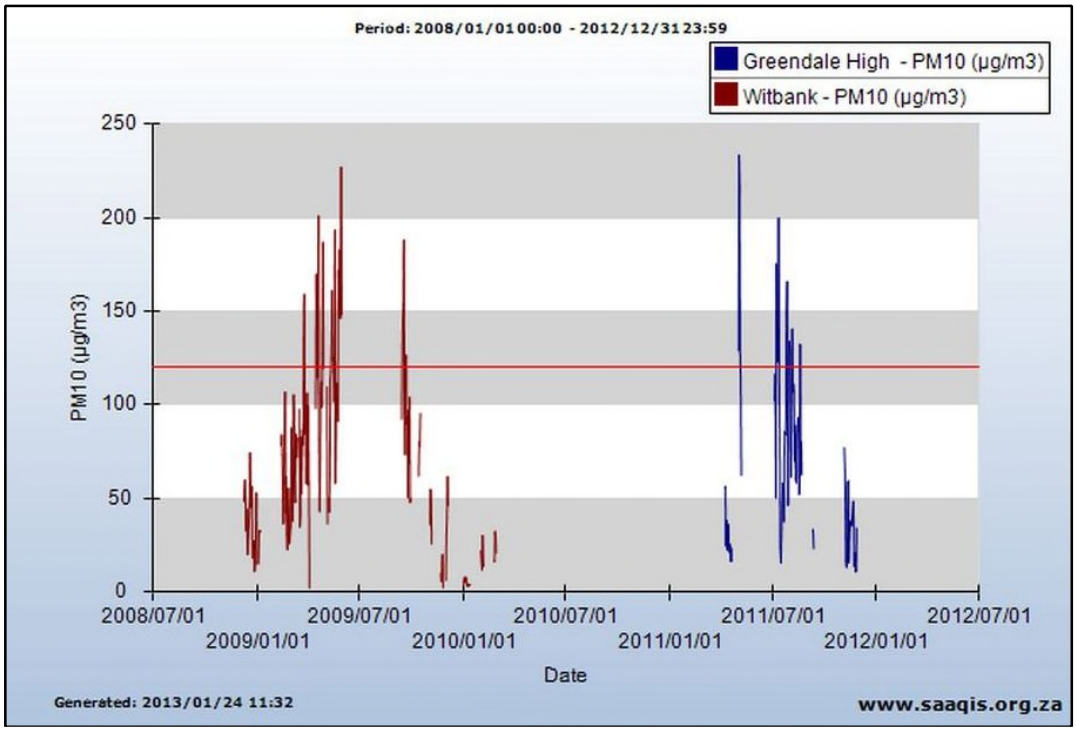

Figure 9-1: Daily PM_{10} concentrations monitored at two stations in the Emahaleni Hot Spot between 2008 and 2012 (from www.saaqis.org.za). The horizontal red line indicates the current daily limit of 120 µg.m^{-3}.

Sources of Pollution

The main pollutant of concern associated with the proposed operations is particulate matter. Gaseous pollutants (such as sulphur dioxide, oxides of nitrogen, carbon monoxide, etc.) derived from vehicle exhausts and other combustions were considered to be insignificant in relation to the particulate emissions.

The study found that the establishment of the ash/gypsum co-disposal facility will result in particulate emissions during the following operations:

- land preparation during establishment and progression of the ash/gypsum co-disposal facility;
- freshly exposed topsoil, as a step in rehabilitation of the ash/gypsum co-disposal facility, that will be prone to wind erosion before establishment of vegetation; and
- Movement of vehicles across exposed soil or ash, will also be a source of pollution.

Table 9-1 provides a summary of the activities and aspects identified for the construction, operational and closure phases that would result in pollution.

Table 9-1: Activities and aspects identified for the construction, operational and closure phases of the proposed operations

Pollutant(s)	Aspect	Activity
Construction		
Particulates	Construction of progressing ash disposal facility site	Clearing of groundcover
		Levelling of area
		Wind erosion from topsoil storage piles
		Tipping of topsoil to storage pile
	Vehicle activity on-site	Vehicle and construction equipment activity during construction operations
Gases and particles	Vehicle and construction equipment activity	Tailpipe emissions from vehicles and construction equipment such as graders, scrapers and dozers
Co-disposal of gypsum and ash		
Particulates	Wind erosion from ash disposal facility	Exposed dried out portions of the ash disposal facility
	Vehicle activity on-site	Vehicle activity at the ash disposal facility
Gases and particles	Vehicle activity	Tailpipe emissions from vehicle activity at the ash disposal facility
Rehabilitation		
Particulates	Rehabilitation of ash disposal facility	Topsoil recovered from stockpiles
		Tipping of topsoil onto ash disposal facility
	Wind erosion	Exposed cleared areas and exposed topsoil during rehabilitation
	Vehicle activity on unpaved roads and on-site	Truck activity at site during rehabilitation
Gases and particles	Vehicle activity	Tailpipe emissions from trucks and equipment used for rehabilitation

9.1.5.2. Construction Phase

It is not anticipated that the various construction activities will result in higher off-site impacts than the operational activities. The temporary nature of the construction activities, and the likelihood that these activities will be localised and for small areas at a time, will reduce the potential for significant off-site impacts.

9.1.5.3. Ash/gypsum co-disposal facility

Annual emissions were quantified for the scenarios shown in **Table 9-2**, which also provides a summary of the results of the assessment.

Table 9-2: Annual emissions for the disposal facility for each of the modelled scenarios

Scenario	Particulate fraction	Annual emissions (tpa)
Unmitigated	TSP	27 913
	PM_{10}	11 098
	$PM_{2.5}$	3 198
Re-vegetation CE = 97%	TSP	840
	PM_{10}	334
	$PM_{2.5}$	96
Wetting CE = 74%	TSP	7 259
	PM_{10}	2 871
	$PM_{2.5}$	827
Both (re-vegetation & wetting) CE = 99%	TSP	218
	PM_{10}	86
	$PM_{2.5}$	25

9.1.5.4. Rehabilitation

Rehabilitation is planned to occur continuously throughout the co-disposal of ash and gypsum and will include the removal and tipping of topsoil onto the completed disposal facility surface areas. Dust may be generated from the dried out exposed surfaces before it is covered with topsoil. Once vegetation is established the potential for dust generation will reduce significantly. The tipping of topsoil and vehicle entrainment on associated unpaved roads will also result in dust generation.

9.1.5.5. Dust Deposition

The study showed that dust deposition due to unmitigated operations exceeds the draft dust fallout regulations of 600mg/m²/day as recommended for residential areas at the closest sensitive receptors (identified with satellite imagery within the boundary) and at the boundary. This is reduced by applying mitigation measures as shown in **Table 9-3**.

Table 9-3: Predicted dust deposition at sensitive receptors due to windblown dust from the disposal facility

Scenario	Receptor	Highest daily dust deposition (mg/m²/day)
Unmitigated	Closest identified sensitive receptor (individual farmstead onsite)	2000
	Boundary	950

Scenario	Receptor	Highest daily dust deposition (mg/m²/day)
	Wilge	<400
	Kendal Forest Holdings	<400
	Phola	<400
	Ogies	<400
Re-vegetation	*Dust deposition predicted to be <400mg/m²/day at all sensitive receptors*	
Wetting	Closest identified sensitive receptor (individual farmstead onsite)	1000
	Boundary	<400
	Wilge	<400
	Kendal Forest Holdings	<400
	Phola	<400
	Ogies	<400
Both (re-vegetation and wetting)	*Dust deposition predicted to be <400mg/m²/day at all sensitive receptors*	

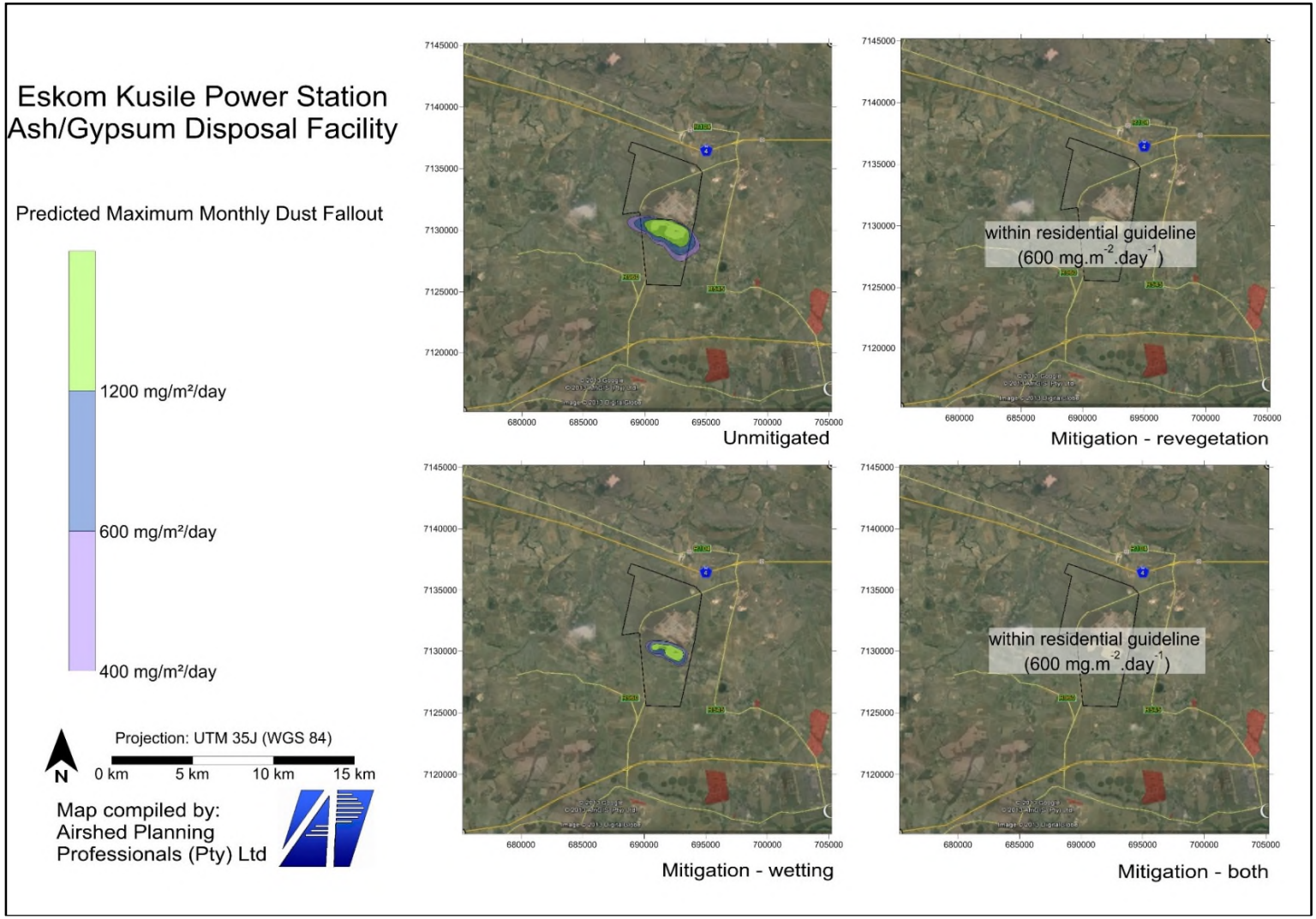
Eskom Kusile Power Station
Ash/Gypsum Disposal Facility
Predicted Maximum Monthly Dust Fallout
1200 mg/m²/day
600 mg/m²/day
400 mg/m²/day
Projection: UTM 35J (WGS 84)
N
0 km
5 km
10 km
15 km
Map compiled by:
Airshed Planning
Professionals (Pty) Ltd
Unmitigated
within residential guideline
(600 mg.m-2.day-1)
Mitigation - revegetation
Mitigation - wetting
within residential guideline
(600 mg.m-2.day-1)
Mitigation - both

Figure 9-2: Predicted maximum monthly dust deposition as a result of windblown dust from the disposal facility at the Kusile Power Station

9.1.5.6. PM_{10} and $PM_{2.5}$ ground-level concentrations

The study found that for unmitigated operations, the predicted impacts from the disposal facility are in non-compliance with the daily and annual PM_{10} and $PM_{2.5}$ NAAQS beyond the boundary. Compliance with the daily NAAQS for these pollutants were predicted to be achieved with mitigation by either re-vegetation or with the combination of re-vegetation and watering (**Figure 9-3** to **Figure 9-6**).

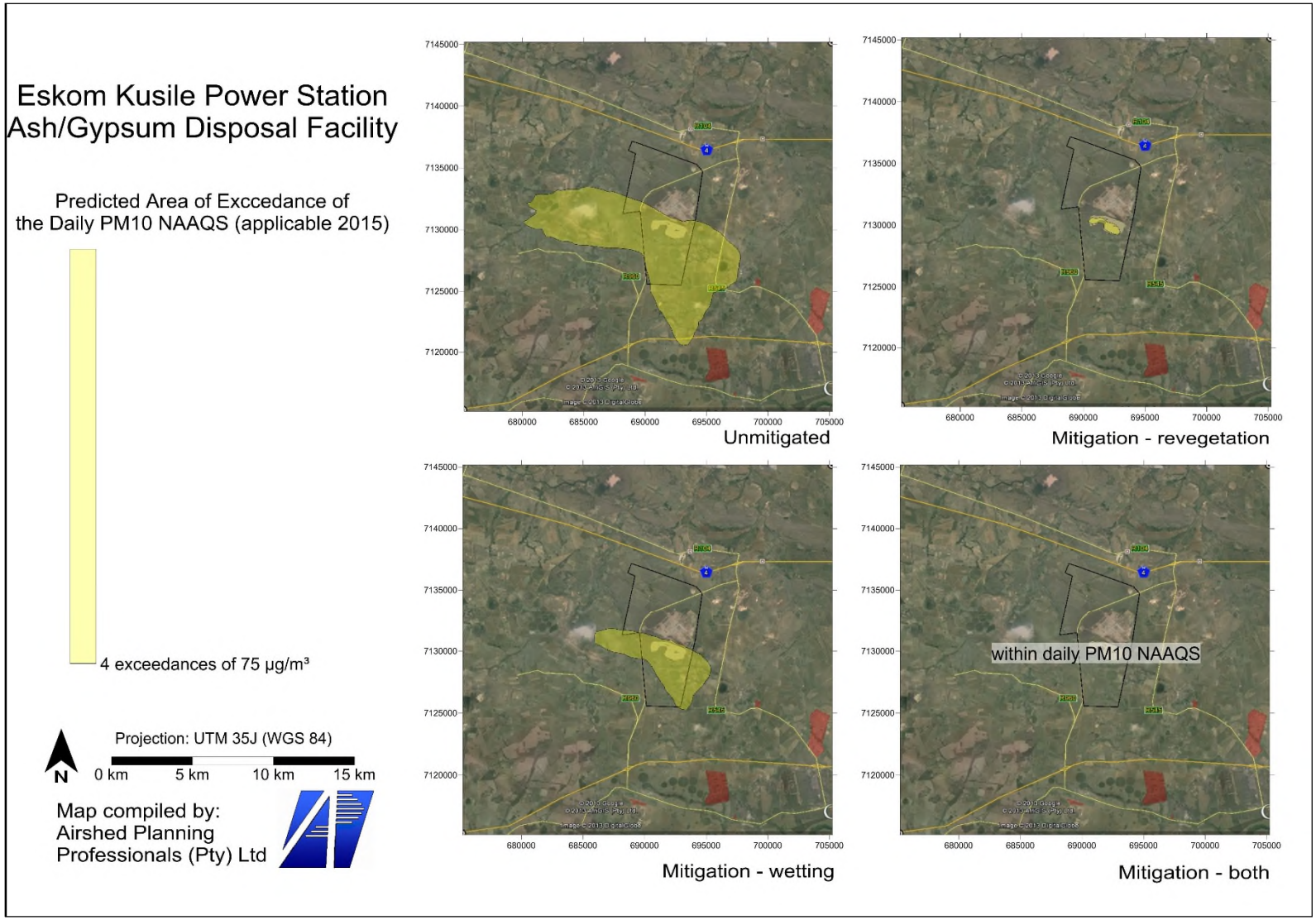

Figure 9-3: Predicted area of exceedance of the daily PM_{10} NAAQS due to the disposal facility at Kusile Power Station

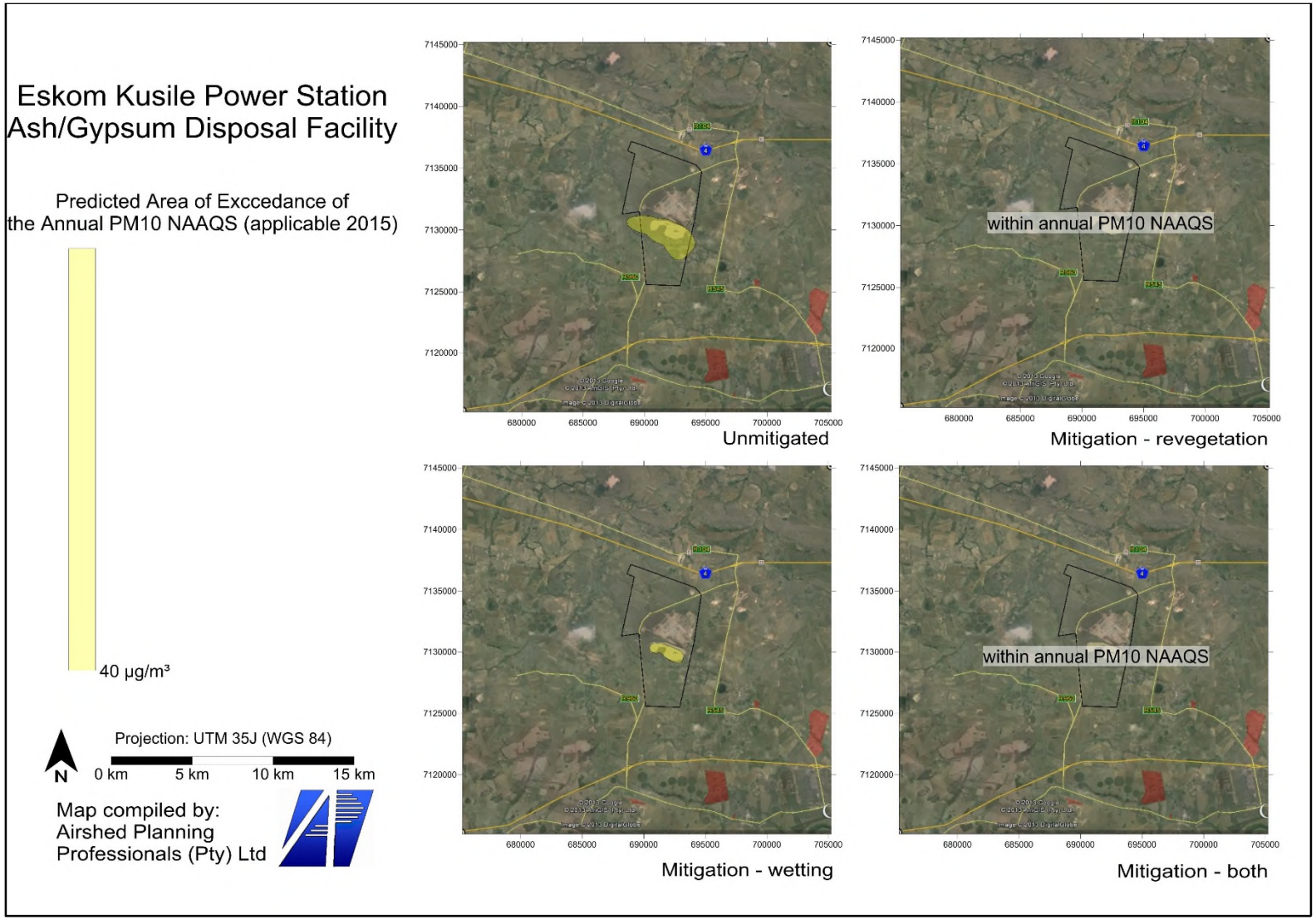

Figure 9-4: Predicted annual average PM_{10} concentrations due to the disposal facility at Kusile Power Station

Table 9-4: Predicted annual average PM_{10} ground-level concentrations and number of exceedances of daily PM_{10} NAAQ limits as a result of wind-blown emissions from the disposal facility

Scenario	Receptor	No. of exceedances of the daily PM_{10} NAAQ limit of 75 µg/m³ (applicable from 2015)	Annual average PM_{10} concentration (µg/m³)	Within compliance with the daily and annual PM_{10} NAAQS applicable from 2015 (Y/N)
Unmitigated	Closest identified sensitive receptor (individual farmstead onsite)	100	150	N
	Boundary	70	80	N
	Wilge	2	<40	Y
	Kendal Forest Holdings	1	<40	Y
	Phola	<1	<40	Y
	Ogies	<1	<40	Y
Re-vegetation	Closest identified sensitive receptor (individual farmstead onsite)	2	<40	Y
	Boundary	1	<40	Y
	Wilge	<1	<40	Y
	Kendal Forest Holdings	<1	<40	Y
	Phola	<1	<40	Y
	Ogies	<1	<40	Y
Wetting	Closest identified sensitive receptor (individual farmstead onsite)	30	40	N
	Boundary	15	<40	N
	Wilge	<1	<40	Y
	Kendal Forest Holdings	<1	<40	Y
	Phola	<1	<40	Y
	Ogies	<1	<40	Y
Both (re-vegetation and wetting)	Closest identified sensitive receptor (individual farmstead onsite)	<1	<40	Y
	Boundary	<1	<40	Y
	Wilge	<1	<40	Y
	Kendal Forest Holdings	<1	<40	Y
	Phola	<1	<40	Y
	Ogies	<1	<40	Y

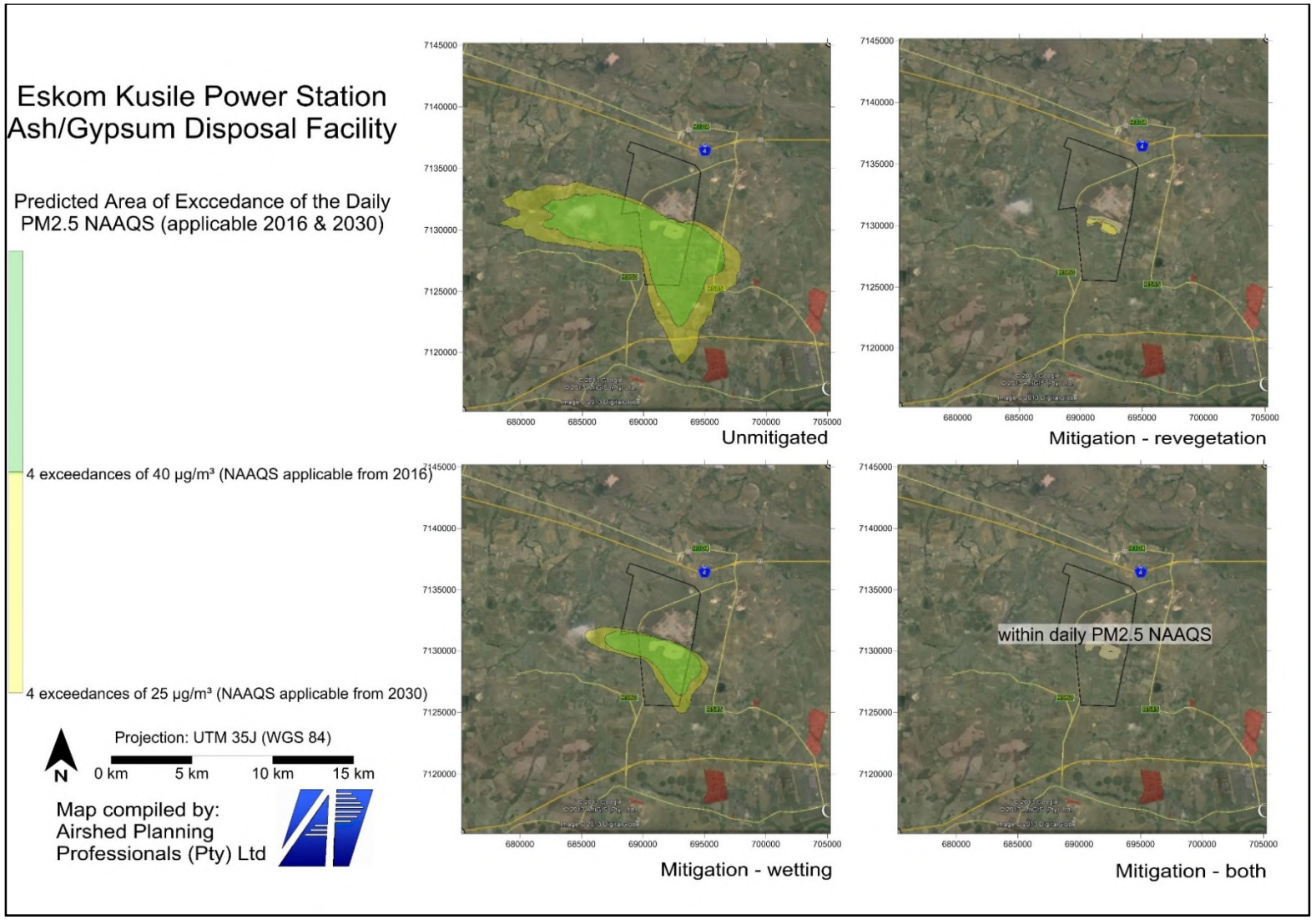

Figure 9-5: Predicted area of exceedance of the daily $PM_{2.5}$ NAAQS due to the disposal facility at Kusile Power Station

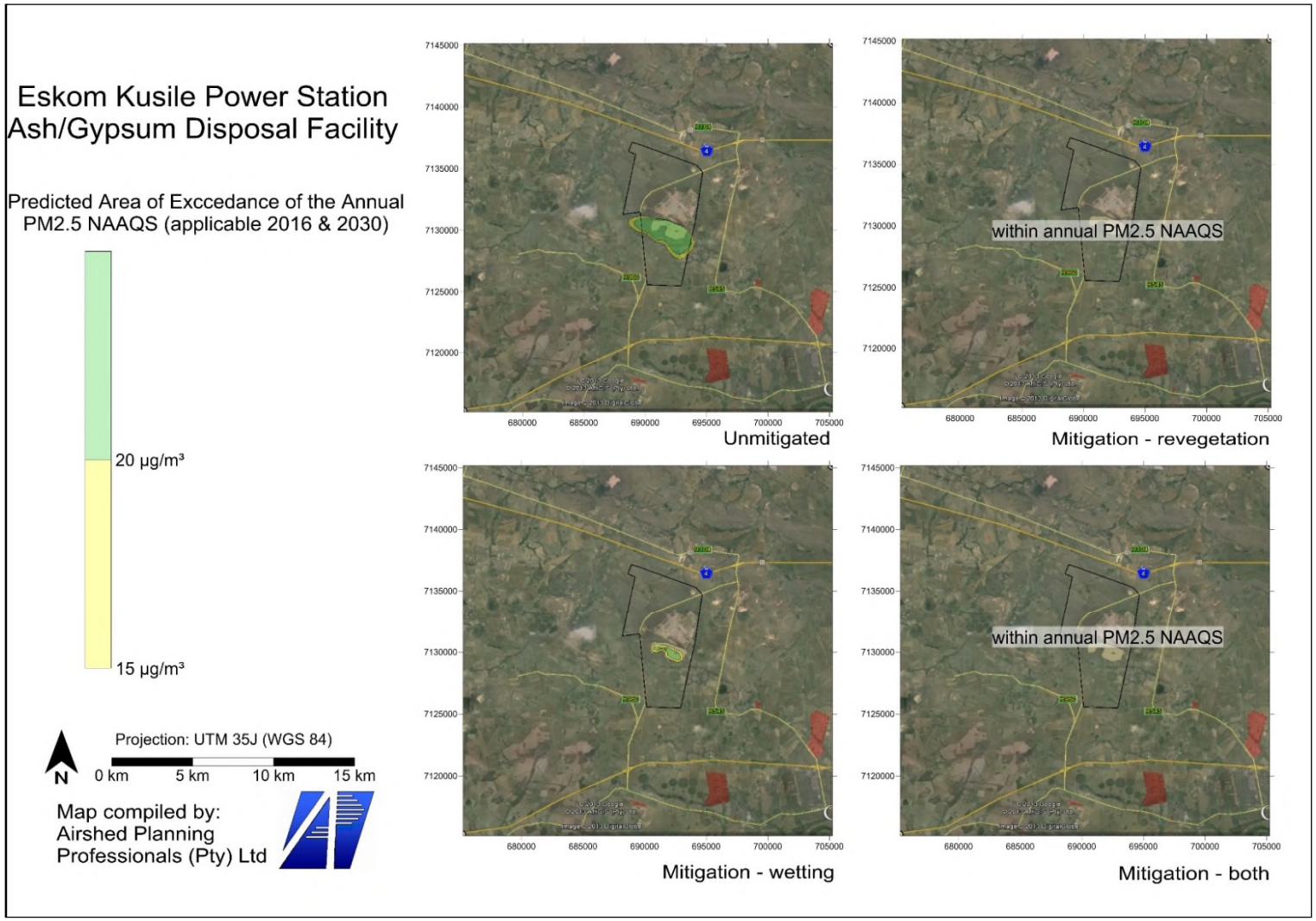

Figure 9-6: Predicted annual average $PM_{2.5}$ concentrations due to the disposal facility at Kusile Power Station

Table 9-5: Predicted annual average $PM_{2.5}$ ground-level concentrations and number of exceedances of daily $PM_{2.5}$ NAAQ limits as a result of wind-blown emissions from the disposal facility

Scenario	Receptor	No. of exceedances of the daily $PM_{2.5}$ NAAQ limit of 40 µg/m³ (applicable from 2016)	No. of exceedances of the daily $PM_{2.5}$ NAAQ limit of 25 µg/m³ (applicable from 2030)	Annual average $PM_{2.5}$ concentration (µg/m³)	Within compliance with the daily and annual $PM_{2.5}$ NAAQS applicable from 2016 (Y/N)	Within compliance with the daily and annual $PM_{2.5}$ NAAQS applicable from 2030 (Y/N)
Unmitigated	Closest identified sensitive receptor (individual farmstead onsite)	80	90	45	N	N
	Boundary	50	60	28	N	N
	Wilge	<1	2	<15	Y	Y
	Kendal Forest Holdings	<1	1	<15	Y	Y
	Phola	<1	<1	<15	Y	Y
	Ogies	<1	<1	<15	Y	Y
Re-vegetation	Closest identified sensitive receptor (individual farmstead onsite)	<1	2	<15	Y	Y
	Boundary	<1	1	<15	Y	Y
	Wilge	<1	<1	<15	Y	Y
	Kendal Forest Holdings	<1	<1	<15	Y	Y
	Phola	<1	<1	<15	Y	Y
	Ogies	<1	<1	<15	Y	Y
Wetting	Closest identified sensitive receptor (individual farmstead	23	30	<15	N	N

Scenario	Receptor	No. of exceedances of the daily $PM_{2.5}$ NAAQ limit of 40 µg/m³ (applicable from 2016)	No. of exceedances of the daily $PM_{2.5}$ NAAQ limit of 25 µg/m³ (applicable from 2030)	Annual average $PM_{2.5}$ concentration (µg/m³)	Within compliance with the daily and annual $PM_{2.5}$ NAAQS applicable from 2016 (Y/N)	Within compliance with the daily and annual $PM_{2.5}$ NAAQS applicable from 2030 (Y/N)
	onsite)					
	Boundary	12	15	<15	Y	Y
	Wilge	<1	<1	<15	Y	Y
	Kendal Forest Holdings	<1	<1	<15	Y	Y
	Phola	<1	<1	<15	Y	Y
	Ogies	<1	<1	<15	Y	Y
Both (re-vegetation and wetting)	Closest identified sensitive receptor (individual farmstead onsite)	<1	<1	<15	Y	Y
	Boundary	<1	<1	<15	Y	Y
	Wilge	<1	<1	<15	Y	Y
	Kendal Forest Holdings	<1	<1	<15	Y	Y
	Phola	<1	<1	<15	Y	Y
	Ogies	<1	<1	<15	Y	Y

9.1.5.7. Increased Life-Time Cancer Risk

The study showed that increased life-time cancer risk for arsenic, nickel and chromium at the identified sensitive receptors is very low to low in all cases (**Table 9-6**). These estimates are based on the annual PM_{10} concentrations for the unmitigated scenario.

Table 9-6: Increased cancer risk at identified sensitive receptors, as a result of exposure to arsenic, nickel and chromium in the PM_{10} fraction of dust from the Kusile disposal facility

<table>
<tr><th>Sensitive receptor</th><th>Arsenic</th><th>Nickel</th><th>Chromium</th></tr>
<tr><td>Closest identified sensitive receptor (individual farmstead onsite)</td><td rowspan="6">Very low</td><td>Low</td><td>Low</td></tr>
<tr><td>Boundary</td><td rowspan="5">Very low</td><td rowspan="5">Very low</td></tr>
<tr><td>Wilge</td></tr>
<tr><td>Kendal Forest Holdings</td></tr>
<tr><td>Phola</td></tr>
<tr><td>Ogies</td></tr>
</table>

9.1.6. Impact Assessment

The operational phase was identified as the phase with the largest impact on the ambient air quality. The construction, closure and post-closure phases will not impact the ambient air quality more than the status quo situation. All impacts were determined based on the results from dispersion modelling where the certainty of impacts are considered *probable*.

9.1.6.1. Status Quo

The status quo air quality is of *moderate-high* significance at a *regional* scale. The impacts of the status quo have a *high probability* in the *long-term* and result in a *moderate-high* impact risk.

9.1.6.2. Project Impact – Unmitigated

Impacts from the operational disposal facility will probably result in elevated PM_{10} concentrations, exceeding the NAAQS beyond the boundary. The scale impact of the disposal facility on the ground-level $PM_{2.5}$ concentrations is likely to be similar to PM_{10} concentrations. The impacts of the proposed disposal facility, under unmitigated

operation, have a ***high probability*** to result in impacts of moderate significance at *local* scale over the ***long-term***, resulting in ***moderate*** impact risk.

9.1.6.3. Cumulative Impact

The cumulative impact of proposed disposal facility – when dust emissions are unmitigated – is likely to result in regular exceedances of the NAAQS for PM_{10} and $PM_{2.5}$. These impacts will be of HIGH significance at a *regional* scale. The ***high probability*** will result in ***high*** impact risk.

9.1.6.4. Residual Impact

The study found that the residual impact of the ash/gypsum co-disposal facility would be reduced substantially with frequent watering and progressive re-vegetation of the exposed areas. The impacts are reduced to within NAAQS including on-site. The impacts have thus, similar to the status quo impacts, a ***high probability*** to be of moderate-high significance at a *regional* scale over the long-term, resulting in ***moderate-high*** impact risk.

9.1.7. Mitigation Measures

Effective mitigation of particulate emissions will include:

- Regular wetting of the exposed areas of disposed ash and gypsum;
- Stabilisation of the exposed areas of ash with a top-soil covering;
- Wetting of exposed top-soil for additional mitigation of dust emissions from the top-soil layer; and
- Re-vegetation of the ash/gypsum co-disposal facility through application of a deeper top-soil layer and seeding with appropriate grass seeds.

9.2. GROUNDWATER

The hydro-geological study was undertaken by Ms Claudia Brites from GCS Consulting (Pty) Ltd (GCS).

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Employer: GCS Consulting (Pty) Ltd
Tel: 0 11 803 5726
Fax: 0 11 803 5745
E-mail: claudia@gcs-sa.biz
Address: 63 Wessel Road, Rivonia, 2128

9.2.1. Expertise of the Specialist

Claudia Brites is a level 2 hydro-geologist with 4 years' experience. Her key experience is in conducting contamination assessments (hydrocarbon and inorganic related contaminants), general soil and water sampling (cation/anion, metals, bacteriological, hydrocarbon); groundwater investigations; hydrocarbon site investigations; due diligence studies; assessments of groundwater availability and sustainable abstraction rates; evaluation of water chemistry, waste disposal site suitability studies, soil vapour surveys to aid in hydrocarbon plume delineation, aquifer classification, hydro-geological investigations for EIA's and WULA's, data interpretation; and report writing

9.2.2. Declaration of Independence

GCS is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialized services as stipulated in the terms of reference. A signed declaration of independence is attached together with the groundwater specialist report in **Appendix H**.

9.2.3. Approach and Methodology

The approach included 4 main activities as follows:

- Desktop Study;
- Hydrocensus Investigation within a 2 km radius of the site area;
- Aquifer Testing; and
- Groundwater Sampling.

9.2.4. Findings

9.2.4.1. Previous Investigations

A water quality monitoring programme is currently being undertaken for the Kusile Power Station, since June 2008 by Zitholele Consulting. During this period a total of thirty-four (34) water samples were collected, which includes 16 boreholes and 16 surface water points and 2 duplicates. Fifteen of the 47 monthly monitoring sites were not sampled due to dried up springs, no flowing water, destroyed or collapsed boreholes.

9.2.4.2. General Geology and Hydrogeology

According to the 1:250 000 geological map for Pretoria (2528), the site is underlain by the following lithologies (refer to **Figure 9-7**):

- Dwyka Formation of the Karoo Supergroup (Pd) – Tillite, shale;
- Ecca Formation of the Karoo Supergroup (Pe) – Shale, shaley sandstone, grit, sandstone, conglomerate, coal in places;
- Diabase (Di) – Intrusive; and
- Silverton Formation – Pretoria Group (Vsi) – Shale, carbonaceous in places, hornfels, chert.

According to the 1:500 000 Hydrogeological Map of Johannesburg 2526 (1999), the study area is mostly associated with fractured and intergranular aquifers based on the geology. The average groundwater yields associated with these aquifers, range from 0.1-0.5 l/s.

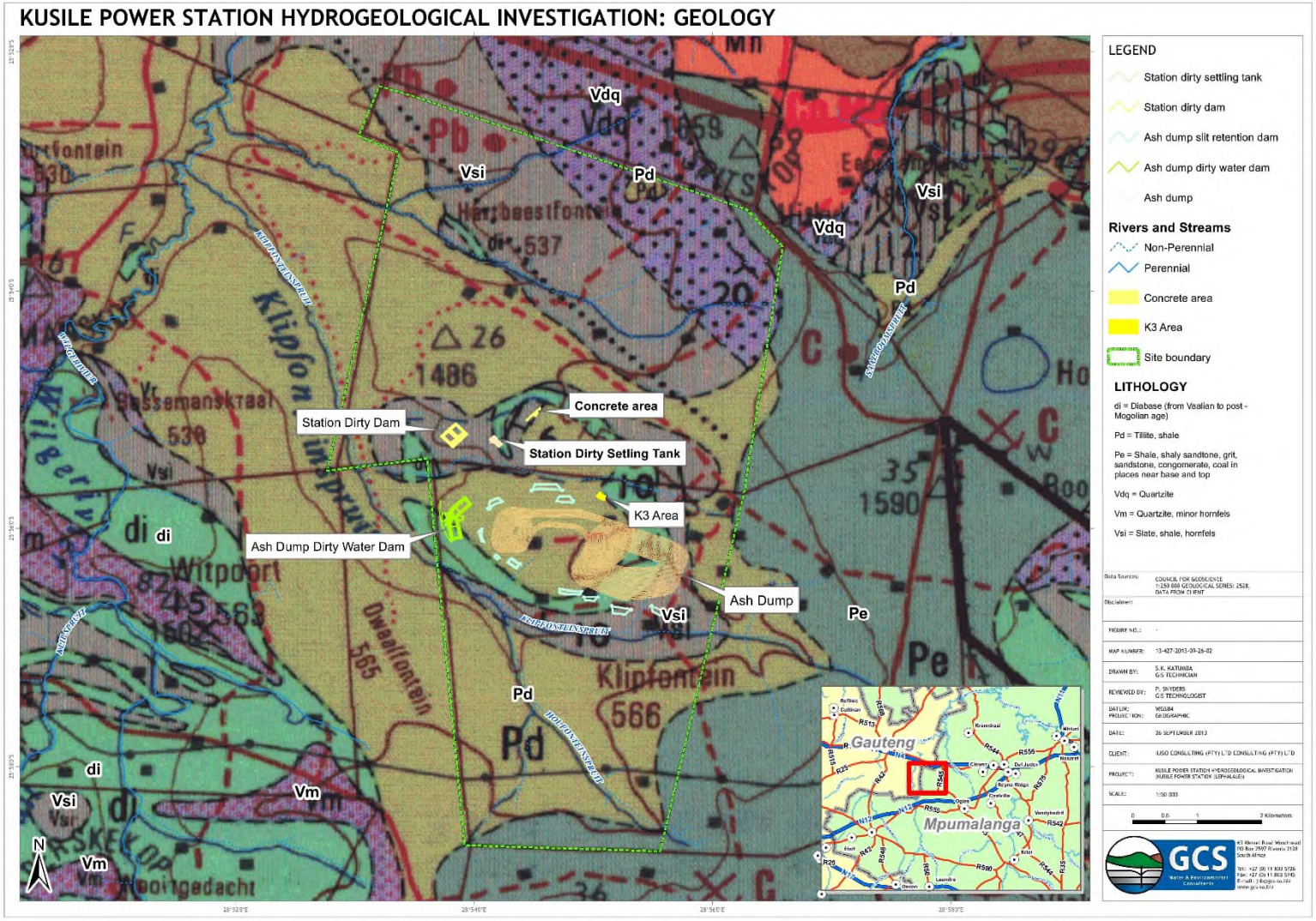

Figure 9-7: Geological Map

9.2.4.3. Field Investigation

In total, 20 boreholes were identified during the hydrocensus from which data was collected (**Figure 9-8**). The depths of the boreholes ranged from 16 to 60 metres. The static water levels recorded ranged between 0.59 to 25.34 mbgl (metres below ground level).

9.2.4.4. Groundwater Levels

The groundwater contours indicate that the groundwater flows in a north westerly/westerly direction across the site area. This indicates that the groundwater mimics the topography and flows towards the perennial river to the west. The groundwater level contour map is presented in **Figure 9-9**.

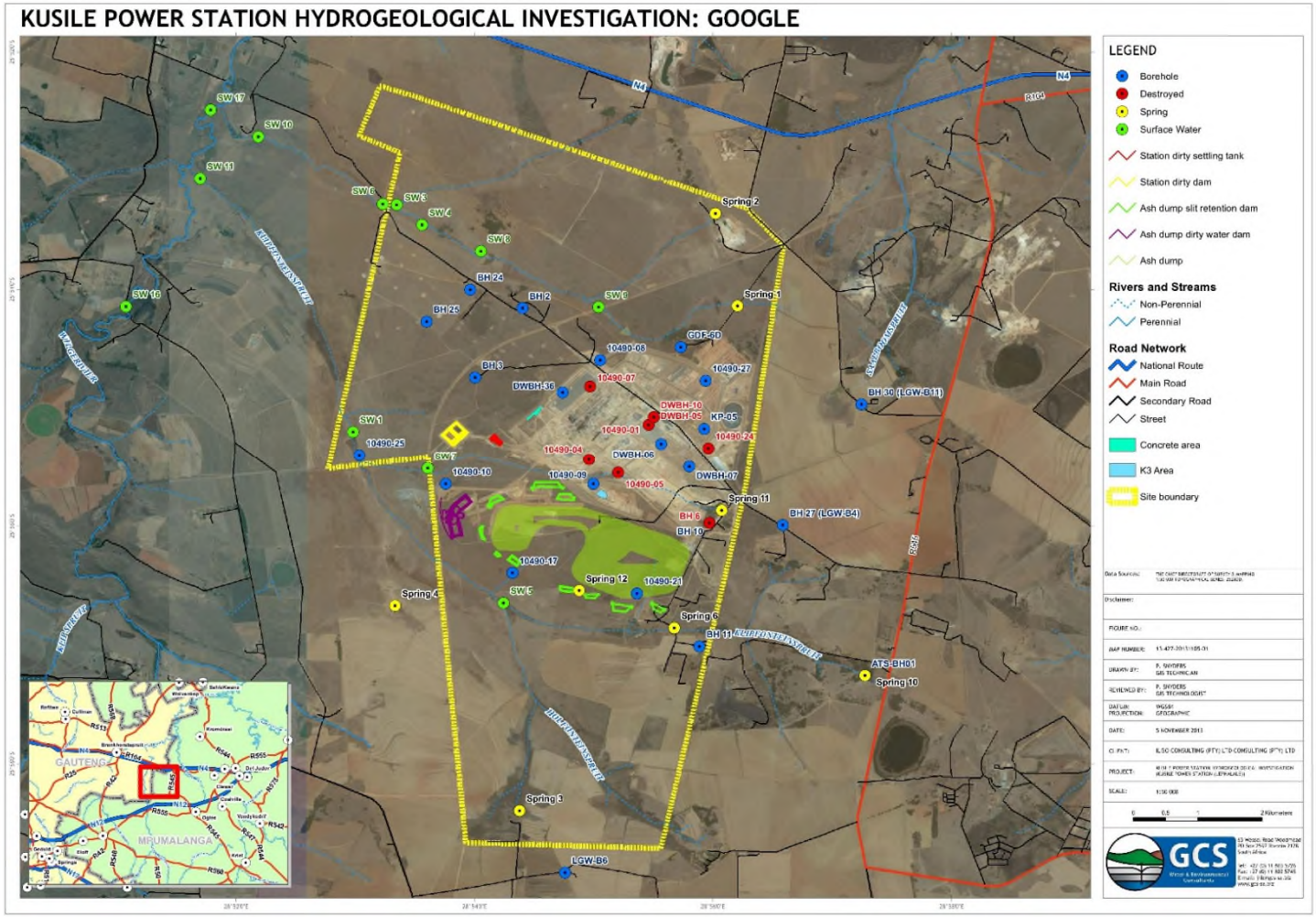

Figure 9-8: Hydrocensus Map

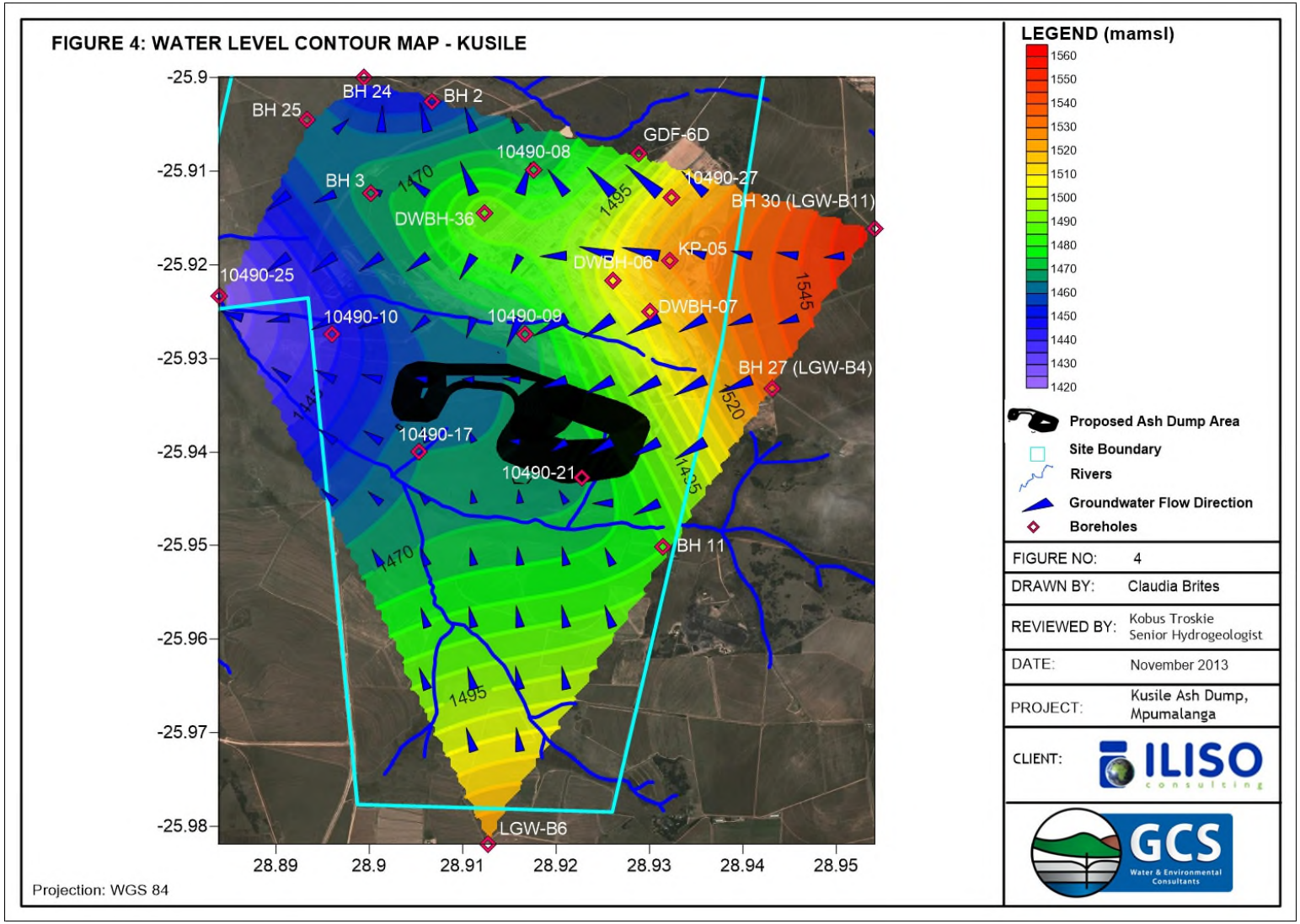

Figure 9-9: Groundwater Level Contour

9.2.4.5. Aquifer Testing

The results from the short duration aquifer testing are summarised in **Table 9-7**.

Table 9-7: Aquifer Test Results

Borehole ID	Borehole SWL (mach)	Borehole Depth (m)	Test (min)	Recovery Test (min)	Test Rate (l/s)	Transmissivity Theis residual drawdown/recovery method (m^2/day)
10490-09	5.39	25	12	90	0.8	0.5
10490-10	0.67	25	40	70	0.58	0.2
10490-17	4.45	25	7	120	0.8	-
BH 27 (LGW-B4)	8.96	32	120	15	0.92	-

The data obtained from borehole 10490-17 indicated insufficient results as minimal recovery was observed. This would be indicative of a very low yielding borehole with a low transmissivity value of less than 0.05 m^2/day. Borehole BH 27 (LGW-B4) indicated a high yielding borehole. In order to obtain accurate aquifer parameters for the borehole, long duration aquifer testing is recommended. Based on the results obtained, a transmissivity value ranging between 20 and 50 m^2/day was allocated for the borehole.

9.2.4.6. Hydrochemistry

The chemistry of majority of the boreholes indicated good water quality with very few parameters which were not compliant with the SANS 241-1:2011 drinking water quality standards. **Table 9-8** provides a summary of the results from the chemical analysis of the boreholes.

Table 9-8: Chemistry Analysis of the Boreholes Sampled

Parameter (mg/l)	Units	SANS 241-1: 2011	10490-09	10490-10	10490-17	10490-21	10490-25	BH11	BH27	BH3	BH30	LGW-B6
pH	pH units	5-9.7	6.8	6.5	7	7.4	8	6.9	6.4	7	6.8	8.1
Conductivity	mS/m @25°C	170	11	7.2	10.8	19.6	30.5	8.5	7.8	12.8	7.7	16.3
Total Dissolved Solids	mg/l	1200	86	50	54	122	166	16	6	74	30	84
Calcium	mg/l Ca	NV	8.7	5	5.8	15.7	18.4	2.3	0.84	9.2	5	18.1
Calcium Hardness as CaCO3	mg/CaCO3		22	12.5	14.5	39	46	5.7	2.1	23	12.5	45
Magnesium	mg/l Mg	NV	5	2.7	3.9	11.5	11.2	1.8	0.9	7.2	3.5	9.6
Magnesium Hardness as CaCO3	mg/CaCO3		21	11.1	16.1	47	46	7.4	3.7	30	14.4	40
Sodium	mg/l Na	200	9.2	6.9	9.1	19.9	48	4.5	2.2	7.2	2.7	6
Potassium	mg/l K	NV	2.8	1.6	4.2	1.2	3.2	2.2	0.96	5.2	2	7.2
T. Alkalinity	mg/l $CaCO_3$	NV	47	29	50	119	194	15	5.5	64	22	87
Phosphate	mg/l PO3	NV	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
Bicarbonate	mg/l HCO_3	NV	57	35	61	145	237	18.3	6.7	78	27	106
Carbonate	mg/l CO_3	NV	0	0	0	0	0	0	0	0	0	0
Chloride	mg/l Cl	300	2	3.7	1.7	0.9	2	2	0.4	2.6	1.6	1.6
Sulphate	mg/l SO_4	500	0.5	2.4	1.7	0.9	1.1	1.1	2.7	<0.2	1	0.2
Nitrate, NO3	mg/NO3	NV	13.2	0.7	<0.1	0.1	0.2	4	4.7	0.2	17.3	0.1
Nitrate	mg/l N	11	3	0.2	<0.1	<0.1	<0.1	0.9	1.1	<0.1	3.9	<0.1
Nitrite as N	mg/l N	0.9	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.2	<0.10
Fluoride	mg/l F	1.5	0.1	0.1	0.2	0.1	1.8	0.1	0.1	0.1	0.1	0.5
Ammonia	mg/l NH3	1.5	<0.10	<0.10	0.7	<0.10	0.1	<0.10	<0.10	0.7	0.4	0.5
Arsenic as As (µg/l)	mg/l As	0.01	0.001	<0.001	0.02	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Aluminium	mg/l Al	0.3	0.03	0.22	<0.003	<0.003	0.006	0.14	0.009	0.007	0.03	0.01
Manganese	mg/l Mn	0.5	0.17	0.15	4	0.05	0.07	0.001	0.13	0.58	0.15	0.007
Cobalt	mg/l Co	0.5	0.001	0.001	<0.001	<0.001	0.001	0.001	0.001	0.001	0.001	0.001
Chromium	mg/Cr	0.05	0.005	<0.003	0.003	0.003	<0.003	0.003	<0.003	0.004	0.003	0.006
Sum of Cations	meq/ℓ	NV	1.318	0.816	1.11	2.62	4.015	0.515	0.235	1.502	0.711	2.138
Sum of Anions	meq/ℓ	NV	1.224	0.75	1.415	2.427	4.053	0.455	0.181	1.303	0.794	1.843
% Error	-	NV	3.698	4.215	-6.791	3.783	-0.471	6.846	-4.665	4.852	-5.263	5.665
Iron	mg/l Fe	2	0.18	0.12	0.1	0.07	0.36	0.13	0.03	0.03	0.11	0.05
Vanadium	mg/l V	0.2	0.02	0.01	0.01	0.04	0.04	0.007	0.003	0.02	0.01	0.03
Zinc	mg/l Zn	5	0.01	0.006	0.01	<0.005	<0.005	0.01	0.009	0.03	0.01	0.01
Lead	mg/l Pb	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/l Cu	2	0.01	0.009	0.01	0.01	0.02	0.02	0.007	0.009	0.01	0.02
Hydroxide Alkalinity as OH-	mg/l	NV	0	0	0	0	0	0	0	0	0	0
Values in red indicate concentration higher than SANS 241-1:2011												

Boreholes 10490-17 and BH3 indicated non-compliant manganese with concentrations of 4mg/l and 0.58mg/l respectively, which exceeded the SANS standard of 0.5mg/l. Borehole 10490-25 indicated non-compliance for fluoride with a concentration of 1.8mg/l which exceeded the SANS standard of 1.5mg/l.

9.2.4.7. Ash/gypsum co-disposal facility Leachate

The following conclusions were made based on research that has been done in South Africa on the impacts of ash from coal-fired power stations on groundwater:

- Without lining of the facility, the salt load in the groundwater will definitely increase, originating mainly from the process water waste streams co-disposed with the ash, together with evaporation processes to cool the power plant.
- The concentration of metals in the coal type determines the concentration of metals in the ash and therefore the leachate.

- Studies on South African sites show contamination of soils and groundwater directly under the ash disposal facility, with limited plume development and movement at well selected sites.
- Shallower water tables will develop as a mound under the disposal site, driving the groundwater flow in the direction of streams or other discharge points.
- Over the long term life of the ash/gypsum co-disposal facility, the pH tends to decrease to around 7 and the mobilization of metals becomes problematic from below pH 9.
- Acid leaching will take place from the coal stockpiles (if not mitigated), increasing the overall potential for groundwater contamination.

Depending on the on-site composition of both the gypsum and the ash, the following is expected:

- Hardening of the ash/gypsum and the formation of cracks, which will provide a preferential pathway for groundwater flow instead of groundwater moving through the material resulting in the salts being leached out;
- The addition of gypsum lowers the permeability of the material, which reduces the chance that leaching will occur. Hardening also reduces permeability, which again locks in the potential contaminants.

The addition of gypsum will reduce the permeability of the composite material, which in turn will reduce the reaction surface of the leaching potential of the material. This could result in a reduced potential of the material to leach. The gypsum acts as a binding agent, causing the material to consolidate into a mass with low primary permeability when cured. This has several benefits in terms of reducing the risk of leachate.

The benefits of co-disposing gypsum with ash include:

- The potential of the ash/gypsum material to oxidize or leach is reduced due to the nature of thickened material;
- Less free water and oxygen will be available to react with the ash/gypsum;
- Preferential flow of groundwater will be through the cracks that form as a result of the hardening process, rather than through it due to lower hydraulic conductivity of the matrix; and

- The Ca content of the gypsum introduces neutralization potential to the mixture and also reduces the effective diffusion in the porous material due to a decrease in permeability of the matrix.

The main benefit of the co-disposal of gypsum and ash is the reduction in permeability of the tailings. Possible contaminants are entrapped in the matrix, controlling the contaminant migration and limiting the transport of potentially soluble constituents.

The following uncertainties apply regarding the co-disposal of gypsum and ash, based on this being the first site this process will be applied to in South Africa:

- The pH of the material, which is important in determining where the metals in the waste product will be released or not.
- No leach tests results are available for the ash/gypsum product. Since this is the first power station to implement to Flue-Gas Desulphurization process and thereby co-disposal of ash with gypsum, limited relevant literature is available for comparison. Therefore leach tests are imperative to determine, the contaminants of concern.

Sequential extraction with different leach solutions is recommended.

9.2.5. Impact Assessment

9.2.5.1. Construction Phase - Hydrocarbon contamination

During the construction phase, hydrocarbon contamination is possible due to the presence of heavy machinery on site. Spillages may occur which may impact both the soil and groundwater environment. The impacts are costly and difficult to clean up, however, only small amounts envisaged.

9.2.5.2. Operational Phase - Poor quality artificial recharge from the ash disposal facility

The major potential impacts of ash/gypsum disposal on groundwater resources are generally associated with changes in the pH of the water, the increase in salt content and the concentration of the potentially toxic trace elements. The most important factor in determining the resulting pollution impact of the ash/gypsum is the way in which it is stored.

The pH of the ash/gypsum material is imperative in determining the risks of leaching. At this stage, it is unknown what the pH of the material will be. The impacts must be re-evaluated once laboratory results are available.

During dry disposal, the ash still has a moisture content of up to 15% as this water is added to suppress the dust during transport and deposition.
Fly ash mainly consists of small, glassy hollow particles and contains all the natural elements, and in comparison with the parent material is enriched in trace elements. Studies show that trace elements are usually concentrated in the smaller ash particles. The ash is usually enriched in arsenic, boron, calcium, molybdenum, sulphur, selenium and strontium.

By understanding the chemistry of the ash, a better insight into its reactions with various other elements can be reached. The pH of the ash is normally elevated due to the abundance of calcium oxide. Calcium oxide usually constitutes about 8 % of the ash and is of great importance in the forming of the pozzolanic layer. As stated above, another factor that plays an important role is the presence of water in the ash. If there is enough water to isolate the ash from the atmosphere (as is the case with wet disposal) the ash will not be able to react with the oxygen in the air and the pozzolanic layer will not be able to form.

In a regular ash disposal facility, if the ash is wetted and dried cyclically, the ash will have time to react with the atmosphere. This will cause a reaction between calcium oxide and the carbon dioxide that will then lead to the crystallisation of calcium carbonate (limestone). Another reaction that occurs is that between calcium and sulphate that results in the crystallisation of gypsum.

These two minerals (calcium carbonate and gypsum) form the so-called pozzolanic layer, which is a layer of very low permeability. The layer can be expected to occur in the upper 0.5 m of the ash disposal infrastructure. It is thus evident that the formation of the pozzolanic layer is mostly confined where wetting and drying of ash occurs, during deposition in the wet process and near the surface on a dry ash pile. In the case of ash/gypsum co-disposal, the gypsum reduces the permeability which also reduces the

reaction surface of the leaching potential of the material. This could result in a reduced potential of the material to leach.

It is also understood that the addition of gypsum will result in hardening, therefore preferential flow of groundwater will be through the cracks that form as a result of the hardening process, rather than through it due to lower hydraulic conductivity of the matrix.

The ash and neutralised regeneration effluents must always be disposed of as a semi-homogeneous mixture and spread across the ash pile. Prolonged disposal of neutralised regeneration effluents in one location can compromise the pozzolanic characteristics of the ash (due to high sulphate concentrations), which will increase the risk of leaching.

The quality of the water seeping from the ash/gypsum facility must be determined by performing leach testing. The volume of water that will seep from the ash/gypsum disposal facility in the long term will be affected by the recharge from rainfall.

9.2.5.3. Poor quality water from the Flue Gas Desulphurisation Wastewater Treatment Plant

An assessment of the potential impacts envisaged with the use of FGD technology on the water resources was conducted to assist in making decisions and developing management plans. The hazards identified with the use of FGD technology at a power station are related to the use of water in the emissions reduction process, the creation and storage of poor quality water and waste, and its impact on the groundwater environment.

Flue Gas Desulphurisation (FGD) waste will be dewatered and the poor quality water stored on site for reuse in the FGD process. The possibility exists that artificial recharge will occur through permeable soil and weathered material and contaminate the aquifer.. The dam/storage area where the waste water will be stored, must be lined.

9.2.6. Groundwater Monitoring Programme

The following boreholes are currently being monitored by Zitholele Consulting on a monthly basis: 10490-09, 10490-10, 10490-17, 10490-21, 10490-25, 10490-27, BH2, BH3, BH11, BH25, BH27, BH30, GDF-6D, DWBH-06, DWBH-07 and DWBH-36 in order to comply with the conditions of the Environmental Authorisation (EA) issued by the Department of Environmental Affairs (DEA), and the Water Use License (WUL) from the Department of Water Affairs (DWA).

The specialist recommended that the boreholes should be sampled on a quarterly basis as per **Table 9-10** which includes all boreholes sampled during this investigation. Boreholes should be sampled on a quarterly basis for indicator elements and a full analysis on a bi-annual basis.

Figure 9-10: Recommended Groundwater Monitoring Programme

Borehole Name	Proposed Sampling Frequency	Analysis
10490-09	Quarterly for indictor elements and a full analysis on an bi-annual basis	Indicator elements include TDS, SO4, Na, Cl, Mg, Al, B, As, Cr, Fe, Ni, Se and Zn As per Table 6.6 for bi-annual analysis
10490-10		
10490-17		
10490-21		
10490-25		
BH11		
BH 27 (LGW-B4)		
BH 3		
BH 30 (LGW-B11)		
LGW-B6		

A significant data set is currently in place for baseline data as the groundwater monitoring is already in place. Therefore all new data collected from the existing boreholes must be compared to the existing data to identify any trends in the groundwater levels and chemistry over time. Long-term groundwater monitoring at similar ash disposal facilities have indicated varying degrees of groundwater quality deterioration.

Typically groundwater monitored within boreholes adjacent to ash/gypsum disposal facilities indicates a rise in the salt content of the groundwater due to seepage from surface sources and also because of the dissolution of salt from the previously unsaturated zones. The increase in salinity is, therefore, a combination of artificial recharge from poor quality (saline) surface water sources and the mobilisation of salts in the exposed zones in the boreholes.

The rate of salts leaching into the subsurface depends on the ash/gypsum disposal facility (wet versus dry), liners, soil /geology and depth to water level. Typically very slow migration of salts and metals are expected if the site is well selected and managed.
Water levels are in general expected to rise due to the availability of water on the site and increase in recharge from both the clean water and dirty water systems. This will cause a flow gradient away from the site, even in slight upgradient direction of groundwater flow.

If the monitoring data indicates the need for corrective action, the magnitude of the impact must be assessed by an appropriately qualified and experienced specialist and the necessary measures put forward based on the magnitude of the impact.

9.2.7. Conclusions and Recommendations

A total of 20 boreholes were identified during the hydrocensus. The depths of the boreholes ranged from 16 to 60 metres. The static water levels recorded ranged between 0.59 to 25.34 mbgl (metres below ground level). The transmissivity in the two boreholes associated with the Dwyka Formation (10490-09 & 10490-10) ranged from 0.3 to 0.5 m^2/day. The data obtained from borehole 10490-17 indicated insufficient results as minimal recovery was observed. This would be indicative of a very low yielding borehole with a low transmissivity value of less than 0.05 m^2/day. Borehole BH 27 (LGW-B4) indicated a high yielding borehole and the pump test results indicated insufficient drawdown based on the pump capacity.

The chemistry of majority of the boreholes indicated good water quality with very few parameters which were not compliant with the SANS 241-1:2011 drinking water quality standards for domestic use. Boreholes 10490-17 and BH3 indicated non-compliant

manganese with concentrations of 4mg/l and 0.58mg/l respectively, which exceeded the SANS standard of 0.5mg/l. Borehole 10490-25 indicated non-compliance with the fluoride concentration of 1.8mg/l which exceeded the SANS standard of 1.5mg/l.

The hazards associated with the proposed ash/gypsum co-disposal facility and its impact on the groundwater environment include: Hydrocarbon contamination as well as poor quality water stored on site recharging the groundwater. The impact of hydrocarbon contamination on the soil and groundwater environment during construction indicates moderate environmental significance without mitigation in place and low environmental significance with mitigation in place.
Another negative impact envisaged is the result of poor quality artificial recharge from the ash/gypsum disposal facility. The proposed mitigation measures would include:

- Lining the ash/gypsum disposal facility to reduce the impact on the groundwater environment as it inhibits the seepage of poor quality water into the aquifer; and
- Implementing the proposed groundwater monitoring programme.

The main benefit of the co-disposal of gypsum and ash is the reduction in permeability of the tailings. Possible contaminants are entrapped in the matrix, controlling the contaminant migration and limiting the transport of potentially soluble constituents.

It was recommended that the boreholes that are currently being monitored at Kusile, must be monitored on a quarterly basis and must include the additional boreholes that were included in this assessment. A full analysis must be conducted on a bi-annual basis.

It was also recommended that leach tests be conducted on the ash/gypsum waste in order to determine the leachable concentrations of the waste samples and whether they are within acceptable limits. The results can also be used to assess the type of waste in accordance with the NEMWA.

9.3. ECOLOGY

The Ecological Specialist Studies were conducted by Professor Johann du Preez from MDA Town & Regional Planners, Environmental and Development (MDA).

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9.3.1. Expertise of the Specialist

Professor Johann du Preez is a registered Professional Natural Scientist (Reg Number: 400271/07) with more than 30 years' experience in ecological studies. His experience includes research in vegetation ecology and data management, biomontoring, impact assessment, environmental management and environmental education.

9.3.2. Declaration of Independence

MDA is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialized services as stipulated in the terms of reference. A signed declaration of independence is attached together with the terrestrial specialist report in **Appendix H**.

9.3.3. Approach and Methodology

The study entailed an assessment of the environment and vegetation with special emphasis on the possible presence of Red Data species on the site earmarked for the proposed development. In general, the assessment included the following:

- Identification and description of ecologically sensitive areas.
- Identification problem areas in need of special treatment or management e.g. bush encroachment, erosion, degraded areas, reclamation areas.
- Making recommendations on aspects that should be monitored during development.

A vegetation and habitat survey was undertaken on 11 September 2013 at each of the vegetation type / plant community on site by:

- Determining relatively homogeneous potential ecological units / plant communities / ecosystems on aerial photographs.
- Listing the plant species (trees, shrubs, grasses and herbaceous species of special interest) present in each ecological unit for plant community and ecosystem description.
- Identifying potential Red Data plant species, possible encroacher species and exotic plant species.
- Assessment of alien invasive species.

The following conservation priority or sensitivity categories were used for each site:

- High: Ecologically sensitive and valuable land with high species richness and / or sensitive ecosystems or Red Data species that should be conserved and no development should be allowed.
- Medium-high: Land where sections are disturbed but which is in general ecologically sensitive to development/disturbances.
- Medium: Land on which low impact development with limited impact on the vegetation / ecosystem could be considered for development. It is recommended that certain portions of the natural vegetation be maintained as open space.
- Medium-low: Land of which small sections could be considered to be conserved but where the area in general has little conservation value.
- Low: Land that has little conservation value and that could be considered for development with little to no impact on the vegetation.

Species richness was determined as shown in **Table 9-11**. Alien woody species and weeds are not included.

Figure 9-11: Species richness category determination.

NO	NUMBER OF SPECIES	SPECIES RICHNESS CATEGORY
1	1 – 24	Low
2	25 – 39	Medium
3	40 – 59	High
4	60+	Very high

9.3.4. F

indings

9.3.4.1. Flora

According to Mucina and Rutherford (2006), the project is situated in an area covered by Eastern Highveld Grassland (Gh12). In pristine conditions the ground layer is dominated by grassland vegetation mixed with a number of forbs and bulbous species.

The dominant grasses included:

- The *Eragrostis curvula – Themeda triandra* community is limited to the undisturbed areas around the fallow crop fields at the site.
- The *Hyparrhenia hirta – Cynodon dactylon*is dominating the degraded fallow crop fields which cover the majority of the planned co-disposal site.
- The *Acacia mearnsii – Tagetes minuta* alien plant community is dominated by a dense stand of the exotic invader namely the Black Wattle (*Acacia mearnsii*) and the weed *Tagetes minuta*.

Table 9-9 provides a summary of the species richness and sensitivity of the identififed plant communities in the project area.

Table 9-9: Species Richness and Sensitivity of the identified plant communities in the project area

NO	PLANT COMMUNITY	SPECIES RICHNESS	SENSITIVITY
1.	*Eragrostis curvula – Themeda triandra* community	Medium	Low
2.	*Hyparrhenia hirta – Cynodon dactylon* degraded fallow land community	Low	Low
3.	*Acacia mearnsii – Tagetes minuta* alien plant community	Low	Low

No Red Data species or protected species were found on the site.

9.3.4.2. Fauna and Avi-Fauna

Due to the degradation and the soil disturbance on the property, very few signs of animal communities were noted. The tracks of porcupines (*Hystrix africae-australis*) (Figure 4.5) was as well as the runways and tunnels of striped mice (*Rabdomys pumilio*) (Figure 4.6) were noted.

During the site assessment the bird species identified included of Northern Black Korhaan, Blue Korhaan, a single Black-headed Heron and a flock of Helmeted Guineafowl.

No Red Data species or protected species were found on the site.

9.3.5. Potential Impacts/Risks

The risks identified for the construction and operational phases were:

- Construction Phase
  - Destruction of natural vegetation;
  - Migration of animals away from site;
  - Vegetation loss due to the removal of vegetation cover and soil disturbance may cause erosion damage; and
  - Alien plants that colonise disturbed areas.
- Operational Phase
  - Loss of vegetation due to contamination of the soil downwind from the waste dump due to dust pollution;
  - Loss of vegetation due to contamination of the soil due to ash and gypsum spillage;
  - Erosion damage due to soil disturbance and poor vegetation cover;
  - Alien plants that colonise disturbed areas;
  - Decline in the biodiversity of the surrounding vegetation due to wind deposition of ash and gypsum; and
  - Negative effect on crop production and the palatability of grazing due to wind deposition of ash and gypsum on plants.

9.3.5.1. Mitigation Measures

To reduce the predicted emissions, the follow recommendations were provided as a minimum:

- Spillage of ash and gypsum between the Kusile Power Station and the ash/gypsum co-disposal facility must be prevented.
- Dust suppression measures must always be applied to prevent dust pollution.
- The lining of the ash/gypsum co-disposal facility and dirty water dams must be tested for leaks before the deposition of the first ash takes place.
- Care must be taken not to rupture the lining during the construction and operational phases.
- Areas must be regularly monitored for alien plants that could colonise the topsoil cover of the ash/gypsum co-disposal facility.
- The ash/gypsum co-disposal facility must be regularly monitored for erosion damage of the topsoil cover.

9.3.5.2. Conclusion

Three plant communities were identified namely *Eragrostis curvula – Themeda triandra* community, *Hyparrhenia hirta – Cynodon dactylon* degraded fallow land community and the *Acacia mearnsii – Tagetes minuta* alien plant community. No Red Data species or protected species occur on the site.

Should the development be undertaken at the study area, the vegetation of the footprint area of the proposed development will be destroyed along with its specific species richness. The footprint of the proposed development is extensive but is mostly limited to the already degraded grassland communities.

The impact on these plant communities can be regarded as relatively small in terms of the regional context and the plant communities have a relatively low biodiversity conservation importance in a local, regional or national context.

The assessed environmental risks can be minimised if the proposed mitigation measures are implemented during the construction and operational phase of the

proposed project. Construction workers should be trained in the prevention (including mitigation measures) of any environmental impacts associated with the project.

9.4. SURFACE WATER AND HYDROLOGY

The surface water and hydrological studies were conducted by Mrs Manda Hinsch from SRK Consulting (Pty) Ltd (SRK).

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9.4.1. Declaration of Independence

SRK is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialized services as stipulated in the terms of reference. A signed declaration of independence is attached together with the surface water specialist report in **Appendix H**.

9.4.2. Approach and Methodology

The methodology implemented to develop the Surface Water Study included:

- **Collection of data:** Data and information related to the Kusile Power Plant was collected from various sources. This data was used to develop the necessary spatial representations (maps) and database to support the Surface Water Study, as well as to determine new control measures and proposed upgrade of existing controls;
- **Assessment of relevant standards and guidelines:** Relevant Eskom and related South African standards/legislation were investigated to determine the requirements related to stormwater management and pollution control at the Kusile Power Station;
- **Site Visit and Status Quo Investigation:** The aim of this visit was to investigate the current building status of infrastructure at the Kusile Power Station and to ascertain the floodline levels which could influence the compilation of the risk assessments. Where required, data and information such as measurements related to the capacity of infrastructure was obtained from relevant collected data;
- **Hydrological Modelling:** A hydrological model was compiled based on the catchment and input parameters (Storm rainfall, Soil conditions, Catchment shape, slope and size; and urbanisation, vegetation and land use) for both the existing drainage system as well as the possible future drainage system.

- **Determination of required control measures:** identifying required additional control measures as well as remediation opportunities for the identified existing control measures.

9.4.3. Findings

9.4.3.1. Status Quo

- Zero liquid effluent discharge: Eskom's Kusile Power Station has implemented a zero liquid effluent discharge philosophy at the Kusile Power Station to ensure that water management is optimised.
- Minimising seepage losses: The engineering of the ash/gypsum co-disposal facility and its associated infrastructure lining for all dirty water is designed to reduce seepage losses and reduce risks on the receiving water environment.
- Segregation of clean and dirty water systems: In accordance with the principles of Regulation 704 of the Water Act, clean storm water will be diverted around the footprint area of ash/gypsum co-disposal facility and the impacted storm water within the footprint area of ash/gypsum co-disposal facility will be contained and reutilised through the ADDD and SDD.
- Existing Pollution Control System: The existing pollution control system consisting mainly of the Dirty Dams which are not yet in operation.
- Catchment Delineation and Classification: The study area lies approximately 35km east south east of Witbank, situated in Quaternary Catchment B20F, which has a MAP of 661 mm and MAR of 16.7 mm. A summary of the catchment land-use classification relevant to the project is given in **Table 9-10**.

Table 9-10: Catchment Land-use Classification

Classification	Area	Comment
Clean	Undisturbed land area	Regional geology of agricultural practices may contaminate runoff.
Moderately dirty	Residue deposits	Includes coal discard, slurry facilities, slime dams, waste rock dumps and sand dumps.
	Unrehabilitated areas	Dissolved and suspended contaminants.
	Haul roads	Dissolved and suspended contaminants.
	Pollution control dams	Depends on contents of dam.
Dirty	Residue deposits	Includes coal discard, slurry facilities, slime dams, waste rock dumps and sand dumps.
	Unrehabilitated areas	Dissolved and suspended contaminants.
	Haul roads	Dissolved and suspended contaminants.
	Pollution control dams	Depends on contents of dam.

9.4.3.2. Hydrological Modelling

A hydrological model was used to determine the flood peaks and runoff volumes from the catchments and sub catchments. Visual SCS and Rational methods were used to determine the Peak flows for floodline determination and rational method flood peaks were adopted for the ash/gypsum co-disposal facility dirty water and clean water catchments as better correlation was observed between this method and the peak flows used for the designing of the dirty water and clean water channels. Relevant input parameters were calculated from the determined as follows:

- **Rainfall Assessment:** Rainfall for the model was based on IDF (intensity-duration-frequency) curves derived for this study area by J C Smithers and R E Schulze. The estimated design rainfall depths for durations ranging from 15 minutes to 7 days and for return periods ranging from 2 to 200 years for the Kusile study area were calculated. The 24-hour design rainfall for various return periods is given in Table 4-3 below:

Table 9-11: Design Rainfall (24 hr.)

Return Period	1:2 Year	1:5 Year	1:10 Year	1:20 Year	1:50 Year	1:100 Year
Rainfall depth (mm)	59	81	99	119	143	165

- **Catchment Details:** The catchment details and land-use classification for the natural watercourse (Including diversion canal) for the Kusile Power Plant are summarised in **Table** 9-12**9-12**. **Figure 9-12** shows the locality of catchments and detailed delineation descriptions.

Table 9-12: Summary of storm water delineated catchments and classification thereof

Catchment Name	Classification	Individual Area (km^2)	Cumulative Area (km^2)
KLF	Clean	9.20	60.38
KLFS1	Clean	2.26	49.51
KLFS2	Dirty	9.77	34.86
KLFS3	Dirty	6.54	21.23
KLFS1T	Moderately Dirty	1.67	1.67
KLFS2T1	Dirty	4.05	12.84
KLFS2T2a	Dirty	3.40	3.40
KLFS2T2b	Dirty	0.54	4.0

Catchment Name	Classification	Individual Area (km^2)	Cumulative Area (km^2)
KLFS2T2c	Dirty	0.54	6.0
KLFS2T2d	Dirty	0.86	9.66
KLFS2T2e	Dirty	1.59	1.59
KLFS2T2f	Dirty	2.8	2.80
HLF	Clean	14.63	14.63
Wilge1T1	Clean	4.75	28.95
Wilge1T2	Clean	7.28	17.50
Wilge1T3	Moderately Dirty	6.40	6.40
Wilge1T1T	Clean	6.70	6.70
Wilge1T2T	Clean	3.82	3.82

The study showed that:

i. More than half of sub-catchments are classified as dirty. This is mainly due to the construction of the dirty water dams, ash/gypsum co-disposal facility and the haul roads.
   - There is some mining activity in the area which contributes to the moderately dirty and dirty catchments. The most prominent coal mine is found to the south east of the power station.
   - A quarry is situated to the north-east corner of the power station.
   - The ash/gypsum co-disposal facility will be built to the south of the power station, which contributes to the dirtying of a few of the catchment areas.
   - All the areas in direct contact with the power plant were also classified as dirty

ii. Only two catchments were classified as moderately dirty.
   - The moderately dirty catchment areas have a haul road which will be used to transport coal.

iii. The defined clean sub-catchments consist of the following areas:
   - Natural vegetation and farm land lies mostly to the south, west and north of the power station.
   - To the south east lies farmland with what appears to be a clean dam on the border of the catchment area.

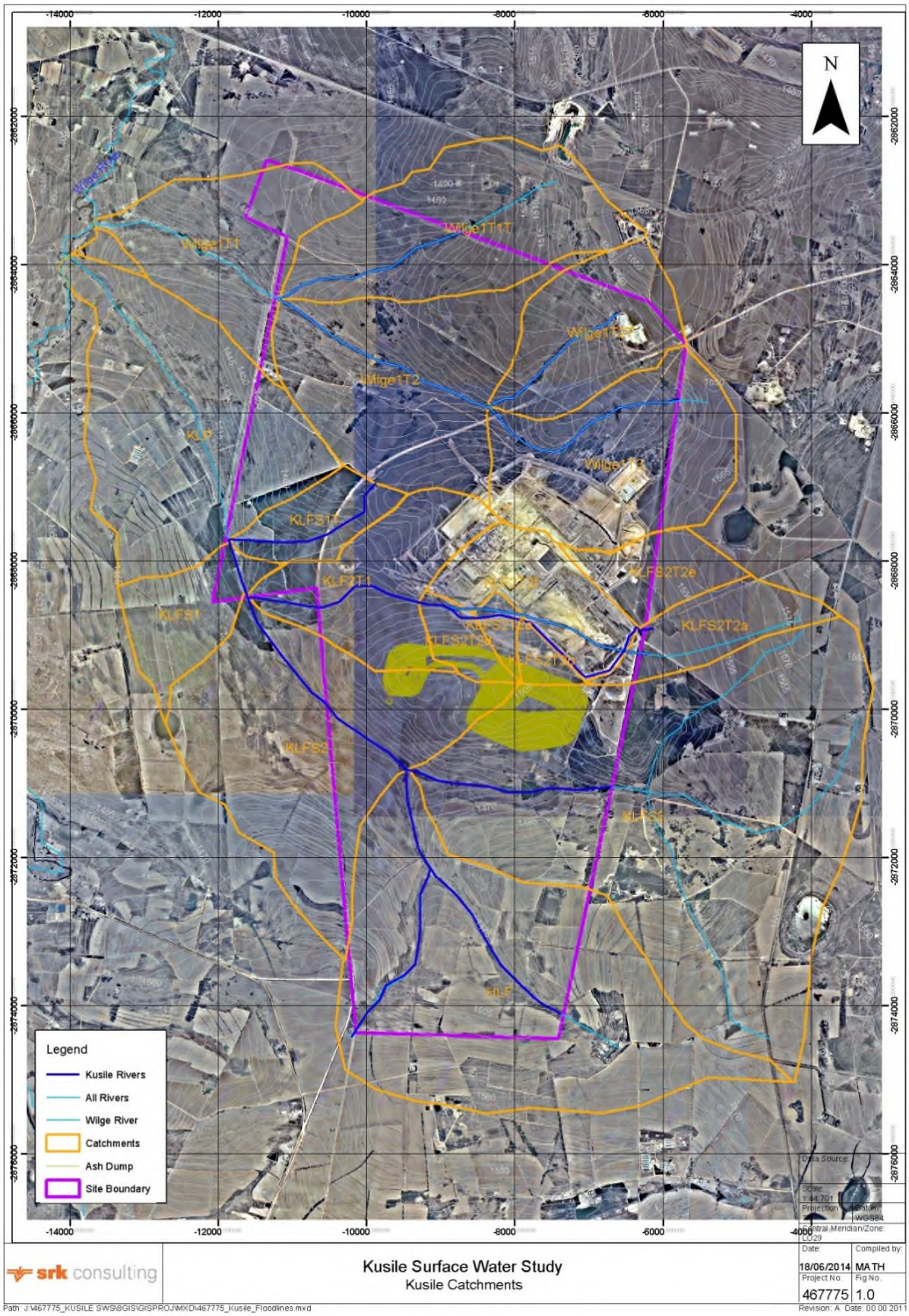

Figure 9-12: Kusile Water Catchments

9.4.3.3. Assessment of current drainage system

The current drainage system is still in its infancy as the power plant is not yet in operation. Storm water diversion culverts and berms are operational around the construction of the various dirty water dams and the ash disposal facility and are compliant at this point as per the site visit conducted on the 11 of September 2013.

- The Ash/gypsum co-disposal facility Clean Water and Dirty Water Systems: The Dirty Water and Clean Water collection system for the ash/gypsum co-disposal facility as designed by Panel B Consultants Joint Venture (Panel B Consortium joint Venture PBC JV#19, 2008) handles a 1:100 year/ 24 hour storm event. The ADDD was designed for a 1:50 year/24 hour duration storm. The study determined the Ash/gypsum co-disposal facility dirty catchment areas that will contribute the dirty water runoff and determined the peak flows that will be generated from these dirty water catchments. The Dirty water canal running around the ash/gypsum co-disposal facility that will collect the ash/gypsum co-disposal facility dirty water were sized based on the calculated 1:50 year and 1:100 year peak flows, a minimum of 1:200 canal slope and a 2.5m base with a manning value of 0.018. The **Table 9-13** below shows the dirty water canal sizes around the ash/gypsum co-disposal facility that can handle the generated peak flows.

Table 9-13: Dirty Water Canal Sizes to accommodate the generated peak flows

Catchment Name	Area km^2	Length m	1:50 Year Peak Flow	1:100 Year Peak Flow	1:50 Year Flow Depth	1:50 Year Flow Velocity	1:100 Year Flow Depth	1:100 Year Flow Velocity
AD1	0.21	355.75	3.47	4.42	0.53	2.15	0.61	2.31
AD2	0.08	181.90	2.13	2.71	0.4	1.84	0.46	1.98
AD3	0.19	303.21	3.77	5.50	0.56	2.2	0.7	2.47
AD4	0.27	635.45	3.54	5.20	0.54	2.16	0.67	2.43
AD5	0.19	424.42	2.97	3.78	0.49	2.04	0.56	2.2
AD6	0.42	636.45	5.50	7.01	0.7	2.47	0.8	2.65
AD7	0.16	440.55	2.47	3.63	0.44	1.93	0.52	2.12
AD8	0.19	324.97	3.25	4.77	0.51	2.1	0.64	2.37
AD9	0.13	428.34	2.02	2.97	0.39	1.8	0.49	2.04
AD10	0.07	176.17	1.93	2.84	0.38	1.78	0.47	2.01
AD11	0.07	335.62	1.18	1.74	0.28	1.51	0.35	1.72
AD12	0.11	377.74	1.78	2.62	0.36	1.73	0.45	1.96

The clean water undeveloped catchment areas were determined and peak flows generated using the Rational method to determine the clean water channel sizes. The channels were sized based on the calculated 1:50 year and 1:100 year peak flows, a minimum of 1:200

channel slope and a 2.5m base with a manning value of 0.018. The details of the clean water channel sizes are given in **Table 9-14**.

Table 9-14: Clean water Cannel Sizes

Catchment Name	Areak m^2	Length m	1:50 Year Peak Flow	1:100 Year Peak Flow	1:50 Year Flow Depth	1:50 Year Flow Velocity	1:100 Year Flow Depth	1:100 Year Flow Velocity
CW1	0.17	623.62	2.04	3.00	0.39	1.81	0.49	2.05
CW2	0.17	863.26	1.95	2.87	0.38	1.78	0.48	2.05

The 1:150 year and 1:100 year dirty water volumes for each of the dirty water sub-catchments were determined and are given in the **Table 9-15** below:

Table 9-15: Dirty Water Catchments Volumes

Catchment Name	1:50 Year Volume (10^3 m^3)	1:100 Year Volume (10^3 m^3)
AD1	9.0	11.3
AD2	3.3	4.2
AD3	5.8	8.4
AD4	5.4	8.0
AD5	6.4	8.0
AD6	14.3	18.1
AD7	3.8	5.5
AD8	8.5	12.4
AD9	3.1	4.5
AD10	4.1	6.1
AD11	3.0	4.5
AD12	3.8	5.5
CW1	4.3	6.3
CW2	5.9	8.6
Total	**70.5**	**96.6**

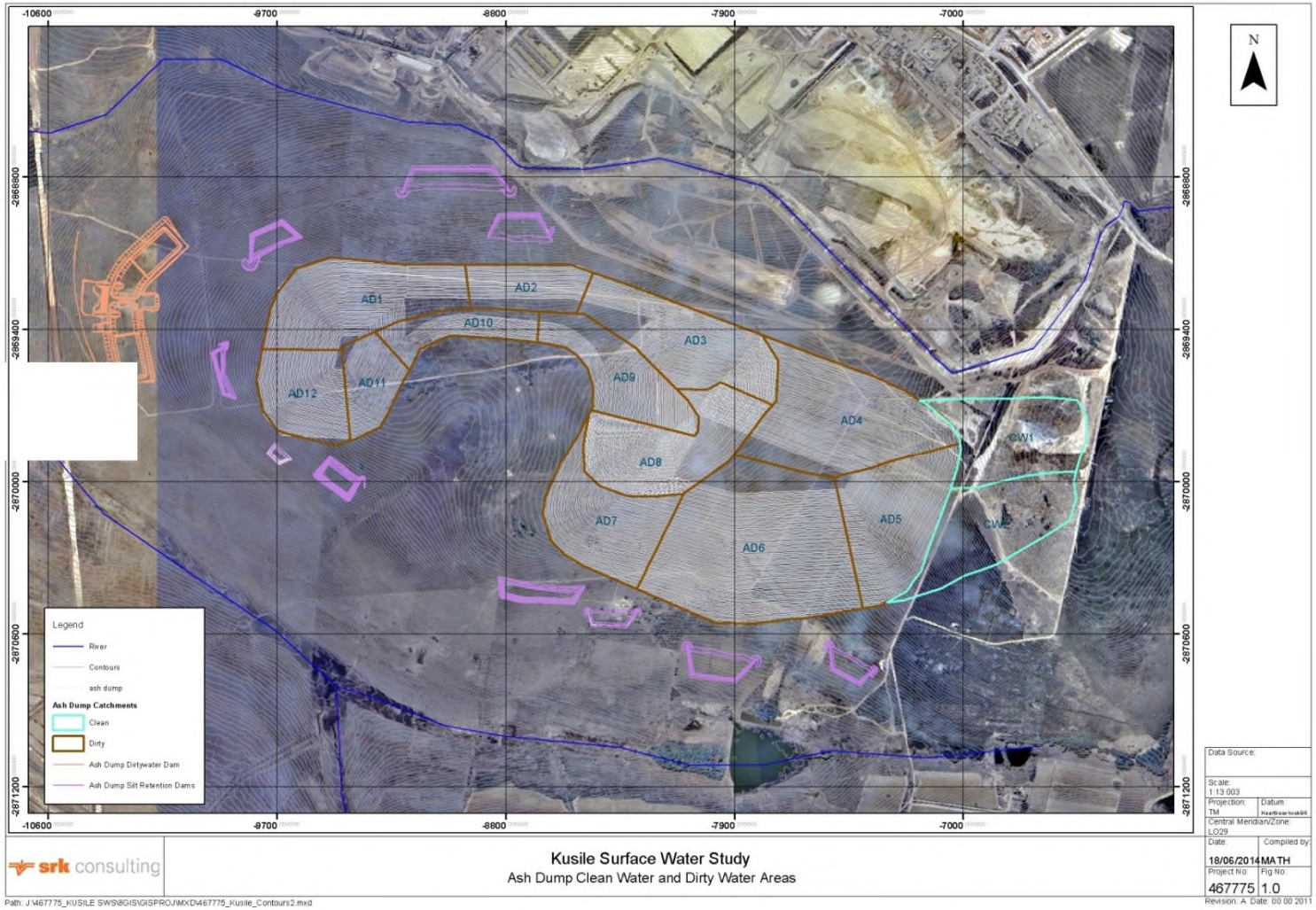

Figure 9-16: Ash/gypsum co-disposal facility Clean Water and Dirty Water Catchments

9.4.3.4. Assessment of Current Pollution Control Dams

An assessment of the pollution control dams was conducted in terms of GN 704 storage facility requirements. The storage capacity of the facilities is facilities is provided in **Section 5** of this report. In addition to the storage capacity, the required minimum “surge" volumes were determined to be:

- The ADDD has been built to handle the capacity of a one in 50 year/24hr storm event.
- The SDD ST can handle the dirty water runoff from its inflow sources for the 1:50 year, peak instantaneous storm event including an emergency spillway to accommodate larger events.

9.4.3.5. Water Quality Assessment

Kusile Power Station has been conducting water quality monitoring since 2004. At the time of the study the latest report available from September 2013. No new sampling was undertaken for this study. As several of the sampling points are not perennial, only 30 of the 47 sampling points yielded any water.

The sampling points that are relevant to the ash/gypsum co-disposal facility and associated infrastructure are Spring 6, SW5, Spring 11, SW8 and SW9. The significance of the surface water sampling points to the ash/gypsum co-disposal facility is shown in **Table 9-17**.

Table 9-17: Surface Water Sampling Points relevant to the Ash/gypsum co-disposal facility

Site Name	Y co-ord	X co-ord	Site Type
Spring 6	-25.94760	28.92797	Spring to the south of the Ash/gypsum co-disposal facility. Water quality of this spring could be an indication of the groundwater quality
SW5	-25.94410	28.90410	Surface water point upstream of the Ash/gypsum co-disposal facility in the Klipfontein Spruit after confluence with the Holfontein spruit
Spring 11	-25.93110	28.93460	Spring to the north of the Ash/gypsum co-disposal facility. Water quality of this spring could be an indication of the groundwater quality
SW 8	-25.8946	28.90094	Surface water point north to the dam in a small un named tributary of the Klipfontein Spruit (regarded as downstream of activities)
SW 9	-25.90245	28.91739	Surface water point north to the dam in a small un named tributary of the Klipfontein Spruit (regarded as downstream of activities)

The positions of the monitoring points are provided in **Figure 9-13**.

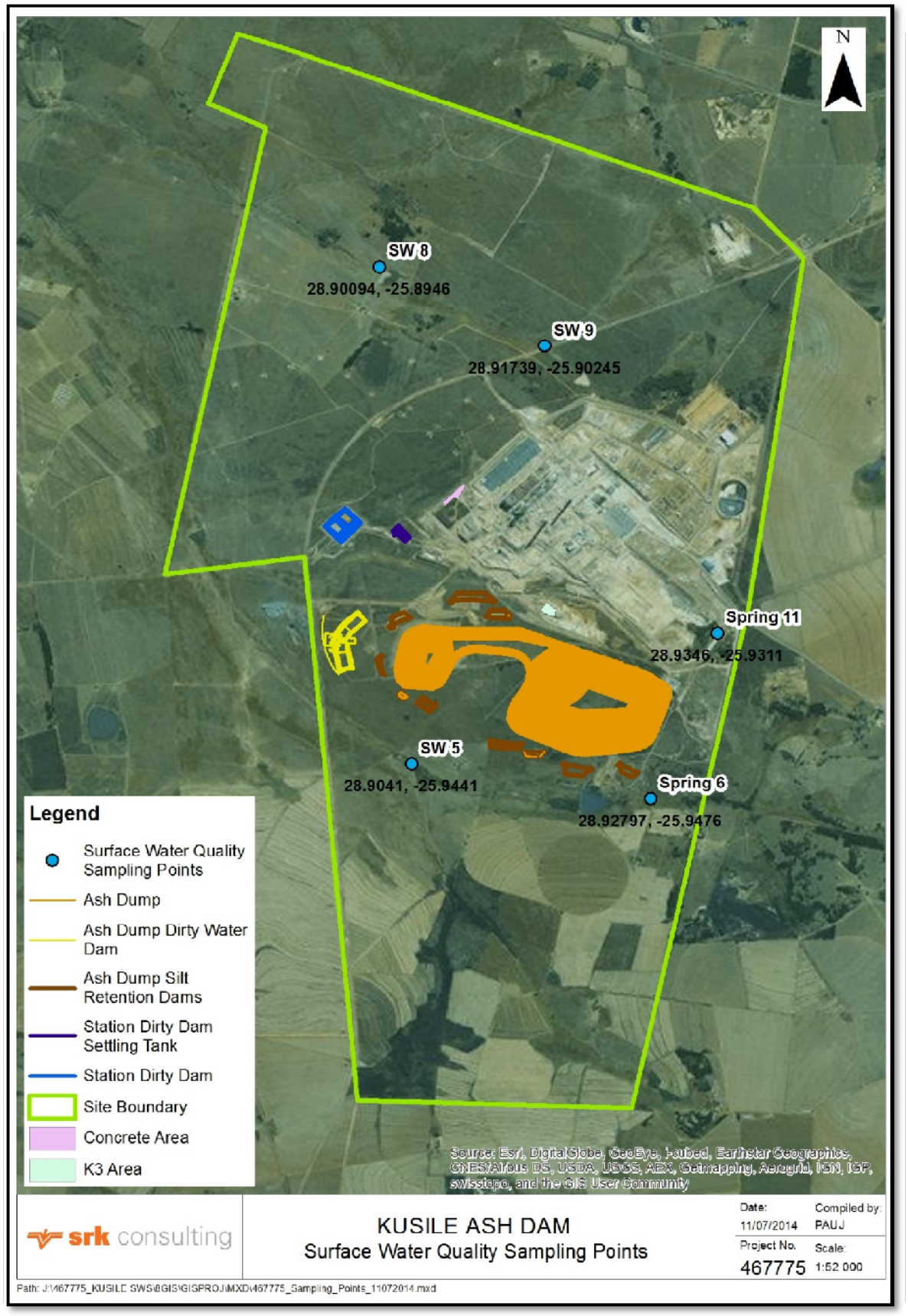

Figure 9-13: Water Sampling Points

Water Quality Results

Water Users downstream from Kusile Power Station

The study found that the land use downstream from Kusile and surrounding the power station is dominated by maize, grazed fields, coal mines and power stations. Water bodies are the only land use regarded as sensitive. It was found that the most sensitive user in the study area is the domestic water use.

Water Quality Assessment Results

The results from the water quality assessment undertaken by Zitholele since 2008 are summarised in **Table 9-18**.

Table 9-18: Summary of the Surface Water Quality Results taken between 2008 and 2012 from the relevant surface points

Sample ID		pH	EC (mS/m)	Dissolved Solids (mg/L)	Suspended Solids (mg/L0)	Turbidity (NTU)
Spring 6						
Max		7.80	84.0	680.0	32.80	22.80
Med		7.3	54.0	383.0	5.20	5.13
Min		7.3	1.29	67.0	0.8	1.46
Number of samples		44	44	44	36	32
Spring 11						
Max		9.28	39.0	248.0	408.0	392.0
Med		6.96	7.2	48.0	11.0	10.5
Min		6.11	6.0	36.0	0.2	0.53
Number of samples		36	36	36	34	27
SW8*						
Max		7.7	11	84	150	389
Med						
Min		7.3	1.06	73	84	62
Number of samples		2	2	2	2	2
SW5						
Max		8.03	38	240	142	22.8
Med		7.98	34	32	32	5.13
Min		7.6	9	74	8.2	1.46
Number of samples		44	44	44	44	44
SW9**						
Max		8.03	38	240	142	188
Med		7.98	34	226		39
Min		7.6	9	74	32	36.7
Number of samples		4	4	4	4	4
***Water Quality Guidelines**	Ideal	6.0-9.0	0-70	0-450	No Guideline Value	0-1
	Marginal/ No Health effect	4-6,9-11	71-150	450-1000		1-5

Sample ID		pH	EC (mS/m)	Dissolved Solids (mg/L)	Suspended Solids (mg/L0)	Turbidity (NTU)
	Unacceptable	<4, >11	>300	>1000		>5

* *Only two samples were taken during the monitoring period and therefore the reliability of this data is low*

*** (Department of Water Affairs and Forestry, 1996)*

1. *Colour coding is used to denote whether values measured comply with the South African Water Quality Guidelines (DWAF, 1996).*
2. *Where the lab gives results concentrations as µg/l and the South African Water Quality Guidelines (DWAF, 1996) gives concentrations as mg/l, the guideline values were converted to µg/l*

The trend analysis showed that:

- There has been an upward trend in terms of turbidity which might be due to increased construction activities in the area.
- For the EC, no upward trend (which at this time and stage can be expected) was detected. Insufficient sampling has taken place at SW8 and SW 9.
- The pH has generally remained within the ideal range for domestic use over time.

Macro constituents

The surface water sites of relevance to this ash ash/gypsum co-disposal facility are within the ideal water quality range according to the SAWQG for Domestic Use with the exception of:

- SW 5 with a calcium concentration (59.05 mg/l) within the marginal to no health effects range and spring 6 with a calcium concentration of (80.2) which falls just within the unacceptable level.
- Sulfate on levels in spring 6 exceeds the ideal level for domestic use and falls within the marginal/ no health effects range
- All other parameters are within the ideal range

Table 9-19: Summary of the macro constituents of surface water quality (median values)

Sample ID	Potassium (K) mg/l	Sodium (N) mg/l	Chloride (Cl) mg/l	Fluoride (F) mg/l	Nitrate(NO_3) mg/l	Sulfate (SO_4) mg/l	Calcium (Ca) mg/l	Magnesium (Mg) mg/l	Ammonia As N mg/l
Spring 6	2.4	6.1	3.9	0.2	0.5	234	80.2	13.8	[3]<2.5
Spring 11	1.0	5.2	2.9	0.00	1.6	4.2	5.5	2.5	<2.5
SW5	2.3	8.3	4.6	0.3	0.2	167	59.1	12.1	<2.5
SW 8	3	7.3	4.05	0.26	0.1	9.64	7.1	3.7	

Sample ID		Potassium (K) mg/l	Sodium (N) mg/l	Chloride (Cl) mg/l	Fluoride (F) mg/l	Nitrate(NO_3) mg/l	Sulfate (SO_4) mg/l	Calcium (Ca) mg/l	Magnesium (Mg) mg/l	Ammonia As N mg/l
SW 9		3.42	14.20	8.66	0.26	0.18	60.64	27.10	15.80	<2.50
Water Quality Guidelines	Ideal	0-50	0-100	0-100	0-1.0	0-6	0-200	0-32	0-50	0-1
	Marginal/ No Health effects	50-100	100-200	200-600	1.0-1.5	6-10	200-400	32-80	50-100	1-10
	Unacceptable	>100	>200	>1200	>1.5	>10	>400	>80	>100	>10

Table Notes:

1. Colour coding is used to denote whether values measured comply with the South African Water Quality Guidelines (DWAF, 1996).

2. Where the lab gives results concentrations as µg/l and the South African Water Quality Guidelines (DWAF, 1996) gives concentrations as mg/l, the guideline values were converted to µg/l

3. The median value has been

3. Method for using for analysis's detection level is higher than the ideal water quality limit

4. SW8 maximum values are reflected since only 2 samples were taken over the period

Micro-constituents

The assessment of the micronutrients showed that:

- The Aluminium (Al) levels for SW8 and Spring 6 are within ideal ranges, Spring 11 are within the marginal to no health effect range and SW5 is within the unacceptable for human consumption range. There was insufficient data on SW9 to make any conclusive assessments on Al levels. Water quality with regards to Al concentrations seems to be stable over time
- The surface water sites show that the Iron concentrations are within the marginal to no health effects range with SW 5 having the highest concentration (20.0mg/l). The iron concentration trend appears to be stable over time.
- In terms of the Manganese, SW 8, and Spring 11 have concentrations within the marginal to no health effects range with SW 5 having the highest concentration. There is an upward trend in Manganese concentrations over time. Manganese concentrations are, however, mostly under the unacceptable threshold as far as water quality for domestic use goes.

Insufficient sampling of the other micro constituents was done over the sampling period, making it impossible to make meaningful conclusions in terms of trends. The water quality measured to date indicates that the water user requirements are being met and only Al and Manganese showing elevated levels and falling within the unacceptable level

for domestic water use. It is assumed that the higher levels are normal background levels since no activity as yet has taken place which could have increased these values.

Water Quality Monitoring Program

Additional to the sampling of the natural surface water points that Kusile is already monitoring, (which is sufficient for determining the impact of upstream activities and also the impact of the ash/gypsum co-disposal facility on downstream activities), the sampling program should be extended to also include the following once the infrastructure has been built and commissioned.

- Ash/gypsum co-disposal facility Site Retention Dams;
- Ash/gypsum co-disposal facility Dirty water Dam;
- Station Dirty Dam; and
- Station Dirty Dam Settling Tank

It is recommended that sampling at the following points associated with the ash/gypsum co-disposal facility and the dams be conducted during construction and operation as shown in **Table 7-2**, in accordance with the ash/gypsum co-disposal facility Section 21 (g) that was issued to Kusile in 2013.

Table 9-20: Recommended Surface water Monitoring Programme as stipulated in the WULA

Sampling Point	Description	Latitude	Longitude	Variables
1	Spruit upstream of the ash/gypsum co-disposal facility (south)	25°56'55.1"S	28°55'50.6"E	Temperature, pH, Electrical Conductivity, Suspended Solids, Dissolved Oxygen, Chemical Oxygen Demand, Turbidily, Sechi disk depth, Alkalinity, Calcium, magnesium, Sodium, Potasium, Suphate, Fluoride, Iron, Manganese, Aluminium, Chromium VI, Boron, Arsenic, Mercury, Silica,
2	Spruit upstream of the ash/gypsum co-disposal facility tributary (south)	25°57'24.8"S	28°54'30.0"E	
3	Spruit downstream of the ash/gypsum co-disposal facility (south)	25°55'41.3"S	28°53'04.9"E	
4	Spruit north of the ash/gypsum co-disposal facility	25°55'34.9"S	28°53'39.3"E	
5	Before Wilge River	25°53'04.3"S	28°51'41.7"E	

Sampling Point	Description	Latitude	Longitude	Variables
	confluence			Ammonia, Phosphate, Nitrate/Nitrite, BTES, TPH, Faecal Coliforms
6	Pan	25°56'12.5"S	28°54'39.1"E	
7	Offset Wetland Upstream	25°52'36.7"S	28°55'16.0"E	
8	Offset Wetland Downstream	25°53'17.5"S	28°53'21.9"E	
9	Wilge River A	25°52'17.6"S	28°51'57.7"E	
10	Wilge River B	25°52'40.4"S	28°51'48.7"E	

The sampling frequency for the identified variables should be weekly during construction and monthly during operation, as stipulated in **Section 3.3** of the water use licence issued to Kusile for the ash/gypsum co-disposal facility and associated infrastructure.

Water Sampling Monitoring

Kusile must ensure that all their sampling procedures are based on SABS procedures (SABS ISO 5667), ASTM Standards on Environmental Sampling (ASTM, 1995) and Department of Water Affairs (South African) Sampling Guide (DWAF, 2000). This will ensure that the data obtained can be confidently used to interpret water chemistry thus facilitating meaningful water modelling, risk assessment and the choice of suitable remedial measures.

9.4.4. Impact Assessment

9.4.4.1. Construction Phase

- Increase in turbidity of surface water during construction caused by an increase in runoff from the cleared and stripped areas or from topsoil stockpiles which is high in suspended solids (Aluminium, Manganese, and Iron).
- Accidental spillages of hazardous substances from construction vehicles used during the site clearing and grubbing.
- Reduction of catchment yield as a result of the footprint areas of the dirty water dams and the ash/gypsum co-disposal facility. The footprint areas will no longer form part of the natural downstream catchment thereby potentially resulting in a decrease of runoff downstream.
- Increase of surface runoff and potentially contaminated water that needs to be maintained in the areas where site clearing and grubbing occur.

- Excess storage of rainfall within the dirty water dams and settling tanks during the construction phase.
- Failure to properly separate the clean water runoff upstream of the dirty water dams and settling tanks.

9.4.4.2. Operation Phase

- Spillages from the dirty dams and wastewater treatment plant.
- Inadequate removal of silt will result in a steady decrease in the storage capacity of the SDD ST.
- Maintenance of upstream clean water controls.
- Increase in volume of contaminated water that needs to be managed on the Kusile Power Station footprint.

9.4.4.3. Closure Phase

- Seepage of water out of the ash/gypsum co-disposal facility into the environment.
- Accidental spillages of hazardous substances from decommissioning vehicles used during the closure phase of the power station.

9.4.5. Mitigation Measures

9.4.5.1. Construction Phase

- The runoff from the upstream clean water catchment is to be diverted away from the dirty water dams and co-disposal disposal facility. Temporary surface water ditches should be constructed on the upstream boundary of the ash/gypsum co-disposal facility, which will meet regulation 704 requirements regarding the separation of clean and dirty water runoff. All clean water runoff will therefore be diverted away from the cleared area.
- Management measures regarding the maintenance of all Power Plant vehicles must be undertaken. This will ensure that any spillages or leakages of fuel and oil are reduced.
- The loss of catchment area as a result of the dirty water dams and the ash/gypsum co-disposal facility and other associated infrastructure cannot be mitigated. The only way to mitigate the above mentioned impacts is to not proceed with the Power Plant which has already started. Therefore the impact rating for pre and post mitigation measures will remain unchanged.

- Within the cleared area along the downstream boundary of the ash/gypsum co-disposal facility, temporary ditches are to be constructed along with temporary excavated storage areas. All dirty water runoff will then be captured and contained within the temporary storage facility.
- During the period of construction of the dirty water dams and settling tanks, high storm events could result in excessive ponding within the dirty water dams and settling tanks. Depending on the extent of the ponding this water could either be allowed to remain and evaporate naturally or it could be pumped out.
- Based on Reg 704 requirements regarding stormwater management it is noted that all clean and dirty water must be separated. Therefore clean water emanating from upstream of the dirty water dams and settling tanks will be diverted away and discharged to the nearby watercourse or environment. The clean water diversion will be sized to accommodate the 1:50 year storm event and the dirty water dams will also have a minimum freeboard from spillway to crest of 0.8 m as per Reg 704 requirements.

9.4.5.2. Operation Phase

- A monitoring program for structural maintenance of the dirty dams and wastewater treatment plant must be developed and maintenance on leakages or spills should be carried out immediately.
- The SDD ST will consist of two equal capacity concrete basins that clarify contaminated water from the power station terrace before it travels by gravity pipeline to the SDD. The two compartments will allow for occasional maintenance and inspection access (preferably during the dry season) without interrupting the functionality of the SDD ST under normal circumstances.
- Upstream clean water controls should be maintained regularly by site monitoring, to ensure no blockages by vegetation or debris occur. Also to ensure berm walls that has collapsed or have been damaged be repaired
- A stormwater management maintenance program should be maintained regularly to ensure that the stormwater system is functioning sufficiently.
- Water upstream of the dirty water dams and settling tanks is considered clean and will have to be separated from the dirty water area. Dirty water Spillages from the dirty water dams and settling tanks into the environment must be managed.

9.4.5.3. Closure Phase

- A monitoring program of ground and surface water must continue to be implemented and maintenance on any seepage must be carried out immediately if detected.
- Management measures regarding the maintenance of all power plant vehicles must be undertaken. This will ensure that any spillages or leakages of fuel and oil are reduced.

9.4.6. Conclusion

Many of the water related environmental impacts are considered as moderate significance, in the absence of appropriate mitigation measures. There is the risk of spillage of ash and gypsum into the surface water system both from the ash/gypsum co-disposal facility itself and from the dirty water dams and wastewater treatment plant. These risks are significantly reduced if the mitigation measures are applied.

Of concern is the increase in turbidity and suspended solids in the surface water. The mitigation measures will need to be implemented immediately during the current construction phase and managed during operation to maintain acceptable water quality levels.

It is expected that consideration will also be given to the on-going updates to the National Waste Management Strategy including the Waste Classification Regulations, Waste Information System Regulations and National Standard for Leach Tests and Screening Values for Risk Profiling of Waste and Standard for the Disposal of Waste to Solid waste management services.

9.5. FLOODLINE DETERMINATION

During the public comment period for the DSR, DWA requested that the 1:100 year floodlines for the streams around the ash/gypsum co-disposal facility be determined. The **1:100-year** floodline is required in terms of the National Water Act, Act 36 of 1998, Chapter 14 Part 3 as given below.

144. For the purposes of ensuring that all persons who might be affected have access to information regarding potential flood hazards, no person may establish a township unless the layout plan shows, in a form acceptable to the local authority concerned, lines indicating the maximum level likely to be reached by flood waters on average once in every 100 years.

The floodline determination was conducted by Ms Joyce Mathole and certified by Mr Matt Braune from SRK Consulting (Pty) Ltd (SRK).

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9.5.1. Declaration of Independence

SRK is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialized services as stipulated in the terms of reference. A signed declaration of independence is attached together with the hydrology/floodline determination specialist report in **Appendix H**.

9.5.2. Expertise of the Specialists

Joyce Mathole has been involved in the field of hydrology for the past 5 years. Her expertise includes Geographic Information Systems, hydraulic modelling of watercourses using HECRAS software and programs such as NWSRFS and other local programs developed by the Department of Water Affairs such as DT, OGEE for dams, SIDECHAN for side channels, determination of 1:50 and 1:100 floodlines and· water resources modelling using WRSM and yield models.

Matt Braune has been involved in the field of water engineering for the past 19 years. His expertise include surface water assessments, stormwater management systems and compilation of new regulations to improve the control of stormwater; compilation of stormwater management plans for municipalities and Regional Services Councils; twelve-year involvement on technical and economic aspects of stormwater management for various major City Councils as well as hydrological and water-related studies and design of hydraulic and pollution control structures.

9.5.3. Approach and Methodology

The 1:50 and 1:100-year floodlines were determined based on the HECRAS model and peak flow rates for existing watercourse conditions.

9.5.4. Results

The floodline determination study showed that:

- The existing development and infrastructure is not affected by the 1:50 year and 1:100 year floodlines.
- The diverted channel running on the south eastern and south western sides of the coal stock yard can handle the 1:50 year and 1:100 year flood events.
- The 1:50 and the 1:100 year average flood depths and average flood velocities along the floodplains are shown below in **Table 9-21** and
- **Table** 9-22, respectively.

Table 9-21: Summary of Average flood depths along floodplains

Chainage	Average Flood depths (m)			
	1:50 Year		1:100 Year	
	Hydr depth L	Hydr depth R	Hydr depth L	Hydr depth R
KLFS2	0.75	0.76	0.82	0.83
KLFS3	0.35	0.40	0.39	0.44
KLFS2T1	0.27	0.27	0.33	0.33

KLFS2T2a	0.97	0.97	1.10	1.10
KLFS2T2b	1.04	1.04	1.19	1.19
KLFS2T2c	1.26	1.26	1.42	1.42
KLFS2T2d	1.30	1.30	1.48	1.48

Table 9-22: Summary of Average flood velocity along floodplains

Chainage	Average Flood velocity (m^3/s)			
	1:50 Year		1:100 Year	
	Vel Left	Vel Right	Vel Left	Vel Right
KLFS2	1.95	2.01	2.08	2.14
KLFS3	1.53	1.63	1.66	1.83
KLFS2T1	1.14	1.15	1.28	1.27
KLFS2T2a	4.69	4.69	5.03	5.03
KLFS2T2b	4.87	4.87	5.24	5.24
KLFS2T2c	4.83	4.83	5.16	5.16
KLFS2T2d	4.92	4.92	5.28	5.28

9.5.5. Conclusions

The following conclusions were drawn from the assessment:

- The existing development and infrastructure at Kusile Power Station is situated outside the 1:50 and 1:100 year floodlines.
- The diverted channel can handle the 1:50 year and 1:100 year flood events.

9.6. AQUATIC ENVIRONMENT

The Aquatic Baseline and Environmental Assessment for the ash/gypsum co-disposal facility was conducted by Ms Kylie Farrell from Golder Associates Africa (Pty) Ltd (Golder).

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9.6.1. Expertise of the Specialist

Kylie Farrell holds a Bachelor of Science Honours degree in Zoology from the University of Pretoria and is currently completing her Masters degree in Aquatic Ecology through the University of Johannesburg. She has five years post-graduate experience in the environmental consultancy field in South Africa. She currently specialises in Aquatic Ecology.

9.6.2. Declaration of Independence

Golder is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialized services as stipulated in the terms of reference. A signed declaration of independence is attached together with the aquatic environment specialist report in **Appendix H**.

9.6.3. Approach and Methodology

The assessment conducted in August/September 2013 aimed to quantify the potential impacts emanating from the proposed project on the biotic ecosystem in the Klipfonteinspruit and adjoining tributaries of the Wilge River, and to further identify potential impacts and recommend suitable mitigation measures.

9.6.3.1. Sampling

A total of eight (8) sites were monitored within the watercourses associated with the Kusile Power Station construction site. Sites KUS4, KUS15, KUS7 to KUS9 form part of the monitoring sites for the Kusile's quarterly aquatic monitoring events. The sampling points are shown in **Figure 9-16.**

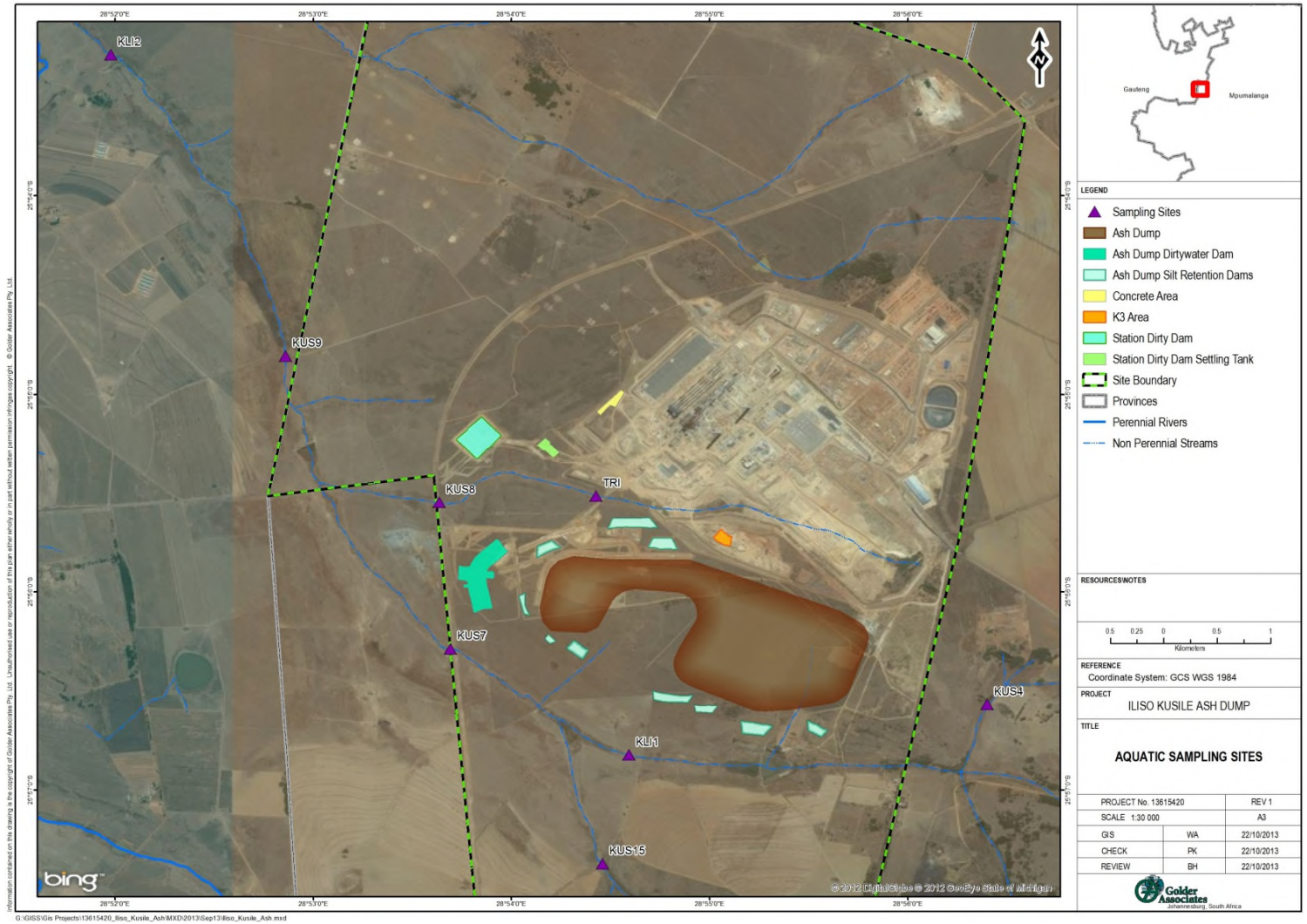

Figure 9-14: Map of aquatic monitoring sites

9.6.3.2. Habitat Assessment

- Integrated Habitat Assessment System: The Integrated Habitat Assessment System (IHAS, Version 2) was applied at each of the sampling sites in order to assess the availability of habitat biotopes for macroinvertebrates.
- Aquatic Macroinvertebrates: Aquatic macroinvertebrates were sampled using the South African Scoring System, version 5 (SASS5) (Dickens & Graham, 2002).

9.6.3.3. Ichthyofauna

Fish were used as indicators of the river condition as they are relatively long-lived and mobile, and indicate long-term influences and general habitat conditions, integrate effects of lower trophic levels and are consumed by humans (Uys et al., 1996). All fish were identified in the field using the guide Freshwater Fishes of Southern Africa (Skelton, 2001) and reference specimens were preserved for laboratory confirmation of field identifications and the remainder of the fish released at the point of capture.

9.6.3.4. Expected fish species list

An expected fish species list was compiled based on information gathered from the desktop review of available literature.

9.6.3.5. Fish Assemblage Integrity Index (FAII)

The Fish Assemblage Integrity Index (FAII) was applied to sites associated with the Kusile ash/gypsum co-disposal facility alternatives.

9.6.4. Findings

9.6.4.1. In-Situ Water Quality

The assessment of the *in situ* water quality illustrated that Dissolved Oxygen (DO) concentration and percentage saturation was a limiting factor for the aquatic biodiversity at certain sites. **Table 9-16** provides a summary of the results from the in-situ water quality assessment.

Figure 9-15: In-Situ Water Quality results

Site	pH	EC (mS/m)	TDS (mg/ℓ)	DO (mg/ℓ)	DO Saturation (%)	Temp (˚C)	Clarity (cm)
TWQR	6.5 – 9.0	<154	<1000	>5.00	80 – 120	5 – 30	>25

Site	pH	EC (mS/m)	TDS (mg/ℓ)	DO (mg/ℓ)	DO Saturation (%)	Temp (˚C)	Clarity (cm)
KUS4	8.4	4.0	26.0	5.0	84.4	15.0	>20
KUS15	8.0	10.0	65.0	3.9	74.5	20.6	>23
KLI1	8.3	97.0	630.5	4.5	90.4	27.1	>24
TRI1	8.2	2.0	13.0	1.7	29.6	18.3	>12
KUS7	7.4	37.0	240.5	7.1	98.4	5.7	>20
KUS8	7.8	16.0	104.0	7.2	100.2	6.1	>70
KUS9	7.9	29.0	188.5	7.4	113.6	10.2	>31
KLI2	8.4	93	604.5	5.6	111.7	22	13

(Red highlighted text indicate exceedances of the guideline values detailed in the report; [1]EC - Electrical Conductivity; [2]TDS - Total Dissolved Solids; [3]DO - Dissolved Oxygen; mS/m – milliSiemens per metre; mg/l – milligrams per litre; % Sat – percentage saturation.

Clarity figures that display a ">" indicates the maximum depth of the river where the secchi disk could still be seen, and thus an accurate clarity measurement could not be recorded as the water was either too shallow or clear.

The results showed that the DO and DO % were below the TWQR guidelines at sites TRI1 and KUS15. Low DO concentrations may be attributed to the large amount of decaying organic matter on the stream beds and limited flow conditions at the time of the survey. The remainder of the *in situ* water quality parameters were within the guideline values.

9.6.4.2. Habitat Assessment

The study found that habitat availability was a limiting factor of aquatic macroinvertebrate diversity at all sites except KUS4 and KUS9. The limited habitat availability was due to the absence of the stones biotope.

Based on the IHAS results habitat availability during the August/September 2013 survey ranged from **adequate** to **poor**. **Table 9-23** shows the final IHAS score as well as a bar graph of the normalised percentage contribution per biotope for August/September 2013.

Table 9-23: Integrated Habitat Assessment System Evaluation for the August/September 2013 survey

Site	Sampling Habitat				IHAS	
	Stones-in-Current	Vegetation	Other Habitat / General	Physical Stream Condition	Score	Description
KUS4	10	13	9	25	57	Adequate
KUS15	0	13	7	17	37	Poor
KLI1	0	10	9	14	33	Poor
TRI1	6	11	15	15	47	Poor
KUS7	0	11	9	20	40	Poor
KUS8	0	0	7	18	25	Poor
KUS9	13	12	16	22	63	Adequate
KLI2	0	8	7	16	31	Poor

Bar graphs within cells indicate the normalized percentage contribution per biotope

n/a SASS5 not applicable due to site being dry or lack of flow

Results showed that vegetation (VEG) and gravel, sand and mud (GSM) were strong drivers for higher IHAS scores within the Kusile ash/gypsum co-disposal facility area. The **poor** habitat availability observed during the August/September 2013 survey was largely attributed to the absence of the SIC habitats, and the presence of incised banks and the homogenous habitats at the sampling points and the low flow conditions at the time of the survey and winter die-back of vegetation.

9.6.4.3. Long-Term Trends in Habitat Availability

The long term trends in habitat availability for the wet season and dry season are presented in **Table 9-20** and **Table 9-21** respectively.

The results showed that habitat availability in the tributaries of the Wilge River decreases during the high flow surveys. Habitat availability during the high flow season is primarily **poor** at all the sites, with the exception of site KUS9 which improved from **poor** to **good** during the December 2012 survey, and subsequently reduced to **adequate** during the February 2013 survey.

Table 9-24: Historical IHAS scores - high flow surveys

Site	Mar '09	Mar '10	Dec '10	Mar '11	Nov '11	Dec'12	Feb'13
KUS4	44	43	51	58	38	60	53
KUS7	59	45	42	41	41	42	29

Site	Mar '09	Mar '10	Dec '10	Mar '11	Nov '11	Dec'12	Feb'13
KUS8	40	34	39	35	33	53	40
KUS9	49	34	36	32	51	65	60
KUS15		44	44		42	43	Dry

During the dry season surveys, habitat availability was predominantly poor, although sites KUS4 and KUS9 were adequate during the August/September 2013 survey. The poor habitat availability displayed temporarily may be attributed to these sites being located within smaller tributaries of the Wilge River, of which some of the sites have been directly associated and impacted by the infrastructure of the Kusile Power Station (newly constructed road and pipeline at sites KUS7 and KUS 9).

Table 9-25: Historical IHAS scores - low flow surveys

Site	Jul '09	Jun '10	Sep '10	Jun '11	Sep '11	Aug'12	May'13	Aug'13
KUS4	40	50	52	48	44	Dry	48	57
KUS7	54	56	37	40	46	25	32	40
KUS8	48	45	34	35	39	39	40	25
KUS9	40	44	31	47	48	38	60	63
KUS15		50	55	44	37	Dry	32	37

9.7. AQUATIC MACROINVERTEBRATES

A total of 33 aquatic macroinvertebrate taxa were recorded in the sample area during the August/September 2013 survey (4 to 19 taxa per site) (**Table 9-26**).

The SASS5 scores ranged from 17 at site KUS7 to 92 at site KUS4 (**Table 9-26**). The Average Score per Taxa (ASPT) values ranged from 3.5 at site KLI1 to 5.5 at sites KUS8 and KUS9 (Table 9-26). The ASPT scores indicated that the macroinvertebrate communities at the majority of the sites are composed primarily of tolerant (1 - 5) taxa (Dickens & Graham, 2002).

Table 9-26: SASS5 scores recorded during the August/September 2013 survey

Site	Total number of taxa	SASS Score	ASPT
KUS4	19	92	4.8
KUS15	12	54	4.5

Site	Total number of taxa	SASS Score	ASPT
KLI1	8	28	3.5
TRI1	18	83	4.6
KUS7	4	17	4.3
KUS8	11	61	5.5
KUS9	15	82	5.5
KLI2	14	64	4.6

The different taxa were assigned different tolerance scores, which are based on their susceptibility or resistance to pollution and perturbations (Dickens & Graham, 2002). As a result the biotopes and ASPT scores are presented in **Figure 9-16.**

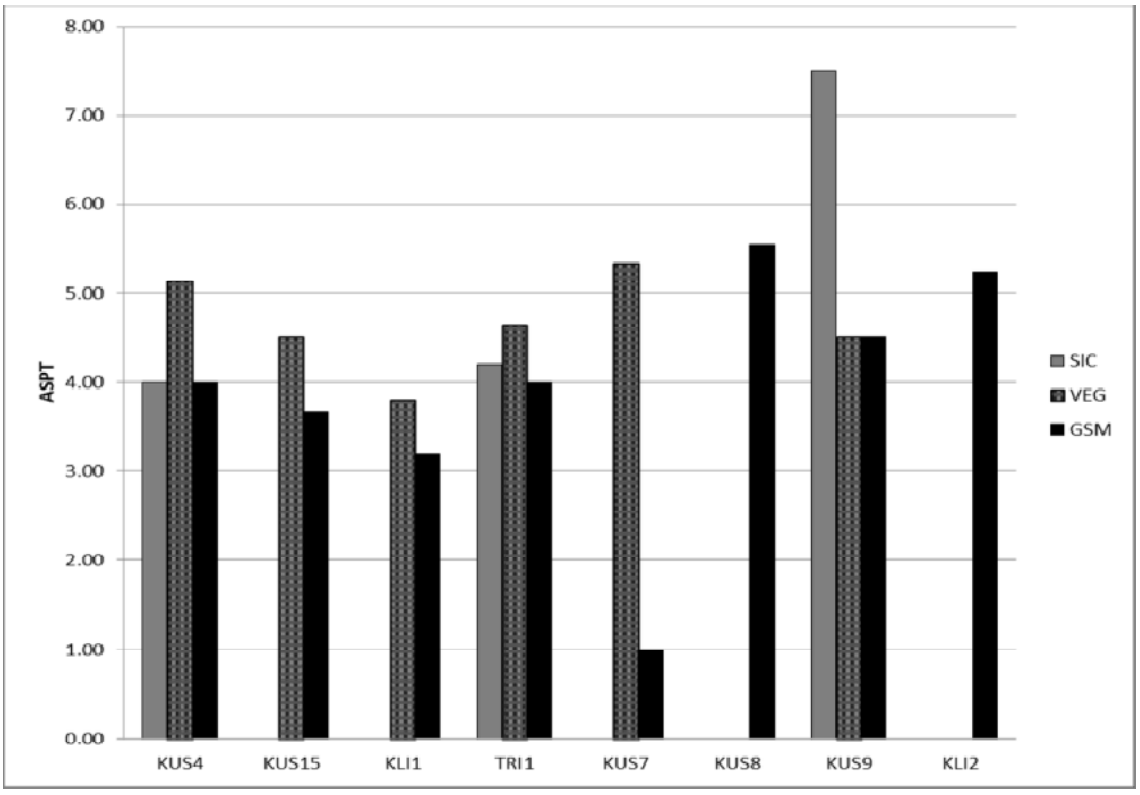

Figure 9-16: ASPT score for the SIC, VEG and GSM biotope, August/September 2013. (Dashed line indicates the reference point between biotope graphs)

The VEG and GSM were the most abundant biotopes sampled at all the sites. Although the SIC biotope was sampled at three of the sites, this biotope recorded the highest

ASPT scores at site KUS9. This may be attributed to more sensitive taxa such as Heptageniidae (quality value (QV) score: 13) and Leptophlebiidae (QV score: 9) being recorded in this biotope. The VEG biotope at sites KUS4 and KUS7 recorded an ASPT score of greater than 5.0 while site KUS8, which only had the GSM biotope also recorded a high ASPT score, although this may be contributed to the low number of taxa recorded.

Although the GSM biotope recorded an average ASPT score of 5.0, this primarily comprised high abundances of highly tolerant taxa such as Oligochaeta (QV score: 1), Chironomidae (QV score: 2), Simulidae (QV score: 5) and Corixidae (QV score: 3).

The number of taxa, SASS5 scores and ASPT scores were variable in the tributaries with the lowest number of taxa and SASS5 scores recorded at site KUS7. The habitat at this site is poor with eroded banks and limited VEG in which to sample. Typically, sensitive taxa populate the SIC biotope and with site KUS7 lacking this biotope/habitat, these taxa are not recorded and consequently result in a lower number of taxa and SASS5 scores. The ASPT scores fluctuated spatially during this survey with no real trend identified. The highest ASPT scores were recorded at sites KUS8 and KUS9, of which the score decreases at site KLI2, prior to reaching the confluence of the Wilge River.

Historically, there has been a large degree of variation in the number of taxa and SASS5 scores at sites KUS4, KUS8 and KUS9. This may be attributed to seasonal fluctuations and thus the presence or absence of certain biotopes at the sites, consequently influencing the type of aquatic biota recorded. Overall, the ASPT scores in the tributaries generally do not exceed an ASPT score of 5.0, indicating that these tributaries are historically characterised by tolerant taxa.

9.7.1.1. Biotic Integrity based on SASS5 Results

Based on the August/September 2013 results, biotic integrity ranged from slightly modified (PES Class B) as the majority of the sites to critically modified (PES Class F) at site KUS7 (**Table 9-25**). This may be attributed to the extensive agricultural activities in close proximity to the site, as well as direct impacts from Kusile.

Table 9-27: Present Ecological State (PES) classes based on SASS5 results obtained during the August/September 2013 survey

Site	Reach		PES Class
KUS4	Klipfonteinspruit	B	Slightly modified
KUS15	Holfonteinspruit	D	Considerably modified
KLI1	Klipfonteinspruit	E	Seriously modified
TRI1	Unknown tributary of the Wilge River	B	Slightly modified
KUS7	Lower Klipfonteinspruit	F	Critically modified
KUS8	Lower Klipfonteinspruit	B	Slightly modified
KUS9	Lower Klipfonteinspruit	B	Slightly modified
KLI2	Klipfonteinspruit	D	Considerably modified

The long term SASS5 results show that during the high flow surveys, biotic integrity at the upstream site (KUS4) has remained slightly modified since December 2012 (**Table 9-28**), whilst biotic integrity at sites KUS7 and KUS8, downstream of the Kusile ash/gypsum co-disposal facility, has decreased in integrity over the past three years. Biotic integrity at site KUS9 has improved from slightly modified in December 2012 to unmodified in the February 2013 survey.

Table 9-28: Historical PES classes based on SASS5 results – high flow surveys

Site	Mar'09	Mar'10	Dec'10	Mar'11	Dec'12	Feb'13
KUS4	E	E	B	C	B	B
KUS7	F	E	F	E	E	E
KUS8	F	E	C	F	B	E
KUS9	C	D	E	E	B	A
KUS15		D	B	*Dry*	D	*Dry*

A comparison of long term results illustrated that biotic integrity tends to decrease during the low flow season (**Table 9-29**). This is likely due to reduced flow and habitat availability. During previous dry seasons, biotic integrity in the majority of the tributaries in the project area ranged from slightly to critically modified (PES Class B to F). Biotic integrity at site KUS7 has continued to decrease further since the May 2013 survey. This site is directly impacted by the newly constructed Kusile road and bridge and the lack of river bank rehabilitation, which may be contributing to the already impacted state of the river reach. Site KUS9 has maintained its biotic integrity since September 2011 while

sites KUS4 and KUS8 have improved to slightly modified in this recent survey (August 2013).

Table 9-29: Historical PES classes based on SASS5 results – low flow surveys

Site	Jul'09	Jun'10	Sep'10	Jun'11	Sep'11	Aug'12	May'13	Aug'13
KUS4	E	D	B	D	E	*Dry*	C	B
KUS7	E	B	E	F	D	D	E	F
KUS8	D	D	D	F	C	D	D	B

9.7.1.2. Ichthyofauna

Based on this assessment, a total of 10 indigenous fish species were expected to occur within the area (7 to 10 indigenous species per site). In addition the introduced species *Cyprinus carpio (Carp), Gambusia affinis* (Mosquito fish) and *Micropterus salmoides* (Largemouth Bass) were also expected to occur in the area. This may be due to limited flow conditions and poor habitat availability at the time of the survey (low flow season). As the water level lowers, it exposes the river banks thus resulting in limited vegetation cover. Vegetation cover and flow are preferable habitats by the fish expected to be recorded in this catchment area. Therefore, the low fish diversity was likely attributed to the fish seeking out deeper pools or moving downstream during that low flow period.

9.7.1.3. Presence of Red Data species

Of the 13 fish species expected to occur in the sampling area:

- Four are currently unlisted on the IUCN Red List of which two of them are exotic in South Africa;
- Eight are currently listed as Least Concern (LC) on the IUCN Red List. Species in this category are considered to be widespread and abundant (IUCN, 2012); and
- One is Vulnerable (V) on the IUCN Red List although *Cyprinus carpio* is classed as an exotic species in South Africa.

Based on the IUCN Red List no rare, threatened or endangered fish species were recorded during the August/September 2013 survey (IUCN, 2013).

An assessment of the ichthyofauna within the study area showed that the fish species diversity in the Klipfonteinspruit and adjoining tributaries was lower than expected. Two

of the 10 expected indigenous fish species were recorded in the project area as shown in **Table 9-28**.

Table 9-30: Fish species recorded in the Kusile ash/gypsum co-disposal facility project area during the August/September 2013 survey

Site	*Barbus anoplus*	*Pseudocrenilabrus philander*	Diversity	Abundance
KUS4	17		**1**	**17**
KUS15	1		**1**	**1**
KLI1	71	59	**2**	**130**
TRI1			**0**	**0**
KUS7			**0**	**0**
KUS8			**0**	**0**
KUS9	16	2	**2**	**18**
KLI2	23	1	**2**	**24**
Total Individuals	**128**	**62**		

The low fish diversity and abundance at some sites may be attributed to fish seeking out deeper pools or moving downstream during the low flow conditions

9.7.1.4. Fish Health Assessment

A large number of the individuals sampled during the August/September 2013 survey, showed signs of abnormalities and heavy parasite loads. The prevalence was considerably higher in *B. anoplus* which showed the highest infection rates.

9.7.1.5. Fish Assemblage Integrity Index (FAII)

The PES classes for each of the sites are presented in Table 9-31.

Table 9-31: Present Ecological State (PES) Classes recorded during the August/September 2013 survey

Site	River Reach	Relative FAII Score	Class Rating	Description
KUS4	Klipfonteinspruit	22	E	Seriously Modified
KUS15	Holfonteinspruit	22	E	Seriously Modified
KLI1	Klipfonteinspruit	24	E	Seriously Modified
TRI1	Unknown tributary of the Wilge River	0	F	Critically Modified
KUS7	Lower Klipfonteinspruit	0	F	Critically Modified
KUS8	Lower Klipfonteinspruit	0	F	Critically Modified
KUS9	Lower Klipfonteinspruit	44	D	Largely Modified
KLI2	Klipfonteinspruit	24	E	Seriously Modified

Based on the fish results biotic integrity in the project area ranged from largely to critically modified. The low biotic integrity was primarily attributed to limited habitat availability and low flow conditions.

9.7.1.6. Summary of aquatic assessment results

A summary of the habitat and biological indices per site is provided in **Figure 9-17**. The water quality was based on a professional opinion where the four *in situ* parameters (pH, DO ,DO%, EC/TDS and Temperature) were evaluated according to whether they met the South African water quality guideline values or not. Additional visual observations in terms of algal blooms, flow or observed pollutant sources were also included to give an overall professional opinion on the baseline state of the *in situ* water quality based on the scoring system summarised in **Table 9-32**.

Table 9-32: In situ water quality baseline state interpretation classes

Interpretation of *in situ* water quality parameters	
Class	**Class description**
Natural	As close to natural conditions as possible
Good	Above or within guideline values/ranges - optimal
Fair	Close to or at the limit of guideline values/ranges, but sub-optimal
Poor	Below or exceeding guideline values or ranges – non optimal

A summary of the in situ water quality baseline state of the aquatic ecosystems is shown in **Table 9-33**.

Table 9-33: Summarized *in situ* water quality baseline state of the in-stream sites, based on individual *in situ* water quality parameters as well as additional water quality impacts observed at the sites

Site	*In situ* parameter baseline state						General site baseline state for *in situ* water quality
	pH	DO	DO%	TDS	Temp.	Additional Impacts	
KUS4	Natural	Fair	Good	Natural	Natural	Fair	Fair
KUS15	Natural	Poor	Poor	Natural	Natural	Fair	Fair
KLI1	Natural	Poor	Good	Natural	Natural	Fair	Fair
TRI1	Natural	Poor	Poor	Natural	Natural	Poor	Poor
KUS7	Natural	Good	Good	Natural	Natural	Poor	Fair
KUS8	Natural	Good	Good	Natural	Natural	Poor	Fair
KUS9	Natural	Good	Good	Natural	Natural	Fair	Fair
KLI1	Natural	Good	Good	Natural	Natural	Fair	Good

DO: Dissolved Oxygen; DO%: Saturation Percentage; TDS: Total dissolved solids; Temp.: Temperature

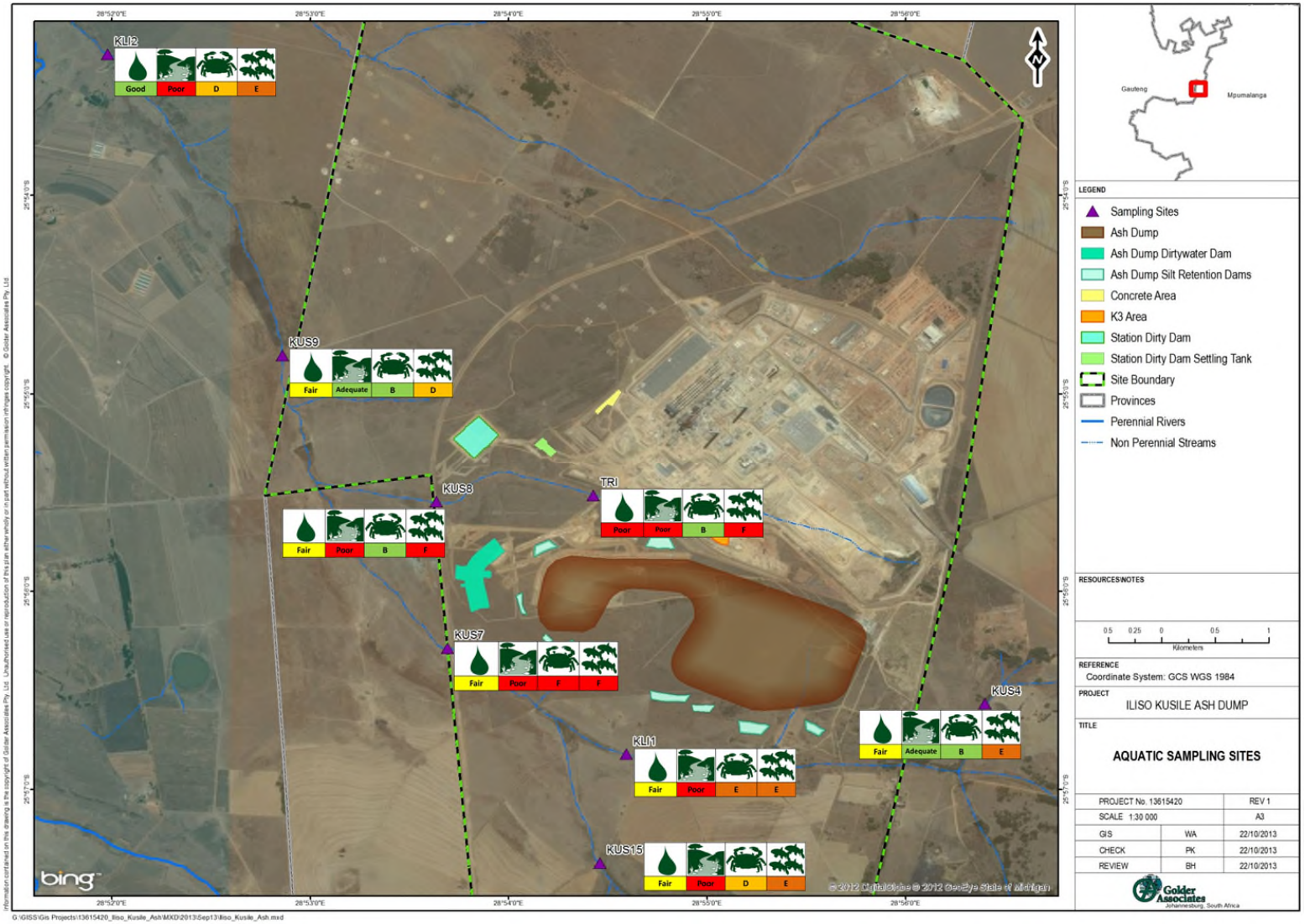

Figure 9-17: Summary of the habitat and biological indices per site

9.7.2. Impact/Risk Assessment

The potential impacts on aquatic ecosystems identified, were as follows:

- Degradation of aquatic ecosystems due to increased sedimentation;
- Change to natural flow regime; and
- Loss of indigenous species and biodiversity due to declines in water quality and habitats.

The majority of the identified impacts were rated as low, should mitigation measures be implemented. Although their severity was primarily high, the probability of the impacts taking place was low, duration was short term over a regional scale. However, should mitigation measures not be implemented, the significance of the impacts would be moderate. The only impact rated high prior to mitigation measures was degradation of aquatic ecosystems due to increased sedimentation. The high significance will be as a result of no adequate sediment control measures installed into the aquatic systems in order to evade large sediment plumes migrating downstream from the project site. However, the significance of this impact will be reduced to moderate, following the implementation of mitigation measures.

However, not only are there site specific impacts, but further cumulative impacts. The existing construction footprint of the Kusile Power Station, surrounding agricultural activities, industrial activities (waste rock crushing plant), and surrounding mining activities, all contribute to the cumulative impacts on the receiving environment.

9.7.3. Recommendations

It was recommended that appropriate mitigation measures concerning the aquatic environment should be implemented during both the construction and operational phase of the project. The following were recommended for the proposed project:

- Erosion control measures such as silt traps should be placed down-slope of where vegetation stripping will take place to minimise siltation in rivers and wetlands. These erosion control measures need to be regularly maintained to ensure effective drainage;
- Routine monitoring for acidity/alkalinity and TDS as an early warning for potential increases in discharge water should be conducted. The water in these pollution control dams should be reused at the Kusile Power Station if possible; and

- Water quality and biotic integrity should be routinely monitored in the Klipfonteinspruit and adjoining tributaries of the Wilge Rivers to assess and quantify the potential impact on the receiving environment.

10. RISK ASSESSMENT METHODOLOGY

A quantitative risk assessment methodology was used for the risk assessment. This method makes use of the basic risk assessment approach of deriving an expression for risk from the product of likelihood (probability) and consequences.

The main objective of the risk assessment is to identify the negative impacts that can be avoided and/or mitigated and the benefits of the positive impacts during the construction and operation phases of the ash/gypsum co-disposal facility on the environment.

10.1. PHASE 1: IDENTIFICATION OF THE RISKS

The identification of risks was conducted in collaboration with the specialists. The identified risks were included in **Section 9** of this report.

10.2. PHASE 2: QUANTITATIVE RISK ASSESSMENT (RISK PRIORITISATION)

The risk assessment entailed the quantification of the risks associated with the project. The potential significance of potential environmental risks identified was determined using the significance rating as described below. The terminology has been taken from the Guideline Documentation on EIA Regulations as follows:

- Severity / magnitude;
- Reversibility;
- Duration of impact; and
- Spatial extent.

Table 10-1: Consequence and probability ranking

Severity / magnitude (S)	Reversibility (R)	Duration (D)	Spatial extent (E)	Probability (P)
5 – Very high / don't know	1 – Reversible (regenerates naturally)	5 – Permanent	5 – International	5 – Definite / don't know
4 – High		4 – Long term (impact ceases after operational life)	4 – National	4 – High probability
3 – Moderate	3 – Recoverable (needs human input)	3 – Medium term (5 – 15 years)	3 – Regional	3 – Medium probability
2 – Low		2 – Short term (0 – 5 years)	2 – Local	2 – Low probability-negligible

Severity / magnitude (S)	Reversibility (R)	Duration (D)	Spatial extent (E)	Probability (P)
1 – Minor	5 – Irreversible	1 - Immediate	1 – Site only	1 – Improbable
0 - None				0 - None

The maximum value which can be obtained is 100 significance points. The risks will be rated as High, Moderate or Low significance by combining the consequence of the impact and the probability of occurrence:

Consequence = severity + reversibility + duration + spatial scale

Consequence X Probability = Significance

- More than 60 significance points indicate **High** environmental significance;
- Between 30 and 60 significance points indicate **Moderate** environmental significance;
- Less than 30 significance points indicate **Low** environmental significance.

The abovementioned criteria were used to generate likelihood (probability) and consequence for the construction and operation phases of the project.

10.3. QUANTITATIVE RISK ASSESSMENT RESULTS

10.3.1. Construction Phase

Risk	Rating Before Mitigation Measures							Mitigation Measure	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
SURFACE WATER															
Increase in turbidity of surface water during construction caused by an increase in runoff from the cleared and stripped areas or from topsoil stockpiles which is high in suspended solids (Aluminium and Iron).	4	3	4	3	14	4	56 - Moderate	• The runoff from the upstream clean water catchment must be diverted away dirty water dams and ash/gypsum co-disposal facility. • Temporary surface water ditches must be constructed on the upstream boundary of the ash/gypsum co-disposal facility, to meet regulation 704 requirements regarding the separation of clean and dirty water runoff. All clean water runoff will therefore be diverted away from the cleared area.	3	3	4	2	12	3	36 - Moderate
Accidental spillages of hazardous substances from construction vehicles used during the site clearing and grubbing.	4	3	3	2	12	3	36 - Moderate	• Management measures regarding the maintenance of all Power Plant vehicles must be undertaken. This will ensure that any spillages or leakages of fuel and oil are reduced.	3	3	2	1	9	2	18 – Low
Reduction of catchment yield as a result of the footprint areas of the dirty water dams and the Ash/gypsum co-disposal facility Disposal Facility and associated infrastructure. The footprint areas will no longer form part of the natural downstream catchment thereby potentially resulting in a decrease of runoff downstream	3	3	4	3	13	5	65 - High	• The loss of catchment area as a result of the dirty water dams and the ash/gypsum co-disposal facility and other associated infrastructure cannot be mitigated. The only way to mitigate the above mentioned impacts is to not proceed with the Power Plant which has already started. Therefore the impact rating for pre and post mitigation measures will remain unchanged.	3	3	4	3	13	5	65 - High
Increase of surface runoff and potentially contaminated water that needs to be maintained in the areas where site clearing and grubbing occur.	4	3	4	3	14	4	56 - Moderate	• Temporary ditches must be constructed along with temporary excavated storage areas, within the cleared area along the downstream boundary of ash/gypsum co-disposal facility to ensure that all the dirty water runoff is captured and contained within the temporary storage facility.	3	3	4	2	12	3	36 - Moderate
Excess storage of rainfall within the dirty water dams and settling tanks during the construction phase.	2	3	2	1	8	2	16 - Low	• During the period of construction of the dirty water dams and settling tanks, high storm events could result in excessive ponding within the dirty water dams and settling tanks. Depending on the extent of the ponding this water could either be allowed to remain and evaporate naturally or it could be pumped out.	1	3	1	1	6	2	12 - Low
Separation of clean water runoff upstream of the dirty water dams and settling tanks. Water upstream of the dirty water dams and settling tanks is considered clean and will have to be separated from the dirty water area. Dirty water Spillages from the dirty water dams and settling tanks into the environment must be managed.	4	3	4	3	14	4	56 - Moderate	• Based on Reg 704 requirements regarding stormwater management it is noted that all clean and dirty water must be separated. Therefore clean water emanating from upstream of the dirty water dams and settling tanks will be diverted away and discharged to the nearby watercourse or environment. The clean water diversion will be sized to accommodate the 1:50 year storm event. The dirty water dams will also have a minimum freeboard from spillway to crest of 0.8 m as per Reg 704 requirements.	3	3	4	2	12	3	36 - Moderate
TERESTRIAL ECOLOGY															
Destruction of natural vegetation	4	5	5	1	15	4	60- Moderate	• Construction activities should be minimised to the smallest area possible. • Areas outside the construction area must not be disturbed. • Construction activities must be limited to as short a time as possible • Topsoil must be stockpiled separately with the natural seed bank intact and protected against weed infestation and erosion	4	5	5	1	15	4	60- Moderate

Risk	Rating Before Mitigation Measures							Mitigation Measure	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
Migration of animals away from site	4	5	5	1	15	4	60- Moderate	• Construction activities should be minimised to the smallest area possible. • Areas outside the construction area must not be disturbed. • Disturbed areas should be revegetated after the construction phase had been finalised. • Construction activities must be limited to as short a time as possible • Open fires must not be allowed on site. Contained fires for heating and cooking should be restricted to designated areas on site. • Fire breaks around the work sites must be established and maintained and immediate action must be taken to extinguish any fire which may break out on the construction site • No smoking should be permitted within 3m from any fuel or chemical storage area. • All buildings / infrastructure should be equipped with adequate firefighting equipment – employees should be trained in the use of these firefighting equipment. • Animal Species, populations and nests to be relocated must be identified. The identified animal species, populations and nests must be relocated to areas where these will not be at risk. • Animals must not be relocated to areas where population stress is already evident. • Animals may not be hunted, snared, captured, injured or killed. The work site must be kept clean, tidy and free of waste that would attract animal pests. • Problem animals and venomous animals should be reported to the ECO. • No pesticides may be used unless approved by the ECO	4	5	5	1	15	4	60- Moderate
Vegetation loss due to the removal of vegetation cover and soil disturbance may cause erosion damage	2	1	1	1	5	3	15-Low	• Visual inspections for possible erosion must be undertaken on a regular basis. • Erosion should be allowed to develop on a large scale before effecting repairs, and in any case not later than six months before the termination of the construction period to allow for sufficient rehabilitation growth. • All areas susceptible to erosion should be protected and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. • The natural vegetation must be retained, wherever possible. • Vehicular / pedestrian access into natural areas beyond the demarcated area must be prohibited. • A free-draining surface should be ensured at areas to be disturbed as far possible to prevent ponding of surface water	1	1	1	1	4	3	12-Low
Alien plants that colonise disturbed areas	2	1	1	1	5	3	15-Low	• All exotic and invasive plants to be eradicated must be identified, located and mapped. • Invasive / exotic plants should be controlled by means of mechanical or chemical removal of the plants and seeds. Chemical removal should only be undertaken by following the manufacturers instruction at all times, especially in terms of quantities, time of application etc. • An indigenous alternative plant cover should be established and manages (where necessary) to limit re-growth and re-invasion of the unwanted plant species. • All sites disturbed by construction activities should be monitored for colonisation of exotic / invasive plant species. The exotic/invasive plant species must be eradicated as they emerge. • Mechanical methods must be favoured rather than chemical methods where possible to remove unwanted vegetation cover and trees	1	1	1	1	4	3	12-Low
AQUATIC ECOLOGY															

Risk	Rating Before Mitigation Measures							Mitigation Measure	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
Degradation of aquatic ecosystems due to increased sedimentation	5	3	2	4	14	5	70-High	• Runoff water from the ash/gypsum co-disposal facility should be channelled into pollution control dams to avoid effects on the aquatic ecosystem. • Silt traps should be placed down-slope of where vegetation stripping will take place to minimise siltation in rivers and wetlands. These silt traps need to be regularly maintained to ensure effective drainage. • It is important that rehabilitation and re-vegetation of the exposed areas be undertaken on a continual basis and should not be left for the closure phase. • If erosion has taken place, rehabilitation should be implemented as soon as possible	0	1	1	1	3	1	10-Low
Change to natural flow regime	2	1	2	2	7	2	14-Low	• Runoff water from the ash disposal facility should be channelled into pollution control dams to avoid effects on the natural flow regime. • The water in the pollution control dams should be reused at the Kusile Power Station if possible. • Silt traps should be placed down-slope of where vegetation stripping will take place to minimise siltation in rivers and wetlands. These silt traps need to be regularly maintained to ensure effective drainage. • The runoff should be routinely monitored for acidity/alkalinity and TDS as an early warning for potential increases in discharge water. The water in these pollution control dams should be reused at the Kusile Power Station if possible. • Water quality and biotic integrity should be routinely monitored in the Klipfonteinspruit and adjoining tributaries of the Wilge Rivers to assess and quantify the potential impact on the receiving environment	4	3	1	2	10	1	3-Low
AIR QUALITY															
Dust deposition	3	1	2	2	8	4	32-Moderate	• Exposed areas of disposed ash and gypsum must be regularly wetted. • Exposed areas must be stabilised top-soil covering. • Additional mitigation of dust emissions from the top soil layer can be achieved by wetting of exposed top-soil. • Re-vegetation of the ash/gypsum co-disposal facility through application of a deeper top-soil layer and seeding with appropriate grass seeds.	2	1	2	1	6	3	18-Low
PM_{10}	4	1	2	2	9	4	36-Moderate		2	1	2	1	6	3	18-Low
$PM_{2.5}$	4	1	2	2	9	4	36-Moderate		2	1	2	1	6	3	18-Low
GROUNDWATER															
Hydrocarbon contamination associated with heavy machinery on site	3	3	3	2	11	3	33-Moderate	• Secondary containment for all fuel stored on site. • Implementation of the groundwater monitoring programme must continue as this will allow for the early detection of water quality deterioration associated with the site. • Accurate oil records must be kept (purchased, disposal, and recycled). Ensure clean up protocols in place and followed	3	3	3	2	11	2	22-Low

10.3.2. Operational Phase

Risk	Rating Before Mitigation Measures							Mitigation Measures	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
SURFACE WATER															
Spillages from the dirty dams and wastewater treatment plant.	4	3	4	3	14	3	42 - Moderate	• A monitoring program for structural maintenance of the dirty dams and wastewater treatment plant must be developed and clean-up of leakages or spills should be carried out immediately.	3	3	2	1	9	2	18 - Low

Risk	Rating Before Mitigation Measures							Mitigation Measures	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
Inadequate removal of silt will result in a steady decrease in the storage capacity of the SDD ST.	2	3	1	2	8	3	24 - Low	• The SDD ST will consist of two equal capacity concrete basins that clarify contaminated water from the power station terrace before it travels by gravity pipeline to the SDD. The two compartments will allow for occasional maintenance and inspection access (preferably during the dry season) without interrupting the functionality of the SDD ST under normal circumstances.	1	3	1	1	6	2	12 – Low
Maintenance of upstream clean water controls.	4	3	2	2	11	3	33 - Moderate	• Upstream clean water controls should be maintained regularly by site monitoring, to ensure no blockages by vegetation or debris occur. • Berm walls that have collapsed or have been damaged must be damaged be repaired immediately	2	3	2	1	8	2	16 - Low
Increase in volume of contaminated water that needs to be managed on the Kusile Power Station footprint.	4	3	4	3	14	3	42 - Moderate	• A stormwater management maintenance program must be maintained regularly to ensure that the stormwater system is functioning sufficiently.	3	3	2	1	9	2	18 - Low
TERESTRIAL ECOLOGY															
Loss of vegetation due to contamination of the soil downwind from the waste dump due to dust pollution	3	5	3	1	12	1	12-Low	• Dust suppression measures must always be applied to prevent dust pollution	3	5	3	1	12	1	12-Low
Loss of vegetation due to contamination of the soil due to ash and gypsum spillage	3	5	3	1	12	1	12-Low	• Spillage of ash and gypsum between the Kusile power plant and the ash/gypsum co-disposal facility must be prevented. • The lining of the ash/gypsum co-disposal facility and dirty water dams must be tested for leaks before the deposition of the first ash takes place. • Care must be taken not to rupture the lining during the construction and operational phases. • Spills of any product shouldl be cleaned up immediately by removing the spillage together with the polluted soil and by disposing it at a recognised facility	3	5	3	1	12	1	12-Low
Erosion damage due to soil disturbance and poor vegetation cover	3	1	2	1	7	4	28-Low	• The facility must be regularly monitored for erosion damage of the topsoil cover	1	1	1	1	4	4	16-Low
Alien plants that colonise disturbed areas	2	1	1	2	6	3	18-Low	• Invasive / exotic plants must be controlled by means of mechanical or chemical removal of the plants and seeds. Chemical removal should only be undertaken by following the manufacturers instruction at all times, especially in terms of quantities, time of application etc. • An indigenous alternative plant cover should be established and manages (where necessary) to limit re-growth and re-invasion of the unwanted plant species • All sites disturbed by construction activities should be monitored for colonisation of exotic / invasive plant species, which must be eradicated as they emerge. • Mechanical methods must be favoured rather than chemical methods where possible to remove unwanted vegetation cover and trees • Construction areas must be regularly monitored for alien plants that could colonise the topsoil cover of the ash/gypsum co-disposal facility	1	1	1	1	4	3	12-Low
Decline in the biodiversity of the surrounding vegetation due to wind deposition of ash and gypsum	1	1	1	2	5	3	15-Low	• Dust suppression measures must always be applied to prevent dust pollution as this will minimise the wind deposition of ash and gypsum	1	1	1	1	4	3	12-Low
Negative effect on crop production and the palatability of grazing due to wind deposition of ash and gypsum on plants	1	1	1	2	5	3	15-Low	• Dust suppression measures must always be applied to prevent dust pollution as this will minimise the wind deposition of ash and gypsum	1	1	1	1	4	3	12-Low
AQUATIC ECOLOGY															

Risk	Rating Before Mitigation Measures							Mitigation Measures	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
Change to natural flow regime	0	1	1	1	3	2	6	• Runoff water from the ash/gypsum co-disposal facility should be channelled into pollution control dams to avoid effects on the aquatic ecosystem; • Silt traps should be placed down-slope of where vegetation stripping will take place to minimise siltation in rivers and wetlands. These silt traps need to be regularly maintained to ensure effective drainage. • Exposed areas must be rehabilitated and revegetated on a continual basis and should not be left for the closure phase. • If erosion has taken place, rehabilitation should be implemented as soon as possible	0	1	1	1	3	1	3-Low
Loss of indigenous species and biodiversity due to declines in water quality and habitats	5	5	2	3	15	2	30	• Runoff water from the ash disposal facility should be channelled into pollution control dams to avoid effects on the natural flow regime. • The water in the pollution control dams should be reused at the Kusile Power Station if possible. • Silt traps should be placed down-slope of where vegetation stripping will take place to minimise siltation in rivers and wetlands. • The silt traps should be regularly maintained to ensure effective drainage. • The runoff should be routinely monitored for acidity/alkalinity and TDS as an early warning for potential increases in discharge water. • The water in these pollution control dams should be reused at the Kusile Power Station if possible. • Water quality and biotic integrity should be routinely monitored in the Klipfonteinspruit and adjoining tributaries of the Wilge Rivers to assess and quantify the potential impact on the receiving environment	4	3	1	2	10	1	10-Low
AIR QUALITY															
Dust deposition	3	1	4	2	10	4	40-Moderate	• Exposed areas of disposed ash and gypsum must be regularly wetted. • Exposed areas must be stabilised top-soil covering. • Additional mitigation of dust emissions from the top soil layer can be achieved by wetting of exposed top-soil. • Re-vegetation of the ash/gypsum co-disposal facility through application of a deeper top-soil layer and seeding with appropriate grass seeds.	2	1	4	1	8	3	24-Low
PM_{10}	4	1	4	2	11	4	44-Moderate		2	1	4	1	8	3	24-Low
$PM_{2.5}$	4	1	4	2	11	4	44-Moderate		2	1	4	1	8	3	24-Low
Cancer Risk	1	1	4	2	8	4	32-Low		1	1	4	1	7	3	21-Low
GROUNDWATER															
Poor quality artificial recharge from the ash gypsum ash/gypsum co-disposal facility	4	3	4	2	13	4	52-Moderate	• The ash/gypsum co-disposal facility will be lined in a way that will reduce the impact on the groundwater environment as it inhibits the seepage of poor quality water into the aquifer. • Leach tests must be conducted on the ash/gypsum waste in order to determine the leachable concentrations of the waste samples and whether they are within acceptable limits. • The continual implementation of the groundwater monitoring programme will allow for the early detection of water quality deterioration associated with the site.	3	3	4	2	12	3	36-Moderate
Artificial recharge to groundwater	3	3	4	2	12	4	48-Moderate	• The pollution control dams must be lined as this will reduce the impact on the groundwater environment as it inhibits the seepage of poor quality water into the aquifer. • The continual implementation of the groundwater monitoring programme will allow for the early detection of water quality deterioration associated with the site.	2	3	4	2	11	3	33-Moderate

Risk	Rating Before Mitigation Measures							Mitigation Measures	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
Poor quality water emanating from the Flue Gas Desulphurisation Wastewater Treatment Plant	4	3	4	1	12	4	48-Moderate	• Lining of the area where the waste water is to be stored will reduce the impact on the groundwater environment as it inhibits the seepage of poor quality water into the aquifer. • The continual implementation of the groundwater monitoring programme will allow for the early detection of water quality deterioration associated with the site.	2	3	4	1	10	3	30-Moderate

10.3.3. Closure Phase

Risk	Rating Before Mitigation Measures							Mitigation Measures	Rating After Mitigation Measures						
	S	R	D	E	C	P	Significance =C*P		S	R	D	E	C	P	Significance =C*P
Seepage of water out of the Ash/gypsum co-disposal facility into the environment.	4	3	4	3	14	3	42 - Moderate	• A monitoring program of ground and surface water needs to be implemented and maintenance on any seepage needs to be carried out immediately if detected.	3	3	2	1	9	2	18 - Low
Accidental spillages of hazardous substances from decommissioning vehicles used during the closure phase of the power station.	4	3	3	2	12	3	36 - Moderate	• Management measures regarding the maintenance of all power plant vehicles must be undertaken. This will ensure that any spillages or leakages of fuel and oil are reduced.	3	3	2	1	9	2	18 – Low

11. ENVIRONMENTAL MANAGEMENT PROGRAMME

An assessment of the existing Kusile Environmental Management Programme that was compiled in 2006 and the Wetland Management Plan (WMP) that was compiled in 2013 showed that most of the potential impacts and mitigation measures that were identified by the specialists were included. Kusile Power Station designed the lining system for the ash/gypsum co-disposal facility, in conjunction with the DWS, taking the gypsum into account. The liner system was designed to ensure minimum seepage into the groundwater and surface water resources. An additional EMPr for the co-disposal facility and associated dams has been included. The EMPrs and WMP have been included in **Appendix G**.

12. PUBLIC PARTICIPATION PROCESS

12.1. BACKGROUND

The public participation process (PPP) is important to acquire the inputs from the potentially Interested and Affected Parties (I&APs). This is to ensure the environmental rights of the people are protected as contained in Section 24 of the Constitution of the Republic of South Africa, 1996 (No. 8 of 1996), as follows:

Everyone has the right –

(a) to an environment that is not harmful to their health or wellbeing; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

i) prevent pollution and ecological degradation;

ii) promote conservation; and

iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

12.2. OBJECTIVES

The objectives of the public participation, based on the IAIA publication of *Public Participation – Best Practice Principles* (IAIA, 2006), are –

- To invite the I&APs to participate into the decision-making process to promote environmental justice, equity and collaboration;
- To inform the stakeholders, (which includes the proponent, general public, and decision-makers) on the planned activity and its consequences;
- To gather data and information from the public about their human (including cultural, social, economic and political dimensions) and biophysical environment, as well as about the relations they have with their environment;
- To seek input from the public on the planned activity, including its scale, timing and ways to reduce its negative impacts, to increase its positive outcomes or to compensate impacts which may not be mitigated;
- To contribute to more sustainable development and consequently greater public acceptance and support; and
- To contribute to the mutual learning of stakeholders and to improvement of the public participation.

12.3. THE PROCESS FOLLOWED

12.3.1. Notification

Necessary measures were taken to ensure that the PPP complies with Regulation 56 of the EIA Regulations No. R. 543 of 2010. On-site notices were placed at the entrance and around the Kusile Power Station on **1 August 2014** (**Figure 12-1**).

Figure 12-1: Site notices placed at and around the Kusile Power

Newspaper advertisements were placed in the Sowetan and Citizen publications on 1 August 2014. **Figure 12-2** shows the advertisements that were placed in the newspapers.

The Citizen Newspaper Advertisement
The Sowetan Newspaper Advertisement

Figure 12-2: Newspaper Advertisements

Registered letters, e-mails and bulk smses were sent to the registered stakeholders to inform them about the availability of the draft report. A feedback letter was attached to the e-mail, whilst the website links were included in the body of the e-mail for convenience.

12.3.2. Public Comment Period

On 1 August 2014 the Draft EIR was placed on the Sebata Institute website (www.sebatagroup.com) and the Eskom website (www.eskom.co.za) for a period of 40 days for the I&APs (till 12 September 2014).

Two copies of the report, including a comments register were made available to stakeholders at the Kusile Power Station. I&APs were also informed that electronic copies of the report on CD were available on request.

Copies of the Draft Scoping Report were also made available to the following Government Departments for 40 days 960 days for the DWA) to review and provide comments:

Department	Contact Person
Department of Environmental Affairs	Ms Kim Balutto
Department of Water Affairs (Bronkhorstspruit Office)	Mr Dumisane Hlongwane
Mpumalanga Department of Agriculture, Rural Development and Land Administration (DARDLA	Ms N.L Sithole Another copy of the report was made available to Mr Jan Venter
Mpumalanga Department of Economic Development, Environment and Tourism	Ms Dineo Tswai and Dr G.R. Batchelor
South African Heritage Resources Agency (SAHRA)	A case was opened on SAHRIS Ms Jenna Lavin was the designated official responsible for commenting. SAHRA indicated that they had no objections with the project during the Scoping phase.
Delmas Local Municipality.	Ms Yolanda Pulasegami

Comments received from the stakeholders will be incorporated into the Draft EIR and a Final EIR (FEIR) will be compiled. The FEIR will be made available to all the stakeholders for a 21-day comment period to confirm that all the comments received during the DEIR comment period have been accurately captured and adequately addressed.

Registered letters, e-mails and bulk smses will be sent to the registered stakeholders to inform them about the availability of the final reports (FEIR, FEMP final specialist reports and IRR.

12.4. COMMENTS FROM I&APS ON THE DRAFT REPORT

All comments received will be collated into an Issues and Responses Report (IRR) which will be attached as an Appendix to the FEIR. The copies of the original letters,

minutes and e mails received during the public comment period are also included as an appendix to the IRR.

13. ENVIRONMENTAL IMPACT STATEMENT

All predicted negative impacts (except for the impact on the catchment) can be mitigated. Mitigation measures identified were included in the original EMPr and Wetland Management Plans that were submitted to the DEA in 2006 and 2013 respectively. The EMPr and the WMP are already being implemented to guide the construction activities at the Kusile Power Station and must continue to be used in the construction of the ash/gypsum co-disposal facility and associated infrastructure.

From a social and economic point of view, the project carries both risks, and opportunities for local communities. Recommendations were provided in the 2006 specialist report, EIA Report and EMPr to ensure that the risks are adequately managed and the opportunities fully harnessed. Positive socio-economic impacts will automatically result from the project (during construction and operation (e.g. stimulation of the local economy, job creation).

Negative socio-economic impacts may also result from the project. These will be related to nuisance inherent to construction activities (e.g. noise, dust) but also to risks which may materialise as a result of the project (e.g. safety, social disruption, in-migration and effect of temporary workers on social dynamics. The recommended mitigation measures in the 2006 EMPr should be adhered to in order to minimise them.

The ash/gypsum co-disposal facility is expected to have an impact on surface water, groundwater and aquatic flora and fauna. The specialist studies conducted showed that the impacts will generally be of low significance, except for the impacts on catchment yield and impact on aquatic ecosysystems, sedimentation which was rated to be of high significance. Most of the mitigation measures that were identified are already in place at the Kusile. Kusile Power Station designed the lining system for the ash/gypsum co-disposal facility in conjunction with the Department of Water Affairs (the liner system approvals are attached as **Appendix K**) to avoid/minimse seepage into the groundwater and surface water resources.

All the impacts can be mitigated to low or moderate impact rating except for the impact on catchment yield. To minimize the impacts on the catchment, Kusile Power Station reduced the size and changed the shape of the co-disposal facility to create a buffer that would protect the pan associated with the facility.

Additional impacts that were identified during the 2006 EIA include impact on wetlands. According to the wetland delineation studies, unless the ash/gypsum co-disposal facility is relocated the impacts associated with the loss of wetlands and their functions were unavoidable. However relocating the facility to another site will impact on grasslands, which have higher biodiversity than wetlands (higher negative impact). Wetlands were classified into high integrity, medium integrity and low integrity wetlands and the ash/gypsum co-disposal facility footprint will only impact on medium integrity wetlands.

Site options were considered during the 2006 EIA and the current position was found to be the most optimal. Eskom is currently investigating how to rehabilitate and protect the high integrity wetlands on the Kusile site.

According to the specialist studies conducted for the ash/gypsum co-disposal facility and associated infrastructure, there are no additional impacts from the impacts that were identified during the 2006 EIA. As such, it is expected that the 2006 EMPr and the additional WMP that was developed in 2013 will be adequate in management of the environmental impacts.

14. CONCLUSION AND RECOMMENDATIONS

The co-disposal of gypsum with ash at the Kusile Power Station is not authorised in terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008). Since gypsum is considered to be a hazardous waste, a Waste Management Licence (WML) must be applied for to co-dispose ash and gypsum as a listed activity 9, Category B of GN718. The construction of the facility (ash/gypsum co-disposal facility, the ADDD, the SDD and SDD ST) will trigger activity 11, Category B of GN 718. Act. NEMA listed activities 11 and 18 of GN R544 will be triggered as a result of the construction of the ADDD within a wetland.

The project team believes that the EIA undertaken for the co-disposal of ash and gypsum at the Kusile Power Station fulfils the process requirements of the NEMA and the NEMWA. The construction of the ash/gypsum co-disposal facility and associated infrastructure should be conducted under duty of care and must be in accordance with the recommendations that were included in this EIR, the 2006 EMPr, 2013 WMP and specialist reports.

The majority of the impacts identified were classified as medium and low without mitigation. All the identified impacts can be mitigated to low or moderate impact rating except for the impact on catchment yield. The majority of the mitigation measures identified during this assessment were included in the 2006 EMPr and 2013 WMP and are already in place at the Kusile Power Station. To minimize the impacts on the catchment, Kusile Power Station reduced the size and changed the shape of the co-disposal facility to create a buffer that would protect the pan associated with the facility. Kusile Power Station also designed the lining system for the ash/gypsum co-disposal facility in conjunction with the Department of Water to avoid/minimise seepage into the groundwater and surface water resources.

The EAP recommends that a Waste Management Licence be issued by the DEA and the following conditions should be included in the WML:

- Specific mitigation requirements included in the accompanying EMPR, the 2006 EMPr, the SES for Kusile Power Station and the Wetland Management Plan (WMP) must be adhered to.
- All monitoring, rehabilitation and reporting requirements in the Kusile IWULs must be implemented.

- The monitoring of the groundwater at the Kusile Power Station should continue and must be expanded to include the monitoring points that were included in the Groundwater Assessment.
- Sufficient monitoring of the surface water at the Kusile Power Station must be conducted for all the variables and must be extended to include the monitoring points that were stipulated in the Ash Dum IWUL.

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APPENDIX A

2006 EIA REPORT

APPENDIX B

ENVIRONMENTAL MANAGEMENT PROGRAMME

APPENDIX C

ENVIRONMENTAL AUTHORISATION

APPENDIX D

2010 KUSILE WASTE MANAGEMENT LICENCE

APPENDIX E

DESIGN REPORTS

APPENDIX F

FGD PROCESS FLOW DIAGRAM

APPENDIX G

WATER USE LICENCE

APPENDIX H

LIST OF KUSILE STAKEHOLDERS AND PUBLIC PARTICIPATION DOCUMENTS

APPENDIX I

ISSUES AND RESPONSES REPORT (IRR)

APPENDIX J

2006 SPECIALIST STUDIES