63 Wessel Road, Rivonia, 2128 PO Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 **Fax:** +27 (0) 11 803 5745 **Web:** www.gcs-sa.biz

Surface Water Assessment for the Eskom Arnot Power Station Ash Disposal Facility

Scoping Report

Version - 1

07 May 2018

EIMS (Pty) Ltd

GCS Project Number: 16-0468

Client Reference: GCS - SW Eskom Arnot Ash Dump Scoping Study

Report
Version – 1

07 May 2018

EIMS (Pty) Ltd

16-0468

DOCUMENT ISSUE STATUS

Report Issue	Version 1		
GCS Reference Number	GCS Ref - 16-0468		
Client Reference	GCS - Eskom Arnot Ash Dump SW Scoping Study		
Title	Surface Water Scoping Report for the Arnot Power Station Ash Disposal Facility		
	Name	**Signature**	**Date**
Author	Daniel Fundisi	[signature]	07 May 2018
Document Reviewer	Robert Verger	[signature]	07 May 2018
Director	Alkie Marais		07 May 2018

LIST OF ACRONYMS

DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
GN 704	General Notice 704 of the National Water Act, Act 36 of 1988
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MPRDA	Mineral and Petroleum Resources Development Act, Act Number 28 of 2002
NEMA	National Environmental Management Act, Act Number 107 of 1998
NWRS	National Water Resource Strategy
NWA	National Water Act, Act Number 36 of 1998
SWMP	Storm Water Management Plan
WMA	Water Management Areas

GLOSSARY OF TERMS

Buffer Zone A buffer zone defines an area in which certain activities are restricted, to limit the potential impact of an activity on an entity that needs to be protected. An example would be to not allow mining activities within 100m of a watercourse. The 100m buffer reduces the likelihood that mining activities could potentially pollute the water resource.

Catchment A catchment defines an area within which water will naturally drain to a defined point

Hydrology Hydrology describes a field of study that analyses natural cycles of water as it passes through the environment. Aspects analysed include rainfall, evaporation, transpiration and runoff. Hydrology also refers to the results of analysis of certain aspects of hydrological cycles, such as river flow, or likely peak floods

Runoff Surface runoff is defined as the water that finds its way into a surface stream channel without infiltration into the soil and may include overland flow, interflow and baseflow

EXECUTIVE SUMMARY

GCS Water and Environment (Pty) Ltd (GCS) was appointed by EIMS (Pty) Ltd (EIMS) to undertake a scoping study for the proposed new ash disposal facility at the Arnot Power Station in the Mpumalanga Province of South Africa. The proposed project site is approximately 50 km from Middelburg Town. Two potential sites were screened as preferred Alternatives and these are the subject of discussion for this study. This document serves as the Hydrological Scoping Report for the two preferred Alternative sites 1 and 2 for the construction of the proposed ash disposal facility. The proposed footprint area of the ash disposal facility is 120ha.

Baseline Receiving Environment

The Mean Annual Precipitation (MAP) calculated for this area is 699 mm while the Mean Annual Evaporation (MAE) is 1 552 mm and the Mean Annual Runoff (MAR) is 36.6 mm, indicating an area with distinct wet and dry seasons.

Site Sensitivity

The mapped-out floodplain of proximal streams surrounding the two proposed alternative ash disposal facility sites is considered to be Highly Sensitive (+2) since it is prone to siltation and pollution which could potentially arise from the proposed project. These sensitive surface water features fall within the 1 km buffers around the proposed Alternative 1 and 2 sites.

Preliminary Risk Assessment

- Soil erosion is expected to have a negative effect with medium significance ratings of -10.00 and -09.00 for Site Alternatives 1 and 2, respectively, as the scale of the impact will be restricted to the site. If sediment control mitigation is put in place correctly, the impact will rank as low with significance ratings of -4.00 and -3.50, respectively.
- The risk resulting from spillage of oils, fuels and chemicals during the Construction Phase is ranked as low with a significance rating of -9.00 and -8.00 for Site Alternatives 1 and 2, respectively. If the recommended mitigation measures are implemented correctly, the impact during construction will be lower with respective significance ratings of -3.75 and -2.00.

- The risk resulting from surface water contamination due to seepage, leakage and spillage during the Operation Phase is ranked as low with significance ratings of -9.75 and -8.25 for Site Alternatives 1 and 2, respectively. If the recommended mitigation measures are implemented correctly, the impact will be lower with respective significance ratings of -4.00 and -3.50.
- The risk resulting from surface water contamination due to seepage, leakage and spillage during the Decommissioning Phase is ranked as low with significance ratings of -9.75 and -8.25 for Site Alternatives 1 and 2, respectively. If the recommended mitigation measures are implemented correctly, the impact during decommissioning will be lower with respective significance ratings of -4.00 and -3.50.

Site Alternative 2 has lower significance ratings for all assessed impacts and is, therefore, considered more suitable for the proposed ash disposal facility project.

Recommendations

The following studies are recommended for the Environmental Impact Assessment (EIA) Phase:

- Flood lines determination,
- Conceptual Storm Water Management Plan,
- Water Balance,
- Water Quality Analysis and Monitoring,
- Risk and Mitigation Assessment, and
- Surface Water Management and Action Plan.

CONTENTS PAGE

LIST OF FIGURES

LIST OF PHOTOS

LIST OF TABLES

1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by EIMS (Pty) Ltd (EIMS) to undertake a scoping study for the proposed new ash disposal facility at the Arnot Power Station in the Mpumalanga Province of South Africa. The proposed project site is approximately 50 km from Middelburg Town, off the N4 National Road and it is within the Olifants Water Management Area 4 (WMA 4) and in quaternary catchment B12B (see Figure 5.1). Two potential sites were screened as preferred Alternatives and these are the subject of discussion for this study. This document serves as the Hydrological Scoping Report for the two preferred Alternative sites 1 and 2 for the construction of the proposed ash disposal facility.

1.1 Project Background

The current ash disposal facility at the Arnot Power Station has been providing disposal services since the establishment of the station in 1975. This ash disposal site is facing challenges which need to be addressed. The ash disposal facility complex was designed to operate until the original end of the power station life in 2021. This date has been revised to 2032. An ash disposal facility capacity study was compiled and circulated in February 2012; this study showed that the rate of rise of the ash disposal facility complex will be more than 4m by the year 2026. The main reason that Arnot Power Station is in need of a new ash disposal facility is to reduce this rate of rise to an acceptable rate. The new ash disposal facility was thus recommended and the size of the site of the proposed ash disposal facility should be 120ha.

This study will contribute to specialist study requirements for an Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). The study will also comply with the requirements of the water use authorisation requirements of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

1.2 Project Objective

The objective of this report is to assess the two selected potential ash disposal facility sites for the scoping phase of the project and determine the best suited site from a hydrological perspective.

2 SCOPE OF WORK

The Scope of Work (SoW) for the scoping study can be summarised as follows:

1. Desktop Assessment:
    - A description of the hydrological baseline receiving environment.
    - Identification and description of surface water drainage systems that occur in the study area.
    - Identification and description of sensitive surface water features that occur in the study area.
2. Hydrology:
    - Calculation of the study site's Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR) and Mean Annual Evaporation (MAE).
3. Sensitivity Mapping:
    - Sensitivity assessment and mapping of identified sensitive features relating to surface water resources within the project study area.
4. Preliminary Risk Assessment:
    - Identification and description of potential impacts resulting from the proposed activity were determined for the following phases:
        - Construction;
        - Operation; and
        - Decommissioning.
    - Description of recommended mitigation measures.
5. Plan of Work for the Surface Water Impact Assessment Stage:
    - Determination of all surface water study components for the detailed EIA.

3 METHODOLOGY

The scoping study commenced with the assessment of the proposed new ash disposal facility in relation to surface water features. The methodology followed is indicated in the subsections that follow.

3.1 Information Sourcing and Literature Review

Relevant existing literature for the study site was reviewed. This included previous report and the legislative and policy framework documents relating to the management of surface water resources for the Olifants WMA 4 and quaternary catchment B12B in particular, were investigated and summarised.

3.2 Desktop Assessment

Desktop assessment of site sensitivities and constraints was undertaken using satellite imagery such as the Google Earth Pro and the available 5 m topographical data (RSA National Geospatial Institute, 2017)of the study area. The desktop assessment also involved reviewing a previous screening report dated the 15th of December 2017.

3.3 Hydrology

A meteorological analysis was undertaken within the context of this study in order to understand rainfall-runoff processes for the site. Rainfall, runoff and evaporation data were obtained from the WR2012 database (WRC, 2015). These data were analysed to determine the Mean Annual Precipitation (MAP) and Mean Annual Evaporation (MAE) and their average monthly distributions for the proposed new ash disposal facility. Runoff data were also analysed to determine the Mean Annual Runoff (MAR) for the project site.

3.4 Sensitivity Analysis

Identification and description of any sensitive receptors with regard to surface hydrology in the study area were undertaken. The focus of the sensitivity assessment was to determine how the proposed ash disposal facility will impact on surface water resources and any associated features on site. The sensitivity mapping methodology was obtained from EIMS, which involves identifying sensitive and non-sensitive areas in terms of the development activity and scoring it according to Table 3.1. The sensitivity mapping will inform on the final site selection decisions.

An assessment to determine the occurrence of sensitive areas on site was conducted as part of the impact assessment. Features which were considered sensitive included wetlands, marshes and riparian zones. Identified features were then plotted on a map so that their location could be viewed in relation to the proposed ash disposal facility sites.

Table 3.1: Sensitivity ratings and weighting

Sensitivity Rating	Description	Weighting	Preference
Least Concern	The inherent feature status and sensitivity is already degraded. The proposed development will not affect the current status and/ or may result in a positive impact. These features would be the preferred alternative for mining or infrastructure placement.	-1	Preferable ↑
Low/ Poor	The proposed development will not have a significant effect on the inherent feature status and sensitivity.	0	Negotiable
High	The proposed development will negatively influence the current status of the feature.	+1	Restricted ↓
Very High	The proposed development will significantly negatively influence the current status of the feature.	+2	

3.5 Preliminary Risk Assessment

The assessment of potential impacts of proposed activities was undertaken conjunctively considering orientation of the proposed ash disposal facility, with respect to local rivers and streams. The hydro-meteorological evaluation results were also incorporated in order to draw conclusions on potential impacts on surface water resources in the project area.

The EIMS impact assessment methodology elaborated-upon hereafter is guided by the requirements of the National Environmental Management Act Environmental Impact Assessment Regulations (NEMA, 2014). The broad approach to the significance rating methodology is to determine the Environmental Risk (ER) by considering the Consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the Probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall Significance (S).

3.5.1 Determination of Environmental Risk:

The Significance (S) of an impact is determined by applying a Prioritisation Factor (PF) to the Environmental Risk (ER). The environmental risk is dependent on the Consequence (C) of the particular impact and the Probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact. For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C} = \frac{(\boldsymbol{E} + \boldsymbol{D} + \boldsymbol{M} + \boldsymbol{R})}{\boldsymbol{4}} \times \boldsymbol{N}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 3.2.

Table 3.2: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/detrimental impact
	+1	Likely to result in a positive/beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 3.3.

Table 3.3: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows and presented in Table 3.4:

$$ER = C \times P$$

Table 3.4: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 3.5.

Table 3.5: Significance Classes

Environmental Risk Score	
Value	**Description**
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

Table 3.6: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

3.5.2 Impact Prioritisation

In accordance with the requirements of Appendix 3(2) (d) (ii) of the EIA Regulations (GNR 982), and further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process. In an effort to ensure that these factors are considered, an impact Prioritisation Factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented. The impact priority is therefore determined as follows:

$$\boldsymbol{Priority = PR + CL + LR}$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (refer to Table 3.7).

Table 3.7: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance) (refer to Table 3.8).

Table 3.8: Final Environmental Significance Rating

Environmental Significance Rating	
Value	**Description**
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

4 LEGISLATIVE AND POLICE FRAMEWORKS

The surface water study was conducted to adhere to local, regional and national legislation and policy frameworks to ensure not only compliance, but also sustainable operation of the project. The legislation considered in this study is summarised in the following subsections:

4.1 The National Water Act (Act No. 36 of 1998)

The *National Water Act (NWA), Act 36 of 1998* is the principal legal instrument relating to water resource management in South Africa. As guardian and trustee of the nation's water resources, the Government (specifically the DWS) must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons and in accordance with its constitutional mandate. In terms of the proposed project, authorisation will be required for the project to commence lawfully.

4.2 The National Water Resources Strategy

The *National Water Resource Strategy (NWRS)* is a tool designed to assist in the implementation of the National Water Act, 36 of 1998 in order to effectively manage water resources in South Africa (DWA, 2012). The NWRS sets out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, use, development, conservation, management and control of South Africa's water resources. It is the primary mechanism for water management across all sectors in South Africa which helps the Government to work towards achieving its development goals (DWA, 2012).

4.3 Regulations on the Use of Water for Mining and Related Activities (aimed at the protection of water resources)

General Notice 704 of the National Water Act (Act 36 of 1988) (GN704) stipulate the requirement in respect of use of water for mining and related activities aimed at the protection of water resources. As mentioned, the GN704 was established for the mining industry but, in the absence of more appropriate or project-specific legislation, can be and often is applied to other sectors because it is a conservative and detailed piece of legislation.

4.3.1 Regulation 4: Restrictions on locality

No person in control of a mine or activity may:

a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility, within the 1:100-year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

b) except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50-year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;

c) place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or

d) Use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50-year flood line of any watercourse or estuary.

4.3.2 Regulation 6 Capacity requirements of clean and dirty water systems

Every person in control of a mine or activity must:

a) confine any unpolluted water to a clean water system, away from any dirty area; -

b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;

c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;

d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and

e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 metres above full supply level.

4.3.3 Regulation 7: Protection of water resources

Every person in control of a mine or activity must take reasonable measures to-

1) prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;
2) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or instream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;

1) cause effective measures to be taken to minimise the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings;
2) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, slimes, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof
3) prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources;
4) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time;
5) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; and
6) cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of an authorisation under the Act.

5 BASELINE RECEIVING ENVIRONMENT

This section describes the baseline environment which provided the fundamental understanding of the hydrological characteristics of the site.

5.1 Locality

The project site is located within the Olifants Water Management Area 4 (WMA 4) and within quaternary catchment B12B as indicated in Figure 5.1.

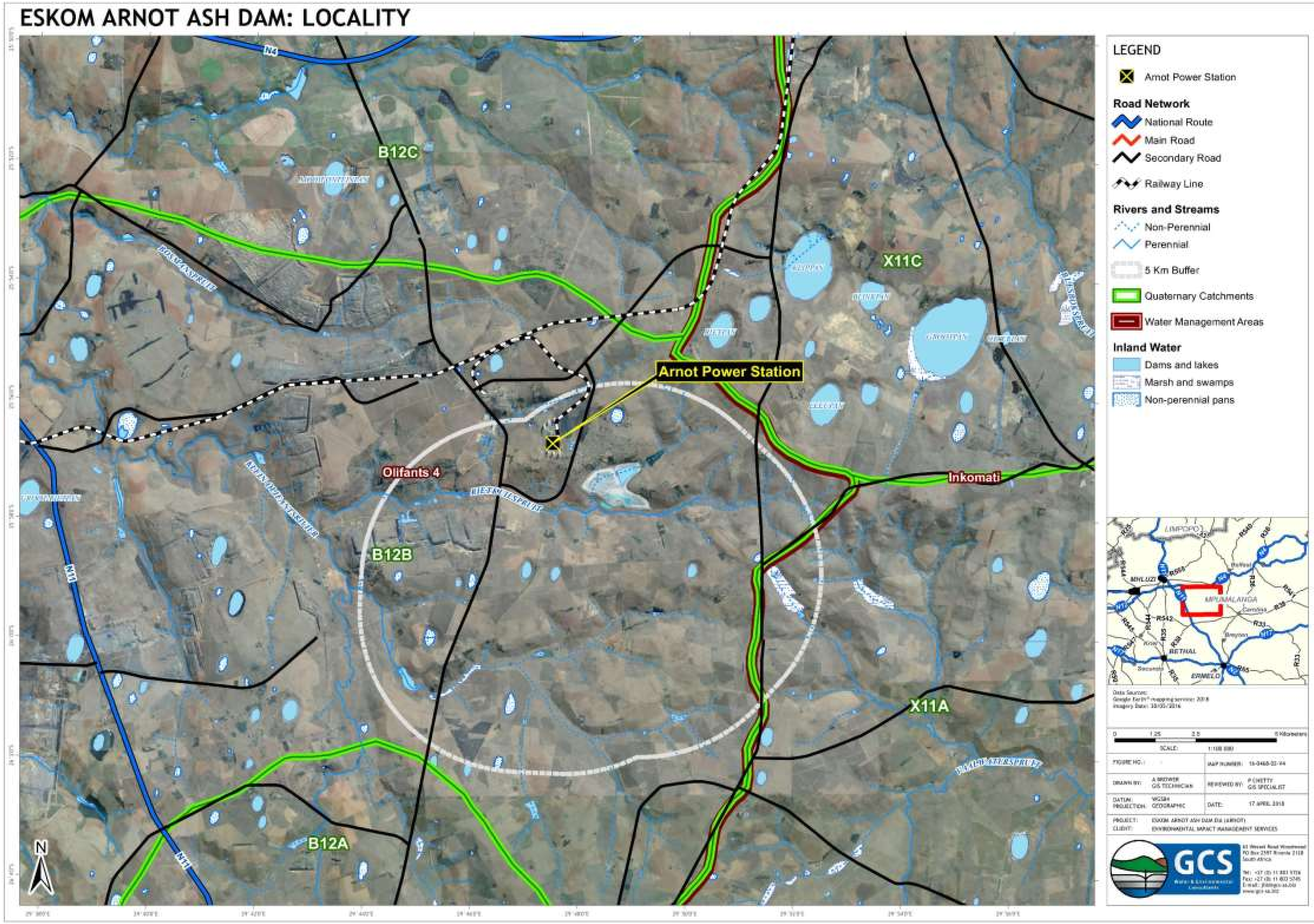


Figure 5.1: Locality of the proposed Arnot Ash Disposal Facility

5.2 Site Conditions

A screening site inspection was undertaken on the 23rd of October 2016 and on the 24th of January 2017, to visually assess the potential sites for the proposed Arnot Ash Disposal Facility. The general site conditions for site alternatives 1 and 2 can be seen in Photograph 5.1 and Photograph 5.2.

The land use in the alternative sites is generally uncultivated grassveld on which the dominant vegetation type is indigenous grass interspersed with brush.

Photograph 5.1: General conditions of site alternative 1

Photograph 5.2: General conditions of site alternative 2

5.3 Mean Annual Precipitation, Evaporation and Runoff

The climate data used in this study were obtained from the Water Resources of South Africa, 2012 Study (WRC, 2015) which contains the climatic and catchment information of each quaternary catchment in South Africa. As mentioned, the sites are located in Quaternary Catchment B12B. The MAP calculated for this area is 699 mm while the MAE is 1 552 mm and the MAR is 36.6 mm, indicating an area with distinct wet and dry seasons. The 36.6 mm runoff depth is only 5.23 % of the MAP. Refer to Table 5.1 for the average climatic data.

Figure 5.2, Figure 5.3 and Figure 5.4 represent the monthly distribution of rainfall, evaporation and runoff, respectively. The numbers represented as E10 to E90 show the exceedance probabilities of events which is the likelihood of an event of this size being exceeded.

Table 5.1: Mean Monthly Precipitation, Evaporation and Runoff for Quaternary Catchment B12B

Month	Precipitation (mm)	Evaporation (mm)	Runoff (mm)
Oct	73	167	1.1
Nov	115	158	3.6
Dec	120	175	5.8
Jan	122	171	7.8
Feb	89	142	7.1
Mar	80	140	4.3
Apr	41	108	2.8
May	15	91	1.4
Jun	8	74	0.9
Jul	6	81	0.7
Aug	7	107	0.6
Sep	23	139	0.5
Annual	**699**	**1 552**	**36.6**

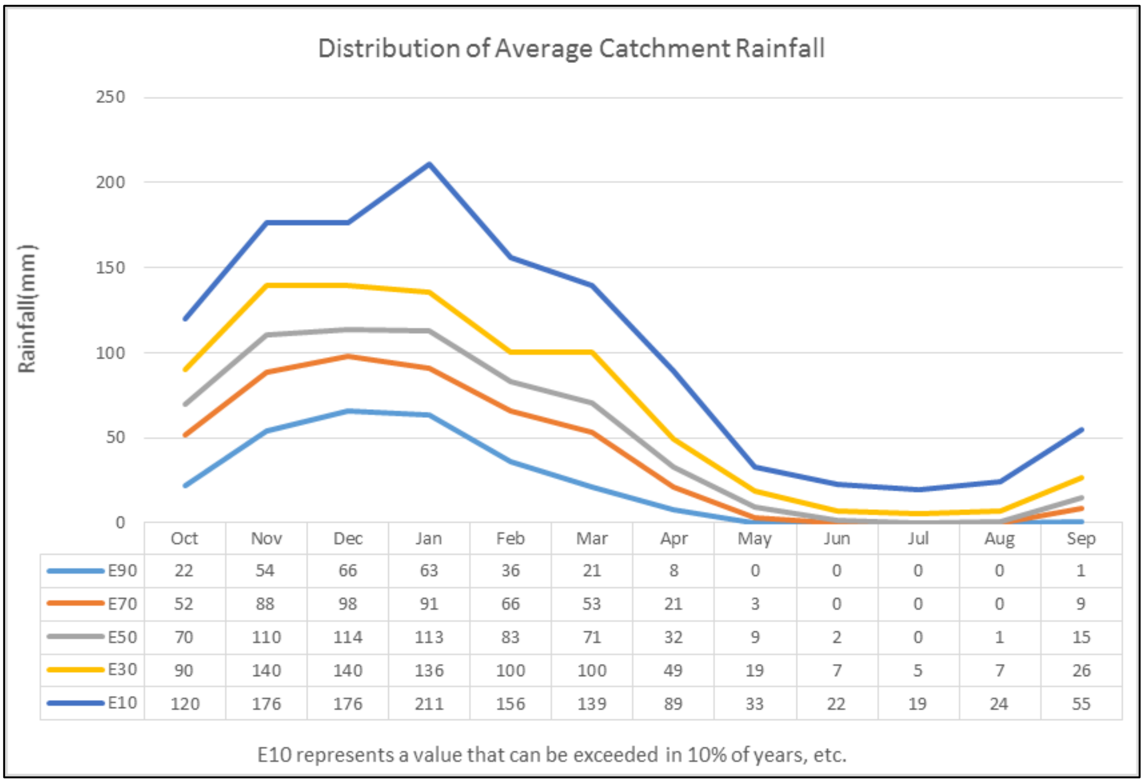
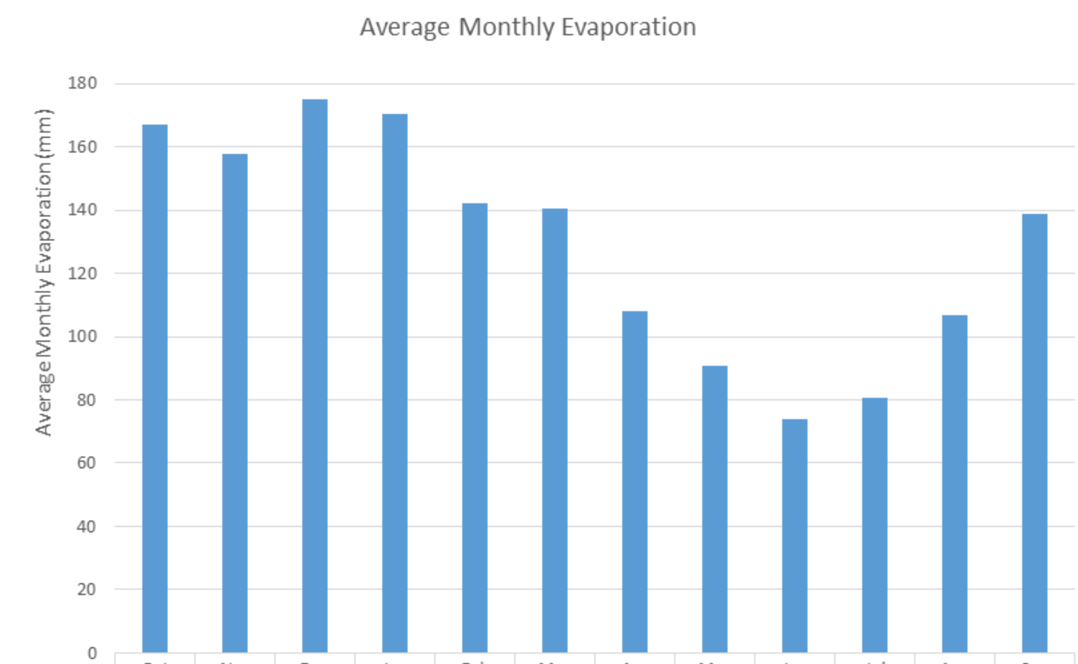
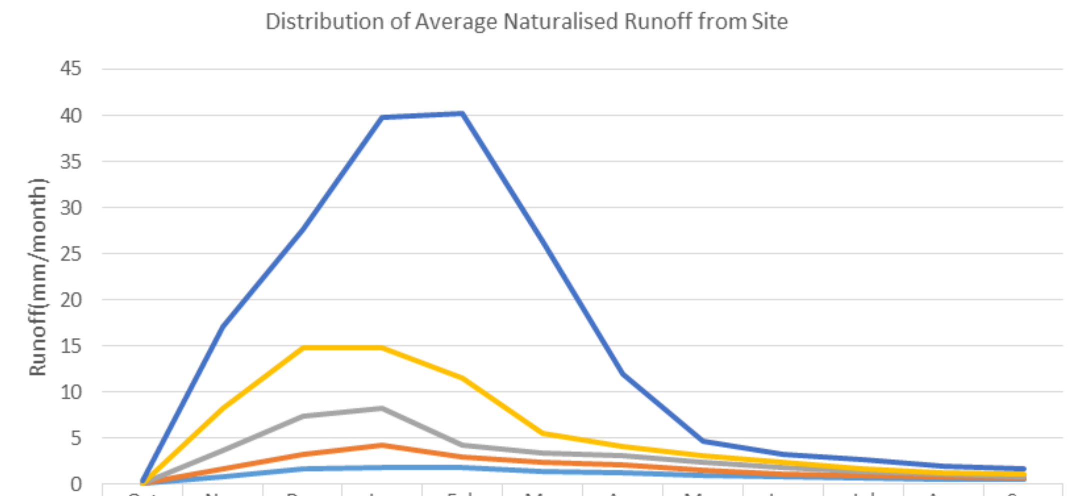


Figure 5.2: Monthly Rainfall Distribution for Quaternary B12B



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
A-Pan(mm)	167	158	175	171	142	140	108	91	74	81	107	139

Figure 5.3: Monthly Evaporation for Quaternary B12B



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E90	0	1	2	2	2	1	1	1	1	1	1	1
E70	0	2	3	4	3	2	2	2	1	1	1	1
E50	0	4	7	8	4	3	3	2	2	1	1	1
E30	0	8	15	15	11	6	4	3	2	2	1	1
E10	0	17	28	40	40	26	12	5	3	3	2	2

E90 represents a value that can be exceeded in 90% of years, etc.

Figure 5.4: Runoff Distribution for Quaternary B12B

5.4 Design Rainfall Depths

The design rainfall depths for the proposed ash disposal facility sites were calculated using the Design Rainfall software for South Africa (Smithers, 2002). The design rainfall depths for the 1:2-year to 1:200-year return periods can be seen in Table 5.2.

Table 5.2: Design Rainfall Depths (mm) for the proposed ash disposal facility sites

Duration	Return Period (Years)						
	2	5	10	20	50	100	200
5 min	9.8	13.2	15.7	18.3	21.9	24.9	28.1
10 min	14.1	19.1	22.7	26.5	31.8	36.1	40.7
15 min	17.6	23.7	28.2	32.9	39.5	44.8	50.6
30 min	21.6	29.2	34.7	40.5	48.5	55.1	62.2
45 min	24.4	32.9	39.2	45.7	54.8	62.2	70.2
1 h	26.6	35.9	42.7	49.8	59.7	67.8	76.5
1.5 h	30	40.5	48.2	56.2	67.4	76.5	86.3
2 h	32.7	44.2	52.5	61.2	73.4	83.4	94
4 h	37	50	59.5	69.3	83.2	94.4	106.5
6 h	39.8	53.8	64	74.6	89.4	101.5	114.5
8 h	41.9	56.6	67.4	78.5	94.2	106.9	120.6
10 h	43.6	58.9	70.1	81.7	98	111.3	125.5
12 h	45.1	60.9	72.5	84.4	101.3	115	129.7
16 h	47.5	64.1	76.3	88.9	106.7	121.1	136.6
20 h	49.4	66.8	79.4	92.5	111	126	142.2
24 h	51.1	69	82.1	95.6	114.7	130.2	146.9

6 SITE SENSITIVITY

A sensitivity map was developed in accordance with the EIMS sensitivity mapping methodology. The purpose of the map is to identify sensitive features relating to surface water within the proposed development area.

The mapped-out floodplain of proximal streams surrounding the two proposed alternative ash disposal facility sites is considered to be Highly Sensitive (+2) since it is prone to siltation and pollution which could potentially arise from the proposed project. These sensitive surface water features fall within the 1 km buffers around the proposed Alternative 1 and 2 sites.

The sensitivity map which indicates the areas associated with the described sensitivities can be seen in Figure 6.1.

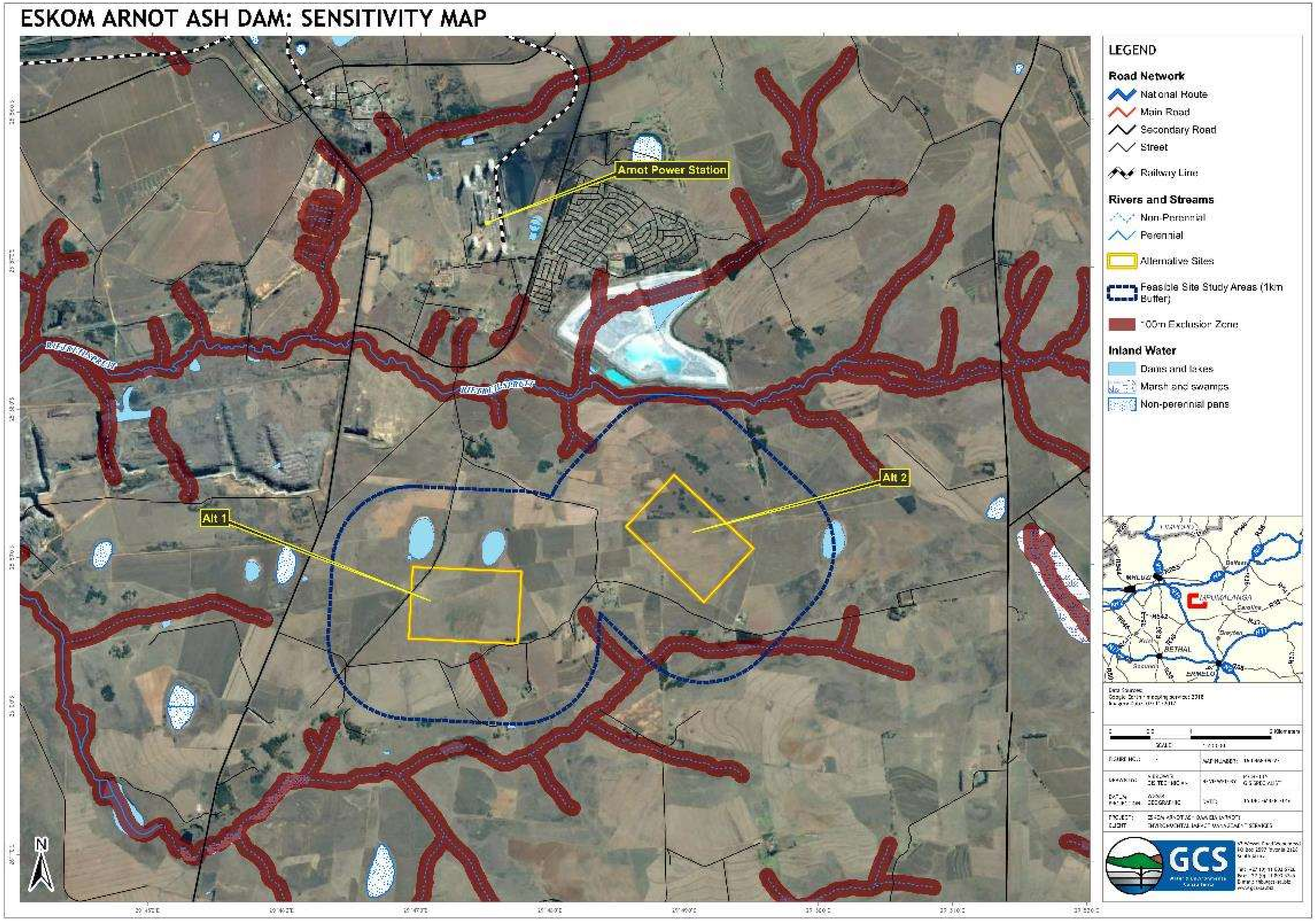


Figure 6.1: Sensitivity map for the proposed Arnot Ash Dump alternative sites

7 DESCRIPTION AND ASSESSMENT OF POTENTIAL IMPACTS

This section describes the potential surface water impacts and mitigation measures for the proposed Arnot Ash Dump project.

7.1 Preliminary Risk Assessment and Mitigation

The preliminary risk assessment was undertaken for the construction, operation and decommissioning phases of the proposed project.

7.1.1 Construction Phase

The following section describes the potential impacts associated with the construction phase of the proposed project:

Impact:

- The removal of vegetation as well as the compaction of surfaces during construction will very likely result in increased runoff and erosion from the site. Runoff with higher sediment loads and the higher flood peaks could thus report to the Rietkuilspruit and its tributaries. The magnitude of this potential impact is, however, very small since it is expected to be localised to the project site and nearby watercourse.

Mitigation Measures:

- Progressive rehabilitation of disturbed land should be carried out to minimise the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff;
- A starter embankment is recommended to prevent sediment runoff;
- Traffic and movement over stabilised areas should be controlled (minimised and kept to certain paths), and damage to stabilised areas should be repaired timeously and maintained; and
- The total footprint area to be cleared for the proposed ash disposal facility should be kept to a minimum by demarcating the construction areas and restricting removal of vegetation to these areas only.

Impact:

- The spillage of oils, fuel and chemicals can result in the pollution of water resources if due care is not taken.

Mitigation measures:

- Oil recovered from any vehicle or machinery on site should be collected, stored and disposed of by accredited vendors for recycling.

7.1.2 Operational Phase

The following section describes the potential impacts associated with the operational phase of the proposed project:

Impact:

- There is a possibility of contamination of the local streams and rivers if the proposed ash disposal facility is not lined, or have an adequate Storm Water Management Plan (SWMP) in place, or due to technical failures which might result in spillage and seepage/leakage of contaminated water.

Mitigation measures:

- A detailed storm water management plan is recommended for the ash disposal facility with adherence to the GN704;
- The engineering design team should ensure that seepage from the Disposal Facility does not occur at the toe of the Disposal Facility;
- Vegetation should be planted on the Ash Disposal facility embankments to prevent erosion and silt runoff; and
- A water quality monitoring plan should be produced and implemented to determine any changes in the water quality.

7.1.3 Decommissioning Phase

The following section describes the potential impacts associated with the decommissioning phase of the proposed project:

Impact:

- Leakages/seepages and spillages can occur during this phase from the proposed ash disposal facility.

Mitigation measures:

- The proposed ash disposal facility should be monitored and checked to ensure that no leakages/seepages of contaminated water occur even when the ash disposal facility has been decommissioned; and
- The water quality monitoring plan should continue during this phase to monitor any deterioration of the water quality even when the mine will no longer be operating.

.

7.2 Significance Rating

A significance rating was undertaken using the methodology proposed by EIMS. This methodology is elaborated on in Section 3.5.

Table 7.1 to Table 7.2 show the significance ratings of increased sediment load from the clearing of vegetation and erosion for the Construction Phase of Site Alternatives 1 and 2, respectively. Soil erosion is expected to have a negative effect with medium significance ratings of -10.00 and -09.00 for Site Alternatives 1 and 2 respectively, as the scale of the impact will be restricted to the site. If sediment control mitigation is put in place correctly, the impact will rank as low with significance ratings of -4.00 and -3.50, respectively (see Figure 7.1 to Figure 7.2).

Table 7.3 to Table 7.4 show the significance ratings of the spillage of oils, fuels and chemicals for the Construction Phase of Site Alternatives 1 and 2, respectively. The unmitigated impact is ranked as low with a significance rating of -9.00 and -8.00 for Site Alternatives 1 and 2, respectively. If the recommended mitigation measures are implemented correctly, the impact during construction will be lower with significance ratings of -3.75 and -2.00 for Site Alternatives 1 and 2, respectively (see Figure 7.3 to Figure 7.4).

Table 7.5 to Table 7.6 show the significance rating of the contamination from seepage, leakage and spillage for the Operation Phase of Site Alternatives 1 and 2 respectively. The unmitigated impact are ranked as low with significance ratings of -9.75 and -8.25 for Site Alternatives 1 and 2, respectively. If the recommended mitigation measures are implemented correctly, the impact during operation will be lower with a significance rating of -4.00 and -3.50 for Site Alternatives 1 and 2, respectively (see Figure 7.5 to Figure 7.6).

Table 7.7 to Table 7.8 show the significance rating of the contamination from seepage, leakage and spillage for Site Alternatives 1 and 2 respectively. The unmitigated impact is ranked as low with significance ratings of -9.75 and -8.25 for Site Alternatives 1 and 2, respectively. If the recommended mitigation measures are implemented correctly, the impact during decommissioning will be lower with significance ratings of -4.00 and -3.50, for Site Alternatives 1 and 2, respectively (see Figure 7.7 to Figure 7.8).

Table 7.1: Alternative 1- Significance rating of increased sediment loads for Construction Phase

Impact Name	Increased sediment loads				
Alternative	Alternative 1				
Phase	Construction				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	3	Probability	4	2
Environmental Risk (Pre-mitigation)					-10.00
Mitigation Measures					
Environmental Risk (Post-mitigation)					-4.00
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.67

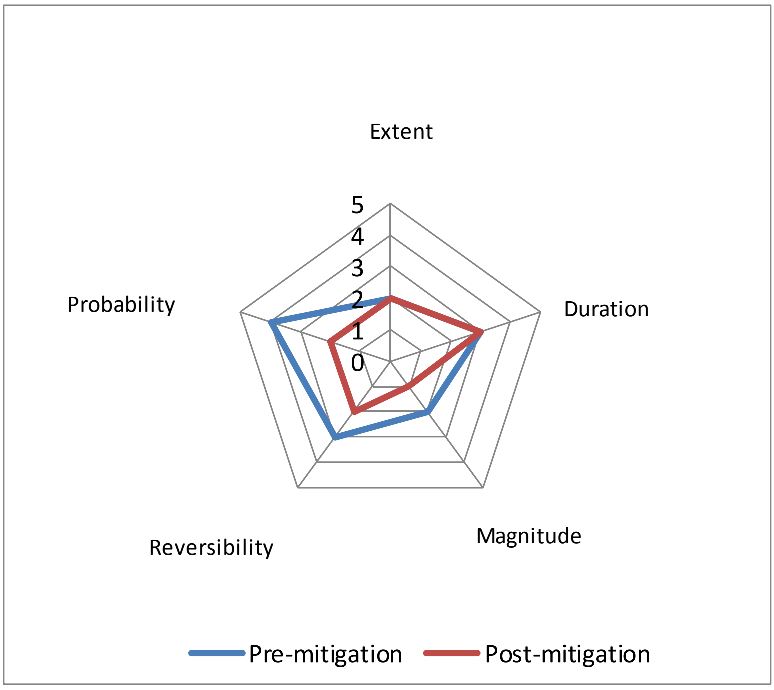


Figure 7.1: Alternative 1 - Radar plot of pre and post mitigation impacts of increased sediment loads for Construction Phase

Table 7.2: Alternative 2- Significance rating of increased sediment loads for Construction Phase

Impact Name	**Increased sediment loads**				
Alternative	**Alternative 2**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	2	2	Probability	4	2
Environmental Risk (Pre-mitigation)					-9.00
Mitigation Measures					
Environmental Risk (Post-mitigation)					-3.50
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.08

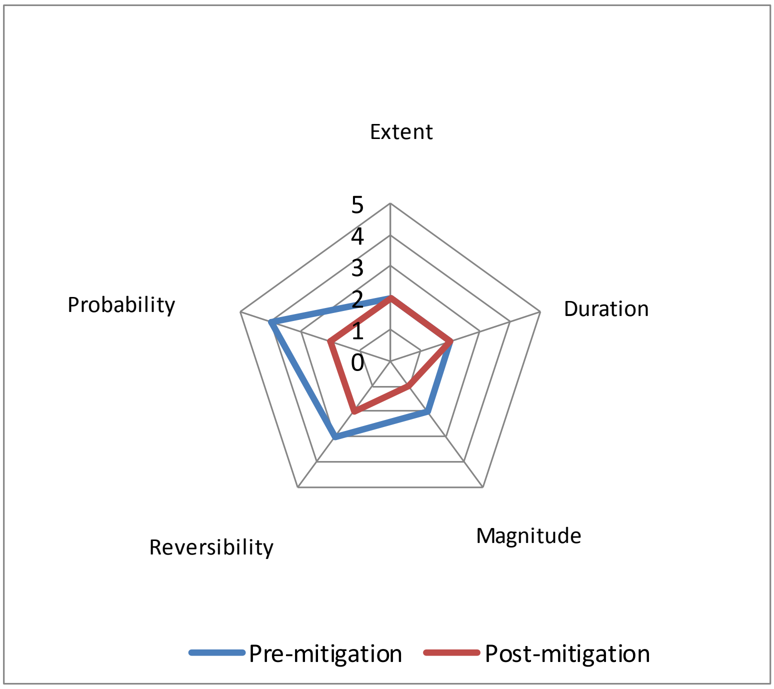


Figure 7.2: Alternative 2 - Radar plot of pre and post mitigation impacts of increased sediment loads for Construction Phase

Table 7.3: Alternative 1 - Significance rating of Spillage of oils, fuel and chemicals for Construction Phase

Impact Name	**Spillage of oils, fuel and chemicals**				
Alternative	**Alternative 1**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	1	Reversibility of Impact	3	2
Duration of Impact	2	1	Probability	4	3
Environmental Risk (Pre-mitigation)					-9.00
Mitigation Measures					
Environmental Risk (Post-mitigation)					-3.75
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.38

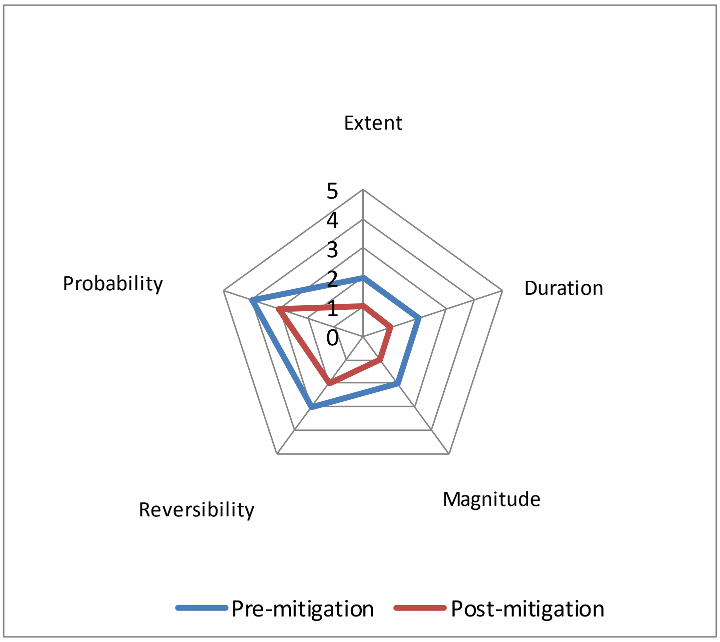


Figure 7.3: Alternative 1 - Radar plot of pre and post mitigation impacts of spillage of oils, fuels and chemicals for Construction Phase

Table 7.4: Alternative 2 - Significance rating of spillage of oils, fuel and chemicals for Construction Phase

Impact Name	**Spillage of oils, fuel and chemicals**				
Alternative	**Alternative 2**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	1	Reversibility of Impact	2	1
Duration of Impact	2	1	Probability	4	2
Environmental Risk (Pre-mitigation)					-8.00
Mitigation Measures					
Environmental Risk (Post-mitigation)					-2.00
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-2.33

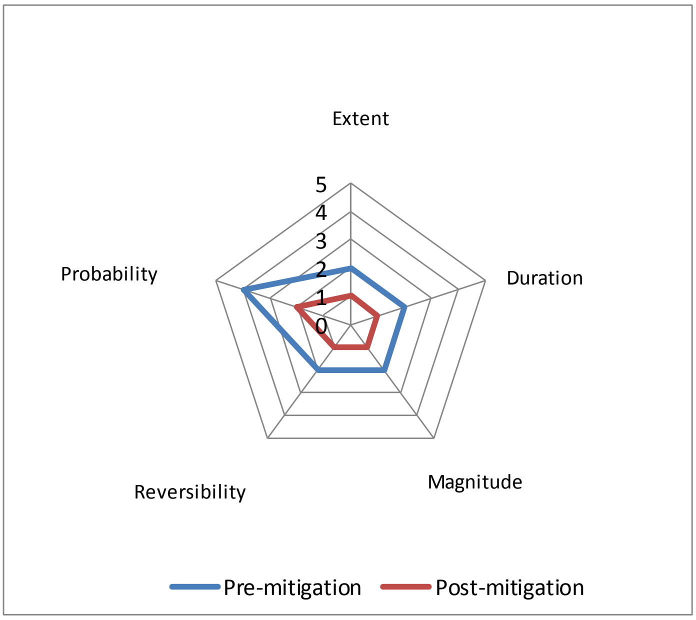


Figure 7.4: Alternative 2 - Radar plot of pre and post mitigation impacts of spillage of oils, fuels and chemicals for Construction Phase

Table 7.5: Alternative 1 - Significance rating of contamination from seepage, leakage and spillage for Operational Phase

Impact Name	Contamination from seepage, leakage and spillage				
Alternative	Alternative 1				
Phase	Operation				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	1
Extent of Impact	3	2	Reversibility of Impact	4	2
Duration of Impact	3	3	Probability	3	2
Environmental Risk (Pre-mitigation)					-9.75
Mitigation Measures					
Environmental Risk (Post-mitigation)					-4.00
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.67

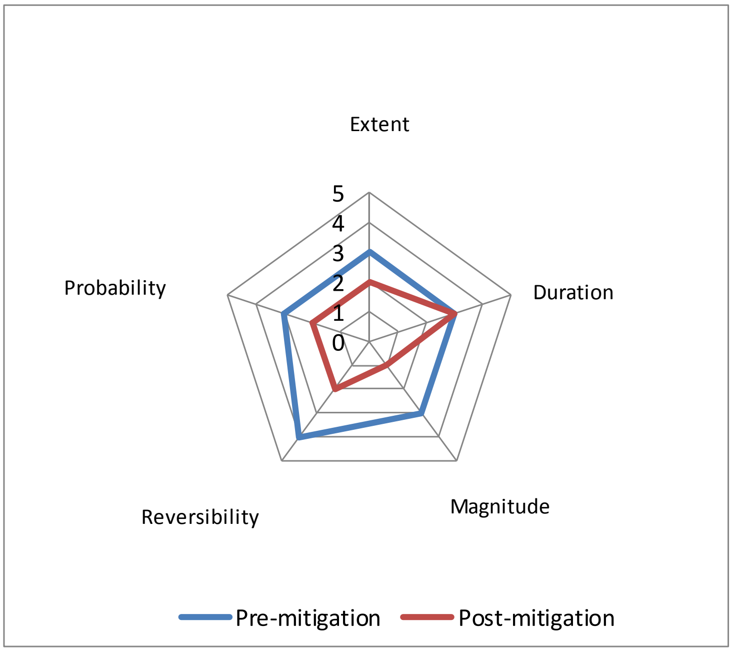


Figure 7.5: Alternative 1 - Radar plot of pre and post mitigation impacts of contamination from seepage, leakage and spillage for Operational Phase

Table 7.6: Alternative 2 - Significance rating of contamination from seepage, leakage and spillage for Operational Phase

Impact Name	**Contamination from leakage and spillage**				
Alternative	**Alternative 2**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	1
Extent of Impact	3	2	Reversibility of Impact	2	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-8.25
Mitigation Measures					
Environmental Risk (Post-mitigation)					-3.50
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.08

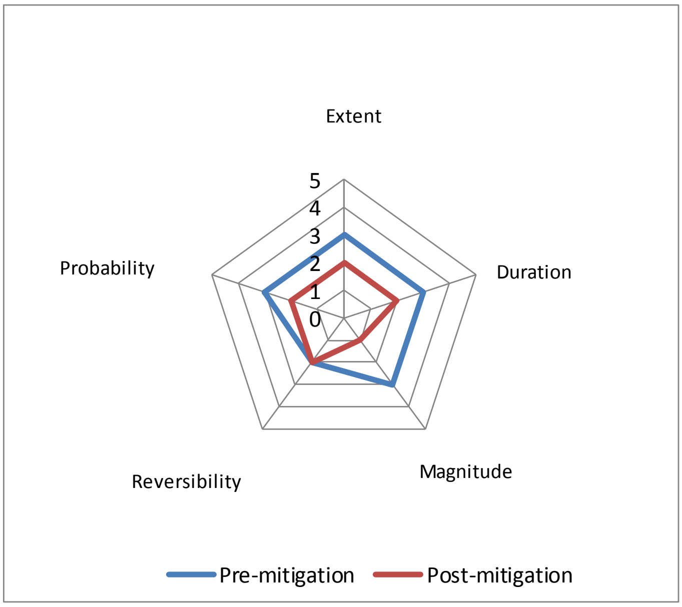


Figure 7.6: Alternative 2 - Radar plot of pre and post mitigation impacts of contamination from leakage and spillage for Operational Phase

Table 7.7: Alternative 1 - Significance rating results: Contamination from seepage, leakage and spillage for Decommissioning Phase

Impact Name	**Contamination from seepage, leakage and spillage**				
Alternative	**Alternative 1**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	1
Extent of Impact	3	2	Reversibility of Impact	4	2
Duration of Impact	3	3	Probability	3	2
Environmental Risk (Pre-mitigation)					-9.75
Mitigation Measures					
Environmental Risk (Post-mitigation)					-4.00
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.67

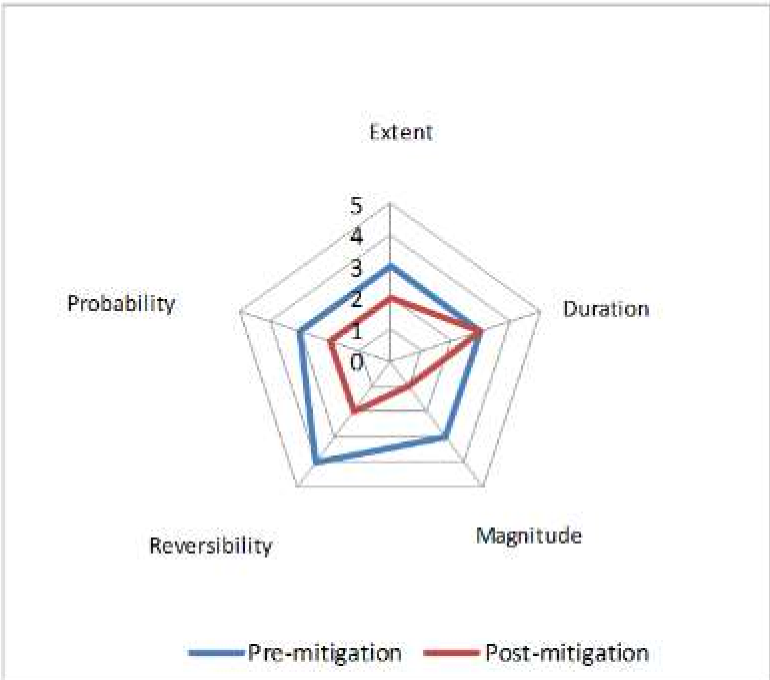


Figure 7.7: Alternative 1 - Radar plot of pre and post mitigation impacts of contamination from seepage, leakage and spillage for Decommissioning Phase

Table 7.8: Alternative 2 - Significance rating results: Contamination from seepage, leakage and spillage for Decommissioning Phase

Impact Name	**Contamination from leakage and spillage**				
Alternative	**Alternative 2**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	1
Extent of Impact	3	2	Reversibility of Impact	2	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-8.25
Mitigation Measures					
Environmental Risk (Post-mitigation)					-3.50
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
The impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.17
Final Significance					-4.08

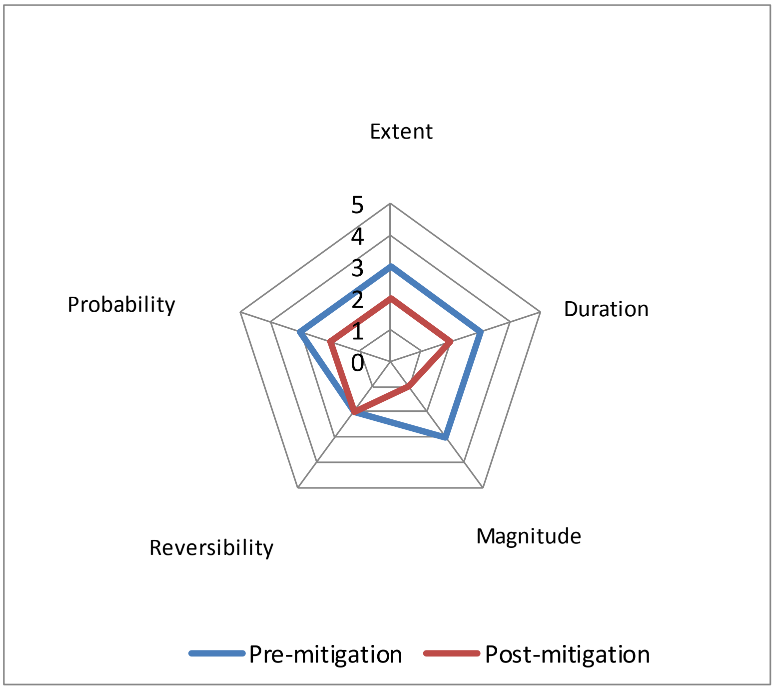


Figure 7.8: Alternative 2 - Radar plot of pre and post mitigation impacts of contamination from seepage, leakage and spillage for Decommissioning Phase

8 PLAN OF WORK FOR THE SURFACE WATER IMPACT ASSESSMENT

Based on the findings of the current scoping study, the following components should constitute the detailed surface water assessment for the EIA phase of the project.

8.1 Flood Lines

The 1:50-year and 1:100-year flood lines will be calculated for the Rietkuilspruit and associated tributaries surrounding the selected site. These calculations will be undertaken using ArcGIS or QGIS and HEC-RAS software. Maps showing the proposed ash disposal facility in relation to the relevant flood lines will be produced using GIS software.

8.2 Conceptual Storm Water Management Plan

The conceptual SWMP will be generated for the selected site using PCSWMM software in order to separate areas of clean and dirty water and to contain dirty water on site. Recommendations for how to achieve an efficient and legally-compliant conceptual SWMP will be made in writing and visually, using a series of recommended channels, berms and storage structures, if necessary. A final project site plan is required to finalise the SWMP.

8.3 Water Balance

The Water Balance modelling process will commence by utilising the hydrological assessment results to provide hydrological inputs; these include obtaining recent information on meteorology, runoff and catchments. The Water Balance will be based on a Process Flow Diagram (PFD) developed in conjunction with relevant site personnel and the client. This will indicate sources of water, the movement of water within the site and water storage and discharges.

8.4 Water Quality Assessment and Monitoring Plan

Water quality data obtained from the selected site will be compared against the relevant Department of Water and Sanitation (DWS) water quality standards limits. The chemistry data will also be illustrated graphically by means of relevant hydro-chemical plots (Piper and Durov plots). A detailed baseline water quality assessment will be undertaken in order to establish water quality-associated risks on site. A water quality monitoring plan will be developed around the selected site to determine key water quality monitoring points, chemical monitoring suites and the frequency of water quality sampling and analysis.

8.5 Risk Assessment, Mitigation and Management Plan

A detailed risk and mitigation assessment will be undertaken with adherence to EIMS' Risk Assessment Methodology, which will build on the existing assessment conducted during this scoping study.

A surface water management plan will be detailed, based on the risks, sensitivities and constraints identified and mitigation measures proposed. This will include the recommendations of the SWMP, water balance and the proposed water quality monitoring plan, with sampling procedures. Proposed management measure prioritisation will also be outlined.

9 CONCLUSIONS

The following conclusions were determined for the surface water scoping assessment:

- The MAP, MAE and MAR calculated for this area are 699 mm, 1552 mm and 36.6 mm, indicating an area with distinct wet and dry seasons. The runoff depth is 5.23 % of the MAP.
- The mapped-out floodplain of proximal streams surrounding the two proposed alternative ash disposal facility sites is considered to be Highly Sensitive (+2) since it is prone to siltation and pollution which could potentially arise from the proposed project. These sensitive surface water features fall within the 1 km buffers around the proposed Alternative 1 and 2 sites.
- Site Alternative 2 has lower significance ratings for all assessed impacts and is, therefore, considered more suitable for the proposed Ash Disposal Facility project.
- Site Alternative 1 is considered less preferred due to its proximity to two pans which slightly increases its impact significance rating over that of Site Alternative 2.
- The following specialist studies should be undertaken during the EIA Phase of the project:
  - Flood lines determination,
  - Conceptual Storm Water Management Plan,
  - Water Balance,
  - Water Quality Analysis and Monitoring,
  - Risk and Mitigation Assessment, and
  - Surface Water Management and Action Plan.

10 RECOMMENDATIONS

The following recommendations are made based on findings of the scoping study:

<u>Risk Assessment</u>

Construction Phase

Impact: Increased sediment loads

Mitigation Measures: The following measures are recommended:

- Progressive rehabilitation of disturbed land should be carried out to minimise the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff;
- A starter embankment is recommended to prevent sediment runoff;
- Traffic and movement over stabilised areas should be controlled (minimised and kept to certain paths), and damage to stabilised areas should be repaired timeously and maintained; and
- The total footprint area to be cleared for the proposed ash disposal facility should be kept to a minimum by demarcating the construction areas and restricting removal of vegetation to these areas only.

Impact: Spillage of oils, fuel and chemicals could pollute proximal water bodies.

Mitigation measures:

- Oil recovered from any vehicle or machinery on site should be collected, stored and disposed of by accredited vendors for recycling.

Operational Phase

Impact: Contamination of local streams and rivers by pollutants from the ash disposal facility.

Mitigation measures:

- A detailed storm water management plan is recommended for the ash disposal facility with adherence to the GN704;
- The engineering design team should ensure that seepage from the Disposal Facility does not occur at the toe of the Disposal Facility;
- Vegetation should be planted on the Ash Disposal facility embankments to prevent erosion and silt runoff; and

- A water quality monitoring plan should be produced and implemented to determine any changes in the water quality.

Decommissioning Phase

Impact: Contamination from leakage and spillage

Mitigation measures:

- The proposed ash disposal facility should be monitored and checked to ensure that no leakages/seepages of contaminated water occur even when the ash disposal facility has been decommissioned; and
- The water quality monitoring plan should continue during this phase to monitor any deterioration of the water quality even when the mine will no longer be operating.

11 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations have been made:

- Only the 2 selected sites of 120ha form part of the scope of this study; and
- At the time of writing the Scoping Report, the information supplied was correct.

12 REFERENCES

DWA, 2012. Draft National Water Resource Strategy (NWR52): Managing Water For An Equitable and Sustainable Future, Pretoria: Department of Water Affairs.

NEMA, 2014. National Environmental Management: Waste Amendment Act. Government Gazette.

NWA, n.d. The National Water Act, 1998 (Act no. 36 of 1998), Pretoria: South Africa.

RSA National Geospatial Institute, 2017. 1:50000 Topographical Series: 2627BB; 2628AA, AC, s.l.: s.n.

Smithers, 2002. Design Rainfall Estimation for South Africa, Pretoria: WRC.

WRC, 2015. Water Resources of South Africa Study. Pretoria: Water Research Commission.