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Environmental Impact Assessment for the construction of the proposed sludge disposal facility and pipeline associated with the treatment of Acid Mine Drainage in the Eastern Basin of the Witwatersrand, Gauteng

Draft Scoping Report

Project Number:

AEC2588

Prepared for:

AECOM South Africa (Pty) Ltd

June 2014

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This document has been prepared by Digby Wells Environmental.

Report Type:	**Draft Scoping Report**
Project Name:	**Environmental Impact Assessment for the construction of the proposed sludge disposal facility and pipeline associated with the treatment of Acid Mine Drainage in the Eastern Basin of the Witwatersrand, Gauteng**
Project Code:	**AEC2588**

Name	Responsibility	Signature	Date
Degrecia Zwane	Project Administrator		April 2014
Mellerson Pillay	Project Manager		May 2014
Grant Beringer	Project Sponsor		May 2014

EXECUTIVE SUMMARY

Introduction

The Trans Caledon Tunnel Authority (TCTA) was instructed by the National Government, through the Minister of Water and Environmental Affairs, to manage Acid Mine Drainage (AMD) generated in the Western, Central and Eastern Basins of the Witwatersrand gold fields located in the Gauteng Province. The engineering and environmental solutions for the Western and Central Basins are underway and now management of AMD associated with the Eastern Basin is required. The Eastern Basin covers the East Rand area and includes the towns of Boksburg, Brakpan, Springs and Nigel which fall under the jurisdiction of the Ekurhuleni Metropolitan Municipality in the Gauteng Province.

AECOM South Africa (Pty) Ltd (AECOM) has been appointed by TCTA as the Principal Consultant in respect to the implementation of the proposed Short Term Intervention (STI) measures for a sludge disposal facility and pipeline associated with the treatment of AMD from the Eastern Basin. Digby Wells Environmental (Digby Wells) has been appointed by AECOM as the Environmental Consultant to undertake the required regulatory environmental authorisation process.

An Integrated Application was compiled and submitted to the Department of Environmental Affairs (DEA) on 25 April 2014 (reference number *14/12/16/3/3/3/111*) in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEM:WA), as required by the relevant Government Notice Regulation (GNR). The necessary authorisation process involves a Scoping Phase and an Environmental Impact Assessment (EIA) Phase.

This Scoping Report forms part of the EIA process and will be used to inform the compilation of the EIA Report and the Environmental Management Programme (EMP). This report will be made available for public review, and all comments received will be included into this report and submitted to DEA for authorisation. The EIA process is outlined in Figure 1 below.

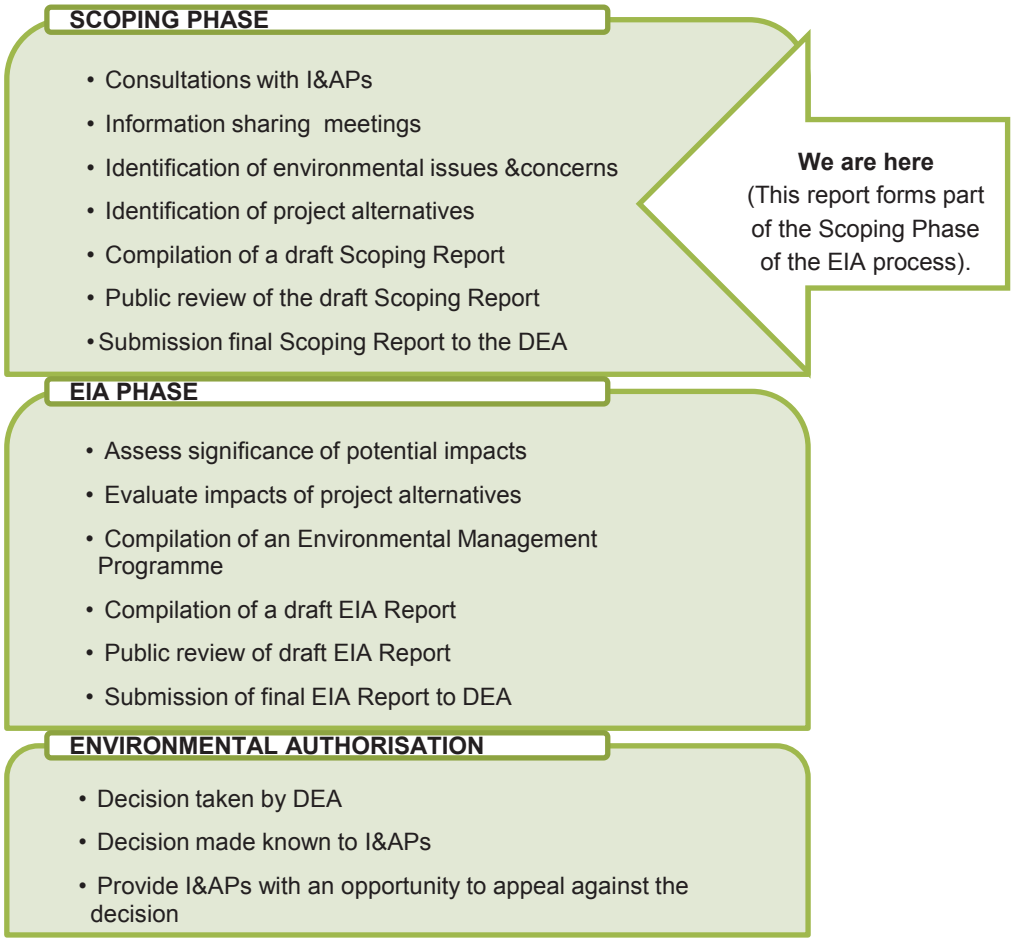

Figure 1: EIA Process

Project Overview

After more than 120 years of deep level gold mining in the Witwatersrand, mining and dewatering has stopped due to the exhaustion of gold resources. The cessation of dewatering has resulted in progressive flooding of the mine voids since 1997.

To prevent impacts to infrastructure and aquifers, an Environmental Critical Level (ECL) has been defined for the Eastern Basin. The ECL for the Eastern Basin was set to be at 1,280 mamsl. The water levels at Grootvlei No. 3 Shaft located in the Eastern Basin during January 2014 were at 1,277 mamsl (or approximately 3m below surface). It has been estimated that the ECL for the Eastern Basin was reached in May 2014. It is therefore crucial that interventions to prevent decant of AMD are implemented. STI measures have been identified in order to manage AMD emanating from the Eastern Basin. The proposed management measures of AMD will result in the generation of a High Density Sludge (HDS), which will need to be managed and disposed of.

Project Description

The HDS treatment process is seen as an active process and more suited to the treatment of AMD than passive treatment. AMD will be abstracted from Grootvlei Shaft No. 3 (i.e. point of abstraction of AMD emanating from the Eastern Basin), and pumped to a new HDS Plant for treatment. The treatment of AMD will result in the generation of HDS, which will need to be pumped to a disposal site. A sludge classification was conducted by Golder Associates in February 2014. The results indicated that the expected sludge is classified as Type 3 waste due to elevated concentrations of Arsenic (As), Cadmium (Cd), Manganese (Mn), Nickel (Ni) and Antimony (Sb). Type 3 waste is classified as general waste according to NEM:WA.

The sludge disposal facility will have a total extent of 30 hectares (ha) and will require a total storage capacity of the 1.75 million m^3 of sludge and is expected to reach a maximum height of 14 m. The sludge disposal site will act as a waste management facility and is expected to have a lifespan of approximately 40 years. The proposed pipelines would have an internal diameter of no more than 300 mm and be constructed adjacent to each other. The one pipeline will be used for the pumping of sludge from the HDS plant to the sludge disposal site. The second pipeline will be a return water pipeline to send excess water back to the HDS plant for treatment.

Two (2) proposed sludge disposal site options have been identified (Grootvlei 6/L/16 and Largo Site 4) as well as their associated pipeline routes which will serve to transport the sludge to the respective site.

The Grootvlei 6/L/16 site is an existing Tailings Storage Facility (TSF) and is located approximately 1 km from Grootvlei Shaft No. 3. Largo Site 4 is located on the eastern banks of the Blesbokspruit and is located approximately 2km from Grootvlei Shaft No. 3.

A simplified description of the proposed processes associated with the treatment of AMD emanating from the Eastern Basin is presented in Figure 2 below. Note, in light of the Exemption issued by the Department of Environmental Affairs, the activity of pumping AMD from Grootvlei Shaft 3, construction of an HDS Treatment Plant and discharge of neutralised water into the Blesbokspruit are excluded from the scope of this EIA process. As per the diagram below, Activities 1, 2 and 4 are subject to the existing exemption mentioned above. This EIA process is limited to Activity 3 (i.e. the construction of a sludge disposal facility and associated pipelines for the transfer of sludge and return water).

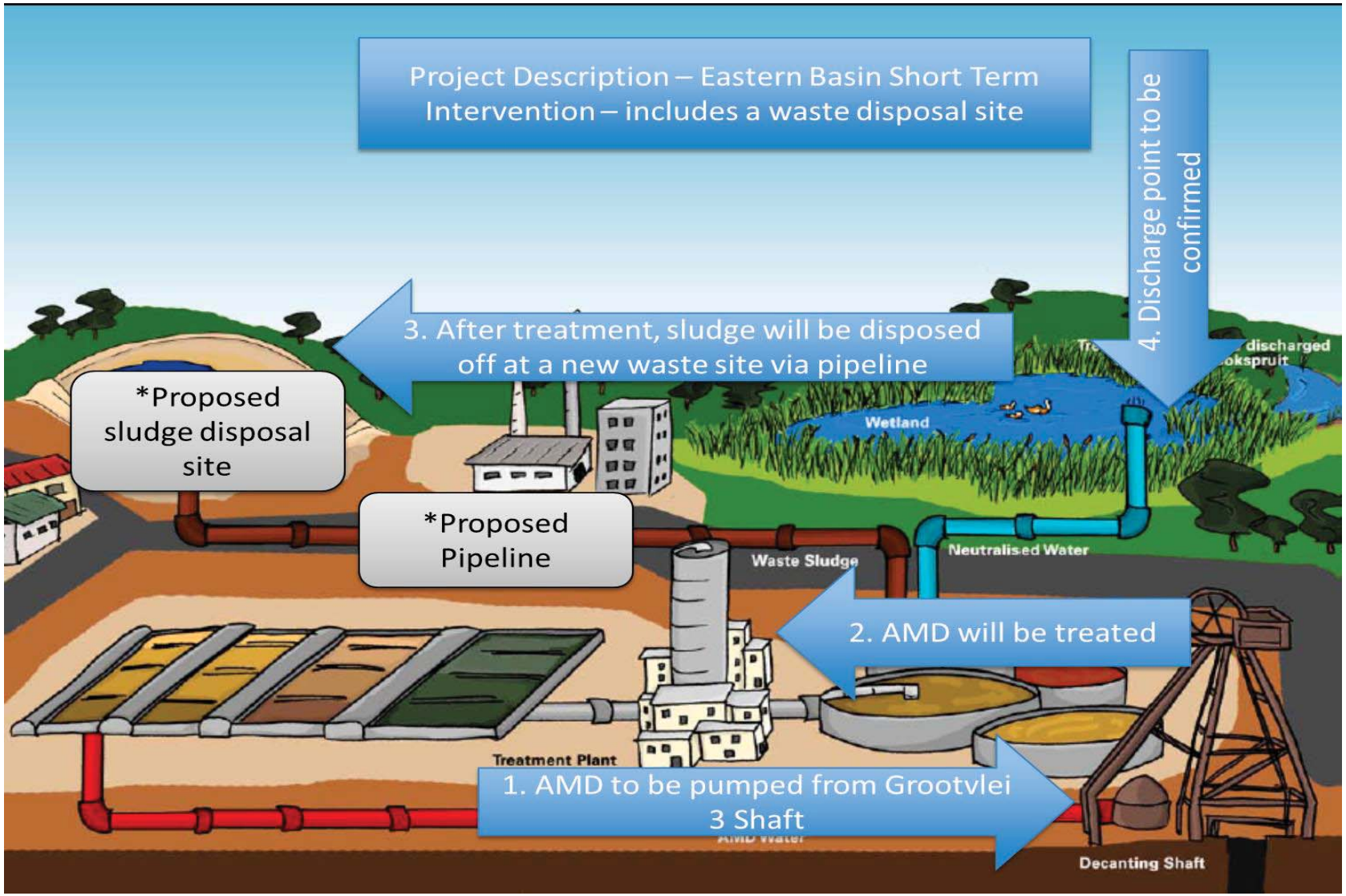

Figure 2: Process flow diagram for the treatment and transportation of HDS for disposal

Triggered NEMA and NEM:WA listed activities

A summary of the listed activities for which the Project requires an Environmental Authorisation is presented in the Table 1 and Table 2 below.

Table 1: NEMA Listed Activities

GN and Listing Notice	Activity No (s)	Description
GN R544 – Listing Notice 1:	9: The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water – i. With an internal diameter of 0.36 metres or more; or ii. With a peak throughput of 120 litres per second or more, Excluding where: a) Such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b) Where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	Pipelines will be constructed for the transportation of sludge from the AMD HDS plant for disposal at the proposed sludge disposal site and a return water pipeline will be constructed.
	11: The construction of: i. Canals; ii. Channels; iii. Bridges; iv. Dams v. Weirs vi. Bulk storm water outlet structures; vii. Marinas; viii. Jetties exceeding 50 square metres in size; ix. Slipways exceeding 50 square metres in size; x. buildings exceeding 50 square meters in size; or xi. Infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a	The proposed pipeline route will cross perennial and/ or seasonal watercourses on route to the proposed sludge disposal site.

GN and Listing Notice	Activity No (s)	Description
	watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	
GN R545 - Listing Notice 2	5: The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.	The disposal of sludge will require a license in terms of the NEM:WA

Table 2: NEM:WA Listed Activities

GN and Listing Notice	Activity No (s)	Description
GN R921 - Category B	Activity No.8: The disposal of general waste to land covering an area in excess of 200 m^2 and with a total capacity exceeding 25 000 tons.	The disposal of general waste of approximately 208.5 tons per day into the proposed sludge disposal site, which is greater than 200 m^2.

Project Alternatives

An environmental and social screening analysis was conducted by Digby Wells in January 2014. An engineering and financial screening analysis was conducted by Golder Associates in February 2014. A total of nine (9) disposal site options were considered as part of the screening analysis.

The objective of the screening assessment was to assess the sites for the proposed sludge disposal facility options and to determine which site (s) are the most relatively preferred based on bio-physical, socio-economic sensitivities as well as the technical and financial criteria.

To determine the most suitable site (s) from an environmental and social perspective, a model was developed in order to investigate and quantify the environmental and social aspects on each site. Each of the sites was ranked which assisted in determining which sites are the most preferred site (s) for the Project.

Two scenarios were used to present the most suitable and the least suitable sites, namely the equal weighting scenario and the specialist weighting scenario. In the equal weighting scenario, each specialist discipline was rated of equal importance and thus compared against each other based on a set of criteria to determine relative preference. In terms of the specialist weighting scenario, key specialist disciplines were weighted of greater importance and thus given greater emphasis in determining a relatively preferred site (s).

In terms of the equal weighting scenario, three (3) site options have been determined as the most suitable sites. These sites include the Daggafontein tailings facility (which falls under the Daggafontein Cluster), Largo Site 2 and Grootvlei Site 6/L/17A. Therefore, no fatal flaws have been identified on any of these sites.

In terms of the specialist weighting scenario, the results depicted below are rated according to each specialist discipline, in which individual specialist disciplines were weighted. The results indicated that Daggafontein remains as the most suitable site and Grootvlei Site 6/L/17A has been identified as the second most suitable site.

The results from the technical and financial outcomes found Largo Site 4 and Grootvlei Site 6/L/16 as the most suitable sites from a technical and financial perspective. Largo Site 4 was ranked as the highest rated site for the proposed sludge disposal facility, with Daggafontein TSF Site as next best rated and Grootvlei Site 6/L/16 as the third best rated site.

It was concluded that the sites Largo 4 and Grootvlei 6/L/16 were selected for a detailed impact assessment due to outcomes of the technical and financial screening analysis. Although the Daggafontein Tailing Facility was identified as the most preferred site (from an environmental and technical/ financial perspective), future activities proposed on the Tailings Facility have precluded this site option and has thus been removed from the alternatives considered.

No Project Option

Should the STI measures for the treatment of AMD from Eastern Basin not proceed, untreated AMD will decant from the Eastern Basin. The uncontrolled decant of AMD into the environment may result in ecological and social impacts, which will eventually spread to the Vaal River. The abstraction and treatment of AMD from the Eastern Basin and the management of the sludge produced from the HDS Plant, therefore, needs to be implemented to mitigate and prevent additional impacts associated with AMD. Managing and maintaining AMD to below the ECL (i.e. below 1,280 mamsl) will prevent future AMD decanting and prevent the contamination of lower level aquifers.

Public Participation

Through the Public Participation Process (PPP), Interested and Affected Parties (I&APs) are provided with the platform to contribute essential local knowledge and raise comments applicable to the project planning and design.

Fifteen (15) directly affected farms were identified in the Project area associated with the proposed sludge disposal site options and pipelines. A stakeholder database was compiled listing stakeholders according to the following categories:

- Government (National, Provincial, District and Local authorities);
- Landowners (directly affected and surrounding landowners within a 100 m buffer);
- Land occupiers (directly affected and surrounding land occupiers);
- Communities (surrounding communities);
- Non-Governmental Organisations (NGOs) made up of Environmental organisations and Community-based Organisations (CBOs);
- Business (Small to medium enterprises and formal business organisations); and
- Other (Agriculture and farmers organisations, industry etc.).

The methods employed to disseminate the Project information are listed below:

- Through the use of Background Information Documents (BID);
- Newspaper advertisements;
- Site notices; and
- Letters that included a comment and registration sheet.

Potential Impacts

In light of the baseline analysis conducted, the following potential impacts were identified during the scoping phase.

Table 3: Potential Impacts Identified during the Scoping Phase

Environmental Aspect	Identified Potential Impacts
Visual and Topography	
Changes that will occur in land use type from agriculture to waste disposal due to disposal on the Largo Site 4 option.	▪ Features will be added to the topography and this will alter the natural topographical functioning of the flat landscape.
Visual	
Visual disturbance on Largo Site 4 due to sludge disposal activities.	▪ Largo Site 4 is situated on flat agricultural land and it is bordered by residential and industrial areas which are already classified as disturbed areas likely resulting in minimal visual impacts.

Environmental Aspect	Identified Potential Impacts
Visual disturbance due to vehicular activities.	▪ Vehicular activities brought by the construction of the pipelines may cause "visual pollution" arising from dust created by the construction vehicles.
Soils	
Clearing of soil.	▪ Loss of soil in the Largo Site 4 as it is currently under cultivation; and ▪ Land use as well as land capability would be lost.
Deposition of sludge.	▪ Impacts on soil due to dust fallout resulting in an impact on the surrounding soils land capability, by reducing fertility and possibly depositing toxic elements; ▪ Dust fallout also reduces the plant's photosynthetic process by covering the leaf or fruit; and ▪ Seepage of sludge may negatively impact the soil in Largo Site 4.
Pipeline bursts due to operation of pipelines	▪ This may lead to a reduction in soil fertility.
Fauna and Flora	
Spillage of sludge in Blesbokspruit may cause an impact to the flora and fauna dependent on the Ramsar status of the Blesbokspruit.	▪ Potential impacts in the form of spillage of sludge into the surrounding wetlands will negatively influence water chemistry thus effecting available food and habitat for local flora and fauna dependent on the Blesbokspruit wetland; ▪ The aquatic environment and wetlands are in direct contact with the facility and will transport any potential spill downstream through/ into the Ramsar wetland site towards the Marievale bird Sanctuary Protected Area; and ▪ Spillage would directly affect the acidity of the Blesbokspruit and in turn affect the mortality rate of preferred food source for many water fowl.
Aquatic Ecology	
Reduction of the quality of aquatic ecosystems due to spillages (hydrocarbon	▪ The change in water flow volume and speed due to discharge may impact on aquatic habitats; and

Environmental Aspect	Identified Potential Impacts
spills during construction and sludge during operational phases)	▪ The increase in salinity and acidity of the water would impact on the ecological functioning of the system.
Spillage of sludge in the Blesbokspruit.	▪ Potential impacts in the form of spillage of sludge into to the surrounding aquatic environment will further negatively influence water chemistry therefore decreasing the quality of the aquatic ecosystem of the Blesbokspruit.
Wetlands	
Spillage of sludge through operation of pipelines and sludge deposition.	▪ Possible impact to the wetlands will include further contamination from the tailings and sludge material already present on Grootvlei 6/L/16 being spilled into the immediately adjacent Blesbokspruit wetland. This will mainly be due to poor management of the construction of the storage facility that results in breakages and spilling of the tailings and sludge material. This would result in a loss of aquatic habitat and reduce the wetland integrity.
Destabilisation of the facility that will allow breakage and spills to flow into the Blesbokspruit wetland downslope.	▪ The storage facility will be a lasting feature in the area of a Ramsar wetland and thus poses a permanent risk on wetlands.
Surface Water	
Site clearing may reduce quality of surface water resources and movement of machinery.	▪ The clearing of vegetation and movement of machinery exposes soil to erosion. In the event of a storm, silted runoff water can contaminate streams.
Sludge pipeline leaks and bursts.	▪ The sludge pipeline could leak or burst resulting in discharge to the surrounding environment and to river courses in particular areas resulting in the siltation of surrounding surface water resources.
Sludge deposition may deteriorate surface water resources.	▪ The sludge disposal facility could potentially burst or have mud/ sludge slides after rainfall and storm events. In addition to this potential seepage could trickle to the Blesbokspruit resulting in deteriorated water quality.

Environmental Aspect	Identified Potential Impacts
Groundwater	
Storage of sludge.	▪ Due to the increased salt load the original contamination plume footprint might extend and include more (previously unaffected) groundwater users; and ▪ Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.
Transportation of sludge.	▪ There are a number of risks associated with the sludge delivery pipelines, the largest of which is the settlement of sludge in the pipeline as a result of a power failure; and ▪ Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.
Noise	
Vehicular movement activities may increase ambient noise levels during the construction phase.	▪ May have potential impacts on the ambient noise levels on the surrounding receptors.
Site Clearing may increase ambient noise levels during the construction phase.	▪ The site clearing and construction of the Largo Site 4 option may impact on the homestead of Mrs Jacobs on portion 17 of the farm Grootvaly 124 IR adjacent to the north as well as the residential/light industrial districts adjacent to the west because of the close proximity to Largo Site 4.
Increase in noise levels during operational phase.	▪ The operation of Largo Site 4 pipelines as well as associated pump station may impact on some residential receptors located west of Largo Site 4 as well as the farmstead to the north; ▪ The operational noise sources attributed to pipelines are water hammers as well as the operation of the associated pump station. The return water pump station at the Largo Site 4 specifically is expected to be the main noise

Environmental Aspect	Identified Potential Impacts
	source during the operational phase; and ▪ The noise impact of the Grootvlei 6/L/16 slurry and return water pipelines as well as associated pump station is however expected to be negligible.
Air Quality	
Increase in dust fallout due to clearing and stripping of soils	▪ This may result in impacts on surrounding ambient air quality concentration levels.
The construction and operation of the HDS Plant may result in wind erosion of loose particulate matter.	▪ Impacts on surrounding ambient air quality, with an increase of Total Solid Particulate (TSP) matter, PM_{10} and $PM_{2.5}$. These particles can be transported away from the Project area through prevailing winds; ▪ Inhalation risk of heavy metals; ▪ Dust nuisance and soiling of surfaces; and ▪ Impacts associated with gaseous pollutants (considered minimal due the short term duration of the construction phase).
Heritage Artefacts	
Clearing activities for installation of pipes and preparation of sludge disposal facility.	▪ Clearing activities are the largest risk posed to heritage resources, where accidental damage and/ or destruction are known to have occurred; and ▪ The presence of workers in new areas during construction increases the potential for vandalism, most prominently on archaeological resources associated with Iron Age stone walled settlement and burial grounds and graves.
Transportation and deposition of sludge.	▪ Potential envisaged risk is limited to burst pipes and or spillages which could potentially damage heritage resources located in close proximity to the established infrastructure.
Social Environment	
Movement of machinery, site clearing and stockpiling of soil for pipelines.	▪ Temporary employment opportunities from which residents in the study areas could benefit from; ▪ Impacts related to population influx, including

Environmental Aspect	Identified Potential Impacts
	pressure on services, expansion of informal settlements, health impacts, and conflict; ▪ Real and perceived safety risks as a result of the construction site and associated activities; and ▪ Nuisance impacts related to increased noise, dust and traffic.
Operation of pipelines.	▪ Health and safety risks associated with leakages or bursts.
Disposal of sludge on waste disposal facility.	▪ Employment opportunities from which residents in the study areas could benefit from; and ▪ Changes in land and property values.

Specialist Studies Required

Through the identification and categorisation of the potential impacts of the Project during the Scoping Phase, the following specialist studies were deemed necessary for the EIA phase of the Project:

- Visual and Topography Impact Assessment – it was determined during the Scoping Phase, visual receptors may be negatively affected by the proposed Project. Topographical impacts may also arise during the various phases of the project;
- Soil Impact Assessment – the Scoping Phase determined that soils, land use and land capability, particularly on Largo Site 4, may be potentially negatively affected by the proposed Project;
- Fauna and Flora Impact Assessment – Due to the close proximity of the Marievale Bird Sanctuary and the Blesbokspruit wetlands, the various phases of the proposed Project may have a negative impact on fauna and flora;
- Wetlands Impact Assessment – the Scoping Phase confirmed that wetlands are present in the Project area and the proposed Project may result in negative impacts;
- Aquatic Impact Assessment – the Scoping Phase determined that the proposed Project may further impact the aquatic ecosystems, especially during the operational phase of the Project;
- Surface Water Impact Assessment – the results of the Scoping Phase indicated that surface water resources (particularly the Blesbokspruit) may be affected by the proposed Project;
- Groundwater Impact Assessment – groundwater resources may be negatively impacted on, as determined during the Scoping Phase;

- Noise Impact Assessment – the ambient noise levels may increase, particularly around Largo Site 4;
- Air Quality Impact Assessment – dust fallout was determined to be the main impact that may decrease the air quality in the Project area;
- Heritage Impact Assessment – an exemption has been applied for the Project and was submitted to SAHRA and PHRA. The exemption applied for was for approval of heritage assessments not being undertaken on the sludge disposal site options and pipeline routes; and
- Social Impact Assessment – the social aspects of the proposed Project may be negatively affected during the various Phases of the project.

Scoping Report Requirements

The information required to be included in a Scoping Report in terms of GN Regulation 543 of the NEMA is described in the Table 4 below.

Table 4: Scoping Report Content

Content	Reference
a) Details of – (i) the EAP who prepared the report; and (ii) the expertise of the EAP to carry out scoping procedures.	Chapter 2 – Section 2.1
b) Description of the proposed activity	Chapter 4
c) A description of any feasible and reasonable alternatives that have been identified	Chapter 5
d) A description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is – (i) A linear activity, a description of the route of the activity; or (ii) An ocean-based activity, the coordinates where the activity is to be undertaken.	Chapter 4
e) A description of the environment that may be affected by the activity and the manner in which the activity may affect the environment.	Chapter 6
f) An identification of all legislation and guidelines that have been considered in the preparation of the scoping report.	Chapter 1 – Section 1.4
g) A description of environmental issues and potential impacts, including cumulative impacts that have been identified.	Chapter 8
h) Details of the Public Participation Process conducted in terms of regulation 27(a), including –	Chapter 7

Content	Reference
(i) The steps that were taken to notify potentially interested and affected parties of the application (ii) Proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the application have been displayed, placed or given. (iii) A list of all persons or organisations that were identified and registered in terms of Regulation 55 as interested and affected parties in relation to the application (iv) A summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues	
i) A description of the need and desirability of the proposed activity.	Chapter 4 – Section 4.2
j) A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity	Chapter 5
k) Copies of any representations any comments received in connection with the application or the scoping report from interested and affected parties.	Chapter 7 and Appendix B
l) Copies of the minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants.	Chapter 7 and Appendix B
m) Any responses by the EAP to those representations and comments and views.	Appendix B
n) A plan of study for the environmental impact assessment which sets out the proposed approach to the environmental impact assessment of the application, which must include – (i) A description of the tasks that will be undertaken as part of the environmental impact assessment process, including any specialist reports or specialised processes and the manner in which such tasks will be undertaken (ii) An indication of the stages at which the competent authority will be consulted (iii) A description of the proposed method of assessing the environmental issues and alternatives, including the option of not proceeding with the activity; and (iv) Particulars of the public participation process that will be conducted during the environmental impact assessment process.	Chapter 9

Content	Reference
o) Any specific information required by the competent authority.	
p) Any other matters required in terms of Section 24(4)(a) and (b) of the Act.	

Way Forward

The purpose of the EIA phase will be to investigate, assess and mitigate/ enhance the potential negative and positive impacts that the Project may pose on the environment. The potential impacts will then be quantified to assess the significance that the impact may pose on the receiving environment. Cumulative impacts will also be considered and discussed.

The purpose of the specialist investigations proposed will serve to inform the findings of the draft EIA Report. The draft EIA Report will be placed in the public domain for a 40 day public review period, and all comments received will be included into the final EIA Report. The final EIA Report will then be submitted to DEA for decision making as well as for a 21 day public comment period simultaneously. The EIA Report will also contain an EMP indicating how the impacts will be managed, monitored and mitigated.

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LIST OF ACRONYMS

AEMC	Attainable Ecological Management Class
AMD	Acid Mine Drainage
BID	Background Information Document
CBO	Community-based Organisations
CEC	Cation Exchange Capacity
CRR	Comments and Response Report
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DRD	Durban Roodepoort Deep
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
ECL	Environmental Critical Level
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERPM	East Rand Proprietary Mines
GDP	Gross Domestic Product
GN	Government Notice
GNR	Government Notice Regulations
Ha	Hectares
HDPE	High-density Polyethylene
HDS	High Density Sludge
I&APs	Interested and Affected Parties

IBS	Important Bird Area
IMC	Inter-Ministerial Committee
IWULA	Integrated Water Use Licence Application
LTI	Long Term Intervention
mamsl	meter above mean sea levels
mbgl	meters below ground level
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
NFEPA	National Freshwater Ecosystem Priority Area
NGO	Non-Governmental Organisations
NHRA	National Heritage Resource Agency
NID	Notification of Intent to Develop
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PHRA-G	Gauteng Provincial Heritage Resources Authority
PM	Particulate Matter
PPP	Public Participation Process
QDS	Quarter Degree Squares
RHP	River Health Programme
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
SSC	Species of Special Concern
STI	Short Term Intervention
TCTA	Trans Caledon Tunnel Authority

TDS	Total Dissolved Solids
ToR	Terms of Reference
TSF	Tailings Storage Facility

1 Introduction

1.1 Project Overview

The Trans Caledon Tunnel Authority (TCTA) was instructed by the National Government, through the Minister of Water and Environmental Affairs, to manage Acid Mine Drainage (AMD) generated from the Western, Central and Eastern Basins of the Witwatersrand Gold Fields in the Gauteng Province. The engineering and environmental solutions for the Western and Central Basins are underway and now management of AMD associated with the Eastern Basin is required. The proposed management measures of AMD includes a treatment process which will result in the generation of a High Density Sludge (HDS) (characterised as non-hazardous), which will need to be managed and disposed of. The aim of this study is to focus on the proposed sludge site disposal options and associated pipelines for the generation of HDS.

AECOM South Africa (Pty) Ltd (AECOM) has been appointed by TCTA as the Principal Consultant in respect to the implementation of the proposed Short Term Intervention (STI) measures for a sludge disposal facility and pipelines associated with the treatment of AMD in the Eastern Basin of the Witwatersrand Gold Fields, situated in the Gauteng Province, as depicted in Plan 1 (attached as Appendix A). Two (2) proposed sludge disposal site options (Grootvlei 6/L/16 and Largo Site 4) and associated pipelines have been selected for a detailed impact assessment, following from the environmental, social, technical and financial screening assessments of nine (9) potential disposal sites.

Digby Wells Environmental (Digby Wells) has been appointed by AECOM as the Environmental Consultants to undertake the required regulatory Environmental Impact Assessment (EIA) authorisation process for the proposed STI measures for the management of AMD generated from the Eastern Basin.

This Scoping Report follows the submission of the Integrated Application form submitted to the Department of Environmental Affairs (DEA) on 25 April 2014 (reference number *14/12/16/3/3/3/111*). The Scoping Report is intended to define the scope of the full impact assessment process for the STI. The Scoping Report will serve to support the authorisation of listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and the National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEM:WA), as required by the relevant Government Notice Regulation (GNR).

1.2 Project Background

After more than 120 years of deep level gold mining in the Witwatersrand, mining and dewatering has stopped due to the exhaustion of gold resources. The cessation of dewatering has resulted in progressive flooding of the mine voids since 1997. AMD occurs when ore and/ or waste material, containing sulphides, (e.g. pyrite) are exposed to water and oxygen thereby increasing the acidity of the water. In the case of gold mining on the

Witwatersrand, numerous large old mining areas have become connected thus allowing water to migrate from one mine to another.

The Witwatersrand gold mining area is divided into three basins; the Western Basin, Central Basin and Eastern Basin[1] (refer to Figure 1-1). In the Western Basin, the voids filled with water and the reaction between the rock surface and the water resulted in heavy metals dissolving and becoming suspended in the water reducing the pH and making the water acidic. Decant started from an old shaft on the Rand Uranium property in the Randfontein area of the West Rand in September 2002. The Central Basin was expected to decant in 2014, but engineering and environmental solutions for the Central Basin are underway and it is anticipated that treatment of AMD in the Central Basin will commence in April/ May 2014. It is now required to commence with treatment of AMD emanating from the Eastern Basin. The Eastern Basin is expected to decant in 2015.

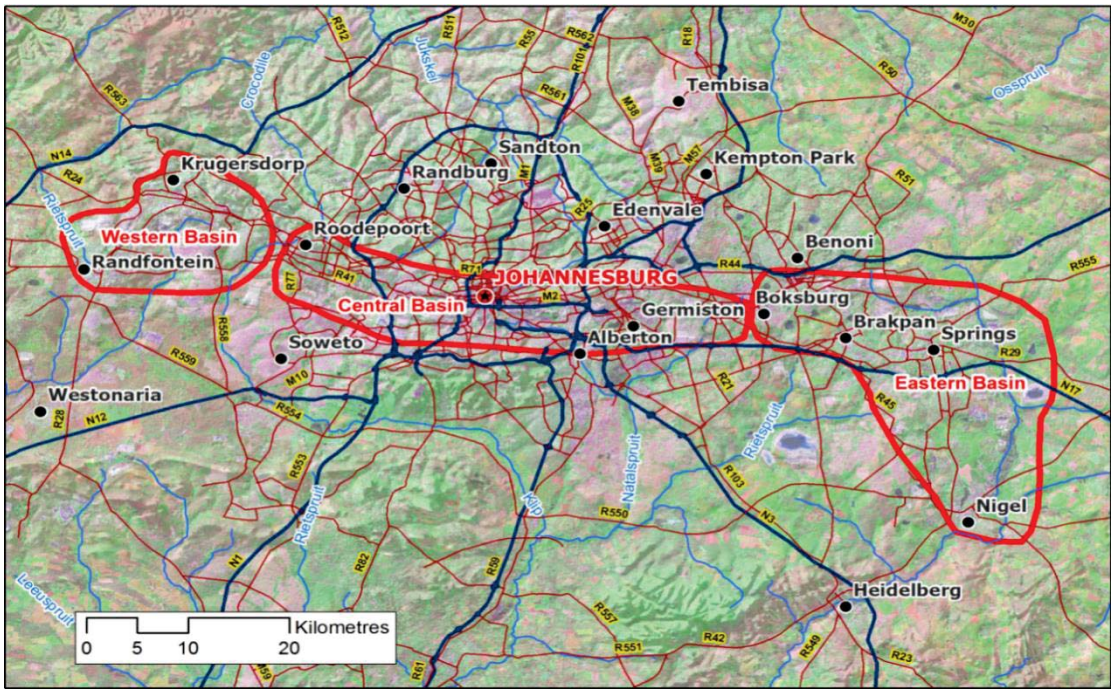


Figure 1-1: Locations of the Western, Eastern and Central basins in the Witwatersrand

TCTA was instructed by the National Government, through the Minister of Water and Environmental Affairs to implement STI measures to treat AMD in the Western, Central and Eastern Basins.

To prevent impacts to infrastructure and aquifers, an Environmental Critical Level (ECL) has been defined for each of the three basins. ECL is defined as the maximum height to which

[1] It should be noted that there is a Far Western Basin which forms part of the Witwatersrand gold mining area, however, this basin currently falls outside of the focus of this study.

the underground water level will be allowed to rise, before it results in significant impacts to the environment. The ECL is governed by the geology and the mining voids in the basins. Due to the presence of dolomite formation in the Western and Eastern Basins, the ECLs in these basins have been selected in order to protect the formations which contain significant aquifers. In the Central Basin there are no sensitive aquifers, however, by maintaining the water level below the chosen ECL, groundwater users would be protected against contamination of their water.

The ECLs for each of the basins, which are represented as meter above mean sea level (mamsl), are as follows and the ECL is depicted in Figure 1-2 below:

- Western Basin: 1,550 mamsl;
- Central Basin 1,467 mamsl; and
- Eastern Basin: 1,280 mamsl.

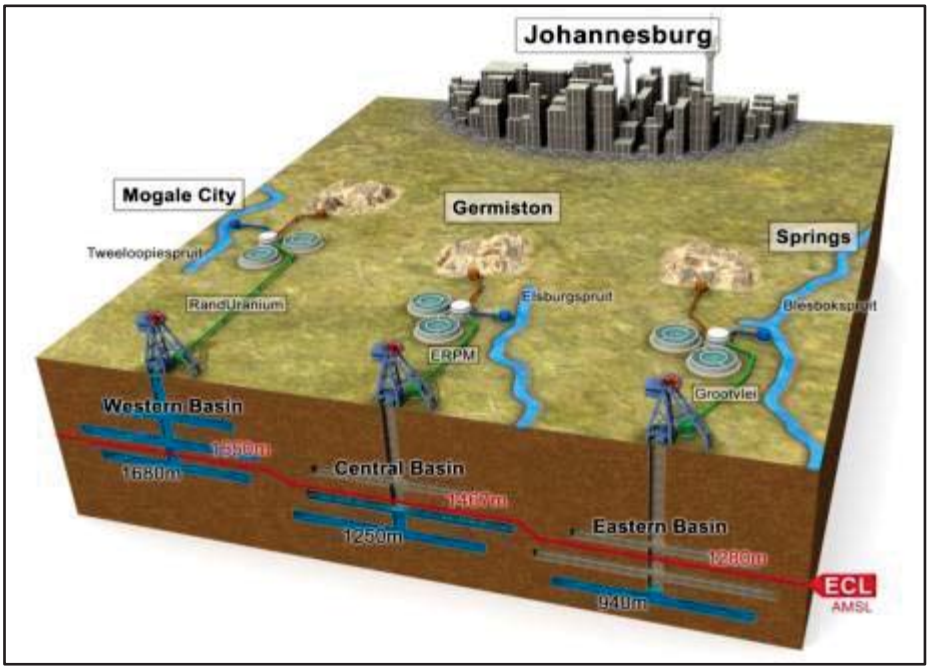


Figure 1-2: Estimated ECL for the Three Basins in Witwatersrand Gold Fields

The Eastern Basin is the focus of this Project and covers the East Rand area, which includes the towns of Boksburg, Brakpan, Springs and Nigel. The mine lease areas in the Eastern Basin extend over 768 km^2. Similar STI measures for AMD treatment in the Eastern Basin, as per the Central and Western Basins are envisaged, that is, the construction of a HDS treatment plant where acid water is treated with lime and neutralised water discharged, with the residual sludge pumped to a storage facility.

In January 2013, DEA granted an exemption for the abstraction of AMD from the Grootvlei Mine Shaft No. 3, the construction and operation of the HDS Plant and neutralised water

pipeline for discharge into the Blesbokspruit. However, the exemption did not include the construction of a new sludge disposal site and associated pipeline for the management of AMD in the Eastern Basin. As a result, a full environmental authorisation process will need to be followed for the construction of the sludge disposal facility and associated pipelines in the Eastern Basin, which aligns with the requirements of the NEMA and NEM:WA regulatory process.

1.3 Terms of Reference and Objectives

Due to the urgency and potential impacts associated with the breaching of the ECL in the Eastern Basin, the purpose of the integrated application is to conduct an environmental authorisation process for the construction of a proposed sludge disposal site and associated pipeline. This will enable the AMD to be treated at an HDS Plant, prior to entering the Blesbokspruit and thus reduce impacts to downstream users.

An Integrated Application Form was compiled and submitted to DEA on 25 April 2014. During the EIA process, the potential impacts that result from the construction, operation and decommissioning of the proposed sludge disposal sites and pipeline routes will be assessed. The regulatory EIA process will be conducted in accordance with NEMA and NEM:WA.

The objectives of the Scoping Process for the proposed sludge disposal facility and associated pipelines are to:

- Give details of the Environmental Assessment Practitioner (EAP) who compiled the report;
- Identify the legal framework applicable to the Project;
- Explain the need and desirability of the Project;
- Present a summary of the Public Participation Process (PPP) undertaken to date, including comments received from Interested and Affected Parties (I&APs);
- Present the Project description and associated activity alternatives;
- Describe the site specific baseline environment in terms of environmental and social aspects that may be impacted on by the proposed project activities;
- Identify potential impacts associated with the Project; and
- Present a Plan of Study for the impact assessment phase, which includes, *inter alia*, impact methodology, specialist studies to be undertaken as well as the associated Terms of Reference (ToR).

1.4 Regulatory Requirements

An Environmental Authorisation is required before an applicant can undertake any activity listed in terms of NEMA and NEM:WA. This section deals with the regulatory requirements applicable to the project. It should be noted that as the listed activities are applicable to both

NEMA and NEM:WA, an integrated application was submitted to DEA in terms of the requirements of Section 24 L of NEMA and Section 44 of NEM:WA.

1.4.1 National Environmental Management Act, 1998 (Act No. 107 of 1998)

NEMA provides for co-operative environmental governance by establishing principles for decision making on matters affecting the environment, institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state.

NEMA also provides for matters related to sustainable development, which means the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations. To achieve the above objectives, the NEMA makes provision for the use of an EIA process as a tool for environmentally sound decision-making. The EIA process is regulated in terms of the Regulations published in GNR 543 issued on 18 June 2010 (EIA Regulations), in accordance with the provisions of Sections 24 (2) and of 24D of NEMA, as amended.

As the project activities associated with the project require the construction and operation of new infrastructure (i.e. two pipelines and associated sludge disposal site), a Scoping and EIA Process is required to comply with NEMA for the authorisation of listed activities contained in GNR 544 of 18 June 2010 (Listing Notice 1), GNR 545 of 18 June 2010 (Listing Notice 2) published in terms of Sections 24(2) and 24D of NEMA.

A summary of the listed activities for which the Project requires an Environmental Authorisation are presented in Table 1-1 below.

Table 1-1: NEMA Listed Activities

GN and Listing Notice	Activity No (s)	Description
GN R544 – Listing Notice 1:	9: The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water – iii. With an internal diameter of 0.36 metres or more; or iv. With a peak throughput of 120 litres per second or more, Excluding where: c) Such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage	Pipelines will be constructed for the transportation of sludge from the AMD HDS plant for disposal at the proposed sludge disposal site and a return water pipeline will be constructed.

GN and Listing Notice	Activity No (s)	Description
	inside a road reserve; or d) Where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	
	11: The construction of: xii. Canals; xiii. Channels; xiv. Bridges; xv. Dams xvi. Weirs xvii. Bulk storm water outlet structures; xviii. Marinas; xix. Jetties exceeding 50 square metres in size; xx. Slipways exceeding 50 square metres in size; xxi. buildings exceeding 50 square meters in size; or xxii. Infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	The proposed pipeline route will cross perennial and/ or seasonal watercourses on route to the proposed sludge disposal site.
GN R545 - Listing Notice 2	5: The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.	The disposal of sludge will require a license in terms of the NEM:WA

1.4.2 National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)

A Waste Licence is required to establish and operate a waste disposal site, in this case, a sludge disposal site. On 29 November 2013 the Minister of Water and Environmental Affairs repealed the list of waste management activities that have, or are likely to have, a detrimental effect on the environment published under Government Notice 718 in Government Gazette 32368 of 3 July 2009 (GNR 718) and replaced it with a new list of waste management activities under Government Notice 921 in Government Gazette 37083 of 29 November 2013. The applicable listed activities of the proposed project in terms of the EIA Regulations are detailed in Table 1-2 below.

All waste management activities are separated into three categories, as published under GNR 921, 29 November 2013. The three categories are detailed below:

- Category A: Waste management activities requiring a Basic Assessment process to be carried out in accordance with the NEMA EIA Regulations supporting an application for a waste management licence;
- Category B: Waste management activities requiring an EIA process to be conducted in accordance with NEMA EIA Regulations supporting a waste management licence; and
- Category C: Waste management activities requiring compliance with the prescribed requirements and standards as prescribed by the Minister.

A summary of the listed activities for which the project requires a Waste Licence are presented in Table 1-2 below.

Table 1-2: NEM:WA Listed Activities

GN and Listing Notice	Activity No (s)	Description
GN R921 - Category B	Activity No.8: The disposal of general waste to land covering an area in excess of 200 m^2 and with a total capacity exceeding 25 000 tons.	The disposal of general waste of approximately 208.5 tons per day into the proposed sludge disposal site, which is greater than 200 m^2.

1.4.3 National Water Act, 1998 Act No. 36 of 1998

In accordance with the NWA, a licence is required for the abstraction, storage, use, diversion, flow reduction and disposal of water and effluent.

In accordance with Section 21 and 40 of the NWA, an Integrated Water Use Licence Application (IWULA) will be required for the identified water uses for the proposed project

activities. Investigations have to be undertaken in order to determine what activities will take place, as well as the impacts thereof. It is likely a Water Use Licence will be required for the following uses:

- Section 21 (a) – Taking water from a resource such as the AMD water that will be pumped from the Grootvlei Mine Shaft No. 3;
- Section 21 (c) – Impeding or diverting the flow of water in a water course for crossing of streams via causeways as the slurry and return water pipelines are proposed to cross water resources;
- Section 21 (g) – Disposing waste or water containing waste in a manner which may detrimentally impact on a water resource due to the disposal of sludge on the proposed site; and
- Section 21 (i) – Altering the bed, banks, course or characteristics of a watercourse as the slurry and water pipelines are proposed to cross water resources.

It should be noted that an IWULA does not form part of this scope of work and is assumed to be compiled and submitted outside of this EIA process.

1.4.4 National Heritage Resources Act, 1999 (Act No. 25 of 1999)

The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) devolves responsibility for the identification of local heritage resources and the inclusion of heritage areas to all municipalities in South Africa. Developers need to incorporate the NHRA and gain approval from the relevant heritage authorities or municipalities before construction may commence.

A Notification of Intent to Develop (NID) was completed for the Project in terms of Section 38 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) for submission to the South African Heritage Resources Agency (SAHRA) and Gauteng Provincial Heritage Resources Authority (PHRA-G). The NID included appropriate information regarding the nature of the development and the existence of potential heritage resources that may occur within the project location.

1.4.5 Additional Requirements

The project must also comply with other applicable South African statutory requirements and guideline documents to enhance good practice relevant to the project. Table 1-3 includes a list of legislation and guidelines that will be considered during the EIA process.

Table 1-3: Additional legislation and guidelines applicable to the proposed Project

National Legislation and Associated Regulations:
Water and Waste
▪ Water Services Act, 1998 (Act No. 108 of 1996); ▪ DWAF: Best Practice Guideline G1: Storm Water Management; ▪ DWAF: Best Practice Guideline G2: Water and Salt Balances; August 2006; ▪ DWAF: Best Practice Guideline GH: Water Reuse and Reclamation, June 2006; ▪ DWAF: Minimum Requirements Guideline for the Handling, Classification and Disposal of Hazardous Waste, 1998; ▪ DWAF: Minimum Requirements Guideline for the Water Monitoring at Waste Management Facilities; ▪ SA Water Quality Guidelines – Aquatic Ecosystems, 1996, ▪ SA Water Quality Guidelines – Domestic Water Use, 1996; ▪ South African National Standards (SANS) 10228 (2010); and ▪ South African National Standards 10234 (2008).
Biodiversity
▪ National Environment Management: Biodiversity Act, 2004 (Act No. 10 of 2004); ▪ National Forest Act, 1998 (Act No. 84 of 1998); and ▪ Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).
Atmospheric Emissions
▪ National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004) including Government Notice 220 of 26 March 2010; ▪ National Ambient Air Quality Standards; ▪ SANS 1929:2005 Edition 1.1 – Ambient Air Quality Limits for Common Pollutants; ▪ SANS 1929:2005: Ambient Air Quality – Limits for common pollutants; ▪ SANS 1929:2011: Ambient Air Quality – Limits for common pollutants and ▪ SANS D113:2012: Standard Test Method for Collection and Measurement of Dust fall (Settleable Particulate Matter).
Noise
▪ National Environmental Management: Air Quality Act, 2004 (Act No 39 of 2004); and ▪ SANS 10103:2008 The Measurement and Rating of Environmental Noise with Respect to Land Use, Health, Annoyance and to Speech Communication.

1.5 Decision Making Authority

The National DEA is the competent authority for this integrated application process. The DEA will be responsible for the review and decision making for the Scoping and EIA phases.

2 Environmental Assessment Practitioner

AECOM appointed Digby Wells as the independent environmental consultants to investigate the environmental and social aspects of the proposed project.

Digby Wells is an internationally recognised environmental consultancy and has vast experience and knowledge of environmental management and assessment processes. Digby Wells also has the experience and knowledge with the requirements of the proposed project for environmental authorisations in terms of NEMA and NEM:WA. The contact details of Digby Wells are presented in Table 2-1 below.

Table 2-1: Digby Wells Contact Details

Company name:	Digby Wells Environmental		
Contact person:	Mr Mellerson Pillay		
Physical address:	359 Pretoria Avenue, Fern Isle, Randburg, 2125	**Postal address:**	Private Bag X10046 Randburg, 2125, South Africa
Telephone:	+27 11 789 9495		

2.1 Project Team

A team of environmental and social specialists were commissioned to conduct the relevant tasks associated with the Scoping Phase. The Project team is presented in Table 2-2 below.

Table 2-2: Project Team

Role	Name
Project Sponsor	Grant Beringer
Project Manager	Mellerson Pillay
Project Administrator	Degrecia Zwane
Public Participation	Steve Horak and Vanessa Viljoen
Topography and Visual Assessment	Stephanie Muller
Soil Assessment	Wayne Jackson
Fauna and Flora Assessment	Leigh – Ann de Wet
Aquatic Ecology Assessment	Russell Tate

Role	Name
Wetlands Assessment	Caroline Wallington
Surface Water Assessment	Chenai Madamombe
Groundwater Assessment	Lucas Smith
Noise Assessment	Lukas Sadler
Air Quality Assessment	Matthew Ojelede
Heritage Assessment	Justin du Piesanie
Social Assessment	Karien Lotter

3 Project Applicant

The Project applicant for this process is the Department of Water Affairs (DWA). The details of the applicant are presented in Table 3-1 below.

Table 3-1: Project Applicant

Project Applicant:	Department of Water Affairs		
Contact person:	Mr Bashan Govender		
Physical address:	Gauteng Regional Office, Level 15, Bothongo Plaza East Building, 285 Francis Baard Street (formerly Schoeman Street), Pretoria	**Postal address:**	Private bag X995, Pretoria
Telephone:	+27 12 392 1415		

4 Project Description

This section outlines the project background and presents a detailed description of the Project activities pertaining to the construction, operation and decommissioning of the sludge disposal facility and associated pipelines.

4.1 Proposed Overview

The water level (recorded in January 2014) at Grootvlei No. 3 Shaft located in the Eastern Basin were measured at 1,277 mamsl (which is approximately 3 m below surface). In response to the potential decant from the Eastern Basin, STI measures have been proposed which includes the abstraction and pumping of AMD from Grootvlei Shaft 3 (i.e. point of abstraction of AMD emanating from the Eastern Basin), the construction of a HDS Treatment Plant and discharge of neutralised water into the Blesbokspruit. These activities are currently subject to an exemption issued by the National DEA.

The treatment of AMD will result in the generation of a non-hazardous HDS, which will need to be disposed of. Further details of the characterisation of the HDS are presented in Section 4.4 below. Consequently, the scope of this Project is limited to the construction of a sludge disposal facility and associated pipelines (which currently fall outside of the existing exemption). The process flow diagram for the abstraction and treatment of AMD and disposal of sludge is outlined in

Figure 4-1 below. The process flow diagram (

Figure 4-1) shows the following relative to the Project:

- Pumping of AMD from Grootvlei Shaft 3 to a new HDS treatment plant (subject to existing exemption issued by DEA);
- Construction of a discharge point for neutralised water (subject to existing exemption issued by DEA);
- Transportation of an average of 1.4 Mega litres/ per day (Ml/d) of sludge produced during the treatment of AMD emanating from Grootvlei Mine Shaft No. 3 via a pipeline;
- Disposal of 600 m^3/d of sludge into the proposed sludge disposal site. 30 hectares (ha) of land is required for disposal of sludge, which is expected to have a total volume of 1.75 million m^3 and reach a maximum height of 14m; and
- Transportation of return water (approximately 800 m^3/ d) from the proposed disposal back to the HDS Plant located at the Grootvlei Mine Shaft No. 3, via a pipeline.

It should be noted that in light of the exemption issued by DEA, the abstraction of the AMD at Grootvlei Shaft No. 3, the HDS treatment plant and the discharge of the neutralised water do not form part of this Project. The focus of this EIA process is limited to the sludge disposal facility and associated pipelines.

Two proposed sludge disposal site options (Grootvlei 6/L/16 and Largo Site 4) have been identified as well as their associated pipeline routes which will serve to transport the sludge to the respective site. The pipelines are proposed to be buried, and will comprise of a sludge pipeline and return water pipeline with a maximum internal diameter of 300 mm each. Plan 3 depicts the proposed disposal sites and associated pipelines (refer to Appendix A)..

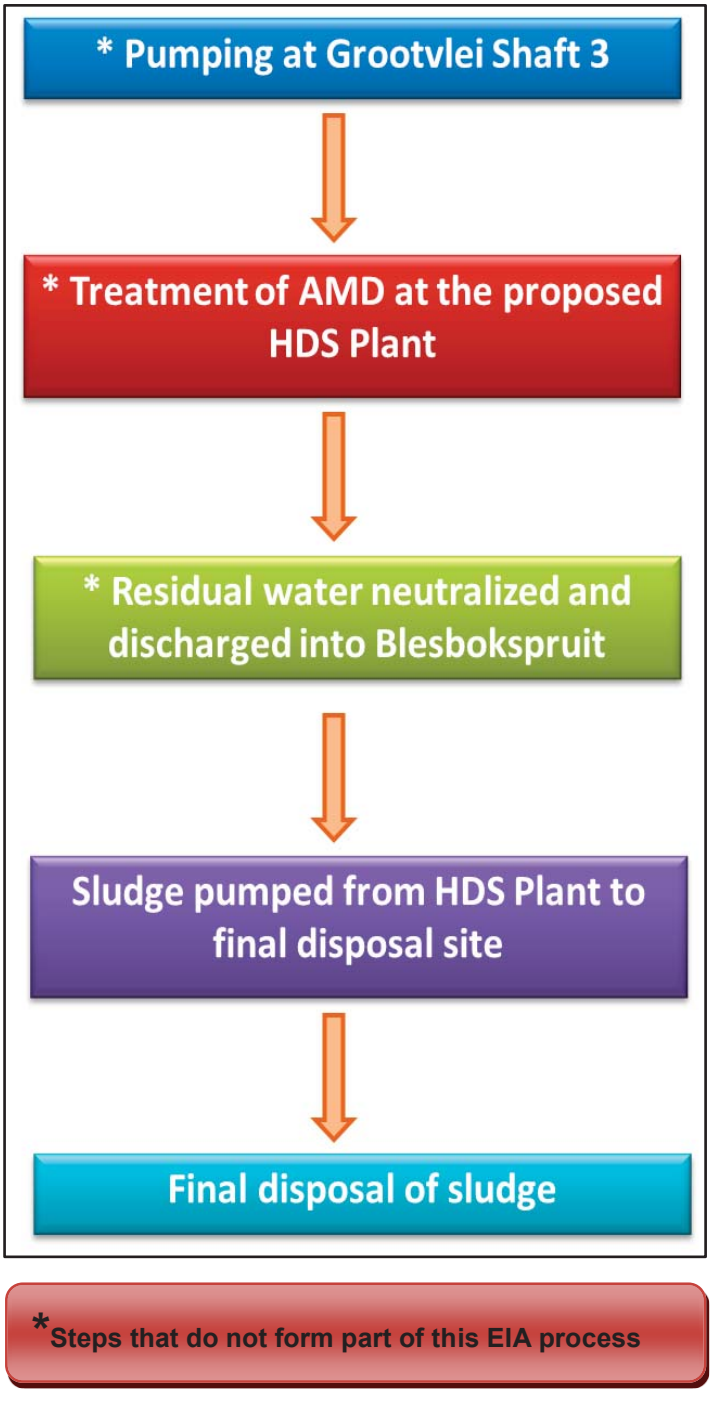


Figure 4-1: Process flow diagram for the treatment and transportation of HDS for disposal

4.2 Location and Site Description

The Project area falls within the Eastern Basin of the Witwatersrand Gold mining area. The Eastern Basin covers the East Rand area and includes the towns of Boksburg, Brakpan, Springs and Nigel. The local municipalities that the Project area falls within is the Ekurhuleni Metropolitan Local Municipality and the Lesedi Local Municipality which fall under the jurisdiction of the Ekurhuleni Metropolitan Municipality in the Gauteng Province (refer to Plan 1 and Plan 2 depicting the regional setting and the local setting of the Project area, attached as Appendix A).

The land tenure for the proposed two sludge disposal site options and associated pipelines is presented in Table 4-1 below and depicted on Plan 4 (Appendix A).

Table 4-1: Land Tenure for the Sludge Disposal Sites and Pipelines

Site	Farm Name	Portion Number	Owner/ Title Position
Sludge Disposal Site Option: Largo Site 4	Grootvaly 124-IR	2	City Council Of Springs
	Palmietkuilen 241-IR	9	Paterson Management Pty Ltd
	Grootvaly 124-IR	29	Ryno Van Blerk
	Palmietkuilen 241-IR	9	Paterson Management Pty Ltd
	Grootvaly 124-IR	31	Largo Prop Pty Ltd
Pipeline route to Largo Site 4 Disposal Site Option	Grootvaly AH	100	Grootvlei Prop Mines Ltd
	Grootvaly AH	101	Grootvlei Prop Mines Ltd
	Grootvaly AH	95	Gauteng Provincial Government
	Grootvaly AH	96	Gauteng Provincial Government
	Grootvaly AH	97	Gauteng Provincial Government
	Grootvaly AH	98	Gauteng Provincial Government
	Grootvaly AH	99	Grootvlei Prop Mines Ltd
	Grootvaly 124-IR	17	Jacobs & Seuns Landgoed Cc

Site	Farm Name	Portion Number	Owner/ Title Position
	Grootvaly 124-IR	2	Ekurhuleni Metropolitan Municipality (City Council of Springs)
Sludge Disposal Site Option: Grootvlei 6/L/16	Grootvaly 124-IR	R/	Grootvlei Prop Mines Ltd
Pipeline route to Grootvlei 6/L/16 Disposal Site Option	Grootvaly AH	102	Grootvlei Prop Mines Ltd
	Grootvaly AH	103	Gauteng Provincial Government
	Grootvaly AH	105	Mayborn INV 75 Pty Ltd
	Grootvaly 124-IR	R/	Grootvlei Prop Mines Ltd

4.2.1 Proposed Sludge Disposal Options

The location and description of the proposed sludge disposal sites are described in the sections below.

4.2.1.1 Grootvlei 6/L/16

The Grootvlei 6/L/16 site option is an existing tailings facility. A pipeline length of approximately 1 km will be constructed from the HDS treatment plant to the Grootvlei 6/L/16 sludge disposal site. From the HDS treatment plant (which will be located at the Grootvlei Mine Shaft No. 3) the proposed pipeline will run in a westerly direction, along the existing road servitude and then in a northerly direction until it reaches the Grootvlei 6/L/16 site. The return pipeline will run in the same pipeline corridor. The sludge disposal capacity will be optimised as far as practicable on the available site footprint (refer to Plan 3, Appendix A).

Figure 4-2 depicts the proposed pipeline route extending from Grootvlei Shaft No. 3 to the proposed sludge disposal site Grootvlei 6/L/16. Figure 4-3 depicts the Grootvlei 6/L/16 proposed sludge disposal option.

Figure 4-2: Photo 1 taken from an easterly direction. A view of the proposed pipeline route extending from Grootvlei Shaft 3 to existing Grootvlei 6/L/16 site

Figure 4-3: Photo 2 taken from a southerly direction. A view of the Grootvlei 6/L/16 proposed sludge disposal site option

4.2.1.2 Largo Site 4

The proposed sludge disposal site option Largo 4 is located on an area zoned as agricultural land and is located between the Blesbokspruit and Aston Lake. A pipeline length of approximately 2 km will be required to be constructed from the HDS treatment plant (located at Grootvlei Shaft No. 3) to this proposed sludge disposal site. From the Grootvlei Mine Shaft No. 3, the pipeline will run parallel along van Niekerk Road in an easterly direction, crossing the Blesbokspruit on an existing bridge structure until it reaches Largo Site 4. The return pipe will run in the same pipeline corridor. Figure 4-4 and Figure 4-5 depicts the proposed pipeline route.

Figure 4-4: Photo 3 taken from a westerly direction. A view of the proposed pipeline route extending from Grootvlei Shaft No. 3 across the Blesbokspruit wetland

Figure 4-5: Photo 4 taken from a westerly direction. A view of the proposed sludge disposal site option (Largo Site 4)

4.3 Preliminary Project Layout and Design

The preliminary site layout and design for the proposed Project includes the construction of a sludge disposal facility and the construction of two pipelines. The pipelines will serve to transport sludge to the disposal facility and the transportation of return water from the disposal facility, respectively.

The preliminary Project layout and design is detailed below.

4.3.1 Sludge Disposal Site and associated pipeline

A waste management facility with a total extent of 30 ha will be required to dispose of the 1.75 million m^3 of sludge and will reach a maximum height of 14 m. The sludge disposal site will act as a waste management facility and is expected to have a lifespan of approximately 40 years.

4.3.1.1 Sludge Disposal Site Design

A wall will be constructed around the facility comprising waste rocks. According to Aurecon (2013), *waste rock is considered for the wall building material for the sludge disposal site as large quantities of the waste appears to be readily available at the proposed HDS Plant area.*

The selected sludge disposal facility will be lined with a 1.5 mm HDPE liner. Storm water channels will be constructed around the facility.

4.3.1.2 Pipelines

Two HDPE pipelines (sludge and return water pipelines) will be constructed adjacent to and parallel with each other, extending from the proposed HDS Plant to the sludge disposal facility, within the same pipeline corridor. One pipeline will be used for the pumping of sludge from the HDS Plant to the proposed sludge disposal site, whereas the other pipeline will be used as a return water pipeline. The return water pipeline will send excess water from the proposed sludge disposal site back to the HDS plant for re-treatment. The pipelines will have a maximum internal diameter of 300 mm and where possible, the proposed pipelines will be constructed in existing pipeline servitudes. Alternatively, a new permanent servitude of approximately 10 m wide will be negotiated and established.

4.3.2 High Density Sludge Plant

The residue product produced by the HDS Plant is sludge, will be disposed of at a sludge disposal facility. It should be noted the HDS Treatment Plant does not form part of this Project. However, it is important to understand the HDS process that produces the sludge.

The HDS process is seen as an active process and more suited to the treatment of AMD than passive treatment. The HDS process generally involves the following:

- Addition of an alkali, typically lime in the slaked lime or un-slaked lime form;
- Aeration to oxidise the iron and manganese;
- Neutralisation of the free and metal-related acidity;
- Precipitation of the metals in the hydroxide or carbonate form;
- Solids separation and production of clear neutralised water; and
- Handling and disposal of waste sludge, which mainly contains metals hydroxides and gypsum.

The HDS process is recognised as the preferred method of treating mine water containing high metal concentrations. This process has been well known for a number of years and has been applied at a number of mines worldwide and in other industries with similar waste waters such as the steel producing and pickling plants.

4.3.2.1 Classification of Sludge

The classification of the sludge was conducted by Golder Associates in February 2014. The results indicated that the sludge is classified as Type 3 waste due to elevated concentrations of Arsenic (As), Cadmium (Cd), Manganese (Mn), Nickel (Ni) and Antimony (Sb). Type 3 waste is classified as general waste according to NEM:WA.

Type 3 waste can be disposed on a Class C or G:L:B^{+} designed disposal facility. According to NEM:WA, Class C facilities must be designed as in Figure 4-6 below.

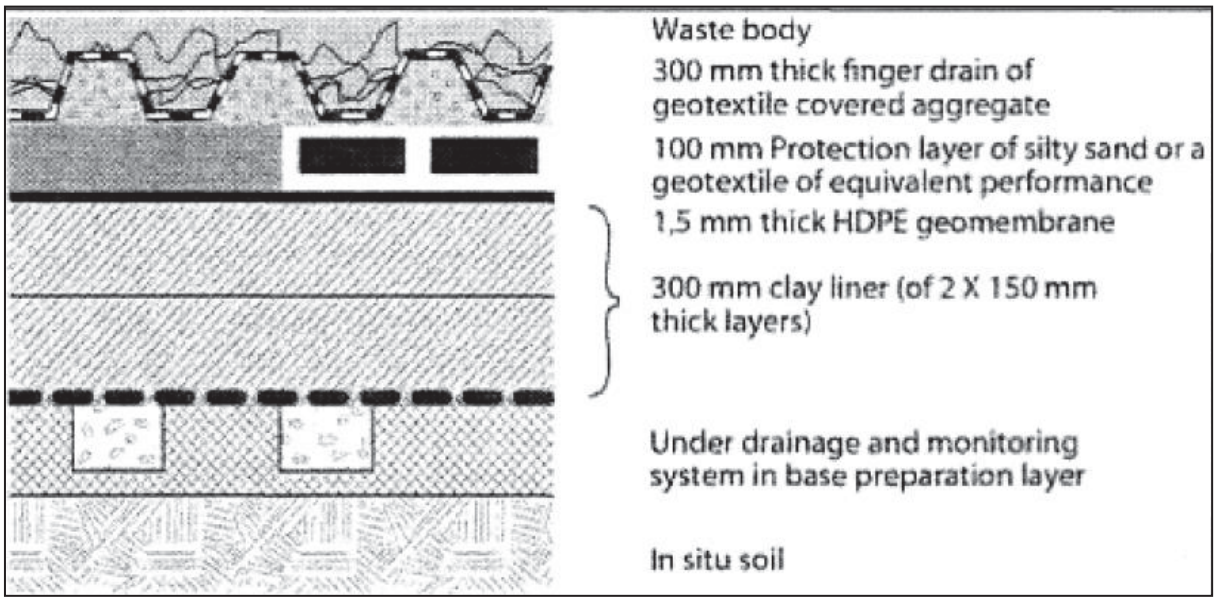


Figure 4-6: Class C Waste Disposal Facility Design according to NEM:WA

4.3.2.2 HDS Plant Infrastructure

The infrastructure that will form part of the HDS Plant is listed below, and forms part of the current exemption is presented below. Note, the HDS Plant itself does not form part of this EIA process, as it is subject to the previous exemption issued by the DEA:

- Deep level pump station taking AMD from Grootvlei Shaft 3;
- Lime and limestone silos and make up tanks;
- Three trains of Reactors carrying out the following process, preneutralisation, neutralisation and gypsum crystallisation;
- A poly mixing tank;
- Three large diameter clarifiers;
- Treated water sump;
- Sludge recycle pump station;
- Treated water pipeline and outfall; and
- Potable water pipeline.

4.3.3 Electricity Supply

Eskom power lines are already established close to the Project area. Therefore, the power will be obtained directly from Eskom. The electrical power will supply a voltage of

6.6 kilovolts (kV) to the pumps to abstract AMD, but will be stepped down to 400 V to supply electricity to the HDS Plant.

The following electrical infrastructure will be required at the HDS plant:

- A mini-substation, rated for current use and pumps;
- A Low Voltage (LV) Room, including auxiliary items, control desk and remote control via General Packet Radio Service (GPRS) or fibre optic back to the control building; and
- Electrical controls and protection.

4.3.4 Site Access

The site is accessible via the R29 Ermelo Road and Grootvaly Road through the suburb of Casseldale.

4.4 Project Activities

The typical activities that will take place during the construction and operation of the pipelines and the disposal sites are listed below:

- Delivery of pipes along the pipeline route and movement of machinery around site during the installation of pipes (including excavation);
- The removal of soil and vegetation;
- The stockpiling of soil;
- Digging of trenches and tunnelling/ pipejacking;
- Backfilling of trenches;
- Re-vegetation of disturbed areas;
- Construction of a new sludge disposal facility at the selected site;
- Lining of the waste disposal site facility;
- Daily disposal of sludge into proposed disposal facility;
- Operation of the return water and sludge pipelines;
- Monitoring of the pipeline route and disposal site facility and immediate surrounds;
- Adhoc maintenance and repairs along the pipeline route and sludge disposal facility;
- Decommissioning of the pipelines, which will be left *in-situ*;
- Decommissioning of the sludge disposal facility, once the disposal site reaches the expected lifespan; and
- Ongoing environmental monitoring based on specialist recommendations during the impact assessment phase.

These activities will be considered in relation to the potential impacts that could be experienced during the construction, operation and decommissioning phases.

5 Consideration of Project Alternatives

An environmental and social screening analysis was conducted by Digby Wells in January 2014. A technical and financial screening analysis was conducted by Golder Associates in February 2014. A total of nine (9) disposal sites (refer to Plan 5, Appendix A) were considered as part of the screening analysis, as listed below:

- Largo Site 1;
- Largo Site 2;
- Largo Site 3;
- Largo Site 4;
- Daggafontein Tailings Storage Facility (TSF) (existing TSF);
- Grootvlei 6/L/13 (existing TSF);
- Grootvlei 6/L/14 (existing TSF);
- Grootvlei 6/L/17A (existing TSF); and
- Grootvlei 6/L/16 (existing TSF).

5.1 Outcomes of Environmental, Technical and Financial Screening Analysis

The objective of the screening assessment was to assess the sites for the proposed sludge disposal facility options and to determine which site(s) are the most suitable based on bio-physical, socio-economic sensitivities as well as the technical and financial aspects.

To determine the most suitable sites from an environmental and social perspective, a model was developed in order to investigate and quantify the environmental and social aspects on each site. Each of the sites was relatively ranked which assisted in determining which sites are the most preferred sites for the Project.

Two scenarios were used to present the most suitable and the least suitable sites in, namely the equal weighting scenario and the specialist weighting scenario. Each specialist identified one or more criteria that reflect the suitability of a site when viewed from the perspective of their specialist discipline. The criteria were then assigned equal weighting, or equal importance of a value of 1. Each site was then ranked according to suitability per criteria. The objective of assigning equal weighting was to determine the most suitable sites selected per specialist discipline, assuming an equal importance of each criteria across all disciplines.

In terms of the equal weighting scenario, three (3) sites have been determined as the most suitable sites. These sites include: the Daggafontein Site (which falls under the Daggafontein Cluster), Largo Site 2 (which falls under the Largo Cluster) and Grootvlei Site 6/L/17A (which falls under the Grootvlei Cluster). Therefore, no fatal flaws have been identified on any of these sites.

In terms of the specialist weighting scenario, the results depicted below are rated according to each specialist discipline, in which individual specialist disciplines were weighted. Upon completing the equal weighting scenario, each specialist discipline was weighted (based on the disciplines importance to the nature of the project) to reflect the suitability of a site when prioritising certain disciplines. The disciplines were assigned a weighting. The objective of the specialist weighting scenario was to determine which site is deemed the most suitable sites, based on higher weighting of key specialist disciplines. The results indicated that Daggafontein remains as the most suitable site and Grootvlei Site 6/L/17A has been identified as the second most suitable site.

The results from the technical and financial outcomes found Largo Site 4 and Grootvlei Site 6/L/16 as the most suitable sites from a technical and financial perspective. Largo Site 4 was ranked as the highest rated site for the proposed sludge disposal facility, with Daggafontein TSF Site as next best rated and Grootvlei Site 6/L/16 as the third best rated site.

5.1.1 The methodology used for the environmental, social, technical and financial screening assessment is described below. Equal Weighing Scenario

Based on the findings of specialist studies, all nine sites were ranked to determine the most suitable sites, adopting an equal weighting scenario for each discipline. Based on the equal weighting scenario results, the Daggafontein TSF was found to be the most suitable site. Largo Site 2 has been ranked as the second most suitable site, with Grootvlei Site 6/L/16 and 6/L/17A being determined as the third and fourth most suitable sites respectively. The difference between these two sites is negligible (refer to Figure 5-1). Table 5-1 summarises the findings of the equal weight scenario for the nine selected sites.

No fatal flaws have been identified on these two sites (Daggafontein and Largo Site 2), and strong preference has been expressed by a variety of the specialists (*inter alia,* air quality, social, visual, heritage, groundwater). Due to limited receptors, the air quality and social specialists have favoured the Daggafontein Site. Based on the disturbed nature of the Daggafontein Site, it is unlikely that heritage resources of importance will be identified on-site. From an aquatic, fauna and flora, air quality and social perspective, Largo Site 2 was identified as the second most preferred site.

However, as indicated above, the Daggafontein TSF was precluded from this EIA process, as future plans for the site would not support the disposal of sludge into the facility.

The findings of the screening analysis conducted for the two selected sites identified for detailed impact assessment in this EIA process are discussed below.

5.1.1.1 Grootvlei 6/L/16

The Grootvlei Site 6/L/16 was ranked as the third most suitable site. This site is an existing slimes dam, therefore, the disturbance of the footprint would be smaller when compared to establishing a new footprint for the proposed sludge disposal. Due to the topography of the

sites, the potential impacts on the topography will be low. Grootvlei Site 6/L/16 is located in close proximity to a Ramsar wetland. However, this site is not located in a National Freshwater Ecosystem Priority Area (NFEPA).

The site is predominantly underlain by sandstone and shale and located in-between two mapped northwest-southeast trending geological structures. The site is located on a water divide (C21D and C21E catchments) and is one of the northern most or upstream sites and adjacent to the Blesbokspruit and the Strubenvale settlement. This site is located further upstream and therefore would result in a larger impact to downstream users.

Due to intense winds blowing mainly from the northwest and west, these conditions would result in wind erosion and poor ambient air quality in the receiving residential environment within 1 km or less from the edge of the Grootvlei 6/L/16.

From a heritage perspective, limited heritage artefacts are expected.

5.1.1.2 Largo Site 4

Largo Site 4 was ranked the eighth most suitable site, due to the site being located directly adjacent to a Ramsar wetland site, however, this site is not located in an NFEPA priority area. The potential impacts to agricultural land also contributed to this site being the least suitable site. Furthermore, as this site has not been subject to mining, there would be a greater risk of encountering important fauna and flora present within this site. This site is situated in the upper reaches of the C21E quaternary catchment, potentially having a larger impact to the entire catchment. Although this site is downstream from some of the other identified sites, it is adjacent to the key receptors (i.e. Blesbokspruit and the Largo settlement). The closest sensitive receptors are located about 100 m from site, therefore, making this site less suitable from a social perspective.

Finally, due to potential receptors (people and agriculture/ cattle), this site was not favoured from a social and air quality perspective. Furthermore, rezoning of agricultural land would be required and the close proximity to the existing coal seam in the region may also warrant approval from the Department of Mineral Resources (DMR) due to potential sterilisation of mineral resources.

Figure 5-1 below provides a summary of the outcomes of the screening analysis for the equal weighting scenario conducted for the nine sites initially considered. Please note that this is a relative ranking in order to determine the most preferred site.

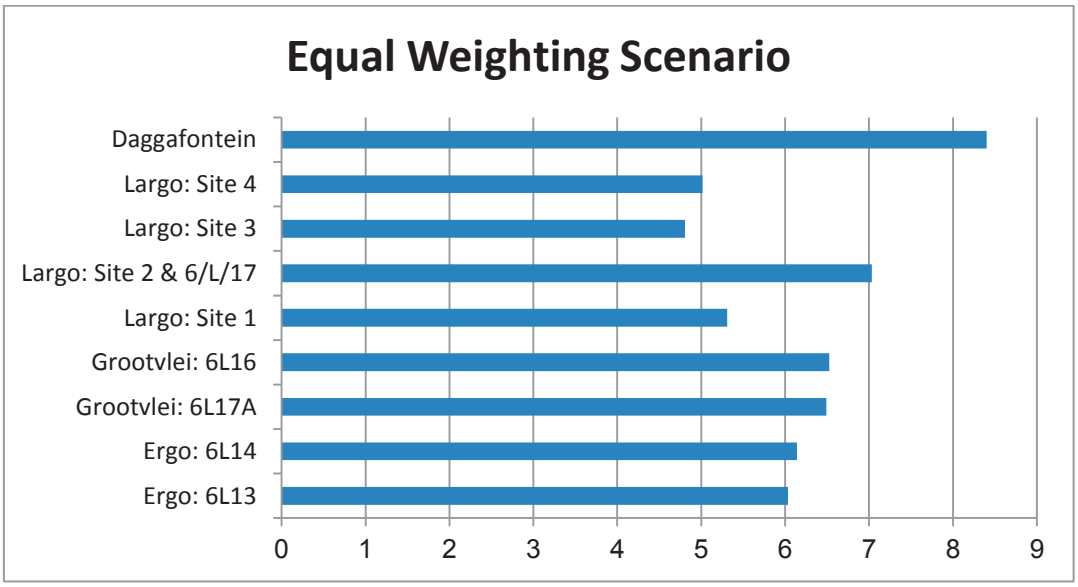


Figure 5-1: Equal Weighting Scenario

Table 5-1: Selected Sites for Scoping Phase and identified

Criteria for Alternatives	Selected Disposal sites for EIA Process		Alternative Disposal Sites						
	Grootvlei 6/L/16 3rd most sutiable site	**Largo Site 4 8th most suitable site**	**Daggafontein 1st most suitable site**	**Grootvlei 6/L/13 6th most suitable site**	**Grootvlei 6/L/14 5th most suitable site**	**Grootvlei 6/L/17A 4th most suitable site**	**Largo Site 1 7th most suitable site**	**Largo Site 2 2nd most suitable site**	**Largo Site 3 9th most suitable site**
Environmental Equal Weighting Scenario	The Grootvlei Site 6/L/16, was ranked as the third most suitable sites. This site is an existing slimes dam, therefore the disturbance of the footprint is less compared to establishing a new footprint for the proposed sludge disposal. From a heritage perspective, limited heritage artefacts are expected. Grootvlei Site 6/L/16 is located in a Ramsar wetland. However, this site is not located in an NFEPA priority area.	Largo Site 4 was ranked as the eighth most suitable site, due to the site being located directly adjacent to the Ramsar site wetland. However, this site is not located in an NFEPA priority area. The potential impacts to agricultural land also contributed to the poor preference of this site. Furthermore, as this site has not been subject to mining, there would be a greater risk of encountering important fauna and flora present within this site. Finally, due to potential proximity to receptors (people and agriculture/ cattle), this site was not favoured from a social and air quality perspective. Furthermore, rezoning of agricultural land would be required and the close proximity to the existing coal seam in the region may also warrant approval from DMR due to sterilisation of mineral resources.	The Daggafontein TSF Site has been determined as the most suitable site. Based on the disturbed nature of the Daggafontein Site, it is unlikely that heritage resources of importance will be identified on-site. Even though this site is the most suitable site for the proposed disposal of sludge, there is uncertainty that specific sections of the underlying geology may contain dolomite structure. The presence of dolomitic formations and aquifers and fault and fold structures could have a major significance in terms of the movement of contamination off site or increasing water quality impacts of a major water resource. The dolomite in the Eastern Basin represents a significant aquifer that is considered a potential long-term water supply source. Acidic mine water can dissolve the dolomite and may impact on ground stability.	Ergo Site 6/L/13 was ranked as the fifth most suitable site. This site is an existing slimes dam, therefore the disturbance of the footprint is less compared to establishing a new footprint for the proposed sludge disposal, with little importance for flora and fauna. Limited heritage artefacts are expected on this site. From a social and air quality perspective, there are a number of receptors bordering the site. In terms of surface hydrology, the Cowles Dam borders the site and may likely be impacted due to the proximity of the sludge disposal site. From a groundwater perspective, the site is underlain by dolomite structures and may contain a fault or fold structure along its western boundary.	Ergo Site 6/L/14 is located on an existing dump, therefore no new footprint will be established and limited heritage artefacts are expected. This site is not located in an NFEPA priority area. The aquatic habitat diversity at the site is expected to be low, resulting in a low impact on macroinveterbates. However, sludge disposal on this site may lead to negative potential impacts, reducing the chances of the Attainable Ecological Management Class (AEMC). This site is one of the furthest north / upstream sites and could have a big impact on downstream users and water resources. This site is also located upstream from a populated area. This site may not be a suitable site for the proposed activities due to the underlying geology of the site and that the potential activities may negatively impact groundwater resources and users.	The Grootvlei Site 6/L/17A was ranked as the fourth most suitable site. The potential impacts may be on fauna and flora. The boundary of the site interacts with the boundary of the Ramsar wetland as well as with NFEPA wetland boundaries, resulting in limited buffer zone from the water resources. This site is located on an existing slimes dam, therefore a new footprint will not be created. The site is predominantly underlain by sandstone and shale and located in-between two mapped northwest-southeast trending geological structures. The sludge storage facility already exists, therefore minimising potential risk to unidentified heritage resources. However the site may require a permit.	Largo Site 1 was ranked as the sixth most suitable site, due to the site being located next to the Blesbokspruit wetland and some areas of this site are located within the NFEPA wetland. There is a small residential area (presumably small holdings) about 250 m south of the site, and an industrial area about 1 km south of the site, thus making it less suitable from a social and air quality perspective. There are vast open areas on this site and may lead to the possibility of illegal settlements. Potential Section 34 heritage resources (burial grounds) occur within the proposed location and will require permitting and exhumation.	Largo Site 2 has been determined as the second most suitable site. For Largo Site 2 (6/L/17), the potential impacts may be on wetlands. The boundary of the site interacts with the boundary of the Ramsar wetland as well as slightly with NFEPA wetland boundaries, providing an inadequate buffer zone from the water resources. From a social perspective, there is a possibility of illegal settlements being established on the site. From an air quality and heritage perspective, limited receptors and potential heritage artefacts are expected. The site is located adjacent to mine dumps to north and west, and disturbed land to the east. The closest sensitive receptors are located about 1.4 km from site, except for dilapidated mining infrastructure. This site is younger than 60 years, therefore a heritage permit will not be required.	Largo Site 3 was ranked as the least suitable site and is located on an agricultural field. Therefore, a new footprint will be created. Largo Site 3 is located on a site which feeds a Ramsar site wetland which may negatively impact the aquatic habitats. The site currently provides some degree of ecological support. However, this site is not located in an NFEPA priority area. Due to the shallow depth of the water table in this site, the proposed activities may negatively impact groundwater resources and users. From a social perceptive, there may be illegal settlements in the northern corner of the site. From a heritage perspective, as the site has not been subject to mining, the presence of heritage artefacts is higher which will require permitting.

5.1.2 Specialist Weighting Scenario

As certain specialists disciplines could be considered of greater importance than others based on site sensitivities, a ranking exercise was conducted to weight certain disciplines with greater importance. It was determined by the project team that the Social, Aquatic Ecology, Heritage, Groundwater, Wetlands and Surface Water have been weighted as the most important specialist disciplines to inform a site ranking process.

The results depicted below are rated according to each specialist discipline, in which individual specialist disciplines were weighted. The results indicated that Daggafontein remains as the most suitable site and Grootvlei Site 6/L/17A has been identified as the second most suitable site. Largo Site 2 is ranked as the third most suitable site. Ergo 6/L/13 was identified as the fourth most suitable site (refer to Figure 5-2 below). The Grootvlei Site 6/L/16 has become the fifth most suitable site. Largo Site 4 has remained as a less preferred site, ranked seventh in preference.

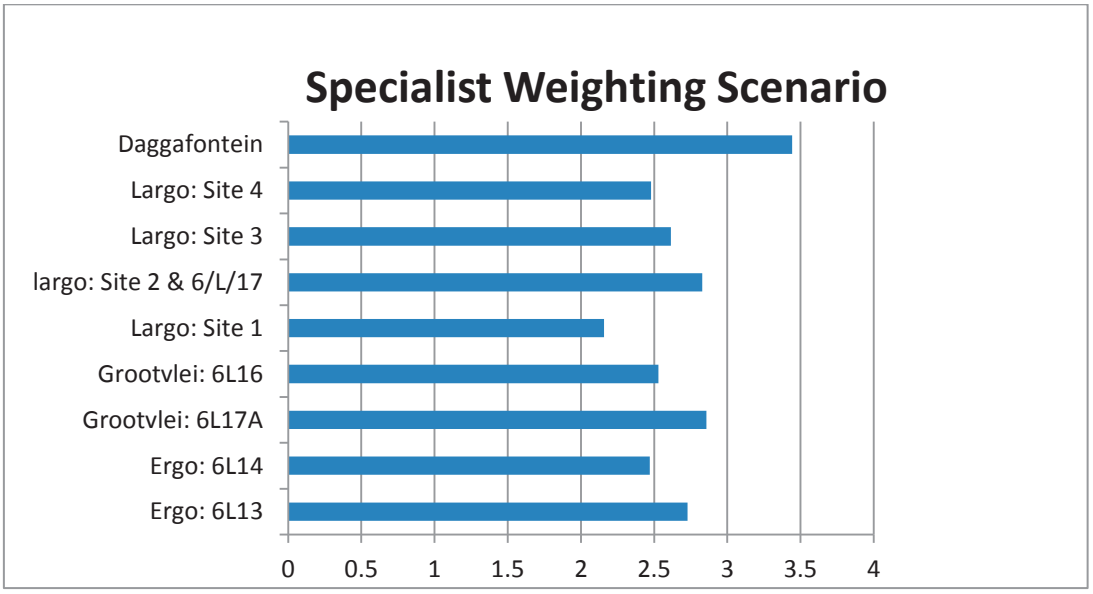


Figure 5-2: Specialist Weighting Scenario

5.1.3 Technical and Financial Outcomes

Please note that the following information has been taken from the Golder Associates (2014) technical and financial feasibility analysis.

A design base case was established to rate and evaluate the nine proposed disposal site options. The results found Largo Site 4, Daggafontein and Grootvlei Site 6/L/16 as the three most suitable sites from a technical and financial perspective. Largo Site 4 was ranked as the highest rated site for the proposed sludge disposal facility, with Daggafontein TSF Site as next best rated and Grootvlei Site 6/L/16 as the third best rated site. It should be noted that these three sites comprise of a greenfield site, a co-disposal site as well as an existing

TSF, respectively. As indicated above, the Daggafontein TSF site was precluded due to future activities that may be impacted by the proposed disposal of sludge.

All the other sites were either fatally flawed from a Geology perspective – sites are on dolomites (Largo Site 2, Grootvlei Site 6/L/17A and Ergo Site 6/L/14 or due to their Mining Status – shallow undermining (Largo Site 1, Largo Site 2 and Largo Site 3).

Although Largo Site 4 is the highest rated, it is known that greenfield sites results in greater social/environmental impacts, whereas both the Daggafontein TSF Site and Grootvlei Site 6/L/17A are associated with existing mining/tailings facilities.

5.1.4 Conclusion

It can be concluded that due to technical and financial fatal flaws identified in the Golder Associates study for several of the sites, Largo Site 4 and Grootvlei Site 6/L/16 were selected to be assessed.

5.2 No Project Option

Should the immediate and STI measures for the treatment of AMD from Eastern Basin not proceed, untreated AMD will decant from the Eastern Basin. Decant of AMD into the environment would likely result in ecological and social impacts, which will eventually spread to the Vaal River. The abstraction and treatment of AMD in the Eastern Basin and the management of the sludge produced from the HDS Plant, therefore, needs to be implemented to mitigate and prevent additional impacts of AMD. Managing and maintaining AMD to below the ECL will prevent future AMD decanting and prevent the contamination of lower level aquifers.

5.3 Need and Desirability

Due to the rising water levels in the Eastern Basin it is crucial that interventions to prevent decant of AMD are implemented. The need and desirability of the project stems from the legacy issues associated with gold mining in the Eastern Basin. In light of current problems experienced with AMD management, the nature of this project can be characterised as remediation, so as to avoid potential biophysical and socio-economic impacts to the surrounding environment. More specifically, the need and desirability of the Project is summarised in Table 5-2 below.

Table 5-2: Need and Desirability

Need and Desirability	Description
Process and Timing	It has been estimated that the ECL for the Eastern Basin was reached in May 2014 and that if intervention does not occur AMD will enter into surrounding watercourses and impact downstream users. The approval for the construction of a sludge disposal facility and associated pipelines will enable effective management of AMD, thus limiting potential negative impacts to the surrounding and downstream environment.
Water Quantity	By implementing the STI measures, it is likely that the water levels will remain below the ECL in the Eastern Basin, thus mitigating potential environmental impacts. Should the water levels in the Eastern Basin be left to rise above the ECL and decant, there is the risk that the weathered and fractured aquifers in the Central and the dolomitic formations in the Eastern Basin will be contaminated by AMD. The transportation and disposal of sludge from the HDS treatment plant will contribute to the management and maintenance of AMD below the ECL. Thus, this Project aims to keep AMD below the ECL by pumping and treating the AMD
Technology	Treatment technology and chemical reagent combinations recommended for the treatment of the decant expected from the Eastern Basin is as follows: ▪ Oxidation by aeration; ▪ Pre-neutralisation with limestone; ▪ Neutralisation and metals removal with lime, produced by the slaking of quicklime; and ▪ Gypsum crystallisation to remove excess sulphate from solution. The HDS Plant to be constructed at the Groootvlei Mine Shaft No. 3 for the STI measures is based on technology that is proven to be effective in the treatment of AMD at full-scale applications. Other neutralising chemicals can be used but these are generally a lot more expensive than limestone and lime. The HDS process is seen as an active process and more suited to the treatment of AMD than passive treatment. Passive treatment systems have been tried and tested but they are mainly implemented for treating low flow systems and diffused flow systems, as stated in the International Network for Acid Prevention's (INAP) Global Acid Rock Drainage Guide. They are generally unsuitable for large flows. The HDS plants will also be required as part of the long term treatment of AMD as neutralisation of the AMD will be required prior to desalinisation. The treatment plants for neutralisation must, therefore, have a high level of reliability to serve the proposed mine water reclamation plants for a long period of time. The HDS technology has been identified to provide this reliability in the long term.

Need and Desirability	Description
Location	It is proposed that potential decant from the Eastern Basin will be treated and managed within said basin. The disposal of sludge will be limited to one of the sites identified in the Eastern Basin. The locations of the proposed disposal site options were evaluated by undertaking an environmental and social screening analysis as well as a financial and technical screening analysis (refer to Section 5 for a detailed description of the alternative sites). The locations of the various options were assessed based on the needs of the long term solution as well. The site selection considered the following: ▪ Proximity of the sites; ▪ Ease of management of the sites; ▪ Rehabilitation and closure of existing tailings facilities; ▪ Long term geotechnical stability; ▪ Risk of environmental approvals; ▪ Potential impact on groundwater resources and surrounding areas; and ▪ Environmental and social aspects were also considered. It should also be noted that the Grootvlei Mine Shaft No. 3 is currently not sealed off and poses a risk to people and animals. The implementation of this project will restrict access to the shaft and reduce potential health and safety risks.

6 Baseline Environment

This section provides a brief overview of the site specific bio-physical and socio-economic baseline environment of the Project area. The key objective of this section is to provide information about the baseline environment that will help to determine the potential impacts of the proposed project.

6.1 Climate

Wind and temperature data are critical for determining the distribution patterns of nuisance or fugitive dust plumes or potentially harmful gaseous or radiogenic emissions (GDACE, 2008).

Site specific MM5 modelled meteorological data was used for the period January 2011 to December 2013 to determine the local prevailing weather conditions of the Project area. The data was obtained from a point approximately 6.5 km near Springs (26.260261 S, 28.501436 E).

The Project falls within the Highveld climatic zone characterised by warm summers with rainfall. Winters tend to be mild to warm during the day to cold at night with sharp frosts.

6.1.1 Temperature

Air temperature is important in determining the mixing and inversion layers and the effect of plume buoyancy. The larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise.

Figure 6-1, the regional average daily maximum temperature in January (the hottest month) was recorded to be 25 ˚C and in July (the coldest month) the regional average daily minimum temperature was recorded as 16.85 ˚C. The mean daily minimum in January was recorded to be 14.82 ˚C and in July, the mean daily minimum was recorded to be 3.45 ˚C.

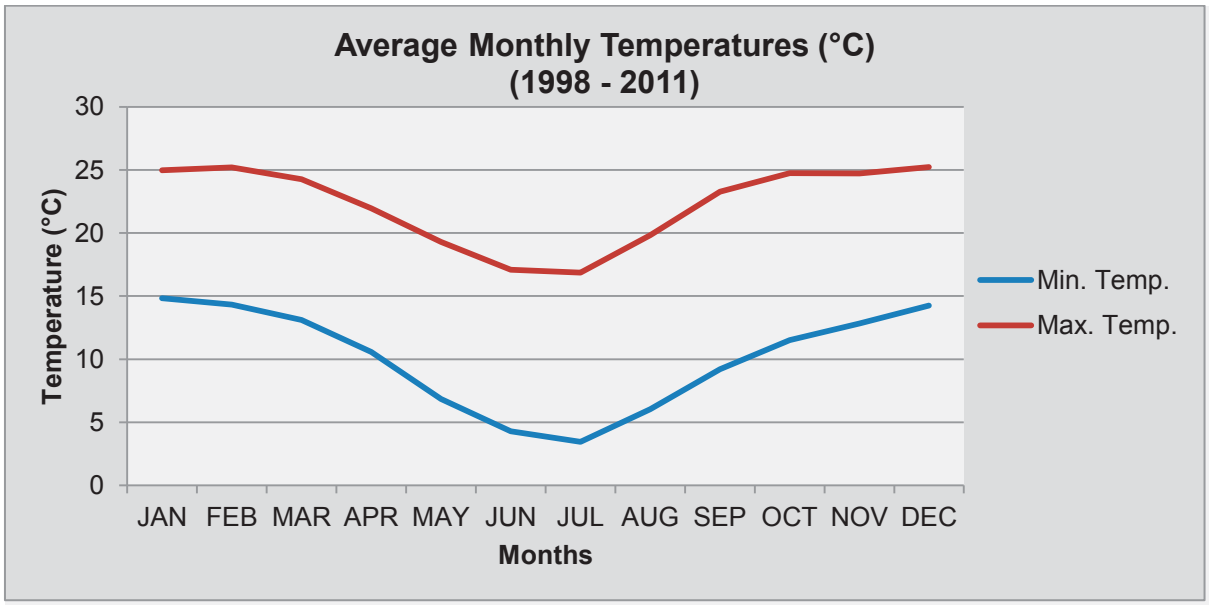


Figure 6-1: Average Minimum and Maximum Temperature for the Period 1998 to 2011 at the Johannesburg International Weather Station (Station Number 04763990)

6.1.2 Relative Humidity

The three year (2011 - 2013) average monthly maximum, minimum and mean relative humidity is depicted in Figure 6-2. The annual maximum, minimum and average relative humidity is given as 70.2 %, 65.8 % and 68.6 %, respectively. The daily maximum relative humidity remains above 65 % for most of the year, and range from 60.1 % in November to 71.3 % in January. The daily minimum relative humidity is above 60 % for the whole year, with the highest minimum (72.9 %) observed in June and the lowest (60.3 %) occurring in October.

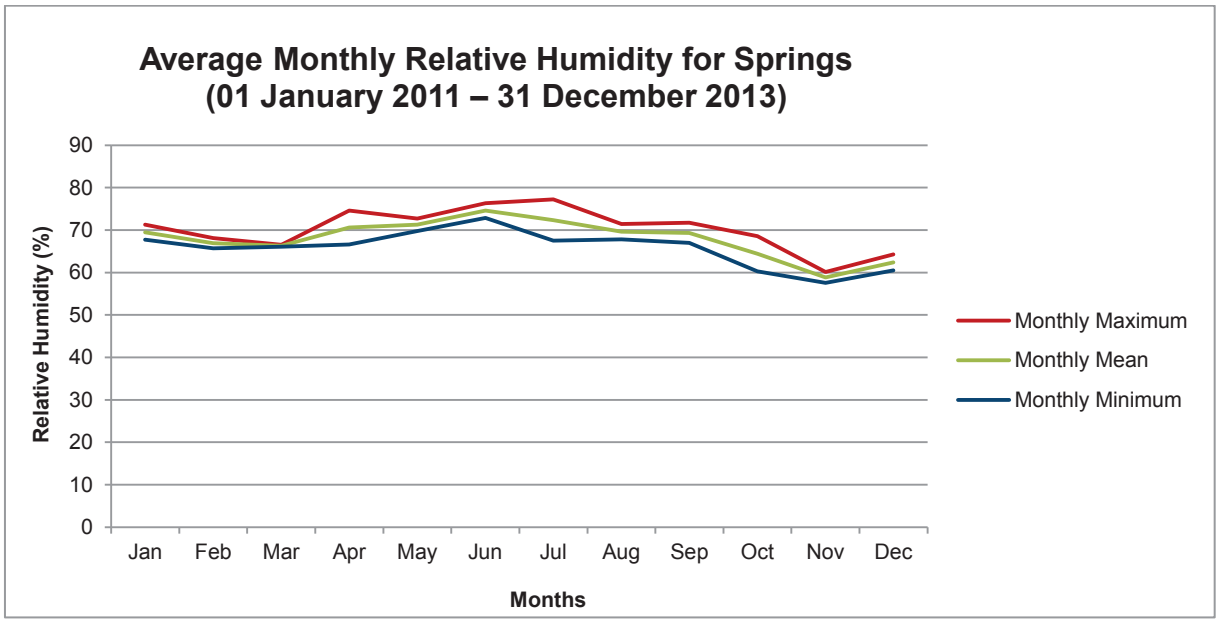


Figure 6-2: Average Monthly Relative Humidity for Springs modelled data, 01 January 2011 – 31 December 2013

6.1.3 Precipitation

The three year (2011 - 2013) average monthly maximum, minimum and mean precipitation is depicted in Figure 6-3. The three year annual maximum, minimum and mean monthly precipitation for the Project area is 85.1 mm, 45.2 mm and 60.8 mm, respectively. The highest monthly maximum precipitation of 221 mm was recorded in January. The rate decreases to 5.1 mm in July. The monthly minimum precipitation ranges between 0 mm in May to 165 mm in December.

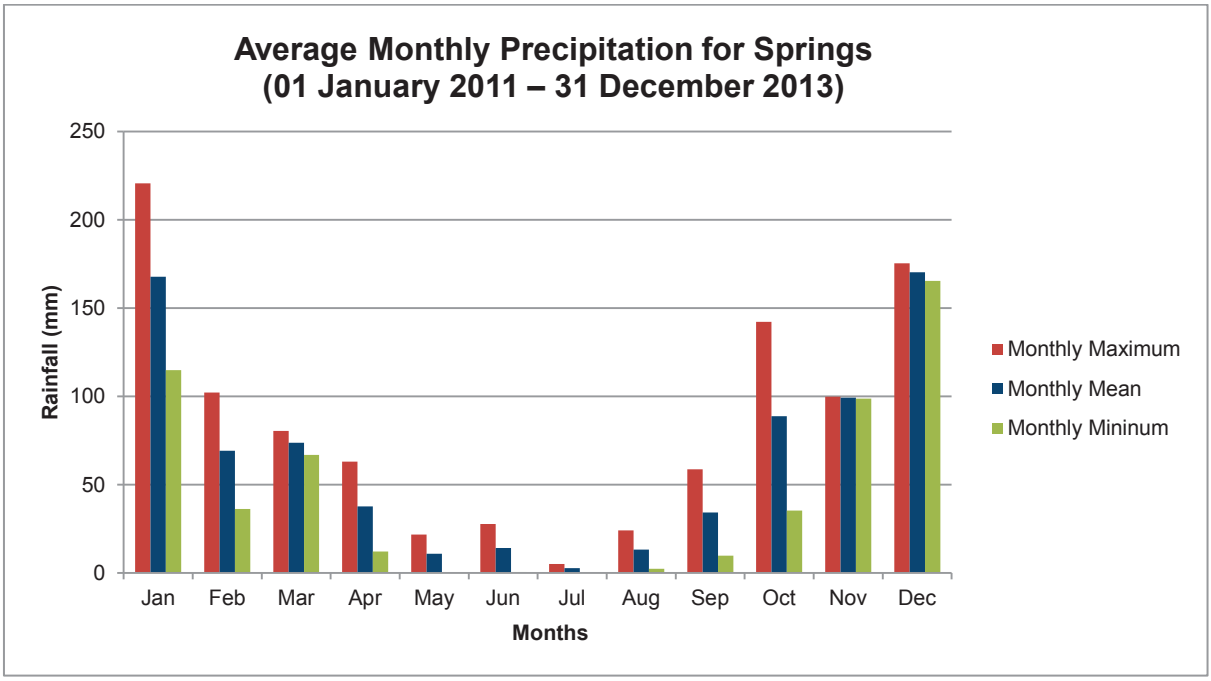


Figure 6-3: Average Monthly Precipitation for Springs modelled data, 01 January 2011 – 31 December 2013

6.1.4 Evaporation

The three year (2011 - 2013) average monthly maximum, minimum and mean monthly evaporation rates are depicted in Figure 6-4. The annual maximum, minimum and mean monthly evaporation rates for the OR Tambo International Airport area (located approximately 26 km north west of the Project area) for the period 1957-1987 are 259 mm, 117 mm and 181 mm, respectively. The highest monthly maximum evaporation (345 mm) occurred in October. The rate decreases to the lowest in 85 mm in June. The monthly minimum evaporation ranges between 85 mm (June) and 164 mm in December.

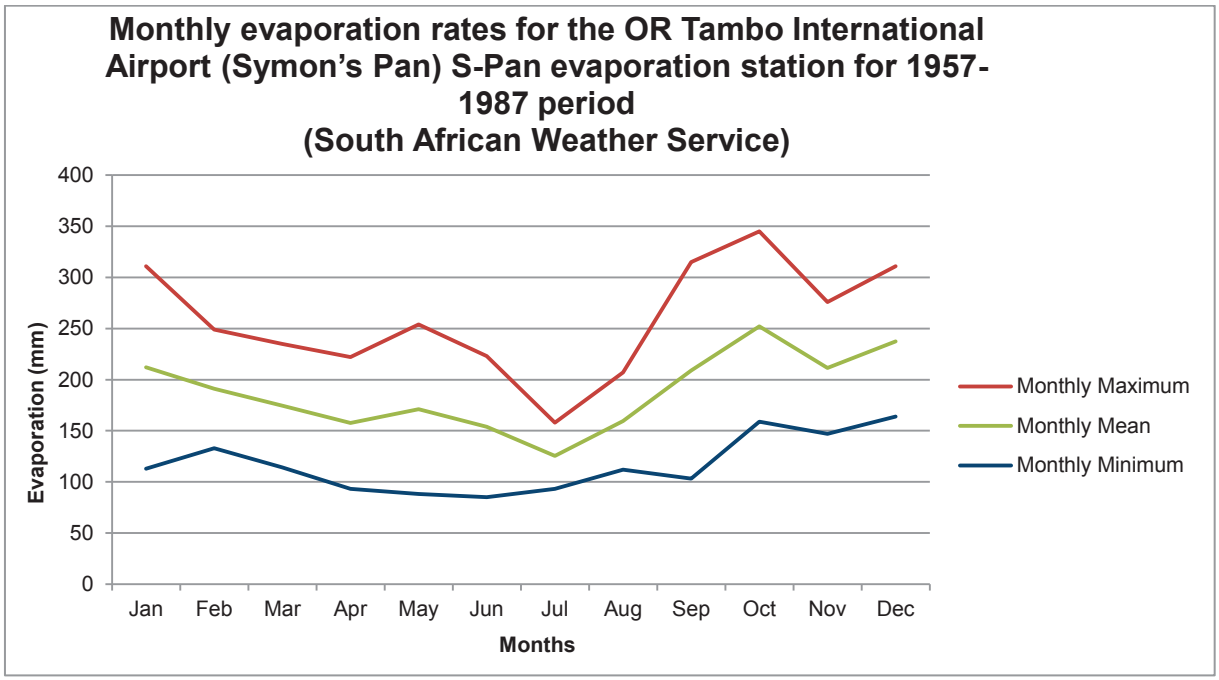


Figure 6-4: Average Monthly Evaporation for OR Tambo International Airport S-Pan Evaporation Station (1957 – 1987) (Source: South African Weather Service)

6.2 Wind

The impact of winds blowing from a sector depends on the intensity of the wind speed, the size of a sludge disposal facility and the distance to the sensitive receptors. The intensity of the wind speeds are illustrated in Figure 6-5 (wind rose for the years 2008 – 2013) and Figure 6-6 (wind rose for the windy season – Aug, Sep and Oct). Three months that are mostly associated with elevated dust events i.e. August, September and October.

The wind class frequency distribution confirms that winds with ability to generate dust, i.e. > 5.4 ms^{-1}, occur for approximately 2% of the time. The wind rose and wind class frequency for the windy season are similar to those generated for the period.

The maximum wind speed recorded was approximately 14 ms^{-1} with the winds coming from the south western sector. This data is based on all wind directions and does not exclude high winds associated with heavy rains which would suppress dust.

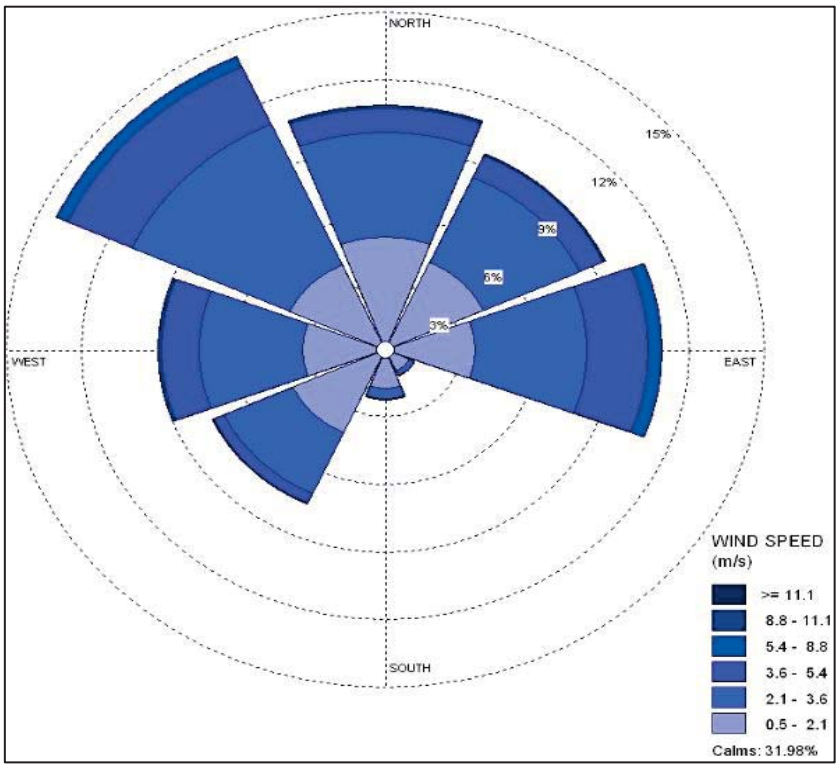


Figure 6-5: Surface wind rose for Springs (2008 – 2013)

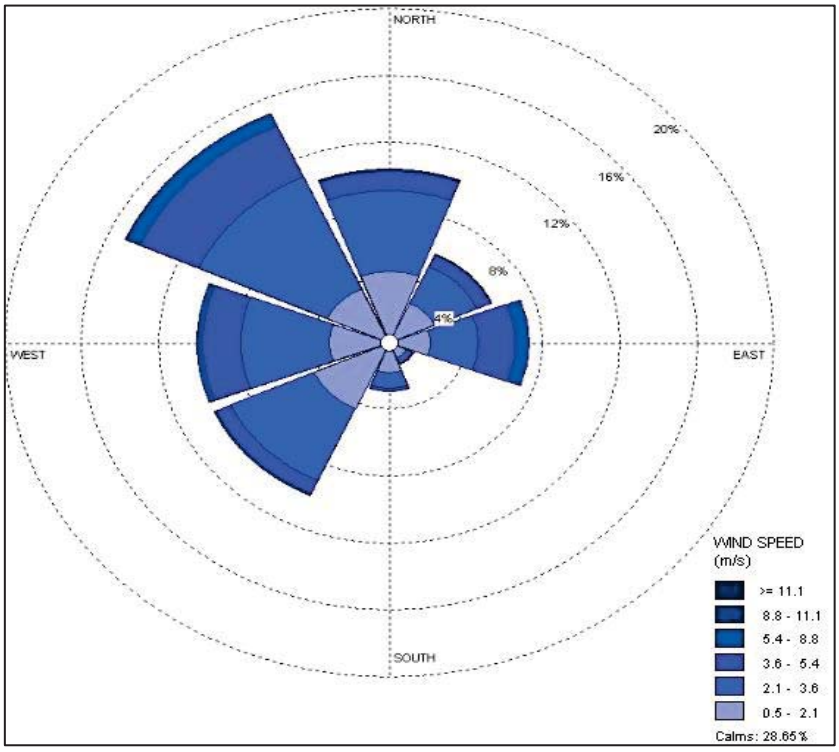


Figure 6-6: Surface wind rose for windy season (Aug, Sep and Oct) (2008 – 2013)

6.3 Geology

6.3.1 Regional Context

Geological structures are important in establishing hydraulic continuity between various rock formations, and thereby determining the movement of groundwater.

The Project is situated within a region underlain primarily by sedimentary strata (quartzite and shale) associated with the Witwatersrand Supergroup, and younger sediments (dolomite, quartzite and shale) associated with the older strata of the Transvaal Supergroup. The region is dominated by a cover of Karoo sandstone, conglomerate, dolerite sills and shale, with minor coal seams. Plan 6 depicts the regional geology of the Project area (Appendix A).

The Eastern Basin is characterised by northwest-striking folds, with two prominent anticlinal structures, namely the Nigel Anticline and Springs Monocline. Two of these structures have been identified within the proposed sludge disposal areas.

The groundwater environment that includes AMD water comprises the karst aquifer associated with two outliers of the Malmani Subgroup dolomite, and various fractured rock aquifers associated with the Black Reef Formation strata and older basement rocks of the Central Rand and West Rand Groups.

6.3.2 Site Specific Context

6.3.2.1 Grootvlei 6/L/16

This site is predominantly underlain by sandstone and shale and located in-between two mapped northwest-southeast trending geological structures – potentially compartmentalised.

6.3.2.2 Largo Site 4

This site is predominantly underlain by sandstone and shale. A potential fault or fold structure is located along its western boundary.

6.4 Visual and Topography

This section provides the results obtained from the analysis of the topographical and slope models created in ArcGIS for the Project area.

6.4.1 Visual

Grootvlei Site 6/L/16 is located on an existing tailings dam; on the western side of Blesbokspruit wetland. The western and southern parts of the site are bordered by the Strubenvale residential area, located 0.5 km from the Project area. Potential visual receptors include people using the railway line on the southern side and residents of nearby settlements.

Largo Site 4 is located on agricultural fields and is surrounded by vacant land (previously associated with mining activities) and an industrial / residential area to the south, Largo settlement. Potential visual receptors are people using the R29 road on the south boundary and the railway line on the northern boundary as well as residents of Largo settlement. It is expected that the topography will only provide minimal screening for both the proposed sludge disposal sites. Vegetation in the area is that typical of the Soweto Highveld Grassland with a number of trees scattered around. During a site visit it was discovered that some of the trees provide screening for the dumps, provided they are planted closely to the dumps. This can impact on the visibility of the dump and result in a decrease in the visual impact. Figure 6-7 depicts an example of the vegetation screening effect provided by trees for the Grootvlei Site 6/L/16. This will be investigated further during the EIA Phase of the Project.

Figure 6-7: Vegetation screening at Grootvlei Site 6/L/16

6.4.2 Topography

Grootvlei Site 6/L/16 is located to the west of the Blesbokspruit wetland, with a total area of 103.6 hectares (ha). It is situated over an existing tailings dam; therefore the topography of this site and surrounding area is gently undulating (refer to Figure 6-8). The elevation of the area ranges from 1560 mamsl on the eastern side to 1575 mamsl towards the western boundary. The slope gradient is relatively flat, ranging from 0 – 4°. Plan 7 depicts he topography of the Project area (Appendix A).

Figure 6-8: Gently undulating topography of Grootvlei 6/L/16

Largo Site 4 is located on a relatively flat area with elevation ranging from 1570 mamsl to 1588 mamsl. The site covers an area of 108 ha and has a slope of 0 – 4°. The overall topography of Largo Site 4 as well as its surrounds is flat (refer to Figure 6-9). Figure 6-9 was taken on the north-eastern boundary looking towards the site.

Figure 6-9: Flat topography of Largo Site 4

6.5 Soil

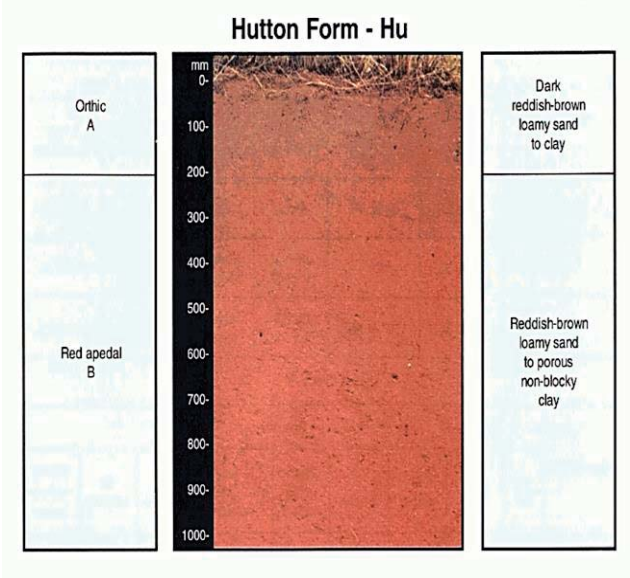
The environment under investigation is considered to be highly modified. This classification is due to the encroachment of urban, agricultural and existing industrial activities. Furthermore, the area has an extensive history of mining impacts stemming largely from the tailings storage facilities in close proximity to the Project area.

6.5.1 Land Type

Existing land type data was used to obtain generalized soil patterns and terrain types for the project site. Landtype data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Landtype Survey Staff, 1989). These maps are general guidelines of what soils can be expected in the area.

The soils present in the Project area are represented by one regional land type, namely Ba1. This land type as well as its associated soil forms is discussed in Table 6-1 below. Plan 8 depicts the land types present in the Project area (Appendix A).

Table 6-1: Soil forms contained in Land Type Ba1

Land Type	Soil Form	Visual Description
Ba1: Land type Ba1 forms part of the Project area, with both the Largo Site 4, and the Grootvlei 6L16 sites and associated pipelines falling within this land type. The dominant soil form expected in this land type is the Hutton (Hu) soil form, which comprises of about 60 % of the area (determined by GIS Analysis), with the remainder of the land type having a diversity of soils. These soils are expected to be sandy with a clay percentage of around 15% - 30% and have depths ranging from 300 mm to deeper than 1200 mm.	**Hutton (Hu):** The Hutton soil form consists of an Orthic A, Red apedal B, and an unspecified C horizon which could be hard rock, saprolite, or unknown as no limiting layer was identified. These soils are freely drained and as a result, can be slightly acidic due to the low cation exchange capacity (CEC) and thus the low base status. These soils are prime soils for irrigated crop production, however they are marginal to good in dry land conditions.	

6.5.2 Land Capability

Land capability is determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes.

Land capability is divided up into classes. Each class is defined as the potential for the land to support cultivation and is divided from land that is suited to cultivation to land that is unsuitable for cultivation. The specific class will determine potential uses of land and each class is based on several factors, such as the depth of the soil, the soils potential to hold water and how workable the soil is.

The Project area falls within the Class III land capability classification, which is a moderate agricultural class. It should be noted that Grootvlei 6/L/16 is an existing mine structure and as a result does not have a classification, however, the land on which it was constructed falls within this Class. Plan 9 depicts the land capability of the Project area (Appendix A).

The Class III land capability classification is described below:

- Land in Class III has severe limitations that reduce the choice of plants or require special conservation practices, or both;
- It may be used for cultivated crops, but has more restrictions than Class II. When used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain;
- The number of practical alternatives for average farmers is less than that for soils in Class II;
- Limitations restrict, singly or in combination, the amount of clean cultivation, time of planting, tillage, harvesting, choice of crops;
- Limitations may result from the effects of one or more of the following;
  - Moderately steep slopes;
  - High susceptibility to water or wind erosion or severe adverse effects of past erosion;
  - Frequent flooding accompanied by some crop damage.
  - Very slow permeability of the subsoil;
  - Wetness or some continuing waterlogging after drainage;
  - Shallow soil depth to bedrock, hardpan, fragipan or claypan that limit the rooting zone and the water storage;
  - Low water-holding capacity;
  - Low fertility not easily corrected;

- Moderate salinity or sodicity; and
- Moderate climatic limitations.

Note: “Severe limitations” and “Low fertility not easily corrected” are taken to imply that land dominated by soils with severe subsoil acidity belongs in Class III.

6.5.3 Land Use

The land use for Grootvlei 6/L/16 is classified as mined land use and a large portion of Largo Site 4 consists of cultivated land and a small portion is most likely grazing fields. A pan is also present in Largo Site 4.

The pipeline route to Largo Site 4 falls within the plantations land use. The pipeline route to Grootvlei 6/L/16 falls within a water body land use. Plan 10 (Appendix A) depicts the land uses of the Project area as well as the surrounds.

6.6 Terrestrial Ecology (Fauna and Flora)

6.6.1 Flora

The study area coincides with two of South Africa’s 9 plant biomes, namely: Grassland (for the majority of the area) and Savanna. The regional vegetation types include: Andesite Mountain Bushveld, Eastern Highveld Grassland, Eastern Temperate Freshwater Wetlands, Soweto Highveld Grassland and Tsakane Clay Grassland). Plan 11 depicts the Gauteng Conservation Plan (Gauteng C-Plan) of the Project area (Appendix A).

The diversity of vegetation types describe the importance of this area, and even areas under cultivation, or areas that have been disturbed in the past can be rehabilitated to contribute to the existing potential for high biodiversity of the region. Any existing natural areas are of high conservation concern.

The study area falls within the Quarter Degree Squares (QDS’): 2628AB, 2628AD and 2628BC. The Gauteng Province has been extensively surveyed from a botanical perspective and as a consequence, the South African database (PRECIS list) adequately represents species diversity for this part of the country. For the expected species lists generated for the QDS in which the study occurs, 940 plant species have been recorded, 13 of which were allocated Red Data Status (3 are listed as declining, 5 are listed as Near-Threatened and 6 listed as Vulnerable).

The plant Species of Special Concern (SSC) that can be expected to occur in the area associated with the two alternative sites are presented in Table 6-2 below. Based on desktop analysis, the vegetation is made up of disturbed grassland, hydromorphic grassland (in wetland areas) and alien bushclumps. Alien species expected to make up the bushclumps include: *Eucalyptus* and *Pinus* species. Alien invasion is likely to be a major concern for the Groenvlei site, owing to the large scale of soil disturbance that has taken place.

Table 6-2: Expected plant SSC species for the QDS' in which the two alternative sites occur

Family	Species	Threat Status
AMARYLLIDACEAE	*Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.*	Declining
APOCYNACEAE	*Pachycarpus suaveolens (Schltr.) Nicholas & Goyder*	VU
AQUIFOLIACEAE	*Ilex mitis (L.) Radlk. var. mitis*	Declining
ASPHODELACEAE	*Kniphofia typhoides Codd*	NT
ASTERACEAE	*Cineraria longipes S.Moore*	VU
CRASSULACEAE	*Adromischus umbraticola C.A.Sm. subsp. umbraticola*	NT
FABACEAE	*Indigofera hybrida N.E.Br.*	VU
HYPOXIDACEAE	*Hypoxis hemerocallidea Fisch., C.A.Mey. & Avé-Lall.*	Declining
IRIDACEAE	*Gladiolus robertsoniae F.Bolus*	NT
MESEMBRYANTHEMACEAE	*Khadia beswickii (L.Bolus) N.E.Br.*	VU
MESEMBRYANTHEMACEAE	*Lithops lesliei (N.E.Br.) N.E.Br. subsp. lesliei*	NT
ORCHIDACEAE	*Eulophia coddii A.V.Hall*	VU
ORCHIDACEAE	*Habenaria bicolor Conrath & Kraenzl.*	NT

VU	Vulnerable
NT	Near threatened

6.6.2 Fauna

Owing to the high level of disturbance for the area, faunal activity is expected to be low. Of particular faunal conservation significance, is the Marievale Bird Sanctuary, within proximity to site.

The Marievale Bird Sanctuary is located downstream of the proposed project site, approximately 1 000 ha in extent, it is located at the southern end of the Blesbokspruit

Ramsar site and is a designated Important Bird Area (IBA SA021). The sanctuary consists of large expanses of marsh with extensive reedbeds interspersed with open patches of water and mudflats during drier periods. There are areas of natural grassland and farmland surrounding the wetlands. Waterbirds are the main attraction with large populations of Cormorants, Coots, Herons and Ducks along with a number of Red Data species having been observed throughout the system. The bird records for the greater study area, including the Marievale Bird Sanctuary, list 218 bird species (17 of which have been allocated a Red Data status).

Five mammal SSC, one amphibian SSC and no reptile SSC have been recorded for the greater study area. Faunal SSC that may occur on site (that are recorded for the greater study area) are presented in Table 6-3 below.

Table 6-3: Faunal SSC expected to occur on site

Common name	Scientific name	Threat Status
Birds		
African Grass-Owl	*Tyto capensis*	Vulnerable
Baillon's Crake	*Porzana pusilla*	Rare
Black-winged Pratincole	*Glareola nordmanni*	Near threatened
Great Crested Grebe	*Podiceps cristatus*	Vulnerable
Greater Flamingo	*Phoenicopterus ruber*	Near threatened
Greater Painted-snipe	*Rostratula benghalensis*	Near threatened
Half-collared Kingfisher	*Alcedo semitorquata*	Near threatened
Lanner Falcon	*Falco biarmicus*	Near threatened
Lesser Flamingo	*Phoenicopterus minor*	Near threatened
Lesser Kestrel	*Falco naumanni*	Vulnerable
Maccoa Duck	*Oxyura maccoa*	Vulnerable
Secretary bird	*Sagittarius serpentarius*	Near threatened
Spotted Crake	*Porzana porzana*	Rare
Striped Pipit	*Anthus lineiventris*	Rare
Western Marsh-Harrier	*Circus aeruginosus*	Rare

Common name	Scientific name	Threat Status
Yellow Wagtail	*Motacilla flava*	Rare
Yellow-billed Stork	*Mycteria ibis*	Near threatened
Mammals		
Rough-haired Golden Mole	*Chrysospalax villosus*	Critically endangered
African Clawless Otter*	*Aonyx capensis*	Protected
South African Hedgehog	*Atelerix frontalis*	Protected
Black-footed Cat	*Felis nigripes*	Protected
Spotted-necked Otter*	*Lutra maculicollis*	Protected
Herpetofauna		
Giant Bullfrog*	*Pyxicephalus adspersus*	Protected

*Denotes species often associated with wetlands and riparian zones

6.6.3 Terrestrial Conservation Important Areas

6.6.3.1 Gauteng Conservation Plan

Gauteng Nature Conservation (hereafter Conservation), a component of the Gauteng Department of Agriculture and Rural Development (GDARD) produced the Gauteng Conservation Plan Version 3 (CPlan3) in December 2010. The latest version is C-Plan 3.3 which became available in October 2011 and was revised in December 2013.

The main purposes of C-Plan 3.3 are to:

- Serve as the primary decision support tool for the biodiversity component of the Environmental Impact Assessment (EIA) process;
- Inform protected area expansion and biodiversity stewardship programmes in the province; and
- Serve as a basis for development of Bioregional Plans in municipalities within the province.

C-Plan 3.3 will be a valuable tool to ensure adequate, timely and fair service delivery to clients of GDARD, and will be critical in ensuring adequate protection of biodiversity and the environment in Gauteng Province.

The floodplain valley bottom NFEPA wetlands, associated with the Blesbokspruit River and Ramsar Wetland, are designated as Important Areas. The wetlands associated with the Marievale Nature Reserve Bird Sanctuary are designated as Protected. This protected area starts approximately 1.1km from the Largo 4 site, below the N17 wetland crossing (refer to Plan 12 depicting the Ramsar wetland as well as the NFEPA wetlands).

The Gauteng conservation plan (refer to Plan 11) considers the Blesbokspruit to be Important, which indicates that no other river systems are available to meet the prescribed ecological targets for the catchment, thus protection is crucial (Ferrar and Lotter, 2007). According to the RHP (2005) the ecological state of the drivers and biological responses associated with the system are in a poor state, and as a result the biodiversity of the system is considered to be critically endangered.

6.6.3.2 National List of Threatened Ecosystems in need of protection

Although not fully updated to include some of the mine dumps in the area, this mapping tool (refer to Plan 13 depicting the threatened ecosystems in the Project area) clearly shows the area to be full of Ecosystems in Need of protection. It is clear that all remaining natural areas should be maintained for conservation and any further habitat loss should be avoided.

6.6.4 Aquatic Ecology (Wetlands and Aquatic Biodiversity)

6.6.4.1 Quaternary Catchments

The Project area is located within the Blesbokspruit water catchment area within the C21D and C21E quaternary catchments. The quaternary catchments C21D and C21E have been allocated an overall Ecological State of 'C', *moderate* and 'B', *high* respectively, based on medium and high confidence respectively.

The quaternary catchments are associated with the Blesbokspruit Ramsar Wetland and National Freshwater Ecosystem Priority Area (NFEPA) wetlands, which are designated as Important Areas. Plan 12 (Appendix A) depicts the Ramsar wetland as well as the NFEPA wetlands.

The National Freshwater Ecosystem Priority Areas (NFEPA) shows that the study area is dominated by the Valley floor, Floodplain wetland associated with the Blesbokspruit River. These wetlands have a rank of one (1) due to the Ramsar site status

The next most dominant wetland associated with the sites is Bench, Flat wetlands with a rank of 6. According to the NFEPA programme, the proposed discharge location for this project area is considered to be situated in a river catchment not considered to be a priority area (WRC, 2011). Refer to the wetlands report for the wetland NFEPA status

6.6.4.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA), are strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water

resources (Nel, et al., 2011). The NFEPA spatial layers used include the wetland classification and ranking. The identified wetland areas play important functions such as the enhancement of water quality, attenuation of floods and biodiversity support.

The data set of NFEPA wetlands have been nationally ranked in terms of importance in the conservation of biodiversity. Table 6-4 below indicates the criteria which were considered for the ranking of wetland areas; note that this is a national level ranking system separate to that which is described in this report.

Table 6-4: NFEPA wetland classification ranking criteria

NFEPA Wetland Criteria	NFEPA Rank
Wetlands that intersect with a RAMSAR site.	1
Wetlands within 500 m of an IUCN threatened frog point locality; Wetlands within 500 m of a threatened waterbird point locality; Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

6.6.4.3 Ramsar Wetland

The Blesbokspruit wetlands are listed as a Ramsar wetland site of International Importance; one of 17 in South Africa and the only one in the Gauteng Province. It was designated as such in October 1986 as it was one of few permanent water bodies in the Transvaal region

with ecological significance (South African Wetlands Conservation Programme, 1999) The Blesbokspruit, prior to mining and industrial development since the 1930's, was a non-perennial stream; but due to causeways built across the stream as well as large volumes of underground water from the neighbouring mine workings being discharged continuously into it, flooding occurred and vast stretches of shallow water were created. The Ramsar wetlands are approximately 1 858 ha and are situated adjacent to Ergo's Daggafontein TSF.

The artificially created and maintained wetland site has a high conservation value as it supports significant numbers of waterfowl and many other aquatic and terrestrial fauna and flora. In addition, the wetland is significant as it forms an important component of one of the tributaries of the Vaal River and its catchment, which provides water to the highly industrialized and densely populated Gauteng Province (South African Wetlands Conservation Programme, 1998).

The Montreux Record of the Ramsar Convention is a register of wetland sites on the List of Wetlands of International Importance where changes in the ecological character and integrity have occurred, are occurring, or are likely to occur as a result of developments, pollution or other human interference. The wetland was listed on the Montreux Record in 1996. This was in response to the rapid decline in ecological integrity of the wetland, in so far as the site no longer meets all of the criteria under which it was designated on the List of wetlands of International Importance. This was and is mostly due to contamination by large quantities of polluted water being discharged into the wetland by the adjacent Grootvlei Mine and other adjacent mine workings, sewage works and urbanisation. These and other sources of water pollution have led to highly eutrophic conditions and a permanently flooded wetland. This has resulted in a severe reed encroachment problem which has brought about the decline on habitat diversity (South African Wetlands Conservation Programme, 1998).

In August 2013, a review on the Ramsar status of the wetland was conducted; however, results of this are not yet published. Figure 6-10 represents examples of –discharge of AMD into the wetlands on site.

A)  B) 

Figure 6-10: Photos of Acid Mine Water (A) being treated and (Inter-Ministerial Committee, 2010) (B) decanting into the wetland (South African Wetlands Conservation Programme, 1998)

6.6.4.4 Site Specific Wetlands

6.6.4.4.1 Grootvlei 6/L/16

This site is found west of and immediately adjacent to the NFEPA and Ramsar wetlands.

6.6.4.4.2 Largo Site 4

This site is characterised mainly by farmland. The western edge of the site boundary interacts with the Ramsar boundary and is approximately 100 m from the boundary of the NFEPA wetland. The remainder of the site boundary is approximately more than 200 m from the wetland boundary. The site is between two wetlands, Blesbokspruit and Dwars-in-die-Weglvlei (associated with Ashton Lake). Figure 6-11 below depicts the proposed pipeline route from the proposed HDS Plant to Largo Site 4. The pipeline is proposed to cross over the Blesbokspruit, attached and running parallel to an existing bridge structure.

Figure 6-11: Picture taken west of Largo Site 4 showing the proposed pipeline route from Largo Site 4 to the proposed HDS Plant

6.6.4.5 Aquatic Biodiversity

The characteristics of the fluvial geomorphology of the river system associated with the proposed sites can be described as heavily influenced by anthropogenic activities and therefore the geomorphology of the river system does not conform to normal geomorphological zonation (Rowntree and Ziervogel, 1999). Based on the location of the proposed sites the gradient is approximately 0.65m/0.001m and therefore classified as a foothill stream. Typically, these foothill streams should have gravel and cobble beds associated with them, however, based on desktop information, lowland sandbed characteristics are prominent in the associated river system. The presence of sand

substrates in an upper foothill zone would allow for a limited aquatic biodiversity (specifically fish and macroinvertebrates) due to the limited nature of diverse habitat.

The lowered biodiversity is compounded by artificial flows, as a result of a myriad of impoundments and altered surface runoff from urban areas. These altered volumes/velocities further restrict habitat and subsequent biodiversity. In addition to altered habitat within the river associated with the proposed sites, water quality modification in the Blesbokspruit is considered high. The water and sediment quality of the Blesbokspruit is considered to be highly impacted (Roychoudhury and Starke, 2006) with “significantly” enriched U, Hg, V, Cr, Co, Cu and Zn concentrations. In addition to these elements high levels of iron, manganese, sulphate, calcium, magnesium, sodium and chloride resulting in severely impacted water quality (Schoeman and Steyn, 2000).

6.7 Surface Water

As mentioned in Section 6.6.4 above, the Project area is situated within the Upper Vaal Water Management Area (WMA) 08 within the quaternary catchments C21D and C21E. Plan 14 (Appendix A) depicts the quaternary catchments within which the Project area lies.

The Project area occupies a negligible area (<0.9 %) of the quaternary catchments, however, the area is in close proximity to the Blesbokspruit catchment. The Blesbokspruit is associated with the Blesbokspruit catchment and the largest river of the quaternary catchments and drains in a southerly direction on surface water resources (rivers, pans and wetlands). The Blesbokspruit is a perennial second order stream which is a tributary of the Suikerbosrand River which then flows into the Vaal River. A number of wetland areas occur on the Blesbokspruit (refer to Section 6.6.4 for the wetlands baseline description).

Grootvlei 6/L/16 is located west of the Blesbokspruit River, feeding a tributary of the Blesbokspruit River. Largo Site 4 is situated between the Aston Lake and the Blesbokspruit River and wetland, with the Blesbokspruit draining along the north western section of the site boundary. The pipeline route is proposed to cross the Blesbokspruit. There are a few pans located within the site boundary. As discussed in Section 6.6.4, the water quality modification of the Blesbokspruit is considered to be high.

6.8 Groundwater

The water levels in the Eastern Basin were not a concern until pumping stopped at Grootvlei No. 3 Shaft in 2010. Figure 6-12 depicts the Grootvlei Shaft No. 3 Shaft.

Figure 6-12: Grootvlei No. 3 Shaft

The water levels at Grootvlei No. 3 Shaft during January 2014 were at 1,277 mamsl (or approximately 330 m below surface and 3 m above the ECL).

According to Scott (1995), water table monitoring in the Eastern Basin indicates several different water table elevations which are probably due to the geometry of the mine void. The mine void consists of at least three different basins, namely the East Rand Basin, Brakpan Basin and Sallies Basin. Long-term water level monitoring by the DWA started in the south-eastern part of the Eastern Basin at the Sub-Nigel workings in early 2010 with a long-term daily rise of 0.30 m. Water level depths obtained from precise water level measurements in nine shafts in the Eastern Basin do not indicate a plane elevation as observed in the Western and the Central Basins. The reason for this phenomenon is unclear, although partial blockage of some shafts might be the reason for these differences.

6.8.1 Hydrocensus

A review of borehole data captured on DWA's groundwater database indicate that the near surface/ shallow groundwater levels lie between 5 and 60 m below surface within the proposed sludge disposal sites.

During March 2014, a hydrocensus survey was undertaken to gather information on the existing groundwater abstraction points and groundwater users in the Project area within a 5 km radius of the Project area. Water levels were measured and samples were taken to determine the current water level and quality conditions of the local aquifers.

During the hydrocensus, a total of 14 boreholes were identified (Refer to Plan 15, Appendix A). It was determined that of the 14 boreholes, only 5 were in use. The identified water uses for these boreholes were for domestic, irrigation and industrial purposes.

A total of 10 groundwater samples were collected from 10 boreholes. Four boreholes were dry and could not be sampled. Water levels were measured from 9 boreholes that were not capped. As indicated in Table 6-5, the water levels in the surveyed area ranged from 2.73 meters below ground level (mbgl) in borehole AECBH03 to 35 mbgl in borehole AECBH13 upstream of the proposed sludge disposal sites (Refer to Plan 15).

Table 6-5: Hydrocensus coordinates water level and measurement summary

Site ID	Elevation (mamsl)	Water Levels (WL) (mbgl)	Hydrocensus undetaken
AECBH01	1583.49	21	Sample was taken and WL were measured
AECBH02	1593.95	7	Sample was taken and WL were measured
AECBH03	1576.77	2.73	Sample was taken and WL were measured
AECBH04	1593.93	-	None. Borehole was dry at the time of the hydrocensus survey
AECBH05	1595.59	-	None. Borehole was dry at the time of the hydrocensus survey
AECBH06	1617.65	Pumping	Sample was taken.
AECBH07	1583.02	2.8	Sample was taken and WL were measured
AECBH08	1576.91	15.4	Sample was taken and WL were measured
AECBH09	1578.33	15	Sample was taken and WL were measured
AECBH10	1580.85	-	None. Borehole was dry at the time of the hydrocensus survey
AECBH11	1580.60	-	None. Borehole was dry at the time of the hydrocensus survey
AECBH12	1579.67	3.1	Sample was taken and WL were measured
AECBH13	1615.85	35	Sample was taken and WL were measured
AECBH14	1589.56	14.5	Sample was taken and WL were measured

6.8.2 Groundwater Quality

During the hydrocensus, groundwater samples were taken from 10 boreholes and were submitted to an accredited laboratory. The results will be available in time for the draft EIA Report for discussion.

According to BKS (2011), the Eastern Basin has always had better water quality compared to the Western and Central Basins. Mine water quality in the Eastern Basin is of a relatively good quality for a number of geohydrological reasons, such as the recharge of the mine workings with relatively good quality dolomitic water as well as the lower concentration of pyrites in the rock below the water levels and the recharge through the alkaline dolomites.

According to Scott (1995), the water quality is expected to change as the water rises into the Kimberley Reef, which typically has higher pyrite content than the Main Reef. The Kimberley Reef was mined to a lesser extent than the Main Reef and therefore provides a much smaller contact surface. Additionally, the rapid filling of the Eastern Basin does not provide contact time between water, oxygen and pyrite, which should have a positive impact on the AMD water quality. Therefore, due to the flooding of the Eastern Basin and the associated mobilisation of accumulated pyrite oxidation products, the water quality will deteriorate in time if not addressed.

The historical water quality data which was measured at the Grootvlei Mine is shown in Table 6-6 below.

Table 6-6: Eastern Basin Water Quality (BKS, 2011)

Parameter	Unit	Black Reef Incline Concentration		IMC Report Concentrations
		Median	95th percentile	
Total Dissolved Solids (TDS)	mg/L	2,880	4,405	5,500
Electrical Conductivity (EC)	mg/L	295	360	450
Calcium (Ca)	mg/L	395	440	550
Magnesium (Mg)	mg/L	160	185	230
Sodium (Na)	mg/L	220	260	325
Potassium (K)	mg/L	5		15
Sulphate (SO_4)	mg/L	2,400	2,620	3,275
Chloride (Cl)	mg/L	16	205	260
pH		6.5	5.9 (5th perc.)	5.0
Alkalinity ($CaCO_3$)	mg/L	230	40 (5th perc.)	0
Acidity ($CaCO_3$)*	mg/L	220	460	750

Parameter	Unit	Black Reef Incline Concentration		IMC Report Concentrations
		Median	95th percentile	
Iron (Fe)	mg/L	120	247	370
Aluminium (Al)	mg/L	0.1	0.3	1
Manganese (Mg)	mg/L	3.5	6.0	10.0
Nickel (Ni)	mg/L	0.3	0.4	1

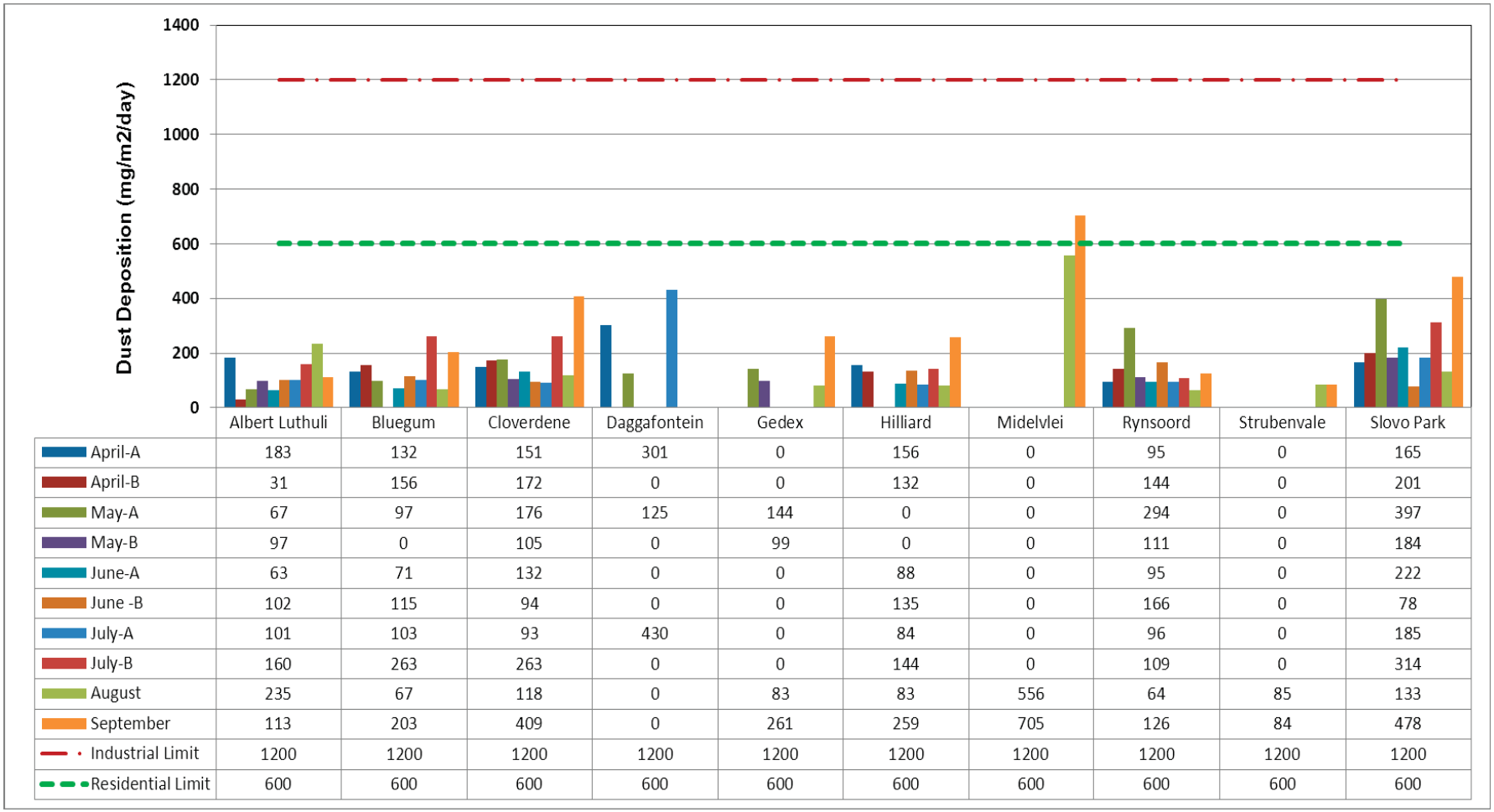
6.9 Air Quality

The major atmospheric pollutants near Springs will be influenced by several local and regional pollutants signature, which includes mainly:

- Precious Metals Refinery;
- TSFs; and
- Agricultural activities.

6.9.1 Dust Fallout

A monitoring network, set up in 2007 and operated by *Environmental and Hygiene Engineering CC* on behalf of Grootvlei Proprietary Mines Limited (Grootvlei), Consolidated Modderfontein Mines 1979 Limited (CMM) and Nigel Gold Mining Company (Pty) Ltd (NGM) comprised mainly of multi-directional sites with exception of Albert Luthuli, Cloverdene, Daggafontein and Slovo Park that were single sites. The average dust deposition rates from the multi-directional units were evaluated and used. The historical dust deposition rates for the aforesaid areas in Springs are presented in Figure 6-13 below. It should be noted that the results should be viewed with caution as sampling was conducted for three weeks during this period in the year 2007 instead of the recommended 30 days (±2) in terms of the internationally accepted results for dust deposition measurements or the SANS 1929:2011 (adapted from ASTM1739-98).



	Albert Luthuli	Bluegum	Cloverdene	Daggafontein	Gedex	Hilliard	Midelvlei	Rynsoord	Strubenvale	Slovo Park
April-A	183	132	151	301	0	156	0	95	0	165
April-B	31	156	172	0	0	132	0	144	0	201
May-A	67	97	176	125	144	0	0	294	0	397
May-B	97	0	105	0	99	0	0	111	0	184
June-A	63	71	132	0	0	88	0	95	0	222
June -B	102	115	94	0	0	135	0	166	0	78
July-A	101	103	93	430	0	84	0	96	0	185
July-B	160	263	263	0	0	144	0	109	0	314
August	235	67	118	0	83	83	556	64	85	133
September	113	203	409	0	261	259	705	126	84	478
Industrial Limit	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
Residential Limit	600	600	600	600	600	600	600	600	600	600

Figure 6-13: Dust deposition rates at the boundaries of Grootvlei Mine, 2007

6.9.2 Particulate and Gaseous Pollutant Baseline

An Air Quality Report was compiled by Airshed in 2012 reporting on the air quality in Springs. The air quality data was measured from the closest station near Springs, located in Pollak Park suburb (south of New Era). The PM daily average value reported by the Ekurhuleni metro at the time was 30 µg/m³.

Daily average SO_2 values for the area was approximately 8 parts per billion or 19 µg/m³.The NO_2 daily average of approximately 16 parts per billion or 26 µg/m³ was measured for the area according to the report.

The DEA has published the New National Dust Control Regulations on November 1, 2013. In the New National Dust Control Regulations, terms such as target, action and alert thresholds were omitted. Another notable observation was the reduction of the permissible frequency from three to two incidences within a year. The standard actually adopted a more stringent approach than previously, and would require dedicated mitigation plans now that it is in force.

The proposed National Dust Fallout standard is given in the Table 6-7 below. As seen in Figure 6-13 above, the residential limit was exceeded in Midelvlei in September. The remaining dust fallout levels were in compliance to the National Dust Fallout Standards.

Table 6-7: National Dust Fallout Standards (using ASTM D1739:1970 or equivalent)

Restriction Areas	Dust fall rate (mg/m^2/day, 30-days average)	Permitted Frequency of exceeding dust fall rate
Residential Area	D < 600	Two within a year, not sequential months
Non-Residential Area	600 < D < 1200	Two within a year, not sequential months

Additionally, the DEA has established National Ambient Air Quality Standards for PM_{10} (Table 6-8) and particulate matter of aerodynamic diameter less than 2.5 micron metres since June 2012 (GN486: 2012) as depicted in Table 6-9.

Table 6-8: National Ambient Air Quality Standards as of 24 December 2009

National Ambient Air Quality Standards for Particulate Matter (PM_{10})			
AVERAGING PERIOD	**LIMIT VALUE ($\mu g/m^3$)**	**FREQUENCY OF EXCEEDANCE**	**COMPLIANCE DATE**
24 hour	120	4	Immediate – 31 December 2014
24 hour	75	4	1 January 2015
1 year	50	0	Immediate – 31 December 2014
1 year	40	0	1 January 2015
The reference method for the determination of the PM_{10} fraction of suspended particulate matter shall be EN 12341.			
National Ambient Air Quality Standards for Ozone (O_3)			

Table 6-9: National Ambient Air Quality Standards for Particulate Matter ($PM_{2.5}$)

National Ambient Air Quality Standards for Particulate Matter ($PM_{2.5}$)			
AVERAGING PERIOD	**LIMIT VALUE ($\mu g/m^3$)**	**FREQUENCY OF EXCEEDANCE**	**COMPLIANCE DATE**
24 hours	65	0	Immediate – 31 December 2015
24 hours	40	0	1 January 2016 – 31 December 2029
24 hours	25	0	01 January 2030
1 year	25	0	Immediate – 31 December 2015
1 year	20	0	1 January 2016 – 31 December 2029
1 year	15	0	01 January 2030
The reference method for the determination of PM2.5 fraction of suspended particulate matter shall be EN 14907.			

6.10 Noise

A baseline analysis was undertaken to determine the current ambient noise levels at the surrounding areas of the proposed project. The noise measurements were taken during day time and night time. The locations of receptors were selected that may possibly be impacted on by the proposed project activities and that were identified as suitable reference points for the measurement of ambient sound levels surrounding the proposed project area (refer to Figure 6-14, Figure 6-15 and Figure 6-16 for the identified noise receptors). The noise measurement locations can be seen on Plan 16 (Appendix A). The results of the noise baseline measurements are presented in Table 6-10.

Figure 6-14: Measurement location N1

Figure 6-15: Measurement location N2

Figure 6-16: Measurement location N3

Table 6-10: Results of the baseline noise measurements

Sample ID	SANS 10103:2008 Rating Limit					
	Type of district	Period	Acceptable rating level dBA	$L_{Areq,T}$ dBA	Maximum/Minimum dBA	Date
N1	Rural	Daytime	45	51	82 / 27	03/04/2014
		Night time	35	43	76 / 25	03/04/2014
N2	Suburban	Daytime	50	50	85 / 31	01/04/2014
		Night time	40	38	66 / 27	01/04/2014
N3	Urban	Daytime	55	47	81 / 38	02/04/2014
		Night time	45	42	68 / 29	02/04/2014
	Indicates current $L_{Aeq,T}$ levels above either the daytime rating limit or the night time rating limit					

6.10.1 Day Time Results

The day time results measured at the rural receptor N1 indicated that the existing ambient noise levels were mostly above the South African National Standards (SANS) rating levels for the maximum allowable outdoor daytime limit for ambient noise in rural districts. The overall ambient noise levels at N1 recorded were agricultural activities involving the operation of the tractor on the farmstead as well as the domestic animals and bird song.

The baseline noise level at the suburban receptor N2 measured at the limit of the daytime noise guideline for suburban districts. The baseline noise level at the urban receptor N3 measured below the SANS rating levels for the maximum allowable outdoor daytime limit for ambient noise in urban districts.

The overall trend of the daytime sound levels indicate the levels peak between 05:00 and 06:00 in the morning and then again between 18:00 and 20:00 in the evening.

6.10.2 Night Time Results

Based on the night time results measured at the rural receptor N1, the existing ambient noise levels are mostly above the SANS guidelines for the maximum allowable outdoor night time limit for ambient noise in rural districts.

The baseline noise level at the suburban receptor N2 measured below the night time noise guideline for suburban districts. The baseline noise level at the urban receptor N3 measured below the SANS rating levels for the maximum allowable outdoor night time limit for ambient noise in urban districts.

The overall trend of the night time sound levels indicate a steady decline in noise levels from 22:00 until 05:00 and then a sharp rise between 05:00 and 06:00, mostly attributed to the increase in bird song and vehicular activity.

6.11 Cultural Heritage Environment

The region of the Project area holds historical value. Gold was first discovered in 1899 on the farm Geduld, and the Main Reef was discovered in 1902, ultimately leading to the establishment of the Grootvlei Proprietary Mine Limited and the town of Springs in 1904. Architecturally, many mine and public buildings were designed by Sir Herbert Baker for the working middle class (Mark, 2010). Additionally, Springs also holds the second largest collection of small scale Art Deco buildings in the world (Anonymous, 2000).

Other heritage resources that add to the cultural landscape include historical burial grounds associated with homesteads and mining complexes. Such cemeteries may be perceived as intangible memorials of the workers who lived, worked and died on the mines. An example of this, although not related to the Project area, is the recent discovery of human remains exposed by erosion from beneath a reclaimed slimes dump opposite the Crown Mines Plant. The remains were determined to be of Chinese origin (Smillie, 2011). Between 1904 and 1908 labour was ‘imported’ from China and employed on several of the Witwatersrand mines

(Richardson, 1977). One result thereof was the establishment of Chinese communities in 'pockets' around the region. The discovery of the Chinese cemetery is an example of intangible heritage[2].

From a site specific point of view, a desktop cartographic survey was conducted to determine the potential of historical sites to exist within the project area and the surrounding region, as well as relative age based on the dates of the maps. Historical aerial photographs, historical maps, current topographic maps and satellite imagery were used to this end. Overall, the Eastern Basin area showed high levels of development associated with industrial and mining activities. Present satellite imagery indicates that the Eastern Basin has over time become progressively more industrial with an increase in residential settlements as well.

The earliest cartographic information for the study area is the 1899 Jeppe Map of the Transvaal. On this map, telegraph lines on Grootvlei 45 (now Grootvaly 124 IR) and on Daggafontein 94 intersected on G.G De Springs 396 (now Springs CBD) station. The location of this station would suggest that the region was inhabited during this period and associated settlement infrastructure would have been located in the area (refer to Figure 6-17).

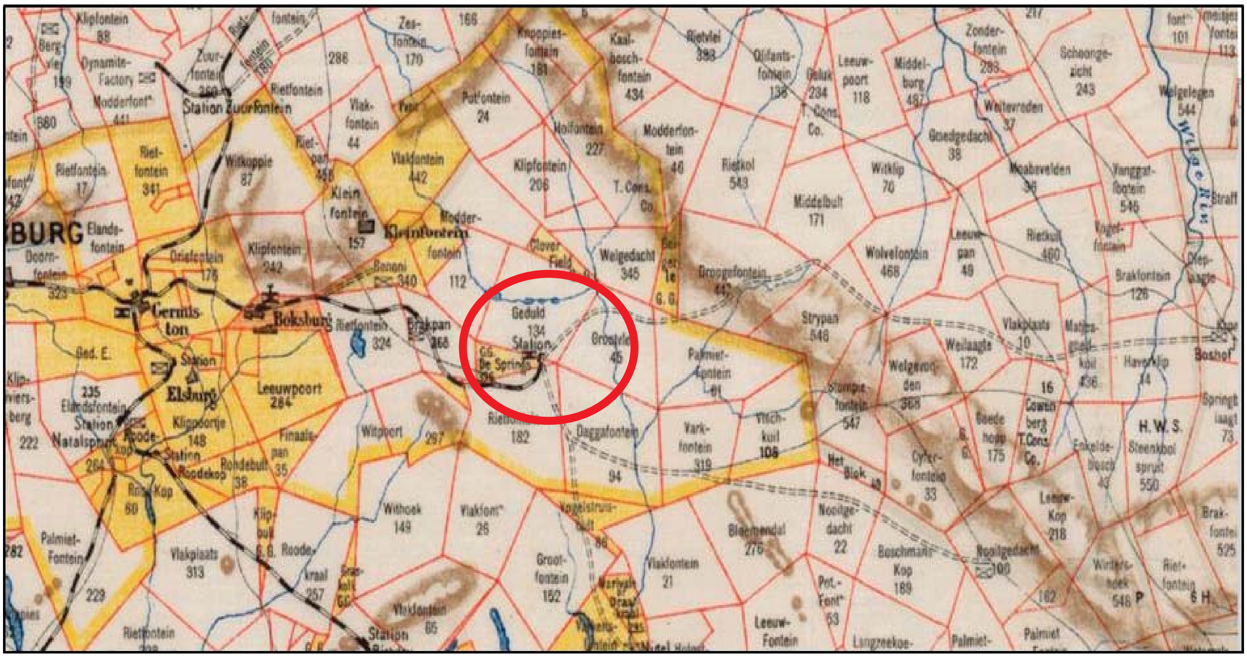


Figure 6-17: Location of Station on G.G. De Springs 396 (red circle)

The earliest aerial imagery of the study area dates to 1938. Within these photographs, it is evident that agricultural and mining operations within the region are well established. The existence of the mining and agriculture industries within the region suggest that built

[2] Intangible refers to heritage associated with living practices such as rituals, but also sense of place, oral histories and significance associated with sacred places.

environments protected under Section 34 of the NHRA and burial grounds and graves protected under Section 36 of the NHRA are likely to occur.

The description and type of heritage resources identified surrounding the Project area is indicted in Table 6-11 below. The site number can be referenced to Plan 17 (Appendix A). As depicted on Plan 17, none of these heritage artefacts occur within the Project area.

Table 6-11: Identified heritage resources from the desktop study

Site Number	Description
S.35-001	Possible Iron Age stone walling
S.36-002	Burial grounds and graves - possibly indentured Chinese labourers
S.36-003	Military cemetery containing graves of coloured soldiers who perished during World War II. Also contains memorial for other soldiers who died outside of South Africa. Listed on the GSSA
S.36-004	Fourie & Ramsden (2002-SAHRA-0088) CM1 Possible graves of Chinese mine labourers from turn of 20th century as suggested by Julian Baker in Van Schalkwyk 1997
S.34-005	Built Environment associated with Modderfontein Mine Fourie & Ramsden (2002-SAHRA-0088) CM2 - CM5 dating from 1910 through 1930s
2008-SAHRA-0540/Site 1	S.34-006 - Built Environment, Foundation remains of mining compound.
2008-SAHRA-0650/Site 1	S.34-007 - Built Environment
2008-SAHRA-0650/Site 2	S.36-008 - Burial Ground, Listed on GSSA
2008-SAHRA-0650/Site 3	S.34-009 - Built Environment
2006-SAHRA-0102/Site 1	S.36-010 - Burial ground, African cemetery
CaseID290/Site 1	S.34-011 - Built Environment, Industrial remains
CaseID290/Site 2	S.34-012 - Built Environment
CaseID290/Site 3	S.36-013 - Built Environment
CaseID290/Site 4	S.36-014 - Built Environment
CaseID290/Site 5	S.34-015 - Built Environment
CaseID290/Site 6	S.34-016 - Built Environment

Site Number	Description
CaseID290/Site 7	S.34-017 - Built Environment
CaseID290/Site 9	S.34-018 - Built Environment
CaseID290/Site10	S.34-019 - Built Environment

6.12 Regional Socio-economic Environment

A social baseline study was conducted for the Project to determine the potential impacts on the socio-economic environment in which the sludge disposal sites and pipelines would be located.

The proposed project is situated in the Ekurhuleni Metropolitan Municipality. This Municipality is known as the country's "industrial hub" due to its flourishing manufacturing sector, and hosts South Africa's largest airport, namely the OR Tambo International Airport.

The baseline description of the socio-economic environment in and surrounding the Project area is described in the sections below. The baseline description is based on the Census conducted on 2011.

6.12.1 Site Specific socio-economic Environment

6.12.1.1 Grootvlei 6/L/16

This site is surrounded by mining infrastructure and land to the east, as well as a mining-related residential area (approximately 800 m to the east). The residential suburb of Bakerton is located about 650 m to the north of the site, with decommissioned mine dumps to the north and north-east, and mining land to the east. Another residential area is situated about 400 m south of the site, representing the closest sensitive receptor.

6.12.1.2 Largo Site 4

The site is immediately north of industrial and residential (small holdings) area. The site is bordered by mining land and infrastructure to the west and north. Upmarket housing development is located approximately 400 m north of the north-eastern corner. Aston Lake and commercial agricultural land is located to the east of the site. The closest sensitive receptors are located about 100 m from site.

6.12.2 Economic Activities

The Ekurhuleni Metropolitan Municipality's economy is both large and diverse; it accounts for nearly a quarter of Gauteng's economy, which, in turn, contributes over a third of the national Gross Domestic Product (GDP). Despite the area historically being one of the largest

producers of gold, the major economic sectors now include manufacturing, wholesale and trade, energy, and finance. About 40% of the province's manufacturing and industry sector is located in Ekurhuleni, hence the nickname of South Africa's "industrial hub". The Ekurhuleni Metropolitan Municipality's economy grew by an estimated average of 3.2% per annum between 1996 and 2011.

6.12.2.1 Mining

The Witwatersrand basin was heavily mined since 1900. The Witwatersrand basin has yielded as much as 98% of the primary gold recovered in South Africa, and still contains an estimated 35 000 tons of gold, representing 45% of the world's known gold resources. Despite this, mining currently contributes only a small percentage to Ekurhuleni's economy (an estimated 2% in 2004), with few mines still in operation.

The legacy of mining (as well as poor land use planning in the past) has severely impacted on the productivity of land and has rendered large areas within the Ekurhuleni Metropolitan Municipality unusable, mostly because of widespread degradation of land and water resources.

6.12.2.2 Agriculture

Approximately 14% of the Ekurhuleni Metropolitan Municipality is regarded as high potential land suitable for agricultural production, while a further 12% is regarded as moderate to high potential land. The Gauteng Agricultural Potential Atlas identified 41% of Ekurhuleni Metropolitan Municipality's surface area as being important for protection for agricultural purposes, and should be reserved and protected from development. As described above, the land capability of the Largo Site is a Type III and thus considered to be of moderate agricultural potential. With Grootvlei 6L16 currently functioning as a TSF, the agricultural potential is not considered.

6.12.3 Summary of Baseline Characteristics

The socio-economic baseline characteristics of the Project area are summarised in Table 6-12 below.

Table 6-12: Summary of baseline characteristics of the primary and secondary study areas

Baseline characteristic	Ekurhuleni Metropolitan Municipality	Lesedi Local Municipality	Primary study area
Population size	3.2 million	100 000	75 300
Number of households	1 million	30 000	23 700
Female headed households	31%	31%	24%
Most prominent racial group	Black African (79%)	Black African (77%)	Black African (54%)

Baseline characteristic	Ekurhuleni Metropolitan Municipality	Lesedi Local Municipality	Primary study area
Second most prominent racial group	Whites (16%)	Whites (20%)	Whites (37%)
Most common first language	IsiZulu (29%)	IsiZulu (40%)	Afrikaans (34%)
Second most common first language	English and Afrikaans (12% each)	Sesotho (21%)	IsiZulu (18%)
Proportion males	51%	52%	52%
Potentially economically active population	72%	69%	72%
Proportion adults with no schooling	4%	7%	4%
Proportion adults who graduated high school	35%	28%	35%
Unemployment rate	29%	25%	14%
Youth unemployment rate	37%	33%	17%
Households with no income	18%	15%	18%
Households with access to flush toilet	85%	84%	71%
Households with access to electricity	81%	90%	72%
Households with weekly refuse removal	88%	83%	71%
Proportion of population with no internet access	57%	68%	-

7 Public Participation Process

7.1 Public Participation during the Impact Assessment Phase

Public participation is an essential and legislative requirement for environmental authorisation. It involves communication and disclosure of relevant project information and provides those interested in, or affected by, a proposed development an opportunity to provide input into the decision making process. It is a legislative requirement to undertake PPP for any development that requires environmental authorisation.

The PPP for the proposed project was undertaken in an effort to ensure that all I&APs were given a platform to raise their issues and comments regarding the proposed project.

7.1.1 Objectives of the Public Participation Process

PPP has been designed to achieve the following objectives:

- To Identify and register all I&APs for the Project;
- To ensure that I&APs are informed about the proposed project and the PPP to be followed;
- To provide I&APs with an opportunity to raise issues of concern and suggest project alternatives;
- To ensure that stakeholders receive accurate and sufficient project information;
- To verify that stakeholder comments have been accurately recorded;
- To document all I&APs concerns and ensure that these concerns are included in the Terms of Reference (ToR) for specialist studies to be undertaken during the EIA Phase; and
- To comply with legal requirements.

7.1.2 Phases of the Public Participation Process

The PPP has been designed with three (3) main phases of stakeholder engagement, namely:

- Scoping Phase;
- Impact Phase; and
- Decision Making Phase.

The activities conducted or to be conducted are described below.

7.1.2.1 Scoping Phase

The Project is currently in the Scoping Phase. The scoping phase comprises the following tasks (refer to Figure 7-1 below illustrating the Scoping Process):

- Identification of additional stakeholders;
- Notification of the public of the formal EIA process;
- Distribution of a Background Information Document (BID), publication of newspaper adverts and erection of site notices;
- Gathering further concerns, suggestions and comments from I&APs; and
- Meetings with stakeholders.

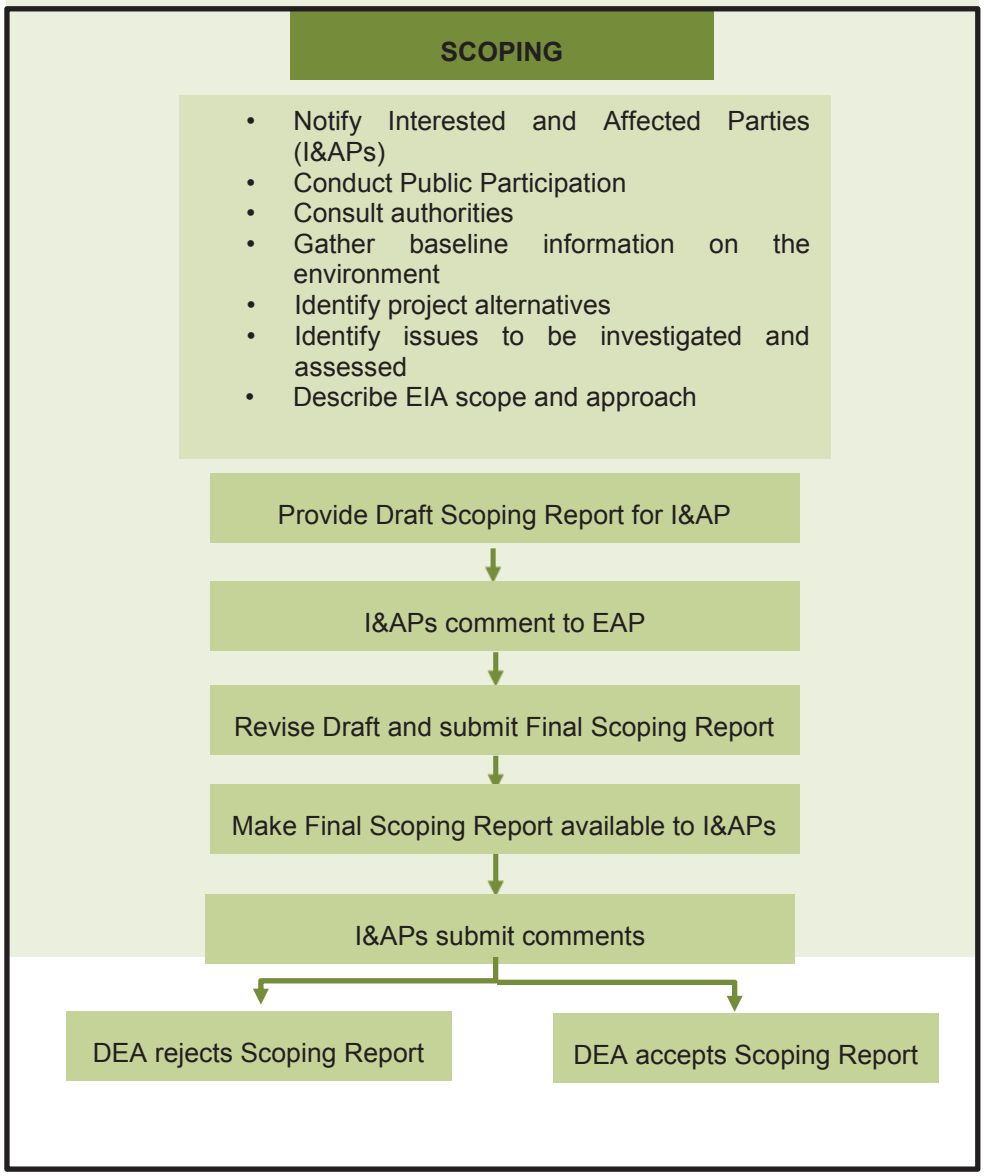


Figure 7-1: Scoping Process

7.1.2.2 Impact Assessment Phase

The impact assessment phase comprises the following tasks:

- Providing feedback regarding the specialist studies conducted and verify that comments have been considered in the environmental investigations;
- Providing I&APs with the opportunity to comment on findings of the specialist impact assessments and proposed mitigation measures; and
- Verification that comments raised by stakeholders have been accurately recorded.

7.1.2.3 Decision-making Phase

The decision making phase comprises the following tasks:

- With completion of the process, all registered IAPs will be notified of the decision made by DEA on the EIA process and provided with details should they want to appeal the decision; and
- Should any stakeholder wish to appeal the decision in terms of Chapter 7 of NEMA, a notice of intention to appeal must be lodged directly with DEA, which is within twenty (20) days of the authorisation date and also accounts for public holidays. Further to the aforementioned regulations, Regulation 62 (1) states that an appeal as contemplated in Regulation 61 (1) must be submitted within 30 days after the lapsing of the 20 days contemplated in 60 (1).

7.1.3 Methodology

The PPP methodology for the EIA process is set out in detail below.

7.1.3.1 Stakeholder Identification

To ensure a proper representation of all stakeholders affected by or interested in the project, the following identification methods were used to develop a stakeholder database:

- Conducted Windeed searches of properties in and around the project site to verify landownership and obtain contact details;
- Went onto to site to try and obtain additional stakeholder information;
- Responses received from the publication of newspaper advertisements and placement of site notices;
- Responses on the distribution of the BID; and
- Telephonic consultation with landowners and land occupiers to identify additional I&APs.

Stakeholders are grouped into the following categories as presented in Table 7-1 below.

Table 7-1: Stakeholder Categories

Category	Description
Government	National, Provincial, District and Local authorities
Landowners	Directly affected and surrounding landowners within a 100 m buffer
Land occupiers	Directly affected and surrounding land occupiers
Communities	Surrounding communities
Non-Governmental Organisations (NGOs)	Environmental organisations and Community-based Organisations (CBOs)
Business	Small to medium enterprises and formal business organisations
Other	Agriculture and farmers organisations, industry etc.

Fifteen (15) directly affected farms were identified in the Project area associated with the proposed sludge disposal sites and pipelines. The directly affected farms and details are presented in Table 7-2 below. A Stakeholder Database has been compiled which will be updated throughout the EIA process (refer to Appendix B for the Stakeholder Database).

Table 7-2: Directly Affected Landowners

Site ID	Farm	Farm Portion	Owner/Title Position
Pipeline to Largo Site 4	Grootvaly AH	100	Grootvlei Prop Mines Ltd
Pipeline to Largo Site 4	Grootvaly AH	101	Grootvlei Prop Mines Ltd
Pipeline to Grootvlei 6L16	Grootvaly AH	102	Grootvlei Prop Mines Ltd
Pipeline to Grootvlei 6L16	Grootvaly AH	103	Gauteng Provincial Government
Pipeline to Grootvlei 6L16	Grootvaly AH	105	Mayborn INV 75 Pty Ltd
Pipeline to Largo Site 4	Grootvaly AH	95	Gauteng Provincial Government
Pipeline to Largo Site 4	Grootvaly AH	96	Gauteng Provincial Government
Pipeline to Largo Site 4	Grootvaly AH	97	Gauteng Provincial Government
Pipeline to Largo Site 4	Grootvaly AH	98	Gauteng Provincial Government

Site ID	Farm	Farm Portion	Owner/Title Position
Pipeline to Largo Site 4	Grootvaly AH	99	Grootvlei Prop Mines Ltd
Largo Site 4	Palmietkuilen 241-IR	9	Paterson Management Pty Ltd
Pipeline to Largo Site 4	Grootvaly 124-IR	17	Jacobs & Seuns Landgoed Cc
Pipeline to Grootvlei 6L16	Grootvaly 124-IR	R/	Grootvlei Prop Mines Ltd
Largo Site 4	Grootvaly 124-IR	31	Largo Prop Pty Ltd
Pipeline to Largo Site 4	Grootvaly 124-IR	2	Ekurhuleni Metropolitan Municipality

7.1.3.2 Public Participation Documents

The methods employed to disseminate the Project information to stakeholders are detailed below. The various Public Participation materials used as part of the project announcement, as indicated above, have been included as Appendix B. Table 7.3 below outlines all specific details associated with the following public participation documents:

- BID: The BID includes the location and a description of the proposed project, the legislative processes that will be followed, specialist studies to be conducted, the PP process to be followed and the contact details of the responsible person.
- Newspaper Advertisements: An advert was placed in one Local Newspaper in English. The advert included a brief project description, information about the required legislation, the decision-making authority, details of the appointed independent environmental consultant.
- Site Notices: Site notices were put up at various places around the project area and conspicuous public places. The site notices contained a brief project description, information about the required legislation, the decision-making authority, details of the appointed independent environmental consultant.
- Letter with Comment and Registration Sheet: A letter was sent to stakeholders via post and email containing information about the proposed project, applicable legislation and decision-making authority. A Registration and Comment Sheet was also provided for stakeholders to use for formal registration as I&APs or to submit comments.

7.1.3.3 Consultation with Stakeholders

Consultation with stakeholders will take place to share content of the Draft Scoping Report and to gather inputs regarding the proposed project. The consultations which will take place are set out below.

- Landowner Consultation: One-on-one meetings will be conducted with directly affected Landowners in June/July. Comments, concerns and suggestions received from the landowners will be captured in the Comments and Response Report (CRR).
- Public Meeting: A Public Meeting will be held in July/August. All stakeholders on the database will be invited to attend the Public Meeting. Information about the proposed project will be shared at the public meeting by means of a formal PowerPoint presentation to:
  - Discuss contents of the Draft Scoping Report in detail;
  - Verify that comments raised during the initial one-on-one consultation meetings and BID were captured correctly;
  - Raise additional comments; and
  - Clarify any questions or comments raised.

All comments raised by stakeholders at the respective meetings as indicated above, and throughout the PPP, will be captured into the CRR (see Appendix B). Stakeholder comments will be closely considered and addressed, where applicable, in the specialist studies undertaken during the Impact Assessment phase. As part of the CRR, responses will be provided to comments raised by stakeholders.

7.1.4 Public Participation Activities

More detail is provided in Table 7-3 regarding the Public Participation activities, together with referencing materials included as Appendices, which were undertaken as part of the EIA process.

Table 7-3: Public Participation Activities

Activity	Details	Reference in Report
Scoping Phase		
Identification of stakeholders	Stakeholder database which includes I&APs from various sectors of society including directly affected and adjacent landowners in and around the proposed project area.	Appendix B Stakeholder Database.
Distribution of announcement material	BID, announcement letter with comment and registration sheet was emailed and posted to stakeholders in May 2014. The Background Information Document is also available on www.digbywells.com (Public Documents). (Registration period: May/ June 2014)	Appendix B BID, letter with registration and comment sheet
Placing of adverts	An advert, in English, was placed in the Springs	Appendix B

Activity	Details	Reference in Report
	Advertiser on *Thursday, 22 May 2014*.	Adverts
Putting up of site notices	Site notices (10), in English, were put up at the proposed project site, local library at municipal offices and venues in the project area on *Monday, 26 May 2014:* ▪ Springs Public Library; and ▪ Brakpan Public Library. A site notice map has been developed which provides location points of the site notices that were put up.	Appendix B Site notices and site notice map
Landowner Consultation	Landowner meetings were held with Directly Affected and Indirectly Affected Landowners on *Thursday, 19 June 2014.* Comments, concerns and suggestions received from stakeholders were captured into the CRR.	Appendix B Comment and Response Report
Announcement of Draft Scoping Report	The availability of DSR was announced by email and posted to stakeholders on *Friday, 20 June 2014.* Copies of the DSR were made available at the following public places: ▪ Springs Public Library; and ▪ Brakpan Library. The Scoping Report is available on www.digbywells.com (Public Documents) and was made available at the Public Meeting. *(Comment period for the DSR is from Monday, 23 June to Monday, 4 August 2014)* A poster was also put up at the Public Libraries mentioning the above to provide details of availability of the DSR and Public Meeting.	Appendix B Announcement Letter
Public Meeting with stakeholders	A Public Meeting will be held on *Wednesday, 23 July 2014* at the Belfast Hotel from 14:00 – 16:00. All comments received at this meeting have been captured into the CRR.	Appendix B Comment and Response Report
Landowner Meetings	Meetings were held on T*hursday, 19 June 2014* at15:00 with the landowners and at 18:00 with the petitioners.	
Obtained comments from stakeholders	Comments, concerns and suggestions received from stakeholders have been captured into the CRR. A Petition was received from landowners adjacent to Largo Site 4, which have been	Appendix B Comment and Response Report.

Activity	Details	Reference in Report
	summarised into the CRR. The Petition has been attached to the CRR for ease of reference.	
Final Scoping Report	The DSR will be updated with lapse of the public comment period and a Final Scoping Report (FSR) made available to stakeholders for 21 days for comment. Stakeholders will be informed of availability of the FSR timeously.	

8 Potential Impacts

This section describes the Project activities to take place and the potential impacts that may emanate from the activities on the receiving environment.

The main Project activities to take place during the construction, operational and decommissioning phases may pose potential impacts on the receiving environment and are described in Table 8-1 below. The following potential impacts have been identified based on the project scope and associated activities. These impacts will be assessed during the EIA Phase, together with any additional impacts that may be identified during the public comment period.

Table 8-1: Project Activities

Environmental Aspect	Identified Potential Impacts
Topography	
Changes that will occur in land use type from agriculture to waste disposal due to disposal on the Largo Site 4 option.	▪ Features will be added to the topography and this will alter the natural topographical functioning of the flat landscape.
Visual	
Visual disturbance on Largo Site 4 due to sludge disposal activities.	▪ Largo Site 4 is situated on flat agricultural land and it is bordered by residential and industrial areas which are already classified as disturbed areas likely resulting in minimal visual impacts.
Visual disturbance due to vehicular activities.	▪ Vehicular activities brought by the construction of the pipelines may cause “visual pollution” arising from dust created by the construction vehicles.
Soils	
Clearing of soil.	▪ Loss of soil in the Largo Site 4 as it is currently under cultivation; and ▪ Land use as well as land capability would be lost.
Deposition of sludge.	▪ Impacts on soil due to dust fallout resulting in an impact on the surrounding soils land capability, by reducing fertility and possibly depositing toxic elements; ▪ Dust fallout also reduces the plant’s photosynthetic process by covering the leaf or fruit; and

Environmental Aspect	Identified Potential Impacts
	▪ Seepage of sludge may negatively impact the soil in Largo Site 4.
Pipeline bursts due to operation of pipelines	▪ This may lead to a reduction in soil fertility.
Fauna and Flora	
Clearing of site during construction phase on Grootvlei 6/L/16	▪ Minimal impacts are expected for terrestrial ecology on this site because of the transformation of natural habitat in this area. No flora SSC are expected to occur and faunal diversity is likely to be low.
Clearing of site during construction phase on Largo Site 4.	▪ Clearing of the site may result in the loss of flora SSC that may occur on site. This is particularly significant for the loss of plant SSC for the area that are commonly found to occur in wetlands such as: *Crinum bulbispermum, Eulophia coddii and Habenaria bicolor*. Movement of vehicles throughout the site during construction may also contribute to the destruction of flora SSC habitat; and ▪ Fossorial animal burrows may be destroyed during construction, which will contribute to a loss of overall biodiversity.
For Largo Site 4, spillage of sludge in Blesbokspruit may cause an impact to the flora and fauna dependent on the Ramsar status of the Blesbokspruit.	▪ Spillage of sludgeay result in the loss of flora SSC that may occur on site. This is particularly significant for the loss of plant SSC for the area that are commonly found to occur in wetlands such as: *Crinum bulbispermum, Eulophia coddii and Habenaria bicolor*. Movement of vehicles throughout the site during construction may also contribute to the destruction of flora SSC habitat; and ▪ Fossorial animal burrows may be destroyed during construction, which will contribute to a loss of overall biodiversity.
Operation of pipelines and disposal of sludge during the operational phase on Grootvlei 6/L/16.	▪ Continued disturbance and human activity on site will contribute to reduced faunal activity. Further to this, it is expected that alien plant species have already colonised this site due to previous

Environmental Aspect	Identified Potential Impacts
	disturbance of the soil. Alien invasion is likely to become prolific owing to further disturbance of the soil.
Operation of pipelines and disposal of sludge during the operational phase on Largo Site 4.	▪ Invasion by alien plant species is expected to occur and any existing animal activity on this site is expected to be reduced due to continued human presence and anthropogenic activity.
Aquatic Ecology (Wetlands and Aquatic Biodiversity)	
Reduction of the quality of aquatic ecosystems and wetlands due to spillages (hydrocarbon spills during construction and sludge during operational phases)	▪ The wetland associated with the Grootvlei area is already highly impacted upon due to the current AMD decant and other legacies of poor industrial management but it is still vulnerable to further impact of the construction of the sludge disposal facility on Grootvlei 6/L/16 due to the nature of the location. Spillage would directly affect the acidity of the system and in turn affect the mortality rate of preferred food source for many water fowl; ▪ Possible impact to the wetlands will include further contamination from the tailings and sludge material already present on Grootvlei 6/L/16 being spilled into the immediately adjacent Blesbokspruit wetland. This will mainly be due to poor management of the construction of the storage facility that results in breakages and spilling of the tailings and sludge material, which is highly toxic; ▪ Potential impacts in the form of spillage of sludge into to the surrounding aquatic environment and wetlands will further negatively influence water chemistry thus effecting available food and habitat for local flora and fauna dependent on the Ramsar status of the Blesboksruit wetland; and ▪ The change in water flow volume and speed due to discharge may impact on aquatic habitats. And the increase in salinity and acidity of the water would impact on the ecological functioning of the system. Hydrocarbon spills are a significant threat from the construction vehicles.
Destabilisation of the facility that will allow breakage and spills to flow into the	▪ For decommissioning, the site needs to be closed and stabilised to prevent any spill or seepage in the future which would have a negative impact on

Environmental Aspect	Identified Potential Impacts
Blesbokspruit wetland downslope.	the immediately adjacent Blesbokspruit wetlands. If done correctly, decommissioning will have minimal impact on the wetlands, aquatics, flora and fauna as the site will no longer be in operational and be stabilised for closure. The storage facility will be a lasting feature in the area of a Ramsar wetland and thus poses a permanent risk if not mitigated, managed and monitored correctly.
Surface Water	
Site clearing may reduce quality of surface water resources and movement of machinery.	▪ The clearing of vegetation and movement of machinery exposes soil to erosion. In the event of a storm, silted runoff water can contaminate streams.
Sludge pipeline leaks and bursts.	▪ The sludge pipeline could leak or burst resulting in discharge to the surrounding environment and to river courses in particular areas resulting in the siltation of surrounding surface water resources.
Sludge deposition may deteriorate surface water resources.	▪ The sludge disposal facility could potentially burst or have mud/ sludge slides after rainfall and storm events. In addition to this potential seepage could trickle to the Blesbokspruit resulting in deteriorated water quality.
Groundwater	
Storage of sludge.	▪ Due to the increased salt load the original contamination plume footprint might extend and include more (previously unaffected) groundwater users; and ▪ Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.
Transportation of sludge.	▪ There are a number of risks associated with the sludge delivery pipelines, the largest of which is the settlement of sludge in the pipeline as a result of a power failure; and ▪ Previously unaffected groundwater sources might

Environmental Aspect	Identified Potential Impacts
	become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.
Noise	
Vehicular movement activities may increase ambient noise levels during the construction phase.	▪ May have potential impacts on the ambient noise levels on the surrounding receptors.
Site Clearing may increase ambient noise levels during the construction phase.	▪ The site clearing and construction of the Largo Site 4 option may impact significantly on the homestead of Mrs Jacobs on portion 17 of the farm Grootvaly 124 IR adjacent to the north as well as the residential/light industrial districts adjacent to the west because of the close proximity to Largo Site 4.
Increase in noise levels during operational phase.	▪ The operation of Largo Site 4 pipelines as well as associated pump station may impact on some residential receptors located west of Largo Site 4 as well as the farmstead to the north; ▪ The operational noise sources attributed to pipelines are water hammers or hydraulic shock as well as the operation of the associated pump station. The effect of water hammer is a loud banging sound, resembling a hammering noise in the pipeline and this is due to when liquid flowing through a pipeline is stopped abruptly. The return water pump station at the Largo Site 4 specifically is expected to be the main noise source during the operational phase; and ▪ The noise impact of the Grootvlei 6/L/16 slurry and return water pipelines as well as associated pump station is however expected to be negligible.
Air Quality	
Increase in dust fallout due to clearing and stripping of soils	▪ This may result in impacts on surrounding ambient air quality concentration levels.
The construction and operation of the HDS Plant may result in wind erosion of loose particulate matter.	▪ Impacts on surrounding ambient air quality, with an increase of Total Solid Particulate (TSP) matter, PM_{10} and $PM_{2.5}$. These particles can be

Environmental Aspect	Identified Potential Impacts
	transported away from the Project area through prevailing winds; ▪ Inhalation risk of heavy metals; ▪ Dust nuisance and soiling of surfaces; and ▪ Impacts associated with gaseous pollutants (considered minimal due the short term duration of the construction phase).
Heritage Artefacts	
Clearing activities for installation of pipes and preparation of sludge disposal facility.	▪ Clearing activities are the largest risk posed to heritage resources, where accidental damage and/ or destruction are known to have occurred; and ▪ The presence of workers in new areas during construction increases the potential for vandalism, most prominently on archaeological resources associated with Iron Age stone walled settlement and burial grounds and graves.
Transportation and deposition of sludge.	▪ Potential envisaged risk is limited to burst pipes and or spillages which could potentially damage heritage resources located in close proximity to the established infrastructure.
Social Environment	
Movement of machinery, site clearing and stockpiling of soil for pipelines.	▪ Temporary employment opportunities from which residents in the study areas could benefit from; ▪ Impacts related to population influx, including pressure on services, expansion of informal settlements, health impacts, and conflict; ▪ Real and perceived safety risks as a result of the construction site and associated activities; and ▪ Nuisance impacts related to increased noise, dust and traffic.
Operation of pipelines.	▪ Health and safety risks associated with leakages or bursts.
Disposal of sludge on waste disposal	▪ Employment opportunities from which residents in

Environmental Aspect	Identified Potential Impacts
facility.	the study areas could benefit from; and ▪ Changes in land and property values.

9 Plan of Study for Environmental Impact Assessment Phase

The purpose of the EIA phase will be to investigate the potential negative and positive impacts of a proposed project activity on the environment. The potential impacts will then be quantified to assess the significance that an impact may pose on the receiving environment. The objectives of the EIA process are to:

- Ensure that the potential environmental and social impacts of the proposed Project are taken into consideration during the decision making process;
- To ensure that the Project activities undertaken do not have a substantial detrimental impact on the environment by presenting management and mitigation measures that will avoid and/ or to reduce/ those impacts;
- Ensure that I&APs are informed about the proposed Project and the PPP to be followed;
- Ensure that I&APs are given an opportunity to raise concerns; and
- Provide a process aimed at enabling authorities to make an informed decision, especially in respect of their obligation to take environmental and social considerations into account when making those decisions.

9.1 Approach

Specialist investigations will be conducted to inform the findings of the draft EIA, which will be placed in the public domain for a 40 day public review period, after which the final EIA Report will be compiled and distributed for a 21 day public comment period, while simultaneously being submitted to the DEA. The EIA will also contain an Environmental Management Programme (EMP) indicating how the impacts will be managed and mitigated.

The various phases of the EIA process (i.e. Scoping Phase, EIA Phase and Environmental Authorisation Phase) are depicted in Figure 9-1 below. The next step of the Project is the EIA Phase.

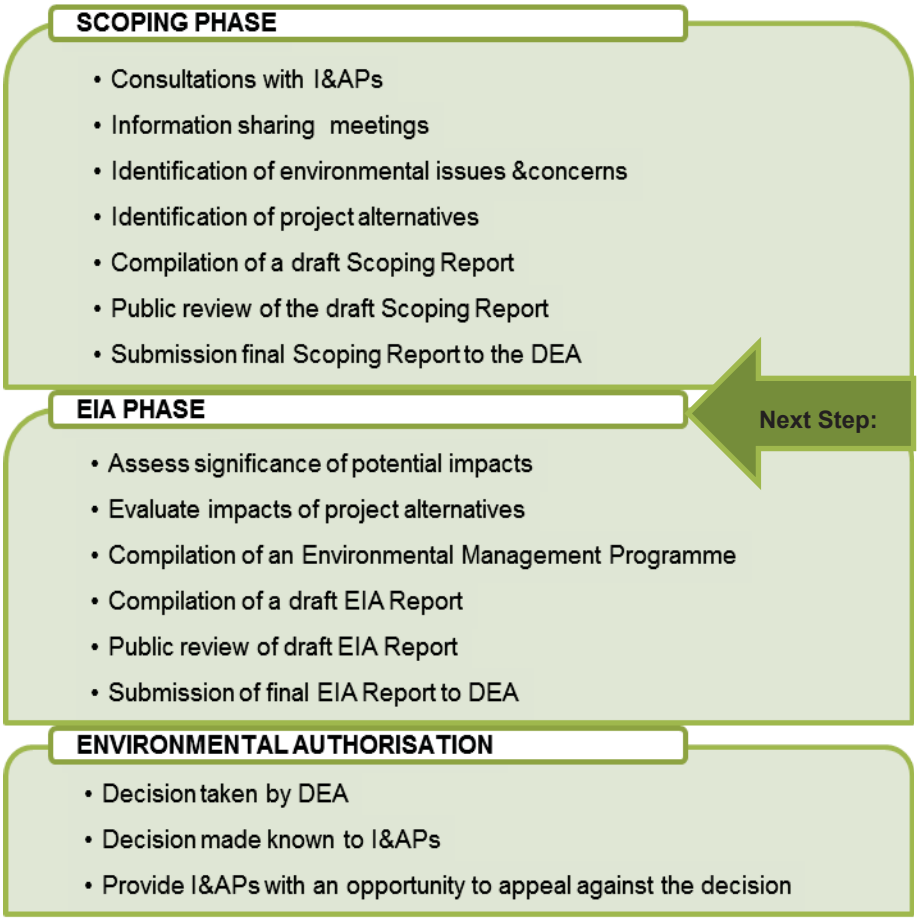


Figure 9-1: Phases of the EIA Process

9.2 Public Participation during the EIA Phase

Public Participation during the EIA Phase will revolve around giving I&APs the opportunity to provide input into the EIA process by providing comments and raising issues regarding the proposed Project.

As part of the EIA Phase, stakeholder meetings will be conducted. These meetings will include a Public Meeting in the Project Area. The Draft EIA Report will be made available to I&APs for comment. The CRR and PPP Report will be updated with stakeholder comments and included in the Final EIA Report for submission to DEA for decision making on the proposed project. All stakeholders will be informed via email, post and adverts of the outcome of the Authority's decision. The public participation steps are outlined below.

9.2.1 On-going Stakeholder Engagement

The identified stakeholders will be engaged through on-going consultation during the EIA process as depicted in Figure 9-1. This engagement will include responding to any additional issues raised by I&APs during the EIA phase.

9.2.2 Meetings

Public feedback meetings will be held once the draft EIA/EMP report is released for public review. The aim of these meetings will be to present the findings of the EIA and to present the EMP report.

9.2.3 Environmental Authorisation Decision

Once the authorities have made a decision with regards to the authorisation of the Project all registered I&APs will be informed of the decision. An advertisement will also be placed in newspapers, informing the general public of the decision.

9.3 EIA Methodology

In order to clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though Digby Wells and the majority of environmental impact assessment practitioners propose a numerical methodology for impact assessment, one has to accept that the process of environmental significance determination is inherently subjective. The weight assigned to each factor of a potential impact and the design of the rating process itself, is based on the values and perception of risk of members of the assessment team, I&APs and authorities who provide input into the process. It is for this reason that it is crucial that all EIAs make reference to the environmental and socio-economic context of the proposed activity in order to reach an acceptable rating of the significance of impacts. It is not the purpose of the EIA process to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts within a specific context.

9.3.1 Impact Identification

Impact identification is performed by use of an input and output model, which serves to guide the assessor in assessing all the potential instances of ecological and socio-economic change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases of the project.

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity. During the determination of outputs, the effect of outputs on the various components of the environment (e.g. topography, water quality, etc.) is considered.

During consultation with I&APs, perceived impacts were identified. These perceived impacts will become part of the impact assessment and significance rating in order to differentiate between probable impacts and perceived impacts.

9.3.2 Impact Rating

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the input and output model. The significance rating process follows the established impact/risk assessment formula:

	Significance = Consequence x Probability
Where	Consequence = Severity + Spatial Scale + Duration
And	Probability = Likelihood of an impact occurring

The severity, spatial scale, duration and probability of an impact occurring are assigned a rating out of seven as indicated in Table 9-1. The matrix calculates an overall significance rating out of 147. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP.

The significance of an impact is determined by reference the significance rating to the probability consequence matrix shown in Figure 9-2 after which it is categorised into one of four categories, as indicated in Table 9-2.

Table 9-1: Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders.	Permanent without mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/definite The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country.	Permanent with mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate.	Very serious widespread social impacts. Irreparable damage to highly valued items.	Provincial/regional Will affect the entire province or region.	Project life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year.	On-going serious social issues. Significant damage to structures/ items of cultural significance.	Municipal area Will affect the whole municipal area.	Long term 6 to 15 years.	Probable Has occurred here or elsewhere and could therefore occur.

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	On-going social issues. Damage to items of cultural significance.	Local Local extending only as far as the development site area.	Medium term 1 to 5 years.	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with or without help of external consultants.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year,	Rare or improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact occurring is very low as a result of design, historic experience or implementation of adequate mitigation measures.
1	Limited damage to minimal area of low significance. Will have no impact on the environment.	Low-level repairable damage to commonplace structures.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month.	Highly unlikely Expected never to happen.

Significance									
		Consequence (severity + scale + duration)							
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Figure 9-2: Probability consequence matrix

Table 9-2: Significance summary table

Significance		
High	**108- 147**	
Medium-High	**73 - 107**	
Medium-Low	**36 - 72**	
Low	**0 - 35**	

9.4 Specialist Study Terms of Reference

The ToRs generally describe the purpose and structure of relevant specialist studies required for a project.

Through the identification and categorisation of the potential impacts of the project, the following specialist studies were deemed necessary for the EIA phase of the AMD Project:

- Visual and Topography Impact Assessment;
- Soil Impact Assessment;
- Fauna and Flora Impact Assessment;
- Wetlands Impact Assessment;
- Aquatic Impact Assessment;
- Surface Water Impact Assessment;

- Groundwater impact Assessment;
- Noise Impact Assessment;
- Air Quality Impact Assessment;
- Heritage Impact Assessment; and
- Social Impact Assessment.

The potential impacts that may result in a medium-high to high significance are summarised in Table 9-3 below.

Table 9-3: Potential Impacts that may result in a High Significance

Environmental Aspect	Identified Potential Impacts
Topography	
Changes that will occur in land use type from agriculture to waste disposal due to disposal on the Largo Site 4 option.	▪ Features will be added to the topography and this will alter the natural topographical functioning of the flat landscape.
Visual	
Visual disturbance on Largo Site 4 due to sludge disposal activities.	▪ Largo Site 4 is situated on flat agricultural land and it is bordered by residential and industrial areas which are already classified as disturbed areas likely resulting in minimal visual impacts.
Soils	
Deposition of sludge.	▪ Impacts on soil due to dust fallout resulting in an impact on the surrounding soils land capability, by reducing fertility and possibly depositing toxic elements; ▪ Dust fallout also reduces the plant's photosynthetic process by covering the leaf or fruit; and ▪ Seepage of sludge may negatively impact the soil in Largo Site 4.
Pipeline bursts due to operation of pipelines	▪ This may lead to a reduction in soil fertility.
Fauna and Flora	
For Largo Site 4, spillage of sludge in Blesbokspruit may cause an impact to the	▪ Clearing of the site may result in the loss of flora SSC that may occur on site. This is particularly

Environmental Aspect	Identified Potential Impacts
flora and fauna dependent on the Ramsar status of the Blesbokspruit.	significant for the loss of plant SSC for the area that are commonly found to occur in wetlands such as: *Crinum bulbispermum, Eulophia coddii and Habenaria bicolor*. Movement of vehicles throughout the site during construction may also contribute to the destruction of flora SSC habitat; and ▪ Fossorial animal burrows may be destroyed during construction, which will contribute to a loss of overall biodiversity.
Operation of pipelines and disposal of sludge during the operational phase on Grootvlei 6/L/16.	▪ Continued disturbance and human activity on site will contribute to reduced faunal activity. Further to this, it is expected that alien plant species have already colonised this site due to previous disturbance of the soil. Alien invasion is likely to become prolific owing to further disturbance of the soil.
Operation of pipelines and disposal of sludge during the operational phase on Largo Site 4.	▪ Invasion by alien plant species is expected to occur and any existing animal activity on this site is expected to be reduced due to continued human presence and anthropogenic activity.
Aquatic Ecology (Wetlands and Aquatic Biodiversity)	
Reduction of the quality of aquatic ecosystems and wetlands due to spillages (hydrocarbon spills during construction and sludge during operational phases)	▪ The wetland associated with the Grootvlei area is already highly impacted upon due to the current AMD decant and other legacies of poor industrial management but it is still vulnerable to further impact of the construction of the sludge disposal facility on Grootvlei 6/L/16 due to the nature of the location. Spillage would directly affect the acidity of the system and in turn affect the mortality rate of preferred food source for many water fowl; ▪ Possible impact to the wetlands will include further contamination from the tailings and sludge material already present on Grootvlei 6/L/16 being spilled into the immediately adjacent Blesbokspruit wetland. This will mainly be due to poor management of the construction of the storage facility that results in breakages and spilling of the tailings and sludge material, which is highly toxic; ▪ Potential impacts in the form of spillage of sludge

Environmental Aspect	Identified Potential Impacts
	into to the surrounding aquatic environment and wetlands will further negatively influence water chemistry thus effecting available food and habitat for local flora and fauna dependent on the Ramsar status of the Blesboksruit wetland; and ▪ The change in water flow volume and speed due to discharge may impact on aquatic habitats. And the increase in salinity and acidity of the water would impact on the ecological functioning of the system. Hydrocarbon spills are a significant threat from the construction vehicles.
Destabilisation of the facility that will allow breakage and spills to flow into the Blesbokspruit wetland downslope.	▪ For decommissioning, the site needs to be closed and stabilised to prevent any spill or seepage in the future which would have a negative impact on the immediately adjacent Blesbokspruit wetlands. If done correctly, decommissioning will have minimal impact on the wetlands, aquatics, flora and fauna as the site will no longer be in operational and be stabilised for closure. The storage facility will be a lasting feature in the area of a Ramsar wetland and thus poses a permanent risk if not mitigated, managed and monitored correctly.
Surface Water	
Sludge pipeline leaks and bursts.	▪ The sludge pipeline could leak or burst resulting in discharge to the surrounding environment and to river courses in particular areas resulting in the siltation of surrounding surface water resources.
Sludge deposition may deteriorate surface water resources.	▪ The sludge disposal facility could potentially burst or have mud/ sludge slides after rainfall and storm events. In addition to this potential seepage could trickle to the Blesbokspruit resulting in deteriorated water quality.
Groundwater	
Storage of sludge.	▪ Due to the increased salt load the original contamination plume footprint might extend and include more (previously unaffected) groundwater users; and

Environmental Aspect	Identified Potential Impacts
	▪ Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.
Transportation of sludge.	▪ There are a number of risks associated with the sludge delivery pipelines, the largest of which is the settlement of sludge in the pipeline as a result of a power failure; and ▪ Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.
Noise	
Site Clearing may increase ambient noise levels during the construction phase.	▪ The site clearing and construction of the Largo Site 4 option may impact significantly on the homestead of Mrs Jacobs on portion 17 of the farm Grootvaly 124 IR adjacent to the north as well as the residential/light industrial districts adjacent to the west because of the close proximity to Largo Site 4.
Increase in noise levels during operational phase.	▪ The operation of Largo Site 4 pipelines as well as associated pump station may impact on some residential receptors located west of Largo Site 4 as well as the farmstead to the north; ▪ The operational noise sources attributed to pipelines are water hammers as well as the operation of the associated pump station. The return water pump station at the Largo Site 4 specifically is expected to be the main noise source during the operational phase; and ▪ The noise impact of the Grootvlei 6/L/16 slurry and return water pipelines as well as associated pump station is however expected to be negligible.
Air Quality	
Increase in dust fallout due to clearing and stripping of soils	▪ This may result in impacts on surrounding ambient air quality concentration levels.

Environmental Aspect	Identified Potential Impacts
The construction and operation of the HDS Plant may result in wind erosion of loose particulate matter.	▪ Impacts on surrounding ambient air quality, with an increase of Total Solid Particulate (TSP) matter, PM_{10} and $PM_{2.5}$. These particles can be transported away from the Project area through prevailing winds; ▪ Inhalation risk of heavy metals; ▪ Dust nuisance and soiling of surfaces; and ▪ Impacts associated with gaseous pollutants (considered minimal due the short term duration of the construction phase).
Heritage Artefacts	
Clearing activities for installation of pipes and preparation of sludge disposal facility.	▪ Clearing activities are the largest risk posed to heritage resources, where accidental damage and/ or destruction are known to have occurred; and ▪ The presence of workers in new areas during construction increases the potential for vandalism, most prominently on archaeological resources associated with Iron Age stone walled settlement and burial grounds and graves.
Social Environment	
Movement of machinery, site clearing and stockpiling of soil for pipelines.	▪ Temporary employment opportunities from which residents in the study areas could benefit from; ▪ Impacts related to population influx, including pressure on services, expansion of informal settlements, health impacts, and conflict; ▪ Real and perceived safety risks as a result of the construction site and associated activities; and ▪ Nuisance impacts related to increased noise, dust and traffic.
Operation of pipelines.	▪ Health and safety risks associated with leakages or bursts.
Disposal of sludge on waste disposal facility.	▪ Employment opportunities from which residents in the study areas could benefit from; and ▪ Changes in land and property values.

In compliance with NEMA and other applicable legislative requirements, the ToRs for all the proposed specialist studies are detailed below.

9.4.1 Topography and Visual Impact Assessment

A Topography and Visual Impact Assessment is a combined specialist study and will be performed to identify the topographical and visual impacts of proposed Project on the receiving environment. The proposed Project will be investigated in terms of the topographic and visual characteristics of the receiving environment.

9.4.1.1 Objective of the Study

The topography and visual impact assessment study for the EIA Phase aims to:

- Examine aerial photography available for the Project area;
- Identify potential visual receptors that will be impacted on by the proposed project, taking into account visibility aspects;
- Examine topographical, slope, aspect and viewshed models created in ArcGIS 3D Analyst Extension;
- Visit the Project area to verify these models;
- Identify the impacts that the mine infrastructure will have on the topographical and visual landscape, and rate the scale, duration, severity and probability of the impacts occurring;
- Describe the current and post mining topography and visual aspects of project area in a specialist report; and
- Provide mitigation measures and recommendations in an attempt to reduce the potential topography and visual impacts.

9.4.1.2 Identified Potential Impacts during the Scoping Phase

The proposed Project is expected to have negative topographical and visual impacts on the receiving environment. For the Largo Site 4 option, a change in land use from agriculture to a waste disposal site will change the topography and visual/ aesthetic character of the Project area. This may result in moderate topographic and visual impacts. While the Grootvlei Site 6/L/16 option will just have additional sludge deposited on an existing TSF and will therefore have minimal topographic and visual impacts. However, because the proposed Project will occur in a disturbed area already prone to mining activities, the resulting topographic and visual impacts for the sites and surrounding area will range from moderate to minimal.

9.4.1.3 Methodology for the EIA Study

Photographs will be taken during a site visit and topographical features (natural and man-made), overall visual resources, the variety of landscape character and sense of place

attributes will be assessed. At a desktop level, aerial photography will be analysed to characterise the landscape.

A Digital Elevation Model (DEM) will be created using ArcGIS 3D Analyst Extension, with contour and point relief data as inputs (refer to Figure 9-3). The resultant DEM will be used to create slope and aspect models.

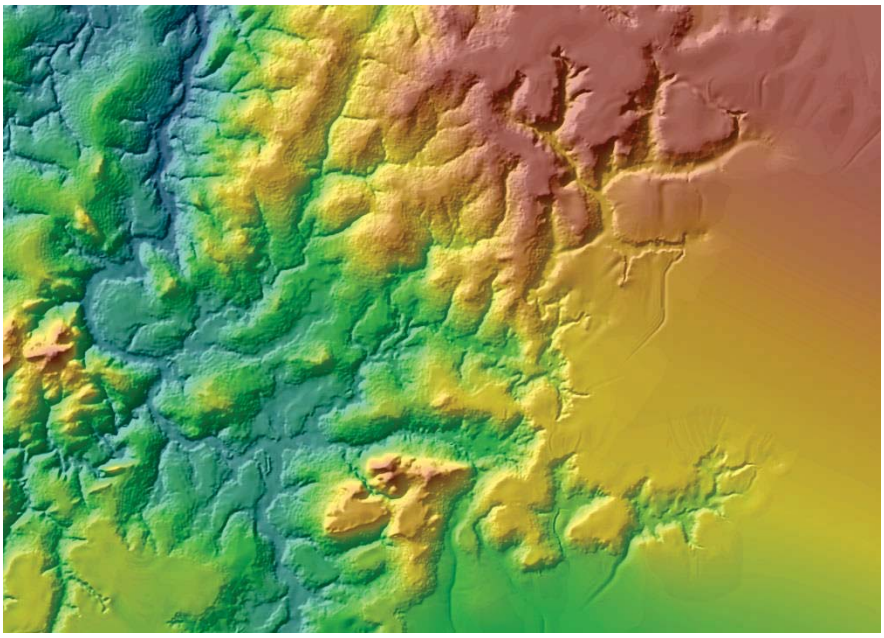


Figure 9-3: Example of a Digital Elevation Model (DEM)

The DEM will also be used as an input to create the theoretical viewshed model using ArcGIS 3D Analyst Extension; this will be done to establish the degree of visibility that the proposed infrastructure is likely to have. The height of the proposed above ground infrastructure will be taken into consideration in the modelling process. Information gathered during the site visit will be used to refine the theoretical viewshed to a practical viewshed. The concept of viewshed modelling is depicted in Figure 9-4 below.

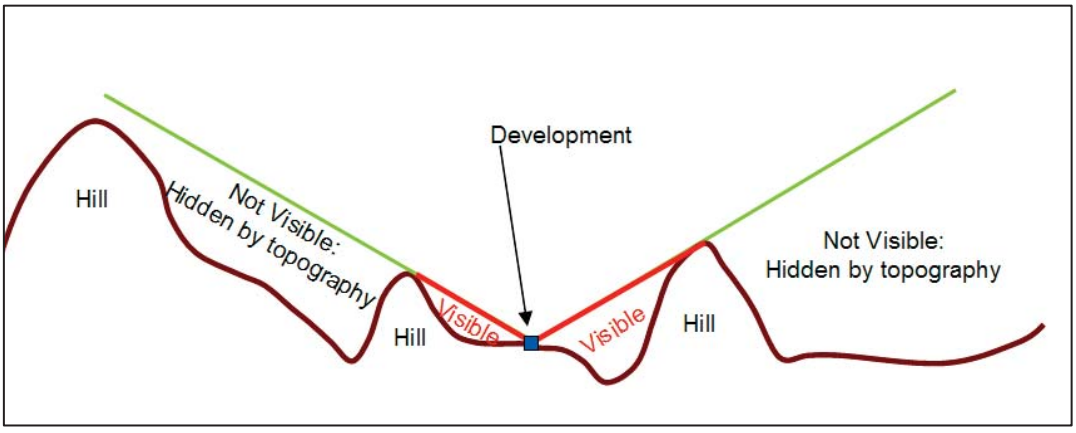


Figure 9-4: Theoretical Background to Viewshed Modelling

9.4.1.4 Project Team

The topographical and visual impact assessment project team will consist of Mathabo Lijo and Stephanie Mulder.

9.4.2 Soils Impact Assessment

A soil impact assessment specialist report will be completed and they will assist in understanding the potential impacts on the future land capability and land use of the Project area.

9.4.2.1 Objective of the Study

The purpose of the soil impact assessment will serve to understand how the proposed Project would impact the soils present in the Project area, and the potential impacts on future use in relation to the land capability.

9.4.2.2 Identified Potential Impacts

The main impacts that may arise from the proposed Project on surface water resources are listed below:

- Loss of soil in the Largo Site 4 as it is currently under cultivation;
- Land use as well as land capability would be lost;
- Impacts on soil due to dust fallout resulting in an impact on the surrounding soils land capability, by reducing fertility and possibly depositing toxic elements;
- Dust fallout also reduces the plant's photosynthetic process by covering the leaf or fruit;
- Seepage of sludge may negatively impact the soil in Largo Site 4; and
- This may lead to a reduction in soil fertility.

9.4.2.3 Methodology for EIA Study

The following methodology will be applied that will assist with understanding the soil in the Project area:

- Existing Land Type data will be used to obtain generalized soil patterns and terrain types for the proposed project sites. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1972 - 2006);
- The soils will then be investigated by making observations with the use of a bucket type auger to a maximum depth of 1200 mm or to the depth of refusal. At each observation point the South African Taxonomic Soil Classification System (Soil

Classification Working Group, 2nd edition 1991) was used to describe and classify the soil. The classification system categorise soil types in an upper soil Form level;

- These results will then be interpreted to give a land capability for an area;
- Potential Impacts will be identified; and
- A comprehensive soil, land capability and land use EIA report will be compiled.

9.4.2.4 Project Team

The soil project team will consist of Wayne Jackson

9.4.3 Ecological Impact Assessment

The aquatic, riparian and wetland habitats are well known and researched throughout the study area and using this information the current ecological status of the systems will be determined.

9.4.3.1 Objectives of the Study

The ecological impact assessment study for the EIA Phase aims to

- Define the ecological state of the receiving systems;
- Detect and report on spatial and temporal trends in the ecological state of the ecosystems affected;
- Identify the wetland systems within the study area;
- Assess the impact of the increase in salinity on:
  - Invertebrates;
  - Fish;
  - Vegetation; and
  - Waterfowl.
- Assess the impact of the increase in water flow on:
  - Aquatic habitats;
  - River geomorphology and wetlands.
  - Assessing the impact of the increase in water volume on:
  - The riparian zone; and
  - Wetlands.

9.4.3.2 Identified Potential Impacts during the Scoping Phase

The Project area is characterised by an NFEPA and Ramsar status wetland body – the Blesbokspruit as well as the Marievale Protected Area. The proposed Project activities may result in negative impacts in these areas.

9.4.3.3 Methodology for the EIA Study

A desktop review will be conducted for this study, which will consider the available literature sources applicable to the study area. This review will establish a description for the relevant systems. Collection of existing data for the Project area will take place through various means, these include:

- Literature – existing studies and publications for the study area will be reviewed and will assist in describing the receiving environment;
- Datasets – a number of datasets are available in-house as well as through organisations. The following dataset will be used in the characterisation of the receiving environment:
  - The ecological integrity (health) database model for the systems;
  - The RHP;
  - The Freshwater Ecological Priority Areas for the catchments; ;
  - The Gauteng Conservation Plan;
  - South African National Biodiversity Institute (SANBI) data resources:
  - Protected ecosystems (SANBI);
  - Protected areas;
  - Important Bird Areas (IBA);
  - South African National Bird Atlas Project 2 (SANBAP 2);
  - Quarter degree square grid for birds;
  - 1:50 000 topographical data (delineation of wetlands);
  - Environmental Potential Atlas (ENPAT); and
  - International Union for Conservation of Nature (IUCN).
- Consultation – consultation with institutions, authorities and professional will be done to gather information for the study area. These include:
- SANBI;
- RHP Gauteng; and
- CSIR.

The data collected will then be interpreted to define aspects relating to the study area. These aspects are listed below:

- Ecological importance - the following components of the systems will be assessed to determine the ecological importance:
- Rivers/Wetlands – The ecological importance of a water resource refers to the ability to maintain ecological diversity and functioning on local and wider scales. Information pertaining to the natural and current species composition for the respective systems will be considered in order to describe the diversity of these systems. In addition to this, the tolerance of the current species will also be considered in order to describe the sensitivity of the species to changes. The functioning of the systems will primarily consider the ability of these resources to enhance water quality, regulate streamflow as well as consider human uses;
- Cultural/Medicinal - Certain plant species identified as being present within the study areas will be of medicinal or cultural values according to National and Provincial legislation. These species play a vital role in cultural beliefs and local medicines and are harvested for their associated value. These values are well documented with existing records and studies. These will be utilised for identification;
- Endemic - The ecological state of being unique to a defined geographic location. Flora and Fauna species identified through previous records and studies of the study areas could be classified as endemic, this status is supported by National and Provincial legislation;
- Red data - The review will involve the classification of species occurring within the study area that are of conservation concern and listed by the International Union for Conservation of Nature (IUCN) or by Provincial legislation as protected and endemic. Each species will be listed and the Red Data status identified and recorded. Use will be made of existing records, findings and sightings to identify keystone and indicator species within the study area;
- Ecological status - The ecological status of each system aspect will be determined. The ecological state of the wetland systems will be determined at desktop level. This will be determined by the application of the WET-Management series which will describe the general services provided by the systems. The health of the wetland systems will be determined by the collation of the available data and information;
- The ecological state of the responders of the aquatic ecosystems will be determined at desktop level compared to the natural or close to natural reference conditions. The state of these responders will be considered in order to determine the ecological state of the respective systems. The ecological state derived for each of the biological response components for a particular river will be used to derive an overall, integrated ecological state;

- The data collected during the characterisation of the social environment detailing the extent and nature of anthropogenic land use, such as agricultural, residential, commercial and industrial, will be compared to empirical data sets for floral communities such as Mucina's and Rutherford Vegetation types of South Africa, to detail the current extent of these vegetation types. Through this process the current status of the floral communities will be determined;
- Sensitive Areas - based on legislated protected areas and Ramsar sites as well as the Protected Ecosystems as defined in NEMA, sensitive areas will be characterised and described for the study area; and
- Using the information collected and the classifications of the ecological status of the systems, impacts will be determined for the project. The impacts of the water quality and increase in flow rates would be the focus in quantifying the impacts on the ecological systems.

Further to this, field investigations will be completed, as outlined in the sections below.

9.4.3.3.1 Fauna and Flora

- For vegetation, a stratified random sampling technique will be used, and the Braun Blanquet sampling technique employed along the linear route. Notes will be taken of any Species of Special Concern or alien invasive species on site. Vegetation will then be mapped based on the desktop information and field data;
- Fauna will be sampled based on observations of animals and signs of animals in the form of burrows, nests, pellets, tracks, etc, as well as using existing information for the area.
- An integrated sensitivity map will be compiled;
- Impact assessment and mitigation measures; and
- Recommendations.

9.4.3.3.2 Wetlands

The following will be produced as part of the wetland assessment:

- A wetlands delineation based on both desktop and field investigations;
- An assessment of the Present Ecological Status of the wetlands;
- The determination of best practice buffers for each of the wetlands of the study site;
- An impact assessment and mitigation measures; and
- Recommendations.

9.4.3.3.3 Aquatics

The following will be produced as part of the aquatics assessment:

- A baseline of the aquatic environment, including both ichthyofauna and invertebrates;
- A basic assessment of water quality based on SASS 5;
- An impact assessment and mitigation measures; and
- Recommendations.

9.4.3.4 Project Team

The ecological impact assessment will comprise the following team members:

- Caroline Wallington – Fauna and Flora;
- Russell Tate – Aquatic Ecosystems; and
- Crystal Rowe – Wetlands.

9.4.4 Surface Water Impact Assessment

A surface water assessment specialist report will be completed and it will have a clear description of the surface water quality and quantity on the proposed project sites. It will also detail potential impacts assessments and associated mitigation measures. A surface water management and monitoring plan will also form part of this report.

9.4.4.1 Objective of the Study

The main objectives of the surface water assessment are to characterise the current receiving environment with regard to:

- The existing hydrology of the receiving streams;
- The existing quality of the receiving streams;
- The geomorphology of the streams;
- Sensitive areas within these systems; and
- The current yields of the rivers and their contribution to the overall systems they exist in.

Additionally, the surface water assessment aims to assess the effects of the proposed Project, in terms of:

- Water quality:
  - The extent of the decrease in water quality downstream, specifically with regards to salinity and heavy metals;
  - The effects on water quality during different seasons;
  - The effect on water quality should the proposed waste management site and pipelines not function optimally; and
  - The effect on the Vaal System and yields.

- Water quantity:
  - The effect on hydrology of the streams taking into consideration seasonal changes;
  - the extent of this change on downstream water users;
  - How the geomorphology of the streams will be altered with the increase in flow relating to erosion and deposition of the channels; and
  - Identify areas which could be vulnerable to potential flooding.

9.4.4.2 Identified Potential Impacts during the Scoping Phase

The main impacts that may arise from the proposed Project on surface water resources are listed below:

- The clearing of vegetation and movement of machinery exposes soil to erosion. In the event of a storm, silted runoff water can contaminate streams.
- The sludge pipeline could leak or burst resulting in discharge to the surrounding environment and to river courses in particular areas resulting in the siltation of surrounding surface water resources.
- The sludge disposal facility could potentially burst or have mud/ sludge slides after rainfall and storm events. In addition to this potential seepage could trickle to the Blesbokspruit resulting in deteriorated water quality.

9.4.4.3 Methodology for EIA Study

The following methodology will be followed for the Surface water studies:

- A full baseline hydrology including the description of the surface catchments and affected streams;
- A baseline surface water quality assessment indicating the quality of the up- and downstream water resources as benchmarked against the SANS 241: 2011 drinking water standard and The Blesbokspruit water quality objective/ targets set for the catchment;
- Detailed impacts from the proposed pipeline and disposal of the sludge on the already impacted storage site and likely to impact on the surface water resources indicating the significance of the impacts on both surface water quality and the water quantity;
- Mitigation measures for implementation to reduce the significance of the surface water impacts; and
- A surface water monitoring plan prepared in line with the DWA BPG: G3 Water Monitoring indicating monitoring points located up- and downstream of the site and the frequency of monitoring.

Water quality assessments will be carried out based on the samples analysis results to understand how current conditions compare to the Blesbokspruit water quality objectives.

Hydrology assessments will be carried out to determine the peak flows form the upstream catchments and the water that would need to be conveyed around the disposal sites

Anticipated impacts will be assessed based on their scale and potential severity. In addition to these assessments, potential mitigation measures will be recommended.

9.4.4.4 Project Team

The surface water project team will consist of Chenai E Makamure and Gary Morgan.

9.4.5 Groundwater Water Impact Assessment

The geohydrological environment will be affected by certain project activities and in turn will affect other activities.

9.4.5.1 Objectives of the Study

The objective of the study is to assess the potential groundwater impact from the sludge deposition on one of the two selected disposal facilities. This can be summarised as follows:

- To develop a hydrogeological conceptual model by reviewing historical reports;
- To characterise the aquifer systems and define the potential impact extent – understand extent of dolomitic aquifers in the basin; and
- To develop a draft groundwater management plan and monitoring programme.

9.4.5.2 Identified Potential Impacts during the Scoping Phase

The following potential impacts were identified during the Scoping Phase:

- Due to the increased salt load the original contamination plume footprint might extend and include more (previously unaffected) groundwater users;
- Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area;
- There are a number of risks associated with the sludge delivery pipelines, the largest of which is the settlement of sludge in the pipeline as a result of a power failure; and
- Previously unaffected groundwater sources might become contaminated and subsequently reduce the volume of potable or usable groundwater in the area.

9.4.5.3 Methodology for EIA Study

A literature review and specialist meetings will be conducted to review and assess available hydrogeological information. This will include:

- Collect all available information on studies conducted in the basin to understand the baseline groundwater water quality and quantity, particularly in the vicinity of the sludge disposal site;
- Assess current groundwater use;
- Using existing studies to determine the effect of sludge disposal of the proposed tailings storage facilities on the groundwater regime;
- Assess the sludge geochemical properties; and
- Recommend a groundwater monitoring programme.

9.4.5.4 Project Team

The groundwater Project team will consist of Lucas Smith, Andre van Coller and Evidence Simango.

9.4.6 Noise Impact Assessment

The terms of reference for the EIA phase will be to compile a specialist environmental noise impact assessment report, including noise dispersion models indicating the expected noise propagation from the proposed construction and operational phases of the Largo Site 4 and Grootvlei 6/L/16 options as well as each option's associated pipelines.

9.4.6.1 Objectives of the Study

The environmental noise impact assessment will assess, via predictive noise modelling, the potential impact of the noise emissions from the proposed construction and operational activities on the surrounding soundscape. The study will include the baseline noise measurements carried out during the scoping phase and also provide recommendations in terms of the mitigation and management measures.

9.4.6.2 Identified Potential Impacts during the Scoping Phase

The following potential impacts were identified:

- Construction phase may have potential impacts on the ambient noise levels on the surrounding farms and communities;
- Site clearing and construction activities of the Largo Site 4 option may impact significantly on the homestead of Mrs Jacobs on portion 17 of the farm Grootvaly 124 IR adjacent to the north as well as the residential/light industrial districts adjacent to the west because of the close proximity to the location of Largo Site 4;
- The operation of Largo Site 4 pipelines as well as associated pump station may impact on some residential receptors located adjacent on the west of Largo Site 4 as well as the farmstead to the north;

- The operational noise sources attributed to pipelines are water hammers as well as the operation of the associated pump station. The return water pump station at the Largo Site 4 specifically is expected to be the main noise source during the operational phase; and
- The noise impact of the Grootvlei 6/L/16 slurry and return water pipelines as well as associated pump station is however expected to be negligible.

9.4.6.3 Methodology for EIA Study

The scope of work during the EIA phase will be carried out in the following steps:

9.4.6.3.1 Step 1: Noise dispersion modelling.

The propagated noise levels will be calculated by means of the dispersion modelling software 'Soundplan'. This model will depict in detail, what the expected noise levels are to be at sensitive receptors, and can predict, per receptor, the intensity of the noise impact. An example of predicted propagated noise levels can be seen in Figure 9-5.

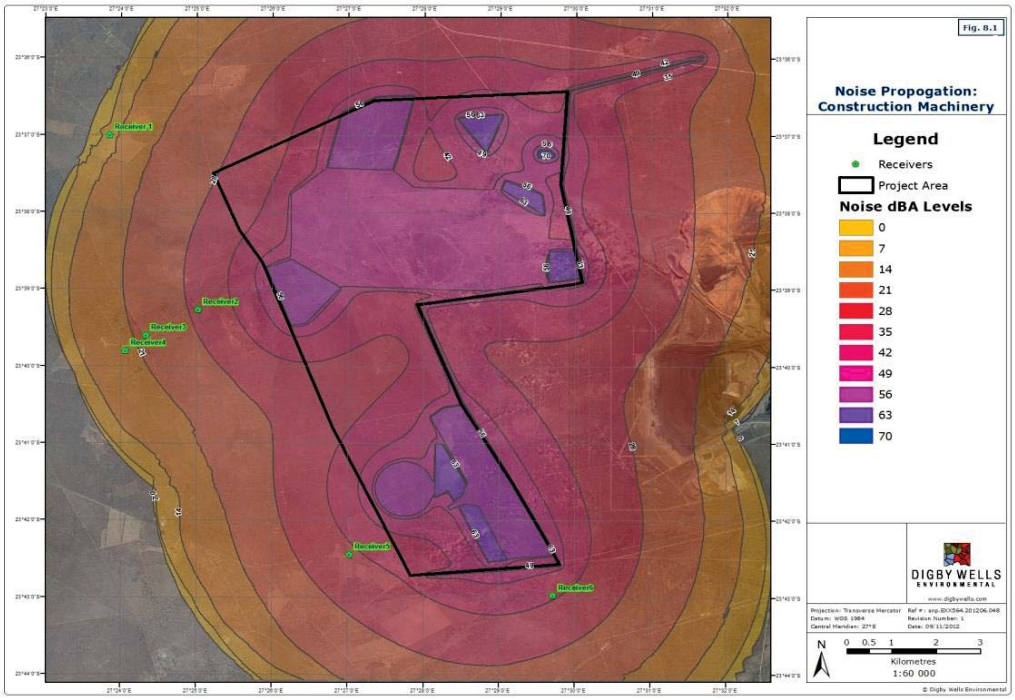


Figure 9-5: Noise model plot

9.4.6.3.2 Step 2: Significance rating of impact

The significance of the noise impact of both options will be rated by comparing the expected noise levels from the models to the existing ambient noise levels as well as by comparing it to the SANS 10103:2008 limit guidelines for the various districts surrounding the project areas of both options.

The environmental noise impact assessment report will include the dispersion models under the findings section and the significance rating under the impact assessment section along with the rating methodology used. Mitigation measures as well as management programme will also be detailed in the report. The kind of mitigation measures and management programme will depend on the significance rating of the noise impact.

9.4.6.4 Project Team

The groundwater Project team will consist of Lucas Sadler

9.4.7 Air Quality Impact Assessment

The Air Quality Impact Assessment will characterise emissions from the relevant sources associated with the proposed sludge tailings employing a conventional approach. The study will attempt to understand existing impacts from the tailings facilities which are planned to be used for sludge disposal as well as understand the sludge physical characteristics and its effects on ambient air quality. The results generated will be used to assess the additional pollutant loading owing to the development of the proposed sludge facility and possible implication on the surrounding communities. This will constitute Phase 1 of the project. Data collected during the latter, will feed into the dispersion modelling, phase 2 of the assessment.

9.4.7.1 Objectives of the Study

The objectives of air quality impact assessment are as follows:

- Identify sensitive receptors in the vicinity of the sludge facility;
- Assess the sludge characterisation with regard to:
  - Particle size distribution;
  - Dispersal potential; and
  - Identify possible impacts associated with levels of fines and composition of the sludge material.

9.4.7.2 Identified Potential Impacts during the Scoping Phase

The following impacts on air quality have been identified during the Scoping Phase:

- The construction phase may result in impacts on surrounding ambient air quality.
- Impacts on surrounding ambient air quality, with an increase of TSP matter, PM_{10} and $PM_{2.5}$. These particles can be transported away from the Project area through prevailing winds;
- Inhalation risk of heavy metals;
- Dust nuisance and soiling of surfaces; and

- Impacts associated with gaseous pollutants (considered insignificant due the short term duration of the construction phase).

9.4.7.3 Methodology for EIA Study

The following methodology will be used during the EIA phase:

9.4.7.3.1 Phase 1 - Data collection and interpretation

In order to characterise the receiving environment, information on the following parameters will be acquired and assessed:

- Particle size distribution (for deposited sludge and tailings storage facilities where sludge will be deposited);
- Sensitive receptors (communities of concern). This will be determined through the characterisation of the social environment as well as existing databases; and
- Acquire infrastructural plan and emission inventory data

9.4.7.3.2 Phase 2 - Assessment

The results of the sludge characterisation will also be assessed to determine the physical nature of the sludge and the associated impacts on ambient air quality following dispersal of loose particulate matter from the sludge facility. These results will serve as input data to complete phase 2 involving dispersion modelling.

9.4.7.3.3 Phase 3 – Dispersion modelling

- Emissions inventory;
- Set up the dispersion model, incorporating the possible sources of pollutants; and
- Generate ground level concentrations of identified pollutants.

AERMOD mathematical models will be used to simulate the dispersion of air pollutants from the proposed sludge facility to the receiving environment. The results of the mathematical models will predict and describe the ground level concentrations at selected sensitive receptors and environment through the simulation of pollutant pathways. Isopleths of ground level concentrations will be used to assess residential exposure to relevant pollutants. Pollutants levels at sensitive receptors are then compared to the recommended standards in order to determine compliance with legal requirements.

9.4.7.4 Project Team

The project team for the study will consist of Matthew Ojelede and Vladimir Jovic (external review).

9.4.8 Heritage Impact Assessment

An exemption was applied for and submitted to SAHRA and PHRA-G during the Scoping Phase. It was recommended, by the heritage specialist, that exemption from any additional heritage assessments is granted for the following activities:

- Sludge disposal site option on Grootvlei 6/L/16;
- Sludge disposal site option on Largo Site 4; and
- Associated pipelines.

The motivation for the granting of the exemption is as follows:

The proposed location of Grootvlei 6/L/16 sludge disposal site option is situated on an existing sludge storage facility younger than 60 years. Therefore, no impact on heritage resources is envisaged for this site. The pipeline associated with this location is also routed through existing servitudes that have been impacted upon by previous activities.

The proposed location of Largo Site 4 sludge disposal site option is situated in an area that has been disturbed through agricultural activities. Desktop based research has identified several heritage resources to the north associated with archaeological remains and burial grounds. No such finds were made in the proposed footprint location during the screening survey.

It is recommended that Chance Find Procedures (CFPs) be adopted and incorporated into the Environmental Management Programme (EMP) for the proposed project. The CFPs must clearly outline the procedure and responsible resource in the event of accidental discovery of heritage resources in line with the requirements of the NHRA.

9.4.9 Social Impact Assessment

The SIA will be geared towards gaining a more comprehensive understanding of the receiving social environment, anticipating the likely changes and subsequent impacts the proposed project may bring about in the receiving environment and devising suitable, practical and cost effective mitigation and enhancement measures. The objectives of the SIA will be achieved through additional data collection activities (including a site visit, interviews with key stakeholders and liaison with other specialists) that will inform the identification of potential social impacts (as well as their mitigation or enhancement measures) and substantiate the significance ratings assigned to each impact. On the basis of the aforementioned, the two proposed sites will be compared and an argument will be made in favour of the site with the least adverse social impacts

9.4.9.1 Objectives of the Study

The overriding objective of the SIA will be to identify, clarify and gauge the significance of potential social impacts that may come about as a result of the proposed project. Objectives specific to the impact assessment phase of the SIA are as follows:

- To gain a first-hand understanding of the primary study area;
- To obtain the necessary project information required for the understanding of impacts related to employment creation, health and safety risks, and nuisance impacts;
- To determine stakeholder attitudes and initial perceptions regarding the proposed project;
- To anticipate the likelihood and magnitude of potential influx as a result of the proposed project, and determine the location and size of lower income settlements in the vicinity of the project area;
- To determine the potential significance of nuisance impacts, particularly those related to water quality and quantity, air quality, and noise; and
- To determine the likely impact the proposed project will have on the land value of surrounding properties.

9.4.9.2 Identified Potential Impacts during the Scoping Phase

The following potential impacts were identified during the Scoping Phase:

- Temporary employment opportunities from which residents in the study areas could benefit from;
- Impacts related to population influx, including pressure on services, expansion of informal settlements, health impacts, and conflict;
- Real and perceived safety risks as a result of the construction site and associated activities;
- Nuisance impacts related to increased noise, dust and traffic;
- Stakeholder opposition that could jeopardise the successful implementation of the proposed project;
- Health and safety risks associated with leakages or bursts;
- Employment opportunities from which residents in the study areas could benefit from; and
- Changes in land and property values.

9.4.9.3 Methodology for EIA Study

The objectives of the impact assessment phase of the SIA will be met by employing the following methodology:

- Additional data collection activities, including a two-day site visit during which the specialist will gain familiarity with the project site and conduct key informant interviews. The social specialist will also liaise with other specialists (particularly the public participation team, hydrologists, and the air quality and noise specialists) in

order to gauge the potential significance of nuisance impacts and likelihood of stakeholder opposition towards the project;

- Update the social baseline profile of the study areas using the information obtained through the abovementioned activities;
- Anticipate, discuss and rate the significance of potential social impacts, both positive and negative, that may arise as a result of the proposed project, and comment on how these impacts will differ between the two alternatives under investigation;
- Design suitable, cost effective and practical mitigation and enhancement measures to ameliorate the significance of the negative impacts, and enhance the positive ones;
- Indicate which of the two alternative sites under investigation would be the preferred option from a social perspective; and
- Propose recommendations relevant to the social environment, geared towards the successful implementation of the proposed project and management of social impacts.

9.4.9.4 Project Team

The SIA will be conducted by Ms Karien Lotter, and reviewed by Dr Jan Perold.

10 Conclusion and Recommendations

This Scoping Report is intended to support the Integrated Application Form submitted to DEA on 25 April 2014 (reference number *14/12/16/3/3/3/111*). This Draft Scoping Report provides the findings of baseline analysis conducted by the relevant specialists and describes the way forward for the EIA Phase.

The PPP for the Project has commenced and issues raised from the public have been documented for consideration. The results from the consultation process are summarised below.

The main potential impacts identified from the Project have been identified during the operational phase. This is mainly due to the piping of sludge to the sludge disposal site. The potential impacts include wear and tear or bursting of pipelines that may impacts on the water resources. The deposition of sludge on the waste disposal site also poses a number of potential impacts that may result in a high significance. This includes an impact on visual receptors, particularly on Largo Site 4 due to the increase in height of the disposal site. The seepage of the sludge from the disposal sites to water resources and contamination thereof is also of concern.

The purpose of the EIA phase will be to investigate the potential negative and positive impacts of a proposed project's activity on the environment. The potential impacts will then be quantified to assess the significance that the impact may pose on the receiving environment, and propose suitable mitigation, management and monitoring requirements. The specialist studies that will be undertaken as part of the EIA Phase for the proposed Project are listed below:

- Topography and Visual Assessment;
- Soils Assessment;
- Fauna and Flora Assessment;
- Wetlands Assessment;
- Aquatic ecology Assessment;
- Surface Water Assessment;
- Groundwater Assessment;
- Noise Assessment;
- Air Quality Assessment;
- Heritage Assessment; and
- Social Environment Assessment.

Specialist investigations will be conducted to inform the findings of the draft EIA Report, which will be placed in the public domain for a 40 day public review period, after which the final EIA Report will be compiled and submitted. The EIA Report will also contain an EMP indicating how the impacts will be managed, monitored and mitigated. The final EIA Report and EMP will be submitted to the authorities for decision making as well as for a 21 day public comment period simultaneously.

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Appendix A: Plans

Appendix B: Public Participation