Mutsho Power Project

Proposed development of the Mutsho Power Project and Associated Infrastructure on a Site near Makhado (Louis Trichardt), Limpopo Province

Environmental Impact Assessment (EIA) Report

April 2018

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PROJECT DETAILS

DEA Reference No.	:	14/12/16/3/3/3/2220
Title	:	Environmental Impact Assessment (EIA) Report for the Mutsho Power Project and Associated Infrastructure on a site near Makhado (Louis Trichardt), Limpopo Province.
Authors	:	Savannah Environmental (Pty) Ltd Jo-Anne Thomas Sarah Watson Gabriele Stein
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Project Applicant	:	Mutsho Power (Pty) Ltd
Report Status	:	Environmental Impact Assessment (EIA) Report for public review from **13 April 2018 – 15 May 2018**
Date	:	April 2018

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PUBLIC REVIEW PERIOD FOR EIA REPORT

This Environmental Impact Assessment (EIA) Report has been made available for a 30-day public review period from **13 April 2018 – 15 May 2018**. The EIA Report which has been submitted to the Department of Environmental Affairs (DEA) and the Limpopo Department of Economic Development, Environment, and Tourism (LDEDET) is also available for download on www.savannahsa.com or on request from Savannah Environmental (Pty) Ltd.

The report has been distributed to relevant Organs of State and copies have been made available at the following locations:

» Musina-Nancefield Public Library, 3 Ralph Small Street, Nancefield Musina
» Louis Trichardt Public Library, Erasmus Street, Makhado (Louis Trichardt)
» Makhado Centre of Learning, Tanga Farm, along D745

Please submit your comments to:
Gabriele Stein of **Savannah Environmental** P.O. Box 148, Sunninghill, 2157 Tel: 011 656 3237 Fax: 086 684 0547 Email: gabriele@savannahsa.com
The due date for comments on the Scoping Report is **Tuesday, 15 May 2018**

Comments can be made as written submission via fax, post or e-mail.

EAP DECLARATION OF INTEREST

I, Jo-Anne Thomas, declare that:

- I act as the independent environmental practitioner in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting EIAs, including knowledge of NEMA, the 2014 EIA Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the NEMA, the 2014 EIA Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8 of the 2014 EIA Regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to Interested and Affected Parties (I&APs) and the public and that participation by I&APs is facilitated in such a manner that all I&APs will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all I&APs are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by I&APs in respect of final reports that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all I&APs that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected from an EAP in terms of the 2014 EIA Regulations; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the Act.
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the EIA Regulations, 2014.

Jo-Anne Thomas
Name

Signature

13 April 2018
Date

DEFINITIONS AND TERMINOLOGY

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Archaeological material: Remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

Commence: The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

Commissioning: Commissioning commences once construction is completed. Commissioning covers all activities including testing after all components of the power station are installed.

Construction: Construction means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity. Construction begins with any activity which requires Environmental Authorisation.

Cumulative impacts: The impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Decommissioning: To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned. This usually occurs at the end of the life of a facility.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

"Do nothing" alternative: The "do nothing" alternative is the option of not undertaking the proposed activity or any of its alternatives. The "do nothing" alternative also provides the baseline against which the impacts of other alternatives should be compared.

Drainage: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may or may not be present.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Endemic: An "endemic" is a species that grows in a particular area (is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

Environment: The surroundings within which humans exist and that are made up of:

i. The land, water and atmosphere of the earth;
ii. Micro-organisms, plant and animal life;
iii. Any part or combination of (i) and (ii) and the interrelationships among and between them; and
iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental Assessment Practitioner (EAP): An individual responsible for the planning, management and coordinating of environmental management plan or any other appropriate environmental instruments introduced by legislation.

Environmental impact: An action or series of actions that have an effect on the environment.

Environmental Impact Assessment (EIA): Environmental Impact Assessment (EIA), as defined in the NEMA EIA Regulations and in relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental Management Programme (EMPr): A management plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a proposal and its on-going maintenance after implementation.

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000).

Hazardous waste: Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment (Van der Linde and Feris, 2010;pg 185).

Incident: An undesired event which may result in a significant environmental impact but can be managed through internal response.

Indigenous: All biological organisms that occurred naturally within the study area prior to 1800.

Indirect impacts: Indirect or induced changes that may occur as a result of the activity (e.g. the reduction of water in a stream that supply water to a reservoir that supply water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.

Interested and Affected Party (I&AP): Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.

Perennial and non-perennial: Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contains flows for short periods, such as a few hours or days in the case of drainage lines.

Pollution: A change in the environment caused by substances (radio-active or other waves, noise, odours, dust or heat emitted from any activity, including the storage or treatment or waste or substances.

Pre-construction: The period prior to the commencement of construction, which may include activities which do not require Environmental Authorisation (e.g. geotechnical surveys).

Riparian: The area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare".

Red data species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Significant impact: An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

Waste: Any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 of NEM:WA; or any other substance, material or object that is not included in Schedule 3 of NEM:WA that may be defined as a waste by that is identified as waste by the Minister of Environmental Affairs (by notice in the Gazette). Any waste or portion of waste, referred to in the section above, ceases to be a waste:

(i) Once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered;
(ii) Where approval is not required, once a waste is, or has been re-used, recycled or recovered;
(iii) Where the Minister of Environmental Affairs has, in terms of Section 74 of NEM:WA, exempted any waste or a portion of waste generated by a particular process from the definition of waste; or
(iv) Where the Minister of Environmental Affairs has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste.

Watercourse: As per the National Water Act means –
(a) A river or spring;
(b) A natural channel in which water flows regularly or intermittently;
(c) A wetland, lake or dam into which, or from which, water flows; and
(d) Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks

Wetlands: Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (National Water Act, No. 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin et al., 1979).

ACRONYMS

AEL	Atmospheric Emission License
AQMP	Air Quality Management Plan
BGIS	Biodiversity Geographic Information System
CBA	Critical Biodiversity Area
DAFF	Department of Agricultural, Forestry and Fisheries (National)
DEA	Department of Environmental Affairs (National)
DWS	Department of Water and Sanitation
CBA	Critical Biodiversity Area
CBIPPPP	Coal Baseload Independent Power Producer Procurement Programme
CFB	Circulating Fluidised Bed
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CoAL	Coal of Africa Limited
CR	Critically Endangered
CSIR	Council for Scientific and Industrial Research
DM	District Municipality
DoE	Department of Energy
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
EN	Endangered
EP	Equator Principles
ESA	Ecological Support Area
FGD	Flue Gas Desulphurisation
GHG	Greenhouse Gas
HRA	Health Risk Assessment
IBA	Important Bird Area
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IPP	Independent Power Producer
IPPPP	Independent Power Producer Procurement Programme
IRP	Integrated Resource Plan
IUCN	International Union for Conservation of Nature
IWUL	Integrated Water Use License
I&AP	Interested and Affected Party
km	Kilometre
kWh	Kilowatt hour
LC	Least Concern

LCPv2	Limpopo Conservation Plan version 2
LDAFF	Limpopo Department of Agriculture, Forestry and Fisheries
LDEDET	Limpopo Department of Economic Development, Environment and Tourism
LDP	Limpopo Development Plan
LEIP	Limpopo Eco-Industrial Park
LEMA	Limpopo Environmental Management Act
LM	Local Municipality
m	Metre
m^2	Square meters
m^3	Cubic meters
mamsl	Metres Above Mean Sea Level
MES	Minimum Emission Standards
mg/m^3	Milligrams per cubic meter
MW	Megawatts
N_2O	Nitrous Oxides
NAAQS	National Ambient Air Quality Standards
NDP	National Development Plan
NEMA	National Environmental Management Act (No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act (No. 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act (No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act (No. 59 of 2008)
NFA	National Forests Act (No. 84 of 1998)
NFEPA	National Freshwater Ecosystem Priority Area
NHRA	National Heritage Resources Act (No. 25 of 1999)
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen ($NO_x = NO + NO_2$)
NT	Near Threatened
NWA	National Water Act (No. 36 of 1998)
PA	Protected Area
PC	Pulverised Coal
PM	Particulate Matter
PM_{10}	Particulate Matter with a diameter less than 10 microns
$PM_{2.5}$	Particulate Matter with a diameter less than 2.5 microns
PoSEIA	Plan of Study for EIA
PS	Performance Standard
S&EIA	Scoping and Environmental Impact Assessment
SABAP	South African Bird Atlas Project
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SDF	Spatial Development Framework
SEZ	Special Economic Zone
SNCR	Selective Non-catalytic Reduction
SO_2	Sulphur Dioxide

TOPS	Threatened or Protected Species
$\mu g/m^3$	Micrograms per cubic meter
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VOC	Volatile Organic Compound
VU	Vulnerable
WB	World Bank
WML	Waste Management License
WRC	Water Research Commission
WTW	Water Treatment Works
WUL	Water Use License
WWF	World Wide Fund for Nature
WWTW	Wastewater Treatment Works
ZLED	Zero Liquid Effluent Discharge

EXECUTIVE SUMMARY

Background

Mutsho Power (Pty) Ltd proposes the development of a new coal-fired power station and associated infrastructure on a site near Makhado (Louis Trichardt), in the Musina Local Municipality of Vhembe District, Limpopo Province. The project is to be known as the Mutsho Power Project, and is intended to form part of the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP).

The Mutsho Power Project will be fuelled by coal mined from MC Mining Ltd's (MCM) (previously known as Coal of Africa Limited (CoAL)) Makhado Project to be developed approximately 20km south-east of the proposed project site. The Makhado Project comprises a new coal mine (i.e. the Makhado Colliery) to be located north of the Soutpansberg Mountains in the Makhado Local Municipality of Vhembe District.

Project Description

The Mutsho Power Project will have a generation capacity of up to 680MW including house load, with an export capacity of 600MW, in accordance with DoE's requirements, and will make use of Circulating Fluidised Bed (CFB) technology operating under Supercritical (SC) conditions. The power plant will comprise 2 x boilers (suitably rated at approximately 300MW each), 2 x steam turbine generators (STGs), a flue / smoke stack, an ash dump, packaged Water Treatment Plant (WTP) and storage or discard ponds and vessels, an ash dump run-off dam, main plant run-off dam, raw water storage dam, strategic and working coal stockpiles and lime supply. The Mutsho Power Project will make use of direct dry cooling systems; dry ash disposal methods; and will be developed as a Zero Liquid Effluent Discharge (ZLED) facility.

The key project components applicable to the Mutsho Power Project can be summarised as follows:

- » Power island consisting of:
  - ∗ 2 x 300MW Supercritical (SC) Circulating Fluidised Bed (CFB) boilers.
  - ∗ Electrostatic Precipitator (ESP).
  - ∗ Flue / smoke stack up to 150m in height.
  - ∗ Direct dry-cooling (air-cooling) systems.
  - ∗ Balance of plant components (including steam turbines and generators etc.).
- » Raw materials storage and handling:
  - ∗ Coal and Limestone / Lime Rail Spur and / or Road off-loading systems.
  - ∗ Upgrading or establishment of a rail siding.
  - ∗ Coal crusher and raw material handling equipment.
  - ∗ Strategic and working coal stockpile.
  - ∗ Limestone or Lime storage and handling area.
- » Ash handling and disposal:
  - ∗ Ash dump (dry-ashing is proposed in order to reduce the project's water requirements in alignment with the recommendations of the National Development Plan (NDP) and Integrated Energy Plan (IEP)).
- » Water infrastructure:
  - ∗ Raw water storage dam (up to 5ha).
  - ∗ Water supply pipelines and booster stations.
  - ∗ Pollution control / run-off dams (up to 2.5ha each).
  - ∗ Packaged Water treatment plant (WTP).
  - ∗ Wastewater treatment plant (WWTP).
  - ∗ Storm water management systems.
- » Electrical infrastructure:
  - ∗ HV Yard and substation components with HV overhead transmission lines connecting to Eskom infrastructure.
- » Associated infrastructure:
  - ∗ Control room, office / administration, workshop, storage and logistics buildings.

  - On-site critical staff accommodation required during construction (up to 1.5ha).
  - Temporary site office, laydown and assembly areas, and batching plant (up to 5ha in total).
  - Upgrading of external roads and establishment of internal access roads.
  - Security fencing and lighting, and access control with guardhouse.
- Services required:
  - Refuse Material Disposal – During construction all refuse material generated by the proposed development will be collected by a contractor to be disposed of off-site at a licensed waste disposal facility. Solid wastes and sludge arising during operation will be collected, and transported to the ash dump. Chemical wastes will be collected and stored separately in a safe manner, and will be transported off-site via road where they will be disposed of according to the local and national standards.
  - Sanitation – During construction, all sewage waste will be collected by a contractor to be disposed of at a licensed waste disposal site. During operation, 2 x $5m^3/h$ buried sanitary sewage treatment systems will be provided for discharge from staff showers, flushing, toilets, canteen, etc. The sanitary sewage will be treated by secondary biological contact oxidation process, filtered, disinfected, and flow into clean water basin for reuse.
  - Water – Between 800 $000m^3/a$ and 1.2 million m^3/a of water is required during the construction phase, while approximately 1 million m^3/a is required to support the operation of the project. A number of bulk water supply options are currently being investigated for the project. The most promising of these include:
    - Transfer of treated effluent from the Makhado Rietvly Wastewater Treatment Works (WWTW)
    - Transfer from dams in Zimbabwe (alternative to above).
    - Direct abstraction from the Limpopo River.
  - Electricity – A power supply will be required during both construction and operation of the project. It is anticipated that electricity required to support the construction will be provided by the Musina Local Municipality.

Bulk water supply and grid integration options are in the process of being finalised, and have been excluded from the current scope of work, as they will be assessed through separate applications for Authorisation.

Project Site

The project site is located approximately 20km north-west of the Makhado Colliery, and approximately 7km south-west of Mopane in the Musina Local Municipality of Vhembe District, Limpopo Province. The area under investigation is approximately 2 161ha in extent and comprises 2 agricultural properties, belonging to Mr. Souis Hendrie Van Der Walt (i.e. the Remainder of the Farm Du Toit 563) and Fumaria Property Holdings (Pty) Ltd, a Special Purpose Vehicle (SPV) which is wholly owned by MCM (i.e. the Remainder of the Farm Vrienden 589).

A desktop site sensitivity assessment was conducted as part of the Scoping Phase. The purpose of the site sensitivity assessment was to inform the location of the development footprint (approximately 350ha in extent) within the larger project site (approximately 2 161ha in extent), such that areas of environmental sensitivity are avoided as far as possible. The development footprint would occupy an area of land equivalent to approximately 16% of the total project site. The extent of the site therefore allowed for the identification of layout design and site-specific alternatives. Following the completion of the Scoping Phase, and based on the outcomes of the site sensitivity assessment, a number of layout alternatives were identified for further investigation. Several of the layouts were abandoned based on technical (such as existing rail and road access, topography, prevailing wind direction and proximity to future Eskom infrastructure etc.), environmental (such as NFEPA buffers, occupied dwellings, ruins etc.) and/or financial feasibility.

The following three layouts alternatives were deemed to be feasible from a technical and financial perspective and have been considered as part of the EIA process:

Preferred Layout Alternative

The Preferred Layout Alternative entails the placement of the Mutsho Power Project, in its entirety, on the Farm Vrienden 589 (refer to **Figure 1**). The power plant and raw water storage dam are both proposed south of the proposed railway line, while the ash dump and ash dump runoff dam are proposed north of the proposed railway line. Based on the desk-top analysis of this proposed layout, this alternative is considered to be most favourable from an environmental perspective as it is perceived to pose the least environmental impacts or risks. The location of the ash dump and ash dump run-off dam away from prominent drainage lines reduces the potential risk of contamination.

Layout Alternative A

Layout Alternative A entails the development of the majority of project related infrastructure on the Farm Vrienden 589, with the remaining infrastructure proposed on the eastern extent of the Farm Du Toit 563 (refer to **Figure 2**). The proposed power plant, transmission substation, and raw water storage dam are all proposed for development north of the proposed railway line on Farm Vrienden 589. The ash dump has been split into two portions, each 60ha in extent. One portion will be developed in the northern extent of the Farm Vrienden 589, while the second portion will be developed in the eastern extent of the Farm Du Toit 563. The ash dump run-off dam will be developed between the two ash dumps at the project site's lowest elevation. Such a layout alternative is considered less favourable from a technical perspective than the preferred layout alternative, as the project would be required to straddle existing infrastructure, such as the railway line which occurs between Farm Du Toit 563 and Farm Vrienden 589. Given the location of the ash dumps, the ash conveyor required to transport ash generated by the power plant to the ash dump would be routed underneath Eskom's proposed 400kV power line. In addition, Layout Alternative A entails the development of the two ash dumps and an ash dump run-off dam between and within close proximity to prominent drainage lines, which is less favourable from an environmental perspective as it increases the potential risk for contamination.

Layout Alternative B

Layout Alternative B entails the development of all infrastructure on the Farm Vrienden 589 (refer to **Figure 3**). The power plant is proposed for development south of the proposed railway line, while a single ash dump and ash dump run-off dam is proposed for development north of the proposed railway line, between two prominent drainage lines. This layout alternative has a possible concern from an environmental perspective given the proximity of the ash dump and ash dump run-off dam to the drainage lines, and the potential risk for contamination, which will be further assessed in this report.

Each of the abovementioned layout alternatives have been assessed as part of the EIA process, to ensure that that layout which is ultimately proposed for development is both preferable, and feasible from an environmental, technical, and economic perspective.

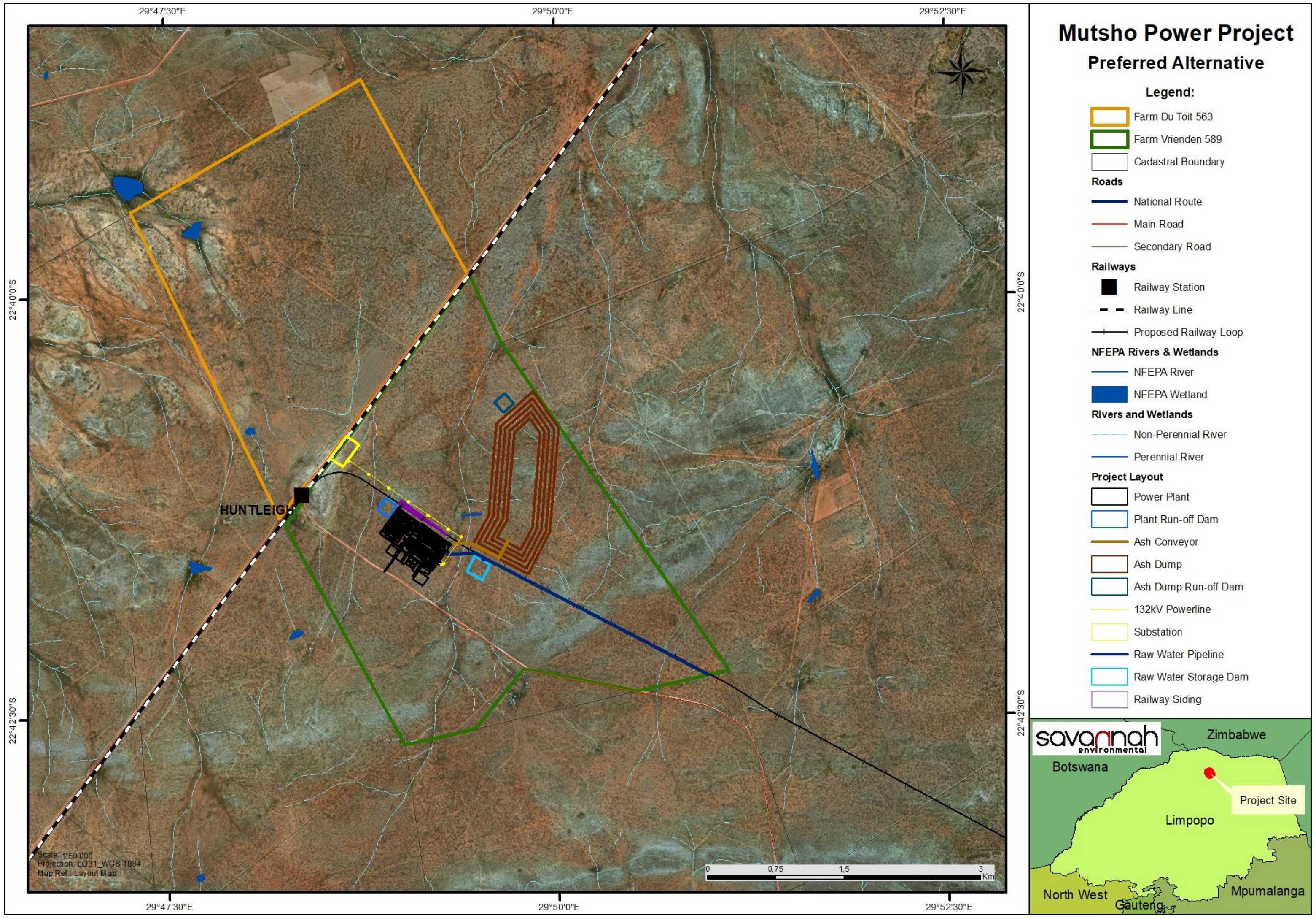


Figure 1: Preferred Alternative Layout.

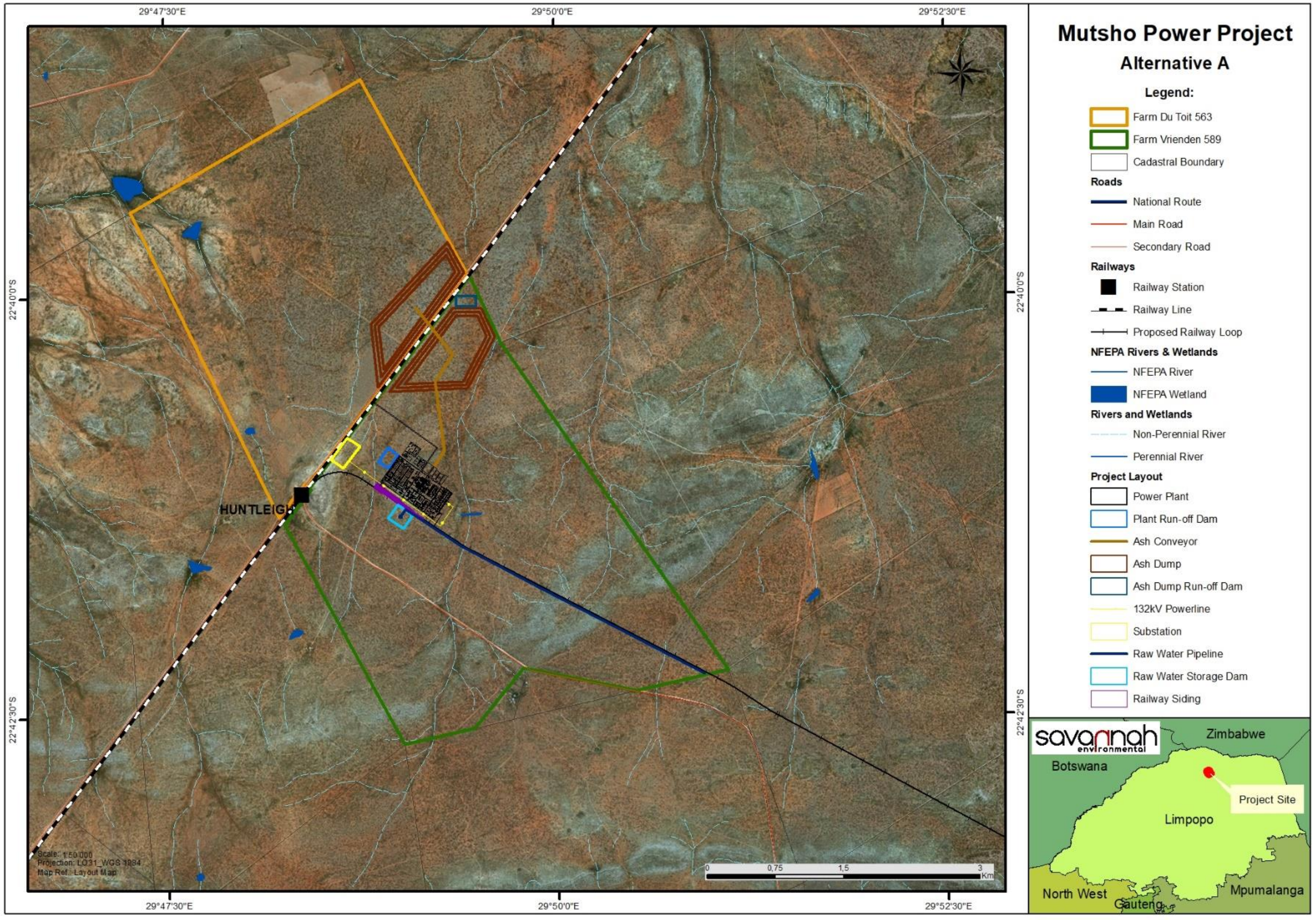


Figure 2: Alternative A Layout.

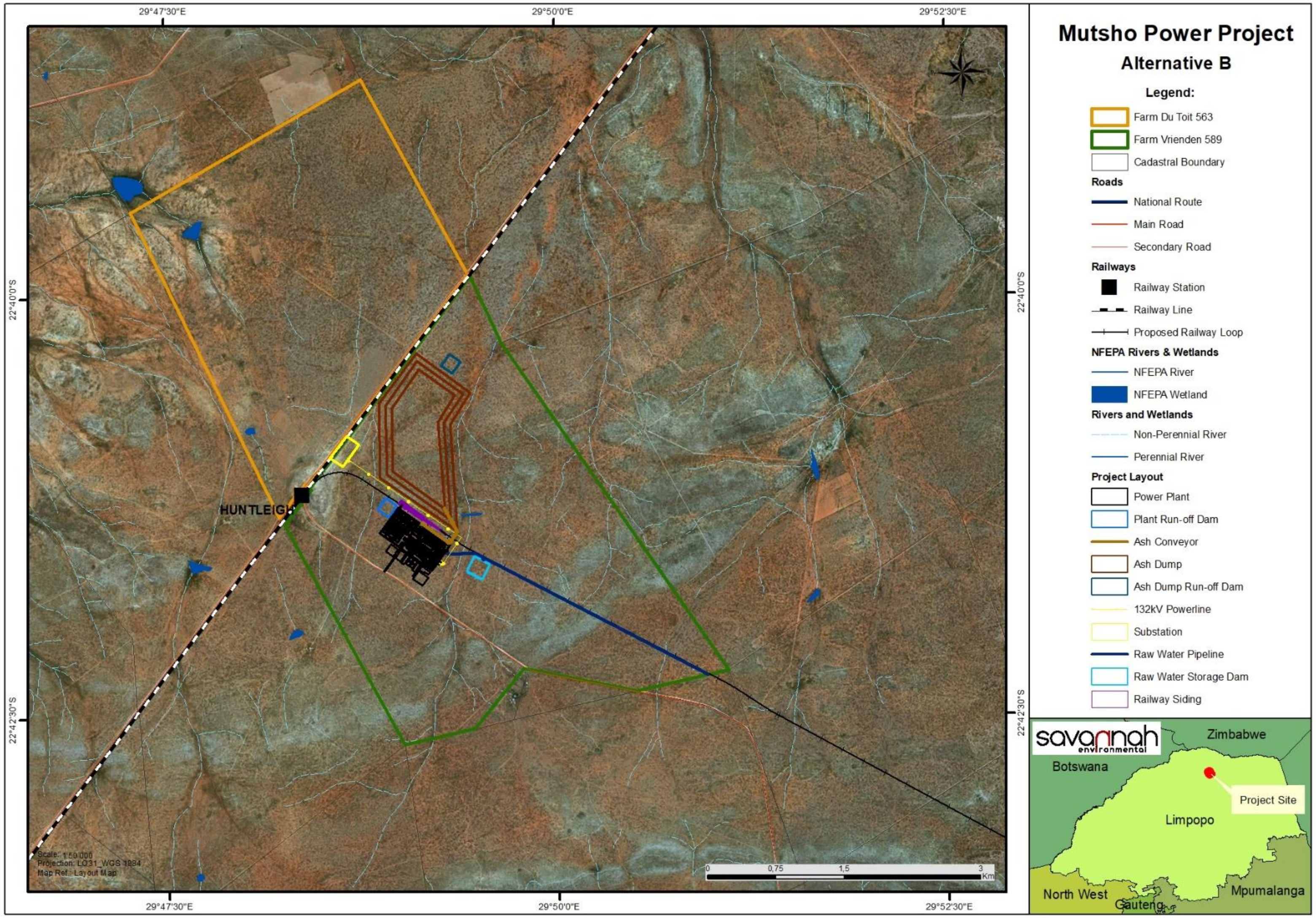


Figure 3: Alternative B Layout.

Environmental Impact Assessment

In accordance with Section 24(5) of the National Environmental Management Act (No. 107 of 1998) (NEMA), and the 2014 Environmental Impact Assessment (EIA) Regulations (GNR 326) the development of the Mutsho Power Project and associated infrastructure requires Environmental Authorisation (EA) from the Competent Authority (CA), the National Department of Environmental Affairs (DEA); in consultation with the Local Commenting Authority, the Limpopo Department of Economic Development, Environment, and Tourism (LDEDET).

Environmental Authorisation (EA) required for the project is subject to the completion of a full Scoping and Environmental Impact Assessment (S&EIA) process as the proposed project entails, amongst others, the development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is 20MW or more (Activity 2, Listing Notice 2 (GNR 325)).

In addition to Environmental Authorisation (EA), the project also requires a Waste Management License (WML) in accordance with Section 19(2) of the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA), and the List of Waste Management Activities (GNR 921). The application for a WML is also subject to the completion of a full S&EIA process as the proposed project entails, amongst others, the disposal of hazardous waste to land (Category B, Activity 7 (GNR 921)), and the construction of a facility for a waste management activity listed in Category B (Category B, Activity 10 (GNR 921)).

This EIA process is therefore being conducted in support of an integrated application for Environmental Authorisation (EA) and a Waste Manahement License (WML) (DEA Reference Number: 14/12/16/3/3/3/218), and is also intended to support future applications for the following:

» A Water Use License (WUL) required in terms of Section 21 of the National Water Act (No. 36 of 1989) (NWA) and the Regulations Regarding the Procedural Requirements for Water Use License Application and Appeals (GNR 267) from the Regional Office of the Department of Water and Sanitation (DWS).
» An Atmospheric Emissions License (AEL) required in terms of Section 21 of the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA) and the List of Activities resulting in Atmospheric Emissions (GNR 893) from the Atmospheric Emissions Licensing Authority (AELA), the Department of Environmental Affair (DEA).

The process of applying for an AEL will be completed following the completion of the EIA process, once EA has been granted for the project. The process of applying for a WUL will only be completed once EA has been granted for the project and once the project has been identified as a preferred bidder under the DoE's CBIPPPP.

The EIA process comprises two phase, namely a Scoping, and Environmental Impact Assessment (EIA) Phase, and involves the identification and assessment of environmental impacts though specialist studies, as well as public participation.

» The Scoping Phase included the identification of potential issues associated with the proposed project through desktop studies (considering existing information), and consultation with affected parties and key stakeholders. This phase has been completed for this project and considered the broader site in order to identify and delineate any environmental fatal flaws, "no-go", or sensitive areas. Following public review of the Scoping Report (SR), this phase culminated in the submission of a Final Scoping Report (FSR) and Plan of Study for EIA (PoSEIA) to DEA for acceptance. The FSR was submitted to DEA, and acceptance of the FSR was received from DEA on 24 November 2017, thus marking the start of the EIA Phase.

» The EIA Phase involves a detailed assessment of potentially significant positive and negative direct, indirect, and cumulative impacts identified during the Scoping Phase. This phase considers a proposed development footprint and includes detailed specialist investigations, field work, and public consultation. Following the public review of the EIA Report, this phase will culminate in the preparation and submission of a Final EIA Report and Environmental Management Programme (EMPr), including recommendations of practical and achievable mitigation and management measures, to DEA for review and decision-making.

Evaluation of the Proposed Project

Impacts associated with the project relate to the following:

» Impacts associated with the power station and associated infrastructure.
» Impacts associated with waste treatment and management activities.

Impacts associated with the proposed power station and associated infrastructure

Potential impacts associated with Mutsho Power Project are expected to occur primarily during the construction and operation phases, and to a lesser extent during the decommissioning phase.

Several areas of sensitivity were identified from the specialist studies undertaken. These are represented on sensitivity maps which have been prepared for the project, and which are intended to inform the micro-siting of project infrastructure (refer to **Figure 4**, **Figure 5**, and **Figure 6**).

Impacts on Ecology

<u>Flora:</u>

» No plant species with IUCN status were recorded during the site survey. However, the likelihood of plants of conservation concern persisting within the study area cannot be excluded.
» Four tree species that are protected under the National Forest Act (1998) were recorded in abundant numbers across the sites:
  * *Adansonia digitata* L. (Baobab).
  * *Boscia albitrunca* (Burch.) Gilg & Gilg-Ben. (Shepard's tree).
  * *Combretum imberbe* Wawra (Leadwood).
  * *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro (Marula).
» The localised presence of massive *Adansonia digitata* is regarded an important consideration in determining the final placement of infrastructure.
» The average number of species recorded in releveès during the site survey reflects a poor floristic species richness of vegetation on a local and regional scale.
» Typical woodland vegetation of the sites strongly reflects regional ecological attributes (Musina Mopane Bushveld).
» Vegetation of the study area conforms to a uniform, but mixed, undifferentiated broadleaf woodland that comprises mostly of deep, highly leached sandy soils. Results of the floristic surveys reflect the proportional and notable prominence of typical woodland constituents such as *Vachellia tortilis*, *Dichrostachys cinerea* and *Colophospermum mopane*.

The proposed activity implies the loss of natural habitat and no impacts of a beneficial nature on the floristic environment are likely to result. Impacts likely to result from the project include:

1) Loss of plant taxa of conservation importance as well as plant taxa of conservation concern,

including habitat that is regarded highly suitable for the persistence of these species.

2) Loss of natural vegetation including the loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance.
3) Local depletion of plant taxa and reduction of phytodiversity.
4) Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.
5) Reduced or severely altered ecological functionality (including fire, erosion).
6) Decreased aesthetic appeal of the landscape.
7) Introduction of invasive, exotic and encroacher plant species.
8) Increased exploitation of natural resources due to increased human presence and resource requirements.
9) Exacerbation of existing levels of habitat fragmentation and isolation.
10) Cumulative impacts on local / regional and national conservation targets and obligations.

Based on results and recommendations presented in the botanical component of the Ecology Impact Assessment the project is regarded as acceptable, but recommends the use of a dedicated, acceptable and appropriate mitigation strategy to prevent undue and unnecessary impacts within the floristic environment.

Fauna:

The study area is located within the Q-grid 2229DB. Ninety-five animals were listed for 2229DB - including three red data species. One hundred and twenty-two (122) animal species were recorded in the study area, representing twenty-two orders (22) and fifty-five (55) families. Of these 122 species, 111 were recorded on the Farm Du Toit 563 and 82 species on the Farm Vrienden 589. The species confirmed for the study area included six red data listed species, namely:

- *Copris cambeforti* Nguyen-Phung, 1988a (Dung Beetle) – Data Deficient;
- *Onthophagus quadrimaculatus* Raffray, 1877 (Dung Beetle) – Data Deficient;
- *Rhinolophus smithersi* Taylor, Stoffberg, Monadjem, 2012 (Smither's Horseshoe Bat) – Near Threatened;
- *Acinonyx jubatus* (Schreber, 1775) (Cheetah) – Vulnerable;
- *Panthera pardus* (Linnaeus, 1758) (Leopard) – Vulnerable; and
- *Parahyaena brunnea* (Thunberg, 1820) (Brown Hyaena) – Near Threatened.

The species inventory results of the field investigation compared well to the known inhabitants of the Q-grid 2229DB. In total, 14 more species were confirmed for the study area than are listed for the Q-grid. Groups that were better represented during the field investigation included spiders, dung beetles, frogs and mammals.

Based on the results obtained during the field investigation and data analyses performed, and the assessment of perceived and anticipated impacts of the activities associated with the construction, operation and closure phases of the proposed project, it is the opinion of the faunal specialist that no reason exists to deem the project as unsuitable. If the mitigation measures proposed are included in the EMPr and adhered to, no reason can be provided to oppose the authorisation of the proposed project, including all proposed activities and portions thereof.

Avifauna

An avifaunal survey was conducted on the Farms Du Toit 563 and Vrienden 589. The following key considerations were identified and noted:

- A total of 270 bird species were expected to occur, of which 176 species were confirmed during the surveys.
- The avifaunal community on the study area was poorly represented by South African

endemics, while the dominant composition is widespread in the region although it consisted of many species with high affinities to the Kalahari-Highveld biome.

- Fourteen (14) threatened and near threatened bird species were expected to be present (with four species confirmed during the surveys). Observed species included the regionally near threatened Kori Bustard (*Ardeotis kori*), critically endangered White-backed Vulture (*Gyps africanus*), endangered Saddle-billed Stork (*Ephippiorhynchus senegalensis*) and the vulnerable Black Stork (*Ciconia nigra*).
- The avifaunal importance of the proposed study area for bird species is summarised below:
  - Part of the undifferentiated mixed woodland, calcrete plains and microphyllous woodland habitat consisted of an open canopy structure, which provided potential foraging habitat for terrestrial large-bodied bird species (e.g. Kori Bustard - *Ardeotis kori* and Secretarybird *Sagittarius serpentarius*).
  - The natural depressions and dams have benefitted the colonisation of "specialised" bird taxa (mainly wader and wading bird species) that were of local importance and contributed towards the regional avifaunal diversity when inundated.
  - The natural depressions and dams provided foraging habitat for threatened stork taxa.
  - The large *Adansonia digitata* trees provided breeding and roosting habitat for the Brown-headed Parrot (*Poicephalus cryptoxanthus*) which is restricted to the East Coast Biome and reached its western distributional limit on the study area.

An evaluation of the expected and likely impacts on the avifaunal component of the study area revealed that certain sensitive parts of the study area should be excluded from the proposed development (these have been included in the Environmental Sensitivity map prepraared for the project). Furthermore, the application of detailed and site-specific mitigation measures is required to ameliorate significant impacts to an acceptable significance level.

Although the general habitat heterogeneity of the area is to be low with very few specialised habitat features (e.g. pans and dams) in occurrence, the perceived overall impact of a power station in a relatively non-urbanised environment appears to be marginal. In this case, it is not necessarily the direct impacts on the avifaunal community that are critical, but the cumulative impacts which inter alia could facilitate unnecessary urban sprawl and the spread of informal settlements in the area resulting in the potential loss of natural resources. In addition, the construction of additional linear electrical networks over time may attain higher impact ratings due to the potential for increased mortalities for birds, caused by collision with overhead powerlines.

Impacts on Air Quality

The main source of emissions from the proposed Mutsho Power Project includes the boiler stack, the coal stockpile, ash dump and the unpaved site access road. Two Scenarios are considered in this assessment: Scenario 1 - boiler stack in isolation and Scenario 2 - all sources (which include the boiler stack, coal stockpile, ash dump and unpaved site access road).

In Scenario 1, the predicted dustfall and ambient concentrations of PM_{10}, SO_2, NO_X and CO are considerably less than the respective national dust standard and NAAQS for all averaging periods throughout the modelling domain. There are no predicted exceedances of the national dust standard or NAAQS within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted dustfall and ambient concentrations are therefore compliant in the ambient environment.

In Scenario 2, exceedance of the dust standard for the residential area category, PM_{10} and $PM_{2.5}$

resulting from all sources at the Mutsho Power Project are predicted over a very small area along the unpaved site access road, which is within the boundary of the proposed Mutsho Power Project site. Predicted dustfall and ambient PM_{10} and $PM_{2.5}$ concentrations are well below the respective national dust standard and NAAQS beyond the Mutsho Power Project site and are therefore compliant in the ambient environment.

According to the dispersion modelling results and air quality impact assessment, emissions from the Mutsho Power Project site operations are expected to result in dustfall and ambient concentrations of air pollutants that are well below the respective national dust standard and NAAQS in the ambient environment. Air quality impacts are therefore considered to have a low significance regardless of the site configuration. From an air quality perspective, it is therefore a reasonable opinion that the project should be authorised considering the outcomes of this study for the preferred site layout option.

Impacts on Climate Change

The proposed power plant will produce greenhouse gas emissions that will contribute to anthropogenic climate change and its ensuing impacts. The extent, duration and probability of the plant's greenhouse gas emissions impacts on climate change will be considerable. The magnitude of the construction phase is considered small and the operational phase considered minor. The overall significance from the single source power plant's impact during construction and operational phases, on global emissions and thus climate change is rated as medium.

The Mutsho Power Project has the potential to contribute almost 2% of the forecasted national inventory for 2050. However, the plant is only likely to contribute 0.75% of the national electricity supply forecasted for 2050. Considering the overall significance of the impact of the greenhouse gas emissions it is important to explore the possible technological alternatives for the plant as well as mitigation options.

CFB and Pulverised Coal (PC) are the technology alternatives available to the project developer under the Coal Baseload Programme. Both technologies will produce emissions intensities above the 2025 forecasted national baseline of greenhouse gas emissions from electricity generation. The limited water resources in the area of operation are unlikely to support the wet scrubbing systems required for pulverised fuel combustion.

The power plant's higher emissions intensity than the forecasted national baseline is to some extent acceptable as the national baseline includes intermitted renewable energy generation. Stable baseload power generation can support higher levels of intermittent renewable energy generation. Therefore even with a higher emission intensity (CO_2e/MWh) of baseload, the overall emission intensity of the grid can be reduced.

It was demonstrated in the Climate Change Impact Assessment that there are options to improve the emissions intensity of circulating fluidised bed combustion. These options include the design of the facility to allow for the future co-firing of alternative fuels (such as biomass) in the circulating fluidised bed combustor and incorporating solar thermal energy from CSP units, should this be required. While these options are beyond the scope of the bid requirements and are not currently possible under the CBIPPPP, they present useful insight for the project developer and possible future hybridisations for the plant.

The Climate Change Impact Assessment concludes that the use of circulating fluidised bed combustion technology in the Mutsho Power Project is likely to be the most suitable option based on the technological requirements of the Coal Baseload Programme. The circulating fluidised bed combustion technology does present opportunities for emissions reductions through the design of the facility in such a way that the future co-firing with alternative fuels (such as biomass) can be considered. It is therefore recommended that the future mitigation opportunities of; co-firing with low carbon fuels, incorporating of solar thermal energy, capturing and storing carbon and implementing management and monitoring plans are considered in detail by the project developer depending on financial feasibility and water availability. However the Department of Energy's Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP) does not currently account for hybridisation.

Impacts on Hydrology and Geohydrology

Aquatic Ecology

A number of moderately significant potential impacts were to be expected within the associated ephemeral drainage areas, as well as further downstream along the Sand River and adjoining tributaries. However, in general, the impact is expected to be limited to the proposed development area following the application of the proposed mitigation and minimisation measures, which results in only rare potential effect upon the mainstem portion of the Sand River, pending an extended contamination event. With regards to cumulative impacts, the proposed development is not likely to detrimentally impact the associated catchment, but it is acknowledged that a number of activities already place additional stress on the study area in terms of surface water availability (e.g. mining-related impacts, crop cultivation and livestock watering).

Should each of the recommended mitigation measures be implemented, it is the opinion of the aquatic ecologist that there will be a limited (or low) impact upon the associated aquatic biodiversity of the surrounding watercourses. However, changes to the inherent flow and / or inundation dynamics of the associated watercourses in direct vicinity of the project are to be expected, which is likely to affect the presence of confirmed microfauna within these system (including seed bank for branchiopod crustaceans). Also, should the Mutsho Power Project be authorised pending reasoned opinions from other Specialist Studies (especially groundwater investigation), a suitable aquatic biomonitoring programme should be drafted and implemented to determine seasonal (or annual) variation and to identify any causes for potential concern during the operational and post-closure phases of the operation.

Wetlands

Two HGM units were identified in the vicinity of the project area, both characterised as pan wetlands. However, most of the freshwater features within project area consist of ephemeral drainage lines that cannot be defined as wetland or riparian resources.

EcoServices scores for the various HGM Units range from 1.3 to 1.6 (Intermediate). The HGM units provide similar EcoServices. Biodiversity maintenance through the harbouring of protected species, the provision of water sources and the provision of grazing land are important EcoServices. The drainage lines provide surface water recharge and trap sediment. The farms are not accessible for tourism, educational and cultural purposes and as such are not used for these purposes. Historical hunting activities were evident; however, through communication with ground staff, this is no longer common. Due to the nature of the systems, flood attenuation and streamflow regulation is low.

The proposed project has the potential to result in a number of impacts that can be considered to be 'medium' once appropriate mitigation measures are implemented.

Geohydrology

The outcomes of the groundwater impact assessment and associated investigations are as follows:

- The current water quality conditions at the project area are not pristine; this is consistent with the description of the regional hydrogeology. The region is expected to have poor water quality naturally. Additionally, impacts from mining activities are also observed in the water chemistry.
- All private boreholes with the exception of VRIBH2 are located downstream of the ash dump and should be monitored. Losing stream groundwater-surface water interaction is expected at the project area therefore the local non-perennial streams aren't expected to receive the contamination plume via baseflow.
- Analytical model predictions indicate that seepage from both the ash dump and coal stockpile is expected to reach the watertable after approximately 7 years of operation without a liner.
- The liner simulated in the model scenario is a Class C liner, this is assumed based on experience from expected ash material geochemistry. This may vary based on the outcomes of the recommended geochemical studies to be conducted.
- The installation of a liner is observed to restrict leachate seepage significantly and therefore negligible impacts to the groundwater are expected with the installation of a liner.
- Formation of the pozzolanic layer is additional mitigation (to the installation of a liner) and it occurs naturally over time, therefore leachate formation is expected to cease at a certain point therefore reducing the risk to the groundwater over time post-closure.

Surface Water

The Sand River is the only major river (ephemeral) within the A71K quaternary catchment (approximately 8km from the western side of the project area). The Sand River flows from the south-west side of the project area towards the north-east side where it eventually joins the Limpopo River approximately 50km away from the project area.

Few drainage lines exist within the demarcated project area and runoff from the site drains from the southern side in a north-western direction via these drainage lines and finally reports to the Sand River approximately 8km west of the project site.

Water quality in this region or along the Sand River has existing monitoring data which indicated elevated levels of various salts which exceed the South African Water Quality Guidelines for irrigation and livestock use. This is mostly attributed to upstream irrigation activities and domestic effluent from the upper Sand River catchment.

The identified potential surface water / hydrological impacts that could emanate from the project and its associated activities include:

- Siltation of surface water resources leading to a poor water quality as a result of eroded material reporting into the streams.
- Contamination of surface water resources when dirty water runoff from the power station reports into the nearby streams.
- Reduction in runoff to the natural streams when all the dirty water runoff is contained within the power station footprint.

With all the mitigation and management measures in place, the Mutsho Power Project is unlikely to pose a significant threat to the natural water courses and the hydrological features within and around the project area. The proposed establishment of the Mutsho Power Project and associated infrastructure can therefore go ahead.

Impacts on Soil, Land Use and Agricultural Potential

The geology of the survey area consists largely of marble of the Gumbu Formation, with arenite (sandstone) Ecca Group in the north (Geological Survey, 1988). Only one land type occurs within the study area, namely Ah89 (Yellow-brown and red, apedal, freely drained soils). The main characteristics of the soils occurring in land type Ah89 are red and yellow-brown, sandy loam to sandy clay loams of varying depths, along with some areas of shallow lithosols. The soils occurring in the survey area are brown to reddish-brown, sandy loam to sandy clay loams of the Hutton and Glenrosa forms, underlain by weathering rock. They are generally shallow (<400 mm), although deeper, red soils occur along the non-perennial stream beds in the area.

In terms of agricultural potential the soils of the survey area are not suited for cultivation due to the shallow rooting depth, along with their stoniness in many parts. An additional limiting factor is the dry, hot climate. The low annual rainfall, coupled with the hot summer temperatures, means that the only practical means of cultivation would be by means of irrigation, and there is little or no evidence of any cultivated lands in the area.

The main potential impact will be the loss of agricultural soil due to the establishment of permanent infrastructure, including the power station and associated waste material sites. This impact was assessed as having medium significance without, and low significance with, the application of appropriate mitigation measures.

Impacts on Heritage

The proposed development footprint may impact on the Farms Vrienden 589 and Du Toit 563. Numerous heritage resources have been identified on these properties. As such, the development of the proposed Mutsho Power Project will have permanent and irreversible impacts on the natural and cultural resources of the region. These impacts require evaluation in light of the contribution the development can make of 600MW of electricity to the national grid.

The Farm Du Toit 563 has areas that are very significant in terms of archaeological resources, with sites D04 to D07 representing one large Middle Stone Age artefact manufacturing site that has high archaeological significance and valuable research potential. This site must not be impacted, directly or indirectly, by any proposed power station, and mitigation by excavation is not recommended as this would result in loss of significant archaeological information. The exact boundaries of the extent of this larger manufacturing site are not clearly determined and as such, a buffer of 100m around the visible extent of this large site be implemented for any proposed activity the close proximity to this site.

In summary, it is recommended that:

- Site V04, on the Farm Vrienden 589, must not be impacted by any proposed development. A buffer of 100m around this site must be implemented.
- Graves at MOP112, on the Farm Vrienden 589, must be avoided. A fence should be erected 5m from the three visible graves, and a buffer of 15m around the fence line must be observed.
- The structure at MOP114, on the Farm Vrienden 589, must be avoided. A buffer of 25m around this site must be implemented.
- Sites D04 to D07, on the Farm Du Toit 563, likely represents one large MSA artefact manufacturing site and must not be impacted by any proposed development. A buffer of 100m around this large artefact manufacturing site must be implemented.
- Graves at MOP033, on the Farm Du Toit 563, must be avoided, and a buffer of 15m around the existing fence line must be observed.

- The structure at MOP034, on the Farm Du Toit 563, must be avoided. A buffer of 25m around this site must be implemented.
- A management plan for potential impacts to Site V04, the "Baobab Room" and buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.
- Should any buried heritage resources be uncovered during the construction or operational phases, work must cease and SAHRA must be contacted to advise on the best way to proceed.

Impacts on Palaeontology

The proposed footprint is underlain by sediments of the:

- Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation.
- Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement.

According to the geology of the development footprint, fossil heritage could be present in the Undifferentiated Karoo which has a very high Palaeontological Sensitivity as well as the Solitude Formation with a high Palaeontological Sensitivity. The Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group is metamorphic rocks which is unfossiliferous and has a very low palaeontological sensitivity. The Farm Du Toit 563 is entirely underlain by the Undifferentiated Karoo and the Solitude Formation. The north-eastern part of the Farm Vrienden 589 falls in the potentially fossiliferous Undifferentiated Karoo and the unfossiliferous Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group. During a field survey of the development footprint (including all three alternative layouts), no fossiliferous outcrops were found. For this reason, a low palaeontological sensitivity is allocated to the development footprint. Irrespective of the uncommon occurrence of fossils a solitary fossil may be of scientific value as many fossil taxa are known from a single fossil. The recording of fossils will expand our knowledge of the Palaeontological Heritage of the development area.

The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Mutsho Power Project, will be of low significance in palaeontological terms.

Noise Impacts

The area has a rural character in terms of appearance and development with ambient sound level measurements indicating significant variation in equivalent sound levels from location to location. All the measurement locations experienced noisy single events (wind-induced and from birds) that impacted on the ambient sound levels although the LA90 levels indicate an area with significant potential to be very quiet.

Night-time construction activities may have a noise impact of medium significance on NSD04 due to potential traffic noises that would result in a noise impact of medium significance during the operational phase. Mitigation is however available that could reduce the significance to a more acceptable low.

Night-time operational activities may have a noise impact of medium significance on NSD03 for the Preferred Alternative and Alternative B layouts, though mitigation measures are available that could reduce the significance of the noise impact. There is a low potential for a noise impact during the operational phase for Alternative A.

It is the opinion of the Noise Specialist that the increases in noise levels can be managed to a low significance. It is therefore the recommendation that the project can be authorised (from a noise impact perspective).

Visual Impacts

The Preferred Alternative is favoured from a visual perspective. It helps to minimise local impacts on the adjacent Mopane / Waterpoort Road when compared with the other layout alternatives. The retention of existing vegetation and implementation of localised screen planting should help to minimise visual impacts from this road. The location of the proposed substation will create a localised visual impact on the Mopane / Waterpoort Road that might be avoided by offsetting this infrastructure slightly from the road sufficiently to provide reasonably dense screen planting (30m). The impact on views from major roads and from protected areas is likely to be negligible. These impacts are largely mitigated by distance and natural vegetation which provides a large degree of screening.

The one impact for which significant mitigation is not possible is the industrialisation of the landscape as viewed from the minor ridge to the north and particularly to a homestead that is located on it. A small degree of mitigation will be possible through management of the ash dump, however the overall impression of large scale industry will remain. Considering the scale and nature of the proposed development, the visual impact that is likely to be experienced by the majority of potential sensitive receptors is anticipated to be low due to the nature of the surrounding landscape. As indicated however, there is also potential for relatively high but localised visual impacts.

The Visual Impact Assessment has confirmed that there are no broad scale visual impacts that will preclude development. However the localised impact that is likely to be experienced by residents of a small number of local homesteads, particularly the one located on the ridgeline to the north (i.e. Plaas Erasmus) of the proposed site is a concern. It is possible that the development could compromise uses. It is recommended that discussion is undertaken with these landowners to investigate detailed mitigation measures that might include localised screen planting within their properties.

Socio-Economic Impacts

The review of key national, provincial, and local policy documents indicates that the development of coal-fired power stations is supported at all levels, from a socio-economic perspective. The national policies are in sync with the view that coal dependence will continue in the long term; thus, the contribution of coal-fired power stations towards the energy mix in the country will remain. However, a proposal for research and development for cleaner coal technology with reduced emission rates is put forward (Department of Energy, 2016). In addition, at lower levels, service delivery is a key issue to be addressed, including electricity provision. After considering the reviewed documentation, no fatal flaws or contraventions from a socio-economic policy perspective exist for the implementation of the proposed project.

However, the need for additional baseload generation capacity needs to be assessed in the context of the current and envisaged future supply and demand of electricity. South Africa's electricity-intensity is declining, while new generating capacities are being developed. The country is already producing more electricity than it can currently consume; therefore, the need for new generating capacities in the near future is not as dire as it was experienced a few years back. The eagerly awaited updated IRP, hopefully to be released during 2018, will inform this path.

Just over a third of the population in the local economy is employed and the unemployment rate is 26%. Key concerns are the low education levels and the skills shortage in the region. These are perpetuated by the vast backlog of classrooms and learner support material, particularly in rural areas. Furthermore, the communities where labour can potentially be sourced are not in close propinquity to the project site.

Overall, it is clear that the local economy is in need of an investment that will provide for a long-term growth and development of the economy. The proposed project is likely to contribute to positive economic development, particularly considering the fact that there are also a number of other mining and industrial developments planned for the region, which may likely lead to the development of a new economic node similar to Lephalale. However, the proposed project without doubt will forever change the aesthetics and tranquil sense of the area, which could negatively impact on some other economic activities in the region such as tourism and agriculture.

Traffic Impacts

It is concluded that:

» The proposed Mutsho Power Plant trip generation will peak during the 4 to 5 years Construction Phase.
» Abnormal Load vehicles will be required to transport various components to the site during the construction phase.
» Overland conveyor system will transport coal and conditioned ash on the project site.
» Gravel service roads (on-site) will be used for maintenance purposes and will also serve as back up should conveyors fail on occasion.
» The N1, D777 and D744 will provide access to the site from the north (Musina).
» The N1 and D1021 will provide access from the south to the site (from Makhado and surrounding towns).
» The bulk of the Mutsho Power Project traffic will route along the D1021 and along the N1 towards Makhado in the south.
» The critical N1/D1021 intersection approaches will yield acceptable Levels of Service in the Construction Phase (and also during the Operations Phase until Year 2045, as assessed). Thereafter the intersection should be re-evaluated and possibly a traffic roundabout would need to be considered to improve the Level of Service on the D1021 approach to the N1.
» The gravel roads (D744 and D1021) will need to be hard surfaced to prevent dust (environmental, road safety and pedestrian safety issues) and to provide an acceptable road surface for the plant traffic (road maintenance, vehicle accessibility, road safety issues).
» A raised sidewalk on at least one side of the D1021 and D777, should be provided for pedestrian safety.
» Signage should be erected along the D1021 and D744 warning motorists of possible pedestrians and cattle / animals along the road.
» Increase in heavy vehicles (transporting coal) on the N1 during the 30 years Operations Phase will result in deterioration of the N1 pavement structure and will require more regular maintenance.
» Increase in heavy vehicles (transporting coal) on the N1 during the 30 years Operations Phase will increase the probability of accidents on the N1.
» Considering the traffic impact on the N1 during the Operations Phase it is preferable that coal be transported to the Mutsho Power Plant by rail.
» The critical N1/D1021 intersection approaches will yield poor Levels of Service in the Decommissioning Phase (and also during the Operations Phase around Year 2050, as assessed). At this point in time, the intersection should be re-evaluated and possibly a traffic roundabout would need to be considered to improve the Level of Service on the D1021 approach to the N1.

Traffic impacts identified for the project were assessed as being of medium significance, without mitigation with the majority being reduced to a lower valued medium significance or low significance with the application of mitigation measures. No fatal flaws were identified for the project from a traffic impact perspective.

Cumulative impacts

Considering the findings of the specialist assessments undertaken for the project, the cumulative impacts for the Mutsho Power Project are anticipated to be within acceptable limits with the majority rated as being of low to medium significance with the implementation of appropriate mitigation. The cumulative impact of the proposed project on climate change is the only impact which was rated as being of high significance due to the global nature of the impact. It should be noted however that the opportunity does exist for future mitigation measures to be implemented which if implemented could assist in reducing the projects GHG emissions.

The following conclusions can be drawn when considering the proposed Mutsho Power Project and associated infrastructure:

» The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected vegetation types or species through clearing, resulting in an impact on the conservation status of such flora or ecological functioning. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an ecological perspective.
» The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected faunal species, and loss or destruction of suitable habitat. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a faunal perspective.
» The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected avifauna species, and loss or destruction of suitable habitat. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an avifaunal perspective.
» The construction and operation of the proposed project will not result in an unacceptable risk to human health through impacts on air quality. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an air quality perspective.
» The construction and operation of the proposed project will result in a contribution to climate change as a result of its GHG emissions. However mitigation measures are available which if implemented may assist in reducing the emissions and climate change impact of the project.
» The construction and operation of the proposed project will not result in an unacceptable risk to hydrology or geohydrology resources resulting due to the increase in the extent of hard or impermeable surfaces in the greater area, additional potential pollutants, and seepage or contamination in the area. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a hydrology or geohydrology perspective.
» The construction and operation of the proposed project will not result in an unacceptable loss of soils or land of high agricultural potential. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a soils, land use, and agricultural potential perspective.
» The construction and operation of the proposed project will not result in an unacceptable loss of heritage resources. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a heritage perspective.
» The construction and operation of the proposed project will not result in an unacceptable loss of palaeontological

resources. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a palaeontological perspective.

» The construction and operation of the proposed project will not result in an unacceptable noise impacts on the surrounding areas. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a noise perspective.
» The construction and operation of the proposed project will not result in a complete or whole-scale change in sense of place and character of an area and unacceptable visual intrusion. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a visual perspective.
» The construction and operation of the proposed project will result in positive and negative contributions from a socio-economic perspective. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a socio-economic perspective.
» The construction and operation of the proposed project will not result in an unacceptable traffic related impacts. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a traffic impact perspective.

Based on a detailed evaluation, the development of the proposed Mutsho Power Project and associated infrastructure on the proposed project site will not result in a significant contribution to cumulative impacts of similar projects within the area.

From the above conclusions of the specialist studies undertaken, it is concluded that apart from climate change impacts which are expected to be of **moderate to high significance**, the majority of impacts associated with the construction and operation of the Mutsho Power Project and associated infrastructure are expected to be of **medium to low significance** with the implementation of appropriate mitigation measures. No environmental fatal flaws were identified to be associated with the proposed project.

Impacts associated with waste treatment and management activities

Impacts associated with waste treatment and management activities relate to those associated with the ash dump and wastewater treatment works (WWTW). Potential impacts on surface and groundwater are anticipated should appropriate mitigation measures not be implemented. In terms of the assessment of impacts undertaken within this EIA study, impacts on water resources are expected to be of **medium to low significance** post-mitigation. On-going water quality monitoring throughout the operational phase is required to be undertaken. A borehole monitoring network should be established for the site in order to monitor groundwater quality. In addition, an appropriate Integrated Water and Waste Management Plan (IWWMP) must be developed and implemented for all phases of the proposed project.

The detail design of the Mutsho Power Project, which will include the ash dump, coal stockyard, as well as Pollution Control Dams (PCDs), will be undertaken post-feasibility and will need to demonstrate compliance with Regulation 3(2) of GNR 636, by confirming compliance with a Class C barrier performance. The barrier system for the dry ash disposal facility and placement by mechanical means will include a 1.5mm HDPE geomembrane compliant with SANS 1526(2015) and will be installed in accordance with SANS 10409 on a compacted clay liner of 300mm thickness compliant with SANS 1200, and Subsection D in particular. Drainage will ensure atmospheric pressure and construction quality assurance compliant with the relevant SANS considerations.

The layout of the facility would need to ensure compliance with GNR 704 through the placement of the ash dump (as well as other infrastructure associated with the power station) outside of the 1:100 year floodline. A geotechnical study will need to be undertaken on the site to confirm suitability of the material for construction of the power station and associated infrastructure. The outcomes of this study will inform the final design. The final designs will be submitted in support of the final Waste Management License (WML) as well as the Water Use License Application (WULA) required for the project.

Assessment of Layout Alternatives

The results of the specialist investigations in terms of the assessment of the three layout alternatives are provided in **Table 1**. Each of the layout alternatives have been assigned a value to indicate their perceived preference as follows:

- A value of 1 indicates the preferred alternative.
- A value of 2 indicates the second preferred alternative.
- A value of 3 indicates the third preferred (or least preferred) alternative.
- A value of 0 represents no preference.

Where all three alternatives are considered as having the same preference (i.e. none of the alternatives are considered to be either more or less favourable than any of the other alternatives) a value of 0 is assigned.

The assigned values were then totalled to indicate an overall preferred alternative (i.e. the layout alternative with the lowest value is considered to be the preferred alternative, while the layout alternative with the highest value is considered to be the least preferred alternative).

Table 1: Outcome of Specialist Investigation of the three Layout Alternatives.

Specialist	Preferred Alternative	Alternative A	Alternative B
Ecology: » *Flora*	1	3	2
» *Fauna*	1	2	3
» *Avifauna*	1	3	2
Air Quality	0	0	0
Climate Change	0	0	0
Hydrology and Geohydrology	3	1	1
Soils, Land Use, and Agricultural Potential	0	0	0
Heritage and Archaeology	2	1	3
Palaeontology	0	0	0
Noise	2	1	3
Visual	1	2	2
Socio-Economic	1	2	2
Traffic	0	0	0
TOTAL	**12**	**15**	**18**

Based on the outcomes of the specialist investigations, the Preferred Alternative has been confirmed as the preferred layout alternative from an environmental perspective.

Assessment of the No-go Alternative

The implementation of the Mutsho Power Project at the proposed site is expected to result in a number of social and environmental costs and benefits.

Environmental costs identified for the project include:

- Direct loss of biodiversity, flora and fauna due to the clearing of land for the construction and utilisation of land for the project (which is limited to the development footprint). Areas of ecological sensitivity have been identified onsite and have been included in an environmental sensitivity map prepared for the project. The cost of loss of biodiversity is therefore expected to be limited with the implementation of appropriate mitigation measures and the appropriate placement of infrastructure to avoid areas of ecological sensitivity identified on site.
- Visual impacts associated with the project. The Preferred Alternative is favoured from a visual perspective, as it helps to minimise local impacts on the adjacent Mopane / Waterpoort Road when compared with the other layout alternatives.
- Change in land-use and loss of land available for agriculture on the development footprint. The cost in this regard is expected to be limited due to the low agricultural potential of the property and the limited use of the footprint associated with the preferred alternative.
- Impacts in terms of GHG emissions. Options to improve the emissions intensity of CFB combustion such as the future co-firing of biomass in the CFB combustor, and incorporating solar thermal energy from CSP units are available. Impacts in this regard can therefore be managed through appropriate planning and design of the facility to meet the South African targets beyond 2025.

Apart from impacts associated with GHG emissions, these costs are largely expected to occur at a local and site level and are considered acceptable provided the mitigation measures as outlined in this EIA and contained within the EMPr are implemented. The Mutsho Power Project's higher emissions intensity than the forecasted national baseline is to some extent acceptable as the national baseline includes intermittent RE generation.

The positive implications of establishing the project on the demarcated site include:

- The project will result in important socio-economic benefits at the local and regional scale through job creation, procurement of materials and provision of services and other associated downstream economic development. These will persist during the pre-construction, construction and operational phases of development.
- The project is considered to be a suitable land use for the proposed site due to the low potential for commercial agriculture and the proximity to an existing coal resource (i.e. MCM's Makhado Colliery). Development of the facility will require the implementation of appropriate management actions which could have positive impacts on the surrounding areas specifically in terms of alien vegetation and erosion management.
- The project site is considered favourable given its proximity to 8 000ha Mopane site which comprises one of two sites which make up the designated Musina-Makhado SEZ. Once developed the SEZ will include several energy intensive industrial users, including mineral beneficiation and base metal refineries.
- The project contributes towards the development of additional power generation sources as outlined in the IRP 2010. The project will start to provide power when Eskom's current fleet of some 44 000MW has decreased to about half of its generating capacity. As such developing the proposed project will meet a future need for baseload power that cannot be met by intermittent renewable energy sources.

The costs associated with the project are anticipated to occur at a site specific level, the significance of which can be largely reduced through the application of appropriate mitigation measures, and through the appropriate placement of infrastructure within areas of lower sensitivity identified on site. Impacts associated with GHG emissions can be managed through appropriate planning and design of the facility to meet the South African targets. Due to the fact that the benefits of the project are expected to occur at a larger (i.e. national, regional and local level), the expected benefits of the project are expected to partially offset the localised environmental costs of the project.

The following impacts are anticipated with the implementation of the "Do Nothing" option:

» Failure to provide additional coal-fired power generation capacity in accordance with the Department of Energy's (DoE's) National Integrated Resource Plan (IRP), which has identified the need for power generation from coal as part of the technology mix for power generation in the country in the next 20 years.
» Failure to provide an additional 600MW of baseload electricity to the national electricity grid through means of a government led IPP Procurement Programme, which in turn has the opportunity to stimulate economic growth and development
» Failure to realise the potential local economic development and social upliftment benefits associated with the implementation of projects under one of the DoE's IPP Procurement Programme's.

Overall Conclusion (Impact Statement)

The findings of the independent specialist studies undertaken as part of this EIA process to assess both the benefits and potential negative impacts anticipated as a result of the project conclude that:

» The Preferred Alternative should be authorised for implementation.
» Although some impacts of high significance were identified, these can be mitigated to acceptable levels. No environmental fatal flaws were identified to be associated with the proposed project provided that the recommended mitigation measures are implemented.
» The majority of impacts associated with the construction and operation of the Mutsho Power Project and associated infrastructure are expected to be of medium significance, most of which can be reduced to lower medium or low significance with the implementation of appropriate mitigation measures.
» Several areas of sensitivity were identified within the project development area. These areas must be taken into consideration when Mutsho Power plan their detailed on-site layouts during the final design phase of the project.
» CFB Technology is considered preferable over conventional PC technology due to the potential to utilise alternative fuel sources, and the reduction of emissions such as SO_2 and NO_x. While CFB technology is more emissions intensive than PC technology in terms of carbon emissions, it should be noted that CFB combustion is more efficient than PC combustion. The more efficient fuel to energy conversion achieved by the proposed CFB combustion technology therefore results in lower fuel costs than the PC alternative when firing coal. The facility should be designed with the potential addition of alternative fuel sources (such as biomass) or solar thermal hybrid technology in mind. Making provisions for the future addition of carbon capture and storage systems presents another opportunity to reduce carbon emissions.
» Dry cooling and dry ashing are proposed as the preferred options as these will minimise the requirements for water.
» An appropriate liner must be implemented at both the ash dump and coal stockpile in order to minimise the potential for impacts on groundwater resources.

Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance, the benefits expected at a regional and national scale, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the project can proceed on condition that all supporting authorisations, licenses, and permits are obtained prior to development commencing; and that the mitigation measures specified in the EIA Report, the independent specialist Impact Assessments, and those provided within the EMPr are observed and implemented.

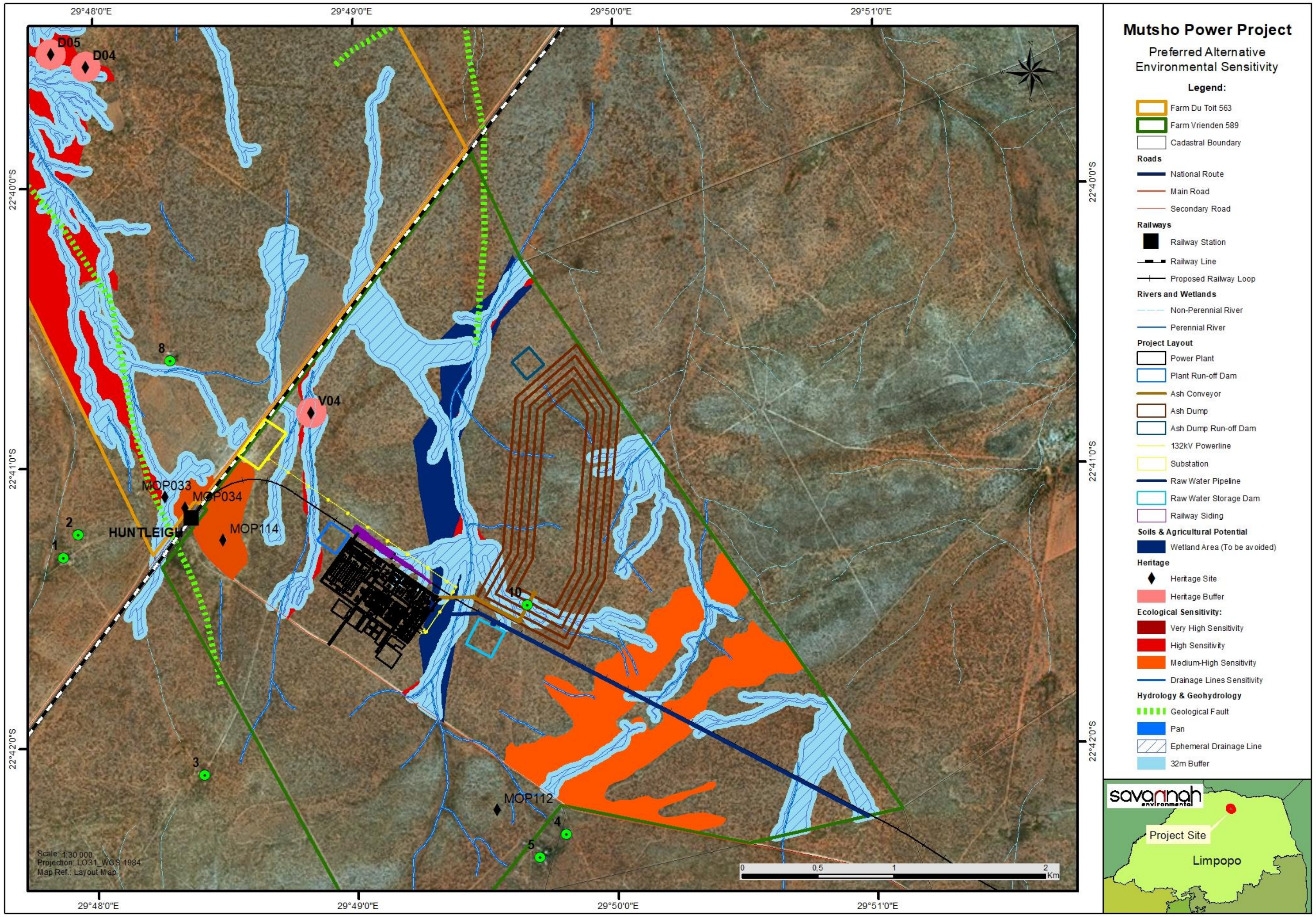


Figure 4: **Environmental Sensitivity map for the project site (Preferred Alternative).**

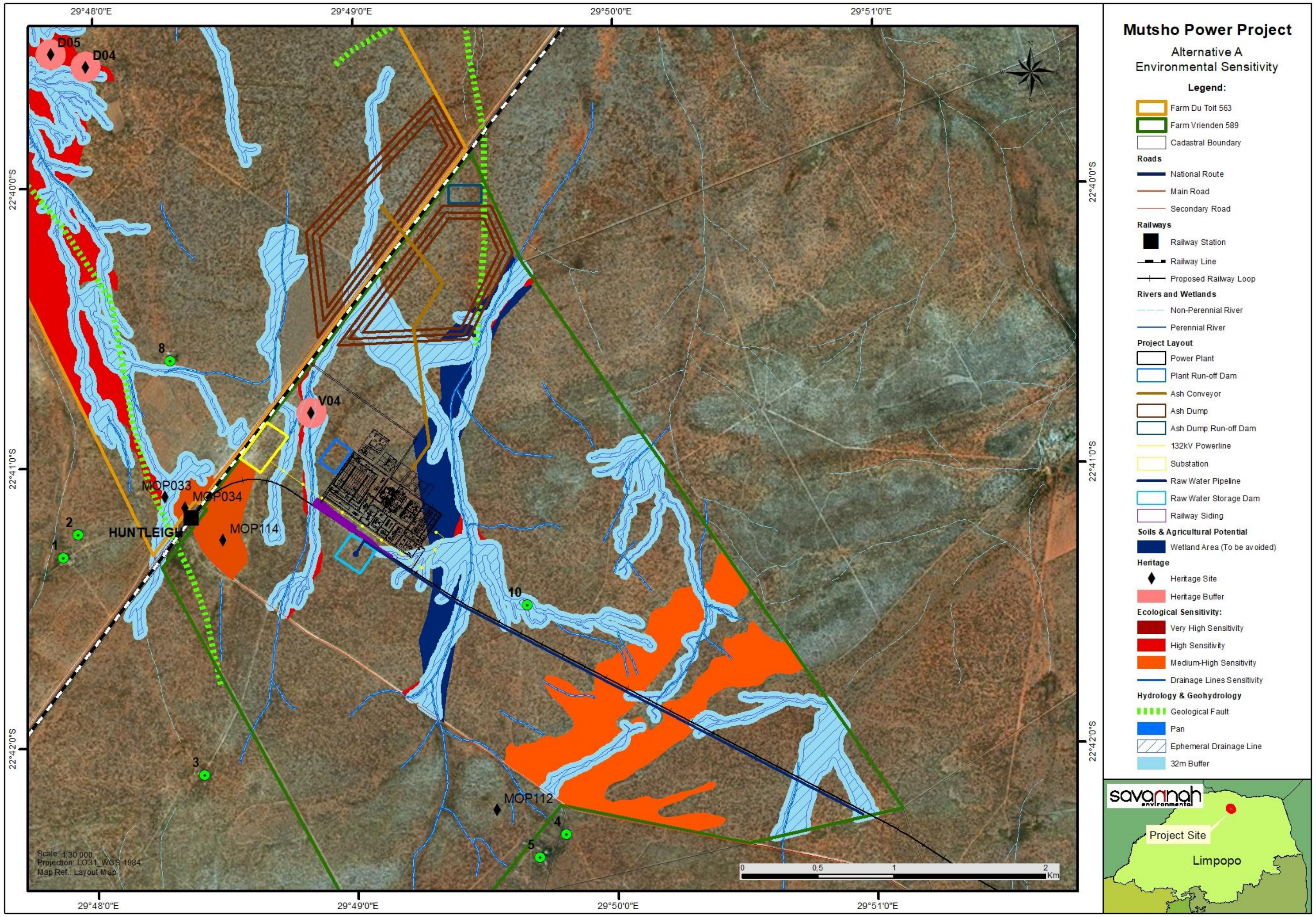
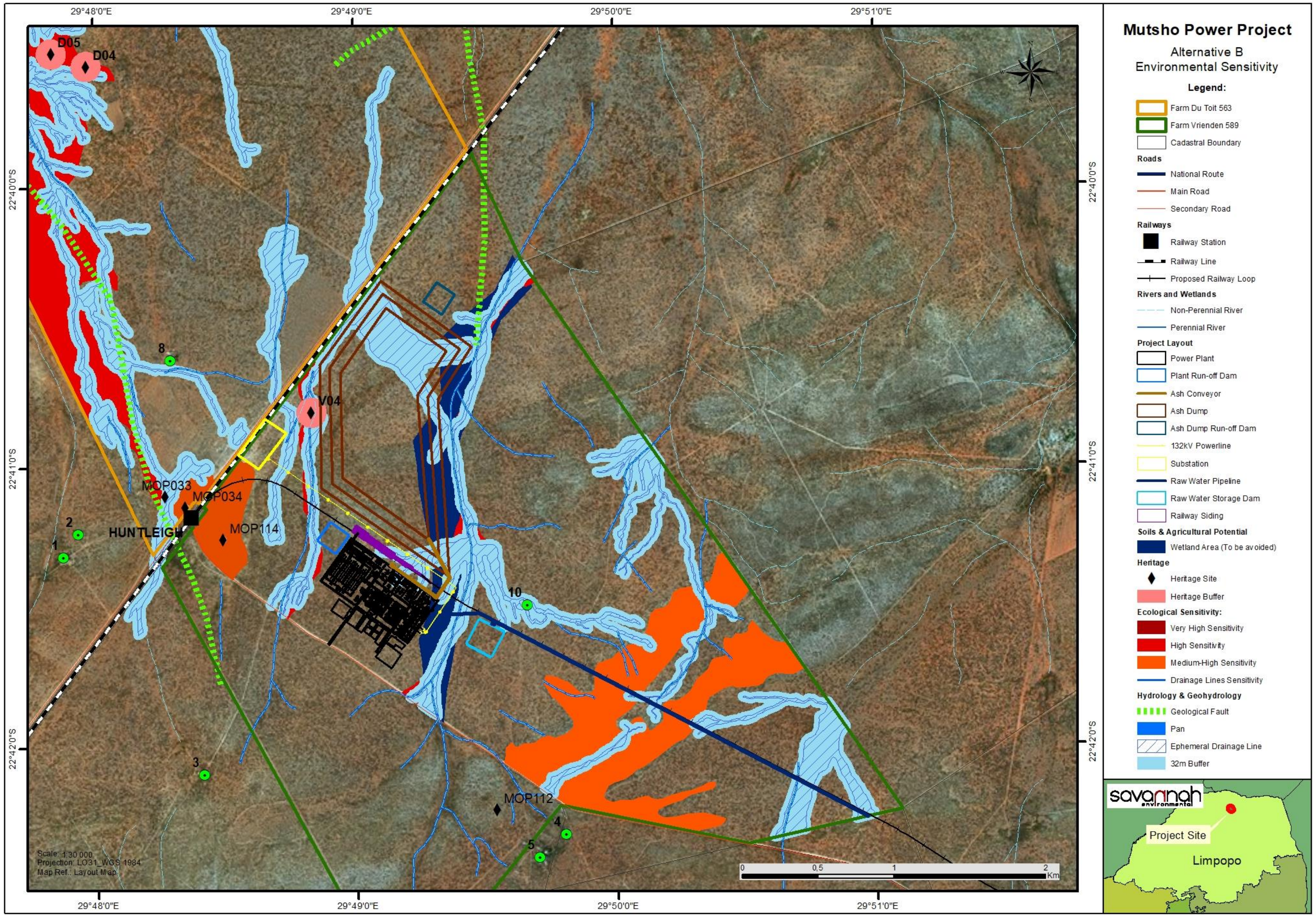


Figure 5: **Environmental Sensitivity map for the project site (Alternative A).**



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CHAPTER 1 INTRODUCTION

Mutsho Power (Pty) Ltd proposes the development of a new coal-fired power station and associated infrastructure on a site near Makhado (Louis Trichardt), in the Musina Local Municipality of Vhembe District, Limpopo Province. The project is to be known as the Mutsho Power Project, and is intended to form part of the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP). The CBIPPPP intends to secure 2 500MW of new generation coal-fired power from Independent Power Producers (IPPs) for integration into the national electricity grid. The first bidding round of the CBIPPPP concluded in November 2015 and resulted in 863.3MW of new generation coal baseload power being awarded to two preferred bidders. If the allocation for the CBIPPPP remains unchanged, approximately 1 636.7MW of coal-fired baseload electricity generation remains to be allocated to IPPs in subsequent bidding rounds. In order to be considered under the CBIPPPP the Mutsho Power Project must satisfy all applicable bidding requirements stipulated by the DoE, one of which includes obtaining Environmental Authorisation (EA) for the project. While the Bid Window 2 Submission date has been postponed, and a Request for Proposal (RFP) is yet to be released; the Mutsho Power Project is being proposed in accordance with the bidding requirements stipulated under Bid Window 1 in anticipation that these would be similar to those applicable to Bid Window 2. The proposed project will therefore have a total export generation capacity of up to 600MW, comprise a new-build facility, and will make use of Supercritical (SC) Circulating Fluidised Bed (CFB) technology, dry cooling methods, dry ash disposal methods, and will be developed as a Zero Liquid Effluent Discharge (ZLED) facility.

1.1 Overview of the Project Applicant

The CBIPPPP requires bidders to establish separate Project Companies for each project under which bids will be submitted. The project applicant for the Mutsho Power Project is Mutsho Power (Pty) Ltd, a consortium comprising CRI-Eagle Investments (Pty) Ltd as the majority 90% shareholder, and MC Mining Ltd (MCM) (previously known as Coal of Africa Limited (CoAL)) as the minority 10% shareholder (refer to **Figure 1**.1).

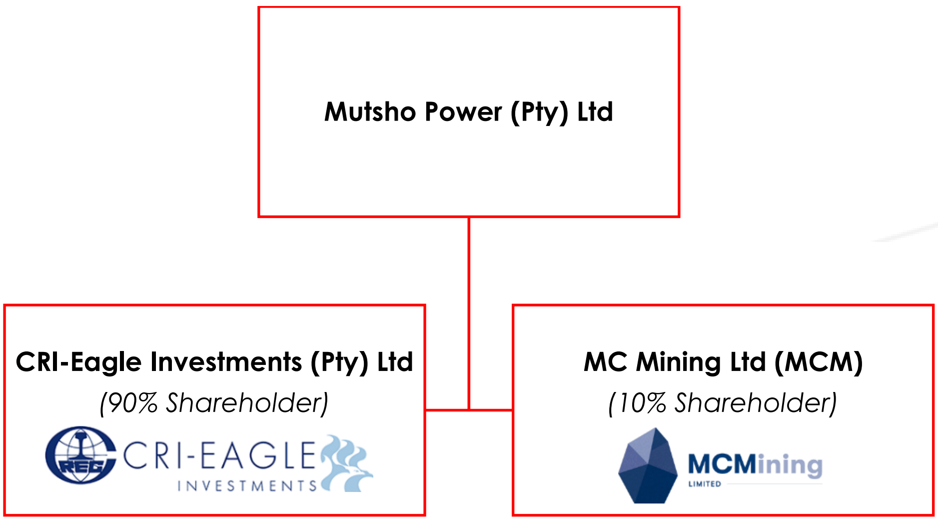

Figure 1.1: Overview of Project Applicant.

1.1.1 CRI-Eagle Investments (Pty) Ltd

CRI-Eagle Investments (Pty) Ltd is the Special Purpose Vehicle (SPV) for a joint venture between Eagle Canyon Golf Estate (Pty) Ltd, and the China Railway Group Limited (CREC). CRI-Eagle's core business is property development, and the facilitation of railway and other infrastructure projects.

1.1.2 MC Mining Ltd (MCM)

MC Mining Ltd (MCM) is a South African coal exploration, development and mining company. MCM's key projects include the Vele Colliery, the Greater Soutpansberg (GSP)/MbeuYashu Project, the Tshipise Energy gas exploration project, and the Makhado Project, all located in Limpopo Province; and the Uitkomst Colliery, located in KwaZulu-Natal Province.

1.2 Project Background

In 2016 Mutsho Power Company (Pty) Ltd initiated an Environmental Impact Assessment (EIA) process for the development of a 600MW coal-fired power station to be situated north of Musina, in the Musina Local Municipality, Limpopo Province. The power station was proposed for development on the Farm Landbou 171 MS or Antonvilla 7 MT, located approximately 15km north-west and 2km north-east of Musina respectively; and was intended to be fuelled with coal mined from MCM's Vele Colliery.

Based on comments received following the project announcement, site-specific sensitivities identified though initial specialist studies conducted for the project, as well as sensitivities associated with developing the project in proximity of the Mapungubwe UNESCO World Heritage Site; a decision was taken to place the EIA process on hold, to allow for a review to be conducted on the proposed project approach and locality.

Mutsho Power Company subsequently commissioned a Site Screening Assessment to allow for the identification of alternative project sites away from the sensitivities of the Mapungubwe UNESCO World Heritage Site and the Limpopo River, and in proximity to their other mines in the broader area. The Site Screening Assessment identified two properties of expected lower sensitivity as possible sites for the proposed development of a coal-fired power station; namely the Farm Du Toit 563 and the neighbouring Farm Vrienden 589 (refer to **Figure 1**.2).

Following the completion of the Site Screening Assessment, the current EIA process considering the two identified sites was initiated for the development of the Mutsho Power Project, which will be developed between the towns of Makhado and Musina, and will be fuelled by coal mined from MCM's Makhado Project to be developed approximately 20km south-east of the proposed project site.

MCM's Makhado Project comprises a new coal mine (i.e. the Makhado Colliery) to be located north of the Soutpansberg Mountains in the Makhado Local Municipality of Vhembe District. It has been estimated that the Makhado Project has 344.8Mt mineable tonnes of coal in situ (MTIS), and once developed is expected to produce coal for domestic and/or export markets. The Makhado Colliery is estimated to operate for 16 years at full capacity (supplying approximately 2.3 million tons hard coking coal and 3.2 million tons thermal coal per annum). In 2017 MCM announced that it would initiate mining via the Makhado Lite Project. This will result in decreased volumes being mined initially, which will extend the life of the colliery. Additional life extension is further possible through the use of adjacent pits and surrounding coal fields as part of the GSP Project. The Mutsho Power Project will have a lifespan of approximately 30 years and will utilise approximately 2 million tons of coal per annum. Should the Mutsho Power Project be selected as a preferred bidder under the CBIPPPP, a coal supply agreement would need to be entered into which satisfies the power station project's financing and CBIPPPP requirements.

The Makhado Project is anticipated to commence operation in mid-2018.

1.3 Requirements for Environmental Authorisation (EA)

Section 24 of the National Environmental Management Act (No. 107 of 1998) (NEMA) pertains to Environmental Authorisations (EAs). It requires that the potential consequences for, or impacts of, listed or specified activities on the environment be considered, investigated, assessed, and reported on, to the Competent Authority (CA). The 2014 EIA Regulations, as amended, published under NEMA in GNR 326 prescribe the process to be followed when applying for EA, while the Listing Notices (published in GNR 327, 325, and 324 respectively) contain those activities which may not commence without EA from the CA.

In terms of NEMA, the 2014 EIA Regulations (GNR 326) and supporting Listing Notices (GNR 327, 325, and 324), the development of the Mutsho Power Project requires EA from the National Department of Environmental Affairs (DEA) subject to the completion of a full Scoping and Environmental Impact Assessment (S&EIA), as prescribed in Regulations 21 to 24 of GNR 326. The need for EA subject to the completion of a full S&EIA is triggered by the inclusion of, amongst others, Activity 2 of Listing Notice 2 (GNR 325)[1]:

"The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is 20MW or more."

In terms of GNR 779 of 01 July 2016, the National DEA has been determined as the CA for all projects which relate to the Integrated Resource Plan for Electricity (IRP) 2010 – 2030 and any updates thereto. The Provincial Limpopo Department of Economic Development, Environment, and Tourism (LDEDET) is therefore a Commenting Authority on the project.

[1] Refer to **Chapter 6** for a full list of applicable listed activities.

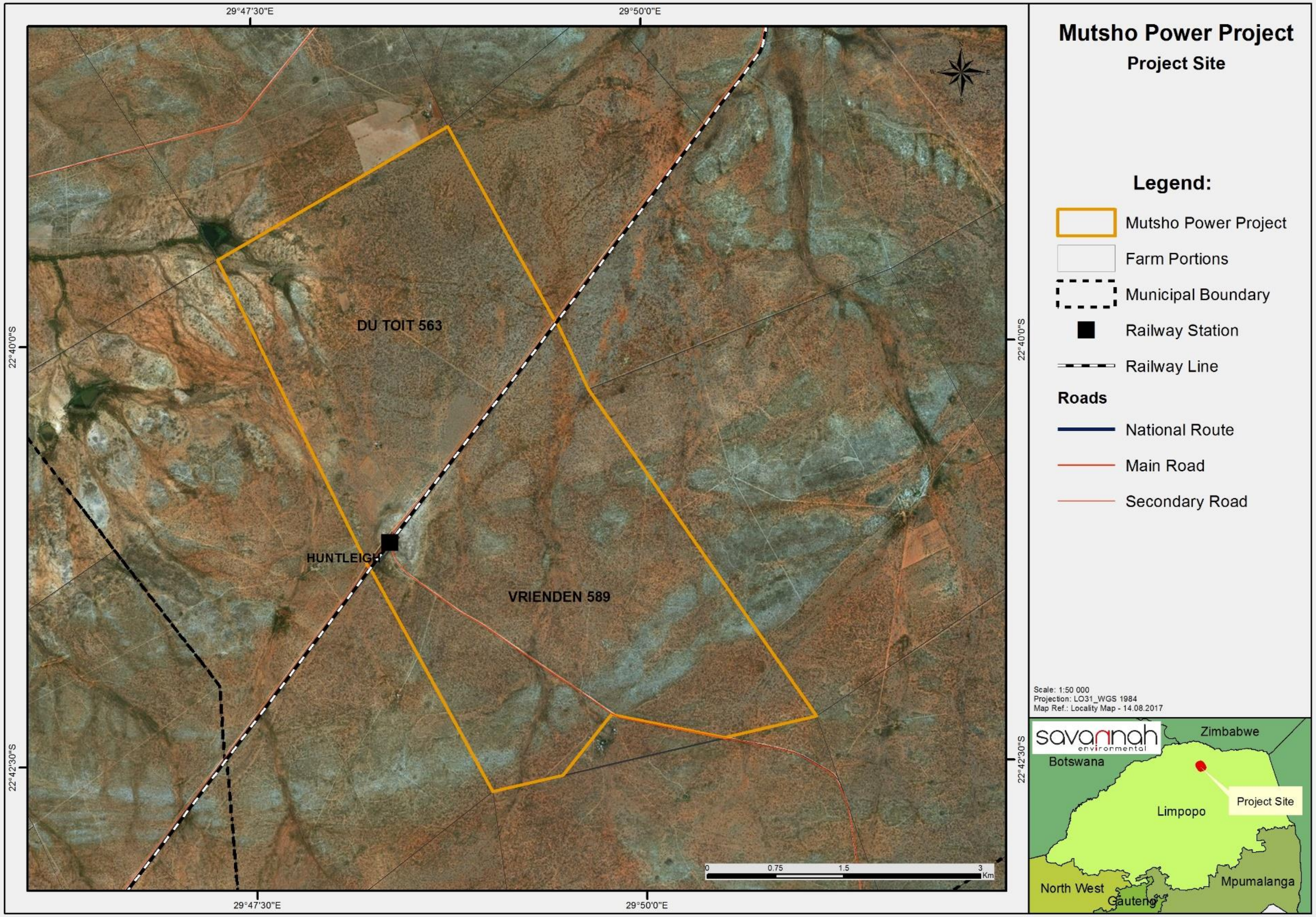

Figure 1.2: **Proposed project site.**

1.4 Additional Environmental Permitting Requirements

In addition to EA required under NEMA and the 2014 EIA Regulations (GNR 326), the Mutsho Power Project also requires the following environmental licenses.

Legislation	Permit or License	Legislation/Policy and Applicable Requirements	Relevant Authority
National Environmental Management: Waste Act (No. 58 of 2008) (NEM:WA), and the List of Waste Management Activities (GNR 921)	Waste Management License (WML)	Listed waste management activities that have, or are likely to have, a detrimental effect on the environment; require a WML in accordance with Section 20(B) of NEM:WA. Listed Waste Management Activities include, amongst others, the treatment, and disposal, of general, and hazardous waste, and the development of supporting facilities and infrastructure. The process of applying for a WML must be supported by an EA process as contemplated in NEMA and the 2014 EIA Regulations (GNR 326). This S&EIA process is therefore being conducted in support of an integrated application for Environmental Authorisation (EA) and a Waste Management License (WML).	National Department of Environmental Affairs (DEA)
National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA), and the List of Activities resulting in Atmospheric Emissions (GNR 893)	Atmospheric Emissions License (AEL)	Activities identified in terms of Section 21 of NEM:AQA which result in atmospheric emissions, and which have or may have a significant detrimental effect on the environment; including health, social conditions, economic conditions, ecological conditions, or cultural heritage; may not commence without an AEL. The process of applying for an AEL can only be completed following the completion of an EIA process, once EA has been granted for the project.	National Department of Environmental Affairs (DEA)
National Water Act (No. 36 of 1998) (NWA), and the Regulations Regarding the Procedural Requirements for Water Use License Application and Appeals (GNR 267)	Integrated Water Use License (IWUL)	Water uses identified in Section 21 of NWA must be licensed with the DWS through means of an IWUL. Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (i.e. activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. In terms of the CBIPPPP, the process of applying for an IWUL can only be completed once the Mutsho Power Project has been identified as a Preferred Bidder. Therefore while the need to apply for an IWUL has been included in the Public Participation process being undertaken as part of the EIA	Department of Water and Sanitation (DWS))

Legislation	Permit or License	Legislation/Policy and Applicable Requirements	Relevant Authority
		process, the process of applying for an IWUL can only be undertaken following the receipt of a positive EA, the conclusion of the next CBIPPPP bidding round, and the announcement of the Mutsho Power Project as a Preferred Bidder..	

1.5 Overview of the Environmental Impact Assessment (EIA) Process

The EIA process comprises two phases – i.e. Scoping and EIA – and involves the identification and assessment of environmental impacts though specialist studies, as well as public participation. The process followed in these two phases is as follows:

» The **Scoping Phase** includes the identification of potential issues associated with the proposed project through a desktop study (considering existing information), and consultation with affected parties and key stakeholders. This phase considers the broader site in order to identify and delineate any environmental fatal flaws, "no-go", or sensitive areas which should be avoided. Following public review of the Scoping Report, this phase culminated in the submission of a Final Scoping Report (FSR) and Plan of Study for EIA (PoSEIA) to the CA for acceptance. The FSR was submitted to DEA on **09 October 2017**, and acceptance of the FSR was received on **24 November 2017**, thus marking the start of the EIA Phase.
» The **EIA Phase** involves a detailed assessment of potentially significant positive and negative direct, indirect, and cumulative impacts identified during the Scoping Phase. This phase considers a proposed development footprint and includes detailed specialist investigations, field work, and public consultation. Following a public review of the EIA Report, this phase culminates in the submission of a Final EIA Report and Environmental Management Programme (EMPr), which includes recommendations of practical and achievable mitigation and management measures for identified impacts, to the CA for review and decision-making.

1.6 Appointment of an Independent Environmental Assessment Practitioner (EAP)

In accordance with Regulation 12 of the 2014 EIA Regulations (GNR 326) Mutsho Power has appointed Savannah Environmental (Pty) Ltd as the independent Environmental Consultants[2] responsible for managing the integrated application for EA and a WML. Savannah Environmental is therefore also responsible for managing the supporting S&EIA process inclusive of comprehensive, independent specialist studies. The integrated application and S&EIA process will be managed in accordance with NEMA, the 2014 EIA Regulations (GNR 326), NEM:WA, the List of Waste Management Activities (GNR 921); and all other applicable legislation.

1.6.1 Details and Expertise of the Environmental Assessment Practitioner (EAP)

Savannah Environmental is a leading provider of integrated environmental and social consulting, advisory and management services with considerable experience in the fields of environmental assessment and management. The company was established in 2006 with a clear objective to provide services to the infrastructure development sector. The undertaking of studies involving all environmental-related disciplines

[2] A signed EAP declaration of interest confirming the Principal Environmental Assessment Practitioner's independence is included in this EIA Report.

has allowed for considerable experience to be gained in the fields of environmental impact assessment and management. Savannah Environmental's team have been actively involved in undertaking environmental studies over the past 12 years, for a wide variety of projects throughout South Africa, including those associated with electricity generation and infrastructure development.

This EIA process will be managed by Jo-Anne Thomas. She will be supported by Sarah Watson, Gabriele Stein, and Lisa Opperman.

Jo-Anne Thomas is a Director at Savannah Environmental (Pty) Ltd and the Principal Environmental Assessment Practitioner (EAP) for the EIA for this project. Jo-Anne holds a Master of Science Degree in Botany (M.Sc. Botany) from the University of the Witwatersrand, and is registered as a Professional Natural Scientist (400024/2000) with the South African Council for Natural Scientific Professions (SACNASP). She has 20 years of experience in the field of environmental assessment and management, and the management of large environmental assessment and management projects. During this time she has managed and coordinated a multitude of large-scale infrastructure EIAs, and is also well versed in the management and leadership of teams of specialist sub-consultants, and dynamic stakeholders. Jo-Anne has been responsible for providing technical input for projects in the environmental management field, specialising in Strategic Environmental Advice, EIA studies, environmental permitting, public participation, Environmental Management Plans (EMPs) and Programmes (EMPrs), environmental policy, strategy and guideline formulation, and integrated environmental management (IEM). Her responsibilities for environmental studies include project management; review and integration of specialist studies; identification and assessment of potential negative environmental impacts and benefits; and the identification of mitigation measures, and compilation of reports in accordance with applicable environmental legislation.

Sarah Watson is an Environmental Consultant at Savannah Environmental, is the EAP for the EIA for this project and main author of this report. Sarah holds a Bachelor of Social Science Honours Degree in Geography and Environmental Management (B.Soc.Sci. Honours G.E.M.) from the University of KwaZulu-Natal (UKZN). She has 7 years of experience as an Environmental Consultant in the field of Environmental Impact Assessment and Environmental Management. Sarah has experience conducting environmental assessment processes for a range of projects in the telecommunications, residential, industrial, bulk infrastructure, rural development, and energy sectors.

Gabriele Stein is a Social and Public Participation Consultant at Savannah Environmental, and is responsible for managing the Public Participation process required as part of the EIA for this project. Gabriele holds a Bachelor of Arts Honours Degree in Anthropology (B.A. Honours) from the University of Johannesburg (UJ). She has 10 years of experience as a Social Consultant in the field of public participation and social research. Her experience includes the professional execution of public participation consulting for a variety of projects, and includes the management and coordination of public participation processes for EIAs for projects in a wide range of sectors, including the energy and infrastructure development sectors.

Curricula Vitae (CVs) detailing the Savannah Environmental team's expertise and relevant experience are provided in **Appendix A**.

1.6.2 Details of the Independent Specialist Team

A number of specialist sub-consultants have been appointed as part of the EIA project team in order to adequately identify and assess potential impacts associated with the project (refer to **Table 1.1**). The specialists have provided input into this EIA Report as well as the draft EMPr attached as **Appendix O** to this EIA Report.

Table 1.1: Specialist Sub-Consultants which form part of the EIA project team

Specialist Name	Specialist Area of Expertise	Specialist Company
Riaan Robbeson, Dewald Kamffer and Lukas Niemand	Ecology, flora, fauna and avifauna	Bathusi Environmental Consulting (BEC)
Mark Zunckel and Atham Raghunandan	Air Quality	uMoya-Nilu Consulting (Pty) Ltd
Robbie Louw, Harmke Immink and Sarah Goodbrand	Climate Change	Promethium Carbon
Byron Bester, Kathryn Roy, Kieren Bremner, Mashudu Rafundisani, Robel Gebrekristos, Ayabonga Mpelwane, Andre van Coller, and Brett Coutts	Hydrology and Geohydrology	Digby Wells
Garry Paterson and Lebea Maribeng	Soils, Land Use and Agricultural Potential	Agricultural Research Council (ARC)
Kathryn Smuts	Archaeology and Heritage	Cedar Tower Services
Elize Butler	Palaeontology	Banzai Environmental (Pty) Ltd
Morné de Jager	Noise	Enviro Acoustic Research CC
Jonathan Marshall	Visual	Environmental Planning and Design CC
Elena Broughton and Ndivhuwo Malemagoba	Socio-economics	Urban-Econ Development Economists
Stephen Fautley	Traffic	Techso

CVs detailing the independent specialist sub-consultants' expertise and relevant experience are provided in **Appendix A**.

1.7 Structure of the EIA Report

This EIA Report has been prepared as part of the S&EIA process being conducted in support of the integrated application for EA and a WML for the Mutsho Power Project. This EIA Report has been prepared in accordance with the Plan of Study for EIA (PoSEIA); prepared as part of the Scoping Phase and accepted by DEA on 24 November 2017; and Appendix 3 of the 2014 EIA Regulations (GNR 326). It provides details of the nature and extent of the proposed project, as well as potential impacts associated with the construction, operation, and decommissioning, of the project. It describes the scope of assessment, the consultation process undertaken throughout the EIA process, and includes an EMPr which provides recommended management and mitigation measures with which to minimise impacts and enhance benefits associated with the project.

An overview of the contents of this EIA Report, as prescribed by Appendix 3 of the 2014 EIA Regulations (GNR 326); and where the corresponding information can be found within the report is provided in **Table 1.2**.

Table 1.2: Summary of where the requirements of Appendix 3 of the 2014 NEMA EIA Regulations (GNR 326) are provided in this EIA Report.

Requirement	Location in Report
(a) Details of – (i) The EAP who prepared the report. (ii) The expertise of the EAP, including a curriculum vitae.	Chapter 1 Appendix A
(b) The location of the development footprint of the activity on the approved site as contemplated in the accepted Scoping Report, including – (i) The 21 digit Surveyor General code of each cadastral land parcel. (ii) Where available, the physical address and farm name. (iii) Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties.	Chapter 2
(c) A plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is – (i) A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken. (ii) On land where the property has not been defined, the coordinates within which the activity is to be undertaken.	Chapter 2 Chapter 10 Appendix B
(d) A description of the scope of the proposed activity, including – (i) All listed and specified activities triggered and being applied for. (ii) A description of the associated structures and infrastructure related to the development.	Chapter 2 Chapter 6
(e) A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context.	Chapter 4 Chapter 6
(f) A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted Scoping Report.	Chapter 5
(g) A motivation for the preferred development footprint within the approved site as contemplated in the accepted Scoping Report.	Chapter 3 Chapter 8 Chapter 10
(h) A full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted Scoping Report, including – (i) Details of the development footprint alternatives considered. (ii) Details of the public participation process undertaken in terms of Regulation 41 of the Regulations, including copies of the supporting documents and inputs. (iii) A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them. (iv) The environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects. (v) The impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – (aa) Can be reversed. (bb) May cause irreplaceable loss of resources (cc) Can be avoided, managed or mitigated. (vi) The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks.	Chapter 2 Chapter 3 Chapter 6 Chapter 7 Chapter 8 Chapter 9 Chapter 10 Appendix C Appendix D – N Appendix O

Requirement	Location in Report
(vii) Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects. (viii) The possible mitigation measures that could be applied and level of residual risk. (ix) If no alternative development footprints for the activity were investigated, the motivation for not considering such. (x) A concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted Scoping Report.	
(i) A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted Scoping Report through the life of the activity, including – (i) A description of all environmental issues and risks that were identified during the environmental impact assessment process. (ii) An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	Chapter 6 Chapter 8 Chapter 9 Appendix D – N
(j) An assessment of each identified potentially significant impact and risk, including – (i) Cumulative impacts. (ii) The nature, significance and consequences of the impact and risk. (iii) The extent and duration of the impact and risk. (iv) The probability of the impact and risk occurring. (v) The degree to which the impact and risk can be reversed. (vi) The degree to which the impact and risk may cause irreplaceable loss of resources. (vii) The degree to which the impact and risk can be mitigated.	Chapter 8 Chapter 9 Appendix D – N
(k) Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report.	Chapter 7 Chapter 8 Chapter 9 Appendix D – N Appendix O
(l) An environmental impact statement which contains – (i) A summary of the key findings of the environmental impact assessment. (ii) A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted Scoping Report indicating any areas that should be avoided, including buffers. (iii) A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.	Chapter 10
(m) Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.	Chapter 8 Chapter 9 Chapter 10 Appendix D – N Appendix O
(n) The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment.	Chapter 3 Chapter 8 Chapter 9

Requirement	Location in Report
	Chapter 10
(o) Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation.	Chapter 8 Chapter 9 Chapter 10 Appendix D – N Appendix O
(p) A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed.	Chapter 8 Chapter 9 Chapter 10 Appendix D – N Appendix O
(q) A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	Chapter 10 Appendix D – N
(r) Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised.	N/A
(s) An undertaking under oath or affirmation by the EAP in relation to – (i) The correctness of the information provided in the reports. (ii) The inclusion of comments and inputs from stakeholders and I&APs. (iii) The inclusion of inputs and recommendations from the specialist reports where relevant. (iv) Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.	EAP Declaration
(t) Where applicable, details of any financial provision for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts.	N/A
(u) An indication of any deviation from the approved scoping report, including the plan of study, including – (i) Any deviation from the methodology used in determining the significance of potential environmental impacts and risks. (ii) A motivation for the deviation.	N/A
(v) Any specific information that may be required by the competent authority.	N/A
(w) Any other matters required in terms of Section 24(4)(a) and (b) of the Act.	N/A
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to an Environmental Impact Assessment Report the requirements as indicated in such notice will apply.	N/A

CHAPTER 2 PROJECT DESCRIPTION

This Chapter provides a description of the Mutsho Power Project and associated infrastructure proposed for development by Mutsho Power (Pty) Ltd. Bulk water supply and grid integration options are in the process of being finalised, and have been excluded from the current scope of work, as they will be assessed through separate applications for Authorisation.

2.1 Project Site Overview

Mutsho Power proposes the development of the Mutsho Power Project on a site near Makhado (Louis Trichardt) in Limpopo Province. The project site is located approximately 20km north-west of the Makhado Colliery (to be developed near the town of Makhado), and approximately 7km south of Mopane in the Musina Local Municipality of Vhembe District, Limpopo Province. The area under investigation is approximately 2 161ha in extent and comprises 2 agricultural properties, belonging to Mr. Souis Hendrie Van Der Walt (Farm Du Toit 563) and Fumaria Property Holdings (Pty) Ltd, a Special Purpose Vehicle (SPV) which is wholly owned by MC Mining Ltd (MCM) (Farm Vrienden 589) (refer to **Table 2.1**).

Table 2.1: Project Site Details

Province	Limpopo Province		
District Municipality	Vhembe District Municipality		
Local Municipality	Musina Local Municipality		
Ward Number	Ward 02		
Nearest Town	Mopane (approximately 7km north of the Project site)		
Farm Names and Numbers	Du Toit 563		
	Vrienden 589		
Portion Numbers	RE/563		
	RE/589		
SG 21 Digit Code	T0MS00000000056300000		
	T0MS00000000058900000		
Landowners	Du Toit 563	Mr. Souis Hendrie Van Der Walt	
	Vrienden 589	Fumaria Property Holdings (Pty) Ltd	
Current Zoning	Agriculture		
Site Extent	Du Toit 563	924ha	
	Vrienden 589	1 237ha	
	TOTAL	**2 161ha**	
Site Co-ordinates		**Latitude:**	**Longitude:**
	Northern-most extent	22° 38' 42.24" S	29° 48' 45.67" E
	Eastern-most extent	22° 42' 13.92" S	29° 51' 05.82" E
	Southern-most extent	22° 42' 39.95" S	29° 49' 00.95" E
	Western-most extent	22° 39' 29.33" S	29° 47' 16.79" E

A locality map depicting the location of the project site in relation to the Makhado Colliery, and N1 National Road is provided in **Figure 2.1**.

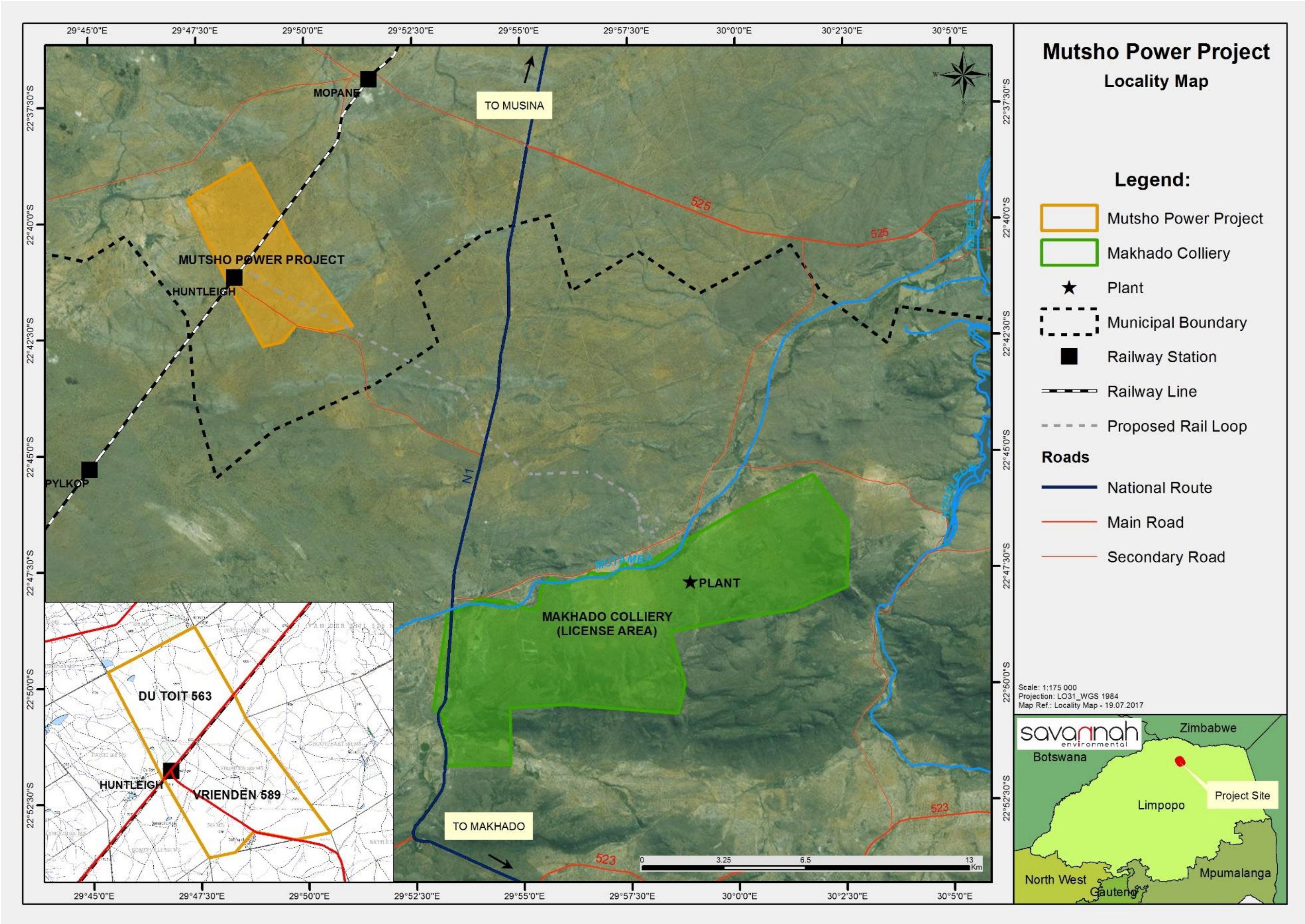

Figure 2.1: Project Locality Map.

2.2 Layout Selection Process

A desktop site sensitivity assessment was conducted as part of the Scoping Phase. The purpose of the site sensitivity assessment was to inform the location of the development footprint (approximately 350ha in extent) within the larger project site (approximately 2 161ha in extent), such that areas of environmental sensitivity are avoided as far as possible. A number of potentially sensitive areas were identified as part of this process, and are reflected within an Environmental Sensitivity Map (refer to **Figure 2**.2). Specific sensitivities identified during site sensitivity assessment undertaken as part of the Scoping Phase, and which were utilised to define potentially suitable development footprints for further investigation are summarised below:

» **Wetlands and associated buffers**
A number of National Freshwater Ecosystem Priority Area (NFEPA) wetlands have been identified on site. These wetlands have been allocated a 100m protection buffer within which all construction activities should be prevented to minimise impacts. In addition, no infrastructure should be placed within wetland areas or their buffers.

» **Drainage lines and associated buffers**
Drainage lines occurring on site have been allocated a 100m buffer within which no infrastructure should be placed, and no construction activities should occur.

» **Heritage sites and associated buffers**
Heritage sites identified during the Scoping level Heritage Assessment have been mapped and allocated the following buffers within which no development may occur:
  * Site V04 on Farm Vrienden must not be impacted by any proposed development. A 100m buffer must be implemented around this site.
  * Graves at MOP112 on Farm Vrienden 589 must be avoided. A fence should be erected 5m from the 3 visible graves, and a 15m buffer must be observed around the fence line.
  * The structure at MOP114 on Farm Vrienden 589, must be avoided. A 25m buffer must be implemented around this site.
  * Sites D04 to D07 on Farm Du Toit 563 must not be impacted by any proposed development. A 100m buffer must be implemented around this artefact manufacturing site.
  * Graves at MOP033 on Farm Du Toit 563 must be avoided, and a 15m buffer must be observed around the existing fence line.
  * The structure at MOP034 on Farm Du Toit 563 must be avoided. A 25m buffer must be implemented around this site.

» **Cultivated Land**
Areas of cultivated land which may occur onsite should as far as possible be avoided. No infrastructure should be placed within such areas.

» **Noise Sensitive Receptors**
Noise Sensitive Receptors identified during the Scoping level Noise Assessment have been mapped. Such receptors should be avoided as far as possible. In addition, it needs to be ensured that the project is positioned in such a way so as to ensure that noise limits are not exceeded at noise sensitive receptors.

» **Limpopo Conservation Plan v2 (2013)**
The project site has been mapped against the Limpopo Conservation Plan v2 (2013) and map of Critical Biodiversity Areas (CBAs). The project site is located fully within an Ecological Support Area (ESA) 1, and occurs outside any CBA 1 or CBA 2 areas. The southern and western boundaries of the Farm Vrienden 589 are aligned with the boundaries between an ESA 1 and CBA 2 area, and development within close proximity to these boundaries should be avoided.

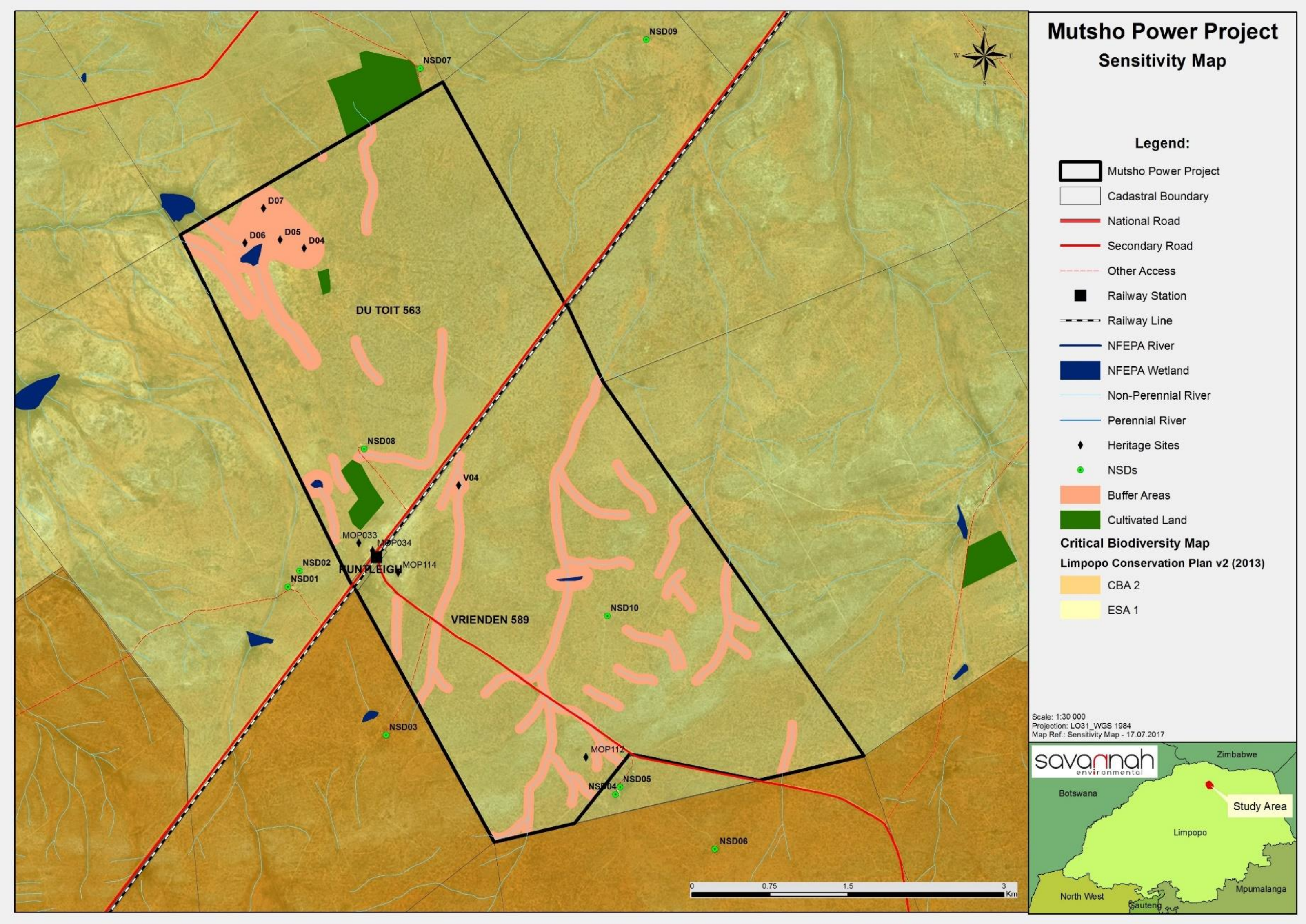

Figure 2.2: Environmental Sensitivity Map (Source: Savannah Environmental, Final Scoping Report, October 2017).

Following the completion of the Scoping Phase, and based on the outcomes of the site sensitivity assessment, a number of layout alternatives were identified for further investigation. Several of the layouts were abandoned based on technical, environmental and/or financial feasibility. Those layout alternatives which were deemed to be potentially feasible from an environmental, technical, and financial perspective, and which have been considered as part of the EIA Process, are described in more detail in **Chapter 3**.

2.3 Overview of How Electricity is generated at Coal-fired Power Stations

Approximately 90% of electricity generated by Eskom, and approximately 77% of South Africa's current electricity mix is generated by coal-fired power stations, which provide baseload power to the national electricity grid (DoE, 2016). The process of burning coal in coal-fired power stations constitutes an energy conversion process, whereby thermal (i.e. heat) energy is converted into mechanical energy, before being converted into electrical energy in the form of electricity.

Coal is burned in large boilers under controlled conditions to produce steam under very high temperatures and pressures. Steam is generated when heated air (generated as a result of the combustion process) comes into contact with water filled boiler feed tubes which line the walls of the boiler. The heated air heats up the water inside the boiler feed tubes, and in doing so generates "superheated" steam.

The superheated steam is directed to a turbine where its thermal energy is used to turn the blades of a turbine. The turbine blades are connected to a turbine shaft, which is connected to a generator. The generator comprises a powerful electromagnet which turns inside a large copper coil, and converts rotating mechanical energy into electrical energy in the form of Alternating Current (AC). A transformer is then used to step-up or increase AC of one voltage to a higher voltage suitable for transmission. The electricity is then fed into the national grid where it is distributed to end users via Eskom's distribution network.

Once used in the turbines, steam is cooled and condensed back into water before being returned to the boiler for reheating. Ash generated by the combustion process is collected from the boiler and flue (i.e. exhaust) stacks and disposed of. Smoke resulting from the combustion process is filtered to remove ash, unwanted chemicals, and gaseous emissions, before being released into the atmosphere. Gases typically generated by coal-fired power stations include sulphur dioxide (SO_2), carbon dioxide (CO_2) and oxides of nitrogen (NO_x). The type of cleaning or removal technology selected for implementation ultimately depends on the type of boiler technology selected for implementation.

2.4 Overview of the Typical Components of a Coal-fired Power Station

The power island constituent of a coal-fired power station typically consists of the following key components (refer to **Figure 2**.3):

- » Boiler units.
- » Steam generator units.
- » Dry-Cooled (Air-Cooled) Condensing Units.
- » Flue-gas handling units and stacks.
- » Generator switchgear and transformer systems.
- » HV yard, switchgear and transmission connections.
- » Raw and wastewater storage and treatment.
- » Coal stockyard, silos and conveyors.

- Limestone yard, silos and conveyors.
- Ash handling, silos and disposal facilities (i.e. conveyors and ash dump).
- Workshops, offices, warehouses and control rooms.

In addition to the abovementioned components which make up the power island, the Balance-of-Plant typically consists of the following:

- Water and wastewater treatment consumables and chemical storage and handling.
- Spent consumables and chemical storage and handling.
- Sewerage handling, treatment and disposal.
- Potable water and sanitation facilities.
- Heavy fuel oil and/or diesel fuel oil supply and storage.
- Liquid Petroleum Gas (LPG) supply and storage.
- Security, access control and fencing.
- Solid and liquid waste handling, storage and disposal.
- Electrical switchgear and distribution systems.
- Offices, Logistics Offloading and Warehousing Facilities.

Lastly, associated supporting infrastructure typically includes:

- Strategic coal stockpile, coal handling systems and conveyors.
- Ash dump, ash handling systems and conveyors.
- Stormwater and polluted water collection, dams and dispatch systems.
- Raw water storage dam, booster pump station and pipeline(s).
- Access, through and operational roads.

2.5 Details of the proposed Project Infrastructure

Coal-fired power stations can utilise various alternative technologies and methods as part of their power generation and operation activities. The technologies and methods selected for use will ultimately influence the overall operation of the facility, as well as the impact the facility is likely to have on the surrounding environment. Alternative technologies and methods include boiler technologies, steam cycles, condensing and cooling methods, flue gas cleaning technologies, ash disposal methods, and wastewater and effluent disposal methods.

The Mutsho Power Project is intended to form part of the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP). As a result, the technology alternatives available for selection are prescribed by the requirements of the CBIPPPP. Based on the information contained in the Request for Proposal (RFP) document issued for the first round of bidding (i.e. Bid Window 1), it is anticipated that projects likely to be considered under subsequent rounds of bidding can utilise either Pulverised Coal (PC) (with Flue Gas Desulphurisation (FGD)) or Circulating Fluidised Bed (CFB) boiler technology.

Figure 2.3: Typical CFB coal-fired power project layout.[3]

During the Scoping Phase, both technologies (i.e. PC with FGD and CFB) were considered as alternatives for the Mutsho Power Project. A comparison of the manner in which electricity is typically generated at PC and CFB power stations is provided in **Table 2.2**.

Table 2.2: Comparison between PC and CFB Power Stations

PC Power Station	CFB Power Station
1. **Pulveriser:** Coal is ground into a very fine powder (i.e. pulverised) before being blown into the boiler via a series of nozzles.	1. **Crusher:** Coal is crushed to a suitable size to allow for combustion within the CFB boiler.
2. **PC Boiler:** Inside the boiler (furnace), the very fine coal particles mix with heated/combustion air and ignite where they burn at a very high temperature (i.e. typically between 1 300°C and 1 700°C). The heat from the combusting coal is absorbed by water filled tubes in the various heater components, which line the boiler and flue gas path, to produce steam under very high pressures.	2. **CFB Boiler:** A Circulating Fluidised Bed (CFB) boiler (furnace), consists of a bed of sand and sorbent which is heated and "fluidised" using jets of air. Crushed coal is introduced to the suspended bed of sand on upward-blowing jets of air where it starts to combust. The sand, coarse particles of coal and sorbent are separated from the flue gases by a cyclone filter, while flue gases are removed from the boiler via an exhaust. The heat from the combusting coal is absorbed by water filled tubes, in the various

[3] Downloaded from the internet: "Plant Model Making Gallery" at http://www.enggmodels.com/plant-model-making/ on 13/02/18).

PC Power Station	CFB Power Station
	heater components, which line the boiler and flue gas path, to produce steam under very high pressures.
3. Steam Generation Cycles: Steam is generated under high temperatures and pressures, and the steam cycles can be described as either Subcritical, Supercritical (SC), or Ultra-supercritical (USC). Whereas subcritical steam cycles operate below Critical Pressure (CP), which is the pressure and temperature at which water exists in both a liquid and vapour state (defined as 22.1 MPa), SC steam cycles operate at supercritical pressure, which is above critical pressure, and USC steam cycles operate at higher pressures than SC steam cycles.	
4. Turbine: The high pressure steam is piped to a turbine through a control valve where it is allowed to expand and pass through the turbine blades, causing them to turn. The movement of steam through the turbine blades causes the thermal (i.e. heat) energy to be converted to mechanical (rotational), energy.	
5. Generator: The turbine is linked to the rotor of a generator which comprises an electromagnet which rotates inside large coils wound from insulated copper wire, and in doing so generates electricity in the form of alternating current (AC).	
6. Transformer: A transformer is used to increase or "step up" one AC voltage to another to allow for transmission of power over long distances at a higher voltage and reduced current (and reduced losses), using smaller conductors (cross section) i.e. typically at 275kV or 400kV.	
7. Transmission: The generated electric power is then fed into the Eskom integrated power grid for distribution and usage.	
8. Condensation and Dry Cooling: Spent steam from the turbine exhaust (at reduced temperature and pressure), is directed into a condenser comprising of finned tubing (much like the radiator on a car). When the spent steam comes into contact with the condenser tubes condensation of the steam takes place, and it is converted back into a liquid state (i.e. water). This water is then pumped back to the boiler for reheating and re-used in the closed loop system.	
9. Emission Abatement Technology: The combustion of coal results in the generation and release of various emissions (i.e. CO_2, SO_2, NO_x, etc.) which need to be removed from flue (i.e. exhaust) gases prior to their release. Emission abatement technology such as Flue Gas Desulphurisation (FGD) and Selective Non-Catalytic Reduction (SNCR) are therefore required to remove SO_2 and NO_x emissions from flue gases respectively.	**9. Sorbents**: Sorbents such as limestone are injected directly into the bed of CFB boilers to neutralise sulphur released during the combustion process, resulting in low sulphur dioxide (SO_2) emissions.
10. Flue Gas Treatment: Fly ash generated by the combustion process is removed from flue gases using systems such as Baghouses (filters), or Electrostatic Precipitators (electrostatic dust attractors).	
11. Smoke Stacks: Gases that are released from the combustion process accumulate in the boilers or furnaces, and are filtered and released into the atmosphere via smoke stacks.	
12. Dry Ash Disposal: Ash generated by the combustion process is removed from the boilers (i.e. bottom ash) and flue gases (i.e. fly ash) and disposed of as waste to an ash dump.	

Following the conclusion of the Scoping Phase, Mutsho Power elected to make use of Supercritical (SC) Circulating Fluidised Bed (CFB) technology as the preferred technology alternative. The decision to make use of CFB as opposed to PC technology was based largely on the perceived environmental benefits associated with CFB technology when compared with PC technology (i.e. abatement of local air emissions, and lower water requirements). Comparative environmental benefits associated with CFB technology include reduced local air emissions as a result of higher efficiencies, higher acceptability of fuels (with regards to both type and quality), and reduced water requirements (which are typically associated with Flue Gas Desulphurisation (FGD) methods required by PC plants). In addition, the higher combustion efficiency of the SC technology results in a reduction in carbon dioxide (CO_2) emissions by 2% to 3% with each percentage point improvement in efficiency.

Therefore, the Mutsho Power Project will have a generation capacity of up to 680MW including house load, with an export capacity of 600MW, in accordance with DoE's requirements, and will make use of Circulating Fluidised Bed (CFB) technology operating under Supercritical (SC) conditions. The power plant will comprise 2 x boilers (suitably rated at approximately 300MW each), 2 x steam turbine generators (STGs), a flue / smoke stack, an ash dump, packaged Water Treatment Plant (WTP) and storage or discard ponds and vessels, an ash dump run-off dam, main plant run-off dam, raw water storage dam, strategic and working coal stockpiles and lime supply. The Mutsho Power Project will make use of direct dry cooling systems; dry ash disposal methods; and will be developed as a Zero Liquid Effluent Discharge (ZLED) facility.

The key project components applicable to the Mutsho Power Project are summarised in **Table 2.3**, and described in more detail under the subsequent sub-headings.

Table 2.3: Key Project Components.

	600MW SC CFB Plant
Power island consisting of:	» 2 x 300MW Supercritical (SC) Circulating Fluidised Bed (CFB) boilers.
	» Electrostatic Precipitator (ESP)
	» Flue / smoke stack up to 150m in height.
	» Direct dry-cooling (air-cooling) systems.
	» Balance of plant components (including steam turbines and generators etc.).
Raw materials storage and handling:	» Coal and Limestone / Lime Rail Spur and / or Road off-loading systems.
	» Upgrading or establishment of a rail siding.
	» Coal crusher and raw material handling equipment.
	» Strategic and working coal stockpile.
	» Limestone or Lime storage and handling area.
Ash handling and disposal:	» Ash dump (dry-ashing is proposed in order to reduce the project's water requirements in alignment with the recommendations of the National Development Plan (NDP) and Integrated Energy Plan (IEP)).
Water infrastructure:	» Raw water storage dam (up to 5ha).
	» Water supply pipelines and booster stations.
	» Pollution control / run-off dams (up to 2.5ha each).
	» Packaged Water treatment plant (WTP).
	» Wastewater treatment plant (WWTP).
	» Storm water management systems.
Electrical infrastructure:	» HV Yard and substation components with HV overhead transmission lines connecting to Eskom infrastructure.
Associated infrastructure:	» Control room, office / administration, workshop, storage and logistics buildings.
	» On-site critical staff accommodation required during construction (up to 1.5ha).
	» Temporary site office, laydown and assembly areas, and batching plant (up to 5ha in total).
	» Upgrading of external roads and establishment of internal access roads.
	» Security fencing and lighting, and access control with guardhouse.
Services required:	» Refuse Material Disposal – During construction all refuse material generated by the proposed development will be collected by a contractor to be disposed of off-site at a licensed waste disposal facility. Solid wastes and sludge arising during operation will be collected, and

	transported to the ash dump. Chemical wastes will be collected and stored separately in a safe manner, and will be transported off-site via road where they will be disposed of according to the local and national standards.
	» Sanitation – During construction, all sewage waste will be collected by a contractor to be disposed of at a licensed waste disposal site. During operation, 2 x 5m³/h buried sanitary sewage treatment systems will be provided for discharge from staff showers, flushing, toilets, canteen, etc. The sanitary sewage will be treated by secondary biological contact oxidation process, filtered, disinfected, and flow into clean water basin for reuse.
	» Water – Between 800 000m³/a and 1.2 million m³/a of water is required during the construction phase, while approximately 1 million m³/a is required to support the operation of the project. A number of bulk water supply options are currently being investigated for the project. The most promising of these include: ∗ Transfer of treated effluent from the Makhado Rietvly Wastewater Treatment Works (WWTW) ∗ Transfer from dams in Zimbabwe (alternative to above). ∗ Direct abstraction from the Limpopo River.
	» Electricity – A power supply will be required during both construction and operation of the project. It is anticipated that electricity required to support the construction will be provided by the Musina Local Municipality.

2.5.1 Overview of Circulating Fluidised Bed (CFB) Boiler Technology

CFB boilers utilise fluidisation techniques to create a liquid-like bed of suspended material during the combustion process. The bottom of CFB boilers are lined with a bed of solid material comprising sand, solid fuel particles (i.e. crushed coal), and sulphur absorbing sorbents (i.e. lime or limestone). During combustion, the bed material is lifted and kept suspended on jets of air, resulting in a fluidised (i.e. liquid-like) bed. The fluidised bed allows for gases and solids to mix together more turbulently, resulting in better heat transfer, and chemical reactions occurring.

During combustion, fine particles of partly burned coal, ash, and bed material (i.e. sand) are carried along with hot flue gases to the upper areas of the boiler into a cyclone. In the cyclone the heavier particles separate from the gases and are returned to the combustion chamber (Johnzactruba, 2009). The hot flue gases from the cyclone pass to the heat transfer surfaces (comprising water filled boiler feed tubes), before being removed from the boiler. Heat is transferred from the hot flue gases to the heat exchangers to produce superheated steam, which is directed to a steam turbine.

The addition of sulphur absorbing sorbents such as limestone to the CFB boiler bed material allows for approximately 95% of the sulphur pollutants released during combustion to be absorbed. Furthermore, by burning coal at lower temperatures of between 750°C and 900°C; NO_x is largely prevented from forming.

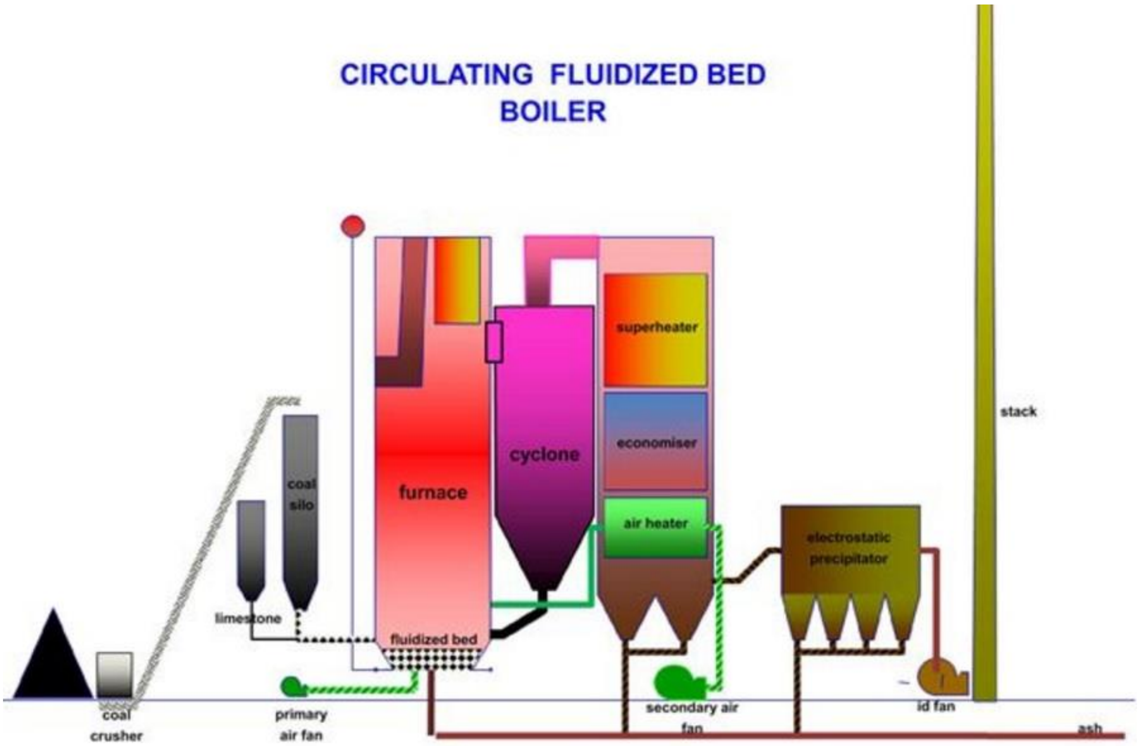

Figure 2.4: Illustration of CFB Boiler Technology (Source: Johnzactruba, 2009).

2.5.2 Overview of Supercritical (SC) Steam Cycles

There are typically three types of steam generation cycles available for implementation in thermal combustion power stations. They are: subcritical, Supercritical (SC), and Ultra Supercritical (USC) steam cycles; however, USC CFB technology is not currently considered as commercially mature as per the CBIPPPP Bid Window 1 criteria. The Mutsho Power Project proposes making use of Supercritical (SC) steam cycles within its power generation units as this is the current best state of commercially available technology. Whereas subcritical steam cycles operate below Critical Pressure (CP), which is the pressure and temperature at which water exists in both a liquid and vapour state (defined as 22.1 MPa), Supercritical (SC) steam cycles operate at supercritical pressure, which is above critical pressure, and are able to immediately transform water from a liquid into a vapour state (i.e. into steam). The percentage of superheated steam generated by SC steam cycles is therefore higher than that generated by subcritical steam cycles. This is significant in that Increases in the combustion efficiency of a boiler result in lower fuel consumption, and fewer ash and flue gas emissions. In addition, carbon dioxide (CO_2) emissions are generally reduced by 2% to 3% with each percentage point improvement in efficiency. Boilers which utilise SC steam cycles are therefore more efficient and less polluting than boilers that utilise subcritical steam cycles (refer to **Table 2.4**).

Table 2.4: Overview of Subcritical and SC Steam Cycles.

Type of Steam Cycle	Operating Pressure	Operating Temperature	Operating Efficiency
Subcritical steam cycle	< 22.1 MPa	Up to 565 °C	36%
Supercritical (SC) steam cycle	22.1 – 25 MPa	540 - 580 °C	45%

Source: Adapted from Nalbandian, 2008.

2.5.3 Coal Fuel Source

Coal required for the project will be sourced from MCM's Makhado Project to be developed approximately 20km south-east of the project site. MCM's Makhado Project comprises a new coal mine (i.e. the Makhado Colliery) to be located north of the Soutpansberg Mountains in the Makhado Local Municipality of Vhembe District. It has been estimated that the Makhado Project has 344.8Mt mineable tonnes of coal in situ (MTIS), and once developed is expected to produce coal for domestic and/or export markets. The Makhado Colliery is estimated to operate for 16 years at full capacity (supplying approximately 2.3 million tons hard coking coal and 3.2 million tons thermal coal per annum). In 2017 MCM announced that it would initiate mining via the Makhado Lite Project. This will result in decreased volumes being mined initially, which will extend the life of the colliery. Additional life extension is further possible through the use of adjacent pits and surrounding coal fields as part of the GSP Project. The Mutsho Power Project will have a lifespan of approximately 30 years and will utilise approximately 2 million tons of coal per annum. Should the Mutsho Power Project be selected as a preferred bidder under the CBIPPPP, a coal supply agreement would need to be entered into which satisfies the power station project's financing and CBIPPPP requirements.

Coal will be transported to site either via a new 22km railway loop proposed for development between the Makhado Colliery and existing Huntleigh railway siding, or via road transport. The proposed new railway loop forms part of the Makhado Colliery development, and is therefore excluded from the current scope of work. In the event that coal is transported via the proposed new railway loop a railway spur would need to be developed onsite for the offloading of coal and other raw materials (i.e. limestone).

2.5.4 Raw Material Storage and Handling

2.5.4.1 Coal

An appropriately lined[4] coal stockpile will be established onsite. This working and strategic stockpile will be established adjacent to the power plant infrastructure. The stockpile will be approximately 13.5m in height, will occupy an area of approximately 4.62ha in extent, and will provide at least 30 days full storage capacity. It is estimated that during its operation the project will have a daily coal transfer rate of up to 6 000 t/d. Stackers will be used for storage, and reclaimers will be used for the extraction of coal from the stockpile, and conveying to the raw coal bunkers within the boiler house. Each raw coal bunker will provide up to 24 hours storage capacity.

2.5.4.2 Limestone

Limestone will be transported to site either via rail or road transport, and will be transferred and stored under a covered stacking and reclaiming area of approximately 0.3ha in extent. The limestone stockyard will be located adjacent to the working coal stockyard, and limestone will be transferred via conveyors to the limestone bunkers in the boiler-house, as required. The project will have a daily lime transfer rate of up to 700 t/d.

[4] A liner is required to be implemented as water draining through the coal stockpile areas could contain waste (thus triggering a Section 21g water use). In this regard, the liner would need to provide the same containment standard as a Class C liner as detailed in Regulation 636 published in terms of the National Environmental Management: Waste Act. . It is therefore proposed that one layer of composite geomembrane liner be applied at the bottom of coal stockpiles.

2.5.5 *Water Infrastructure*

2.5.5.1 Bulk Water Supply

Between 800 000m³/a and 1.2 million m³/a of bulk water is required during construction, while approximately 1 million m³/a is required to support the operation of the project. Bulk water is required for use in the power generation process as feed water for the steam cycle process as well as for the auxiliary cooling system. Water resource and supply options are in the process of being investigated by a Department of Water and Sanitation (DWS), acknowledged, water specialist with extensive experience in the planning and management of water resources in Limpopo Province and through the recent development of the Limpopo (North) Water Management Area Reconciliation Strategy. Bulk water supply options have therefore been excluded from the current scope of work and will be assessed through a separate application for Authorisation.

The following options have been identified as being the most feasible to date and will be considered further as part of the water specialists ongoing investigations:

1. Transfer of treated effluent from the Makhado Rietvly Wastewater Treatment Works (WWTW)
2. Transfer from dams in Zimbabwe (alternative to above).
3. Direct abstraction from the Limpopo River.

Once a preferred option or combination of options are selected, the proposed bulk raw water supply pipeline will be assessed through a separate application for Environmental Authorisation (EA).

Transfer of treated effluent from the Makhado Rietvly WWTW (Preferred Option)

This option entails transporting treated effluent from the Makhado Rietvly WWTW located in Makhado town, to the project site via pipeline for use in operations. The WWTW is owned and operated by the Vhembe District Municipality. It has a current capacity of 5Ml/d and is planned to be upgraded to 10Ml/d by 2025. The WWTW has sufficient capacity to supply the Mutsho Power Project from 2025 onwards, prior to the upgrade. A number of potential pipeline route alternatives have been identified (refer to **Table 2.5** and **Figure 2**.5).

Table 2.5: Proposed Bulk Water Pipeline Route Alternatives.

Pipeline route option	Route orientation	Length (km)
Railway line through Waterpoort	Follow the railway line from WWTW to the project site.	79.6
Release and abstract through Waterpoort	As per above, but with water released into the Sand River before and again abstracted after the poort.	30.1
	Water abstracted at bottom of poort and routed along the railway line to project site.	36.0

An alternative to the preferred pipeline routes provided above entails following the N1 National Road over the Soutpansberg Mountains and routing the pipeline through farmlands to the project site. The alternative pipeline route would be approximately 60.9km in length. Such an alternative has been identified for implementation in the event that a critical problem is found with any of the preferred pipeline routes as identified in **Table 2.5**.

Transfer of water from dams in Zimbabwe via the Zimbabwe to South Africa Water Project (Alternative Option)

The DWS is currently investigating the Zimbabwe to South Africa Water Project, which comprises the following phases:

» Phase 1: The proposed Beitbridge – Musina Water Transfer Scheme. This is being targeted as a short-term water transfer project via the recently completed Beitbridge Water Supply Scheme (which includes a new water treatment plant and water from the Zhove Dam) to Musina, and specifically to the Musina-Makhado Special Economic Zone (SEZ) located immediately east of the project site.
» Phase 2: Transfer from Tokwe – Mukorsi Dam. This was completed and commissioned on 19 May 2017.

Discussions with DWS have indicated that the option of supplying the Mutsho Power Project through this scheme can be considered, however very little information is currently available on this. It has therefore been assumed that, should the Mutsho Power Project be supplied from Phase 1, a pipeline will be required from the Beitbridge Water Treatment Plant (refer to **Table 2.6** and **Figure 2**.5).

Table 2.6: Proposed Bulk Water Pipeline Options.

Pipeline route option	Route orientation	Length (km)
Pipeline from Beitbridge	Follow the N1 from Beitbridge, through Musina towards project site. The last portion will be routed across farm land.	62.8

The option of obtaining water via the Zimbabwe to South Africa Water Project is proposed as a possible alternative to utilising treated effluent from the Makhado Rietvly WWTW; however re-using treated effluent from the Makhado Rietvly WWTW is the preferred alternative.

2.5.5.2 Raw Water Storage Dams

Bulk water required for the project will be pumped to site and stored in a raw water storage dam to be established onsite. The raw water storage dam will be up to 5ha in extent, will have dam wall of 2m in height, and a storage capacity not exceeding 50,000m^3, and will be located at the highest possible location on the project site to the south-east of the power block.

2.5.5.3 Packaged Water Treatment Plant (WTP)

Bulk water required for the project will be treated in an onsite packaged water treatment plant (WTP) to produce different water streams of sufficient quality for the various onsite uses. Primarily the onsite water treatment would produce demineralised water for use in the boiler feed, and would also produce water of sufficient quality to be potable and for use in firefighting and emergency water pumps.

2.5.5.4 Pollution Control / Run-off Dams

Clean water stormwater dams will be developed to collect stormwater runoff from clean catchment areas, while dirty water stormwater dams will be developed to collect polluted stormwater run-off emanating from the ash dump, and coal stockpile and plant area. Storm water runoff collected in the storm water runoff dam will be treated to produce water of sufficient quality for use in general dust suppression, and ash dump spraying activities. Pollution control / run-off dams will be up to 2.5ha each in extent.

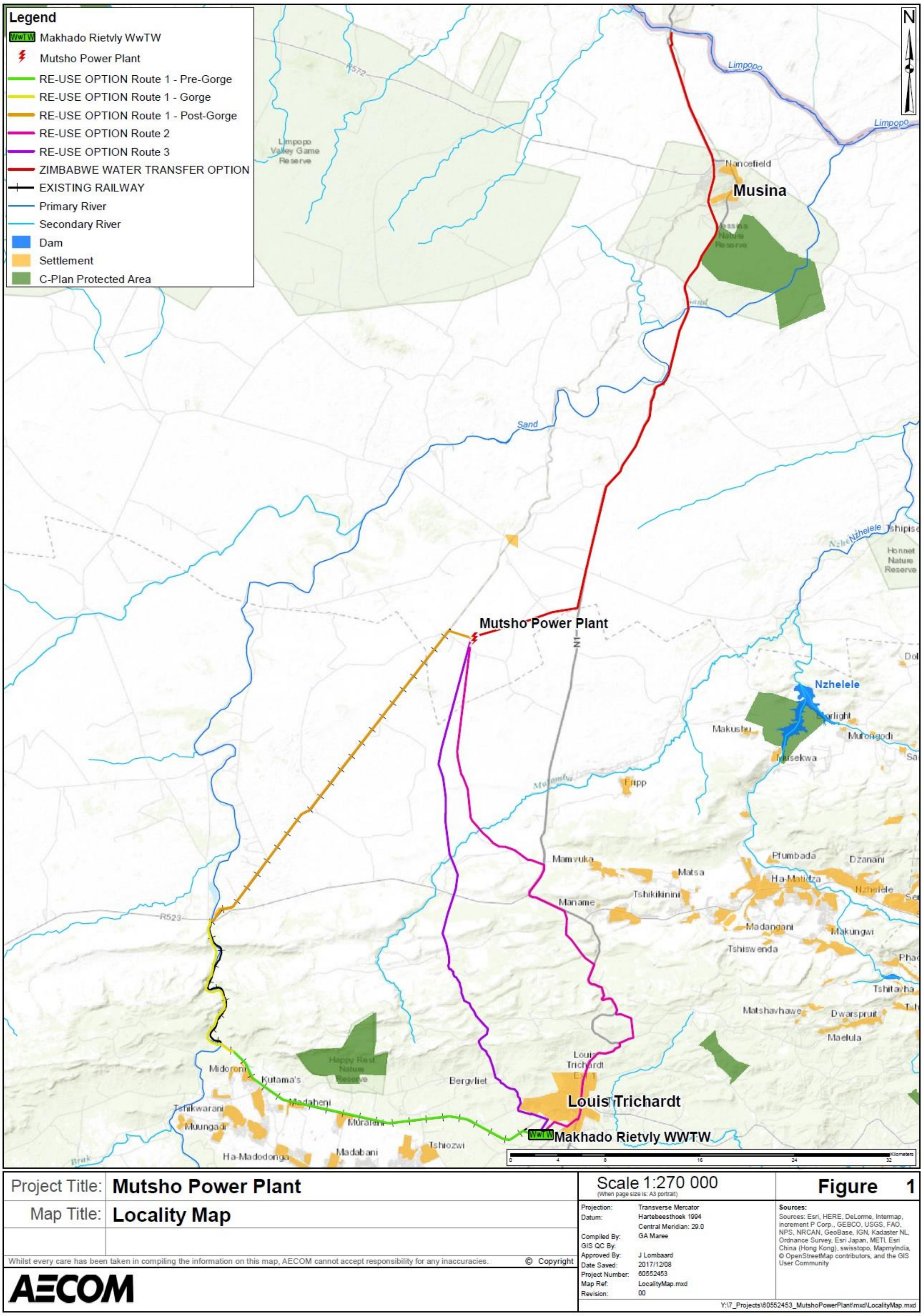

Figure 2.5: Overview of Bulk Water Supply Pipeline Options currently under investigation (Source: AECOM, 2017).

2.5.5.5 Water Supply Pipelines and Booster Stations

A network of water supply pipelines and booster stations will be developed onsite to allow for the transportation of water to, from, and between, the different water infrastructure proposed onsite.

2.5.6 Emission Abatement

CFB boilers do not require post combustion emission abatement technology such as wet or dry Flue Gas Desulphurisation (FGD) and/or Selective Non-catalytic Reduction (SNCR) plants, such as PC boilers do for the removal of SO_2 and NO_x respectively. Limestone will be used as sorbent and will be injected directly into the CFB boiler to minimise the generation and release of SO_2 pollutants. Depending on the location of the source, limestone will be transported to site either by rail or road transport, where it will be stored in a limestone stockyard.

2.5.7 Flue Gas Cleaning

Flue gases emanating from the CFB boilers need to be cleaned of Particulate Matter (PM) prior to their release into the atmosphere. Final flue gas cleaning in the form of electrostatic precipitators is proposed for the project. Electrostatic precipitators apply a high-voltage electrostatic charge and collect the dust particles on charged plates.

2.5.8 Flue / Smoke Stack

Once cleaned flue gases are released into the atmosphere via a flue / smoke stack. The flue / smoke stack will be up to 150m in height, and will have a tip diameter of 7.5m. It is anticipated that gases being released from the flue / smoke stack will have an exit velocity of approximately 18m/s and an exit temperature of 135°C. Primary contaminants likely to be released from the flue / smoke stack include Particulate Matter (PM), SO_2, and NO_2. Release of contaminants via the flue / smoke stack and the design of the facility are required to comply with applicable legislated requirements.

2.5.9 Ash Disposal

Ash produced by the project will be disposed of on an ash dump to be developed onsite. The ash dump will be approximately 120ha in extent, and 10m in height. It is estimated that approximately 1 200 t/d of ash will be transferred daily. The ash dump has been designed to accommodate the total volume of ash and other by-products (i.e. gypsum and sludge) that will be generated throughout the project's operations. The ash dump will be suitably lined (in accordance with the requirements of GNR 636 published in terms of the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA)) to limit seepage and contamination of groundwater sources.

During operation ash will be collected and stored in a silo, before being transported via conveyors to the ash dump. Polluted run-off emanating from the ash-dump will be transported via drains to a recovered-water dam.

The ash dump will be rehabilitated on an ongoing basis, and wastewater generated onsite will be used for dust suppression activities on the ash dump.

2.5.10 Dry-Cooling (Air-Cooling) Technology

Due to water scarcity in the area, and based on the requirements of DWS, use will be made of dry-cooling technology. While dry-cooling methods are associated with lower efficiencies when compared to wet-cooling methods, they also have significantly lower water requirements (i.e. up to 15 times less than that of wet-cooling). The air-cooled condenser method (direct cooling with fans) will be utilised on site.

2.5.10.1 Air-cooled condenser

In the air cooled condenser method, the water cooled condenser is substituted by air-cooled, fin-type heat exchange surfaces arranged in close proximity to the steam turbine building. Air-cooled condensers use mechanical draft type cooling systems (fans), and are therefore associated with higher power consumption. Similarly to dry-cooling tower methods, cooling water for auxiliary cooling systems can be extracted from the main closed cooling water system.

2.6 Waste Management and Treatment

Waste treatment required for the Mutsho Power Project includes:

» Liquid waste storage and treatment
» Waste storage and separation
» Solid waste disposal

Table 2.7 provides an estimate of the quantities of waste likely to be produced by the project.

Table 2.7: Estimate of the quantities of waste produced by the proposed power station

Hazardous waste	Non-hazardous waste	Total waste handled (tonnes per day)
Ash and Gypsum		1 200
Coal stockyard and main plant area runoff		tbd
Ash dump runoff		tbd
Sewage		15
WWTP sludge		tbd – source water quality dependant
	Household and general waste	2
Spent filter bags		tbd

2.6.1 Zero Liquid Effluent Discharge Facility (ZLED)

The project will be developed and operated as a Zero Liquid Effluent Discharge (ZLED) facility. As a result, no wastewater or effluent generated by the project will be collected, removed or disposed of offsite. Wastewater and effluent generated by the project will be treated via an onsite wastewater treatment plant (WWTP). Treated wastewater will be used for ash wetting or dust suppression in the plant area. Any treated wastewater that cannot be used within the plant will be discharged to an evaporation pond to be established onsite. The evaporation pond will be sized appropriately to accommodate all treated wastewater and will be appropriately lined to limit seepage and contamination of groundwater resources.

2.6.2 *Sewage Treatment Plant*

During construction, all sewage waste will be collected by a contractor to be disposed of at a licensed waste disposal site. During operation, a sewage treatment plant comprising 2 x $5m^3/h$ buried sanitary sewage treatment systems will be provided for the treatment of sewage and grey water emanating from the toilets, showers, canteens, laundry, etc. The sanitary sewage will be treated by secondary biological contact oxidation process. Wastewater from the sewage treatment plant will be filtered, disinfected, and flow into the clean water basin where it can be reused for irrigation, or discharged into the onsite evaporation pond. The sewage sludge can be used as fertiliser in agriculture, or will alternatively be disposed of on the ash dump.

2.6.3 *Wastewater Treatment*

The following wastewater treatment systems are proposed for implementation.

2.6.3.1 Industrial Waste Water Treatment

Boiler blowdown would be disposed of to the WWTP as effluent for treatment and reclaim. The on-site industrial process waste water treatment system will include pH-adjustment, mechanical filters, mechanical clarifiers, flocculent chemical dosing, sludge thickeners, and filter presses. Clear, treated effluent, will be discharged to the on-site evaporation pond.

2.6.3.2 Oily Waste Water Treatment System

Waste water potentially containing lubricants, oil, grease etc., will be routed to the Oily Waste Water Treatment System. 1 x $5m^3/h$ oily waste water treatment system will be provided for the oily waste water in the main power house, transformer, and oil tank area. Oily waste water will be unoiled by means of oil-water separation. Once treated, waste water will be discharged into the industrial waste water treatment system for further treatment and reclaim, while the waste oil will be collected, and transported off-site by road to be disposed of at appropriately licensed facilities in accordance with applicable legislative requirements and standards.

2.6.3.3 Coal Waste Water Treatment System

Spray water and preparatory water from the coal storage yard and ash dump will be collected to the slurry pond, where it will be treated by two sets of coal water treatment equipment with a capacity of $15m^3/h$.

2.6.4 *Solid Wastes*

Hazardous and general (non-hazardous) solid wastes likely to be generated onsite include:

» Metallic wastes. This type of waste will be collected in bins for occasional collection from the site, to be sold to or removed by specialist contractors by road transport.
» Oils and cleaning chemicals. Waste oils and chemicals will be recycled by external contractors. Empty oil drums will be returned to suppliers for recycling or re-use.
» Miscellaneous waste. This includes paper, plastic, glass, cloth, etc., which will be collected and re-used wherever possible and once deemed waste, will be discarded as per relevant regulations.

During construction, waste will be collected at source and transported for storage at temporary or permanent storage facilities to be established onsite. Waste will be separated at source, and contained in appropriately labelled containers and storage facilities. Storage facilities will be appropriately designed with appropriate flooring / lining, covered (for protection from direct sunlight, wind and rain) if necessary, and bunded where required to contain accidental spills or leaks. Bulk waste containers (i.e. skips, bins, drums etc.) shall be appropriately labelled to show what class and type of waste can be disposed of within them. Containers shall be appropriately designed to store liquid, solid, hazardous, or non-hazardous waste. No mixing of liquid and solid wastes will occur onsite. Storage of all waste will be conducted in accordance with the requirements of the National Norms and Standards for the Storage of Waste promulgated in terms of the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA) and published in GNR 926.

Chemical waste will be collected and stored in a safe manner, separately from other wastes, in accordance with the requirements of GNR 926.

All wastes will be collected, and transported off-site by road to be disposed of at appropriately licensed facilities in accordance with applicable legislative requirements and standards.

Sludge generated during the operation of the project will be collected, and transported to the ash dump where it will be disposed of.

2.7 Electrical Infrastructure

A power supply will be required during both construction and operation. It is anticipated that electricity required to support the construction will initially be provided by the Musina Local Municipality. An HV Yard and substation components with HV overhead transmission lines are required to evacuate electricity generated by the project from the site. Electricity generated by the project will be fed into the national electricity grid at a point to be determined in consultation with Eskom. It is anticipated that the grid connection will be at 400kV, and will be via Eskom's Nzhelele Substation. The possibility exists that the project may make use of either the proposed 400kV Tabor-Nzhelele transmission line or the 400kV Borutho-Nzhelele transmission line upgrades, with the latter proposed to cross the Farm Vrienden 589. Should the Eskom upgrades not take place, an alternative power line directly to Tabor MTS may need be considered.

Once finalised, grid integration will be assessed through a separate application for Authorisation, and will include the establishment of a power line servitude between the Mutsho Power Project and grid connection point.

2.8 Associated Infrastructure

2.8.1 Critical Staff Accommodation

During construction between 120 and 150 critical staff will be housed onsite in temporary, purpose build living quarters. The critical staff accommodation area will occupy an area of land approximately 1.5ha in extent, and will be located adjacent to the temporary office buildings. The bulk of the workforce will be housed in the surrounding towns and communities through established venues and temporarily created living quarters as required.

In addition to critical staff accommodation an on-site clinic will be provided. The onsite clinic will be manned by emergency personnel, and emergency evacuation arrangements will be provided by a local service provider.

2.8.2 Office and maintenance area(s) and buildings

During construction temporary site offices, laydown and assembly areas, and a batching plant occupying a total area approximately 5ha in extent will be established onsite. Such facilities are required to support activities and personnel required during construction, and will be dismantled and removed from site once construction is complete.

Office and maintenance areas and buildings are required to support the day-to-day operation, and ongoing maintenance of the power station and its supporting infrastructure. These include facilities required to support onsite personnel, and are anticipated to include:

» Control room.
» Office / administration building.
» Workshop.
» Warehouse.
» Storage and logistics buildings.
» Guardhouse.
» Training building.
» Fire brigade station.
» Change houses and bathrooms.
» Security building.
» Medical/first aid station.
» Canteen.
» General waste and industrial waste storage area.

Security fencing and lighting, will be provided along the perimeter of the site. Access to the site will be controlled, and a guardhouse will be provided. The guardhouse will be established at the entrance to the facility along the main plant access road. The remaining office and maintenance building will be housed at the main plant area, adjacent to the power generation infrastructure.

2.9 Overview of the Detailed Design and Construction Phase

The detailed design and construction phase is expected to take approximately 4 to 5 years to complete. It is anticipated that the following activities would be included and form part of the detailed design and construction phase:

» Conducting onsite technical surveys, including:
    * Geotechnical surveys, hydrological surveys, logistics surveys, site surveys, surveys confirming the power station footprint, survey of the proposed substation/switchyard, and surveys of the proposed raw bulk water pipeline(s) and power line servitude (to be assessed under separate applications for authorisation).
» Obtaining additional licenses and permits required for the project.

- Coordinating with relevant regulatory departments and agencies regarding proposed construction activities.
- Upgrading access roads to the site, and establishment of an onsite road access network.
- Upgrading or establishment of a railway siding.
- Detailed design, procurement and fabrication activities.
- Site preparation activities, including:
  - Clearing of vegetation, stripping of topsoil (and associated stockpiling of topsoil for use in backfilling and / or spreading on site), conducting earthworks / terracing, and excavation for foundations.
- Early establishment of stormwater run-off dams to contribute towards onsite water management during the construction phase.
- Civil and structural works.
- Mechanical, piping, ducting, electrical, controls, and instrumentation works.
- Establishment of infrastructure such as office buildings, water supply pipelines, and power line.
- Establishment of the ash dump.
- Establishment of an onsite concrete batching plant. The proposed batching plant will have a capacity of 300 t/h.

As far as is practical and relevant disturbed areas will be rehabilitated as construction is completed within an area and construction equipment demobilised. All disturbed areas not required for operation will be fully rehabilitated following completion of construction.

2.10 Overview of the Operation Phase

Prior to the operation of the project, operational establishment, training, testing, and trials will be undertaken to ensure the complete operational readiness of the plant and Operations and Maintenance (O&M) personnel. The project has been designed for a 30-year life cycle, which is equivalent to the term of agreement contained in the Power Purchase Agreement (PPA) to be entered into between preferred bidders and Eskom under the CBIPPPP.

During its operations, the project will operate as a baseload power plant with an annual average availability of 90%. The project would therefore operate for 24 hours a day and 7 days a week, excluding periods of planned shutdown for maintenance purposes. Staff will work in shifts, with two to three shifts per day, starting at 00:00, 08:00, and 16:00 respectively; and approximately 80 to 100 personnel required per shift. A total of two buses will be utilised to transport personnel to site.

2.11 Overview of the Decommissioning and Rehabilitation Phase

Once the project has reached the end of its economic life (equivalent to a minimum of 30 years with the opportunity for extension or amendment up to 50 years), equipment will be decommissioned. Decommissioning activities will involve the disassembly of production units and ancillary infrastructure, the demolishing of buildings, the removal of hazardous waste, and the rehabilitation of the ash dump and project site. The following decommissioning activities are expected to occur:

- At the end of the project's life cycle, operational access roads are expected to be in good condition as a result of ongoing maintenance during operation, and therefore suitable for the transit of decommissioning equipment (i.e. heavy cranes, special trucks, etc.).

- Laydown areas will be prepared as required. In this regard vegetation may require stripping and topsoil may be stockpiled for use in rehabilitation.
- All waste materials will be removed for reuse, or disposal through authorised waste management service providers.
- All lubricants and chemical products stored at the site will be removed. These products may be sold or removed by an authorised waste management service provider for appropriate disposal.
- Reusable elements not classified as waste will be used.
- Concrete structures and buildings (including foundations) will be demolished and rubble will be disposed of at appropriate facilities, unless otherwise required for an alternative use in line with the decommissioning and closure plan.

Following decommissioning and removal of all project material from site, disturbed areas will be rehabilitated to a state reflective of anticipated future use. Where possible, rehabilitation will be conducted concurrently with decommissioning.

The following rehabilitation activities are expected to occur:

- The existing profiles of affected land will be improved and stabilised, thereby creating profiles that are compatible with the topography of the area.
- Ripping of compacted soils will be done prior to adding topsoil, which will be done by mechanical means. Topsoil and/or subsoil with which to facilitate rehabilitation will be moved and stockpiled during the construction phase of development. Where additional amounts of topsoil and/or subsoil are required, potential areas of land for the extraction of topsoil or subsoil will be identified.
- Vegetation will be re-established on site. Plant species used during site rehabilitation will as far as reasonably possible match those species naturally occurring in the area.

Following the completion of rehabilitation activities on site, a period of maintenance and aftercare will be required to ensure that the rehabilitation measures were successful.

The following aftercare and maintenance activities are expected to occur:

- Control and removal of alien/invasive species.
- Replacement of unhealthy plants and altering vegetation composition.
- Implementation of erosion controls (if required).
- Support irrigation (if required).

CHAPTER 3 CONSIDERATION OF ALTERNATIVES

This Chapter provides an overview of the various alternatives considered for the Mutsho Power Project as part of the EIA Process.

3.1 Alternatives Considered during the EIA Process

In accordance with the requirements of Appendix 3 of the 2014 Environmental Impact Assessment (EIA) Regulations (GNR 326), an EIA Report must contain a consideration of alternatives including site (i.e. development footprint), activity, technology and site access alternatives, as well as the "do-nothing" alternatives.

Most guidelines use terms such as "reasonable", "practicable", "feasible" or "viable" to define the range of alternatives that should be considered. Essentially there are two types of alternatives:

» Fundamentally (totally) different alternatives to the project.
» Incrementally different (modifications) alternatives to the project.

In this instance, 'the project' refers to a 600MW coal-fired power station project proposed to be developed by an Independent Power Producer (IPP) for baseload power supply.

3.1.1 Consideration of Fundamentally Different Alternatives

Fundamentally different alternatives are usually assessed at a strategic level, and as a result project-specific EIAs are therefore limited in scope and ability to address fundamentally different alternatives. At a strategic level, electricity generating alternatives have been addressed as part of the Department of Energy's (DoE's) current National Integrated Resource Plan for Electricity 2010 – 2030 (IRP)[5], and will continue to be addressed as part of future revisions thereto. With regards to the current IRP[6], the need for baseload power generation from coal as part of the technology mix for power generation in the country up until 2030 has been identified. This requirement has been reiterated in the updated IRP which was released for public comment in 2017. As intermittent energy generation technologies, Renewable Energy (RE) alternatives do not currently offer a baseload solution to South Africa's energy requirements and are therefore not presented as an option in this regard. A baseload plant as defined in the IRP refers to an energy plant or power station that is able to produce energy at a constant, or near constant, rate, i.e. power stations with high capacity factors (IRP 2010).

Baseload energy generation capacity identified in the Baseload IPP Procurement Programme determination made under Section 34(1) of the Electricity Regulation Act (No. 04 of 2006) (ERA) and the Electricity Regulations on New Generation Capacity (GNR 399) identified the following baseload generation capacities as being required under their respective Baseload IPP Procurement Programmes:

[5] The Integrated Resource Plan (IRP) is legislated policy which regulates power generation planning.
[6] Note that although an updated IRP has been published for comment, it has not been finalised or promulgated. Therefore, the current IRP is IRP 2010-2030.

» **Coal** – Baseload energy generation capacity is needed to contribute towards energy security including 2 500MW to be generated from coal (PF, FBC, Imports), which is in accordance with the capacity allocated to coal under "New Build" for the years 2014 – 2024 (Table 3 of the IRP 2010).
» **Gas** – Baseload and/or mid-merit energy generation capacity is needed to contribute towards energy security, including 3 126MW[7] to be generated from gas which represents the capacity allocated to "Gas CCGT (natural gas)" and "OCGT (diesel)", under the heading "New Build" for the years 2019 – 2025.
» **Hydro** – Baseload energy generation capacity is needed to contribute towards energy security including 2 609MW to be generated from hydro energy sources which represents the capacity allocated to "Imported Hydro" under the heading "New Build" for the years 2022 – 2024.

While alternative sources of baseload generation capacity in the form of natural gas and hydro are available under their respective proposed Baseload IPP Procurement Programmes (as detailed above), neither of these technologies are considered feasible alternatives for the project at the identified site. The LNG to Power IPPPP provides for the development of a 2 000MW plant at the Port of Richards Bay, and a 1 000MW plant at the Port of Ngqura. Availability of LNG is also a limiting factor in this regard. Similarly the lack of any viable hydro sources within the vicinity of the project exclude the possibility of utilising hydro power as an alternative baseload energy generation source at the proposed location. The timing associated with the different Baseload IPP Procurement Programmes also presents a limiting factor. While new build electricity generation from coal is required in the immediate future (2014 – 2024), gas and hydro are only required in the medium-term (i.e. 2021 – 2025 and 2022 – 2024 respectively) (DoE, Baseload IPP Procurement Programme, GNR 1075).

In terms of the type of technology available for consideration for new coal-fired power stations, the IRP 2010 – 2030 makes specific reference to pulverised coal and fluidised bed technology. In addition, the Technical Qualification Criteria which formed part of the Request for Proposal (RFP) issued for the Bid Window 1 of the CBIPPPP clearly stipulate that the power generation equipment to be used by bidders must be based on thermal steam units and the boiler must be of the pulverised coal or fluidised bed type. While the possibility exists that the Technical Qualification Criteria may differ in the RFP to be issued for Bid Window 2, it is unlikely that any other technology will be included for coal baseload. Mutsho Power therefore proposes the development of a coal-fired power station in response to DoE's CBIPPPP, and have not considered any alternative power generation options for the project.

3.1.2 Consideration of Incrementally Different Alternatives

Incrementally different alternatives relate specifically to the project under investigation. "Alternatives", in relation to a proposed activity, means different ways of meeting the general purposes and requirements of the activity, which may include alternatives to:

» The property on which, or location where the activity is proposed to be undertaken,
» The type of activity to be undertaken,
» The design or layout of the activity,
» The technology to be used in the activity, and/or
» The operational aspects of the activity.

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7 Amended from 2 652MW to 3 126MW by GNR 732 published under section 34(1) of the ERA and the Electricity Regulations on New Generation Capacity (GNR 399).

In addition, the option of not implementing the activity (i.e. the "do-nothing" alternative) must also be considered.

Incrementally different alternatives which have been assessed as part of the EIA process are discussed in more detail below.

3.1.2.1 Property or Location Alternatives

The Farm Landbou 171 MS and Antonvilla 7 MT, located approximately 15km north-west and 2km north-east of Musina respectively, were originally identified by Mutsho Power Company (Pty) Ltd as the proposed sites for the development of a 600MW coal-fired power station. However based on comments received following the project announcement, as well as sensitivities associated with developing the project in proximity of the Mapungubwe UNESCO World Heritage Site and site-specific sensitivities identified though initial specialist studies, a decision was taken to place the EIA process on hold, pending a review of the proposed project locality.

A Site Screening Assessment was undertaken for the project in March 2017, with the objective being to:

» Undertake a site screening assessment process within a larger area within which coal resources were known to occur in order to identify and evaluate potential environmental issues of concern within identified areas for the potential development of a coal-fired power plant, and identify any potential red flags or environmental risks.
» Identify and assess sites for the establishment of a coal-fired power plant considering environmental constraints and sensitivities.
» Make recommendations regarding the most preferred site(s) from an environmental perspective which could become the subject of further detailed investigation.
» Provide the basis for a motivation for not assessing site alternatives in detail during any subsequent EIA processes.

The primary factor which has influence on the development of a new coal-fired power station is the availability of a viable coal resource. As minority shareholders of Mutsho Power, MCM constitutes the primary fuel supplier for the project. The location of coal resources and its associated transport considerations therefore played a significant role in determining the broader regional area within which a coal-fired power project may be developed. Following the identification of MCM's Makhado Colliery as the primary fuel source, an area approximately 135 000ha in extent was identified as the broader study area. The broader study area stretched from Musina in the north to Makhado in the south; and was bordered by Mopane and elevated terrain to the north; the Nzhelele Dam and elevated terrain to the east; the Soutpansberg's elevated terrain to the south; and the Sand River to the west (ILEnergy, 2016).

The broader study area was assessed at a high level using a number of initial limiting factors, including:

» Availability and accessibility of sufficient developable land (i.e. 1 000ha).
» Distance from the railway loop proposed between Makhado Colliery and the Huntleigh siding.
» Proximity to local communities and sensitive receptors such as schools, dwellings, etc.
» Proximity to existing private tourism facilities (such as high-end hunting reserves).
» Topography of the area (i.e. no areas exceeding gradients of 2%).
» Proximity to local airfields and controlled air spaces.

» Location of mineable coal reserves (required to be avoided in terms of Section 53 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA)).

Following an assessment of the broader study area against initial limiting factors, a total of 4 Focus Areas were identified for further, more detailed assessment. A risk assessment approach was utilised to highlight potential environmental issues of concern which could then be used to identify preferred sites for further assessment as part of an EIA process. The assessment was informed by desktop review of available information, sensitivity mapping, and Ecological and Heritage specialist screening studies.

A Criteria-Based analysis of the 4 main Focus Areas was undertaken to identify environmental sensitivities which would affect the selection of a preferred site.

Based on the outcomes of the high level criteria based screening, the farms comprising Focus Area 4 (i.e. Japie 574, Burton 574, Oom Jan 579, Groot Endaba 581 and Oom Jan 586) were identified as potentially having the fewest environmental issues. However, given the distance between these sites and both the Makhado Colliery, and proposed railway loop, it was concluded that the development of a coal-fired power station at any of these sites would result in additional potentially significant environmental impacts being incurred as a result of the additional infrastructure required; and the significant distances such infrastructure would be required to cover in order to transport coal to site. As a result these sites were considered to be undesirable from an environmental and technical perspective. In terms of the remaining sites (i.e. the farms comprising Focus Areas 1, 2, and 3), the high level ranking determined the following as most favourable:

1. **Lina 595** – This site had the fewest constraints from an environmental perspective as identified at desktop level. However, given the distance from the proposed railway loop, potentially significant environmental impacts may be expected with regards to the transportation of coal to site.
2. **Honeymoon 630** – The southern portion of Honeymoon 630 was considered favourable as it represented an unfragmented area largely free from environmental constraints. A number of drainage lines in the northern portion of the site rendered this area unfavourable, which in turn limited the extent of land available for development.
3. **Somme 611** – While the majority of the site was relatively free from environmental constraints, a wetland area and drainage line in the centre of the site has the potential to limit the extent of land available for development and increases the risks of potential impacts on water resources associated with the proposed project.
4. **Du Toit 563 and Vrienden 589** – Both sites are considered to have similar constraints to one another. The areas preferred for development on both sites are those located closest to the existing and proposed railway lines.
5. **Battle 585** – A large portion of this site is classified as CBA 2 which could limit the area of land available for development depending on the condition and sensitivity of the vegetation on the site.
6. **Van der Bijl 528** – This site is characterised by issues of a social and heritage nature, and is therefore considered least preferred.

Considering the above as well as technical aspects, the following 3 properties were identified as being potentially most suited to the development of a coal-fired power station project:

» Vrienden 589
» Battle 585
» Du Toit 563

The abovementioned three sites were therefore taken forward into the more detailed site screening study. Given the nature of the project, the development of a new coal-fired power station would result in potentially significant environmental impacts irrespective of its location. The purpose of the environmental site screening assessment was therefore to assess an area of land to determine any potential red flags or fatal flaws, prior to the initiation of an EIA process. The area under investigation comprises rural undeveloped land. No large urban, residential or industrial areas occur within proximity of the sites. Each of the three sites were therefore considered uniform in terms of any positive impacts or benefits which may have been expected to accrue as a result of siting the project within an already disturbed, previously transformed or developed industrial area.

Similarly the close proximity of the sites to one another infers that the majority of broad scale environmental impacts can be expected to be largely uniform across them, specifically with regards to:

» Impacts associated with a change in land use and characteristics of the area.
» Impacts associated with the transportation of coal to site.
» Impacts associated with access to the electricity grid.
» Air quality impacts.
» Impacts associated with water availability and supply.
» Impacts associated with ash storage and disposal.
» Impacts associated with waste and effluent.
» Other impacts predicted on the baseline environment (i.e. with regards to air, water, noise etc.).

Site-specific impacts such as those associated with ecology or heritage, could however differ between sites. Therefore, the 3 identified sites were subjected to more detailed ecological and heritage screening studies, which included field surveys, and verification of desk-top information. Following these specialist investigations, it was concluded that none of the sites investigated were considered to be fatally flawed from an ecological, biodiversity, avifaunal or heritage/archaeological attribute perspective. However the sites exhibited varying levels of sensitivity towards development.

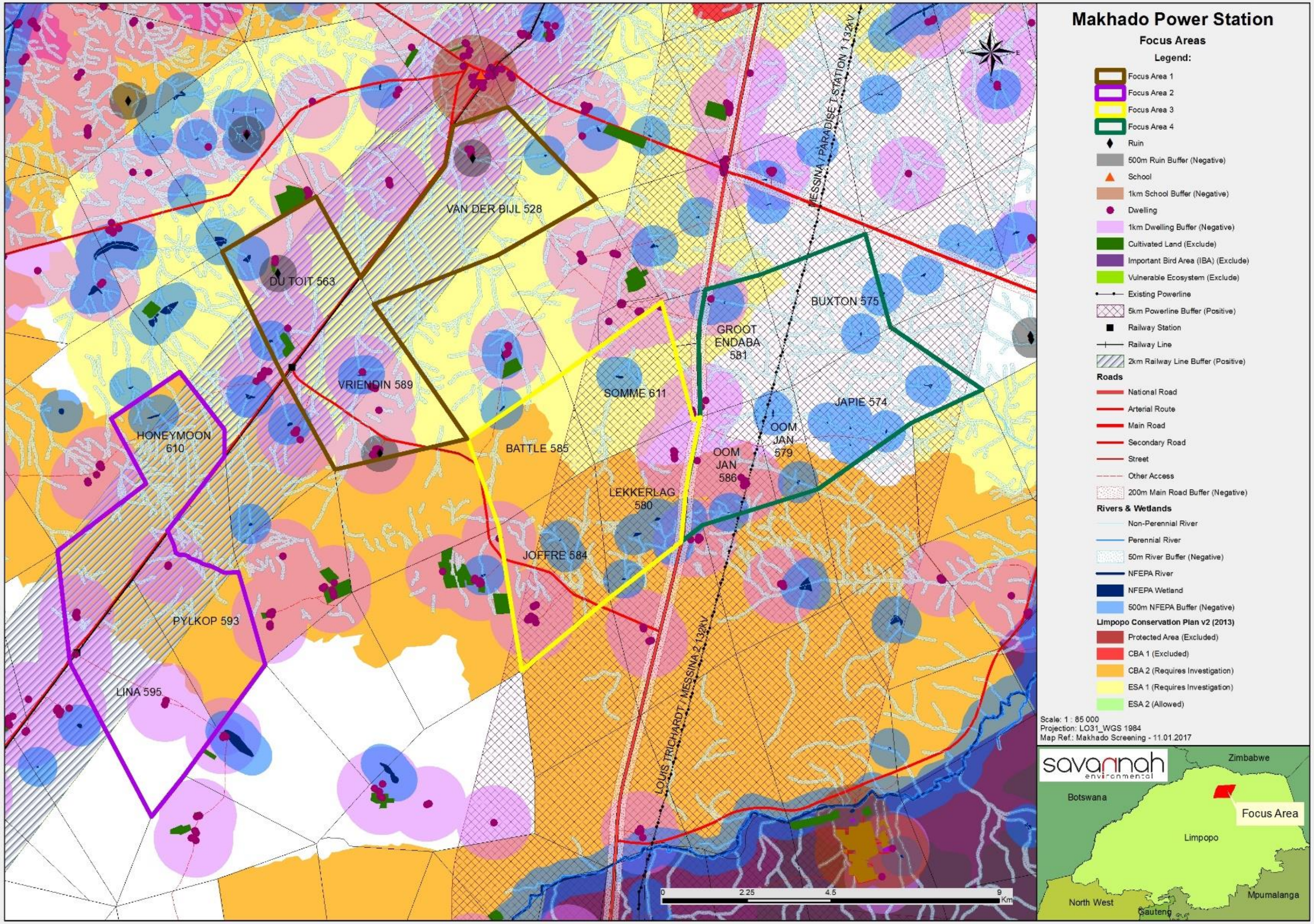

Figure 3.1: Outcomes of Desktop Environmental Sensitivity Screening.

It is significant to note that the majority of the property Battle 585 falls within an area categorised under the Limpopo Conservation Plan (LCP v2) as a Critical Biodiversity Area 2 (CBA 2) area, which presented a risk that the site will be considered unsuitable for development from an environmental authorisation perspective. While the LCP v2 states that the opportunity exists for certain elements of activities to be permitted within CBA 2 areas subject to detailed impact assessment, loss of natural habitat in these areas should be minimised and the requirements of threatened species should be taken into account when developing new infrastructure. The recommendation was therefore made that the Farm Battle 585 be excluded from further consideration, while the Farm Vrienden 589 be considered more preferable, and the Farm Du Toit 563 less preferable for further investigation as part of a site-specific EIA process (refer to **Table 3.1**).

Table 3.1: Overview of Environmental Consultant Recommendations.

Farm Name	Ecology	Avifauna	Heritage/Archaeology	Recommendation
Du Toit 563	2	2	2	Less preferred
Vrienden 589	1	1	1	More preferred
Battle 585				Least preferred

Following the completion of the Environmental Site Screening Assessment, the decision was taken for an EIA process to be initiated on the Farms Du Toit 563 and Vrienden 589. As a result, no further site alternatives have been assessed within this EIA process for the location of the Mutsho Power Project as alternatives were comprehensively considered in the Site Screening Assessment.

3.1.2.2 Design and Layout Alternatives

Given the size of the preferred project site under investigation (i.e. approximately 2 161ha) and the size of the development footprint required for the project (i.e. approximately 350ha) it is anticipated that the proposed project and its associated infrastructure can be appropriately positioned within the larger project site in a manner which avoids any areas of environmental sensitivity identified during the scoping process (refer to **Figure 3.1**). The development footprint would occupy an area of land equivalent to approximately 16% of the total project site. The extent of the site therefore allowed for the identification of layout design and site-specific alternatives. Following the completion of the Scoping Phase, and based on the outcomes of the site sensitivity assessment, a number of layout alternatives were identified for further investigation occupying the six areas (individually or in combination), as shown in **Figure 3**.2.

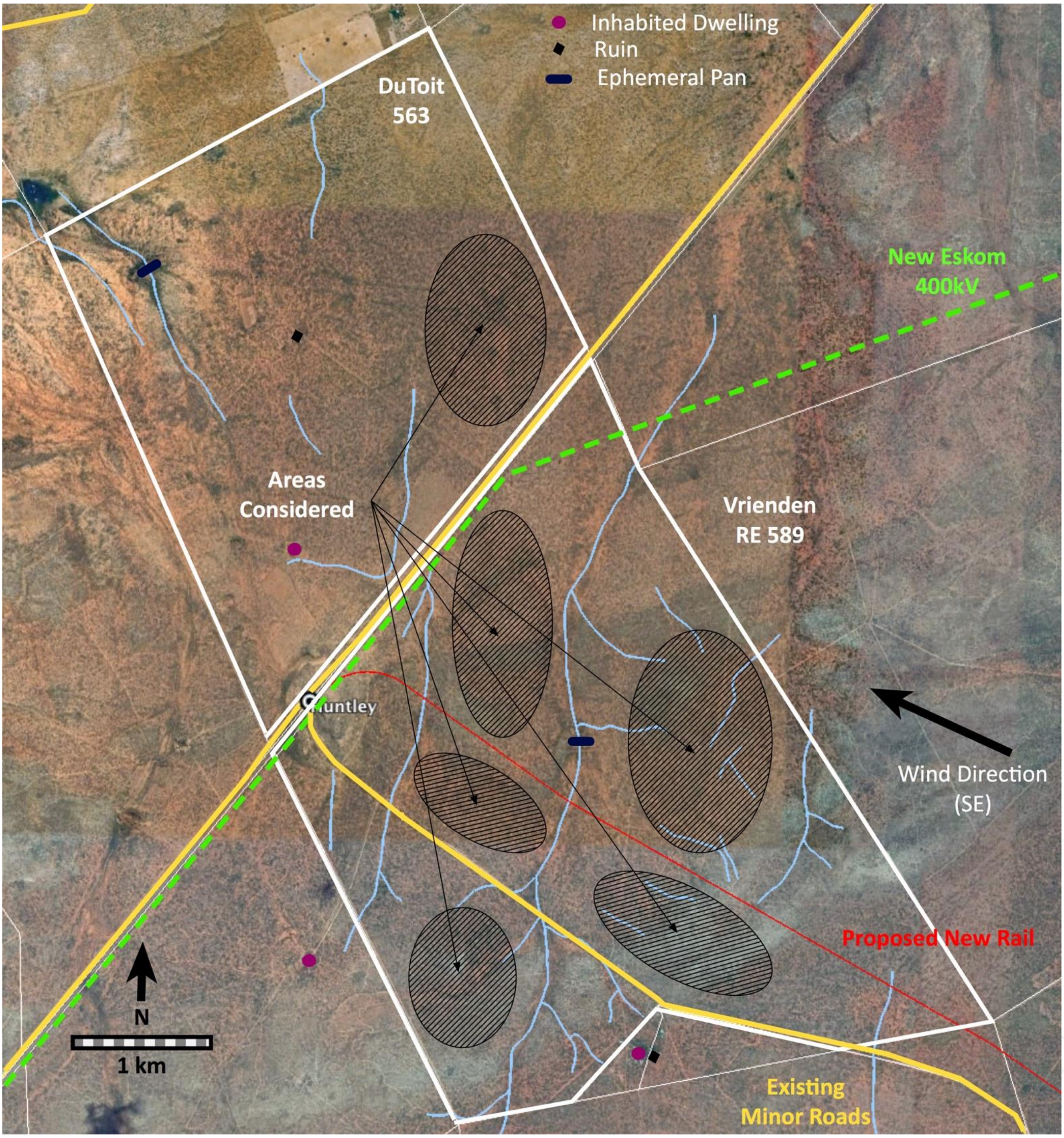

Figure 3.2: Areas within the project site considered feasible for development.

However several of the layouts were abandoned based on technical (such as existing rail and road access, topography, prevailing wind direction and proximity to future Eskom infrastructure etc.), environmental (such as NFEPA buffers, occupied dwellings, ruins etc.) and/or financial feasibility. Those layout alternatives which are deemed to be feasible from a technical and financial perspective and which have been considered as part of the EIA process are described in further detail below.

Preferred Layout Alternative

The Preferred Layout Alternative entails the placement of the Mutsho Power Project, in its entirety, on the Farm Vrienden 589 (refer to **Figure 3**.3). The power plant and raw water storage dam are both proposed south of the proposed railway line, while the ash dump and ash dump runoff dam are proposed north of the proposed railway line. Based on the desk-top analysis of this proposed layout, this alternative is considered to be most favourable from an environmental perspective as it is perceived to pose the least environmental impacts or risks. The location of the ash dump and ash dump run-off dam away from prominent drainage lines reduces the potential risk of contamination.

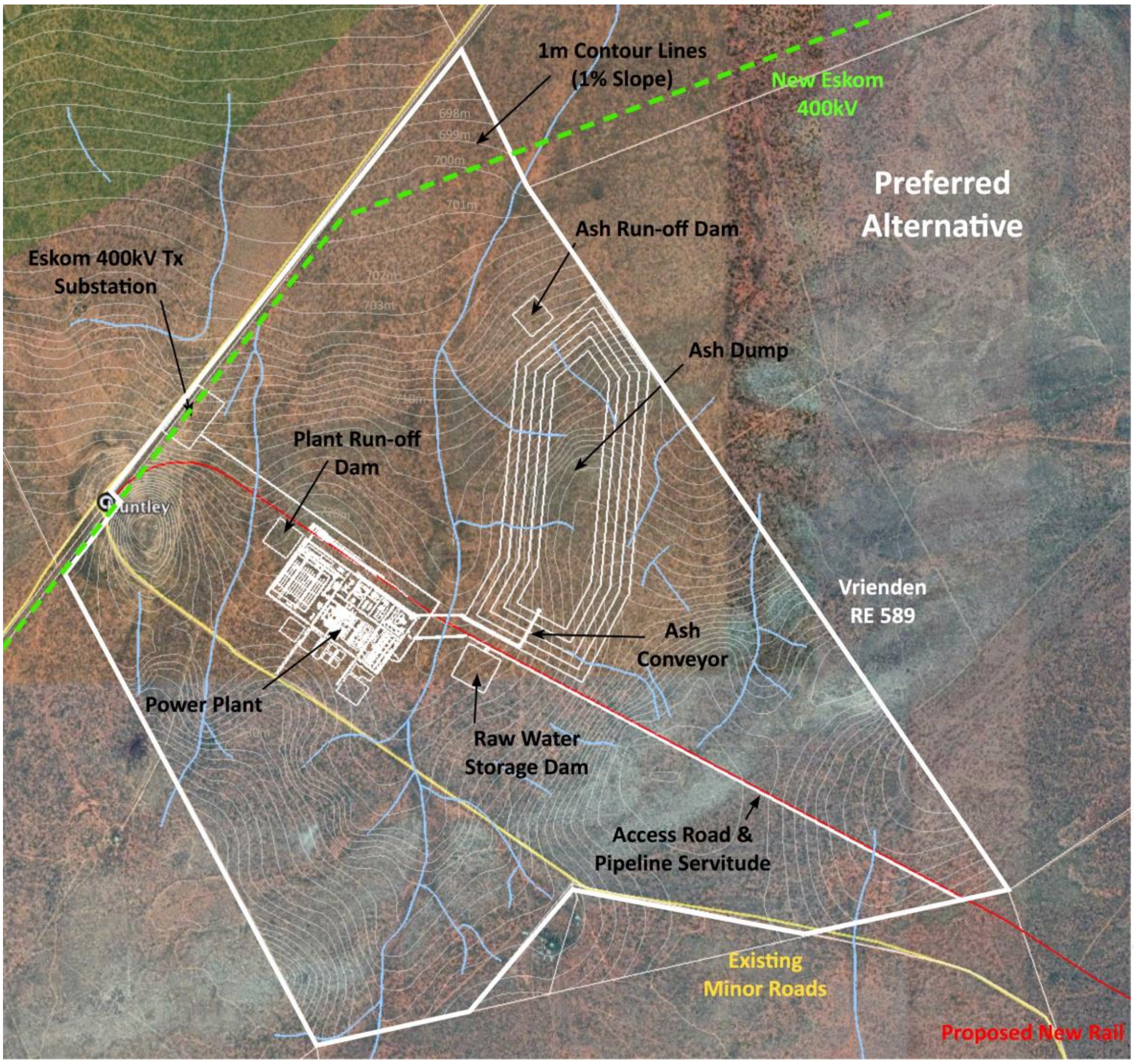

Figure 3.3: Preferred Layout Alternative.

Layout Alternative A

Layout Alternative A entails the development of the majority of project related infrastructure on the Farm Vrienden 589, with the remaining infrastructure proposed on the eastern extent of the Farm Du Toit 563 (refer to **Figure 3**.4). The proposed power plant, transmission substation, and raw water storage dam are all proposed for development north of the proposed railway line on Farm Vrienden 589. The ash dump has been split into two portions, each 60ha in extent. One portion will be developed in the northern extent of the Farm Vrienden 589, while the second portion will be developed in the eastern extent of the Farm Du Toit 563. The ash dump run-off dam will be developed between the two ash dumps at the project site's lowest elevation. Such a layout alternative is considered less favourable from a technical perspective than the preferred layout alternative, as the project would be required to straddle existing infrastructure, such as the railway line which occurs between Farm Du Toit 563 and Farm Vrienden 589. Given the location of the ash dumps, the ash conveyor required to transport ash generated by the power plant to the ash dump would be routed underneath Eskom's proposed 400kV power line. In addition, Layout Alternative A entails the development of the two ash dumps and an ash dump run-off dam between and within close proximity to prominent drainage lines, which is less favourable from an environmental perspective as it increases the potential risk for contamination.

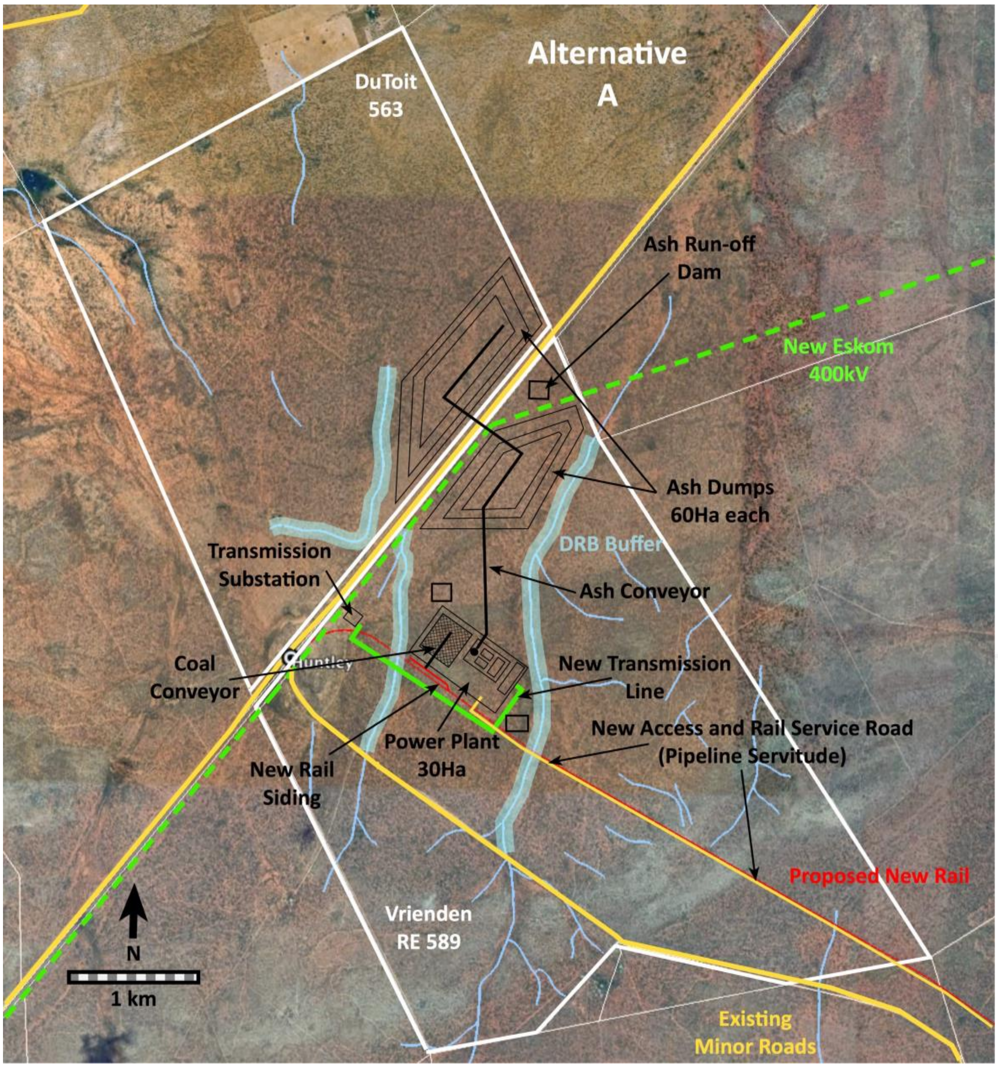

Figure 3.4: Second Preferred Layout Alternative.

Layout Alternative B

Layout Alternative B entails the development of all infrastructure on the Farm Vrienden 589 (refer to **Figure 3**.5). The power plant is proposed for development south of the proposed railway line, while a single ash dump and ash dump run-off dam is proposed for development north of the proposed railway line, between two prominent drainage lines. This layout alternative has a possible concern from an environmental perspective given the proximity of the ash dump and ash dump run-off dam to the drainage lines, and the potential risk for contamination, which will be further assessed in this report.

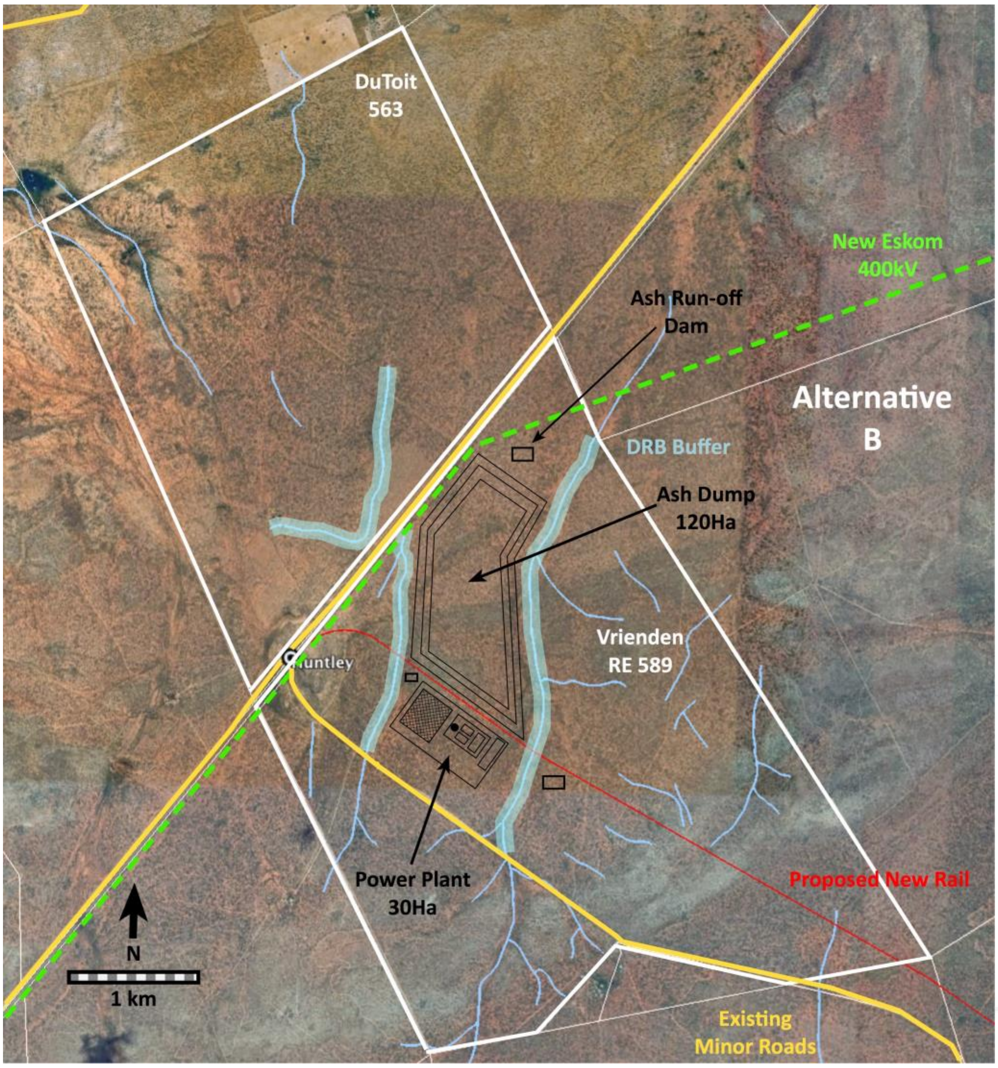

Figure 3.5: Layout Alternative B.

Each of the abovementioned layout alternatives have been assessed as part of the EIA process (refer to **Chapter 8**), to ensure that that layout which is ultimately proposed for development is both preferable, and feasible from an environmental, technical, and economic perspective.

3.1.2.3 Technology Alternatives

An overview of the technology alternatives which were assessed during the Scoping Phase; and those technology alternatives which are excluded from consideration is provided in **Table 3.2**.

Table 3.2: Overview of possible Technology Alternatives.

	Excluded from Consideration	Alternatives Assessed
Power Generation Units		» Pulverised Coal (PC) (with FGD) » Circulating Fluidised Bed (CFB)
Steam Cycle Generation	» Subcritical	» Supercritical (SC) » Ultra-Supercritical (USC)
Cooling Systems	» Wet cooling	» Dry cooling ∗ Dry cooling tower ∗ Air cooled condenser
Ash Disposal Methods	» Wet ashing	» Dry ashing
Flue Gas Cleaning (for PM specifically)		» Flue Gas Cleaning ∗ Bag filters ∗ Electrostatic Precipitators

Only those alternatives which are considered to be more beneficial in terms of reduced emissions, waste generation, and water usage will be considered for implementation. It is therefore proposed that the Mutsho Power Project will utilise Supercritical (SC) Circulating Fluidised Bed (CFB) boiler technology, dry-cooling methods; as well as dry ash disposal methods.

Boiler Technologies:

Whereas both key boiler technologies (i.e. Pulverised Coal (PC) (with Flue Gas Desulphurisation (FGD) and Circulating Fluidised Bed (CFB)) were considered during the Scoping Phase, Mutsho Power have since elected to make use of CFB boiler technology. The reasons for the decision can be summarised as follows:

» CFB technology is able to utilise a wider range of fuels and also has greater flexibility with regards to fuel quality. Such a specification provides the opportunity for alternative fuel sources (such as biomass and waste, amongst others) to be utilised in the energy generation process, as opposed to just coal. The possibility of such a future scenario occurring (i.e. IPPs being permitted to burn alternative fuels within their power stations) would however be dependent on DoE's strategic planning and policy interventions.
» CFB technology has greater flexibility in the quality of limestone which can be utilised as sorbent. This is beneficial with regards to greater ease of access to limestone supply which is of acceptable quality for use in the plant.
» CFB technology does not require any additional screening plants or equipment which would contribute to the project's overall energy consumption.
» CFB boilers are typically associated with lower SO_2 and NO_x emissions when compared to PC boilers. The injection of limestone as sorbent, and the lower temperatures at which coal is combusted in a CFB boiler negates the need for additional emission abatement technology, such a wet or dry Flue Gas Desulphurisation (FGD) plant to remove SO_2; and Selective Non-Catalytic Reduction (SNCR) plant to remove NO_x from emissions. In addition, FGD plants increase a projects bulk water requirements and produce slurry which requires disposal (typically to the ash dump); while SNCR plants require that ammonia be stored on site for use in the plant.
» CFB technology is typically associated with significantly lower water requirements than PC technology, which has increased water requirements for use in wet FGD plants required for the removal of SO_2.

Steam Cycles:

Supercritical (SC) and Ultra-supercritical (USC) steam cycle technology was considered for implementation for the project. The higher the pressure at which steam is produced within a boiler, the higher the overall efficiency achieved. SC and USC steam cycles significantly increase the combustion efficiency of a boiler when compared to subcritical steam cycles, which results in lower fuel consumption, and fewer ash and flue gas emissions. In addition, CO_2 emissions are generally reduced by 2% to 3% with each percentage point improvement in efficiency.

SC steam cycle technology has been selected for implementation for the proposed project. While USC steam cycle technology is associated with higher pressures and fewer emissions than SC steam cycles, SC technology was selected due to the high capital costs associated with USC, and the fact that USC CFB technology does not satisfy the commercially proven requirements as specified in Round 1 of the CBIPPPP and hence cannot be considered as a commercially and technically viable option. SC steam cycles are however more beneficial than subcritical steam cycles, which are currently utilised in the majority of South Africa's existing coal-fired power stations.

Cooling Systems:
Conventional cooling systems available for implementation in combustion power stations include wet-cooling; or direct, or indirect, dry-cooling systems. Wet-cooling systems are the conventional cooling system used worldwide, and are considered to be the more efficient cooling method. Wet-cooling systems make use of condensers, cooling water and cooling towers. Cooling water flows through thousands of condenser tubes, with the steam on the outside. As a result of the temperature difference between the water and steam, condensation occurs. The warmed cooling water then flows to a cooling tower where an upward draft of cold air removes the heat from the water. After cooling, this water returns to the condenser. A substantial amount of water (i.e. up to 85% of the bulk raw water supply) is lost as a result of evaporation in wet cooling systems.

Dry cooling systems utilise approximately 15 times less water than wet cooling systems, and are therefore the favoured technology for implementation in water-stressed environments such as that in which the Mutsho Power Project is proposed to be developed. In order to minimise the proposed project's bulk water requirements, only dry-cooling systems have been considered for implementation. This is also in accordance with the DoE's Draft Integrated Energy Plan (IEP) (2016), and the requirements of DWS. Two dry-cooling methods were considered for the project, namely the dry-cooling tower method (indirect cooling), and air-cooled condenser method (direct cooling with fans). The air-cooled condenser method (direct cooling with fans has been selected for implementation for the proposed project.

Flue Gas Cleaning:
Flue gas cleaning is required to remove residual chemicals and Particulate Matter (PM) from flue gases prior to their release to the atmosphere. Flue gas treatment technology considered for the project includes utilising baghouses or electrostatic precipitators. Baghouses remove suspended dust particles from a gas by means of filtration, using long, cylindrical bags (or tubes) made of fabric; whereas electrostatic precipitators apply a high-voltage electrostatic charge and collect the dust particles on charged plates. Electrostatic precipitators have been selected for implementation for the proposed project.

3.1.3 The "Do-Nothing" Alternative

The "do-nothing" alternative is the option of not constructing the Mutsho Power Project. Should this alternative be selected, any potential negative impacts or positive benefits associated with the project will not be realised. Potential impacts and benefits likely to be associated with the development of the project, including an assessment of the "do-nothing" alternative have been assessed in **Chapter 10** of this EIA Report.

CHAPTER 4 POLICY AND LEGISLATIVE CONTEXT

This Chapter provides an overview of the policy and legislative context within which the Mutsho Power Project is proposed. It identifies legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments which may be applicable or have relevance to the proposed project and which have been considered in the assessment process.

4.1 Strategic Electricity Planning in South Africa

The need to expand electricity generation capacity in South Africa is based on national policy and is informed by ongoing strategic planning undertaken by the Department of Energy (DoE). The hierarchy of policy and planning documentation that supports the development of Independent Power Producer (IPP) projects is illustrated in **Figure 4**.1. These policies are discussed in more detail in the following sections, along with provincial and local policies or plans that have relevance to the development of the proposed project.

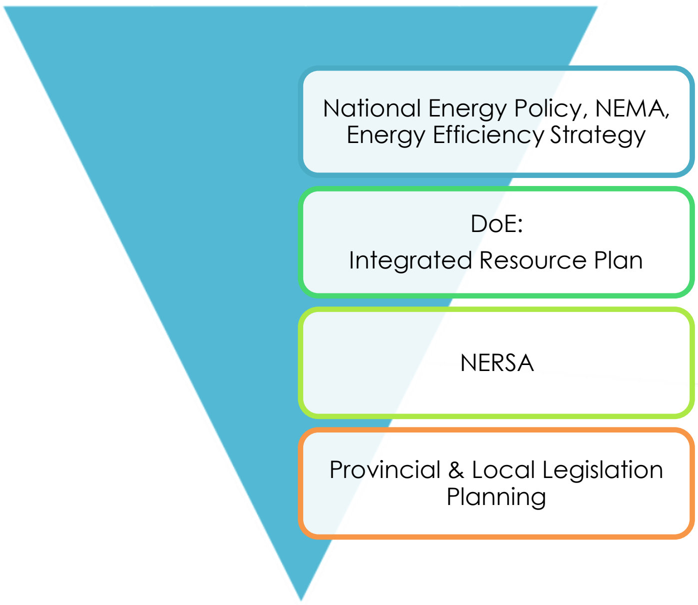

Figure 4.1: Hierarchy of Electricity Policy and Planning Documentation.

4.2 Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP)

The development of coal-fired power stations by IPPs is currently being undertaken through the Coal Baseload IPP Procurement Programme (CBIPPPP) being implemented by the DoE. This programme aims to procure 2 500MW of electricity from IPP developed coal-fired power stations with individual bids capped at 600MW per project. The programme is designed to contribute towards socio-economic development and sustainable growth, and to start and stimulate the participation of IPPs in the Baseload Energy generation capacity industry in South Africa. This programme will procure coal fired power generation technology that include boilers of the pulverised coal or fluidised bed type. The power generated from this programme must be new generation capacity, as defined in the New Gen Regulations. For the purposes of this programme, the refurbishment of existing coal-fired power generation units will not be considered as new generation capacity.

IPPs undergo a bidding process in which the DoE determines preferred bidders based on the satisfaction of a number of qualification criteria. A preferred bidder will be held to compliance with the price and economic development proposals in its bid, with regular reporting to demonstrate compliance during the life of the project. A first round of this programme has already been completed and culminated in the selection of 2 Preferred Bidder projects which are currently working towards Financial Close. It is expected that a second Procurement Round will be held once these projects have been concluded.

4.3 Regulatory Hierarchy

The regulatory hierarchy for energy generation projects consists of three tiers of authorities who exercise control through both statutory and non-statutory instruments, namely National, Provincial and Local levels.

At **National Level**, the main regulatory agencies are:

» **Department of Energy (DoE):** This Department is responsible for policy relating to all energy forms, and is responsible for compiling and approving the Integrated Resource Plan (IRP) for Electricity.
» **National Energy Regulator of South Africa (NERSA):** This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for IPP projects to generate electricity.
» **Department of Environmental Affairs (DEA):** This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the 2014 EIA Regulations (GNR 326). The DEA is the competent authority for this project (as per GNR 779 of 01 July 2016), and is charged with granting the relevant Environmental Authorisation (EA) and Waste Management License (WML) for the project. DEA is also the Atmospheric Emissions Licensing Authority (AELA) responsible for issuing an Atmospheric Emissions License (AEL).
» **South African Heritage Resources Agency (SAHRA):** SAHRA is a statutory organisation established under the National Heritage Resources Act (No. 25 of 1999) (NHRA), as the national administrative body responsible for the protection of South Africa's cultural heritage.
» **South African National Roads Agency Limited (SANRAL):** This Agency is responsible for the regulation and maintenance of all national roads and routes.
» **Department of Water and Sanitation (DWS):** This Department is responsible for effective and efficient water resources management to ensure sustainable economic and social development. DWS is also responsible for evaluating and issuing licenses pertaining to water use (i.e. Integrated Water Use Licenses (IWULs)).
» **Department of Agriculture, Forestry and Fisheries (DAFF):** This Department is the custodian of South Africa's agricultural, forestry, and fishery resources and is primarily responsible for the formulation and implementation of policies governing the Agriculture, Forestry and Fisheries Sector. DAFF is also responsible for the issuing of permits for the disturbance or destruction of protected tree species.
» **Department of Mineral Resources (DMR):** Approval from the DMR will be required to use land surface contrary to the objects of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) in terms of Section 53 of the Act. In terms of the MPRDA approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that may occur on site.
» **Department of Rural Development and Land Reform (DRDLR):** This Department is dedicated to the social and economic development of rural South Africa, and is responsible for providing a framework for rural development. The Comprehensive Rural Development Programme (CRDP) is government's plan for developing rural areas and is aimed specifically at alleviating poverty through the creation of equitable

and sustainable rural communities. One of the most important strategic objectives of the CRDP relates to Agrarian Transformation.

At **Provincial Level**, the main regulatory agencies are:

- **Limpopo Department of Economic Development, Environment, and Tourism (LDEDT):** LDEDET is the commenting authority for the project, and is also responsible for issuing any biodiversity and conservation-related permits. LDEDET's involvement relates specifically to sustainable resource management and land care.
- **Limpopo Department of Public Works, Roads and Infrastructure:** This Department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
- **Limpopo Provincial Heritage Resources Authority (LIHRA):** The LIHRA is responsible for the identification, conservation and management of heritage resources, as well as commenting on heritage related issues within the Province.

At **Local Level** the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. The project is proposed in the **Musina Local Municipality**, and **Vhembe District Municipality**.

4.4 National Policy

4.4.1 The National Energy Act (No. 34 of 2008)

The purpose of the National Energy Act (No. 34 of 2008) is to ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, while taking into account environmental management requirements and interactions amongst economic sectors. The National Energy Act also provides for energy planning, increased generation and consumption of renewable energies, contingency energy supply, holding of strategic energy feedstocks and carriers, adequate investment in, appropriate upkeep and access to energy infrastructure. The Act provides measures for the furnishing of certain data and information regarding energy demand, supply and generation, and for establishing an institution to be responsible for promotion of efficient generation and consumption of energy and energy research.

The Act provides the legal framework which supports the development of power generation facilities.

4.4.2 White Paper on the Energy Policy of South Africa, 1998

The South African Energy Policy, published by the Department of Minerals and Energy (DME) in December 1998 identifies five key objectives, namely:

- Increasing access to affordable energy services.
- Improving energy sector governance.
- Stimulating economic development.
- Managing energy-related environmental impacts.
- Securing supply through diversity.

In order to meet these objectives and the developmental and socio-economic objectives of South Africa, the country needs to optimally use available energy resources. The South African Government is required to address what can be done to meet these electricity needs both in the short and long-term. The White Paper identifies key objectives for energy supply, such as increasing access to affordable energy services, managing energy-related environmental impacts and securing energy supply through diversifying South Africa's electricity mix.

4.4.3 The Electricity Regulation Act (No. 04 of 2006) (ERA)

The Electricity Regulation Act (No. 04 of 2006) as amended by the Electricity Regulation Act (No. 28 of 2007), replaced the Electricity Act (No. 41 of 1987), as amended, with the exception of Section 5B, which provides funds for the energy regulator for the purpose of regulating the electricity industry.

The ERA establishes a national regulatory framework for the electricity supply industry and made the National Energy Regulator of South Africa (NERSA) custodian and enforcer of the national electricity regulatory framework. The ERA provides for licences and registration as the manner in which the generation, transmission, distribution, reticulation, trading, and import and export of electricity is regulated.

4.4.4 Integrated Energy Plan (IEP), November 2016

The purpose and objectives of the Integrated Energy Plan (IEP) are derived from the National Energy Act (No. 34 of 2008). The IEP takes into consideration the crucial role that energy plays in the entire economy of the country and is informed by the output of analyses founded on a solid fact base. It is a multi-faceted, long-term energy framework which has multiple aims, some of which include:

» To guide the development of energy policies and, where relevant, set the framework for regulations in the energy sector.
» To guide the selection of appropriate technologies to meet energy demand (i.e. the types and sizes of new power plants and refineries to be built and the prices that should be charged for fuels).
» To guide investment in and the development of energy infrastructure in South Africa.
» To propose alternative energy strategies which are informed by testing the potential impacts of various factors such as proposed policies, introduction of new technologies, and effects of exogenous macro-economic factors.

A draft version of the Integrated Energy Plan (IEP) was released for comment on 25 November 2016. The purpose of the IEP is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development. The development of the IEP is an ongoing continuous process. It is reviewed periodically to take into account changes in the macroeconomic environment, developments in new technologies and changes in national priorities and imperatives, amongst others.

The 8 key objectives of the integrated energy planning process are as follows:

» Objective 1: Ensure security of supply.
» Objective 2: Minimise the cost of energy.
» Objective 3: Promote the creation of jobs and localisation.
» Objective 4: Minimise negative environmental impacts from the energy sector.

- » Objective 5: Promote the conservation of water.
- » Objective 6: Diversify supply sources and primary sources of energy.
- » Objective 7: Promote energy efficiency in the economy.
- » Objective 8: Increase access to modern energy.

The IEP recognises the need for coal to remain a part of South Africa's electricity generation mix, but states that investments need to be made in new and more efficient technologies, such as new Supercritical (SC) pulverised fuel power plants with Flue Gas Desulphurisation (FGD).

According to the IEP energy policies should support the pursuit of low emission limit targets, and new technologies should be implemented for all coal-fired power stations to ensure that environmental legislation is met. Furthermore, all new coal-fired power plants should be dry-cooled to conserve water in alignment with the National Water Resource Strategy 2.

4.4.5 Integrated Resource Plan (IRP) for Electricity 2010 - 2030

The Integrated Resource Plan (IRP) for Electricity 2010 – 2030[8] constitutes a subset of the IEP and is South Africa's national electricity plan. The current iteration of the IRP for South Africa, initiated by the DoE after a first round of public participation in June 2010, led to the Revised Balanced Scenario (RBS) that was published in October 2010. A second round of public participation was conducted in November/December 2010, which led to several changes to the IRP model assumptions.

The document outlines the proposed generation new-build fleet for South Africa for the period 2010 – 2030. This scenario was derived based on a cost-optimal solution for new-build options (considering the direct costs of new build power plants), which was then "balanced" in accordance with qualitative measures such as local job creation.

The Policy-Adjusted IRP includes the same amount of coal and nuclear new builds as the RBS, while reflecting recent developments with respect to prices for renewables. In addition to all existing and committed power plants (including 10GW committed coal), the plan includes 9.6GW of nuclear; **6.25GW of coal**; 17.8GW of renewables; and approximately 8.9GW of other generation sources such as hydro, and gas.

[8] It should be noted that the requirement for baseload power generation has also been included in the latest IRP, published in November 2016 for comment. The updated IRP is yet to be finalised and promulgated.

	New build options							
	Coal (PF, FBC, imports, own build)	Nuclear	Import hydro	Gas – CCGT	Peak – OCGT	Wind	CSP	Solar PV
	MW	MW	MW	MW	MW	MW	MW	MW
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	300
2013	0	0	0	0	0	0	0	300
2014	500[1]	0	0	0	0	400	0	300
2015	500[1]	0	0	0	0	400	0	300
2016	0	0	0	0	0	400	100	300
2017	0	0	0	0	0	400	100	300
2018	0	0	0	0	0	400[4]	100[4]	300[4]
2019	250	0	0	237[3]	0	400[4]	100[4]	300[4]
2020	250	0	0	237[3]	0	400	100	300
2021	250	0	0	237[3]	0	400	100	300
2022	250	0	1 143[2]	0	805	400	100	300
2023	250	1 600	1 183[2]	0	805	400	100	300
2024	250	1 600	283[2]	0	0	800	100	300
2025	250	1 600	0	0	805	1 600	100	1 000
2026	1 000	1 600	0	0	0	400	0	500
2027	250	0	0	0	0	1 600	0	500
2028	1 000	1 600	0	474	690	0	0	500
2029	250	1 600	0	237	805	0	0	1 000
2030	1 000	0	0	948	0	0	0	1 000
Total	6 250	9 600	2 609	2 370	3 910	8 400	1 000	8 400

Firm commitment necessary now

Final commitment in IRP 2012

1. Built, owned & operated by IPPs 2. Commitment necessary due to required high-voltage infrastructure, which has long lead time 3. Commitment necessary due to required gas infrastructure, which has long lead time 4. Possibly required grid upgrade has long lead time and thus makes commitment to power capacity necessary

Figure 4.2: National Energy Development Commitments detailed in the IRP 2010.

Figure 4.2 indicates the new capacities of the IRP 2010 commitment. The dates shown indicate the latest that the capacity is required in order to avoid security of supply concerns. The IRP notes that projects could be concluded earlier than indicated if feasible.

When promulgated in March 2011, it was indicated that the IRP should be a "living plan" which would be revised by the DoE every two years. Since the promulgation of the IRP 2010 there have been a number of developments in the energy sector in South and Southern Africa. In addition the electricity demand outlook has changed markedly from that expected in 2010. An IRP 2010 – 2030 Update Report was prepared and released in November 2013. The IRP 2010 – 2030 Update Report of 2013 estimated the energy demand in 2030 to be in the range of 345TWh – 416TWh as opposed to 454TWh as was originally expected in the policy-adjusted IRP. This equates to a reduction from 67 800MW to 61 200MW of reliable generating capacity. In addition, to uncertainty regarding the future demand, additional variables in the energy sector including the global agenda to combat climate change and the resulting mitigation requirements on South Africa, were taken into consideration. One of the shorter term recommendations included in the IRP 2010 – 2030 Update report (2013) was to procure a new set of fluidised bed combustion coal generation for a total of 1 000MW – 1 500MW capacity (as part of the "Coal 3" programme), and that this should be based on discard coal. This iteration of the IRP was not adopted by Parliament and is therefore not implemented. The IRP Update report of 2013 was however never implemented.

In November 2016 a draft IRP Update – Assumption, Base Case Results and Observations (Revision 1) document was released for comment, with the comment period closing on 31 March 2017. This current update in progress is being undertaken to take into account the changed electricity landscape, in particular with regards to electricity demand and the underlying relationship with economic growth; new developments in technology and fuel options (both locally and globally); scenarios for carbon mitigation strategies and the impact on electricity supply up to 2050; and the affordability of electricity and its impact on demand and supply.

Unlike the IRP 2010 – 2030 which considered the CSIR as well as Eskom demand forecasts, the IRP Update Base Case only uses the forecast developed by the CSIR. The energy demand forecast developed by the CSIR is presented in **Figure 4**.3. Based on the fact that the IRP update uses the High (less energy intense) forecast, energy demand is still anticipated to increase and is expected to be in the region of approximately 52GWH by 2050.

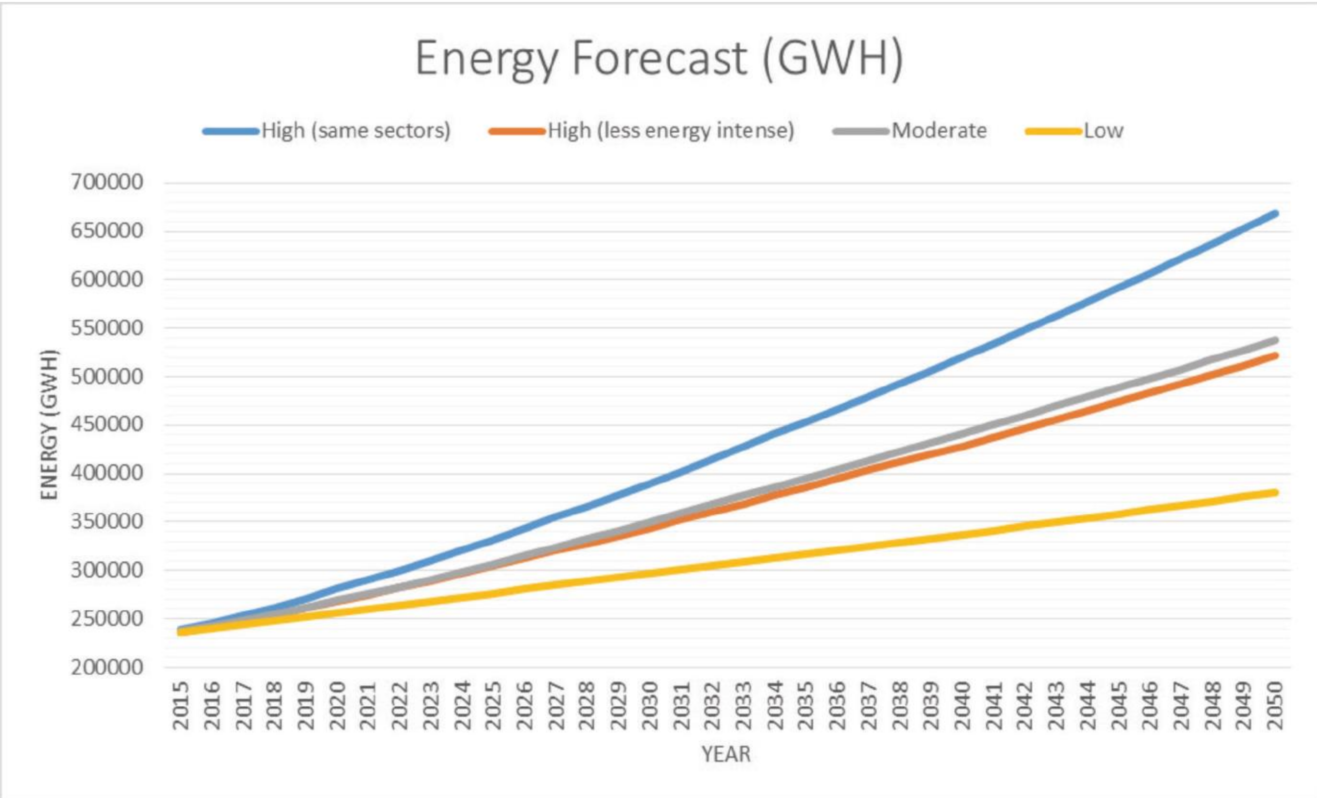

Figure 4.3: Energy Demand Forecast (Source: IRP Update, 2016).

Whereas the IRP 2010 – 2030 assumed Eskom's existing fleet to have an average plant performance of 86%, actual performance has declined to less than 70% in the recent past. Eskom has since adopted a new operation and maintenance strategy which has seen a significant improvement in this performance. The current plant life of the existing Eskom generation fleet includes requirements to comply with the requirements of the National Air Quality: Management Act (No. 39 of 2002) (NEM:AQA). Eskom, in agreement with DEA, has a plan in place to ensure all plants are compliant within a set period of time (refer to **Figure 4**.4). An indication of the 50-year life decommissioning of units for the various Eskom plants is also provided in the IRP (refer to **Figure 4**.4). The need for Eskom to retrofit and decommission several of its plants aligns with the need for new coal generation capacity provided by smaller IPPs while still decreasing South Africa's overall reliance on coal in future years.

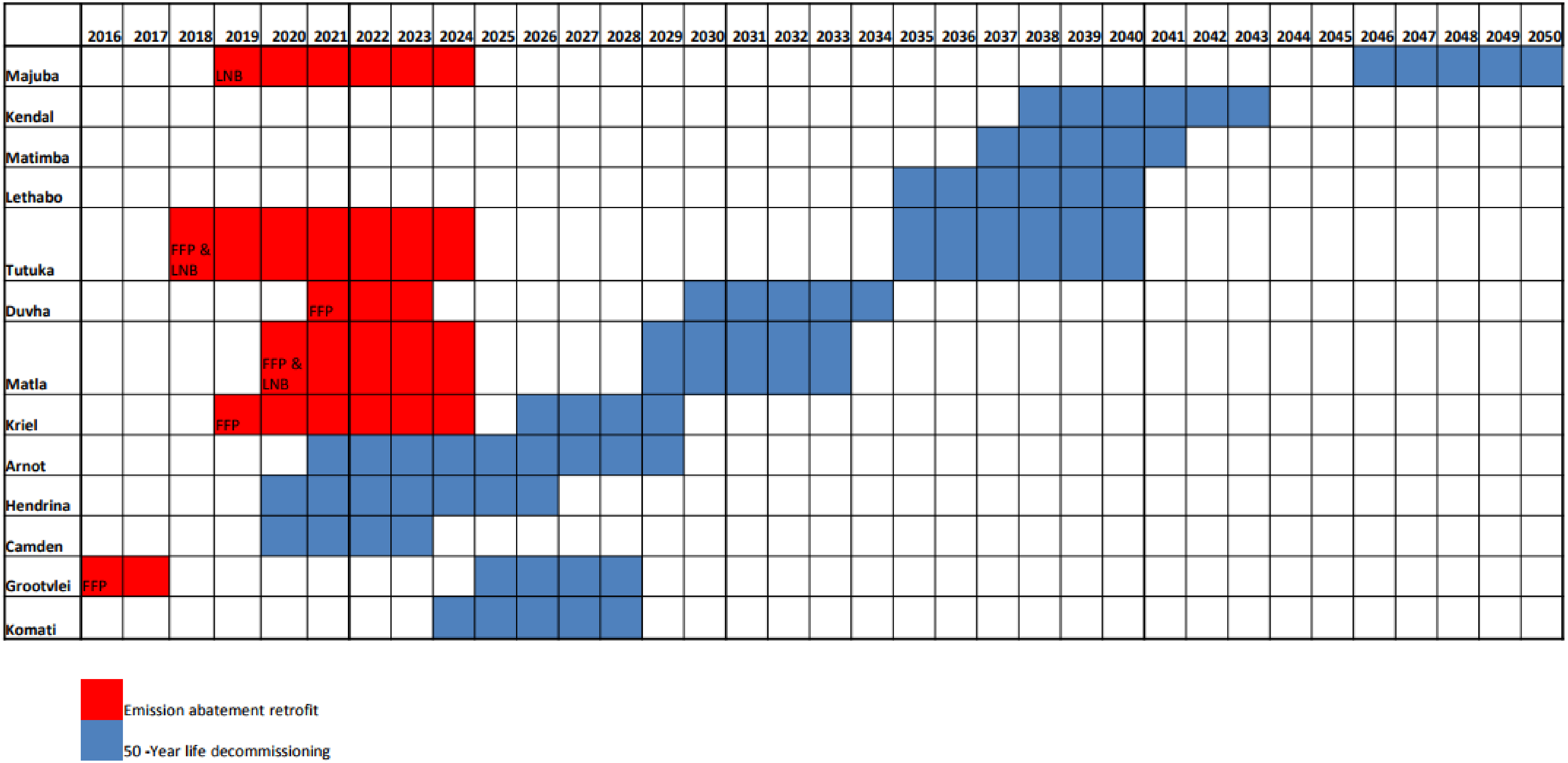

Figure 4.4: Eskom Fleet Air Quality Retrofit Plan and 50-year Life Decommissioning (Source: IRP Update. 2016).

The update process currently underway includes reference to Pulverised Coal (PC) with Flue Gas Desulphurisation (FGD) as part of the IRP Base case; and estimates that 15GW of coal-fired generation capacity would be required by the end of 2050; in addition to 18GW of PV, 37GW of wind, 20GW of nuclear, 34GW of gas, and 2.5GW of import hydro. The 2030 figures in the Base Case exclude the capacity already procured or under procurement (i.e. 6.2GW of renewable energy and 900MW of coal from IPP projects), and therefore differ from those in the IRP 2010 – 2030. This version of the IRP is currently being finalised and is expected to be presented to Parliament in the first quarter of 2018 (National Treasury, 2017).

4.4.6 New Growth Path (NGP) Framework, 23 November 2010

The purpose of the New Growth Path (NGP) Framework is to provide effective strategies towards accelerated job-creation through the development of an equitable economy and sustained growth. The target of the NGP is to create 5 million jobs by 2020. With economic growth and employment creation as the key indicators identified in the NGP, the framework seeks to identify key structural changes in the economy that can improve performance in term of labour absorption and the composition and rate of growth. To achieve this, government will seek to, amongst other things, identify key areas for large-scale employment creation, as a result of changes in conditions in South Africa and globally, and to develop a policy package to facilitate employment creation in these areas.

4.4.7 The National Development Plan (NDP) 2030

The National Development Plan (NDP) 2030 is a plan prepared by the National Planning Commission in consultation with the South African public which is aimed at eliminating poverty and reducing inequality by 2030. The NDP aims to achieve this by drawing on the energies of its people, growing and inclusive economy, building capabilities, enhancing the capacity of the state and promoting leaderships and partnerships throughout society. While the achievement of the objectives of the NDP requires progress on a broad front, three priorities stand out, namely:

» Raising employment through faster economic growth
» Improving the quality of education, skills development and innovation
» Building the capability of the state to play a developmental, transformative role

In terms of the Energy Sector's role in empowering South Africa, the NDP envisages that, by 2030, South Africa will have an energy sector that promotes:

» Economic growth and development through adequate investment in energy infrastructure. The sector should provide reliable and efficient energy service at competitive rates, while supporting economic growth through job creation.
» Social equity through expanded access to energy at affordable tariffs and through targeted, sustainable subsidies for needy households.
» Environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change.

Although electricity generation from coal is still seen as part of the energy mix within the NDP, the plan sets out steps that aim to ensure that, by 2030, South Africa's energy system looks very different to the current situation: coal will contribute proportionately less to primary-energy needs, while gas and renewable energy resources - especially wind, solar and imported hydroelectricity – will play a much larger role.

4.4.8 National Climate Change Adaptation Strategy (NAS) (2017)

South Africa's draft National Climate Change Adaptation Strategy was prepared by the Department of Environmental Affairs (DEA) as a successor to the National Climate Change Response Policy (NCCRP) White Paper (2011). The original NAS was released in 2016, and a second draft was released for public review in October 2017. The National Climate Change Adaptation Strategy is intended to provide a common reference point for all provincial, local, departmental and sectoral adaptation strategies. It is intended to be the cornerstone for climate change adaptation in the country and to reflect a unified, coherent, cross-sectoral, economy-wide approach to climate change adaptation. It signals priority areas for adaptation response, both to provide guidance to adaptation efforts around the country and to be a point of resource to inform resource allocation to climate change adaptation.

The NAS recognises the fact that climate change is intrinsically linked to almost all facets of society, particularly socio-economic progression as resources such as water, feedstock in form on food, fibre, biodiversity, amongst others determine the production potential of many sectors of the economy, which in turn affect human development aspirations of the country. The NAS acts as a common reference point for climate change adaptation efforts in South Africa, and provides a platform upon which national climate change adaptation objectives can be articulated so as to provide overarching guidance to all sectors of the economy. The strategy is intended to help gauge the degree to which development initiatives at different levels of government and business integrate and reflect critical climate change adaptation, to guide stronger coherence and coordination on climate change adaptation activities between different institutions and levels of government, particularly with regards to planning, implementation and reporting, and to provide inputs to the country's legal framework for adaptation. The strategy is the main vehicle for South Africa to meet its international obligations under the United Nations Framework Convention on Climate Change (UNFCCC) as contained in the country's adaptation component of the Nationally Determined Contribution (NDC).

The NAS Framework is based on the development of 10 year plans, which are updated every 5 years along six strategic outcomes. For the first NAS, covering the period of 2017/18 to 2027/28 strategic interventions are identified in relation to each outcome. The approach is that of continuous improvement and focus in order to deliver maximum impact and effective deployment of resources for each of the periods of implementation for the strategy.

The vision of the NAS is to transition to a climate-resilient South Africa, which follows a development path, guided by anticipation, adaptation and recovery to a changing climate and environment to achieve our development aspirations.

The Strategic interventions identified within the NAS are as follows:

» **Strategic Intervention 1:** Achieve an effective adaptation planning regime that adequately responds to climate change threats.
» **Strategic Intervention 2:** Define adaptation practice that integrates biophysical and socio-economic aspects of vulnerability and resilience.
» **Strategic Intervention 3:** Establish effective governance and legislative processes to integrate climate change in development planning.
» **Strategic Intervention 4:** Achieve coherent adaptation implementation that addresses key vulnerabilities and cross-sectoral dynamics.

» **Strategic Intervention 5:** Achieve adequate and predictable financial resourcing of adaptation actions and needs, from a variety of sources.
» **Strategic Intervention 6:** Develop a Monitoring and Evaluation (M&E) system that tracks implementation of adaptation actions and their effectiveness.

4.4.9 Special Economic Zones Act (No. 16 of 2014)

The Special Economic Zones Act (No. 16 of 2014) (SEZA) is intended to support and facilitate the designation, regulation, and development of Special Economic Zones (SEZs) in South Africa. A Special Economic Zone is an economic development tool to promote national economic growth and export by using support measures in order to attract targeted foreign and domestic investments and technology. SEZA provides for, amongst other things; the designation, promotion, development, operation and management of Special Economic Zones (SEZs); the regulation, application, issuing, suspension, withdrawal and transfer of SEZ operator permits; and the provision of functions for SEZ operators.

SEZA provides for the implementation of measures to enhance domestic and regional demand, increase foreign direct investment, and extend export promotion strategically to rapidly growing economies, all while strengthening South Africa's industrial base and promoting a labour-absorbing industrialisation path. SEZA recognises the impact of SEZs in driving industrial and economic growth, and SEZs have been identified by Government as a mechanism that will contribute towards the realisation of South Africa's industrial and economic growth and development goals by providing a response to challenging global and domestic economic conditions through focussing on new sources of competitiveness in innovation and productivity, with an entrenched base in skills, infrastructure, and efficient, responsive state action.

SEZs will be designated areas to promote targeted economic activities, supported through special arrangements and support systems including incentives, business support services, streamlined approval processes and infrastructure.

According to SEZA the purpose of establishing SEZs includes:

» Facilitating the creation of an industrial complex, having strategic national economic advantage for targeted investments and industries in the manufacturing sector and tradable services.
» Developing infrastructure required to support the development of targeted industrial activities.
» Attracting foreign and domestic direct investment.
» Providing the location for the establishment of targeted investments.
» Enabling the beneficiation of mineral and natural resources.
» Taking advantage of existing industrial and technological capacity, promoting integration with local industry and increasing value-added production.
» Promoting regional development.
» Creating decent work and other economic and social benefits in the region in which it is located, including the broadening of economic participation by promoting small, micro and medium enterprises and co-operatives, and promoting skills and technology transfer.
» The generation of new and innovative economic activities.

4.5 Provincial Policy and Planning Context

4.5.1 Limpopo Employment, Growth, and Development Plan (LEGDP) 2009 – 2014

The Limpopo Employment, Growth and Development Plan provides a framework for the provincial government, municipalities, private sector and all organs of civil society to make hard choices in the pursuit of strategic priorities as encapsulated in the Medium Term Strategic Framework (MTSF). The LEGDP provides a brief insight into the state of Limpopo's growth and development.

The LEGDP states that "*the most pressing problem facing Limpopo Province today is the absence of sustained economic growth and job creation, which are essential to reduce poverty and improve living conditions*".

The industrial development emphasis to be pursued by the province is therefore to move onto an industrialization trajectory that is responsive to:

» Intensification of Limpopo's industrialisation process and movement towards a knowledge economy.
» Provision by domestic manufacturers of the capital goods that the growing economy needs and will continue to demand.
» Promotion of more labour-absorbing industrial sectors, with an emphasis on tradable labour-absorbing goods and services and economic linkages that catalyse employment creation.
» Promotion of a broader based industrialisation path that is characterized by greater levels of participation of historically disadvantaged people, and marginalized regions in the mainstream of the industrial economy.

Ensuring more inclusive economic growth, decent work and sustainable livelihoods has been identified as a priority. The main objective with regard to the priority is to respond appropriately, promptly and effectively so that growth in decent employment and improvements in income security are reinforced, and investment sustained to build up provincial economic capability and improve industrial competitiveness. This has to be conducted in an environment of a stable macro-economy which provides conditions for higher rates of investment and creation of decent jobs.

South Africa's energy sector is considered a labour-absorbing industrial sector. The development and operation of Mutsho Power Project would provide for economic growth and job creation within a labour-absorbing industrial sector (i.e. energy production) through industrial development within Limpopo Province. The project is therefore aligned with the LEGDP.

4.5.2 Limpopo Development Plan (LDP) 2015 – 2019

The Limpopo Development Plan (LDP) 2015 – 2019 builds on the foundations of the Limpopo Economic Growth and Development Plan (LEGDP) 2009 – 2014 and the Limpopo Provincial Growth and Development Strategy (PGDS) 2004 – 2008.

The purpose of the LDP 2015 – 2019 is to:

» Outline the contribution from Limpopo Province to the National Development Plan (NDP) objectives and the national MTSF for this period

- Provide a framework for the strategic plans of each provincial government department, as well as the IDPs and sector plans of district and local municipalities
- Create a structure for the constructive participation of private sector business and organised labour towards the achievement of provincial growth and development objectives
- Encourage citizens to become active in promoting higher standards of living within their communities.

Annual growth in job-creation, production and income, access to good public services and environmental management were identified as the essential instruments or means to reach the goal of sustainable development.

4.6 Local Policy and Planning Context

4.6.1 Vhembe District Municipality Integrated Development Plan (IDP)

The vision of the Vhembe DM is as follows:

"A developmental municipality focusing on sustainable service delivery and socio-economic development towards an equal society."

The Mission of the Municipality is:

"To be an accountable and community driven municipality in addressing poverty and unemployment through sustainable socio-economic development and service delivery."

Service delivery and infrastructure development are a priority area for the Vhembe DM. The strategic objective aligned to this priority area is to improve access to services through the provision, operation, and maintenance of socio-economic and environmental infrastructure (Vhembe District Municipality, 2016).

4.6.2 Musina Local Municipality Integrated Development Plan (IDP)

The vision of the Musina Local Municipality is:

"To be the vibrant, viable and sustainable gateway city to the rest of Africa."

The Municipality's mission is as follows:

"Vehicle of affordable quality services and stability through socio-economic development and collective leadership".

The strategic opportunities and major challenges of the Municipality have been identified as follows:

Strategic Opportunities	Major Challenges
Declared Special Economic Zone and Provincial growth point	Land availability for new developments
Mining, Agriculture and Tourism	Influx of undocumented foreign Nationals
Geographic location(gateway to SADC region)	Bulk Electricity capacity
	Bulk water supply
	Maintenance and operation of ageing infrastructure

4.7 International Policy and Planning Context

4.7.1 United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Party (COP)

Climate change is one of the major global challenges of the 21st century that require global response. The adverse impacts of climate change include persistent drought and extreme weather events, rising sea levels, coastal erosion and ocean acidification, further threatening food security, water, energy and health, and more broadly efforts to eradicate poverty and achieving sustainable development. Combating climate change would require substantial and sustained reductions in greenhouse gas (GHG) emissions, which together with adaptation, can limit climate change risks. The convention responsible for dealing with climate change is the United Nations Framework Convention on Climate Change (UNFCCC).

The UNFCCC was adopted in 1992 and entered into force in 1994. It provides the overall global policy framework for addressing the climate change issue and marks the first international political response to climate change. The UNFCCC sets out a framework for action aimed at stabilizing atmospheric concentrations of GHGs to avoid dangerous anthropogenic interference with the climate system.

The UNFCCC has established a variety of arrangements to govern, coordinate and provide for oversight of the arrangements described in the documentation. The oversight bodies take decisions, provide regular guidance, and keep the arrangements under regular review in order to enhance and ensure their effectiveness and efficiency. The Conference of Parties (COP), established by Article 7 of the Convention, is the supreme body and highest decision-making organ of the Convention. It reviews the implementation of the Convention and any related legal instruments, and takes decisions to promote the effective implementation of the Convention.

COP 21 was held in Paris from 30 November to 12 December 2015. From this conference, an agreement to tackle global warming was reached between 195 countries. This Agreement was open for signature and subject to ratification, acceptance or approval by States and regional economic integration organizations that are Parties to the Convention from 22 April 2016 to 21 April 2017, and thereafter open for accession.

The Paris Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

(a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.
(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low GHG emissions development, in a manner that does not threaten food production.
(c) Making finance flows consistent with a pathway towards low GHG emissions and climate-resilient development.

In order to achieve the long-term temperature goal set out in Article 2 of the Agreement, Parties aim to reach global peaking of GHG emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of

GHGs in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.

The Paris Agreement requires all Parties to put forward their best efforts through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. In 2018, Parties will take stock of the collective efforts in relation to progress towards the goal set in the Paris Agreement and to inform the preparation of NDCs. There will also be a global stocktake every 5 years to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual actions by Parties.

In working towards this goal, advanced economies have already included renewables in their energy mix and have planned to increase their use in order to meet their mitigation goals: Japan aims to derive 22 – 24% of its electricity production from renewable sources by 2030 and the European Union plans for them to reach 27% of its final energy consumption. Developing countries are also playing their part, including South Africa which has included a goal of 17.8GW of renewables by 2030 within the IRP.

South Africa signed the Agreement in April 2016, and ratified the agreement on 01 November 2016. The Agreement was assented to by the National Council of Provinces on 27 October 2016, and the National Assembly on 1 November 2016. The Agreement came into force on 04 November 2016, thirty days after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession with the Depositary.

COP 23 was held in Bonn, Germany from 06 to 17 November 2017, and is the second COP to be held since COP 21. One of the key outcomes of COP 23 was the launch of the "Powering Past Coal Alliance", led by the UK and Canada. More than 20 countries joined the alliance, including Denmark, Finland, Italy, New Zealand, Ethiopia, Mexico, and the Marshall Islands; as well as the United States (US) states of Washington and Oregon. The alliance notes that analysis shows that coal phase-out is needed by no later than 2030 in the OECD and EU28, and by no later than 2050 in the rest of the world to meet the Paris Agreement, however it does not commit signatories to any particular phase-out date. It also does not commit the signatories to ending the financing of unabated coal power stations, but rather just restricting it.

4.7.2 The Equator Principles III (June, 2013)

The Equator Principles (EPs) III constitute a financial industry benchmark used for determining, assessing, and managing projects environmental and social risks. The EPs are primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. The EPs are applicable to large infrastructure projects and apply globally to all industry sectors.

The EPs comprise the following principles:

Principle 1: Review and Categorisation
Principle 2: Environmental and Social Assessment.
Principle 3: Applicable Environmental and Social Standards.
Principle 4: Environmental and Social Management System and Equator Principles Action Plan
Principle 5: Stakeholder Engagement
Principle 6: Grievance Mechanism

Principle 7: Independent Review
Principle 8: Covenants
Principle 9: Independent Monitoring and Reporting
Principle 10: Reporting and Transparency.

When a project is proposed for financing, the Equator Principle Financial Institution (EPFI) will categorise it based on the magnitude of its potential environmental and social risks and impacts.

Projects can be categorized as follows:

Category A: Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented.
Category B: Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures.
Category C: Projects with minimal or no adverse environmental and social risks and/or impacts.

Based on the abovementioned criteria, the Mutsho Power Project can be anticipated to be categorised as a Category A project.

Category A and Category B projects require that an assessment process be conducted to address the relevant environmental and social impacts and risks associated with the project. Such an assessment may include the following where applicable:

- An assessment of the baseline environmental and social conditions.
- Consideration of feasible environmentally and socially preferable alternatives.
- Requirements under host country laws and regulations, applicable international treaties and agreements.
- Protection and conservation of biodiversity (including endangered species and sensitive ecosystems in modified, natural and Critical Habitats) and identification of legally protected areas.
- Sustainable management and use of renewable natural resources (including sustainable resource management through appropriate independent certification systems).
- Use and management of dangerous substances.
- Major hazards assessment and management.
- Efficient production, delivery and use of energy.
- Pollution prevention and waste minimisation, pollution controls (liquid effluents and air emissions), and solid and chemical waste management.
- Viability of Project operations in view of reasonably foreseeable changing weather patterns/climatic conditions, together with adaptation opportunities.
- Cumulative impacts of existing Projects, the proposed Project, and anticipated future Projects.
- Respect of human rights by acting with due diligence to prevent, mitigate and manage adverse human rights impacts.
- Labour issues (including the four core labour standards), and occupational health and safety.
- Consultation and participation of affected parties in the design, review and implementation of the Project.
- Socio-economic impacts.
- Impacts on Affected Communities, and disadvantaged or vulnerable groups.

- Gender and disproportionate gender impacts.
- Land acquisition and involuntary resettlement.
- Impacts on indigenous peoples, and their unique cultural systems and values.
- Protection of cultural property and heritage.
- Protection of community health, safety and security (including risks, impacts and management of Project's use of security personnel).
- Fire prevention and life safety.

Such an assessment should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project. In terms of the EPs South Africa is a non-designated country, and as such the assessment process for projects located in South Africa evaluates compliance with the applicable IFC Performance Standards on Environmental and Social Sustainability and the World Bank Group (WBG) EHS Guidelines (refer to the sections below).

The Mutsho Power Project is currently being assessed in accordance with the requirements of the 2014 EIA Regulations, as amended (GNR 326), published in terms of Section 24(5) of the National Environmental Management Act (No. 107 of 1998) (NEMA), which is South Africa's national legislation providing for the authorisation of certain controlled activities. Through this assessment, all potential social and environmental risks are identified and assessed, and appropriate mitigation measures proposed.

4.7.3 International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (January 2012)

The International Finance Corporation's (IFC) Performance Standards (PS) on Environmental and Social Sustainability were developed by the IFC and were last updated on 1 January 2012. The overall objectives of the IFC PS are:

- To fight poverty.
- To do no harm to people or the environment.
- To fight climate change by promoting low carbon development.
- To respect human rights;
- To Promote gender equity;
- To provide information prior to project development, free of charge and free of external manipulation;
- To collaborate with the project developer to achieve the PS;
- To provide advisory services; and
- To notify countries of any Trans boundary impacts as a result of a Project.

The PS comprise of the following:

Performance Standard 1:	Assessment and Management of Environmental and Social Risks and Impacts.
Performance Standard 2:	Labour and Working Conditions.
Performance Standard 3:	Resource Efficiency and Pollution Prevention.
Performance Standard 4:	Community Health, Safety and Security.
Performance Standard 5:	Land Acquisition and Involuntary Resettlement.
Performance Standard 6:	Biodiversity Conservation and Sustainable Management of Living Natural Resources.
Performance Standard 7:	Indigenous Peoples.

Performance Standard 8: Cultural Heritage.

Performance Standard 1 establishes the importance of:

i). Integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects.
ii). Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them.
iii). The management of social and environmental performance throughout the life of a project through an effective Environmental and Social Management System (ESMS).

PS 1 requires that a process of environmental and social assessment be conducted, and an ESMS appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts be established and maintained. PS 1 is the overarching standard to which all the other standards relate. PS 2 through 8 establish specific requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts should be considered as part of the assessment, PS 2 through 8 describe potential social and environmental impacts that require particular attention in emerging markets. Where social or environmental impacts are anticipated, the developer is required to manage them through its Environmental and Social Management System (ESMS) consistent with PS 1.

4.7.4 The IFC Environmental Health and Safety (EHS) Guidelines

The IFC EHS Guidelines are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP). The following IFC EHS Guidelines have relevance to the proposed project:

» IFC EHS General Guidelines
» IFC EHS Guidelines for Thermal Power Plants
» IFC EHS Guidelines for Electric Power Transmission and Distribution

The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines. The EHS Guidelines' general approach to air quality states that projects should prevent or minimise impacts by ensuring that:

» Emissions do not result in pollutant concentrations that reach or exceed the relevant national ambient air quality guidelines and standards, or in their absence, the current World Health Organisation (WHO) Air Quality Guidelines (AQG) or other internationally recognised sources;
» Emissions do not contribute a significant portion to the attainment of relevant ambient AQG or standards. The Guideline suggests 25% of the applicable ambient air quality standards to allow additional, future development in the same airshed.

The IFC EHS Guidelines contain the performance levels and measures normally acceptable to the IFC and are generally considered to be achievable in new facilities at reasonable costs. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever standard is more stringent.

The General EHS Guidelines state that at project level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models. The dispersion model should be internationally recognised and able to take into account local atmospheric, climatic and air quality data as well as the effects of downwash, wakes or eddy effects generated by structures and terrain features.

The General EHS Guidelines also provides guidance with respect to:

- » Projects located in degraded airsheds or ecologically sensitive areas;
- » Points sources and stack heights;
- » Emissions from small combustion facilities (3 to 50 MWth rated heat input capacity);
- » Fugitive sources;
- » Ozone depleting substances;
- » Land based mobile sources;
- » Greenhouse gases;
- » Monitoring; and
- » Air emissions prevention and control technologies

In addition to the General EHS Guidelines, the IFC also provides industry specific EHS Guidelines. The EHS Guidelines for Thermal Power Plants include information relevant to combustion processes fuelled by gaseous, liquid and solid fossil fuels and biomass; designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type (except for solid waste which is covered under a separate Guideline for Waste Management Facilities), with a total rated heat input capacity above 50MWth on Higher Heating Value (HHV) basis.

Table 4.1: IFC emission guidelines for thermal power plants (May, 2017)

Emissions guidelines (in mg/Nm^3 or as indicated) for Boiler

Note:

- » Guideline values are applicable for new facilities
- » Nationally legislated limits should be applied if they are more stringent
- » EA may justify more stringent or less stringent guideline values due to environmental, community health, technical and economic considerations, whilst not exceeding nationally legislated limits. In all cases, the EA should demonstrate that ambient impacts from emissions are in compliance with the requirements of Section 1.1 of the General EHS Guidelines.
- » For fuels other than those specified below, the EA should justify the required emission guidelines taking account of environmental, community health, technical and economic considerations
- » For projects to rehabilitate existing facilities, emission guidelines should be established by the EA considering (i) the existing emission levels and impacts on the environment and community health, and (ii) economic and technical feasibility of ensuring the existing emission levels meet the Guideline values for new facilities.

Combustion Technology / Fuel	Particulate Matter (PM)	Sulphur Dioxide (SO_2)	Nitrogen Oxides (NO_x)	Excess Dry gas O_2 Content (%)
Solid Fuels (Plant ≥600MWth)	40	200 – 600[a]	500	6

Notes:

[a] Targeting the lower guidelines values and recognizing variability in approaches to the management of SO_2 emissions (fuel quality vs. use of secondary controls) and the potential for higher energy conversion efficiencies. Selection of the emission level in the range is to be determined by EA taking account of environmental, community health, technical and economic considerations.

Annex B of the IFC EHS Guidelines for Thermal Power Plants contains guidance for the environmental assessment of thermal power projects, and includes the following:

Suggested Key EHS Elements for Environmental Assessment of a new Thermal Power Project	
Analysis of Alternatives	» Fuel selection including non-fossil fuel options (coal, oil, gas, biomass, other renewable options – wind, solar, geothermal, hydro), fuel supply sources. » Power generation technology ∗ Thermal generating efficiency (HHV-gross, LHV-gross, HHV-net, LHV-net) ∗ Cost ∗ CO_2 emissions performance (gCO_2/kWh) » GHG emissions reduction / offset options ∗ Energy conversion efficiency ∗ Offset arrangement ∗ Use of renewable energy sources, etc. » Baseline water quality of receiving water bodies » Water supply ∗ Surface water, underground water, desalination » Cooling system ∗ Once-through, wet closed circuit, dry closed circuit » Ash disposal system - wet disposal vs. dry disposal » Pollution control ∗ Air emission – primary vs. secondary flue gas treatment (cost, performance) ∗ Effluent (cost, performance) » Effluent discharge ∗ Surface water ∗ Evaporation ∗ Recycling – zero discharge » Siting ∗ Land acquisition consideration ∗ Access to fuel / electricity grid ∗ Existing and future land use zoning ∗ Existing and predicted environmental baseline (air, water, noise)
Impact Assessment	» Estimation of GHG emissions (tCO_2/year, gCO_2/kWh) » Air quality impact ∗ SO_2, NO_2, PM_{10}, $PM_{2.5}$, Heavy metals as appropriate, Acid deposition if relevant ∗ Incremental impacts to the attainment of relevant air quality standards ∗ Isopleth concentration lines (short-term, annual average, as appropriate) overlaid with land use and topographic map ∗ Cumulative impacts of existing sources / future projects if known ∗ Stack height determination ∗ Health impact consideration » Water quality / intake impact ∗ thermal discharge if once-through cooling system is used ∗ other key contaminants as appropriate ∗ water intake impact » Noise impact ∗ Noise contour lines overlaid with land use and locations of receptors

Suggested Key EHS Elements for Environmental Assessment of a new Thermal Power Project	
	» Determination of pollution prevention and abatement measures
Mitigation Measures / Management Program	» Air (Stack height, pollution control measures, cost) » Effluent (wastewater treatment measures, cost) » Noise (noise control measures, cost) » Waste utilization / disposal (e.g., ash, FGD by-product, used oil) ∗ Ash management plan (quantitative balance of ash generation, disposal, utilization, size of ash disposal site, ash transportation arrangement) » Fuel supply arrangement » Emergency preparedness and response plan » Industrial risk assessment if relevant
Monitoring Program	» Parameters » Sampling Frequency » Evaluation Criteria » Sampling points overlaid with relevant » site layout / surrounding maps » Cost

Where applicable the above-mentioned criteria have been incorporated into the project design and environmental assessment of the Mutsho Power Project and associated infrastructure.

CHAPTER 5 NEED AND DESIRABILITY

One of the objectives of the EIA process is to motivate for "*the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted Scoping Report*". The need and desirability of a development needs to consider whether it is the right time and right place for locating the type of land-use/activity being proposed. Need and desirability is therefore equated to the wise use of land, and should be able to answer the question of what the most sustainable use of land is.

This Chapter provides an overview of the suitability of the Mutsho Power Project being developed at the preferred location from a national, regional, and site specific perspective. In addition, this Chapter also provides an overview of the expected socio-economic benefits associated with the development of the project, as detailed in the specialist socio-economic assessment (refer to **Appendix M**).

5.1 Need and Desirability from a National Perspective

The Mutsho Power Project is proposed in specific response to a national government initiative, namely the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP). As a result the need and desirability of the project from a national perspective can largely be assimilated from the project's alignment with national government policies, plans and programmes which have relevance to energy planning and production (as discussed in detail in **Chapter 4**). The following key policies have been developed by government to take into account South Africa's current energy production, projected future demands, and provides the necessary framework within which energy generation projects can be developed:

» Integrated Energy Plan (IEP)
» Integrated Resource Plan (IRP)

The abovementioned policies have been extensively researched and are updated on an ongoing basis to take into consideration changing scenarios, new information, developments in new technologies, and to reflect updated demands and requirements, for energy production requirements within the South African context. These plans form the basis of South Africa's energy generation sector and dictate national priorities for energy production.

The Integrated Energy Plan (IEP) is intended to provide a roadmap of South Africa's future energy landscape which guides future energy infrastructure investments and policy development. The latest iteration of the IEP (25 November 2016) states that South Africa should continue to pursue a diversified energy mix which reduces reliance on a single or a few primary energy sources, and includes the following statement regarding coal's contribution specifically:

"***Coal:*** *Coal should continue to play a role in electricity generation; however investments need to be made in new and more efficient technologies (e.g. new supercritical pulverised fuel power plants with flue-gas desulphurisation). Investments should also continue on the testing of underground coal gasification. New coal-to-liquid (CTL) plants are not competitive if South Africa is to achieve the objective of moving towards a low carbon economy, and despite the beneficiation targets, no new investments are encouraged in this regard. Long-term investment in research and test injections for Carbon Capture and Storage (CCS) should* *continue to be pursued. Given the significant investments required for this technology, South Africa should establish strategic partnerships with countries that have made advancements in the development of CCS technologies (e.g. Norway) as well as those that have abundant coal resources and therefore similar objectives in terms of exploiting their coal resources responsibly (e.g. Australia).*" The IEP further states "*Energy policies should support the pursuit of low emission limit targets. Ongoing work by the Department of Environmental Affairs to determine Desired Emissions Reduction Outcomes (DEROs) should proceed. New technologies should be implemented for all coal-fired power plants to ensure that environmental legislation is met. Furthermore, all new coal-fired power plants should be dry-cooled to conserve water in alignment with the National Water Resource Strategy 2.*" The consideration of appropriate alternative technologies and abatement measures, as proposed as part of the Mutsho Power Project, is therefore required.

The Integrated Resource Plan for Electricity (IRP) 2010 – 2030 is a subset of the IEP, and constitutes South Africa's current gazetted energy plan. The purpose of the plan is to ensure sustainable electricity development which takes into consideration technical, economic, and social constraints; and identifies investments in the electricity sector which are required to meet the country's forecasted electricity demands at minimum costs. The IRP 2010 - 2030 includes 9.6GW of nuclear; **6.25GW of coal**; 17.8GW of renewables; and approximately 8.9GW of other generation sources such as hydro, and gas in addition to all existing and committed power plants (including 10GW committed coal).

In November 2016 a draft IRP Update – Assumption, Base Case Results and Observations (Revision 1) document was released for comment. The latest update of the IRP recognises the value of coal in contributing towards South Africa's electricity requirements, and while provision has been made for electricity to be generated via various alternative resources, it is recognised that coal would still need to form part of South Africa's energy mix up to 2050. The update includes estimates that **15GW of coal-fired power generation**, as well as 18GW of PV, 37GW of wind, 20GW of nuclear, 34GW of gas, and 2.5GW of import hydro, would be required by the end of 2050.

The need for new coal-fired generation identified in the IRP takes into consideration Eskom's average fleet plant performance, as well as the fact that a number of Eskom's existing coal-fired power stations would be nearing the end of their 50 year life cycle and would be decommissioned and removed from service after 2020[9]. In addition a number of Eskom's power stations require emission abatement retrofits to ensure compliance with the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA) Minimum Emission Standards. The significance being that the process of retrofitting Eskom power stations will have an impact on unit outages. In addition, whereas the IRP assumed Eskom's average existing fleet plant performance to be 86%, the actual performance has declined to less than 70% in the recent past. The 15GW of new coal-fired generation capacity contained in the update is therefore considered necessary by government to contribute towards South Africa's baseload energy supply, while also replacing that capacity generated by Eskom's fleet which is nearing the end of its life cycle and will be decommissioned, as well as that which will be out of service during retrofitting.

In line with government policy to reduce greenhouse gas emissions, the IRP update uses the moderate decline constraint for greenhouse gas emissions. Although this is subject to change following recent correspondence received from Department of Environmental Affairs indicating that carbon budget methodology must be used instead of emissions decline constraints, the consideration of GHG emissions in

[9] In terms of Eskom's Transmission Development Plan (2016 – 2025), Eskom has started to consider the decommissioning of the older coal-fired power station units. According to the proposed Eskom schedule, units will start to be decommissioned at Camden and Hendrina from 2020. In 2022, units will start to be decommissioned at Arnot.

the determination of the energy generation mix indicates government's commitment to international obligations under the Paris Agreement.

In response to the IRP, the Department of Energy (DoE) initiated a number of Independent Power Producer (IPP) Procurement Programmes to secure electricity generated by a range of resources from the private sector (i.e. from IPPs). Under these Programmes, IPPs are invited to submit proposals for the finance, construction, operation, and maintenance of electricity generation facilities for the purpose of entering into an Implementation Agreement with the DoE and a Power Purchase Agreement (PPA) with Eskom as the buyer. IPPPPs include the Renewable Energy IPP Procurement Programme (REIPPPP), the Co-generation IPP Procurement Programme, the Liquefied Natural Gas (LNG) to Power IPP Procurement Programme, and the Coal Baseload IPP Procurement Programme (CBIPPPP) (refer to **Table 5.1**).

Table 5.1: Overview of IPP Procurement Programmes and their current allocation (MW).

IPP Procurement Programme	Technology	MW	Total
Renewables	Onshore Wind	6 360 MW	14 725MW
	Concentrated solar thermal	1 200 MW	
	Solar Photovoltaic	4 725 MW	
	Biomass	210 MW	
	Biogas	110 MW	
	Landfill Gas	25 MW	
	Small hydro	195 MW	
	Small Projects	400 MW	
	Solar Parks	1 500MW	
Coal Baseload	Coal	2 500MW	2 500MW
Cogeneration	Cogeneration	800MW	800MW
Gas	Gas	3 000MW	3 000MW

While Renewable Energy (RE) resources are valuable in contributing towards electricity generation and diversifying South Africa's electricity mix, they have not yet been proven (internationally or locally) to be able to provide sufficient quantities of baseload electricity (i.e. electricity which is produced at a constant or near constant, rate by power stations with high capacity factors). Coal-fired power stations are currently the primary form of baseload power generation available in South Africa. While other baseload power stations could comprise gas, co-generation, biomass, nuclear or hydro power stations, such technologies are currently not used for baseload generation within South Africa, due to high capital cost, primary energy and fuel availability concerns.

Under the CBIPPPP the DoE intends to secure 2 500MW of electricity from coal-fired baseload generation facilities utilising either Pulverised Coal (PC) or Circulating Fluidised Bed (CFB) type technologies across a number of bidding windows, while simultaneously contributing towards socio-economic development. A total of 863.3MW of electricity has been awarded to preferred bidders under the first bid submission window, with 1 636.7MW still remaining to be allocated in subsequent bidding rounds. Preferred bidders identified under any IPPPP, including the CBIPPPP, are required to satisfy a number of economic development requirements, including amongst others, job creation, local content, skills development, enterprise and supplier development, and socio-economic development. In addition to electricity generation and supply, IPPPPs therefore also contribute positively towards socio-economic development of a region, over and above job creation.

The need for new power generation from coal has therefore been identified and assessed by government at a national scale considering the national energy requirements as well as international commitments under the Paris Agreement, and provision has been made for the inclusion of new coal-fired power generation capacity in South Africa's' energy mix. The implementation of the proposed project therefore has the potential to contribute positively towards the identified need, while simultaneously contributing to job creation and socio-economic development, identified as a need for the country within the NDP. The proposed power station will make use of newer, cleaner technology than that which is currently in place in a number of Eskom's aging plants, and would ensure compliance with all applicable legislation and permitting requirements including the NEM:AQA Minimum Emissions Standards from project initiation, without the need for retrofitting. In addition, by making use of dry ashing and cooling methods, the project would have reduced water requirements when compared with some of Eskom's older fleet, as required in terms of the National Water Resource Strategy 2.

5.2 Need and Desirability of the project from a Regional Perspective

South Africa's electricity generation mix has historically been dominated by coal. This can be attributed to the fact that South Africa has abundant coal deposits, which are relatively shallow with thick seams, and are therefore easy and comparatively cost effective to mine. According to the coal reserve and resource study conducted by the Council for Geo-Science in 2011, South Africa has in excess of 66 billion tons of coal resources and reserves remaining, with coal supply estimated to be in excess of 200 years at the current production rates (Eskom, 2015). Whereas the majority of South Africa's operational coal mines, and as a result coal-fired power stations, are currently located within Mpumalanga Province, this is likely to change as Limpopo's coal resources are exploited. This is due to the fact that the location options for coal-fired power generation facilities are largely limited by the location of coal resources. Transportation costs associated with transporting coal pose a significant limiting factor in terms of locating a project of this nature. In addition, impacts associated with the development of new large-scale infrastructure over long distances have negative environmental implications which should as far as possible be avoided.

The Mutsho Power Project proposes making use of coal mined at the Makhado Colliery which is to be developed approximately 20km south-east of the project site. The Makhado Colliery is estimated to operate for 16 years at full capacity (supplying approximately 2.3 million tons hard coking coal and 3.2 million tons thermal coal per annum). In 2017 MCM announced that it would initiate mining via the Makhado Lite Project. This will result in decreased volumes being mined initially, which will extend the life of the colliery past the 16 year lifespan. Additional life extension is further possible through the use of adjacent pits and surrounding coal fields as part of the GSP Project. Coal will be transported to site either via a new railway loop proposed for development between Makhado Colliery and the existing Huntleigh Railway siding, or by existing road infrastructure. The railway loop is proposed as part of the Makhado Project to allow for ease of access to railway infrastructure, and is therefore not dependent on the development of the power station. The implementation of the proposed project at the proposed site would however allow for optimal use to be made either of existing infrastructure (i.e. roads), or proposed mining infrastructure (i.e. rail).

Once developed the Makhado Colliery is expected to produce coal for domestic or export markets. The development of the project within proximity of the Makhado Colliery would provide a local market for a portion of the coal which constitutes a locally mined resource. The development of the Mutsho Power Project would support a new mining operation which has already been authorised for development, while some impacts associated with the transportation and export of a portion of thermal coal to be mined by Makhado Colliery can be reduced.

The implementation of the proposed project at the preferred location is also desirable from a regional and local planning perspective which can be demonstrated as detailed in the following sections.

5.2.1 Limpopo Development Plan (LDP) 2015 – 2019

The Limpopo Development Plan provides a framework for the strategic plans of each provincial government department. The LDP makes a case for the investment in a strong network of economic infrastructure designed to support economic and social objectives. The Limpopo Provincial Government views economic infrastructure as a base for economic and social upliftment. As a means to achieve this, the provincial government sought to attract investment in coal and energy. Furthermore, to expand business activities in the province, the coal and energy SMME growth initiative is promoted. The energy sector therefore has the power to contribute to and maintain the growth of the provincial economy.

The desire to attract investment in coal and energy and the development of a coal and energy SMME indicates the Province's support of the development of energy generation projects within the region.

5.2.2 Vhembe District Municipality Integrated Development Plan (IDP) 2016/2017

Service delivery, infrastructure development, socio-economic development, poverty and unemployment have been identified as priority areas for the Vhembe DM. As part of its mission the Vhembe DM has identified sustainable socio-economic development and service delivery as a means of addressing poverty and unemployment.

The development of the Mutsho Power Project would contribute towards employment creation, both directly and indirectly, which could contribute somewhat towards reducing unemployment and poverty levels within the District. In addition the provision of addition electricity within the District could contribute towards some of the current problems faced with regards to energy supply. There are currently 12 substations within the District, and a backlog of 9 x 132/22kV to be built. Challenges include energy supply and interruption, lack of capacity to supply the demand, insufficient capacity of the power stations to supply all areas in the district, cable theft, Illegal connections, poor project management PSPs and slow rate of construction.

5.2.3 Musina Local Municipality Integrated Development Plan (IDP) 2016/2017

The Musina LM has a dualistic economy comprising a "commercial" component located in Musina (urban area) and "non-commercial" component. Development constraints encountered in respect of the "non-commercial component" within which the Mutsho Power Project is proposed include, amongst others, the following:

» The natural resource base and economy does not have the capacity to support the total population, forcing a large percentage of the labour force to seek employment opportunities outside of the municipality.
» The low levels of income from the formal sector forced a portion of the population still residing in the area to enter and participate in informal and marginal activities.
» The low level of income also implies low levels of buying power and, therefore, few opportunities for related activities such as trade. This in turn supports the leakage of buying power since there are fewer local outlets to buy from.

- The economic relationship between the settlements in the municipality and Musina CBD are not strong.
- Employment opportunities in Musina should also benefit people from the other settlements.
- There is a shortage of job opportunities and job creation in the area.

The development of the Mutsho Power Project could be expected to contribute positively towards both increased electricity supply and new employment opportunities. More specifically, such employment opportunities would be formalised, and would be generated outside of the Musina CBD. The creation of new employment opportunities would also in turn contribute towards buying power which will have trickle-down effects for individuals who are not directly employed by the project.

5.3 Receptiveness of the proposed project site to development of the Mutsho Power Project

The overarching objective of the Mutsho Power Project is to maximise electricity production utilising coal resources, while minimising infrastructure, operational and maintenance costs, as well as social and environmental impacts. From a regional site selection perspective, the Limpopo region is considered to be favourable for the development of coal-fired electricity generation projects due to its extensive coal resources. Due to the nature of the project, the location of the facility is largely dependent on technical and environmental factors such as coal resources (i.e. the fuel source), availability of developable land, and access to the electricity grid.

From a local perspective, the project site has been confirmed by Mutsho Power as being technically suitable for the development of a coal-fired power station due to its proximity to the coal resource (i.e. the Makhado Colliery), site access (i.e. to facilitate the movement of machinery and vehicles during the construction and operation phase), land availability (i.e. the land is available for the intended use) and the extent of the site (i.e. the land parcel is able to accommodate the approximate 350ha required for the project, enabling optimal placement of infrastructure while considering potential environmental sensitivities). These criteria are further explored in the sections below.

Extent of the site: The Mutsho Power Project and its associated infrastructure requires an area of land approximately 350ha in extent. The preferred project site which has been identified for the project following the completion of an Environmental Site Screening Assessment is approximately 2 161ha in extent, of which, approximately 350ha (equivalent to approximately 16% of the total area) is required for the development of the project. The extent of the identified project site is therefore considered sufficient for the establishment of the proposed project, while still allowing for the avoidance of environmental sensitivities (refer to **Chapter 3** for details of layout alternatives being considered).

Site access: Access to the Farm Vrienden 589 is obtained via D1201 which traverses the south-western extent of the property. D1021 can be accessed directly via the N1 National Road and ends at the Huntleigh railway siding. In addition the D744 (Mopane-Waterpoort road) runs parallel to the existing railway line along the boundary of the two sites (i.e. the south-eastern boundary of the Farm Du Toit 563 and the north-western boundary of the Farm Vrienden 589), and provides primary access to the Farm Du Toit 563.

Current land use considerations: The two properties comprising the project site have a land use zoning of agriculture. Portions of the Farm Du Toit are currently used for ad hoc agricultural practices (i.e. cultivated land and cattle grazing). The properties comprising the project site are privately owned and belong to Mr. Souis Hendrie Van Der Walt (Du Toit 563) and Fumaria Property Holdings (Pty) Ltd (Vrienden 589). Landowner Consent forms confirming that the landowners have been informed that an EIA process is being undertaken for the Mutsho Power Project and providing consent for the undertaking of the proposed Mutsho Power Project on the respective project sites provided all required consents are obtained have been signed by both of the respective landowners.

Coal resource: The development of the proposed project is directly dependent on the availability of a coal resource, which has been identified as the Makhado Colliery to be developed approximately 20km south-east of the project site. CoAL concluded a Class II Definitive Feasibility Study on the Makhado Colliery which confirmed that the Makhado Project has 344.8Mt mineable tonnes in situ (MTIS). This mine was granted a New Order Mining Right (NOMR) from the Department of Mineral Resources (DMR) in May 2015 (LP 30/5/1/2/2/204 MR). The Makhado Colliery is estimated to operate for 16 years at full capacity (supplying approximately 2.3 million tons hard coking coal and 3.2 million tons thermal coal per annum). Additional life extension is possible through the use of adjacent pits and surrounding coal fields as part of the GSP Project.

Proximity to Musina and Makhado SEZs: The development of the proposed project is in close proximity to the designated Musina-Makhado Special Economic Zone (SEZ). The SEZ programme is one of the tools identified by National government to boost the country's industrialisation and manufacturing capacity. The development of the SEZ is intended to accelerate economic growth, attract foreign and domestic direct investment, expand the manufacturing sector and mineral beneficiation, as well as create employment in the region. Once developed the SEZ will include several energy intensive industrial users, including mineral beneficiation and base metal refineries. Locating a power station close to such a load centre enables the potential for development and reduces the risk of the traditionally long distance supply constraints in Eskom's radially connected transmission system thus enabling supply stability in the greater Musina and Makhado area. In addition, the development of the Mutsho Power Project at the proposed site (i.e. in close proximity to the designated Musina-Makhado SEZ) would allow for the increased availability of electricity to support and encourage future development within and of the Musina-Makhado SEZ, as well as the Musina and Makhado regions as a whole.

Proximity to towns with a need for socio-economic upliftment: The development of the Mutsho Power Project would contribute towards providing employment (both directly and indirectly) within the Musina Local Municipality, Makhado Local Municipality, and Vhembe District Municipality. In addition socio-economic benefits required under the CBIPPPP would make a significant contribution to the area.

Environmental sensitivity of the site: The Scoping process conducted for the project to date has identified no fatal flaws which could restrict the development of the proposed project at the preferred site. Sensitive areas which have been identified onsite can be excluded from the development footprint, as is evident in the layout alternatives presented in **Chapter 3**.

5.4 Socio-Economic Benefits

The development of the Mutsho Power Project has the potential to result in a number of socio-economic benefits as identified in the independent Socio-Economic Specialist Study conducted as part of the EIA process (refer to **Appendix M**). Such benefits would accrue at a local, regional and national level, and are discussed in more detail under the respective sub-headings.

5.4.1 Employment Creation

A third of the working age population in the Musina Local Municipality are unemployed. The development of the Mutsho Power Project will improve this situation and positively impact the community by creating an estimated 3 500 job opportunities during construction. This will improve the socio-economic well-being of the benefitting population, albeit for a temporary period.

The energy sector currently employs the least number of people in the Musina Local Municipality. The operation of the Mutsho Power Project will improve this situation as about 200 jobs may be created for a long-term period during operation. Further, employment opportunities will be created within the local municipality and across South Africa as a result of the project's multipliers. Considering there are about 15 000 unemployed people in the Musina Local Municipality, the creation of sustainable employment opportunities may reduce this number and improve the employment statistics. The demand for supporting services and other goods and services to be created as a result of multiplier effects will also lead to the creation of additional jobs, increasing the positive effect on employment in the region.

5.4.2 Positive impact on skills development

Skills are imperative for satisfying job requirements and adequately performing tasks that ultimately boost the economy. The construction of the project requires a variation of skill sets ranging from semi-skilled construction workers to highly skilled engineers. Employees who are new to the market will develop and attain new skills, whilst workers adept in particular skills will sharpen their abilities. In addition, the employees will improve their marketability for future employment and will be perceived positively by future employers. The construction of the project will improve the current status of 46% low-skilled employees and 15% skilled employees in the Musina Local Municipality.

The employment opportunities generated during the operation of the project will also have a positive impact on skills for benefitting employees. Furthermore, as production and consumption effects filter through the economy creating a demand for additional labour, human resources will be trained and skilled within aligned industries. Ultimately, the Mutsho Power Project will lead to enhanced skills through training and experience in the wider national economy.

5.4.3 Positive impact on household income

Over half the population of the Musina Local Municipality are classified as low-income earners. An increase in disposable income often means that benefiting households (who are also consumers) have the opportunity to make a wider variety of lifestyle choices. In the context of the Mutsho Power Project, workers employed during construction and operation as well as their households will increase the income of their respective households and can expect an improvement in their quality of life and standards of living. The increase in income will assist in access to health care, recreational facilities and leisure. It is likely that households benefitting from the increased income as a result of the multiplier effects which will be spread across South Africa; however, some of the benefits will be concentrated locally.

5.4.4 Increase in production and GDP-R

The construction phase of the project will involve activities such as engineering and design, site and infrastructure development, construction of buildings and facilities, civil engineering works, and other business activities related to the construction of the power station. The economic impact arising from the initial investment will be felt throughout the economy with windfall effects benefitting related sectors in the economy. These various impacts or spill-over effects will spread throughout the economy, contributing to heightened production levels. The initial investment will give rise to a production effect where manufacturers and suppliers of goods and services would experience the need to expand current production levels by ramping up employee numbers and operations. Down-the-line effects will produce a consumption-induced effect on the wider economy - as total salaries paid-out rises, consumer expenditure will lift, thereby raising the sales of goods and services in the surrounding economy.

The Musina Local Municipality's economy was valued at R7 405 million in 2016 (current prices). About R15 billion could be expected to be invested during the construction phase. Considering the requirement stipulated by the DoE, at least 40% of capital expenditure (CAPEX) on the Mutsho Power Project will need to be localised. This includes among others, procurement of the majority of steel power pylons, electrical and telecom cables, as well as valves and actuators from within South Africa. While it will not be possible to source all materials locally, if effort is made to use local suppliers as far as possible, the positive impact on the local economy will be increased. Given that numerous similar projects have been established in the province, a possibility of up-stream businesses may have proliferated in support of the industry.

The proposed development will also provide a sustainable increased revenue to the local government in the form of property rates and taxes. It will further supplement the revenue derived from national government. Moreover, national government will derive tax-related revenue such as Value-Added Tax (VAT), payroll and income taxes. This is as a result of the employment that will be created and the resultant income that will be earned, thus increasing spending power. The increased revenue from the project may assist the Musina Local Municipality's, whereby constituencies may utilise it for public services, such as addressing the housing backlog and service deliver. Overall, the allocation of government revenue should improve socio-economic conditions of the population.

CHAPTER 6 APPROACH TO UNDERTAKING THE EIA PROCESS

An EIA process refers to that process (conducted in accordance with the requirements of the relevant EIA Regulations (i.e. the 2014 EIA Regulations, as amended (GNR 326) in this instance) which involves the identification of and assessment of direct, indirect, and cumulative, environmental impacts associated with a proposed project or activity. The EIA process culminates in the preparation and submission of a Final EIA Report (including an Environmental Management Programme (EMPr)) to the competent authority for decision-making.

An overview of the EIA process is illustrated in **Figure 6**.1.

Figure 6.1: The Phases of an Environmental Impact Assessment (EIA) Process.

The development of the Mutsho Power Project requires Environmental Authorisation (EA) in accordance with the requirements of Section 24 of the National Environmental Management Act (No. 107 of 1998) (NEMA) and EIA Regulations (GNR 326). In terms of Section 19 of the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA) and the List of Waste Management Activities (GNR 921), the project also requires a Waste Management Licence (WML) for the disposal of hazardous waste to land. The EIA for the Mutsho Power Project is therefore being undertaken in support of an integrated application for EA and a WML. Mutsho Power has appointed Savannah Environmental (Pty) Ltd, as the independent environmental consultants responsible for undertaking the EIA process required in support of the Integrated Application for EA and a WML for the Mutsho Power Project. An integrated application for EA and a WML was prepared and submitted to DEA, and the project was assigned Application Reference number: **14/12/16/3/3/3/2220**.

The EIA process will also support future applications for an Integrated Water Use License (IWUL) required in terms of Section 21 of the National Water Act (No. 36 of 1989) (NWA) and the Regulations Regarding the Procedural Requirements for Water Use License Application and Appeals (GNR 267); and an Atmospheric Emissions License (AEL) required in terms of Section 21 of the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA) and the List of Activities resulting in Atmospheric Emissions (GNR 893). In terms of the CBIPPPP, the process of applying for an IWUL can only be completed once the Mutsho Power Project has been identified as a Preferred Bidder. Therefore while the need to apply for an IWUL has been included as part of the EIA process, the process of applying for an IWUL can only be undertaken following the receipt of a positive EA, the conclusion of the next CBIPPPP bidding round, and the announcement of the Mutsho Power Project as a Preferred Bidder. The process of applying for an AEL can also only be completed following the completion of an EIA process, once EA has been granted for the project.

This Chapter provides a brief overview of NEMA and the EIA Regulations, as amended (GNR 326) and their application to the Mutsho Power Project.

6.1 Relevant legislative permitting requirements

The legislative permitting requirements applicable to the Mutsho Power Project as identified at this stage in the process are described in more detail under the respective subheadings.

6.1.1 National Environmental Management Act (No. 107 of 1998) (NEMA)

NEMA is South Africa's key piece of national environmental legislation that provides for the authorisation of certain controlled activities known as "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant Environmental Authorisation. Due to the fact that the Mutsho Power Project is a power generation project which is considered to be of national importance, and due to the fact that the project requires licensing for hazardous waste activities (i.e. the ash dump), the National Department of Environmental Affairs (DEA) is the competent authority. The Mutsho Power Project therefore requires authorisation from the National Department of Environmental Affairs (DEA), with the Limpopo Department of Economic Development, Environment, and Tourism (LDEDET) acting as the commenting authority.

The need to comply with the requirements of the EIA Regulations ensures that developers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimised or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the competent authority with sufficient information in order for an informed decision to be taken regarding the project.

Listed Activities are activities identified in terms of Section 24 of NEMA which are likely to have a detrimental effect on the environment, and which may not commence without Environmental Authorisation (EA) from the competent authority. EA required for Listed Activities is subject to the completion of an environmental assessment process (either a Basic Assessment (BA) of full Scoping and Environmental Impact Assessment (S&EIA)).

Table 6.1 contains all the listed activities identified in terms of NEMA, the EIA Regulations of April 2017 (GNR 326) and Listing Notices (GNR 327, 325, and 324) which may be triggered by the development of the Mutsho Power Project, and for which EA has been applied. The table also includes a description of those project activities which relate to the applicable listed activities. The project requires a full S&EIA process based on the fact that listed activities contained within Listing Notice 2 (GNR 325) are likely to be triggered.

Table 6.1: Listed activities identified in terms of the Listing Notices (GNR 327, 325 and 324) published under NEMA on 07 April 2017.

Notice Number	Activity Number	Description of listed activity
Listing Notice 1 (GNR 327) 07 April 2017	9	The development of infrastructure exceeding 1 000m in length for the bulk transportation of water or storm water – (i) With an internal diameter of 0.36m or more; or

Notice Number	Activity Number	Description of listed activity
		(ii) With a peak throughput of 120l/s or more ***Pipelines are required for the bulk transportation of water and storm water within the project site. These pipelines are anticipated to either have an internal diameter of 0.36m or more, or a peak throughput of 120l/s and will have a combined length greater than 1km.***
Listing Notice 1 (GNR 327) 07 April 2017	10	The development and related operation of infrastructure exceeding 1 000m in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes (i) With an internal diameter of 0.36m or more; or (ii) With a peak throughput of 120l/s or more ***Pipelines are required for the bulk transportation of effluent, process water and waste water within the proposed project site. These pipelines are anticipated to either have an internal diameter of 0.36m or more, or a peak throughput of 120l/s and will have a combined length greater than 1km.***
Listing Notice 1 (GNR 327) 07 April 2017	12	The development of – (i) Infrastructure or structures with a physical footprint of 100m² or more where such development occurs – (a) Within a watercourse (c) If no development setback exists, within 32m of a watercourse, measured from the edge of a watercourse ***Depending on the final location of the development footprint within the greater project site the possibility exists that infrastructure or structures exceeding 100m² in size may be developed within or within 32m of a watercourse.***
Listing Notice 1 (GNR 327) 07 April 2017	13	The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000m³ or more, unless such storage falls within the ambit of Activity 16 in Listing Notice 2 of 2014. ***Storage dams including a raw water storage dam, clean water stormwater dam, and polluted water stormwater are proposed for development. While the exact storage capacity is currently unknown they will have a combined capacity greater than 50 000m³.***
Listing Notice 1 (GNR 327) 07 April 2017	14	The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80m³ or more but not exceeding 500m³. ***Dangerous substances (such as fuel, oils, chemicals, etc.) would need to be stored onsite. The storage capacity of such containers would exceed 80m³.***
Listing Notice 1 (GNR 327) 07 April 2017	19	The infilling or depositing of any material of more than 10m³ into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10m³ from a watercourse.

Notice Number	Activity Number	Description of listed activity
		Depending on the final location of the development footprint within the greater project site the possibility exists that 10m³ of material may be excavated, removed or moved from a watercourse.
Listing Notice 1 (GNR 327) 07 April 2017	24	The development of a road— (ii) With a reserve wider than 13.5m, or where no reserve exists where the road is wider than 8m. ***Access roads are required to provide access to and within the proposed project site, and these are anticipated to be wider than 8m.***
Listing Notice 1 (GNR 327) 07 April 2017	28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development: (ii) Will occur outside an urban area, where the total land to be developed is bigger than 1ha ***The project will result in the transformation of approximately 350ha of land which has previously been used for agriculture since 01 April 1998, to industrial use.***
Listing Notice 2 (GNR 325) 07 April 2017	2	The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is 20MW or more. ***The power station will utilise coal, a non-renewable resource, and will have a generation capacity of up to 600MW.***
Listing Notice 2 (GNR 325) 07 April 2017	6	The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent ***An Integrated Water Use License (IWUL) is required for Section 21 uses, including Section 21 (g) – Disposal of water or water containing waste that may detrimentally affect a water resource.*** ***An Atmospheric Emissions License (AEL) is required under the NEM:AQA for the storage of coal and the release of emissions to the atmosphere.***
Listing Notice 2 (GNR 325) 07 April 2017	9	The development of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275kV or more, outside an urban area or industrial complex. ***A HV yard, switchgear and transmission connections will be established onsite to allow for the evacuation of electricity generated by the project into the national electricity grid. This is anticipated to have a capacity greater than 275kV.***
Listing Notice 2 (GNR 325) 07 April 2017	15	The clearance of an area of 20ha or more of indigenous vegetation. ***The development of the proposed project would require an area greater than 20ha to be cleared of vegetation.***

6.1.2 National Environmental Management: Waste Act (No. 58 of 2008) (NEM:WA)

Waste Management Activities are activities identified in terms of Section 19(2) of the National Environmental Management: Waste Act (No. 58 of 2008) (NEM:WA) that have, or are likely to have, a detrimental effect on the environment; and in respect of which a Waste Management License (WML) is required in accordance with Section 20(B) of NEM:WA. An EA process, as contemplated in the EIA Regulations (GNR 982) must be conducted in support of any WML applications.

Waste Management Activities are divided into 3 categories, namely: Category A, Category B and Category C. Waste Management Activities listed under Category A, require that a BA process be conducted while Category B activities require a full S&EIA process be conducted in support of the WML Application. Activities listed under Category C require compliance with the relevant requirements or standards, as determined by the Minister of Environmental Affairs.

Table 6.2 contains all the Waste Management Activities identified in terms of NEM:WA and the List of Waste Management Activities (GNR 921) which may be triggered by the project, and for which a WML has been applied through means of an integrated application for EA and a WML. The table also includes a description of those project activities which relate to the applicable Waste Management Activities.

Table 6.2: Waste Management Activities identified in terms of the List of Waste Management Activities (GNR 921) published under NEM:WA on 29 November 2013.

Notice No.	Activity No :	Description of Waste Management Activity
GNR 921 29 November 2013	Category B 7	The disposal of any quantity of hazardous waste to land. ***Ash generated as a result of an electricity generation process is considered to constitute a hazardous waste. Ash generated by the project will be stored in an ash dump to be established onsite.***
GNR 921 29 November 2013	Category B 10	The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity). ***Ash generated by the project will be stored in an ash dump to be established onsite.***

6.1.3 National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA)

The List of Activities which Result in Atmospheric Emissions (GNR 893) are activities identified in terms of Section 21 of the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA) which result in atmospheric emissions and which have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage; and which may not commence without an Atmospheric Emission License (AEL).

An applicant wishing to undertake an activity identified in terms of the List of Activities which result in Atmospheric Emissions (GNR 893) must apply for an Atmospheric Emissions License (AEL) by lodging an online application with the Atmospheric Emissions Licensing Authority (AELA), in this instance the DEA. The process of applying for an AEL will only be completed once the EIA process has been finalised and Environmental Authorisation (EA) has been obtained for the project.

Table 6.3 contains activities identified in terms of NEM:AQA and the List of Activities which Result in Atmospheric Emissions (GNR 893) of 22 November 2013 which may be triggered by the proposed project, and for which an AEL is required. The table also includes a description of those project activities which relate to the applicable Atmospheric Emission Activities.

Table 6.3: Activities identified in terms of the List of Activities which result in Atmospheric Emissions (GNR 893) published under NEM:AQA on 22 November 2013.

<table>
<tr><th>Notice No.</th><th>Activity No :</th><th colspan="4">Description of Atmospheric Emission Activity:</th></tr>
<tr><td rowspan="11">GNR 893
22
November
2013</td><td rowspan="11">Category 1
Combustion
Installations
Subcategory 1.1:
Solid Fuel
Combustion
Installations</td><td>Description:</td><td colspan="3">Solid fuels combustion installations used primarily for steam raising or electricity generation</td></tr>
<tr><td>Application:</td><td colspan="3">All installations with design capacity equal to or greater than 50MW heat input per unit, based on the lower calorific value of the fuel used.</td></tr>
<tr><td colspan="2">Substance or mixture of substances</td><td rowspan="2">Plant Status</td><td rowspan="2">mg/Nm³ under normal conditions of 10% O2, 273 Kelvin and 101.3 kPa.</td></tr>
<tr><td>Common Name</td><td>Chemical Symbol</td></tr>
<tr><td rowspan="2">Particulate matter</td><td rowspan="2">N/A</td><td>New</td><td>50</td></tr>
<tr><td>Existing</td><td>100</td></tr>
<tr><td rowspan="2">Sulphur dioxide</td><td rowspan="2">SO_2</td><td>New</td><td>500</td></tr>
<tr><td>Existing</td><td>3,500</td></tr>
<tr><td rowspan="2">Oxides of nitrogen</td><td rowspan="2">NO_X expressed as NO_2</td><td>New</td><td>750</td></tr>
<tr><td>Existing</td><td>1,100</td></tr>
<tr><td colspan="4">The operation of the Mutsho Power Project will burn coal, a solid fuel in boilers with a heat input greater than 50MW per unit as part of a combustion process to generate electricity</td></tr>
<tr><td rowspan="8">GNR 893
22
November
2013</td><td rowspan="8">Category 5
Mineral
Processing,
Storage and
Handling
Subcategory 5.1:
Storage and
Handling of Ore
and Coal</td><td>Description:</td><td colspan="3">Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act (No. 29 of 1996).</td></tr>
<tr><td>Application:</td><td colspan="3">Locations designed to hold more than 100,000 tons.</td></tr>
<tr><td colspan="2">Substance or mixture of substances</td><td rowspan="2">Plant Status</td><td rowspan="2">mg/Nm³ under normal conditions of 10% O2, 273 Kelvin and 101.3 kPa.</td></tr>
<tr><td>Common Name</td><td>Chemical Symbol</td></tr>
<tr><td rowspan="2">Dustfall</td><td rowspan="2">N/A</td><td>New</td><td>a</td></tr>
<tr><td>Existing</td><td>a</td></tr>
<tr><td colspan="4">[a] three months running average not to exceed limit value for adjacent land use according to dust control regulations promulgated in terms of Section 32 of the NEM: AQA, 2004 (Act No. 39 of 2004), in eight principal wind directions.</td></tr>
<tr><td colspan="4">A 15-day working coal stockpile and strategic coal stockpile will be established onsite. The storage capacities of the proposed coal stockpiles will exceed 100 000 tons.</td></tr>
</table>

6.1.4 National Water Act (No. 36 of 1998) (NWA)

In accordance with the provisions of the National Water Act (No. 36 of 1998) (NWA), all water uses must be licensed with the Competent Authority (i.e. the Regional Department of Water and Sanitation (DWS)). Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation.

Table 6.4 below contains Water Uses associated with the proposed project and identified in terms of the NWA which require licensing as part of a Integrated Water Use License (IWUL). The table also includes a description of those project activities which relate to the applicable Water Uses.

Table 6.4: List of Water Uses published under Section 21 of NWA, as amended.

Notice No.	Activity No.	Description of Water Use
NWA (No. 36 of 1998)	Section 21 (a)	Taking water from a water resource. ***Bulk water required for the project is likely to comprise either treated effluent from the Makhado Rietvly WWTW (Preferred Option), or water from dams in Zimbabwe via the Zimbabwe to South Africa Water Project (Alternative Option). Bulk water required for the project would therefore comprise water which would have been taken from a water resource (i.e. from dams in Zimbabwe via the Zimbabwe to South Africa Water Project), or which otherwise would have been released to the natural system (i.e. treated effluent from the Makhado Rietvly WWTW).***
NWA (No. 36 of 1998)	Section 21 (b)	Storing water. ***Bulk water required for the project will be stored in a raw water storage dam prior to being treated in the onsite wastewater treatment plant (WWTP).***
NWA (No. 36 of 1998)	Section 21 (c) Section 21 (i)	Impeding or diverting the flow of water in a watercourse. Altering the bed, banks, course or characteristics of a watercourse. ***The development of access roads or other associated project infrastructure required for the project may result in the flow of water in a watercourse being impeded or diverted, and the bed, banks, course or characteristics of a watercourse being altered.***
NWA (No. 36 of 1998)	Section 21 (g)	Disposing of waste in a manner which may detrimentally impact on a water resource. ***The development of the strategic coal stockpile, ash dump, stormwater runoff dam, ash dump runoff dam have the potential to impact negatively on nearby water resources, including groundwater resources, and would therefore trigger a Section 21(g) water use.***
NWA (No. 36 of 1998)	Section 21 (h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process. ***Water which would have been heated in the power generation process will be disposed of onsite.***

An Integrated Water Use License (IWUL) will be applied for in accordance with the Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals (GNR 267) published under Section 26(1)(k) and 41(6) of the NWA on 24 March 2017. However the application process will only be completed once a positive EA has been received, the next CBIPPPP bidding round has been concluded, and the Mutsho Power Project has been selected as a Preferred Bidder. As per DWS's requirements, DWS will not receive applications or engage in the evaluation process of any WUL or IWUL applications for IPP projects until such time as a project is awarded preferred bidder status.

The DWS prepared a Guidance Note regarding water availability and water use licensing for the Coal Baseload Independent Power Producer (IPP) Procurement Programme which provides information to form the basis for engagement required between prospective bidders and the DWS (DWS, 2015). The guidance note states that the impact that any project established in terms of the CBIPPPP will have on water resources will need to be carefully considered by the DWS when the WUL or IWUL applications are evaluated. It is ultimately a bidder's responsibility to ensure that a project intended to participate in the CBIPPPP is located in an area where water will be available for the requirements of the proposed project and that such water will be available for the duration of the proposed term of the PPA.

Due to water scarcity, the DWS gives preference to water saving technologies in power generation such as dry cooling, dry ashing, and the reuse of treated wastewater, etc. when considering WUL or IWUL applications. Prospective bidders need to demonstrate that they have consulted with DWS regarding all of their water uses and that their WUL or IWUL application is complete and ready for submission to the DWS should they be selected as a Preferred Bidder.

6.1.5 National Heritage Resources Act (No. 25 of 1999) (NHRA)

The National Heritage Resources Act (No. 25 of 1999) (NHRA) provides an integrated system which allows for the management of national heritage resources and to empower civil society to conserve heritage resources for future generations. Section 38 of NHRA provides a list of activities which potentially require the undertaking of a Heritage Impact Assessment.

<u>Section 38: Heritage Resources Management</u>

1). *Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as –*
   - a. *the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;*
   - b. *the construction of a bridge or similar structure exceeding 50 m in length;*
   - c. *any development or other activity which will change the character of a site –*
     - i). *exceeding 5 000m² in extent; or*
     - ii). *involving three or more existing erven or subdivisions thereof; or*
     - iii). *involving three or more erven or divisions thereof which have been consolidated within the past five years; or*
     - iv). *the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;*

   Must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In terms of Section 38(8), approval from the heritage authority is not required if an evaluation of the impact of such development on heritage resources is required in terms of any other legislation (such as NEMA), provided that the consenting authority ensures that the evaluation of impacts fulfils the requirements of the relevant heritage resources authority in terms of Section 38(3) and any comments and recommendations of the relevant resources authority with regard to such development have been taken into account prior to the granting of the consent. However, should heritage resources of significance be affected by the proposed development, a permit is required to be obtained prior to disturbing or destroying such resources as per the requirements of Section 48 of the NHRA, and the South African Heritage Resources Agency (SAHRA) Permit Regulations (GNR 668).

6.2 Scoping Phase

The Scoping Phase of the EIA process refers to the process of identifying potential issues associated with the proposed project, and defining the extent of studies required during the EIA Phase. This is achieved through an evaluation of the proposed project, involving the project proponent, specialists with relevant experience, and a public consultation process with key stakeholders (including government authorities) and Interested and Affected Parties (I&APs).

In accordance with Appendix 2 of the EIA Regulations (GNR 326), the objectives of the Scoping Phase is to, through a consultative process:

» Identify the relevant policies and legislation relevant to the activity.
» Motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location.
» Identify and confirm the preferred activity and technology alternative through an identification of impacts and risks and ranking process of such impacts and risks.
» Identify and confirm the preferred site, through a detailed site selection process, which includes and identification of impacts and risks inclusive of identification of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment.
» Identify the key issues to be addressed in the assessment phase.
» Agree on the level of assessment to be undertaken, including the methodology to be applies, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risk the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site.
» Identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

The preparation and release of a Scoping Report for a 30-day public review period provided stakeholders and I&APS with an opportunity to verify that the issues they had raised during the Scoping process had been captured and adequately considered, and provided a further opportunity for additional key issues to be raised for consideration. The Final Scoping Report incorporated all issues and responses raised during the Scoping Phase prior to submission to the DEA. The Final Scoping Report was accepted by DEA on 24 November 2017 (refer to **Appendix C**). Additional information requested by DEA in acceptance of the Scoping Report and the location of the requested information in this EIA Report is detailed in **Table 6.5**.

Table 6.5: DEA requirements and reference to Section in the EIA Report.

DEA requirement for EIA	Section in report
Comments from all relevant stakeholders must be submitted to the Department with the Environmental Impact Report (EIR). This includes but is not limited, to comments from the Limpopo: Department of Economic Development Environment and Tourism as well as the National Department of Water and Sanitation. Proof of correspondence with the various stakeholders must be included in the Final EIR. Should you be unable to obtain comments, proof of the attempts made to obtain comments should be submitted to the Department	Appendix C.
The following amendments and additional information are required for the EIR: a) The proposed development triggers a listed activity in terms of Section 21 listed activity of the National Environmental Management: Air Quality Act (No. 39 of 2004), Category 1, and Sub-category 1.1 (Solid fuel combustion installations) therefore an Atmospheric Impact Assessment study that includes air dispersion modelling must be conducted.	Appendix E.
b) The Application for Atmospheric Emission License should be lodged with the relevant licensing authority.	The need for an AEL has been identified, however the process of applying for an AEL will only be completed once EA has been received for the project (Chapter 6).
c) The air pollution control device (abatement equipment) maintenance programme must be developed and implemented; to ensure that the air pollution control device does not result in substantial emissions increase.	Appendix E.
d) The knowledge of the prevailing wind should be taken into account when positioning the stockpiles and gypsum disposal sites.	Appendix E.
e) Necessary measures must be undertaken in coal stockpiles in order to avoid spontaneous combustion.	Appendix E.
f) Dust fall out and Particulate Matter monitoring must be conducted during construction and operation and quarterly monitoring reports must be submitted to this Department for review.	Appendix O.
g) All transportation equipment must be covered in such a way that fugitive dust emissions are minimized.	Appendix O.
h) The Climate Change Impact Assessment study should explain how the proposed coal fired power station will contribute to climate change over its lifetime by:	Appendix F.
i) Quantifying GHG emissions during construction, operation and decommissioning.	Appendix F.
j) Identifying the environmental, social and economic impacts of climate change and how the impacts may be avoided, mitigated, or remedied.	Appendix F.
k) The proposed power plant will impact on air quality in the vicinity of the plant and further afield by increasing ambient concentrations. However, the power plant will be required to operate according to Minimum Emissions Standards for SO_2, NO_X and particulates and within respective NAAQS for SO_2, NO_2 and PM_{10}.	Appendix E.
m) It is recommended that the following are assessed in the air quality specialist study: i) Predict ambient concentrations of SO_2, NO_X, and particulates resulting from stack emissions as well as coal processing and ash disposal at the proposed coal-fired power plant for the following scenarios:	Appendix E.

DEA requirement for EIA	Section in report
» Construction (particulates only). » Operations, for the power plant in isolation and against the existing air pollution load of the area (i.e. cumulative effects). » Decommissioning (particulates only).	
ii) The potential risk impact associated with the predicted ambient concentration in potentially affected communities	Appendix E.
iii) iii) Relative contribution of Greenhouse Gas (GHG) emissions associated with the proposed facility to global warming	Appendix F.
The Final EIR must include at least one A3 regional map of the area and the locality maps included in the Final EIR illustrate the different proposed alignments and above ground storage of fuel. The maps must be of acceptable quality and as a minimum, have the following attributes: » Maps are relatable to one another » Cardinal points » Coordinates » Legible legends » Indicate alternatives » Latest land cover » Vegetation types of the study area » A3 size locality map	Appendix B
Should an application for Environmental Authorisation be subject to the provisions of Chapter 2, Section 38 of the National Heritage Resources Act (No. 25 of 1999) (NHRA) the Department will not be able to make nor issue a decision in terms of the application for EA pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter 2, Section 38(8) of the NHRA.	Noted. Comment has been requested from SAHRA.

6.3 EIA Phase

As per the EIA Regulations (GNR 326) the objectives of the EIA Phase are to, through a consultative process:

» Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context.
» Describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted Scoping Report.
» Identify the location of the development footprint within the approved site as contemplated in the accepted Scoping Report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment.
» Determine the:
  * Nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
  * Degree to which these impacts:
    - Can be reversed
    - May cause irreplaceable loss of resources

  - Can be avoided, managed or mitigated

» Identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted Scoping Report based on the lowest level of environmental sensitivity identified during the assessment.
» Identify, assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted Scoping Report through the life of the activity;
» Identify suitable measures to avoid, manage or mitigate identified impacts.
» Identify residual risks that need to be managed and monitored.

This EIA Report assesses potential positive and negative, direct, indirect, and cumulative impacts associated with all phases of the project life cycle including pre-construction, construction, operation and decommissioning. In this regard the EIA Report aims to provide the relevant authorities with sufficient information to make an informed decision regarding the proposed project.

6.3.1 Tasks completed during the EIA Phase

The EIA Phase for the Mutsho Power Project has been undertaken in accordance with the EIA Regulations (GNR 326) published in terms of Section 24(5) of NEMA.

Key tasks undertaken during the EIA Phase to date include:

» Consultation with relevant decision-making and regulating authorities (at National, Provincial and Local levels).
» Undertaking a Public Participation process throughout the EIA process in accordance with the requirements of Regulations 39 to 44 of the EIA Regulations in order to identify any additional issues and concerns associated with the proposed project.
» Preparation of a Comments and Response Report detailing key issues raised by I&APs as part of the EIA Process (in accordance with the requirements of Regulation 44 of the EIA Regulations).
» Undertaking independent specialist studies in accordance with the requirements of Regulation 23(5) and Appendix 6 of the EIA Regulations.
» Preparation of an EIA Report in accordance with the requirements of Regulation 23 and Appendix 3 of the EIA Regulations.

The following subsections outline the EIA process that has been undertaken to date.

6.3.2 Authority Consultation

The National DEA is the competent authority for this application. A record of all authority consultation undertaken is included in this EIA Report. Consultation with the regulating authorities (i.e. DEA and LDEDET) has continued throughout the EIA process.

The following steps are to be undertaken as part of this EIA process:

» Make the EIA Report available for a 30-day public review period.
» Notification and consultation with stakeholders, I&APs and Organs of State that may have jurisdiction over the project, including provincial and local government departments, and State Owned Enterprises.
» Incorporating comments received during the 30-day public review period to prepare a Final EIA Report.

» Submission of the Final EIA Report to DEA for decision making.
» Provide an opportunity for DEA and LDEDET representatives to visit and inspect the proposed site and project area.

A record of the authority consultation received during the EIA process to date is included in **Appendix C**.

6.3.3 *Public Involvement and Consultation*

The public participation process has been undertaken in accordance with the requirements of the Regulations 39 – 44 of the EIA Regulations (GNR 326). The aim of the public participation process is primarily to ensure that:

» Information containing all relevant facts in respect of the proposed project is made available to potential stakeholders and I&APs.
» Participation by I&APs is facilitated in such a manner that all potential stakeholders and I&APs are provided with a reasonable opportunity to comment on the proposed project.
» Comments received from stakeholders and I&APs are recorded and incorporated into the EIA process.

In order to accommodate the varying needs of stakeholders and I&APs within the study area, as well as capture their inputs regarding the project, various opportunities for stakeholders and I&APs to be involved in the EIA Phase have been provided, as follows:

» Opportunity for review of the EIA Report for a 30-day period from **13 April 2018 – 15 May 2018.** Comments received from I&APs during this period will be captured within a Comments and Response Report, which will be included within the Final EIA Report, for submission to the DEA for decision-making.
» Focus Group Meetings and a Public Meeting to be held during the 30-day public review period.
» One-on-one consultation, where required.
» Telephonic consultation sessions (consultation with various parties from the EIA project team, including the Public Participation Consultant, and EIA Consultants).
» Written, faxed or e-mail correspondence.

Comments raised by I&APs during the EIA process will be synthesised into a Comments and Responses (C&R) Report. The C&R Report will include responses from members of the EIA project team and/or project proponent.

Public participation documentation from the process as well as the C&R Report is included in **Appendix C**.

6.3.4 *Assessment of Issues Identified as part of the EIA Process*

Issues which required investigation during the EIA Phase, as well as the specialists involved in the assessment of these impacts are indicated in **Table 6.6**.

Table 6.6: Specialist Studies undertaken as part of the EIA Phase.

Specialist Name	Specialist Area of Expertise	Specialist Company	Appendix
Riaan Robbeson, Dewald Kamffer, and Lukas Niemand	Ecology, flora, fauna and avifauna	Bathusi Environmental Consulting (BEC)	**Appendix D**

Specialist Name	Specialist Area of Expertise	Specialist Company	Appendix
Mark Zunckel, and Atham Raghunandan	Air Quality	uMoya-Nilu Consulting (Pty) Ltd	**Appendix E**
Robbie Louw, Harmke Immink, and Sarah Goodbrand	Climate Change	Promethium Carbon	**Appendix F**
Byron Bester, Kathryn Roy, Kieren Bremner, Mashudu Rafundisani, Robel Gebrekristos, Ayabonga Mpelwane, Andre van Coller, and Brett Coutts	Hydrology and Geohydrology	Digby Wells	**Appendix G**
Garry Paterson and Lebea Maribeng	Soils, Land Use and Agricultural Potential	Agricultural Research Council (ARC)	**Appendix H**
Kathryn Smuts	Archaeology and Heritage	Cedar Tower Services	**Appendix I**
Elize Butler	Palaeontology	Banzai Environmental (Pty) Ltd	**Appendix J**
Morné de Jager	Noise	Enviro Acoustic Research CC	**Appendix K**
Jonathan Marshall	Visual	Environmental Planning and Design CC	**Appendix L**
Elena Broughton and Ndivhuwo Malemagoba	Socio-economics	Urban-Econ Development Economists	**Appendix M**
Stephen Fautley	Traffic	Techso	**Appendix N**

Identified impacts are assessed in terms of the following:

» The **nature**, a description of what causes the effect, what will be affected, and how it will be affected
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score of between 1 and 5 is assigned as appropriate (with a score of 1 being low and a score of 5 being high)
» The **duration**, wherein it is indicated whether:
  * The lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1
  * The lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2
  * Medium-term (5–15 years) – assigned a score of 3
  * Long term (> 15 years) - assigned a score of 4
  * Permanent - assigned a score of 5
» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  * 0 is small and will have no effect on the environment
  * 2 is minor and will not result in an impact on processes
  * 4 is low and will cause a slight impact on processes
  * 6 is moderate and will result in processes continuing but in a modified way
  * 8 is high (processes are altered to the extent that they temporarily cease)
  * 10 is very high and results in complete destruction of patterns and permanent cessation of processes
» The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale, and a score assigned:
  * Assigned a score of 1–5, where 1 is very improbable (probably will not happen)
  * Assigned a score of 2 is improbable (some possibility, but low likelihood)
  * Assigned a score of 3 is probable (distinct possibility)
  * Assigned a score of 4 is highly probable (most likely)
  * Assigned a score of 5 is definite (impact will occur regardless of any prevention measures)

- The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high
- The **status**, which is described as either positive, negative or neutral
- The degree to which the impact can be reversed
- The degree to which the impact may cause irreplaceable loss of resources
- The degree to which the impact can be mitigated

The **significance** is determined by combining the criteria in the following formula:

S = (E+D+M) P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
- **30-60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
- **60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area)

As the developer has the responsibility to avoid or minimise impacts and plan for their management (in terms of the requirements of NEMA and the EIA Regulations (GNR 326)), the mitigation of significant impacts is discussed. Assessment of impacts with mitigation is made in order to demonstrate the effectiveness of the proposed mitigation measures. An EMPr is included as **Appendix O**.

6.3.5 Assumptions and Limitations

The following assumptions and limitations are applicable to the studies undertaken within this EIA Phase:

- All information provided by the developer and I&APs to the environmental team was correct and valid at the time it was provided.
- It is assumed that the development site identified by the developer and their engineers represents a technically suitable site for the establishment of the proposed power station and associated infrastructure.
- Grid connection alternatives have been excluded from the current scope of work, however it is assumed that the development of the proposed project at the preferred site would provide for a grid connection solution which is both feasible and viable, and that the developer has consulted with Eskom in this regard.
- Conclusions of specialist studies undertaken and this overall Impact Assessment assume that any potential impacts on the environment associated with the proposed development will be avoided, mitigated, or offset.

- This report and its investigations are project-specific, and consequently the environmental team did not evaluate any other power generation alternatives.

Refer to the specialist studies provided in **Appendices D – N** for limitations specific to the independent specialist studies.

6.4 Legislation, Policies and Guidelines which have informed the EIA Process

The following legislation and guidelines have informed the scope and content of this EIA Report:

- National Environmental Management Act (No. 107 of 1998) (NEMA).
- The 2014 EIA Regulations, and Listing Notices published under Chapter 5 of the NEMA (GNR 326, 327, 325 and 324).
- International guidelines – the Equator Principles and IFC Performance Standards (including Environmental, Health and Safety (EHS) Guidelines for Thermal Power Plants).

Several other Acts, Standards, or guidelines have also informed the project process and the scope of issues addressed and assessed in this EIA Report. A review of legislative requirements applicable to the proposed project is provided in **Table 6.7**.

Table 6.7: Relevant legislative permitting requirements applicable to the proposed Mutsho Power Project.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
National Legislation			
Constitution of the Republic of South Africa (No. 108 of 1996)	In terms of Section 24, the State has an obligation to give effect to the environmental right. The environmental right states that: "*Everyone has the right –* » *To an environment that is not harmful to their health or well-being; and* » *To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:* ∗ *Prevent pollution and ecological degradation;* ∗ *Promote conservation; and* ∗ *Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*."	Applicable to all authorities	There are no permitting requirements associated with this Act. The application of the Environmental Right however implies that environmental impacts associated with proposed developments are considered separately and cumulatively. It is also important to note that the "right to an environment clause" includes the notion that justifiable economic and social development should be promoted, through the use of natural resources and ecologically sustainable development.
National Environmental Management Act (No 107 of 1998) (NEMA)	The EIA Regulations have been promulgated in terms of Chapter 5 of NEMA. Listed activities which may not commence without an Environmental Authorisation are identified within the Listing Notices (GNR 327, 325 and 324) which form part of these Regulations (GNR 326). In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be assessed and reported on to the competent authority charged by NEMA with granting of the relevant environmental authorisation. In terms of the Listing Notices (GNR 327, 325 and 324), a full Scoping and EIA Process is required to be undertaken for the proposed project.	DEA – Competent Authority LDEDET – Commenting Authority	The listed activities triggered by the proposed project have been identified and assessed in the EIA process being undertaken (i.e. Scoping and EIA). This EIA Report will be submitted to the competent and commenting authority in support of the application for EA.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
National Environmental Management Act (No 107 of 1998) (NEMA)	In terms of the "Duty of Care and Remediation of Environmental Damage" provision in Section 28(1) of NEMA every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment. In terms of NEMA, it is the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts.	DEA LDEDET	While no permitting or licensing requirements arise directly by virtue of the proposed project, this section has found application during the EIA Phase through the consideration of potential impacts (cumulative, direct, and indirect). It will continue to apply throughout the life cycle of the project.
Environment Conservation Act (No. 73 of 1989) (ECA)	The Noise Control Regulations in terms of Section 25 of the Environment Conservation Act (no. 73 of 1989) (published in GNR 154 dated 10 January 1992) contain regulations applicable for the control of noise in the Provinces of Limpopo, North West, Mpumalanga, Northern Cape, Eastern Cape, and KwaZulu-Natal Provinces. The Noise Control Regulations cover the powers of a local authority, general prohibitions, prohibitions of disturbing noise, prohibitions of noise nuisance, use of measuring instruments, exemptions, attachments, and penalties. In terms of the Noise Control Regulations, no person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof (Regulation 04).	DEA LDEDET Local Authorities	Noise impacts are expected to be associated with the construction and operation phases of the project and granted that the mitigation measures identified by the Noise Impact Assessment conducted for the project are implemented, are not likely to present a significant intrusion to the local community. There is therefore no requirement for a noise permit in terms of the legislation.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
Minerals and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA)	In accordance with the provisions of the MPRDA a mining permit is required in accordance with Section 27(6) of the Act where a mineral in question is to be mined, including the mining of materials from a borrow pit.	DMR	Any person who wishes to apply for a mining permit in accordance with Section 27(6) must simultaneously apply for an Environmental Authorisation. No borrow pits are expected to be required for the construction of the project, and as a result a mining permit is not required to be obtained.
	Section 53 of the MPRDA states that any person who intends to use the surface of any land in any way which may be contrary to any object of the Act, or which is likely to impede any such object must apply to the Minister for approval in the prescribed manner. Approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resource that might occur on site.		In the event that the Mutsho Power Project, or any of its associated infrastructure is proposed for development above a mineral resource, a Section 53 application would be required. This would ultimately be determined by the layout alternative selected for implementation. It should however be noted that the preferred project layout takes into consideration coal resources which may occur within the area.
National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA)	Section 21 of NEM:AQA provides for the listing of activities which result in atmospheric emissions and which have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage. Minimum Emission Standards (MES) are set for Listed Activities, and the MES for existing and new plants are defined in GNR 893 of 22 November 2013. The consequence of listed activities is that no person may conduct a listed activity without an Atmospheric Emissions License (AEL) (Section 22).	DEA	Solid fuel combustion installations using solid fuel for electricity generation are Listed Activities (Category 1: Sub-category 1.1) in term of Section 21 of NEM:AQA. Therefore an AEL must be obtained for the project. In addition, the project is required to comply and report on its compliance with (amongst others) the Minimum Emission Standards (MES) contained within GNR 893.
	Section 29 pertains to pollution Prevention Plans, whereby the Minister may declare any substance contributing to air pollution as a priority air pollutant; and require persons falling within a category specified in the notice to prepare,		The operation of the project will result in the generation and release of GHGs, and therefore requires that a pollution prevention plan be prepared and submitted to the Minister for approval. The project is also

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	and implement pollution prevention plans in respect of a substance declared as a priority air pollutant. GNR 710 published in Government Gazette No. 40996 on 21 July 2017 declared Greenhouse Gases (GHGs) as priority air pollutants. Section 03 of GNR 710 states that a person conducting a production process set out in Annexure A (which includes electricity production) which involves emission of GHGs in excess of 0.1Mt annually, reported as carbon dioxide equivalents (CO_2), is required to submit a pollution prevention plan to the Minister for approval.		required to comply with the approved pollution prevention plan throughout its lifecycle.
	The National Dust Control Regulations (GNR 827) published under Section 32 of NEM:AQA prescribe the general measures for the control of dust in all areas; and provide a standard for acceptable dustfall rates for residential and non-residential areas. In accordance with the Regulations (GNR 827) any person who conducts any activity in such a way as to give rise to dust in quantities and concentrations that may exceed the dustfall standard set out in Regulation 03 must, upon receipt of a notice from the air quality officer, implement a dustfall monitoring programme. Any person who has exceeded the dustfall standard set out in Regulation 03 must, within three months after submission of the dustfall monitoring report, develop and submit a dust management plan to the air quality officer for approval.		The possibility exists that a dustfall monitoring programme would be required for the project. Dustfall monitoring results from the dustfall monitoring programme need to be included in a dust monitoring report, and a dust management plan would need to be developed.
	The National Atmospheric Emission Reporting Regulations (GNR 283) were published under Section 12 of NEM:AQA, and regulate the reporting of data and information from		The project proponent is required to make annual emission reports in the format required

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	identified point, non-point and mobile sources of atmospheric emissions to an internet-based National Atmospheric Emissions Inventory System (NAEIS) for use in the compilation of atmospheric emission inventories. The Regulations apply to groups of emission sources and corresponding data providers as classified in Regulation 4 and listed in Annexure 1 of the Regulations, and include any person that undertakes a listed activity in terms of Section 21(1) of NEM:AQA.		for NAEIS and in accordance with the AEL issued for the project.
National Heritage Resources Act (No. 25 of 1999) (NHRA)	Section 07 of the NHRA stipulates assessment criteria and categories of heritage resources according to their significance. Section 35 of the NHRA provides for the protection of all archaeological and palaeontological sites, and meteorites. Section 36 of the NHRA provides for the conservation and care of cemeteries and graves by SAHRA where this is not the responsibility of any other authority. Section 38 of the NHRA lists activities which require developers or any person who intends to undertake a listed activity to notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development.	SAHRA Limpopo Provincial Heritage Resources Authority (LIHRA)	A Heritage Impact Assessment (HIA) has been undertaken as part of the EIA Process to identify heritage sites within the study area and determine significance thereof (refer to **Appendix I**). Should a heritage resource be impacted upon, a permit may be required from SAHRA or LIHRA in accordance with of Section 48 of the NHRA, and the South African Heritage Resources Agency (SAHRA) Permit Regulations (GNR 668). This will be determined once the final location of the project and its associated infrastructure within the project site has been determined.
National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA)	Section 53 of NEM:BA provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process. Three government notices have been published in terms of Section 56(1) of NEM:BA as follows:	DEA LDEDET	Under NEM:BA; a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. The independent ecological specialist study undertaken as part of the EIA process (refer to **Appendix D**) identified the following TOPS as potentially

<table>
<tr><th>Legislation</th><th>Applicable Requirements</th><th>Relevant Authority</th><th>Compliance Requirements</th></tr>
<tr><td></td><td>» Commencement of Threatened or Protected Species (TOPS) Regulations, 2007 (GNR 150).
» Lists of critically endangered, vulnerable and protected species (GNR 151).
» Threatened or Protected Species (TOPS) Regulations (GNR 152).

It provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), and vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (Government Gazette 34809, GNR 1002), 09 December 2011).</td><td></td><td>occurring within the study area, and in terms of which a permit may be required:

<table><tr><th>Common Name</th><th>Taxonomic Name</th><th>Category</th></tr><tr><td>Bateleur, Bateleur</td><td>Terathopius ecaudatus</td><td>VU</td></tr><tr><td>Bustard, Kori</td><td>Ardeotis kori</td><td>PROT</td></tr><tr><td>Eagle, Martial</td><td>Polemaetus bellicosus</td><td>VU</td></tr><tr><td>Eagle, Tawny</td><td>Aquila rapax</td><td>VU</td></tr><tr><td>Ground-hornbill, Southern</td><td>Bucorvus leadbeateri</td><td>VU</td></tr><tr><td>Vulture, Cape</td><td>Gyps coprotheres</td><td>VU</td></tr><tr><td>Vulture, Lappet-faced</td><td>Torgos tracheliotus</td><td>VU</td></tr><tr><td>Vulture, White-backed</td><td>Gyps africanus</td><td>PROT</td></tr></table>
Of those species identified as potentially occurring within the project site, the Kori Bustard (Protected) and White-backed Vulture (Protected) were observed onsite.</td></tr>
<tr><td>National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEM:BA)</td><td>Chapter 5 of NEM:BA pertains to alien and invasive species; and states that a person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7 of NEM:BA; and that a permit may only be issued after a prescribed assessment of risks and potential impacts on biodiversity is carried out.</td><td>DEA

LDEDET</td><td>Restricted Activities and the respective requirements applicable to persons in control of different categories of listed invasive species are contained within the Alien and Invasive Species Regulations (GNR 598) published under NEM:BA; together with the requirements of the Risk Assessment to be undertaken.</td></tr>
</table>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	Applicable, and exempted alien and invasive species are contained within the Alien and Invasive Species List (GNR 864).		
Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA)	Section 05 of CARA provides for the prohibition of the spreading of weeds. Regulation 15 of GNR 1048 published under CARA provides for the classification of categories of weeds and invader plants, and restrictions in terms of where these species may occur. Regulation 15E of GNR 1048 published under CARA provides requirement and methods to implement control measures for different categories of alien and invasive plant species.	DAFF	CARA will find application throughout the life cycle of the project. In this regard, soil erosion prevention and soil conservation strategies must be developed and implemented. In addition, a weed control and management plan must be implemented. The permission of agricultural authorities will be required if the Project requires the draining of vleis, marshes or water sponges on land outside urban areas. However this is not anticipated to be required for the project. In terms of Regulation 15E (GNR 1048) where Category 1, 2 or 3 plants occur a land user is required to control such plants by means of one or more of the following methods: » Uprooting, felling, cutting or burning. » Treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer. » Biological control carried out in accordance with the stipulations of the Agricultural Pests Act (No. 36 of 1983), the Environment Conservation Act (No. 73 of 1989) and any other applicable legislation.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
			» Any other method of treatment recognised by the executive officer that has as its object the control of plants concerned, subject to the provisions of sub-regulation (4). » A combination of one or more of the methods prescribed, save that biological control reserves and areas where biological control agents are effective shall not be disturbed by other control methods to the extent that the agents are destroyed or become ineffective.
National Forests Act (No. 84 of 1998) (NFA)	According to this Act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that "no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister".	DAFF	A licence is required for the removal of protected trees. It is therefore necessary to conduct a survey that will determine the number and relevant details pertaining to protected tree species on the property for the submission of relevant permits to authorities prior to the disturbance of these individuals. The following protected trees have been recorded within the study site as part of the independent ecological specialist study undertaken as part of the EIA process (refer to **Appendix D**), and which may require a license in terms of the NFA.

Binomial Name	Family	Status
Adansonia digitata L.	*Malvaceae*	Protected Tree
Boscia albitrunca	*Capparaceae*	Protected Tree

<table>
<tr><th>Legislation</th><th>Applicable Requirements</th><th>Relevant Authority</th><th>Compliance Requirements</th></tr>
<tr><td></td><td></td><td></td><td><table><tr><td>(Burch.) Gilg & Gilg-Ben.</td><td></td><td></td></tr><tr><td>Combretum imberbe Wawra</td><td>Combretaceae</td><td>Protected Tree</td></tr><tr><td>Sclerocarya birrea (A.Rich.) Hochst. subsp. caffra (Sond.) Kokwaro</td><td>Anacardiaceae</td><td>Protected Tree</td></tr></table>
The localised presence of massive Adansonia digitata is regarded an important consideration.</td></tr>
<tr><td>National Veld and Forest Fire Act (No. 101 of 1998) (NVFFA)</td><td>Chapter 4 of this Act places a duty on owners to prepare and maintain firebreaks, the procedure in this regard, and the role of adjoining owners and the fire protection association. Provision is also made for the making of firebreaks on the international boundary of the Republic of South Africa. The applicant must ensure that firebreaks are wide and long enough to have a reasonable chance of preventing a veldfire from spreading to or from neighbouring land, it does not cause soil erosion, and it is reasonably free of inflammable material capable of carrying a veldfire across it.

Chapter 5 of the Act places a duty on all owners to acquire equipment and have available personnel to fight fires. Every owner on whose land a veldfire may start or burn or from whose land it may spread must have such equipment, protective clothing and trained personnel for extinguishing</td><td>DAFF</td><td>While no permitting or licensing requirements arise from this legislation, this Act will be applicable during the construction and operational phase of the project, in terms of the preparation and maintenance of firebreaks, and the need to provide appropriate equipment and personnel for firefighting purposes.</td></tr>
</table>

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	fires; and ensure that in his or her absence responsible persons are present on or near his or her land who, in the event of fire, will extinguish the fire or assist in doing so, and take all reasonable steps to alert the owners of adjoining land and the relevant fire protection association, if any.		
Hazardous Substances Act (No. 15 of 1973) (HAS)	This Act regulates the control of substances that may cause injury, or ill health, or death due to their toxic, corrosive, irritant, strongly sensitising or inflammable nature or the generation of pressure thereby in certain instances and for the control of certain electronic products. To provide for the rating of such substances or products in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, modification, disposal or dumping of such substances and products. » Group I and II: Any substance or mixture of a substance that might by reason of its toxic, corrosive etc., nature or because it generates pressure through decomposition, heat or other means, cause extreme risk of injury etc., can be declared as Group I or Group II substance » Group IV: any electronic product; and » Group V: any radioactive material. The use, conveyance, or storage of any hazardous substance (such as distillate fuel) is prohibited without an appropriate license being in force.	Department of Health	It is necessary to identify and list all Group I, II, III, and IV hazardous substances that may be on site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health (DoH).
National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA)	The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment.	DEA – hazardous waste LDEDET – general waste	A WML is required for the disposal of waste to land (ash) and for the construction of the ash disposal facility associated with the power

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	The Minister may amend the list by – » Adding other waste management activities to the list. » Removing waste management activities from the list. » Making other changes to the particulars on the list. In terms of the Regulations published in terms of this Act (GNR 912), a Basic Assessment or Environmental Impact Assessment is required to be undertaken for identified listed activities. Any person who stores waste must at least take steps, unless otherwise provided by this Act, to ensure that: » The containers in which any waste is stored, are intact and not corroded or in » Any other way rendered unlit for the safe storage of waste. » Adequate measures are taken to prevent accidental spillage or leaking. » The waste cannot be blown away. » Nuisances such as odour, visual impacts and breeding of vectors do not arise; and » Pollution of the environment and harm to health are prevented.		station. In terms of NEM:WA Amendment Act, ash is classified as hazardous waste. General waste handling, storage and disposal during construction and operation is required to be undertaken. In addition to the Waste Classification and Management Regulations (GNR 634), National Norms and Standards for the assessment of waste for Landfill Disposal (GNR 635), and the National Norms and Standards for the Disposal of Waste to Landfill (GNR 636); the 1998 Waste Management Series produced by the DWAF (now the DWS) entitled Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste, and the Minimum Requirements for Waste Disposal by Landfill will also need to be considered.
National Road Traffic Act (No. 93 of 1996) (NRTA)	The technical recommendations for highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads" outline the rules and conditions which apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in	SANRAL – national roads Limpopo DoT	An abnormal load/vehicle permit may be required to transport the various components to site for construction. These include route clearances and permits will be required for vehicles carrying abnormally heavy or abnormally dimensioned loads. Transport vehicles exceeding the dimensional limitations

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts. The general conditions, limitations, and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power/mass ratio, mass distribution, and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the National Road Traffic Act and the relevant Regulations.		(length) of 22m. Depending on the trailer configuration and height when loaded, some of the power station components may not meet specified dimensional limitations (height and width).
Limpopo Environmental Management Act (No. 07 of 2003)	LEMA provides for the consolidation and amendment of the environmental management legislation of, or assigned to the Province, and to provide for matters incidental thereto. LEMA must be interpreted and applied in accordance with the principles of national environmental management as set out in Section 2 of NEMA. The objectives of LEMA are: » To manage and protect the environment in the Province. » To secure ecologically sustainable development and responsible use of natural resources in the Province. » To contribute to the progressive realisation of the fundamental rights contained in Section 24 of the Constitution of the Republic of South Africa (Act No. 108 of 1996).	LEDET	In the event that the construction of operation of the project results in a prohibited activity occurring with respect to any of the protected areas, specially protected wild animals, protected wild animals, game, wild animals, non-indigenous wild animals, invasive alien animals, prohibited aquatic growths, invertebrates, specially protected plants, and protected plants, listed in Schedules 1 to 12 of LEMA; a permit would be required from LEDET.

Legislation	Applicable Requirements	Relevant Authority	Compliance Requirements
	» To give effect to international agreements effecting environmental management which are binding on the Province. Lists of protected areas, specially protected wild animals, protected wild animals, game, wild animals, non-indigenous wild animals, invasive alien animals, prohibited aquatic growths, invertebrates, specially protected plants, and protected plants, which could trigger the need for a permit to be applied for from LEDET are provided in Schedules 1 to 12 of LEMA.		

CHAPTER 7 DESCRIPTION OF THE RECEIVING ENVIRONMENT

This Chapter provides a description of the receiving environment that may be impacted by the development of the Mutsho Power Project. The information presented in this Chapter has been sourced from existing information available for the area and the findings of independent specialist investigations, and aims to provide the context within which the EIA is being conducted.

7.1 Location of the Study Area

The proposed project site is located approximately 7km south of Mopane, approximately 40km south-south-west of the town of Musina; and approximately 40km north-north-east of the town of Makhado (previously Louis Trichardt). The site is located in Ward 2 in the south-central extent of the Musina Local Municipality (LM), of Limpopo's Vhembe District (refer to **Table 7.1**).

Table 7.1: Overview of the Identified Sites.

Farm Name:	Area (ha)	Central Coordinates	
		Latitude	Longitude
Du Toit 563	924ha	22° 38' 01.71" S	29° 47' 25.52" E
Vrienden 589	1 237ha	22° 44' 33.30" S	29° 46' 58.56" E

The project site is approximately 2 1618ha in extent and comprises 2 properties, with a current land use zoning of "Agricultural". Some agricultural activities (in the form of grazing and cultivated land) occur on the Farm Du Toit 563, while the Farm Vrienden 589 is not currently utilised for agricultural purposes. The project site is bordered by agricultural land to the north, south, east and west, while private hunting and eco-tourism activities are also practised within the surrounding area. The largest towns in proximity of the project site are Musina, Makhado and Thohoyandou located in the Musina, Makhado and Thulamela LMs, respectively, and the closest settlement to the project site is Mudimeli (Vhembe District Municipality, 2016).

A railway line separates the two properties in a north-east to south-west direction. The Huntleigh railway siding is situated adjacent to the southern-most point of the Farm Du Toit 563 and adjacent to the eastern most point of the Farm Vrienden 589. The sites are located approximately 12km west of the N1 National Road at the intersection of District Roads D744 and D1021 (refer to**Figure 7.1** and **Figure 7.2**). D1021 which can be accessed directly from the N1 provides primary access to the project site, while D744 which runs parallel to the railway line provides access between the two sites.

7.1.1 Limpopo Province

Limpopo Province is approximately 125 755km² in extent and accounts for just over 10.3% of South Africa's total land area, making it the fifth largest province in South Africa (StatsSA, 2011). It is located in the north-eastern extent of the country, and is South Africa's northern-most province. Limpopo Province is considered the gateway to Africa as its northern border (which comprises the Limpopo River) is shared with Zimbabwe and Botswana; while it is bordered by Mozambique to the east. Due to its location the Province is therefore in a favourable position for economic collaboration with other parts of Africa (Department of Government Communications and Information System, 2014).

Figure 7.1: Location of the project sites relative to the towns of Makhado (Louis Trichardt) and Musina.

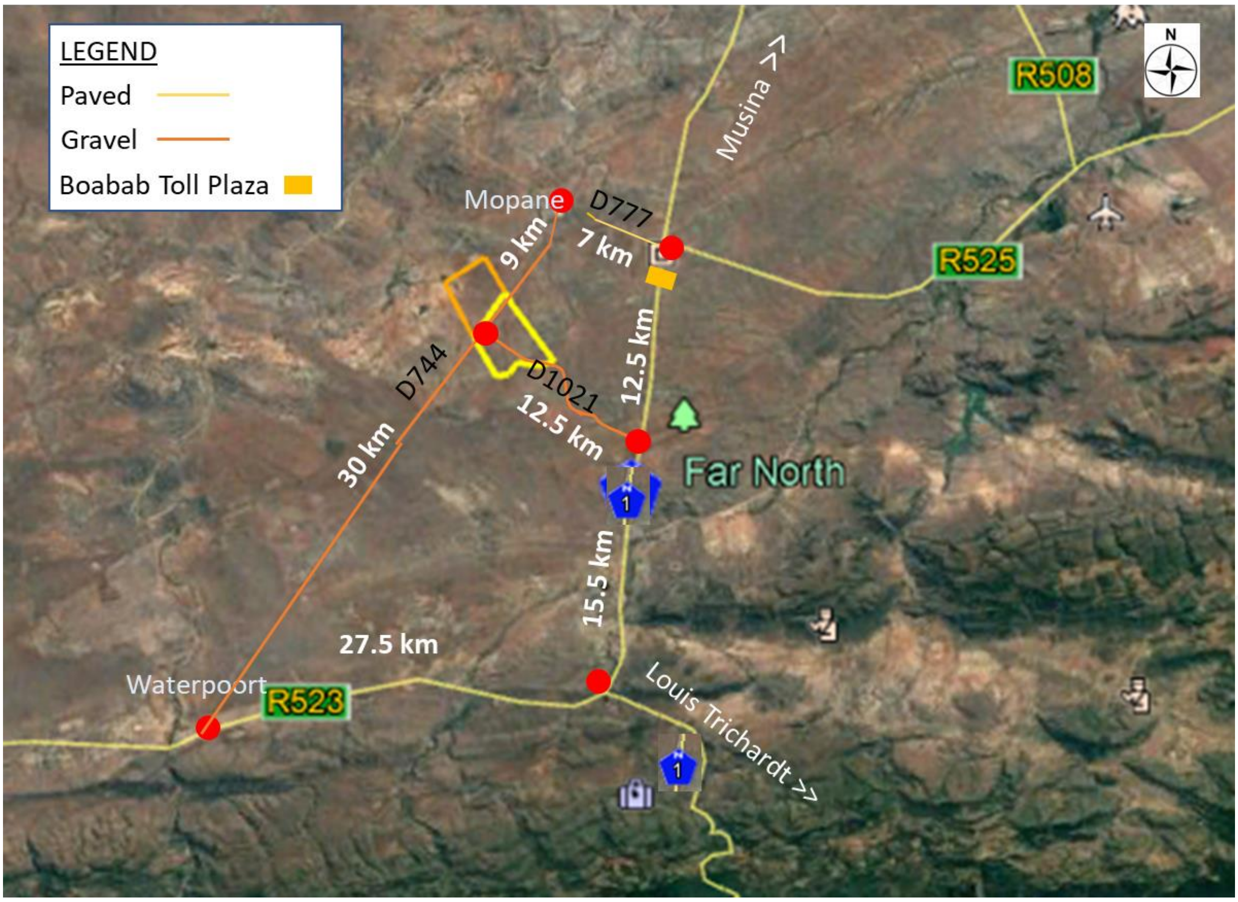

Figure 7.2: Location of the project sites relative to the D744 – D1201 intersection.

Most of the trans-South African freight headed to and from landlocked countries such as Zimbabwe, Zambia, and Malawi is transported through Limpopo. The Maputo Development Corridor links Limpopo directly with the Port of Maputo in Mozambique, while the Province also connects to the corridor via the Phalaborwa

Spatial Development Initiative, which comprises a network of rail and road corridors linked to major seaports. Airports are located in centres such as Phalaborwa and Musina, as well as the Polokwane International Airport in Polokwane. The N1 National Road, runs through the centre of the Province and connects a series of towns including Bela-Bela, Mudimeli, Mokopane, Polokwane, Makhado, and Musina.

7.1.2 Vhembe District

The Vhembe District Municipality (DM) is a Category C municipality, which indicates that the municipality has a municipal executive and legislative authority in an area that includes more than one municipality (Statutes of Republic of South Africa, 1996). The Vhembe DM is one of 5 Districts which make up Limpopo Province. The others include: Capricorn, Mopani, Sekhukhune, and Waterberg Districts. Vhembe District is South Africa's northern-most District and is bordered by Zimbabwe to the north, Mopani District to the south, Capricorn District to the south-west, and Waterberg District to the west. It comprises four local municipalities, namely Musina, Thulamela, Makhado, and Collins Chabane (refer to **Figure 7**.3). The Vhembe DM is predominantly rural in nature and is considered a cultural hub and catalyst for agricultural and tourism development.

Figure 7.3: The four municipalities located in the Vhembe District Municipality (Local Government Handbook, 2017).

7.1.2.1 <u>Vhembe Biosphere Reserve</u>

In 2011 the Vhembe region was officially declared the Vhembe Biosphere Reserve (UNESCO's MAB Programme). The Vhembe Biosphere Reserve is approximately 3 038 852ha in extent and covers approximately 24% of Limpopo Province. The Vhembe Biosphere Reserve includes the northern part of the Kruger National Park (KNP), the Mapungubwe Cultural Landscape comprising the Mapungubwe National Park and Mapungubwe Hill World Heritage site, several Provincial Nature Reserves, 2 recognized centres of biodiversity and endemism (i.e. the Soutpansberg and Blouberg Mountain Ranges) and the Makgabeng Plateau which contains more than 1 000 rock art sites; and the Makuleke Wetlands. It is a prime destination for eco-tourism, cultural tourism and related activities such as hunting. There are a large number of Private

Game Farms and agricultural farms within the Vhembe Biosphere Reserve which create the opportunity for unleashing the economic potential of the Vhembe Biosphere Reserve.

The Vhembe Biosphere Reserve is intended to promote an integrated approach to sustainable development, ensuring that essential ecosystem services are maintained; education is improved; and human development and wealth creation are stimulated through better communication and training, while conserving the unique ecosystems, species, and cultural resources, of the region (refer to **Figure 7**.4). The reserve comprises 3 biomes; namely savanna, grassland, and forest; 4 bioregions; and 23 vegetation types; 8 of which are endemic to South Africa. The area is also a bio-geographical node, comprising the Kalahari, Lowveld bioregions characterised by temperate, tropical climatic conditions. This creates zones of ecologically important interactions, which need to be protected to ensure conservation viability.

The South African National Spatial Biodiversity Assessment (NSBA) included the Blouberg and Soutpansberg complex as 1 of its 9 priority areas for conservation action based on a combined analysis of species, ecosystems and ecological processes. This area is also listed as a hotspot of South African biodiversity and endemism (Van Wyk & Smith, 2001). Lake Fundudzi located in the Soutpansberg Mountains is Southern Africa's only natural inland lake, while several of the wetlands within the mountain range contain peat which contains information going back 12 000 years BP (before present).

7.1.3 Musina Local Municipality (LM)

The Musina LM is one of 4 LMs which form part of the Vhembe District of Limpopo. It is also the largest of the four LMs which comprise Vhembe DM. The others include Makhado, Thulamela and Collins Chabane (refer to **Figure 7**.3). Whereas the Vhembe District previously consisted of Musina, Makhado, Thulamela and Mutale LMs, the defunct Mutale LM was subsequently disestablished and portions of it merged into the Musina and Thulamela LMs on 03 August 2016. The Collins Chabane LM was also subsequently established through the merging of portions of Musina and Thulamela LMs. The Musina LM is bordered by Makhado LM to the south, Thulamela LM to the east, and by Blouberg LM of Limpopo's Capricorn District to the south-west. Musina LM forms the northern-most extent of Limpopo Province and is also bordered by Botswana and Zimbabwe to the north-west and north-east respectively. Musina LM covers an area of land approximately 757 829ha in extent and extends from the convergence of the Mogalakwena and Limpopo Rivers in the west to the convergence of the Nwanedi and Limpopo Rivers in the east; and from Tshipise and Mopane in the south; to Botswana and Zimbabwe in the north.

According to the Spatial Development Framework (SDF) prepared for the Musina LM and contained in the latest iteration of its Integrated Development Plan (IDP) (2016/17 – 2021) (refer to **Figure 7**.5) the project site is located on land with a medium agricultural potential of 6 and is outside areas identified as having mining potential (shown in **Figure 7**.5 in orange). The closest road network to the project site is the N1 Primary corridor. Direct access to the N1 Primary Corridor can be obtained via D1201 which originates from the N1 and traverses eastwards, coming to an end at Huntleigh siding. The closest node to the project site is the Primary Node at Musina, followed by the Secondary Node at Beitbridge.

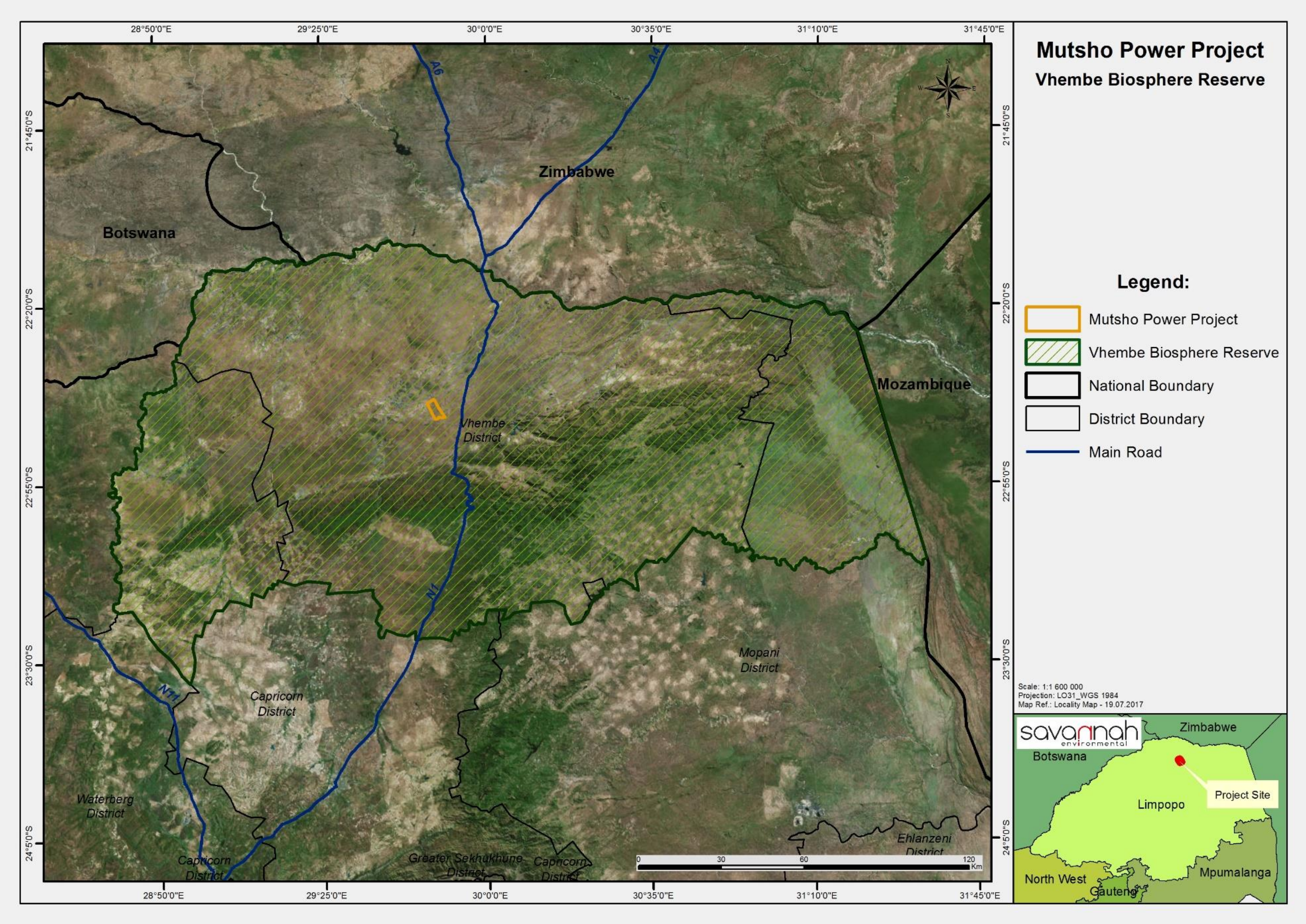

Figure 7.4: Overview of the Vhembe Biosphere Reserve in relation to the project site.

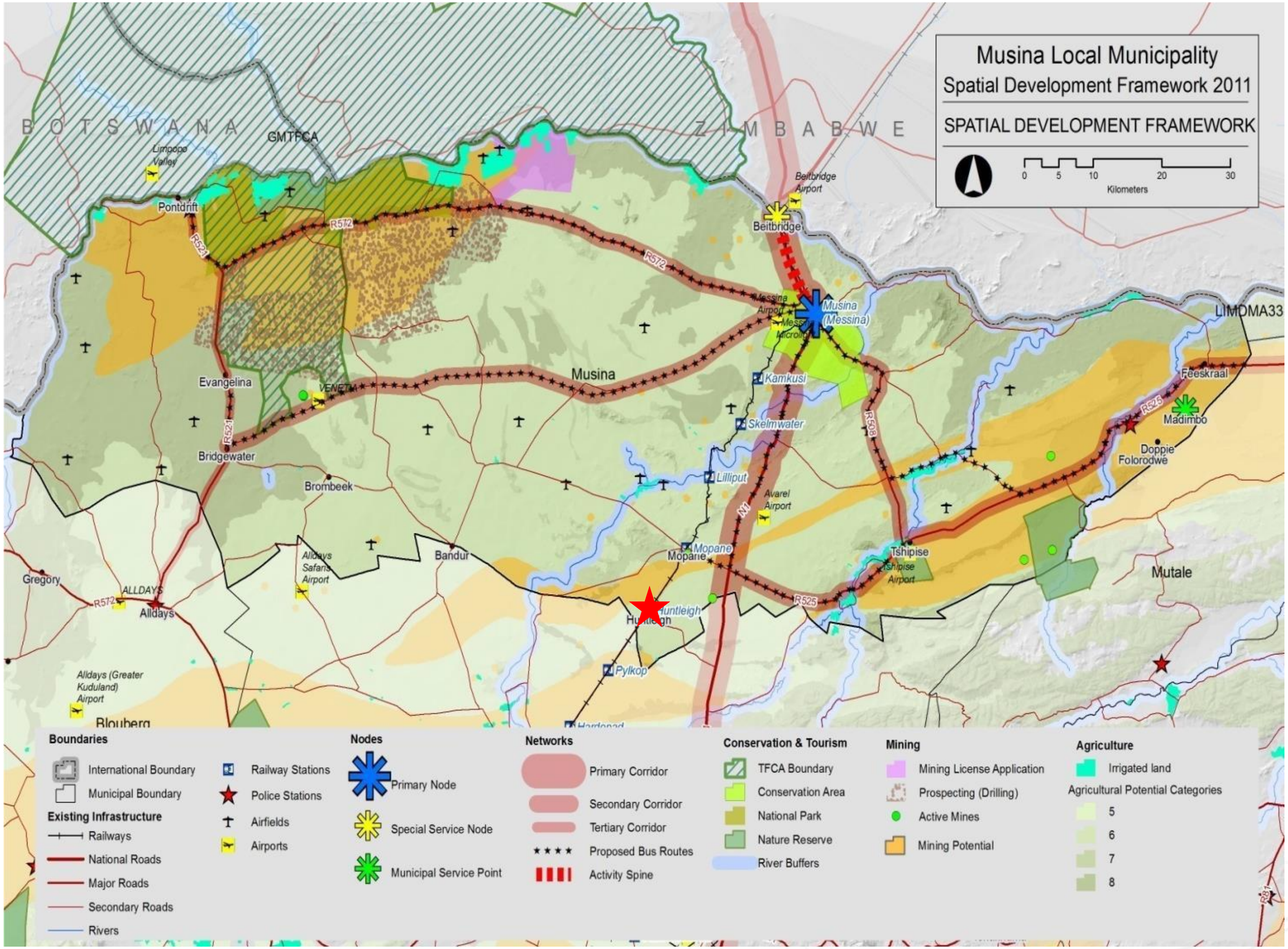

Figure 7.5: SDF for the Musina Local Municipality (IDP 2016/17 – 2021) (project site locations depicted by red star).

7.1.4 Major Tourism attractions within the region

The terrain around Musina which supports low-shrub and thorny tree vegetation, which in turn supports animal life in the regional enabled the area to develop as a tourist attraction. Lodges and safaris are therefore prevalent within the area. The Musina Nature Reserve which is located approximately 38km north of the project site is characterised by an abundance of oddly shaped baobab trees. In addition, the Limpopo Valley National Park also located in Musina LM is South Africa's youngest and northernmost park. The Limpopo Valley National Park was declared around the historical Mapungubwe archaeological site, which is said to constitute South Africa's first kingdom, and is located approximately 65km north-west of the project site (South Africa, 2017).

7.1.5 Sense of place, history and cultural aspects

The principle languages in Musina are Venda and Sotho followed by Tsonga and Afrikaans. The extensive natural features and resources hold great sentiment to the locals and are embodied in the naming of the district and local municipalities.

» Vhembe is a Venda name for what is also known as the Limpopo River and is a symbol of a fountain of life (Vhembe District Municipality, 2016).
» Musina is a Venda word for "spoiler" which expresses the disappointment of the settlers who were in search for minerals to trade and considered copper as a poor substitute for iron.

"Sense of place" is the distinctiveness of place resulting from cultural transformations and traditions associated with the historic use and habitation of the area (Stedman, 2003). Place attachment is the symbolic relationship formed by people attributing culturally shared emotional meanings to a particular piece of land. Many areas in the region have strong historical meanings. For instance, Mapungubwe is a protected site characterised by an extensive wilderness and extraordinary history. Thus, it can be suggested that the sense of place in the area is that of strong natural aesthetic and is dominantly rural, suggesting that the character of the place is associated with rural features.

7.1.6 Protected Areas

Limpopo Province is home to more than 50 Provincial Nature Reserves as well as several Private Game Reserves. Mapungubwe Hill (meaning "hill of the Jackal"), located approximately 65km north-west of the project site and 75km west of Musina in the Mapungubwe National Park is an Iron Age archaeological sites which has been declared a UNESCO World Heritage Site. There are currently four land-based protected areas declared in the Musina Local Municipality, which cover approximately 5.26 % of the municipality.

These include:

Name	Type of Protected Area	Area	Coverage
Baobab Tree Reserve	Conservation Area	12 281ha	1.62%
Honnet Nature Reserve	Nature Reserve	1 992ha	0.26%
Mapungubwe National Park	National Park	19 929ha	2.63%
Nwanedi Nature Reserve	Nature Reserve	5 660ha	0.75%

There are no protected areas within the immediate surrounds of the project site. The closest protected areas are the Baobab Tree Reserve, and the Honnet Nature Reserve located approximately 32km north-east and 35km east of the site respectively.

7.2 Climatic Conditions

The regional climate is hot, semi-arid, and characterised by hot temperatures throughout most of the year. The area has an annual average precipitation of 372mm and receives most of its rain during the summer months from October to April, when severe thunderstorms are common in the late afternoon and evening. Winter is extremely dry with almost no precipitation. The driest months of the year are typically from June to August. During this time of year temperatures plunge to close to freezing (0°C) at night, although frost is fairly uncommon. Droughts occur frequently during the winter months, and infrequently during the summer months when very little rain falls and drought conditions prevail. These erratic summer droughts are becoming more common as a result of the effects of climate change within the area (refer to **Figure 7**.6).

month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Okt	Nov	Dec
mm	78	63	38	19	7	4	3	2	6	26	54	68
°C	26.5	26.1	25.0	23.3	20.4	17.0	17.4	19.3	22.2	24.8	25.7	26.2
°C (min)	21.0	20.7	19.4	16.9	12.9	9.3	9.9	11.7	15.2	18.4	19.8	20.5
°C (max)	32.0	31.5	30.7	29.7	27.9	24.8	24.9	26.9	29.3	31.3	31.7	32.0
°F	79.7	79.0	77.0	73.9	68.7	62.6	63.3	66.7	72.0	76.6	78.3	79.2
°F (min)	69.8	69.3	66.9	62.4	55.2	48.7	49.8	53.1	59.4	65.1	67.6	68.9
°F (max)	89.6	88.7	87.3	85.5	82.2	76.6	76.8	80.4	84.7	88.3	89.1	89.6

Figure 7.6: Average climate data for Musina

7.2.1 Average Rainfall

The area has an average annual precipitation of 372mm. Precipitation is lowest in August, with an average typically between 0mm and 2mm, and highest in January with an average of 78mm (refer to **Figure 7**.7).

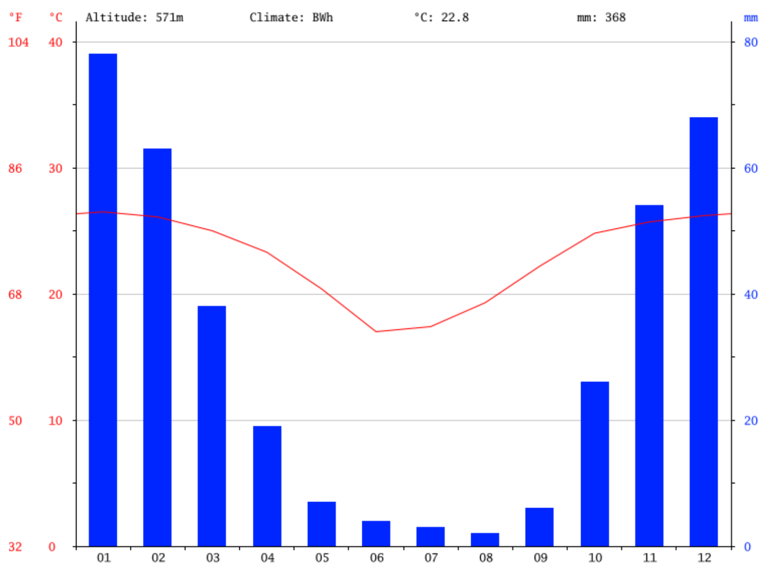

Figure 7.7: Average rainfall data for Musina.

Evaporation rates are very high, at around 2 800 mm yr-1, which gives a climate with an extreme aridity index, as compared to the average annual rainfall.

7.2.2 *Average Temperature*

The annual average temperature in Musina is 22.8°C. January is the hottest month of the year with an average temperature of 26.5°C, while June is typically the coldest month of the year with an average temperature of 17.0°C (refer to **Figure 7**.8).

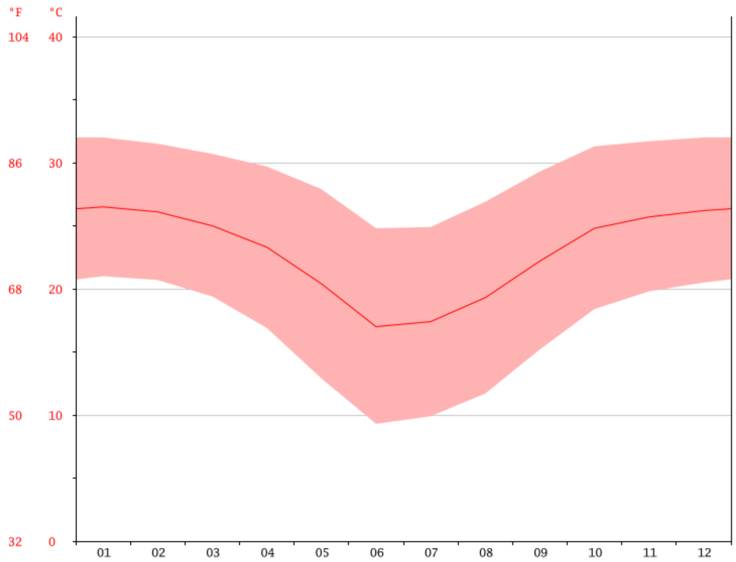

Figure 7.8: Average temperature data for Musina.

7.2.3 *Average Wind Speed and Direction*

A wind rose, used to represent wind data, simultaneously depicts the frequency of occurrence of wind from the 16 cardinal wind directions and defined wind speed classes. Wind direction is given as the direction from which the wind blows, for example south-westerly winds blow from the southwest. Wind speed is given in m/s, and each arc represents a frequency of occurrence of 500 hours, with 8 760 hours making a year.

According to the wind rose generated for the Mopane Air Quality Impact Assessment the wind field is dominated by south-easterly winds which occur approximately 27% and 12% of the time, followed secondly by easterly winds which occur 18% of the time. Calm periods (i.e. periods during which the wind speed is less than 1m/s) occur approximately 0.12% of the time (refer to **Figure 7**.9). The predominant wind speeds are between 2.1m/s – 3.6m/s, and 3.6m/s – 5.7m/s. Higher wind speeds of 5.7m/s – 8.8m/s do occur, however these wind speeds are typically only associated with south-easterly winds.

The local wind field has significance with regards to the potential for pollution dispersion, transportation and dilution. The vertical dispersion of pollution is largely a function of the wind field (i.e. wind direction), whereas the wind speed would determine both the distance of downward transportation and the rate at which pollutants are diluted.

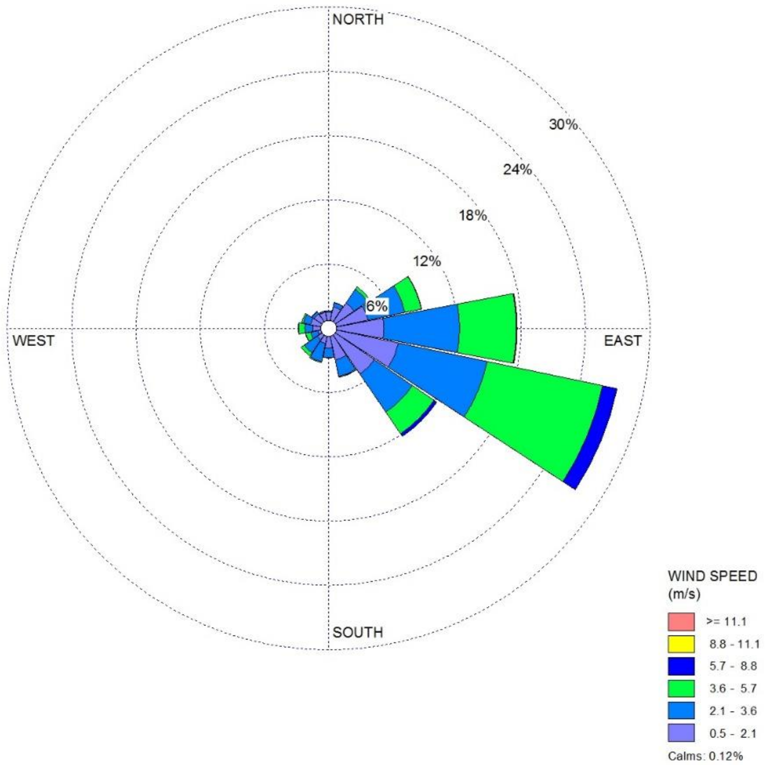

Figure 7.9: Wind rose taken from CoAL's Mopane Project's Air Quality Impact Assessment (Royal HaskoningDHV).

7.2.4 Air Quality

The project site is not located within any air quality priority areas. The DEA has identified the Capricorn, Waterberg and Mopani District Municipalities as areas of potentially poor air quality within Limpopo; with the Waterberg District Municipality forming part of the Waterberg-Bojanala priority area. Given the absence of a Municipal Air Quality Management Plan (AQMP), the Limpopo Department of Economic Development, Environment and Tourism's (LDEDET's) Provincial AQMP (October, 2013) has reference. According to the Limpopo AQMP the main air quality concerns identified for the Province are related to the concentrations of PM, SO_2, and NO_x from mining activities, power generation, metallurgical activities and biomass burning. Ambient air quality monitoring is undertaken at four locations in the District, measuring SO_2, NO_X and O_3 using passive samplers. No ambient air quality data is however reported in the AQMP. Despite this, ambient air quality is expected to be relatively good and is expected to comply with the National Ambient Air Quality Standards (NAAQS). While there are considered to be relatively few sources of air pollution the reliance on biomass fuels for cooking and space heating implies that ambient air quality in high-density low income residential areas will be compromised and may be poor at times.

Residential areas are commonly classed as sensitive receptors as people generally spend more time at home than elsewhere. Potentially sensitive receptors would therefore include any residential areas relatively close to the facility, and particularly those in the downwind sector that may be affected by emissions of SO_2, NO_X and particulates from the proposed coal-fired power plant. The downwind sector is located west-south-west to north-west of the facility, i.e. downwind under the prevailing east-north-easterly to south-easterly winds.

7.3 Biophysical Characteristics of the Study Area

The following section provides an overview of the biophysical characteristics of the study area.

7.3.1 Soils and Land Types

According to available GIS information the area under investigation is characterised by a single land type, namely Ah89. This land type comprises Beitbridge Complex, Malala Drift Formation; leucogneiss, metaquartzite, and amphibolite, Gumbu Gneiss, marble, gneiss; metaquartzite and amphibolite. The soils are characterised as red-yellow apedal, freely drained soils; with a high base status. Land type Ah89 has a soil depth of between 450mm and 750mm, and a clay content usually less than 15%. Soil potential is defined as being of intermediate suitability for arable agriculture where climate permits. Land type Ah89 is characterised as having moderate dryland agricultural potential.

Table 7.2: Soils occurring within the project site

Land Type	Dominant Soils	Depth (mm)	Description	Agric. Pot.
Ah89	Hutton 34/35/36	400 – 1 000	Red, structureless, apedal soils on rock	High:10.5%
	Hutton 44/45/46	500 – 900	Red, structureless, apedal soils, calcareous, on rock	**Med: 65.3%**
	Clovelly 34/35/36	400 – 900	Yellow-brown, structureless, apedal soils, occasionally calcareous, on rock	Low: 24.2%

7.3.2 Agricultural Potential

The study area is dominated by moderately deep (400 – 1 000mm), apedal soils of the Hutton and Clovelly forms. Some of the soils are calcareous. Very few soils deeper than 900mm occur, while some areas of shallow soils (i.e. <400mm), with occasional surface rock, occur.

The main limiting factor to agricultural potential is the dry, hot climate. Low annual rainfall, coupled with hot summer temperatures, indicated the only practical means of cultivation would be by means of irrigation. Based on the national Land Cover database there is limited evidence of areas of cultivated lands. The land use map is derived from the national Land Cover database, and shows woodland, thicket and bushland as the main land use types.

Soils of the project site do not have a high susceptibility to erosion, by either wind or water. Topsoils have a light texture but are not excessively sandy.

7.3.3 Topography, Relief and Slopes

Topographical heterogeneity of an area has influence on the biodiversity of the area. This is due to the fact that landscapes made up of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than homogeneous landscapes do. As a result, species richness and biodiversity has been found to be significantly higher in areas of geomorphological heterogeneity.

According to the Environmental Potential Atlas of South Africa (ENPAT), the general area is characterised as "extremely irregular plains" (ENPAT, 2002). However, the topographical heterogeneity of the site is described as low with relatively flat topography. No significant topographical features have been observed within the project site. The site lies at an elevation of approximately 700m above mean sea level (amsl), with the highest point located in the southern extent of the site. The site is situated in virtually flat terrain, with slopes of less than 2%. Only minor undulations and localised topographical variances in the form of mall, non-perennial streams occur within the area.

7.3.4 Land Cover and Land Use

Land use often determines land cover; and is an important contributing factor to the overall condition of the land. This is due to the fact that different land uses have varying effects on the integrity of the land. Areas that are characterised by high levels of transformation and habitat degradation are generally considered to be more suited for development purposes, as it is unlikely that biodiversity attributes of conservation importance will be present or affected by development in such areas. Conversely, areas that are characterised by extensive untransformed and pristine habitat are generally regarded unsuitable options for development purposes.

The Musina LM is approximately 758 000ha in extent, of which approximately 717 000ha (equivalent to 94.59%) remains untransformed (BGIS, 2015). The general region within which the project sites are located can be classified as being definitively rural, with very little anthropogenic development and/or transformed environments.

7.3.5 Hydrology

The sites are situated within the Limpopo Water Management Area (WMA) secondary drainage area A7, tertiary catchment A71, and quaternary catchment A71K (refer to **Figure 7**.10 and **Figure 7**.11). No major rivers are present in the immediate surrounds. The Sand River is situated approximately 8.5km north of the project sites. According to information contained in SANBI's BGIS database, no RAMSAR sites occur within the Musina Local Municipality.

The sites exhibit attributes of periodic flooding with ill and well-defined drainage lines and floodplains. The north-western portion of Farm Du Toit 563 comprises a significant floodplain with a defined drainage line in which an artificial impoundment has been constructed. This drainage line flows northwards towards the Sand River, and exhibits atypical vegetation attributes. Similarly, ill-defined flood zones are noted on the Farm Vrienden 589, which contribute towards habitat diversity on a local scale. The presence and ecological contribution of these attributes increases the habitat diversity of the sites and, ultimately, the perceived sensitivity.

7.3.5.1 <u>Sand catchment (A71)</u>

The Sand catchment is the driest area in the Limpopo North WMA with very limited surface water resources. The water requirements within the Sand catchment are large compared to the rest of the WMA, with irrigation comprising the largest water user. The majority of the irrigation sector's water requirements are met by the extraction of groundwater reserves via boreholes in the Sand/Limpopo Rivers, however these have largely been over-exploited. Although the urban requirements are high, a large portion of water is supplied through transfers from other WMAs.

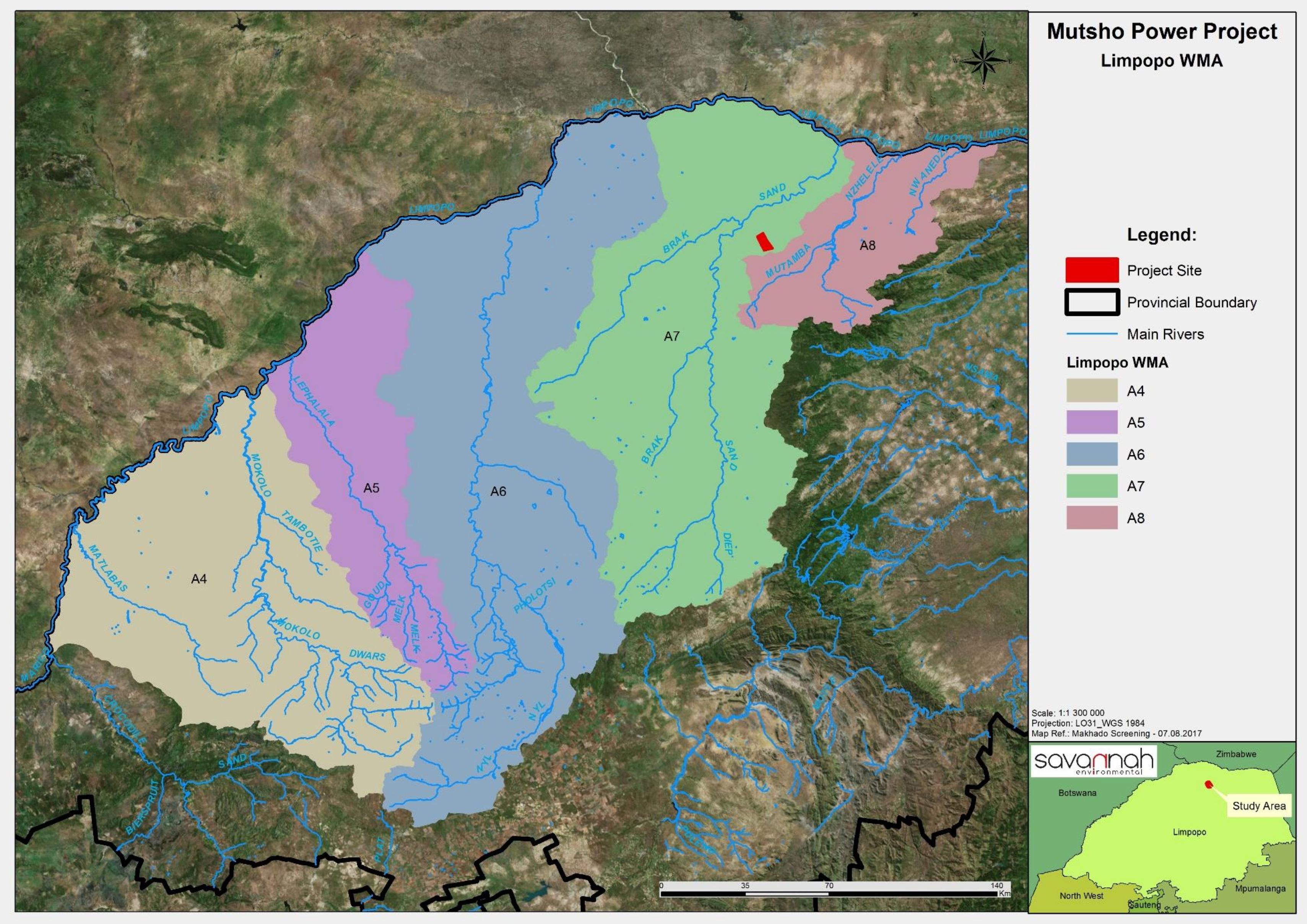

Figure 7.10: Location of the project site in relation to the Limpopo Water Management Area (WMA).

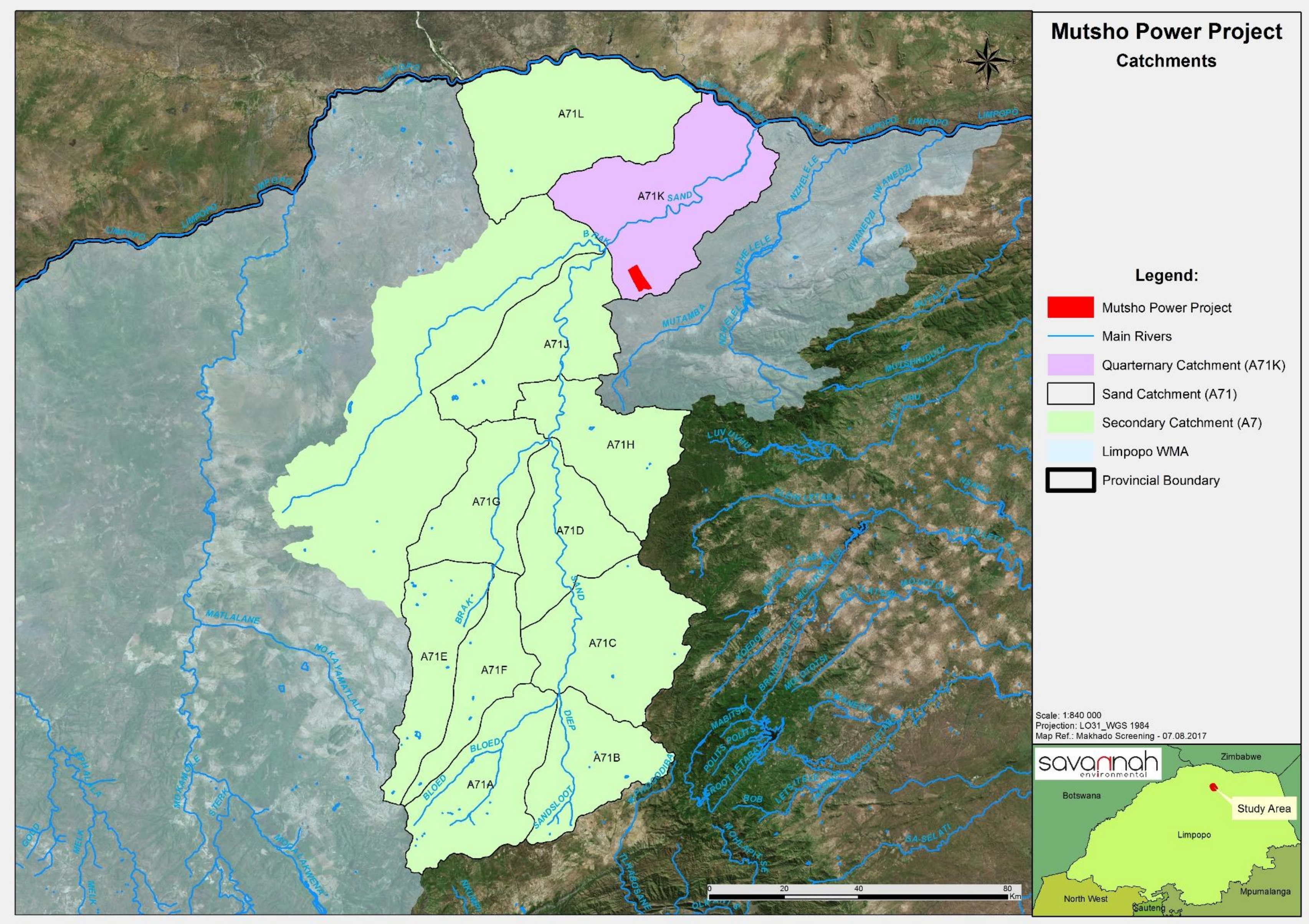

Figure 7.11: Location of the project site in relation to the Sand Catchment (A71) and Quaternary Catchment (A71K).

Growth in industrial and mining water requirements within the Sand catchment will mainly be supplied by transfer schemes from neighbouring WMAs, such as Phase 2A of the Mokolo-Crocodile River (West) Water Augmentation Project (MCWAP), and Phases 2B and 2G of the Olifants River Water Resources Development Project (ORWRDP). The water requirements planned to be supplied by these transfer schemes have fluctuated since the start of the projects but are continuously being updated. The water requirements for the Limpopo Eco-Industrial Park (LEIP), and the Musina-Makhado Special Economic Zone (SEZ), both of which are located within the Musina LM, have also not been confirmed, however, initial estimates indicated that both developments will require approximately 11 million m^3/a by 2040.

7.4 Ecological Profile

7.4.1 Flora

The project site is characterised by the Musina Mopane Bushveld vegetation type (Mucina & Rutherford, 2006)). This vegetation type forms part of the Savanna Biome and Mopane Bushveld Bioregion. The vegetation unit is geographically situated in the Limpopo Province on undulating plains and extends from around Baines Drift and Alldays in the west, remaining north of the Soutpansberg and south of the Limpopo River (but also occurring to the north in Zimbabwe), through Musina and Tshipise to Malongavlakte, Masisi and Banyini Pan in the east. Altitude associated with this vegetation types ranges between 300m (in the eastern Limpopo Valley) to 800m.

Landscape features associated with the Musina Mopane Bushveld vegetation type include undulating to very irregular plains, with some hills. In the western section of its distribution range it occurs as open woodland to moderately closed shrubveld dominated by *Colophospermum mopane* on clayey bottomlands; and *Combretum apiculatum* on hills. In the eastern section of its distribution range it occurs on basalt, as moderately closed to open shrubveld dominated by *Colophospermum mopane* and *Terminalia prunioides*. On areas with deep sandy soils, it occurs as moderately open savanna dominated by *Colophospermum mopane*, *T. sericea*, *Grewia flava* and *Combretum apiculatum*. The field layer within the vegetation type is well developed (especially on the basalt), and open during the dry season; while the herbaceous layer is poorly developed in areas with dense cover of *Colophospermum mopane* shrubs, for example, north of Alldays bordering the Limpopo floodplain.

The Musina Mopane Bushveld vegetation type has a conservation target of 19% and a conservation status of Least Threatened (LT). Approximately only 2% is statutorily conserved, mainly in the Mapungubwe National Park as well as in Nwanedi and Honnet Nature Reserves. Additionally, about 1% is conserved in the Baobab Tree Reserve. Roughly, 3% has been transformed, mainly as a result of cultivation. This unit is the most diverse mopaneveld type in South Africa. The Musina region has the highest species richness – also relative to *Colophospermum mopane*-dominated areas in Namibia and the Save River Valley in Zimbabwe (F. Siebert et al. 2003). The relationship of this unit with adjacent and often fragmented parts of Limpopo Ridge Bushveld is spatially complex.

The high palatability of the graminoid (grassy) composition and geographic position makes this vegetation type very suitable for game and livestock (mainly cattle) farming practices, which is also responsible for occurrences of large-bodied birds of prey (especially scavenging vultures).

7.4.1.1 Background to the Savanna Ecology

The Savanna Biome is the largest biome in southern Africa, covering about 46% of the country's total land area. The term savanna is widely accepted as describing a vegetation type with a well-developed grassy layer and an upper layer of woody plants. Many environmental factors correlate with the distribution of different savanna vegetation types, including landform, climate, soil types, fire and a very specific fauna. South African savannas of nutrient-poor substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny. Nutrient-rich savannas have high grass layer productivity and the grasses are acceptable to grazers, resulting in a high grazing capacity (Knobel, 1999).

The diversity of African savanna comprises more than 13 000 plant species, of which 8 000 are savanna endemics. Specifically, dry savannas have more than 3 000 plant species. This diversity equals that of the South African grasslands and is exceeded only by the Fynbos Biome (Knobel 1999). Similarly, savannas are associated with significant animal diversity, including approximately 167 mammals (15% endemism), 532 birds (15% endemism), 161 reptiles (40% endemism), 57 amphibians (18% endemism) and an unknown number of invertebrates (Knobel, 1999). Flagship species include the Starburst Horned Baboon Spider (*Ceratogyrus bechuanicus*), ground Hornbill (*Bucorvus leadbeateri*), Cape Griffon (*Gyps coprotheres*), Wild dog (*Lycaon pictus*), Short-Eared Trident Bat (*Cloeotis percivali*) and the White Rhino (*Ceratotherium simum*) (EWT, 2002).

Conservation within and of the savanna biome is good in principle, mainly due to the presence of a number of wildlife reserves. Urbanisation is not a threat, perhaps due to the fact that the hot, dry climate and diseases prominent in the savanna areas have hindered urban development. Much of the area is used for game farming and the importance of tourism and big-game hunting in the conservation areas must not be underestimated. Savannas are the basis of the African wildlife and ecotourism industry and play a major role in the meat industry.

Five major regions are present, three of which are represented in the immediate region. Sweet Bushveld occurs on fertile soils in the dry and hot valleys of the Limpopo River and the thorny, small-leaved vegetation is dominated by Acacia species that increase to dense, impenetrable thickets at the expense of the grass layer when over-utilised. Mixed Bushveld varies from short, dense bushveld to a rather open tree savanna. On shallow, infertile soils the broad-leaved Red Bushwillow (*Combretum apiculatum*) dominates, whereas on deeper, leached soils the Silver Clusterleaf (*Terminalia sericea*) becomes dominant. The Waterberg moist mountain bushveld is a typical example of moist, infertile savanna. Due to the high proportion of unpalatable grasses, the area has become known as 'sour bushveld'. An interesting phenomenon is the presence of many plant species showing affinities with the flora of the Drakensberg, which indicates an ancient link with this range (Knobel, 1999).

The vegetation that characterises the area has developed many survival strategies, including the ability to produce tannins that are triggered when the leaves are browsed, the production of toxic sap, the development of thorns, or their adaptation to sourveld areas that are generally not favoured by grazers. The interaction of vegetation, fire and animals play important roles in maintaining savanna ecosystems (Knobel, 1999).

Over thousands of years, the savanna system and the antelope that inhabit them have developed side by side. Grasses, for example, have become well adapted to defoliation, as much a defensive response to constant pressure by grazers as to the regular veld fires that rage through the savanna in the dry seasons. The success of grasses has been a constantly renewed vast reservoir of food upon which large herds of grazers flourish. The woody component is also constantly exploited by many browsers, and with so many herbivores present, the carnivore component of the complex ecological system has also flourished (Knobel, 1999).

The savanna biome is populated by a greater diversity of bird species than any other biome in South Africa. The presence of both woody plants and a well-developed herbaceous layer provides diverse sources of food and shelter for specialist and generalist bird species, including seedeaters, insectivores and diurnal and nocturnal birds of prey abound.

7.4.1.2 Regional Conservation Planning

The purpose of the Limpopo Conservation Plan version 2 (LCP) (Desmet 2013) is to develop the spatial component of a bioregional plan (*i.e.* map of Critical Biodiversity Areas (CBA) and associated land-use guidelines). Incomplete biodiversity datasets and generally coarse mapping of biodiversity features impose limitations on this plan, which although they do not restrict the application of the plan, need to be recognized and appropriately accommodated when it is used:

» The conservation plan does not replace the need for site assessments, particularly for Environmental Impact Assessments. Although it is based on a systematic conservation plan using best available data, this does not remove the need for on -site verification of the identified CBAs. Further, due to incomplete knowledge of the distribution of biodiversity features, it is likely that additional or alternative areas will need to be identified in the future as we gain a better understanding of rare, threatened, cryptic and understudied species.
» This LCP is designed to be used at a scale of approximately 1:50 000. Although it can be used at a finer scale, this requires specialist interpretation of the specific biodiversity features identified in the systematic biodiversity plan.
» Ongoing changes in land-use, especially loss of natural habitat, as well as changes in the distribution of biodiversity (*e.g.* in response to climate change), will impact on the identified network of Critical Biodiversity Areas. It is likely that in future additional areas would need to be designated as CBAs to meet biodiversity targets in future iterations of the plan.

Categories employed in the LCP (which are also spatially represented in the general project area (refer to **Figure 7**.12), include the following:

» **Critical Biodiversity Areas** – Based on the LCP, 40 % of the province is designated as Critical Biodiversity Area. These CBAs have been split into CBA 1 and CBA 2, based on selection frequency and the underlying characteristics of the biodiversity features that are being protected (*i.e.* location fixed features such as sites for CR species and flexible ones such as Least Cost Corridors). The majority of the CBAs in the province are CBA 1 (22 %), which can be considered "irreplaceable" in that there is little choice in terms of areas available to meet targets. If CBA 1 areas are not maintained in a natural state then targets cannot be achieved. CBA 2 areas are considered "optimal" as there is significant design involved in their identification. CBA 2 areas make up 18% of the province, and represent areas where there are spatial options for achieving targets and the selected sites are the ones that best achieve targets within the landscape design objectives of the plan.

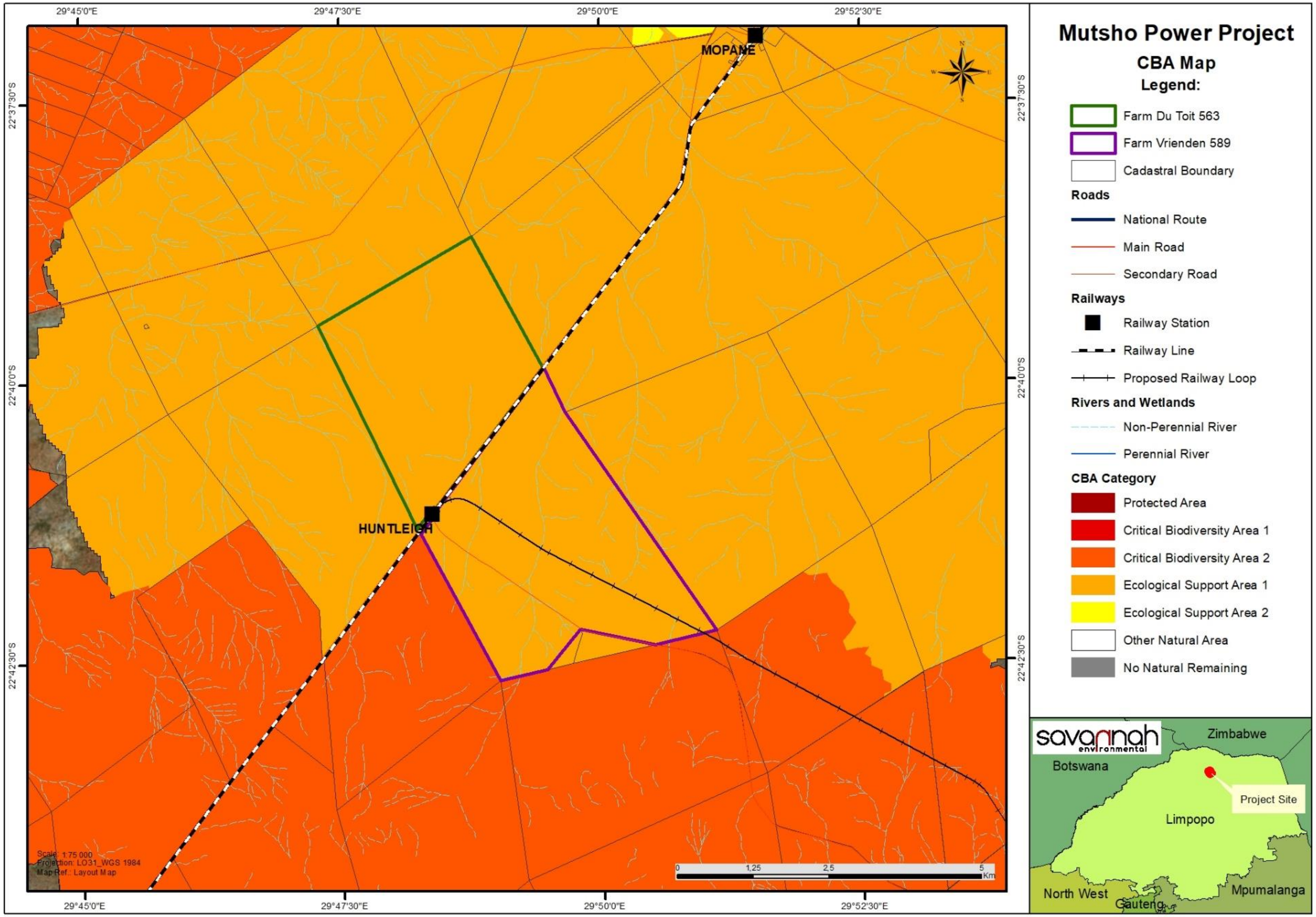

Figure 7.12: Spatial representation of CBAs and ESAs within the project area and surrounds.

» **Ecological Support Areas**, spatially represented in Farms Du Toit and Vrienden, cover a further 22 % of the province, of which 16 % are intact natural areas (ESA 1) and 7 % are degraded or areas with no natural remaining, which are nevertheless required as they potentially retain some value for supporting ecological processes (ESA 2).

7.4.1.3 Regional Floristic Traits

The study area corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina and Rutherford (2006), comprising an ecological type known as the Musina Mopane Bushveld (refer to **Figure 7**.13). This unit is geographically situated in Limpopo Province on undulating plains from around Baines Drift and Alldays in the west, remaining north of the Soutpansberg and south of the Limpopo River (but also occurring to the north in Zimbabwe), through Musina and Tshipise to Malongavlakte, Masisi and Banyini Pan in the east. Altitude ranges between 300m (in the eastern Limpopo Valley) to 800m.

Vegetation and landscape features comprise undulating to very irregular plains, with some hills. In the western section, open woodland to moderately closed shrubveld dominated by *Colophospermum*[10] *mopane* on clayey bottomlands and *Combretum apiculatum* on hills. In the eastern section on basalt, moderately closed to open shrubveld is dominated by *Colophospermum mopane* and *Terminalia prunioides*. On areas with deep sandy soils, moderately open savanna dominated by *Colophospermum mopane*, *T. sericea*, *Grewia flava* and *Combretum apiculatum*. The field layer is well developed (especially on the basalt), and open during the dry season; the herbaceous layer is poorly developed in areas with dense cover of *Colophospermum mopane* shrubs, for example, north of Alldays bordering the Limpopo floodplain.

The conservation status is set at Least threatened; only 2% is statutorily conserved mainly in the Mapungubwe National Park as well as in Nwanedi and Honnet Nature Reserves. Additionally, about 1% is conserved in the Baobab Tree Reserve. Roughly, 3% is transformed, mainly by cultivation. This unit is the most diverse mopaneveld type in South Africa. The Musina region has the highest species richness – also relative to *Colophospermum mopane*-dominated areas in Namibia and the Save River Valley in Zimbabwe (F. Siebert et al. 2003). The relationship of this unit with the adjacent and often fragmented parts of Limpopo Ridge Bushveld is spatially complex. It is very dependent on scale and has not been fully captured on the map.

7.4.1.4 Regional Phytodiversity

The SANBI database was consulted to provide a brief account of the known regional phytodiversity; the presence of 59 plant species within quarter-degree grid (2229DB) has been recorded, reflecting a poor knowledge of the floristic diversity of the area in general.

[10] Possible name change to *Hardwickia*, to be confirmed

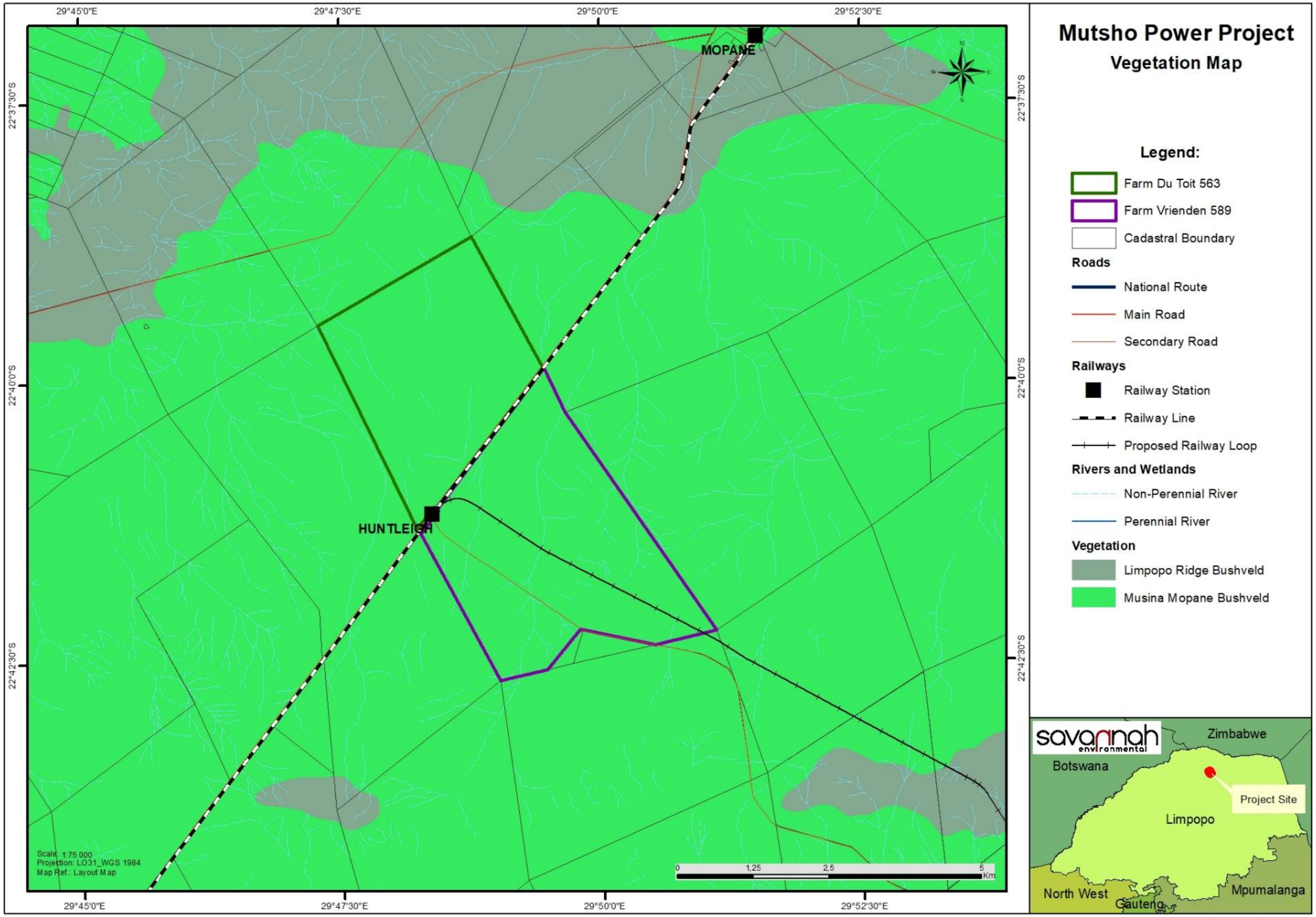

Figure 7.13: Vegmap categories of the surrounding region.

7.4.1.5 Plants of Conservation Importance

The assessment of plants of conservation concern and importance is based on the following:

- International Union for Conservation of Nature (IUCN)
- National Forests Act (No. 84 of 1998) (NFA)
- Limpopo Environmental Management Act (No. 07 of 2003) (LEMA)

7.4.1.6 International Union for Conservation of Nature (IUCN)

South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalised in 2001), which was amended to include additional categories to indicate species that are of local conservation concern (refer to **Figure 7**.14). The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). The SANBI database for quarter degree grid 2229DB indicate the known presence of four species of conservation concern within the immediate region (refer to **Table 7.4**).

The absence of conservation important taxa from the regional sampling records reflects on the paucity of accurate floristic knowledge for the region. Taking cognisance of the status and availability of habitat within the site and surrounds, the possibility that plant species of conservation importance would persist within the region cannot be discounted at this stage of the process.

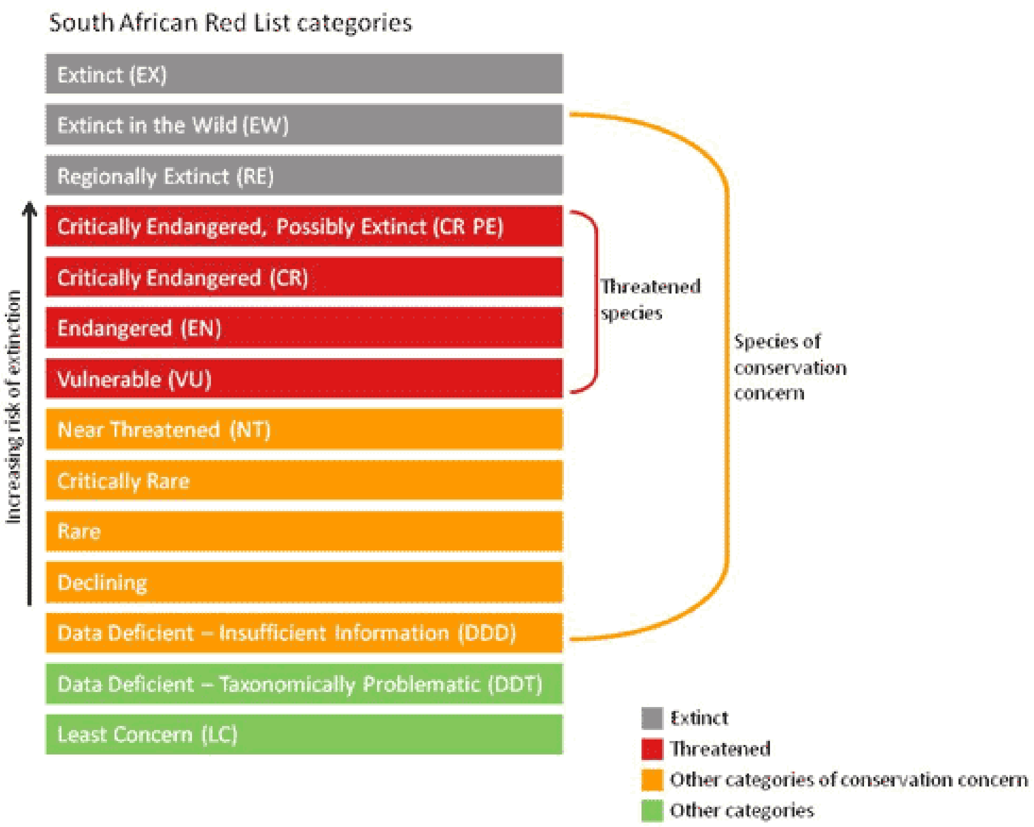

Figure 7.14: South African Red List Categories (courtesy of SANBI).

7.4.1.7 National Forests Act (No. 84 of 1998) (NFA)

In terms of the National Forests Act (No. 84 of 1998) (NFA), certain tree species can be identified and declared as protected. All trees occurring in natural forests are also protected in terms of the Act. Protective actions take place within the framework of the Act as well as national policy and guidelines. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. In terms of the NFA, protected tree species may not be "cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold, except under license granted by the Department of Water Affairs and Forestry, (now the Department of Agriculture, Forestry and Fisheries) (or a delegated authority)". It is therefore necessary that a survey be conducted to determine the number and relevant details pertaining to protected tree species which occur on the properties for the submission of relevant permits to authorities prior to the disturbance of these individuals. **Table 7.3** presents a list of protected trees that have been recorded within the study sites.

Table 7.3: Table 1: Historic sampling records of protected trees in the region

Taxon	***Family***	***Status***
Adansonia digitata	Malvaceae	Protected tree (NFA, 1998)
Boscia albitrunca	Capparaceae	Protected tree (NFA, 1998)
Combretum imberbe	Combretaceae	Protected tree (NFA, 1998)
Sclerocarya birrea subsp. *caffra*	Anacardiaceae	Protected tree, (NFA, 1998), Declining (IUCN)

7.4.1.8 Limpopo Environmental Management Act (No. 07 of 2003) (LEMA)

The Limpopo Environmental Management Act (No. 07 of 2003) (LEMA) provides for the consolidation and amendment of the environmental management legislation of, or assigned to the Province and to provide for matters incidental thereto. Specifically, Schedules 11 (Specially protected plants) and Schedule 12 (Protected plants) have relevance to this section. **Table 7.4** provides a list of protected plant taxa that are known to occur in the immediate region of the study sites.

Table 7.4: Regional sampling records of protected species in the region (POSA 2014, LEMA 2003)

Taxon	***Family***	***Status***
Adansonia digitata	Malvaceae	LEMA, Protected, Schedule 12
Hibiscus sabiensis	Malvacea	Data Deficient - Taxonomically Problematic, LEMA, Protected, Schedule 12
Hoodia species	Apocynaceae	LEMA, Protected, Schedule 12

7.4.1.9 Local Floristic Context

From a floristic perspective, four broad habitat types are prominent in the area, as discussed below.

7.4.1.10 Undifferentiated arid broad-leaved woodland on sandy soils

The majority of the study area comprise open, arid woodland located on sandy soils, notably a well-developed woody layer consisting of *Colophospermum (=Hardwickia) mopane, Terminalia prunioides*, *Vachellia tortilis, Kirkia acuminata, Grewia bicolor, Boscia albitrunca, Lannea schweinfurthii* and various species of *Commiphora*. Typical canopy constituents include *Xanthocercis zambesiaca, Senegalia* *nigrescens* and *Adansonia digitata*. The graminoid layer includes dominant taxa such as *Panicum maximum, Schmidtia pappophoroides* and *Stipagrostis uniplumis*. Open structure and sparse graminoid layer (presumably due to grazing pressure and climatic factors such as unpredictable precipitation and frequent aridity) was noted. Some sections of this woodland type comprise dense *Grewia flavescens* and *Dichrostachys cinerea* shrubs. This natural woodland community includes the large *Adansonia digitata* (Baobab) canopy constituents that are encountered as scattered individuals across the region. Although described in the avifaunal report as a separate entity, in a floristic context, it is not regarded separate to the natural woodland.

7.4.1.11 Seasonal drainage lines

This habitat type represents the linear riparian zones along drainage lines, which were most prominent on the Farm Du Toit, but also occurs on the Farm Vrienden. The riparian vegetation consists of a dense canopy of *Schotia brachypetala, Xanthocercis zambesiaca,* and *Peltophorum africanum*. The understory is well defined and thicket-like, consisting of *Grewia flava, G. hexamita* and *Ziziphus mucronata*. *Panicum maximum* dominates the graminoid layer. A high vertical heterogeneity and leaf litter deposition associated with the alluvial vegetation allow for, specifically, avifaunal compositions that are not typically associated with adjacent dryland habitat types - thereby enhancing local biodiversity.

7.4.1.12 Impoundments and natural depressions (pans)

These respectively represent manmade water bodies and shallow depressions, mostly situated within the riparian floodplains and linear drainage lines. Vegetation associated with these features are frequently degraded as a result of high grazing pressure, and often conforms to a piosphere type of nodal vegetatal development pattern.

7.4.1.13 Secondary woodland and deteriorated vegetation

These represent areas of secondary woodland previously used for agricultural purposes and exhibit few attributes of the surrounding natural woodland vegetation patterns. The leaved *Acacia* (*Senegalia/ Vachellia*) species predominate in these parts.

7.4.2 Fauna

The study area is geographically situated within quarter-degree grid 2229DB. The Animal Demography Unit (ADU) of the University of Cape Town (UCT) provides quarter-degree level distribution data on various plant and animal groups in their Virtual Museum (vmus.adu.org.za). Distribution data on the following animal groups is currently available and is used as a basis for this report:

1. Scorpions (Arachnida: Scorpiones);
2. Spiders (Arachnida: Araneae);
3. Dung Beetles (Coleoptera: Scarabaeinae);
4. Dragonflies and Damselflies (Insecta: Odonata);
5. Lacewings (Insecta: Neuroptera and Megaloptera);
6. Butterflies and Moths (Insecta: Lepidoptera);
7. Frogs (Amphibia: Anura);
8. Reptiles (Reptilia: Testudines and Squamata); and

9. Mammals (Mammalia).

7.4.2.1 Invertebrates

Thirty-nine invertebrates are listed for quarter-degree grid 2229DB (vmus.adu.org.za), including:

» Three scorpion species
» One spider species
» Four dragonfly species
» One antlion species
» One dung beetle species
» Twenty-six butterfly species
» Three moth species

None of the invertebrate species listed for quarter-degree grid 2229DB are considered sensitive or threatened (Red Data listed); however, one alien/ invasive species, the Cucumber Moth, *Diaphania indica* (Saunders, 1851), is listed (refer to **Table 7.5**).

Table 7.5: Invertebrates of the quarter-degree grid 2229DB

Order	***Family***	***Genus species***	***English Name***	***Regional***	***Global***
Scorpiones	Buthidae	*Afroisometrus minshullae* (Fitzpatrick,	Pygmy Thicktail	NL	NL
		Hottentota trilineatus (Peters, 1861)	Eastern Thicktail	NL	NL
	Hormuridae	*Hadogenes troglodytes* (Peters, 1861)	Giant Rock Scorpion	NL	NL
Araneae	Nephilidae	*Nephila senegalensis* (Walckenaer,	Banded-legged	NL	NL
Odonata	Libellulidae	*Crocothemis erythraea* Brullé, 1832	Broad Scarlet	NL	LC
		Orthetrum chrysostigma Burmeister,	Epaulet Skimmer	NL	LC
		Trithemis arteriosa Burmeister, 1839	Red-veined	NL	LC
		Trithemis kirbyi Selys, 1891	Kirby's Dropwing	NL	LC
Neuroptera	Myrmeleontida	*Lachlathetes moestus* (Hagen, 1853)	Antlion	NL	NL
Coleoptera	Scarabaeidae	*Chalconotus convexus* Boheman,	Dung Beetle	NL	NL
Lepidoptera	Hesperiidae	*Gomalia elma elma* (Trimen, 1862a)	Green-marbled	LC	NL
	Pieridae	*Belenois aurota* (Fabricius, 1793)	Brown-veined White	LC	NL
		Belenois creona severina (Stoll, [17811])	African Common	LC	NL
		Colotis evagore antigone (Boisduval,	Small Orange Tip	LC	NL
		Colotis evenina evenina (Wallengren,	Orange Tip	LC	NL
		Colotis ione (Godart, [1819])	Bushveld Purple Tip	LC	LC
		Colotis regina (Trimen, 1863)	Queen Purple Tip	LC	NL
		Colotis vesta argillaceus (Butler, 1877)	Veined Arab	LC	NL
		Eurema brigitta brigitta (Stoll, [1780])	Broad-bordered	LC	LC
		Pinacopteryx eriphia eriphia (Godart,	Zebra White	LC	NL
		Teracolus eris eris (Klug, 1829)	Banded Gold Tip	LC	NL
		Teracolus subfasciatus (Swainson,	Lemon Traveller	LC	NL
	Nymphalidae	*Acraea oncaea* Hopffer, 1855	Rooibok Acraea	LC	NL
		Byblia ilithyia (Drury, [1773])	Spotted Joker	LC	NL
		Charaxes jasius saturnus Butler, 1866	Foxy Charaxes	LC	NL
		Coenyropsis natalii natalii (Boisduval,	Natal Brown	LC	NL
		Danaus chryssipus orientis (Aurivillius,	African Monarch	LC	LC
		Junonia hierta cebrene Trimen, 1870	Yellow Pansy	LC	LC
		Junonia oenone oenone (Linnaeus,	Blue Pansy	LC	LC
		Telchinia serena (Fabricius, 1775)	Dancing Acraea	LC	NL
		Vanessa cardui (Linnaeus, 1758)	Painted Lady	LC	LC

Order	Family	Genus species	English Name	Regional	Global
	Lycaenidae	*Aloeides damarensis mashona* Tite &	Damara Copper	LC	NL
		Chilades trochylus (Freyer, [1843])	Grass Jewel Blue	LC	NL
		Lampides boeticus (Linnaeus, 1767)	Pea Blue	LC	LC
		Leptotes pirithous pirithous (Linnaeus,	Common Zebra	LC	NL
		Virachola antalus (Hopffer, 1855)	Brown Playboy	LC	NL
	Crambidae	*Diaphania indica (Saunders, 1851)*	Cucumber Moth	NL	NL
	Noctuidae	*Cyligramma latona* Cramer, 1779	Cream-striped Owl	NL	NL
	Sphingidae	*Batocnema africanus* Distant, 1899	Harlequin	NL	NL

7.4.2.2 Herpetofauna

Twenty-seven herpetofaunal species are listed for quarter-degree grid 2229DB (vmus.adu.org.za), including:

- Four frog species;
- One tortoise species; and
- Twenty-two reptile species.

Two of the reptile species listed for quarter-degree grid 2229DB are listed Red Data species (refer to **Table 7.6**).

Table 7.6: Herpetofauna of quarter-degree grid 2229DB

Order	Family	Genus species	English Name	Regional Status	Global Status
Anura	Bufonidae	*Sclerophrys garmani* (Meek, 1897)	Eastern Olive Toad	LC	LC
	Rhacophoridae	*Chiromantis xerampelina* Peters, 1854	Southern Foam Nest Frog	LC	LC
	Phrynobatrachidae	*Phrynobatrachus natalensis* Smith, 1849	Snoring Puddle Frog	LC	LC
	Breviceptidae	*Breviceps adspersus* Peters, 1882	Bushveld Rain Frog	LC	LC
Testudines	Testudinidae	*Stigmochelys pardalis* Valverde, 2005	Leopard Tortoise	LC	LC
Squamata	Pythonidae	*Python natalensis* Smith, 1840	Southern African Python	LC	NL
	Lamprophiidae	*Hemirhagerrhis nototaenia* (Günther, 1864)	Eastern Bark Snake	LC	NL
		Psammophis angolensis (Bocage, 1872)	Dwarf Sand Snake	LC	NL
		Psammophis subtaeniatus Peters, 1882	Western Yellow-bellied Sand Snake	LC	LC
		Rhamphiophis rostratus Peters, 1854	Rufous Beaked Snake	LC	NL
	Elapidae	*Aspidelaps scutatus scutatus* (Smith, 1849)	Speckled Shield Cobra	LC	NL
	Scincidae	*Panaspis maculicollis*	Spotted-neck Snake-eyed Skink	LC	NL
		Panaspis wahlbergi (Smith, 1849)	Wahlberg's Snake-eyed Skink	LC	NL
		Trachylepis margaritifer Branch et al, 2005	Rainbow Skink	LC	LC

Order	Family	Genus species	English Name	Regional Status	Global Status
		Trachylepis varia (Peters, 1867)	Variable Skink	LC	NL
	Gerrhosaurida e	*Gerrhosaurus flavigularis* Wiegmann, 1828	Yellow-throated Plated Lizard	LC	NL
	Varanidae	*Varanus albigularis albigularis* Daudin, 1802	Rock Monitor	LC	NL
	Agamidae	*Agama armata* Peters, 1855	Peters' Ground Agama	LC	NL
	Gekkonidae	*Afroedura transvaalica* (Hewitt, 1925)	Zimbabwe Flat Gecko	LC	NL
		Chondrodactylus turneri (Gray, 1864)	Turner's Gecko	LC	NL
		Hemidactylus mabouia (Moreau De Jonnès, 1818)	Common Tropical House Gecko	LC	NL
		Homopholis mulleri Visser, 1987	Muller's Velvet Gecko	VU	VU
		Lygodactylus capensis capensis (Smith, 1849)	Common Dwarf Gecko	LC	NL
		Pachydactylus punctatus Peters, 1854	Speckled Gecko	LC	NL
		Pachydactylus wahlbergii wahlbergii	Kalahari Ground Gecko	LC	NL
		Ptenopus garrulus garrulus (A. Smith, 1849)	Common Barking Gecko	LC	NL
	Crocodylidae	*Crocodylus niloticus* Laurenti, 1768	Nile Crocodile	VU	LC

7.4.2.3 Mammals

Seventeen mammals are listed for quarter-degree grid 2229DB (vmus.adu.org.za), including:

- One monkey species;
- One squirrel species;
- Seven carnivore species; and
- Eight even-toed ungulate species.

Three of the mammal species listed for quarter-degree grid 2229DB are listed Red Data species (refer to **Table 7.7**).

Table 7.7: Mammals of quarter-degree grid 2229DB

Order	Family	Genus species	English Name	Regiona l Status	Global Status
Primates	Cercopithecidae	*Chlorocebus pygerythrus* (F. Cuvier, 1821)	Vervet Monkey	LC	LC
Rodentia	Sciuridae	*Paraxerus cepapi* (A. Smith, 1836)	Tree Squirrel	LC	LC
Carnivora	Felidae	*Panthera pardus* (Linnaeus, 1758)	Leopard	VU	VU
	Viverridae	*Civettictis civetta* (Schreber, 1776)	African Civet	LC	LC
	Hyaenidae	*Parahyaena brunnea* (Thunberg, 1820)	Brown Hyaena	NT	NT

Order	Family	Genus species	English Name	Regional Status	Global Status
		Proteles cristatus (Sparrman, 1783)	Aardwolf	LC	LC
	Canidae	*Canis mesomelas* Schreber, 1775	Black-backed Jackal	LC	LC
		Otocyon megalotis (Desmarest, 1822)	Bat-eared Fox	LC	LC
	Mustelidae	*Aonyx capensis* (Schinz, 1821)	African Clawless Otter	NT	NT
Artiodactyla	Suidae	*Phacochoerus africanus* (Gmelin, 1788)	Common Warthog	LC	LC
	Bovidae	*Aepyceros melampus* (Lichtenstein, 1812)	Impala	LC	LC
		Nyala angasii (Angas, 1849)	Nyala	LC	LC
		Raphicerus campestris (Thunberg, 1811)	Steenbok	LC	LC
		Tragelaphus strepsiceros (Pallas, 1766)	Greater Kudu	LC	LC
		Sylvicapra grimmia (Linnaeus, 1758)	Bush Duiker	LC	LC
		Syncerus caffer (Sparrman, 1779)	African Buffalo	LC	LC
		Tragelaphus scriptus (Pallas, 1766)	Cape Bushbuck	LC	LC

7.4.2.4 Red Data Animals of 2229DB

Five red data animals are listed for quarter-degree grid 2229DB, namely:

» Muller's Velvet Gecko, *Homopholis mulleri Visser*, 1987 (Vulnerable)
» Nile Crocodile, *Crocodylus niloticus Laurenti*, 1768 (Vulnerable)
» Leopard, *Panthera pardus* (Linnaeus, 1758) (Vulnerable)
» Brown Hyaena, *Parahyaena brunnea* (Thunberg, 1820) (Near Threatened)
» African Clawless Otter, *Aonyx capensis* (Schinz, 1821) (Near Threatened)

Given the size of the study area, and the habitat diversity, quality and un-fragmented nature of the faunal habitats available in the study area and surrounds, all five species are considered potential inhabitants of the region. Based on the known geographical distribution of these five animals, as well as the habitat preferences of each species, the likelihood of each species occurring in the study area are estimated as follows:

» Muller's Velvet Gecko, *Homopholis mulleri Visser*, 1987 (Vulnerable): **medium-high Possibility of Occurrence**
» Nile Crocodile, *Crocodylus niloticus Laurenti*, 1768 (Vulnerable): **low Possibility of Occurrence**
» Leopard, *Panthera pardus* (Linnaeus, 1758) (Vulnerable): **high Possibility of Occurrence**
» Brown Hyaena, *Parahyaena brunnea* (Thunberg, 1820) (Near Threatened): **high Possibility of Occurrence**
» African Clawless Otter, *Aonyx capensis* (Schinz, 1821) (Near Threatened): **low Possibility of Occurrence**

Even though these are the only Red Data listed animals currently listed for quarter-degree grid 2229DB, other threatened or sensitive species are likely to persist within the boundaries of the study area. The available datasets are not regarded comprehensive and new species distributions are added on a regular basis.

Specific reference is made of the baboon spider burrows that were located on Farm Du Toit 563. Specific attention will be provided to locating community knowledge of the presence and abundance of these species across the study sites.

7.4.2.5 Preliminary Faunal Habitat Diversity

A close relationship exists between vegetation units and specific faunal composition. Broadly speaking, floristic macro-habitats are regarded representative of faunal habitat diversity for a given area. Preliminary macro-habitats are considered ecologically distinctive and descriptive of the faunal habitat diversity of the study area. Based on brief site observations and from aerial imagery the following general faunal habitats are expected to be found within the study sites:

» Transformed/ Deteriorated Woodland Habitat
» Untransformed Terrestrial Woodland Habitat
» Faunal Wetland Habitat

7.4.2.6 Transformed/ Deteriorated Woodland Habitat

Minor portions of the terrestrial woodland have been altered, mainly for agricultural purposes, comprising physiognomy that is atypical to the surrounding, natural woodland. The absence of a dominant woodland canopy, with tall and dominant trees are characteristic, rendering the faunal component that are likely to utilise these parts, atypical and compositional different to the normal animal constituents. Although atypical, it is not expected that any animal of conservation importance will utilise these parts for prolonged periods. It is likely that these areas will play a minor role in the ecological functionality of the immediate region, despite providing some contribution to the species richness through the presence of species that are not typically associated with the surrounding natural woodland. Alien and invasive species are typically associated with these parts. A low to moderately-low faunal sensitivity is typically ascribed to such habitat types.

7.4.2.7 Untransformed Terrestrial Woodland Habitat

Natural, and untransformed woodland of the sites correspond to the Musina Mopane Bushveld regional vegetation community of the Central Bushveld Bioregion and Savanna Biome of South Africa. Observations made during the brief site visitation for the screening assessment indicated that the untransformed terrestrial woodland habitat of the study area is unlikely to include significant natural ecological variation and habitat feature diversity. A relatively high homogeneity is noted in terms of structural and compositional vegetatal aspects and this is likely to translate into a similar homogenous composition of the typical faunal constituents of the terrestrial woodland. Terrestrial woodland habitat is described as undifferentiated arid broad-leaved woodland on sandy soils, conforming to the regional ecological type and exhibiting a moderate to moderate-high sensitivity in terms of faunal components.

Minor and isolated variations are likely to occur because of habitat degradation, fragmentation, edge effects that results from variable ecological management. Habitat status, level of degradation, landscape connectivity, red data hosting ability and ecological diversity will likely determine the specific faunal sensitivity of each habitat fragment. The anticipated variation in the faunal sensitivities of these habitat fragments is likely to result in disparities in the suitability and development potential of these fragments within the project scope.

7.4.2.8 Wetland Habitat

The Bushveld region in which the study area is situated, normally receives about 400 mm of rain per year, most of which occur during midsummer. The arid nature of the region complicates wetland delineation and confounds an understanding of the ecological processes and biodiversity functions of the wetlands of the study area region. Wetlands of arid regions are seldom obvious and their processes not well understood. Within the arid landscape, wetlands are scarce and unique; the presence of arid wetlands significantly enhances the biodiversity and ecosystem process diversity of an area.

Wetlands (as per the formal definition) generally conforms to seasonal drainage lines and localised depressions. These parts of the study area are considered to exhibit high faunal sensitivities, irrespective of the habitat status; wetlands are known to have high restoration potential and their ecological importance cannot be overestimated. A moderately-high to high sensitivity is likely to be ascribed to these parts of the sites and an extensive presence within a site is likely to render the option less preferable for the proposed development.

7.4.3 Avifauna

7.4.3.1 Regional Vegetation Types – Regional Context

The study area corresponds to the Savanna Biome and more particularly to the Mopane Bushveld Bioregion as defined by Mucina & Rutherford (2006) and comprehends an ecological type known as Musina Mopani Bushveld (Mapping Unit SVmp 01; Mucina & Rutherford, 2006). This vegetation type extends from Baines Drift and Alldays in the west, eastwards and north of the Soutpansberg to Banyini Pan. It is predominantly located on undulating plains that are irregularly interspersed by tributaries of the Limpopo River. On the study area, it forms a moderately open, albeit arid savanna dominated by *Colophospermum (=Hardwickia) mopane*, *Terminalia prunioides, Commiphora* species, *Kirkia acuminata* and *Combretum apiculatum*. The graminoid layer is open and sparse, while the herbaceous layer is poor in species richness. *Adansonia digitata* and *Senegalia (=Acacia) nigrescens* are typical canopy constituents.

This vegetation type was widespread, least threatened and dominant on the study area.

The high palatability of the graminoid composition and the geographic position of the study area makes this vegetation type very suitable for game and livestock (mainly cattle) farming practices, which is also *responsible for the occurrences of large-bodied birds of prey (especially scavenging vultures*).

It should be realised that bird diversity is invariably positively correlated with vegetation structure, although floristic richness is not regarded to be the most important contributor of bird abundance patterns. Therefore, grasslands are generally poor in woody plant species although it is considered an important habitat for many terrestrial bird species such as larks, pipits, korhaans and cisticolas. On the other hand, woodlands are rich in woody plant species and are an important constituent of the Savanna Biome that provides habitat for a large number of bushveld bird species that are not partial to grassland habitat types (notably birds of prey).

However, in contrast to the Grassland Biome, the bird assemblages occupying the Savanna Biome are generally rich in Accipitriform taxa such as the Tawny Eagle (*Aquila rapax*), African White-backed Vulture (*Gyps africanus*), Brown Snake-eagle (*Circaetus cinereus*), Black-chested Snake-eagle (*Circaetus* *pectoralis*), African Harrier-hawk (*Polyboroides typus*), African Hawk Eagle (*Aquila spilogaster*) and Wahlberg's Eagle (*Hieraaetus wahlbergi*).

This regional habitat type supports a fairly high richness of bird species. However, it is evident that a number of smaller habitat units (depressions, seasonal drainage lines and cultivated land) are also prevalent and provide habitat for bird compositions that are different to those ecological types that dominate the region. It should be emphasised that the depressions provide ephemeral habitat for wetland-dependant bird species (mainly wading bird and wader species – to be discussed in more detail as part of the EIA) which have subsequently contributed to the avifaunal richness in the area. These wetland features also provide foraging habitat for threatened stork species.

7.4.3.2 Avifaunal Broad-scale Habitat Types

From an avifaunal perspective, five macro-habitat types are prominent in the area:

1. ***Undifferentiated arid broad-leaved woodland on sandy soils*** - The majority of the study area consists of open, arid woodland located on sandy soils. It comprises of a well-developed woody layer consisting of *Colophospermum (=Hardwickia) mopane, Terminalia prunioides*, *Vachellia tortilis, Kirkia acuminata, Grewia bicolor, Boscia albitrunca, Lannea schweinfurthii* and various species of *Commiphora*. Typical canopy constituents include *Xanthocercis zambesiaca, Senegalia nigrescens* and *Adansonia digitata*. The graminoid layer includes dominant taxa such as *Panicum maximum, Schmidtia pappophoroides* and *Stipagrostis uniplumis*. Based on their distribution, the avifaunal assemblages occurring on the study area are likely to include a high proportion of taxa with evolutionary links to the Zambezian region and the Kalahari-Highveld basin (refer to **Table 7.8**). The open structure and sparse graminoid layer (presumably due to grazing pressure and climatic factors such as unpredictable precipitation resulting in frequent aridity) favoured the colonisation of large terrestrial bird species such as the Kori Bustard (*Ardeotis kori*), Red-crested Korhaan (*Lophotis ruficrista*) and Secretarybird (*Sagittarius serpentarius*).

   Some sections of the woodland type consist of dense *Grewia flavescens* and *Dichrostachys cinerea* shrub which are colonised by elusive and skulking warbler and robin taxa such as Marsh Warbler (*Acrocephalus palustris*) and Thrush Nightingale (*Luscinia luscinia*), especially when on passage. Both these species are easily overlooked and have not been recorded previously from the area.

Table 7.8: A list of biome-restricted and range-restricted species (according to Marnewick et al., 2015) expected to be present on the study areas

Species	***Common Name***	***Biome Affinity***	***Predicted Status***
Erythropygia paena	Kalahari Scrub-robin	Kalahari-Highveld	Common
Cossypha humeralis	White-throated Robin-chat	Zambezian Affinity	Uncommon
Poicephalus cryptoxanthus	Brown-headed Parrot	East African Coastal Affinity	Uncommon (study site is part of western edge of distribution)
Turdus libonyanus	Kurrichane Thrush	Zambezian Affinity	Common
Calamonastes fasciolatus	Barred Wren-warbler	Kalahari-Highveld	Common
Cinnyris talatala	White-bellied Sunbird	Zambezian Affinity	Common

1. ***Seasonal drainage lines*** - This habitat type represents a linear riparian zone along drainage lines, which were most prominent on the Farm Du Toit. The riparian vegetation consists of a dense canopy of *Schotia brachypetala, Xanthocercis zambesiaca, Peltophorum africanum*. The understorey is well defined and thicket-like, consisting of *Grewia flava, G. hexamita* and *Ziziphus mucronata*. *Panicum maximum* dominates the graminoid layer. The high vertical heterogeneity and leaf litter deposition associated with the alluvial vegetation allow for avifaunal compositions not typically associated with adjacent dryland habitat types - thereby enhancing local biodiversity. From a functional perspective, these habitat types play an important role in maintaining genetic stability between bird populations along their entire length. These constitute important dispersal corridors for faunal species since it increases the probability of colonisation of areas outside of the study site, thereby reducing the isolation of residing populations.

Apart from the aforementioned habitat types, three important azonal habitat types were also prevalent and scattered across the study area:

2. ***Impoundments and natural depressions (pans)*** – these respectively represent man made water bodies and shallow depressions. However, these waterbodies have undoubtedly benefit the colonisation and range expansion of many waterbird species that favours open water habitat (e.g. White-faced Duck - *Dendrocygna viduata*, Comb Duck - *Sarkidiornis melanotos* and Egyptian Goose - *Alopochen aegyptiacus*). They also provide foraging habitat for threatened stork species (e.g. Black Stork - *Ciconia nigra*).

3. ***Large Adansonia digitata (Baobab) canopy constituents*** – these include large baobab trees, which were scattered across the study area, but were particularly prominent on the Farm Vrienden. They provide optimal roosting and breeding habitat for a host of cavity-nesting bird species (including Brown-headed Parrot - *Poicephalus cryptoxanthus*). In addition, these trees are also the favourite breeding platforms used by Red-billed Baffalo Weavers (*Bubalornis niger*) and Red-headed Weavers (*Anaplectes rubriceps*). Lastly, they also function as important hunting and roosting posts for large birds of prey.

4. ***Secondary woodland and areas that were historically cleared of vegetation –*** these represent areas of secondary woodland previously used for agricultural purposes. The sequential colonisation by graminoid (grass) species makes it possible for terrestrial species (mainly Kori Bustard - *Ardeotis kori*) to utilise these area.

7.4.3.3 Species Richness and predicted summary statistics

Approximately 262 bird species are *expected* to occur on the study area (refer to **Table 7.9**). The expected richness was inferred from the South African Bird Atlas Project (SABAP1 & SABAP2)[11] (Harrison et al., 1997; www.sabap2.org) and the presence of suitable habitat on the study area. The expected richness is also strongly correlated with favourable environmental conditions (e.g. when ephemeral pans are inundated) when waterbird and wading bird taxa are anticipated to temporarily colonise the area (e.g. stork taxa).

[11] The expected richness statistic was derived from the QDS 2229DB (Mopane) with a total of 233 bird species recorded (based on 14 cards submitted) AND three pentad grids (including adjacent pentad grids) totaling 358 bird species (based on 12 full protocol cards). The SABAP2 statistic was corrected by excluding erroneous submissions pertaining to the Damara Hornbill (*Tockus damarensis*) and hybrids with Southern Red-billed Hornbill (*T. rufilatus*), Orange River White-eye (*Zosterops pallidus*), Green-backed Camaroptera (*Camaroptera brachyura*) and Northern Grey-headed Sparrow (*Passer griseus*).

Figure 7.15: Undifferentiated arid broad-leaved woodland on sandy soils; note the poorly developed basal or graminoid layer.

Figure 7.16: Undifferentiated arid broad-leaved woodland on sandy soils; note the poorly developed basal or graminoid layer.

Figure 7.17: Undifferentiated arid broad-leaved woodland on sandy soils; note the poorly developed basal or graminoid layer.

Figure 7.18: Undifferentiated arid broad-leaved woodland on sandy soils; note the poorly developed basal or graminoid layer.

Figure 7.19: Dense Grewia thickets which provide suitable habitat for Palearctic migratory warbler taxa when on passage.

Figure 7.20: An inundated seasonal drainage line as viewed on the Farm Du Toit 563.

Figure 7.21: An ephemeral pan on the Farm Du Toit 563.

Figure 7.22: A large Adansonia digitata tree on the Farm Vrienden which provide breeding habitat for Red-billed Baffalo Weavers (*Bubalornis niger*) and Brown-headed Parrot (*Poicephalus cryptoxanthus*).

Figure 7.23: Secondary savannoid grassland along the edge of Farm Du Toit 563, the typical foraging habitat of the near threatened Kori Bustard (*Ardeotis kori*).

This equates to 27% of the approximate 972[12] species listed for the southern African subregion[13] (and approximately 31% of the 848 species recorded within South Africa[14]). However, the SABAP2 database (www.sabap2.adu.org.za) for the three pentad grids corresponding to the study area was significantly lower (c. 33-52 species/pentad), which emphasises the poor atlas coverage of the area. According to personal observations, the average number of species observed per pentad within a given time period (c. 2 hours) is approximately 90 – 100 species. This is much lower than the regional SABAP1 statistic, and best explained by the monotonous habitat structure that is prevalent across the two farms. On a national scale, the species richness per pentad on the study area is considered low (refer to **Figure 7**.24).

[12] *sensu* www.zestforbirds.co.za (Hardaker, 2016) with the addition of Rufous-tailed Scrub-Robin (*Erythropygia galactotes*) and Pied Flycatcher (*Ficedula hypoleuca*).

[13] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).

[14] With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2017).

Table 7.9: Summary table of the statistics of birds expected to occur within the proposed study area.

Description	Expected
Total number of species	262 (31 %)
Number of Red Listed species (Taylor et al., 2015)*	13 (10 %)
Number of biome-restricted species (Marnewick et al., 2015) – Zambezian, African East Coast & Kalahari-Highveld)**	6 (23 %)
Number of endemics (Hockey *et. al*., 2005)**	0 (0 %)
Number of near-endemics (Hockey *et. al*., 2005)**	2 (7 %)

(Taylor et al., 2015; IUCN, 2017), endemics and biome-restricted species (Marnewick et al., 2015)

Percentage values in brackets refer to derived totals compared against the number of species in South Africa (BirdLife South Africa, 2017)[15].

* - only in South Africa (including Lesotho and Swaziland).

** - only species in the geographic boundaries of South Africa (including Lesotho and Swaziland) were considered.

Although the *expected* richness of bird species for the area is higher than the observed richness, it is poorly represented by endemic and near-endemic species. It provides habitat for a single near-endemic species (*c*. Fiscal Flycatcher - *Sigelus silens*). In addition, the study area holds a number of geographically-restricted species, and it contains six biome-restricted (Zambezian, Kalahari-Highveld and East African Coastal biomes) species in South Africa.

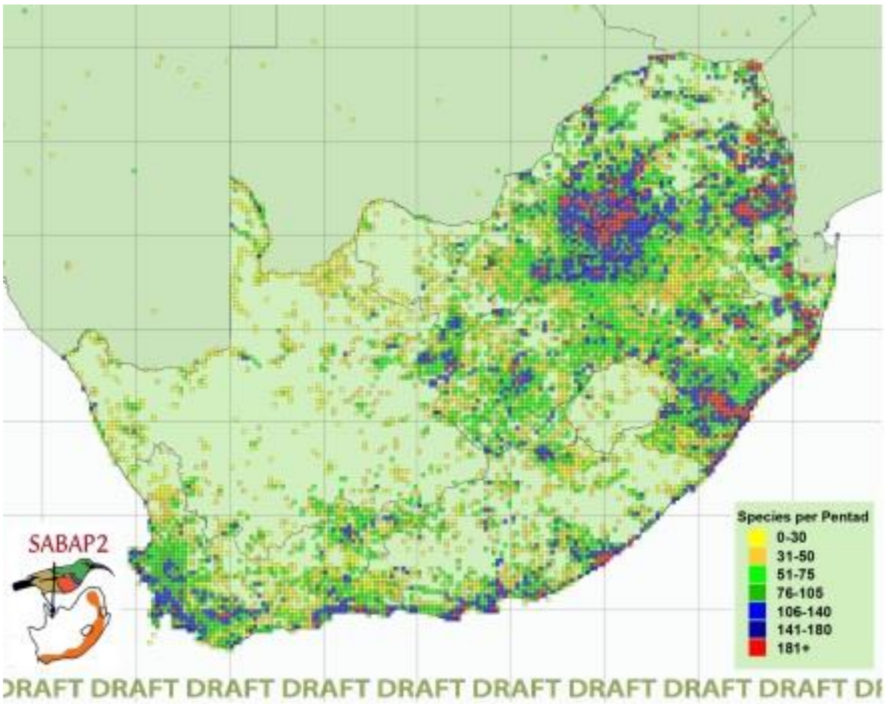

Figure 7.24: Bird species richness per pentad grid for South Africa (map courtesy of SABAP2 and the ADU).

[15] With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2017).

7.4.3.4 Species of conservation concern

Table 7.10 provides an overview of the threatened and near-threatened bird species that could occur on the study area based on their respective distribution ranges and the presence of suitable habitat. According to **Table 7.10**, 13 species are known to occur in the region of which seven species are expected to be regular. Six of the 13 species are globally threatened species and two are globally near-threatened, while nine are regionally threatened species and three regionally near-threatened species. Noteworthy species include the regionally near-threatened Kori Bustard (*Ardeotis kori*), the endangered African White-backed Vulture (*Gyps africanus*), the endangered Bateleur (*Terathopius ecaudatus*), the vulnerable Secretarybird (*Sagittarius serpentarius*) and the vulnerable Black Stork (*Ciconia nigra*). The remaining species are regarded as uncommon residents or irregular and highly opportunistic foraging visitors to the area.

Table 7.10: Threatened and near-threatened bird species that could utilise the proposed study area based on their known distribution range and the presence of suitable habitat.

Species	Global Conservation Status*	Regional Conservation Status**	Preferred Habitat	Occurrence Status
Aquila rapax (Tawny Eagle)	-	Endangered	Lowveld and Kalahari savannas, especially game farming areas and reserves.	An irregular foraging visitor. Its occurrence depends on the presence of carcasses.
Ardeotis kori (Kori Bustard)	Near-threatened	Near-threatened	Arid open lowland savanna and karroid shrub.	A fairly common resident and expected to be widespread on the study area (especially Farm Du Toit)
Bucorvus leadbeateri (Southern Ground Hornbill)	Vulnerable	Endangered	Open woodland and grassland habitat	An uncommon resident to the area.
Ciconia abdimii (Abdim's Stork)	-	Near-threatened	Open stunted grassland, fallow land and agricultural fields	A fairly common summer foraging visitor to areas consisting of secondary grassland or cleared of woodland. Could also utilise the depressions (pans) as ephemeral foraging habitat.
Ciconia nigra (Black Stork)	-	Vulnerable	Breeds on steep cliffs within mountain ranges; forages on ephemeral wetlands.	A fairly common summer visitor to the pan depressions in the area.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor on the study area. Partial to pan depressions in open woodland (utilised as hunting habitat).
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas.	A common foraging visitor. Often roosts on top of large trees.

Species	Global Conservation Status*	Regional Conservation Status**	Preferred Habitat	Occurrence Status
Gyps coprotheres (Cape Vulture)	Vulnerable	Endangered	Mainly confined to mountain ranges, especially near breeding site. Ventures far afield in search of food.	An uncommon foraging visitor (mainly individuals) - often in company with White-backed Vultures (Gyps africanus).
Leptoptilos crumeniferus (Marabou Stork)	-	Near-threatened	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas	An irregular foraging visitor - often encountered at the pans.
Polemaetus bellicosus (Martial Eagle)	Vulnerable	Endangered	Varied, from open karroid shrub to lowland savanna.	An uncommon foraging visitor.
Sagittarius serpentarius (Secretarybird)	Near-threatened	Vulnerable	Prefers open grassland or lightly wooded habitat.	Regarded as a fairly common visitor to the secondary and open woodland.
Terathopius ecaudatus (Bateleur)	Vulnerable	Endangered	Lowveld and Kalahari savanna; mainly on game farms and reserves	A fairly common foraging visitor - access to carcasses regarded as important.
Aegypius tracheliotos (Lapped-faced Vulture)	Vulnerable	Endangered	Lowveld and Kalahari savanna; mainly on game farms and reserves	An irregular foraging visitor.

Conservation categories were used according to the IUCN (2017)* and Taylor et al. (2015)**.

A brief account of the important taxa is presented under the respective headings below:

1. *Kori Bustard (Ardeotis kori)*

Ardeotis kori is globally listed as near-threatened (BirdLife International 2013a) while a recent conservation assessment has downgraded it from regionally vulnerable to near-threatened (Taylor et al., 2015). *A. kori* is a large terrestrial bird with a preference for lightly wooded savanna which is nowadays mainly encountered on larger conservation areas and game farms (Barnes, 2000; BirdLife International, 2013a). It is expected to be common on the study area, especially on open woodland and secondary grassland habitat. It should be emphasised that collision of birds with the game fence pose a real risk to the long-term survival of this species. However, it also utilises old cultivated land or areas cleared of woodland, which allows for unrestricted movement during foraging bouts and provides suitable habitat for this species. Therefore, this species has undoubtedly benefited from selective clearing of woodland areas, which facilitate unhindered movement and foraging of such a large-bodied species.

2. Storks (*Ciconiidae*)

Three (3) stork species of conservation concern are expected to be present on the study area, which include the regionally vulnerable Black Stork (*Ciconia nigra*), regionally near-threatened Abdim's Stork (*C. abdimii*) and the regionally near-threatened Marabou Stork (*Leptoptilos crumeniferus*). The occurrence of these species is opportunistic, and most individuals are attracted to the nearby agricultural activities. However, these species tend to utilise the depressions as important ephemeral foraging habitat.

3. *Martial Eagle (Polemaetus bellicosus)*

P. bellicosus is globally listed as vulnerable (BirdLife International, 2013b) while a recent conservation assessment has upgraded it from regionally vulnerable to endangered (Taylor et al., 2015) due to rapid declines in South Africa during the last 10 years (owing to habitat loss and poisoning; Taylor et al., 2015). Although it has an extensive range across most of sub-Saharan Africa, it is nowhere common and generally occurs at low densities. *P. bellicosus* is a large and charismatic species that is more numerous in large conservation bodies although it also occurs on large game farms, or areas where human densities and activities remain sparse. However, it is regarded as an uncommon foraging visitor on the study area and its status (including breeding status) on the study area requires verification. It requires exceptionally large home ranges in excess of 130 km^2 (Brown et. al., 1982) and sometimes even up to 1 000 km^2, accentuating the importance of additional foraging habitat for the long-term survival of this species.

4. *Scavenging Birds of Prey (genera Gyps, Aegypius, Aquila* and *Terathopius)*

Five species of large-bodied scavenging raptors are expected to be present. All of these were formerly listed as vulnerable or near threatened in South Africa (Barnes, 2000), but evidence according to regional declining trends has upgraded their status to the endangered and critically endangered categories (Taylor et al, 2015). Of these, only the White-backed Vulture (*Gyps africanus*) and Bateleur (*Terathopius ecaudatus*) are considered as regular foraging visitors to the study area. The remaining species (*c*. Cape Vulture - *Gyps coprotheres*, Lappet-faced Vulture - *Aegypius tracheliotos* and Tawny Eagle - *Aquila rapax*) are irregular and opportunistic since their occurrences are best explained by the presence of carcasses.

5. *Lanner Falcon (Falco biarmicus)*

F. biarmicus is a fairly common species within its global distribution range, where it occurs from south-eastern Europe to the Middle East, south-west Asia and across most of Africa (Jenkins, 2005). The global population consists of more than 30 000 breeding pairs with approximately 1 400 pairs confined to the eastern parts of South Africa (Tarboton & Allen, 1984). It was recently upgraded from near threatened to Vulnerable in South Africa due to persistent transformation of suitable foraging habitat (open areas) to make way for agricultural land. This species is often associated with ridges and mountain ranges where it prefers to nest on cliffs. It prefers to forage over open terrain and will hunt indiscriminately on almost any open area with suitable prey (mainly other terrestrial birds such as francolins and lapwings), although pans/water holes located within open woodland are preferred. Its occurrence on the study area is regarded as occasional.

6. *Secretarybird (Sagittarius serpentarius)*

This species was recently upgraded from near-threatened to vulnerable (Taylor et al., 2015; BirdLife International, 2013c) since recent evidence suggests that it has experienced rapid declines across its entire range due to habitat loss, anthropogenic disturbances and intensive grazing. Secretarybirds are widespread in Africa south of the Sahara, but have declined over most of their geographic distribution range. They prefer open areas, in particular open savanna and grassland, but tend to avoid areas of dense bush or very rocky areas. *S. serpentarius* is considered as a regular foraging visitor on the study area. Owing to its preference for open and secondary woodland units, it is predicted to share a habitat in common with the Kori Bustard (*Ardeotis kori*).

7. *Southern Ground Hornbill (Bucorvus leadbeateri)*

This species is listed as endangered (Taylor et al., 2015) with less than 1 500 mature individuals remaining within South Africa. They prefer open areas, in particular open savanna where suitable natural cavities in trees are available. It is considered an uncommon resident in the area and its occurrence requires verification.

7.4.3.5 Key Avifaunal Features and Synthesis

Based on the results, the avifaunal community on the study area is summarised in terms of the following key features:

- The study area supports a high diversity of bird species representing approximately 31 % of the regional richness (irrespective of the SABAP2 statistic);
- In general, habitat diversity and heterogeneity were relatively low, and the woodland structure was monotonous across the area;
- The avifaunal community on the study area is not regionally unique (on a national level) and poorly represented by South African endemics and near-endemics. The dominant composition is widespread in the region;
- A number of threatened and near threatened species (mainly scavenging bird of prey species and Kori Bustard - *Ardeotis kori*) is expected to be present. The majority of these species requires large home range sizes, with many species occupy low densities;
- Part of the woodland habitat consists of an open canopy structure which is expected to provide optimal foraging habitat for terrestrial large-bodied bird species (e.g. the near-threatened Kori Bustard - *Ardeotis kori* and vulnerable Secretarybird *Sagittarius serpentarius*);
- The depressions, pans and impoundment features on some of the farms (especially Farm Du Toit) have benefitted the colonisation of "specialised" bird taxa (mainly wader and wading bird species) that are of local importance and contribute towards the regional avifaunal diversity. It also provides ephemeral foraging habitat for threatened and near threatened stork taxa.

7.5 Socio-Economic Characteristics

7.5.1 Demographic Profile

The population of any geographical area has influence over any development process, as it ultimately has the potential to affect the economic growth through the provision of labour and entrepreneurial skills; and determines the demand for the production output. An examination of population dynamics is therefore essential in gaining an accurate perspective of those who are likely to be affected by any prospective development or project.

7.5.1.1 Population Demographics

The demographic profile reflects the amalgamation of Mutale LM with Musina LM that took effect from 03 August 2016. The Musina LM has a population of approximately 172 932, with a total of 47 300 households (Quantec, 2015).

Figure 7.25: Snapshot of demographic profile of Musina LM (Quantec, 2015).

The Musina Municipality constitutes just over a tenth of the population of the Vhembe DM. Furthermore, similar to the population size, 13% of the total households in the Vhembe DM are located in the Musina LM. A large portion of 58% of the population resides in tribal areas, followed by 28% located in urban areas, and the remaining 13% resides on farm land. Of the population, 97% are Black, 2% are White, whilst Asian/Indian and Coloured constitute the remaining 1%. A slightly greater proportion of 53% of the population is comprised of females, while males comprise 47% of the total municipal population.

Close to two-thirds of the population are of working age (i.e. 15 – 64 years of age), whereas a third are aged below 15. Just over 4% of the population in the Musina LM are aged over 65. The majority of the population is therefore of working age and the minority is senior citizens.

7.5.1.2 Income Levels

The average monthly household income in the Musina LM was R4 991 in 2011, with 7% earning no income. Overall, 65% of the households within the Musina LM earn up to R3 200 per month. In Musina town, 7% of the households have no income and 55% earn up to R3 200. The closest settlement to the proposed project site is Mudimeli, which is not located within the Musina LM but in the adjacent Makhado LM. As the closest community to the project site it must be considered as a possible labour pool. A great proportion of the study areas observed earns between R1 – R3 200 per month, as indicated in **Figure 7**.26. The household incomes indicate that low-income earners dominate and conversely high-income earners are a minority.

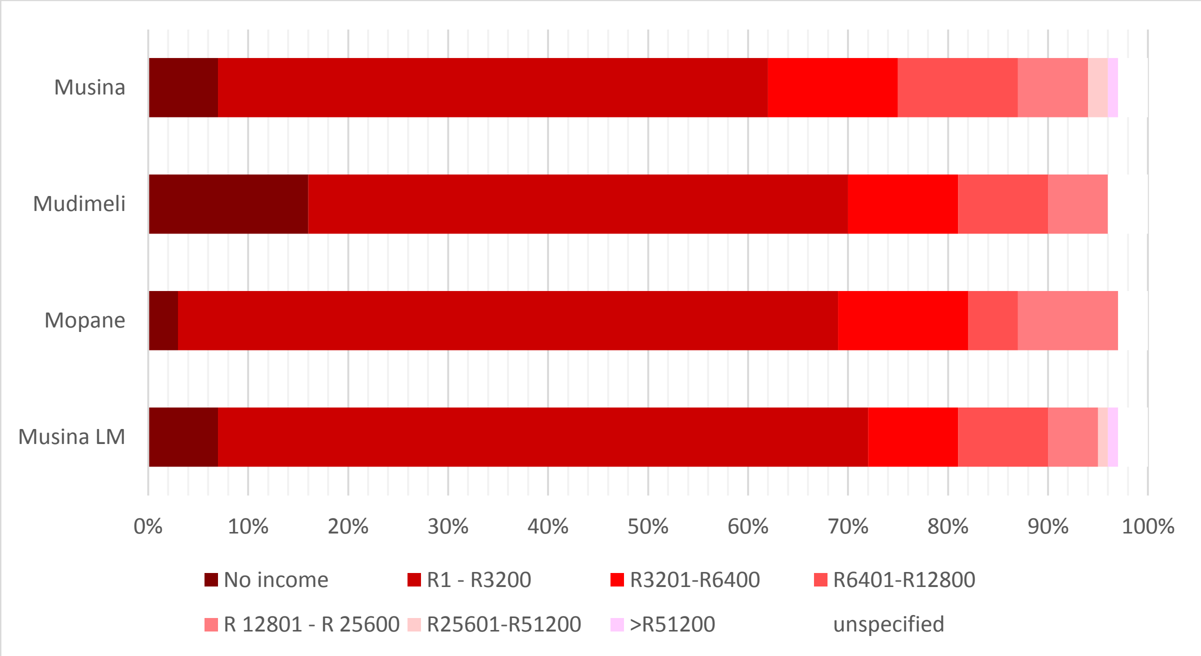

Figure 7.26: Income Levels across study areas (Quantec, 2016).

7.5.1.3 <u>Education Levels</u>

Of the adult population (i.e. over 20 years of age), 15% do not have any schooling. In the Musina LM, 71% of the adult population do not hold a Matric certificate. The remaining 29% have obtained a Matric certificate of which 8% have also attained a higher qualification (refer to **Figure 7**.27).

The education levels within the area are indicative of an education completion problem. In addition, these education levels may correlate with the dominant low-income earned in the municipality as most of the adult population do not have qualifications to attain better earning jobs.

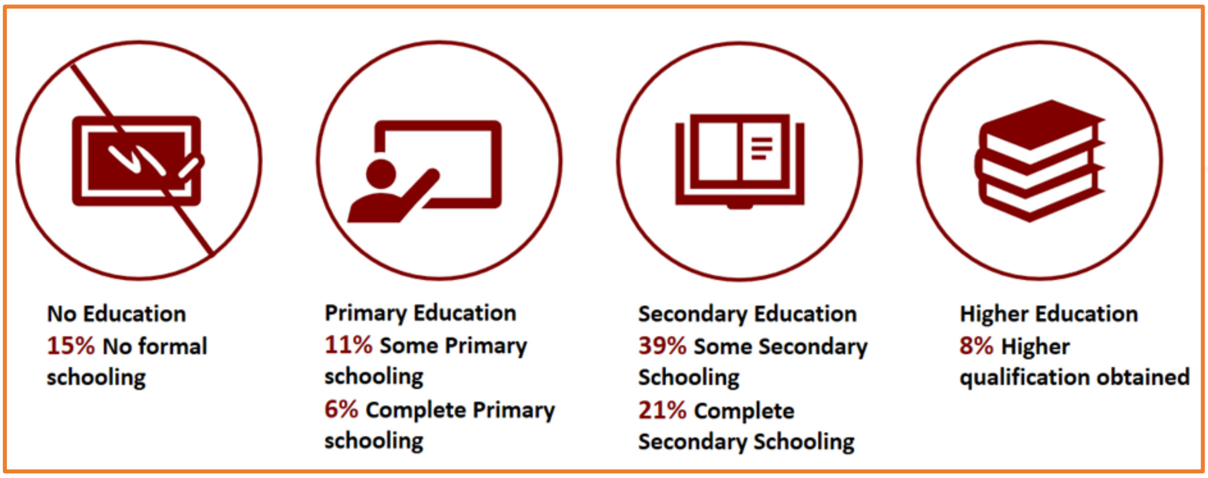

Figure 7.27: Education Levels in Musina LM (Quantec, 2015).

7.5.2 *The Economy*

In 2016, the Musina LM's economy was valued at R7 405 million in current prices. The Musina LM contributes 16% to the economy of the Vhembe DM and 3% to the economy of Limpopo. Over a 10 year period between 2005 and 2015, the municipality's economy grew at a positive Compounded Annual Growth Rate (CAGR) of 1.6% per year. This is similar to the Vhembe DM and Limpopo provincial growth rates, but suggest of a stagnating economy.

Table 7.11: Limpopo and Musina LM structure of economies (2016, nominal).

Economic Sector	Limpopo			Musina LM		
	GDP (R'mil)	% of GDP	CAGR (2005-2015)	GDP (R'mil)	% of GDP	CAGR (2005-2015)
Agriculture, forestry and fishing	6 458	7.3%	1.8%	452	6.1%	2.6%
Mining and quarrying	76 354	9.5%	0.0%	1 645	22.2%	-6.9%
Manufacturing	8 794	10.1%	0.8%	127	1.7%	1.8%
Electricity, gas and water	12 216	17.0%	-0.8%	236	3.2%	1.0%
Construction	8 886	14.3%	4.4%	197	2.7%	4.1%
Trade	43 162	10.8%	2.0%	1 508	20.4%	5.0%
Transport and communication	14 756	7.3%	2.1%	468	6.3%	2.8%
Finance and business services	39 652	8.2%	2.3%	894	12.1%	4.0%
General government	55 269	10.7%	2.9%	1 586	21.4%	3.9%
Personal services	11 857	7.6%	1.6%	293	4.0%	2.0%
TOTAL	277 404	100%	1.5%	7 405	100%	1.6%

Source: Urban-Econ Calculations based on Quantec, 2017

The economic sectors with the greatest contribution to the GDP-R of Limpopo Province are mining and general government. Similarly, the mining sector and general government are among the highest contributing economic sectors in the Musina LM. The wholesale and trade sector closely follow and contribute a fifth to the Musina LM economy. The manufacturing and construction sectors make the least contribution to the GDP-R of the municipality.

Over the years, the mining industry has been declining, which considering its large contribution to the local economy has had a negative effect on the Musina LM. This negative impact was possible to offset by the above-average growth rate observed among the tertiary industries and specifically the trade and general government sectors, which as mentioned previously are among the top three contributing industries to the local municipality's economy.

7.5.2.1 <u>Labour Force and Employment Structure</u>

Employment is the primary means by which individuals who are of working age may earn an income that will enable them to provide for their basic needs and improve their standard of living. As such, employment and unemployment rates are important indicators of socio-economic well-being. The following paragraphs examine the study area's labour market from a number of perspectives, including the employment rate and sectoral employment patterns.

7.5.2.2 Labour Force Composition

According to Census 2011 data, the working age population of the Musina LM comprised approximately 105 884 people. Amongst these, 50 624 were economically active. Not economically active (NEA) persons are those who were neither employed nor unemployed, including discouraged job seekers. The Musina LM had 46 992 NEA persons in 2011. The employed labour in the LM was estimated at 35 576, whilst the unemployed labour was about 15 048. The Musina LM has an unemployment rate of 30%.

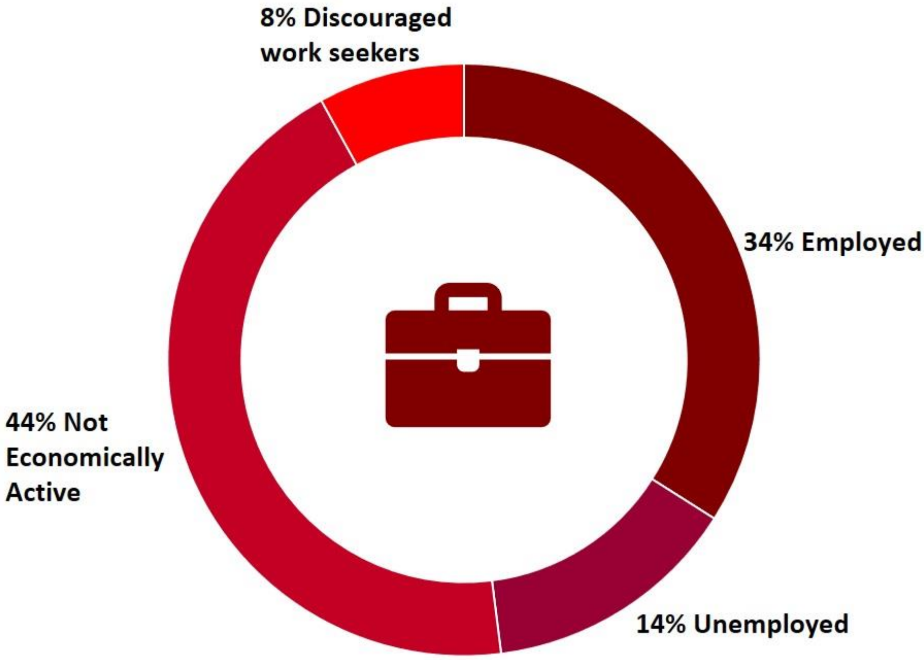

Figure 7.28: Labour Force Statistics for Musina LM2011 (Stats SA, 2011).

In the town of Musina, 13 484 of the working age population are employed, whereas 4 760 are unemployed. This indicates a 26% unemployment rate. In the case of Mopane, the unemployment rate (7%) is significantly lower than that of the municipality and closest town due to the small population size. Conversely, Mudimeli has the highest unemployment rate of 33%. In terms of skills levels, the largest proportion of the labour force is semi-skilled in the Limpopo Province and the Vhembe DM. In the Musina LM, the labour force is dominantly low-skilled.

7.5.2.3 Employment Structure

In the Vhembe DM, the wholesale and trade sector employed the most people whereas the mining sector employed the least. A decline in employment across all sectors of the economy took place between 2008 and 2010. The manufacturing sector particularly experienced a decline in employment numbers from 2007 to 2012 in the Vhembe DM. The exception has been the general government sector, which has consistently experienced growth in employment over the past 10 years.

Close to a third of the Musina LM labour force are informally employed. Just over two-thirds of the employed individuals are employed in the formal sector. As indicated in **Figure 7**.29 below, the agricultural sector employed the largest number of people in the Musina LM in 2015, whereas the electricity, gas and water sector employed the least (Quantec, 2017). Observing 2010 and 2015 employment figures, it is evident that most economic sectors have increased their labour absorption during this period. Only the mining sector employed fewer individuals in 2015 than in 2010.

7.5.3 Status of infrastructure and basic service delivery

Access to basic service delivery and infrastructure such as shelter and transport are indicators that assist in understanding the standard of living of the households residing in the study area. Comprehension of the extent to which households in the area have access to water, sanitation, and electricity assists in the understanding of communities' living standards and their needs. The availability of service infrastructure such as roads, educational and health facilities, etc., further indicates the nature of the study area, which is valuable in developing a complete profile of the circumstances in which communities are living.

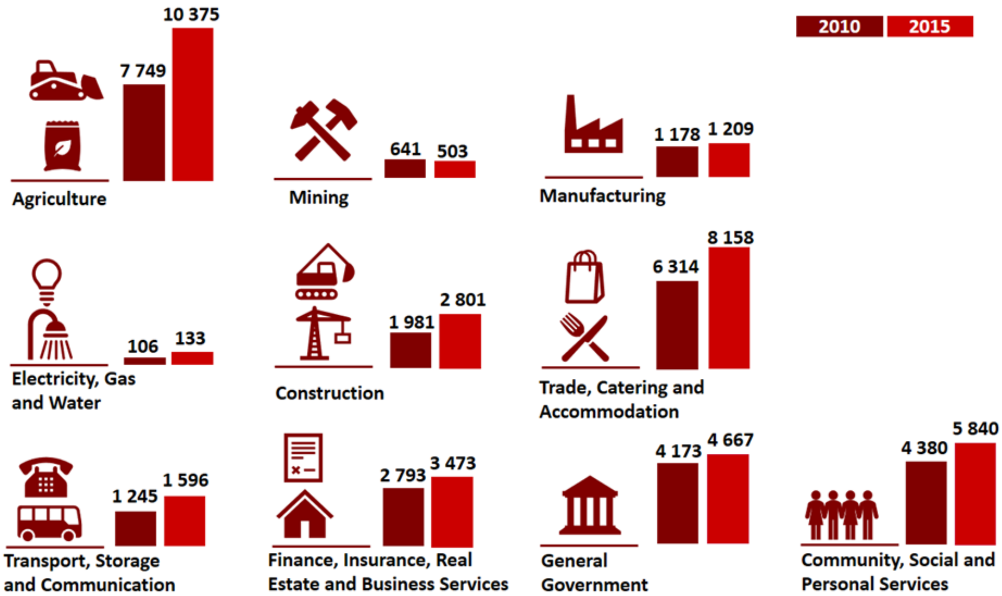

Figure 7.29: Employment figures per Economic Sector for 2010 and 2015 in the Musina LM (Quantec 2017).

7.5.3.1 <u>Basic service delivery</u>

According to the Musina LM IDP (2016), housing development has reached crisis levels due to the ever-increasing demand. The challenge to supply housing at required quantities is the shortage of land for human settlement. In addition, the majority of people do not qualify to receive government subsidy houses. The backlog in 2016 was 3 200 houses.

The Vhembe DM is both a water authority and water provider. The Musina LM then reticulates water to households through household water tap connections and standpipes. In the urban area of Musina, 8 108 households have metered connections and 2 811 households receive free basic water. A large number of households have access to water; however, upgrading, resource extension, operation, and maintenance as well as refurbishment needs are immense.

In 2014, Vhembe DM managed to complete 3 950 Ventilated Improved Pit latrines (VIP). Nonetheless, a backlog of 87 658 remained. The challenges in sanitation are the bucket system and the lack of policy clarity (Musina LM, 2016).

There is no backlog in electricity in the municipal areas, whereas the total backlog in electricity in the villages is 1 013. The main source of energy used in the Musina LM is electricity, followed by wood. The key challenges are energy supply, energy interruption, cable theft, illegal connections, poor project management, and the slow rate of construction (Musina LM, 2016).

In terms of road infrastructure, the Musina LM has one cost centre maintaining 413km surfaced and 650km unsurfaced roads. Roads in the LM are generally in bad condition and many are not numbered. Roads that need to be tarred and re-surfaced are 20km in distance (Musina LM, 2016).

7.5.3.2 Status of Social Facilities

With regard to healthcare, there is a shortage of healthcare facilities in the Musina LM resulting in overcrowding in all health centres. In addition, residents travel long distances for healthcare as certain areas do not have health care facilities and are remotely located.

The Musina LM IDP (2016) states that community safety is a matter of concern as crime is a problem across the municipal area. It attributes this to, amongst others, the high unemployment level and alcohol and drug abuse. There are three police stations and one magisterial district court in the Musina LM (Musina LM, 2016).

Regarding education, there are nine secondary schools, 29 primary schools, and no tertiary institutions in the Musina LM. In addition, some educational facilities do not meet required norms and standards. The vast backlog of classrooms and learner support material, particularly in rural areas, impedes adequate teaching and learning. As indicated in **Section 7.5.1.3**, the education levels in the LM are dire. Moreover, older persons are not actively participating in ABET programmes (Musina LM, 2016).

The provision of libraries is a key instrument for social and educational upliftment, specifically in areas where low literacy levels prevail. The current library provision is inadequate to serve the community, in both size per service point and location. Moreover, the lack of technical skills institutions to support mining operations, amongst others, leads companies to source the skills from other towns. The lack of educational facilities will exacerbate the negative culture of learning and prolong the high illiteracy rate of the Musina LM.

Sport is perceived as an avenue to enable residents, particularly children, to keep away from negative influences such as crime and drugs and provides the prospect for future opportunities in sport. Sport and recreation facilities provision is very low and there is a demand for new and upgraded facilities.

Improvement across all service delivery departments is required. Of utmost importance is education as the high illiteracy rates have ripple effects of a dominantly non-participatory, unemployable and highly government dependent society. This is not progressive and also worsens social ills. With the merging of Musina and Mutale LMs, a positive result may prevail as the consolidated efforts may possibly address all current challenges more efficiently.

7.6 Visual Characteristics

7.6.1 Landscape Character

Landscape character is defined as "a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another". The region has a strong natural character, interspersed with agricultural activities (maize crop production) and human settlements. The region north, east, west, and immediately south of the project site appears relatively natural whilst there are extensive areas of settlement further to south.

The predominant surrounding land use appears to be agricultural with large scale grazing units interspersed with isolated farmsteads.

7.6.1.1 <u>Landform and Drainage</u>

The project site is located on the southern edge of the broad Limpopo Valley. The Limpopo River is the main regional drainage feature, and forms the border between South Africa and Zimbabwe. The Limpopo River is in excess of 50km from the proposed site at its closest. It is therefore unlikely that views of the development will be visible from this range.

The southern valley limit is provided by the rugged Soutpansberg which forms the upper valley slope approximately 30km south of the project site. A cross section of the valley ranges in elevation between approximately 450mamsl at the river to the north of the project site and 1 600mamsl at the upper valley slope and ridgeline to the south. The project site is characterised by elevations of between 700 and 730mamsl.

Figure 7.30 indicates that the valley floor slopes gently from the proposed site towards the river for approximately 5km. It then increases in gradient forming a series of koppies and secondary ridgelines with a summit at approximately 650 – 700mamsl behind which the proposed development is located. The land then falls into a minor valley through which the Sand River flows. The floor and gently sloping lower slopes of this minor valley are approximately 20km wide. To the south of this more rugged terrain rises steeply forming the southern edge of the Limpopo Valley.

This landform is likely to have a number of implications for visibility of the proposed development.

7.6.1.2 <u>Landcover</u>

Landcover within the study area can be divided into the following types:

- » Urban Development
- » Natural Areas
- » Cultivated Areas
- » Degraded Areas
- » Industrial Development

Urban Development

Urban development includes the settlements of Musina located approximately 40km north-east and Makhado (Louis Trichardt) located approximately 40km south of the proposed site. Both settlements have well-established middle and upper income housing areas and more recent low cost housing areas.

There is a band of well-established settlements approximately 25km south of the proposed site that extends to the east within the Soutpansberg. These settlements include Makusha, Mudimeli, Manyii, Musekwa and Makhado which are the closest settlements to the proposed site.

Given the distances involved and the fact that topography is likely to play a major role in screening views, it is unlikely that the proposed development will be visible from these settlements. All settlements appear to be relatively dense and have well established mature vegetation including street trees and ornamental vegetation. Should views of the development be possible, this is likely to provide significant screening from within each settlement.

Natural Areas

Natural areas are the main land cover type surrounding the proposed development. It is likely that this is largely used for game and low intensity cattle grazing. This activity has resulted in the majority of the area retaining a relatively natural appearance. It is also likely that a proportion of land owners have diversified into tourism as is evident from the number of bush lodges in the area which include Tokwe Safaris approximately 12km north-west and Magorgor Safari Lodge approximately 25km north-east of the proposed site. Within the natural areas there are also a large number of farmsteads that that are likely to include; farm sheds, farm houses and workers accommodation. It is also likely that a proportion of these are used as guest houses. There are a number of protected areas in the region the closest of which include the Honnet Nature Reserve which is approximately 34km east and the Baobab Tree Reserve which is approximately 34km north-east of the proposed site. Within these areas vegetation is likely to be relatively dense and more pristine than surrounding areas due to conservation management.

In terms of visual implications, natural areas are likely to provide a significant amount of screening for the development particularly where thicket and woody vegetation extends above head height.

Cultivated Areas

Cultivation occurs within the natural areas and is focused around the Sand River approximately 15km south-west of the proposed site. Cultivated areas are likely to be relatively open providing opportunities for long distance views across the surrounding landscape.

Degraded Areas

Degraded areas are evident largely on the edges of settlement. This probably stems from grazing and clearing for cultivation.

Industrial Development

Industrial development within the area is relatively sparse, however there is a limestone works in the vicinity of Mopane approximately 5km north-east of the proposed site. This facility is likely to be comprised of extensive dumps and over burden stockpiles that may have a similar appearance and scale as the dumps and stockpiles that are associated with the proposed development.

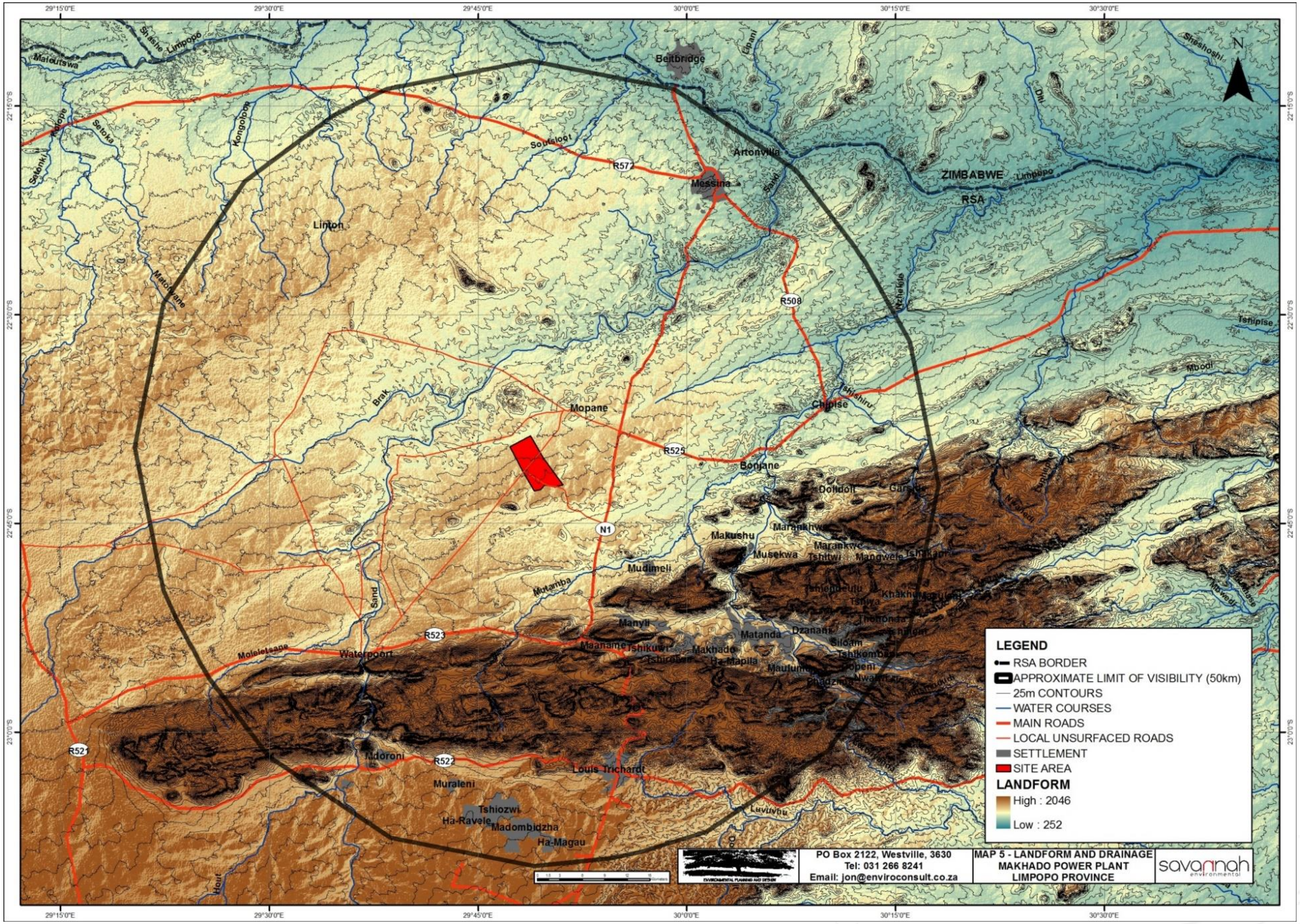

Figure 7.30: Landform and drainage map.

7.6.1.3 Vegetation Patterns

The main natural vegetation types in the vicinity of the site defined by Mucina and Rutherford can be divided into:

- Musina Mopane Bushveld.
- Limpopo Ridge Bushveld.
- Soutpansberg Mountain Bushveld.

In addition the following are also evident:

- Ornamental vegetation.
- Arable crops.

Musina Mopane Bushveld is the most dominant vegetation type surrounding the proposed site and extending to the Limpopo River in the north and the Soutpansberg in the south. According to Mucina and Rutherford this vegetation type occurs on the undulating plains from around Baines Drift and Alldays in the west, remaining north of the Soutpansberg and south of the Limpopo River. It is comprised of open woodland to moderately closed shrubveld. The Musina Mopane Bushveld is the most dominant vegetation type surrounding the site and is likely to provide a large degree of screening.

Limpopo Ridge Bushveld occurs on and around the minor ridgelines and koppies to the north and south of the proposed site. This vegetation type is a moderately open savanna with poorly developed ground layer.

Soutpansberg Mountain Bushveld occurs on the slopes of the Soutpansberg Mountains to the south of the site. It is generally comprised of a dense tree layer and poorly developed grassy layer.

Whilst botanically, these vegetation types are different, in visual terms they are all comprised of a matrix of herbaceous/grasses and small trees and shrubs. Areas with greater water retention close to water courses and pans are likely to have a greater proportion of shrub and tree vegetation whereas dryer sandier areas are likely to have a greater proportion of grass and herbaceous vegetation cover.

It is likely that trees and tall shrubs within the bushveld matrix will extend to above head height in most areas and could have a significant screening effect for mid to long distance views.

Ornamental garden vegetation and street trees appear to be relatively dense within the more established settlement areas. This vegetation is likely to restrict views within these settlements.

Arable cropping occurs close to the Sand River to the south-west of the site. Where this occurs, generally the natural vegetation has been cleared over a wide area which opens up long distance views.

7.6.2 Landscape Character Areas (LCAs) and Visual Absorption Capacity

Landscape Character Areas (LCAs) are defined as "single unique areas which are the discrete geographical areas of a particular landscape type".

Visual Absorption Capacity (VAC) is defined as the landscape's ability to absorb physical changes without transformation in its visual character and quality. Where elements that contrast with existing landscape character are proposed, VAC is dependent on elements such as landform, vegetation and other development to provide screening of a new element. The scale and texture of a landscape is also critical in providing VAC. For example; a new large-scale industrial development located within a rural small scale field pattern is likely to be more obvious due to its scale.

The affected landscape can be broadly divided into the following LCAs that are largely defined by development:

» Undulating Plains Landscape Character Area (LCA)
» Soutpansberg Landscape Character Area (LCA)
» Limpopo Valley Ridgelines Landscape Character Area (LCA)

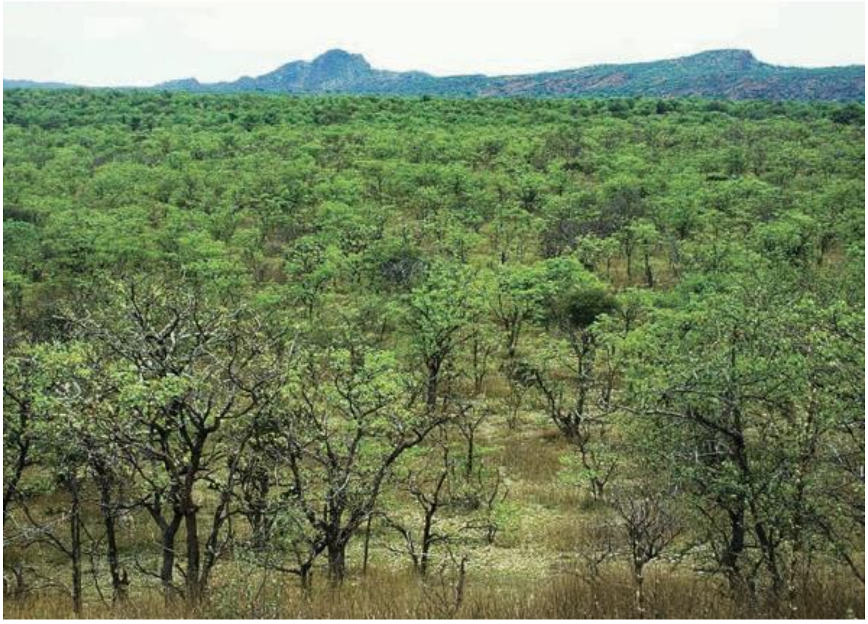

Figure 7.31: Musina Mopane Bushveld comprised of open woodland (extracted from Mucina and Rutherford).

The Undulating Plains LCA is comprised of the undulating plains to the north of the Soutpansberg and south of the Limpopo River. It is largely covered with semi-natural bushveld, and is likely to be largely used for low intensity grazing. There also appears to be a large eco-tourism secondary bias to the landuse. The bushveld and in particular the taller shrubs and trees that extend above head height are likely to provide significant VAC in this LCA screening outside elements from the area. It is only likely that elements outside this LCA will be obvious when the viewer is located in an elevated area above the natural vegetation or when a road alignment or clearing channels external views.

The Soutpansberg LCA comprises the Soutpansberg mountain range to the south of the proposed site. The mountain slopes are vegetated but much of the valley floor is developed. The dominant element is the landform which will provide a high degree of VAC within this LCA.

The Limpopo Valley Ridgelines LCA comprises of the narrow ridgelines that run through the main valley to the north and south of the proposed site. The ridgelines are generally covered with natural bushveld. This LCA provides a moderate degree of VAC, and it is likely to limit visibility within the surrounding undulating plain.

Figure 7.33 provides an initial landscape analysis, which will be ground-truthed during the EIA phase. It should be noted that the landform is the main character defining factor. The LCAs as indicated generally coincide with vegetation types which are largely dictated by topography.

7.6.3 Landscape Quality and Importance

7.6.3.1 Undulating Plains Landscape Character Area.

The importance of this LCA lies largely both with its agricultural and tourism role. It is therefore both important for its productivity as well as its natural aesthetics which support ecotourism activities. Due to topography and the natural vegetation cover which results in a high VAC, it is likely that there is capacity for limited development to occur without compromising these natural aesthetics as experienced by the majority of stakeholders.

Figure 7.32: Undulating Plains LCA.

7.6.3.2 Soutpansberg Landscape Character Area

The Soutpansberg LCA is the most dramatic of the LCAs. The contrast between the wide undulating plains to the north and the rugged mountains provides a dramatic and memorable scene that underpins and provides potential for tourism related activities in the region. It is also likely to be critical to regional landscape character.

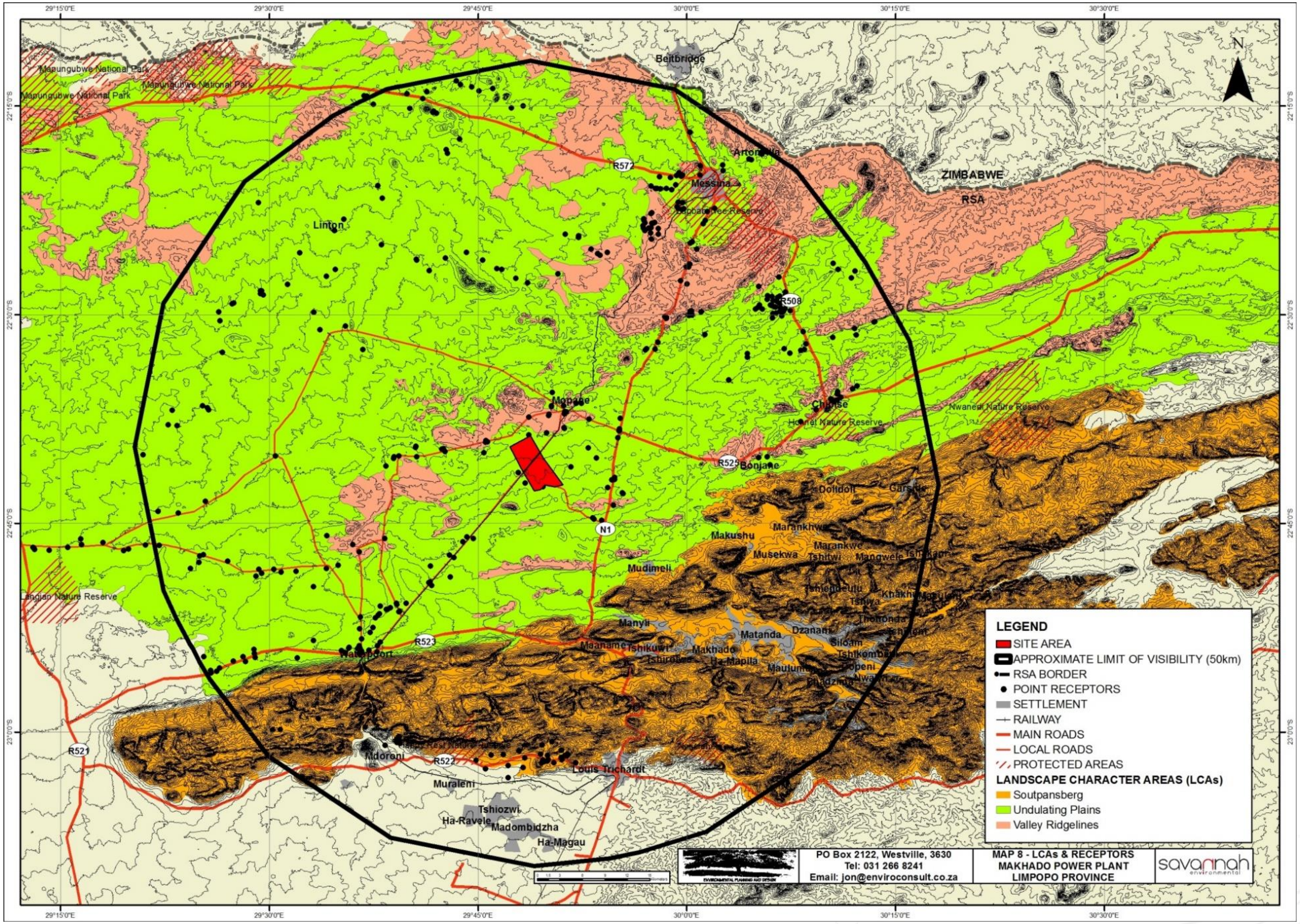

Figure 7.33: Landscape Character Areas (LCAs) and visual receptors.

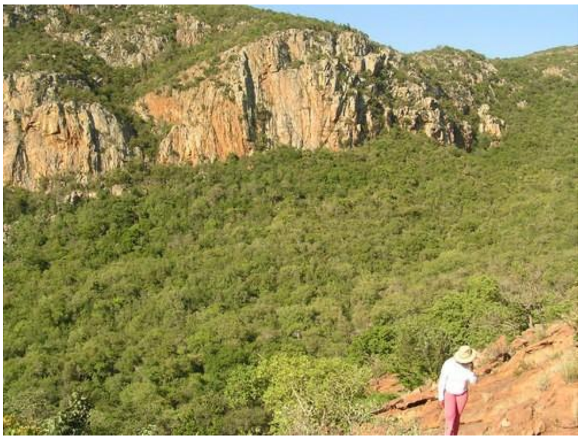

Figure 7.34: Soutpansberg LCA.

7.6.3.3 Valley Ridgelines Landscape Character Area

The Valley Ridgelines LCA provides high points within the undulating plain. It punctuates the area with points of focus within what would otherwise be a relatively featureless landform. It also breaks up and provides separation and identity to the surrounding LCA. The natural aesthetics of this area are therefore likely to be important particularly for eco-tourism activities.

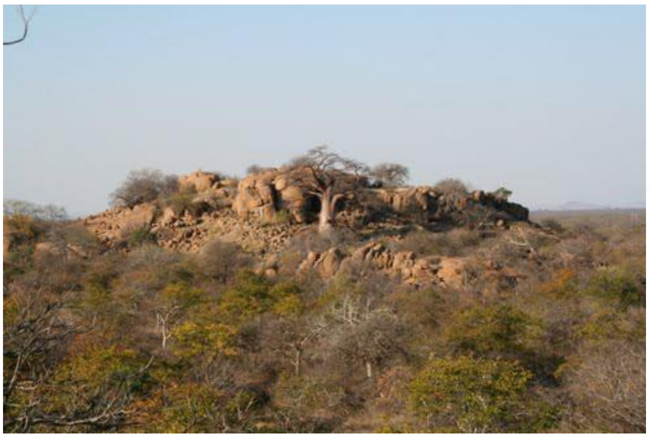

Figure 7.35: Valley Ridgeline LCA.

From a visual perspective, the most important LCAs are therefore the Soutpansberg and the lower Valley Ridgelines LCAs. These are the two characteristics that provide the regional and local landscape with identity. Any development that reduces or changes the existing natural ruggedness of these LCAs can be expected to have negative visual implications.

The contrast between the Undulating Plains and the rugged upland areas is also critical, however, due to the extent of the plains and the degree of VAC that is likely to be provided by its natural vegetative cover, it is likely that a degree of development can occur before the landscape change as experienced by most stakeholders undermines the regional and local character.

7.6.4 *Visual Receptors*

Visual Receptors are defined as "individuals and/or defined groups of people who have the potential to be affected by the proposal". It is also possible that an area might be sensitive due to an existing use. The nature of an outlook is generally more critical to areas that are associated with recreation, tourism and in areas where outlook is critical to land values.

7.6.4.1 <u>Possible visual receptors</u>

Area Receptors

Area receptors comprise of:

» Settlement Areas, particularly Mudimeli which is the closest settlements to the proposed development.
» Protected Areas. There are a number of Protected Areas to the north and east of the proposed site. The closest include the Baobab Tree Reserve which is approximately 34km north-east and the Honnet Nature reserve which is approximately 34km east of the proposed site.


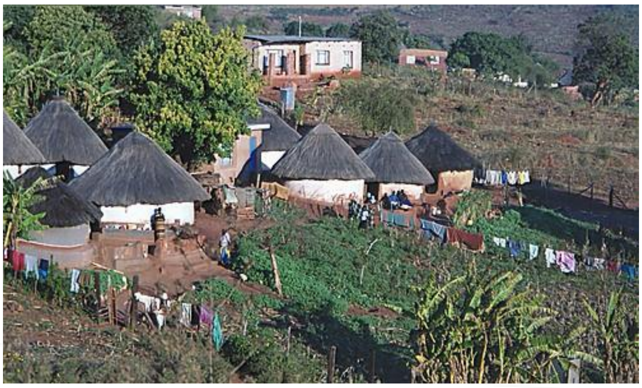

Figure 7.36: Area Visual Receptors.

Linear Receptors

Linear receptors generally include routes through the area. Because there is such a focus on eco-tourism activities, it is likely that both major and minor routes could be important. It might be argued that minor unsurfaced roads are more important than major surfaced roads as they are likely to provide access to the eco-tourism attractions.

Major routes include:

» The N1 which is the main regional arterial route that carries traffic from the Zimbabwe border crossing at Beitbridge and Gauteng. At its closest the N1 runs approximately 6km from the proposed site.
» Regional roads including the R525, the R572, the R508 and the R523. The closest regional road is the R525 which at its closest is approximately 10km from the proposed site.
» Local Roads that are likely to be largely unsurfaced. A number of local roads run in close proximity to the proposed site area including one that runs between the two properties that make up the site area (i.e. D1201 and D744).

In addition to roads, a railway line runs between the two properties that make up the site. This section of the railway is likely to be largely carrying freight between Zimbabwe and South Africa. Passenger services in

South Africa currently terminate at Musina and commence on the Zimbabwe side of the border at Beitbridge so it is also likely to carry passengers. Initial research indicates that none of the tourist trains such as the Blue Train use this route. The importance of the railway as a receptor is therefore likely to be relatively low.

Figure 7.37: Linear Visual Receptors.

Point Receptors

Three hundred and eighty six point receptors have been identified from mapping and aerial photography within the approximate visual limit of the proposed development (50km). These include:

» Individual buildings that are likely to be mainly rural homesteads and farms. It is possible that a proportion of these could include tourist lodges and accommodation.
» Small groups of dwelling that are likely to include small settlement areas and larger farm establishments but may also include tourist bush camps.

Figure 7.38: Point Visual Receptors.

7.7 Noise

Ambient sound levels were measured at a number of locations previously during July 2013 in accordance with the South African National Standard SANS 10103:2008 "The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication".

Equivalent sound levels varied significantly from location to location, with all locations experiencing noisy single events at times that impact on the sound levels (both LAeq and LA90). LA90 levels however indicate an area with significant potential to be quiet at times. Equivalent daytime ambient sound levels were measured between 22 and 75 dBA (10-minute measurements) with equivalent night-time ambient sound levels measured between 19 and 75 dBA (10-minute measurements).

The developmental character is typical of a rural area, and the measurement locations provided little indication of any significant noise impacts from external sources (of anthropogenic origin). While the gravel roads in the area does increase noise levels due to single events, the main source of noise appears to be originating from local dwellings, relating mainly to faunal activity around the dwellings.

An assessment of the area using available topographical maps indicated there are a number of Noise-sensitive developments (NSDs) that occur in the area (refer to **Figure 7**.39).

7.8 Heritage and Archaeology

7.8.1 Archaeological and Historical Background of the Makhado/Musina region

The area surrounding the project site is known for a variety of different kinds of heritage resources including Stone Age and Iron Age archaeology, structures and living heritage sites such as significant baobab trees as well as burial grounds and graves.

South Africa has an extensive Stone Age archaeological record including Earlier Stone Age (approximately 2.5mya to 200 kya), Middle Stone Age (200 kya to 40 kya) and Later Stone Age (40 kya to 2000 years ago) deposits. These sites tend to present as scatters of Stone Age artefacts. Rarely, archaeologists may find a stone tool manufacture site with evidence of stone flake tools as well as the flaked pieces of stone.

Later Iron Age sites, such as Mapungubwe, tend to present as the remnants of Iron Age settlements identified through distinct patterns of stone features that formed the foundations of Iron Age structures. Often, Early Iron Age sites are not visible on the surface, but are evidenced by material culture associated with the Early Iron Age such as pottery sherds, Iron slag and other material culture located beneath the land surface.

There are numerous informal burial grounds and graves located in this area, associated with farm workers or mine workers. Often these burial grounds are not fenced and have minimal surface markings denoting their presence. These informal burial grounds and graves have a significant role to play in terms of the cultural continuity of residents of the area and care must be taken to avoid any impact to sites such as this.

Figure 7.39: Potentially noise-sensitive receptors close to the proposed development.

Table 7.12: Sites previously identified within the proposed development areas.

Site ID	Site no	Full Site Name	Site Type	Grading
37464	MOP035	Mopane 035	Deposit	Grade IIIc
37563	MOP110	Mopane 110	Structures, Deposit	Grade IIIc
37564	MOP111	Mopane 111	Structures	Grade IIIc
37566	MOP113	Mopane 113	Structures	Grade IIIc
37567	MOP114	Mopane 114	Structures	Grade IIIa
37568	MOP115	Mopane 115	Building	Grade IIIb
37455	MOP031	Mopane 031	Artefacts	Grade IIIb
37456	MOP032	Mopane 032	Structures	Grade IIIc
37459	MOP034	Mopane 034	Building	Grade IIIa
37466	MOP036	Mopane 036	Structures	Grade IIIc
37468	MOP037	Mopane 037	Building	Grade IIIb
37565	MOP112	Mopane 112	Burial Grounds & Graves	Grade IIIa
37458	MOP033	Mopane 033	Burial Grounds & Graves	Grade IIIa

7.8.2 Identification of Heritage Resources

The most significant heritage resources from a site assessment conducted on the project site include Site V04, the Baobab Room, located on Farm Vrienden 589, and graded IIIA, and Sites D04 to D07 which appear to be a Middle Stone Age artefact manufacturing site located on Farm Du Toit 563, and were also graded IIIA (refer to **Figure 7.44** to **Figure 7.48**).

The palaeontology across the project site is noticeably different. The Farm Du Toit 563 is underlain by deposits of high fossil sensitivity, while the Farm Vrienden 589 is largely underlain by deposits of low or unknown palaeontological significance, with small areas of high sensitivity deposits in the extreme north. The high sensitivity deposits include sandstones, siltstones and mudstones of the Karoo Supergroup, and Bosbokpoort, Fripp, Solitude, Klopperfontein, Madzaringwe and Mikambeni Formations. These various deposits are mostly fluvial, and are known to contain a wide variety of fossils including dinosaur remains, fossil plants and petrified wood. The low sensitivity deposits comprise gneisses, representing the Malala Drift Gneiss Suite, and metamorphic rocks of the Archean Gumbu Group, which are unfossiliferous, as well as red sandstones of an indeterminate origin.

7.8.3 Heritage Resources identified onsite

Living Heritage

The Baobab Room, Site V04, is an interesting example of living heritage that continues to be used today (refer to **Figure 7.44**). The baobab, which has an entirely hollow trunk at ground level, has a number of windows that allow light into the shelter provided within the trunk (refer to **Figure 7.45**). Pegs have been hammered into the external bark to facilitate access inside the tree through one of these windows (refer to **Figure 7.45**). There appears to be deposit of unknown depth inside the trunk.

Archaeology

Sites D04 to D07 appear to be a Middle Stone Age artefact manufacturing site (refer to **Figure 7.46** to **Figure 7.48**). These sites extend and blend into one another, forming one large site. The density of flakes and flaked pieces that occur within this larger site is very high, with the ground surface littered with Middle Stone Age artefacts and individual instances of manufacture. The highest density appears around site D06. Such open air Middle Stone Age sites are rare and provide a unique window into the origins of modern humans.

7.8.4 *Mapping and spatialisation of heritage resources*

A number of heritage resources of varied significance were identified within the project site (refer to **Figure 7**.40 to **Figure 7**.43). These sites included isolated archaeological artefacts, larger, coherent archaeological sites, recent agricultural infrastructure and a single living heritage site, all ranging from a grading of IIIa to Not Conservation Worthy.

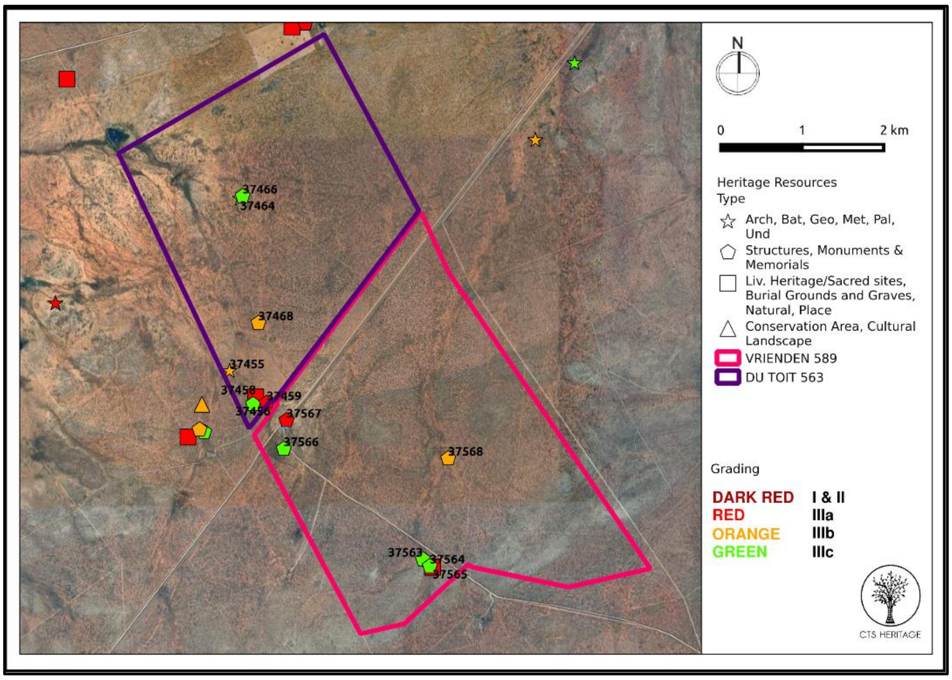

Figure 7.40: Spatialisation of known heritage resources in the vicinity of the proposed development.

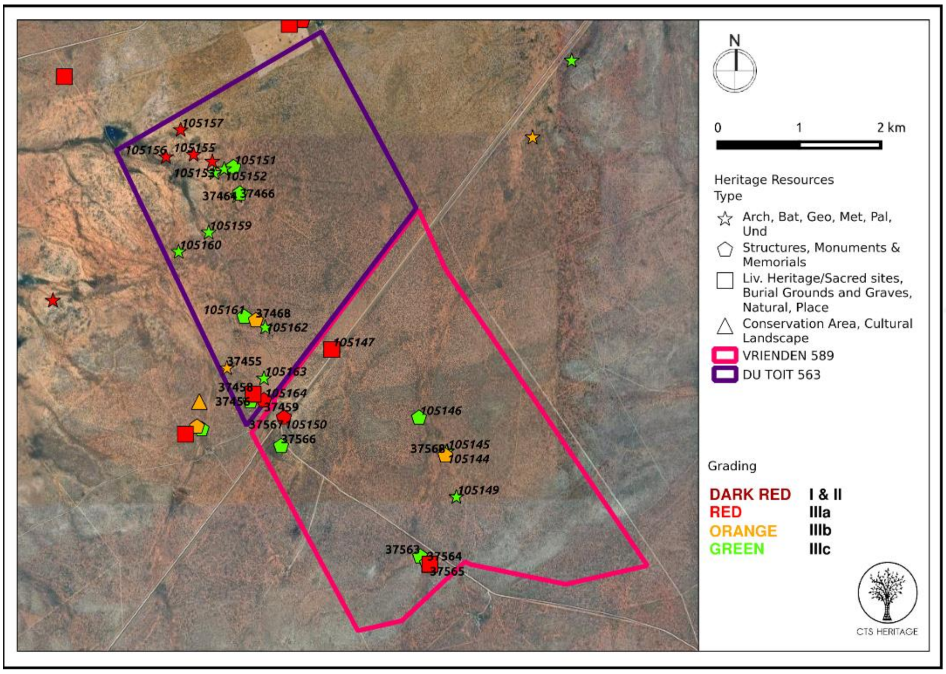

Figure 7.41: Spatialisation of heritage resources identified during the field assessment.

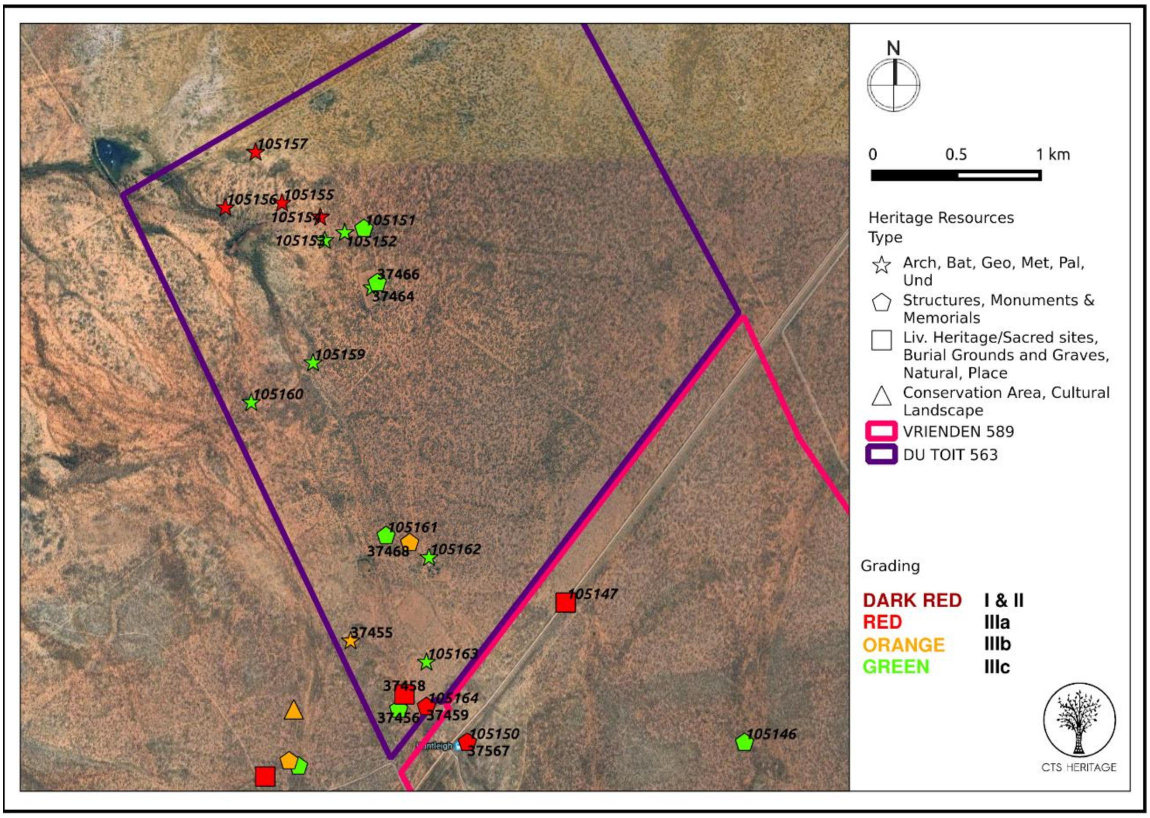

Figure 7.42: Spatialisation of all known heritage resources within the Farm Du Toit 563.

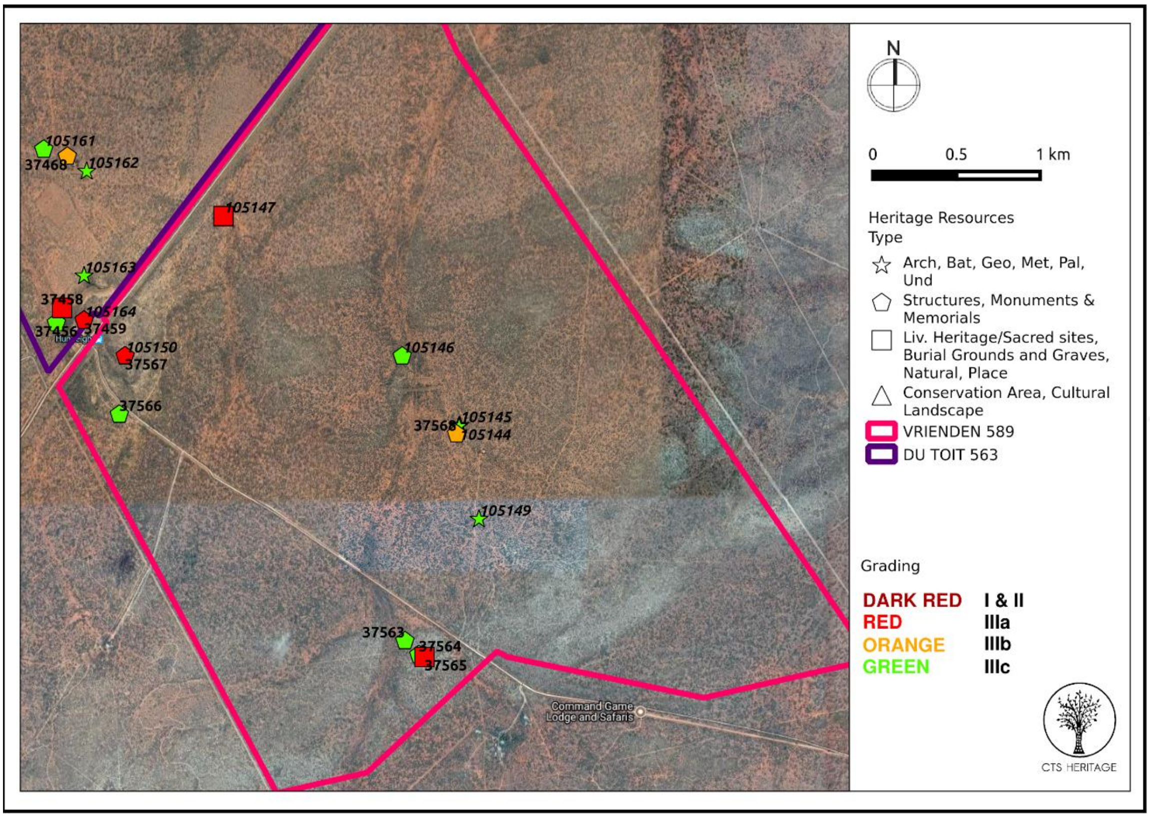

Figure 7.43: Spatialisation of all known heritage resources within the Farm Vrienden 589.

Figure 7.44: Site V04, the "Baobab Room".

Figure 7.45: Inside the "Baobab Room" at V04 (left) and pegs used to assist with entry (right).

Figure 7.46: Site D04 with the 1x4m pit indicated.

Figure 7.47: A selection of MSA artefacts from site D04.

Figure 7.48: An example of the density of artefacts at Site D06.

Table 7.13: Artefacts identified during a previous foot survey

SAHRIS Site ID	Artefact Number	Site Name	Site Description	Grading
105144	V01	Vrienden 1	Archaeological, 1 stone artefact	NCW
105145	V02	Vrienden 2	Archaeological, 1 stone artefact	NCW
105146	V03	Vrienden 3	Modern disused agricultural infrastructure	NCW
105147	V04	Vrienden 4	Living Heritage/Sacred sites, the "Baobab Room"	Grade IIIa
105149	V05	Vrienden 5	Archaeological, 1 stone artefact	NCW
105150	V06	Vrienden 6	Ruin of agricultural infrastructure	NCW
105151	D01	Du Toit 1	Modern agricultural infrastructure	NCW
105152	D02	Du Toit 2	Archaeological, 1 potsherd	NCW
105153	D03	Du Toit 3	Archaeological, potsherd and some stone tools, low density	Grade IIIc
105154	D04	Du Toit 4	Archaeological, MSA stone tools identified emerging from 1x4m hole previously dug, Additional artefacts and raw material scattered on surface. High density	Grade IIIa
105155	D05	Du Toit 5	Archaeological, MSA stone tools raw material scattered on surface. High density	Grade IIIa
105156	D06	Du Toit 6	Archaeological, MSA stone tools raw material scattered on surface. Highest density	Grade IIIa
105157	D07	Du Toit 7	Archaeological, MSA stone tools raw material scattered on surface including hammerstone. High density	Grade IIIa
105159	D08	Du Toit 8	Archaeological, isolated artefacts. Low density	Grade IIIc
105160	D09	Du Toit 9	Archaeological, artefacts and ochre. Moderate density	Grade IIIc
105161	D10	Du Toit 10	Remains of modern disused agricultural infrastructure	NCW
105162	D11	Du Toit 11	Archaeological, small dam with sporadic artefacts in spoil heap	Grade IIIc
105163	D12	Du Toit 12	Archaeological, near to the boundary of Vrienden. Area cleared for powerline construction. Piece of iron slag identified.	NCW
105164	D13	Du Toit 13	Ruin of disused modern agricultural infrastructure	NCW

7.9 Palaeontology

The project site is underlain by sediments of the:

» Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation.
» Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement (refer to **Figure 7.49**).

Fossil heritage could be present in the Undifferentiated Karoo as well as the Solitude Formation which has a high to very high Palaeontological Sensitivity. The Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group is metamorphic rocks which is un-fossiliferous and with a very low palaeontological sensitivity.

Palaeontological Sensitivity Almond et al (2008) and Groenewald et al., (2014)	Group	Group/Formation	Lithology	Period	Fossils /Exposures
High to very high Palaeontological sensitivity / vulnerability	Undifferentiated Karoo		Sandstone, conglomerateshale, mudstone, and **coal deposits**	Permian-Triassic	Very poor levels of surface exposure (most data obtained from borehole cores
High to very high Palaeontological sensitivity / vulnerability	Karoo	Solitude	Reddish and grey mudrocks, sandstones and minor coals, meandering fluvial setting	Upper part possibly = Elliot Lower part probably = Molteno	Upper part possibly = Elliot Lower part probably = Molteno Coal floras including *Dicroidium* in basal Solitude succession. Dinosaur remains supposedly
Very Low Palaeontological sensitivity / vulnerability grey	Archaean Granite-Gneiss Basement	Malala Drift Suite Beit Bridge Complex	Leucogneiss with metaquartzite, hornblende granitoid gneiss, amphibolite, metapelite and calc-silicate rocks	Early to Late Archaean (3.6 – 2.4 Ga) (Swazian/Randian)	No fossils recorded
Very Low Palaeontological sensitivity / vulnerability grey	Archaean Granite-Gneiss Basement	Beit Bridge Complex; Gumbu Group	Calc-silicate rocks and marble, together with leucogneisses and subordinate pink hornblende granitoid gneiss, metaquartzite and amphibolite	Early to Late Archaean (3.6 – 2.4 Ga) (Swazian/Randian)	No fossils recorded

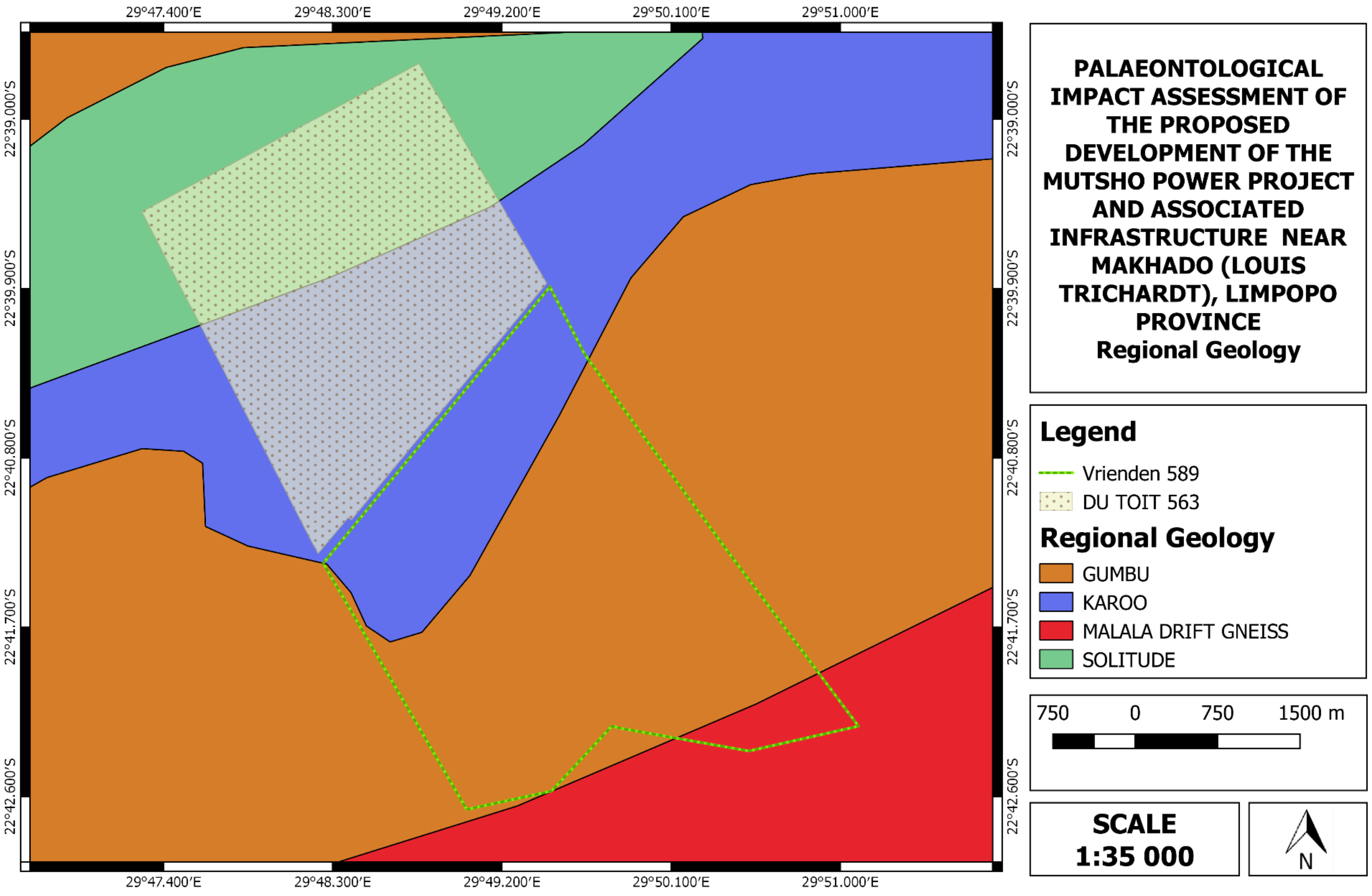

Figure 7.49: The surface geology of the Farm Du Toit 563 and Vrienden 589, near Makhado, Limpopo Province.

CHAPTER 8 ASSESSMENT OF IMPACTS

This Chapter provides an overview of the significance of positive and negative direct and indirect environmental impacts and benefits identified to be associated with the construction, operation, and decommissioning of the Mutsho Power Project and associated infrastructure. Cumulative impacts associated with the project are assessed separately under **Chapter 9**. Impacts associated with all the key components of the Mutsho Power Project have been identified and assessed. These include:

600MW SC CFB Plant	
Power island consisting of:	» 2 x 300MW Supercritical (SC) Circulating Fluidised Bed (CFB) boilers.
	» Electrostatic Precipitator (ESP)
	» Flue / smoke stack up to 150m in height.
	» Direct dry-cooling (air-cooling) systems.
	» Balance of plant components (including steam turbines and generators etc.).
Raw materials storage and handling:	» Coal and Limestone / Lime Rail Spur and / or Road off-loading systems.
	» Upgrading or establishment of a rail siding.
	» Coal crusher and raw material handling equipment.
	» Strategic and working coal stockpile.
	» Limestone or Lime storage and handling area.
Ash handling and disposal:	» Ash dump (dry-ashing is proposed in order to reduce the project's water requirements in alignment with the recommendations of the National Development Plan (NDP) and Integrated Energy Plan (IEP)).
Water infrastructure:	» Raw water storage dam (up to 5ha).
	» Water supply pipelines and booster stations.
	» Pollution control / run-off dams (up to 2.5ha each).
	» Packaged Water treatment plant (WTP).
	» Wastewater treatment plant (WWTP).
	» Storm water management systems.
Electrical infrastructure:	» HV Yard and substation components with HV overhead transmission lines connecting to Eskom infrastructure.
Associated infrastructure:	» Control room, office / administration, workshop, storage and logistics buildings.
	» On-site critical staff accommodation required during construction (up to 1.5ha).
	» Temporary site office, laydown and assembly areas, and batching plant (up to 5ha in total).
	» Upgrading of external roads and establishment of internal access roads.
	» Security fencing and lighting, and access control with guardhouse.
Services required:	» Refuse Material Disposal – During construction all refuse material generated by the proposed development will be collected by a contractor to be disposed of off-site at a licensed waste disposal facility. Solid wastes and sludge arising during operation will be collected, and transported to the ash dump. Chemical wastes will be collected and stored separately in a safe manner, and will be transported off-site via road where they will be disposed of according to the local and national standards.
	» Sanitation – During construction, all sewage waste will be collected by a contractor to be disposed of at a licensed waste disposal site. During operation, 2 x 5m³/h buried sanitary sewage treatment systems will be provided for discharge from staff showers, flushing, toilets,

	canteen, etc. The sanitary sewage will be treated by secondary biological contact oxidation process, filtered, disinfected, and flow into clean water basin for reuse.
	» Water – Between 800 000m³/a and 1.2 million m³/a of water is required during the construction phase, while approximately 1 million m³/a is required to support the operation of the project. A number of bulk water supply options are currently being investigated for the project. The most promising of these include: * Transfer of treated effluent from the Makhado Rietvly Wastewater Treatment Works (WWTW) * Transfer from dams in Zimbabwe (alternative to above). * Direct abstraction from the Limpopo River.
	» Electricity – A power supply will be required during both construction and operation of the project. It is anticipated that electricity required to support the construction will be provided by the Musina Local Municipality.

Bulk water supply and grid integration options are in the process of being finalised. Potential impacts associated with bulk water supply and grid integration options have therefore been excluded from the current scope of work, as they will be assessed through separate applications for Authorisation.

The development of the project will comprise the following phases:

Detailed Design and Construction Phase: The detailed design and construction phase is expected to take approximately 4 to 5 years to complete. It is anticipated that the following activities would be included and form part of the detailed design and construction phase:

Conducting onsite technical surveys, including:
Geotechnical surveys, hydrological surveys, logistics surveys, site surveys, surveys confirming the power station footprint, survey of the proposed substation/switchyard, and surveys of the proposed raw bulk water pipeline(s) and power line servitude (to be assessed under separate applications for authorisation).
Obtaining additional licenses and permits required for the project.
Coordinating with relevant regulatory departments and agencies regarding proposed construction activities.
Upgrading access roads to the site, and establishment of an onsite road access network.
Upgrading or establishment of a railway siding.
Detailed design, procurement and fabrication activities.
Site preparation activities, including:
Clearing of vegetation, stripping of topsoil (and associated stockpiling of topsoil for use in backfilling and / or spreading on site), conducting earthworks / terracing, and excavation for foundations.
Early establishment of stormwater run-off dams to contribute towards onsite water management during the construction phase.
Civil and structural works.
Mechanical, piping, ducting, electrical, controls, and instrumentation works.
Establishment of infrastructure such as office buildings, water supply pipelines, and power line.
Establishment of the ash dump.
Establishment of an onsite concrete batching plant. The proposed batching plant will have a capacity of 300 t/h.

As far as is practical and relevant disturbed areas will be rehabilitated as construction is completed within an area and construction equipment demobilised. All disturbed areas not required for operation will be fully rehabilitated following completion of construction.

Operation Phase: Prior to the operation of the project, operational establishment, training, testing, and trials will be undertaken to ensure the complete operational readiness of the plant and Operations and Maintenance (O&M) personnel. The project has been designed for a 30-year life cycle, which is equivalent to the term of agreement contained in the Power Purchase Agreement (PPA) anticipated to be entered into between preferred bidders and Eskom under future rounds of the CBIPPPP.

During its operations, the project will operate as a baseload power plant with an annual average availability of 90%. The project would therefore operate for 24 hours a day and 7 days a week, excluding periods of planned shutdown for maintenance purposes. Staff will work in shifts, with two to three shifts per day, starting at 00:00, 08:00, and 16:00 respectively; with approximately 80 to 100 personnel required per shift. A total of two buses will be utilised to transport personnel to site in both the mornings and evenings.

Decommissioning and Rehabilitation Phase: Once the project has reached the end of its economic life (equivalent to a minimum of 30 years with the opportunity for extension or amendment up to 50 years), equipment will be decommissioned. Decommissioning activities will involve the disassembly of production units and ancillary infrastructure, the demolishing of buildings, the removal of hazardous waste, and the rehabilitation of the ash dump and project site. The following decommissioning activities are expected to occur:

At the end of the project's life cycle, operational access roads are expected to be in good condition as a result of ongoing maintenance during operation, and will therefore be suitable for the transit of decommissioning equipment (i.e. heavy cranes, special trucks, etc.).
Laydown areas will be prepared as required. In this regard vegetation may require stripping and topsoil may be stockpiled for use in rehabilitation.
All waste materials will be removed for reuse, or disposal through authorised waste management service providers.
All lubricants and chemical products stored at the site will be removed. These products may be sold or removed by an authorised waste management service provider for appropriate disposal.
Reusable elements not classified as waste will be used.
Concrete structures and buildings (including foundations) will be demolished and rubble will be disposed of at appropriate facilities, unless otherwise required for an alternative use in line with the decommissioning and closure plan.

Following decommissioning and removal of all project material from site, disturbed areas will be rehabilitated to a state reflective of anticipated future use. Where possible, rehabilitation will be conducted concurrently with decommissioning.

The following rehabilitation activities are expected to occur:

The existing profiles of affected land will be improved and stabilised, thereby creating profiles that are compatible with the topography of the area.
Ripping of compacted soils will be done prior to adding topsoil, which will be done by mechanical means.
Topsoil and/or subsoil with which to facilitate rehabilitation will be moved and stockpiled during the

construction phase of development. Where additional amounts of topsoil and/or subsoil are required, potential areas of land for the extraction of topsoil or subsoil will be identified.
Vegetation will be re-established on site. Plant species used during site rehabilitation will as far as reasonably possible be indigenous to the area.

Following the completion of rehabilitation activities on site, a period of maintenance and aftercare will be required to ensure that the rehabilitation measures were successful.

The following aftercare and maintenance activities are expected to occur:

- » Control and removal of alien/invasive species.
- » Replacement of unhealthy plants and altering vegetation composition.
- » Implementation of erosion controls (if required).
- » Support irrigation (if required).

8.1 Potential impacts identified during the Scoping Study

Issues identified through the Scoping process as requiring assessment in the EIA Phase include the following:

- » Impacts on Ecology (including flora, fauna, and avifauna)
- » Impacts on Air Quality
- » Impacts on Climate Change
- » Impacts on Surface Water
- » Impacts on Geohydrology
- » Impacts on Soils, Land Use and Agricultural Potential
- » Impacts on Archaeology and Heritage
- » Impacts on Palaeontology
- » Noise Impacts
- » Visual Impacts
- » Socio-Economic Impacts
- » Traffic Impacts

These environmental issues have been assessed during the EIA Phase, and where applicable potential sensitivities have been mapped accordingly based on the detailed specialist studies and site investigations undertaken.

8.2 Methodology for the assessment of potentially significant impacts

8.2.1 Rationale for the assessment of the preferred development footprint

The full project site (approximately 2 161ha in extent and comprising the Farms Du Toit 563 and Vrienden 589) was evaluated as part of a desktop site sensitivity assessment conducted as part of the Scoping Phase. The purpose of the site sensitivity assessment was to inform the location of the development footprint (which requires a minimum area approximately 350ha in extent) within the larger project site (approximately 2 161ha in extent), such that areas of environmental sensitivity are avoided as far as possible. A number of potentially sensitive areas were identified as part of this process, these include:

- Wetlands and associated buffers
- Drainage lines and associated buffers
- Heritage sites and associated buffers
- Cultivated Land
- Noise Sensitive Receptors
- Limpopo Conservation Plan v2 (2013)

Following the completion of the Scoping Phase, and based on the outcomes of the site sensitivity assessment, a number of layout alternatives were identified for further investigation occupying the six areas (individually or in combination), as shown in **Figure 8**.1. Several of the layouts were abandoned based on technical (such as existing rail and road access, topography, prevailing wind direction and proximity to future Eskom infrastructure etc.), environmental (such as NFEPA buffers, occupied dwellings, ruins etc.) and/or financial feasibility. Those layout alternatives which are deemed to be feasible from a technical and financial perspective and which have been considered as part of the EIA process are described in further detail below.

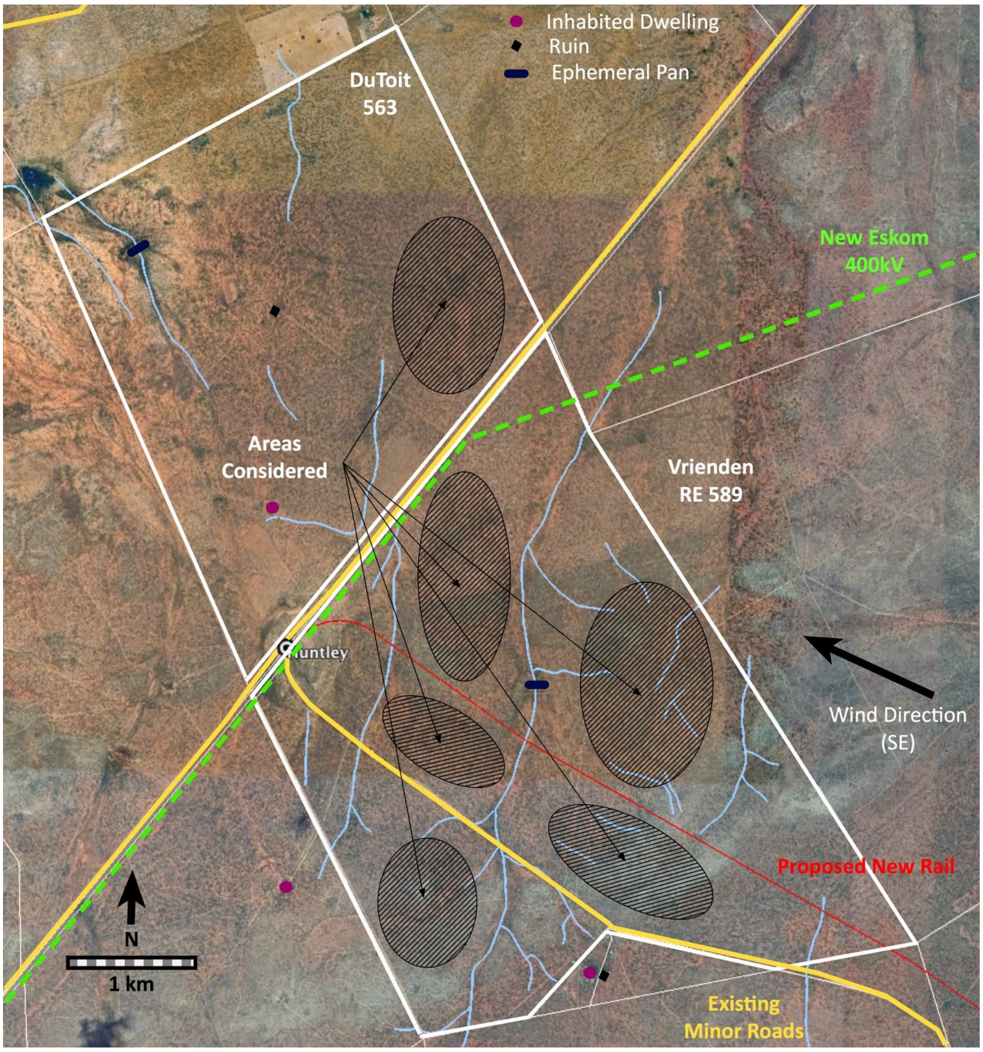

Figure 8.1: Areas within the project site considered feasible for development.

Preferred Layout Alternative

The Preferred Layout Alternative entails the placement of the Mutsho Power Project, in its entirety, on the Farm Vrienden 589 (refer to **Figure 8**.2). The power plant and raw water storage dam are both proposed south of the proposed railway line, while the ash dump and ash dump runoff dam are proposed north of the proposed new railway line. Based on the desktop analysis of this proposed layout, this alternative is considered to be most favourable from an environmental perspective as it is perceived to pose the least environmental impacts or risks. The location of the ash dump and ash dump run-off dam away from prominent drainage lines reduces the potential risk of contamination.

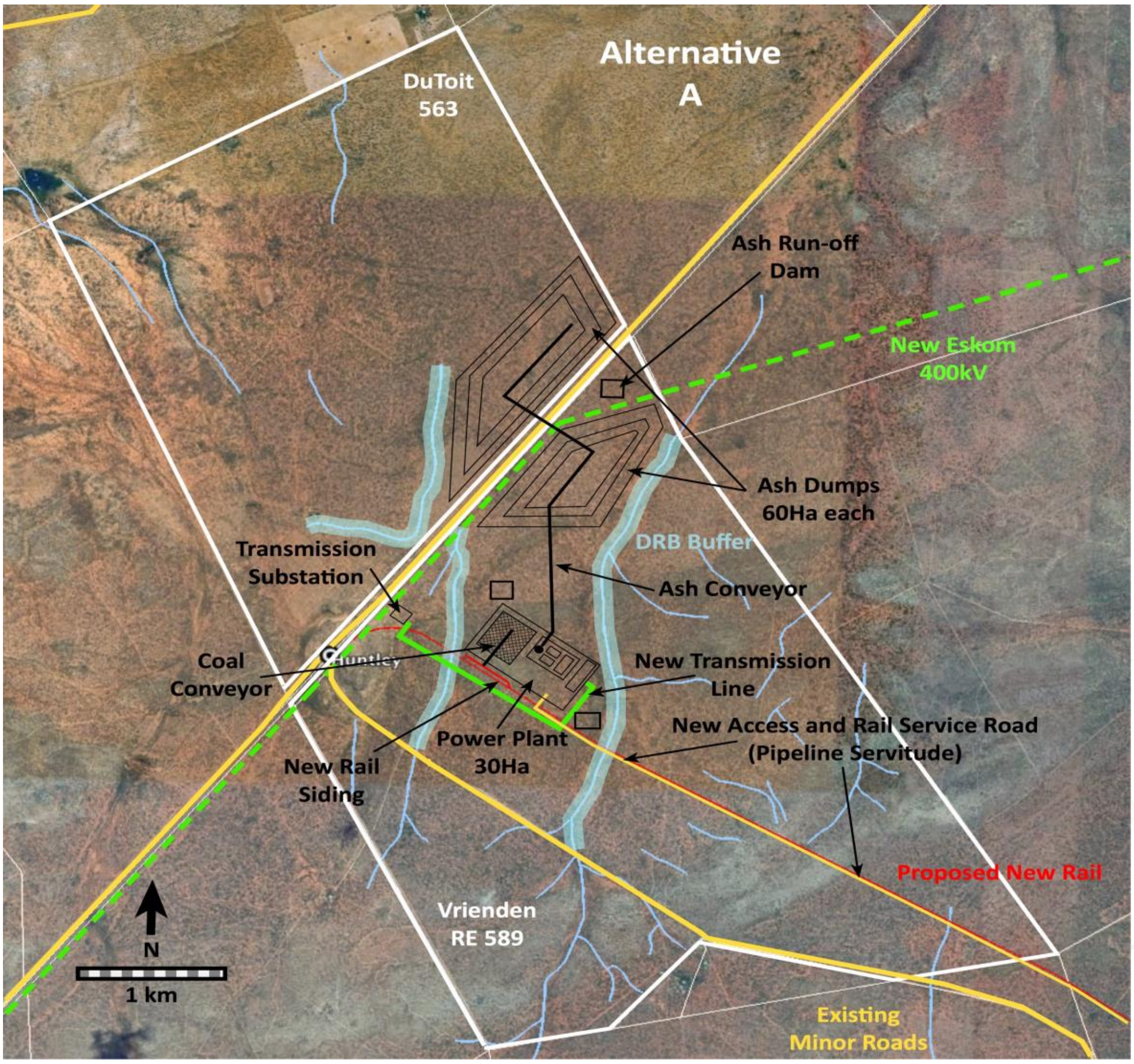

Figure 8.2: **Preferred Layout Alternative.**

Layout Alternative A

Layout Alternative A entails the development of the majority of project related infrastructure on the Farm Vrienden 589, with the remaining infrastructure proposed on the eastern extent of the Farm Du Toit 563 (refer to **Figure 8**.3). The proposed power plant, transmission substation, and raw water storage dam are all proposed for development north of the proposed new railway line on the Farm Vrienden 589. The ash dump has been split into two portions, each up to 60ha in extent. One portion will be developed in the northern extent of the Farm Vrienden 589, while the second portion will be developed in the eastern extent of the Farm Du Toit 563. The ash dump runoff dam will be developed between the two ash dumps at the project site's lowest elevation. Such a layout alternative is considered less favourable from a technical perspective than the preferred layout alternative, as the project would be required to straddle existing infrastructure, such as the railway line which occurs between the Farm Du Toit 563 and the Farm Vrienden 589. Given the location of the ash dumps, the ash conveyor required to transport ash generated by the power plant to the ash dump would be routed underneath Eskom's proposed 400kV power line. In addition, Layout Alternative A entails the development of the two ash dumps and an ash dump run-off dam between and within close proximity to prominent drainage lines, which is less favourable from an environmental perspective as it increases the potential risk for contamination.

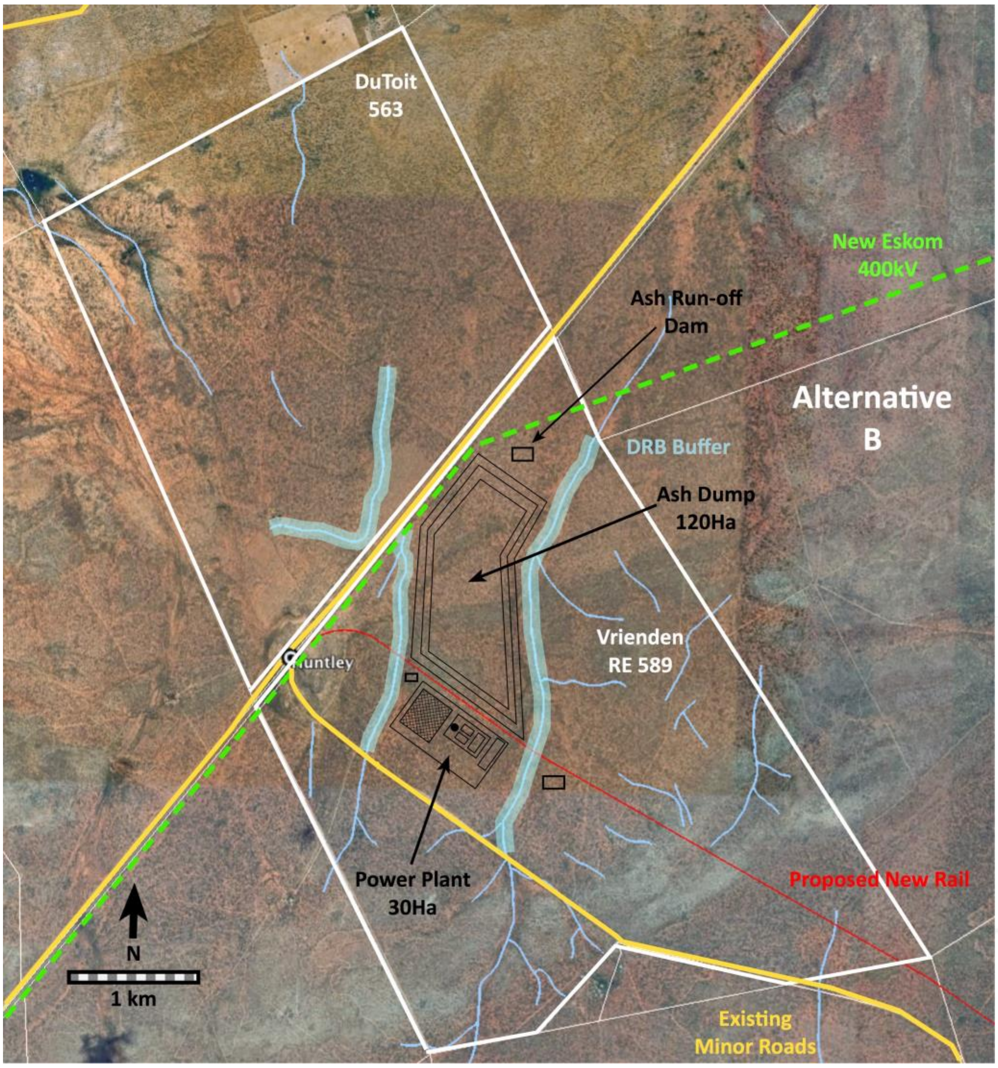

Figure 8.3: Layout Alternative A.

Layout Alternative B

Layout Alternative B entails the development of all infrastructure on the Farm Vrienden 589 (refer to **Figure 8.4**). The power plant is proposed for development south of the proposed railway line, while a single ash dump and ash dump runoff dam is proposed for development north of the proposed railway line, between two prominent drainage lines. This layout alternative has a possible concern from an environmental perspective given the proximity of the ash dump and ash dump runoff dam to the drainage lines, and the potential risk for contamination.

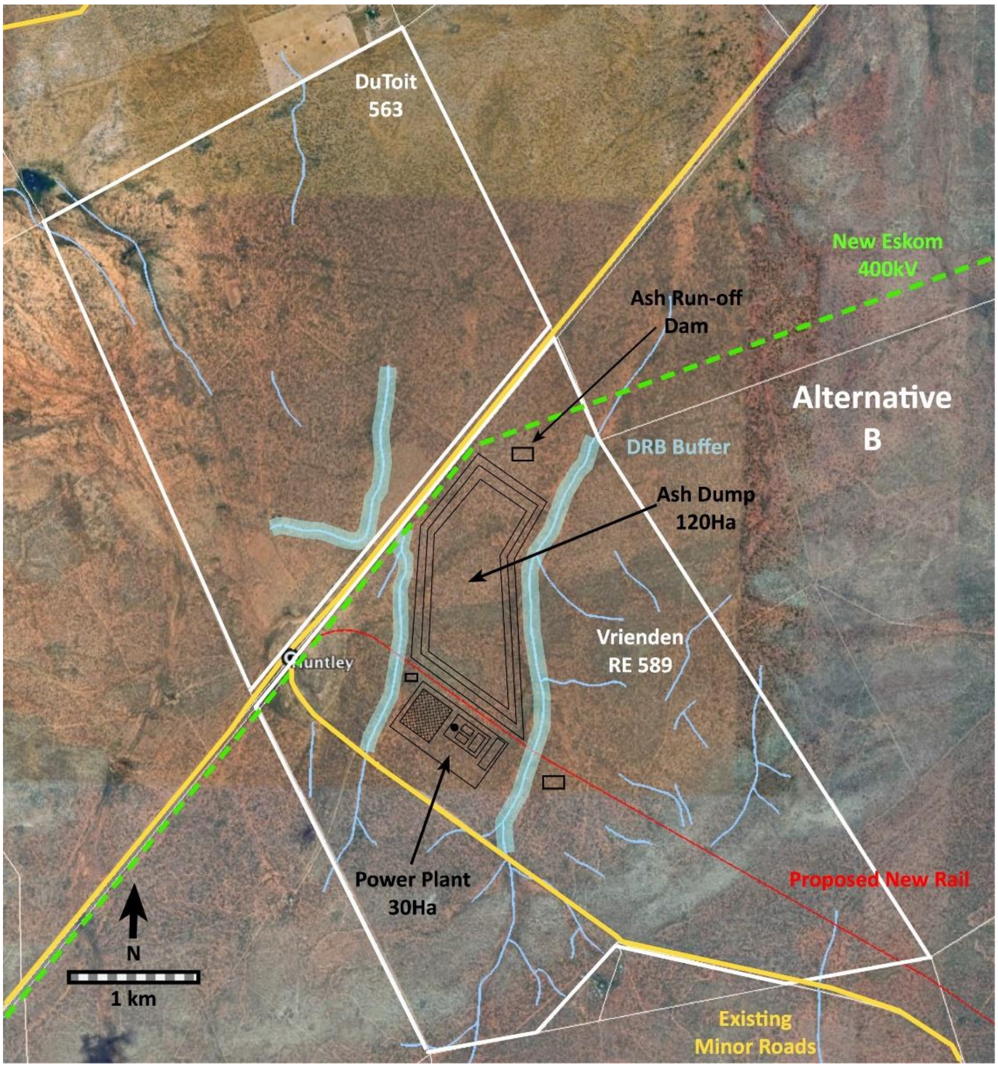

Figure 8.4: Layout Alternative B.

This assessment considers potential environmental impacts associated with the development of the Mutsho Power Project and associated infrastructure in accordance with the Preferred Layout Alternative, Layout Alternative A, and Layout Alternative B respectively.

8.2.2 Assessment of issues and impacts

The assessment of potential issues has involved key input from independent specialist consultants, the project proponent, key stakeholders, and Interested and Affected Parties (I&APs). In order to assess the potential impacts associated with the development of the Mutsho Power Project and associated infrastructure the project proponent provided a project description, Preferred Layout Alternative, Layout Alternative A, and Layout Alternative B for consideration by the independent specialist consultants.

In addition, waste treatment and management activities have been considered in the assessment of impacts. These activities relate specifically to:

- Liquid waste disposal.
- Solid waste disposal (i.e. ash).
- Waste storage and separation.
- Waste transport.

Direct and indirect impacts were assessed in terms of the requirements of the 2014 EIA Regulations (GNR 326) and the methodology presented in **Chapter 6** of this EIA Report. Details of the methodology of assessment and impact assessment determination by each independent specialist consultant are included in the respective specialist reports contained within **Appendices D – N**.

8.3 Potential Impacts on Ecology

8.3.1 Results of Impact Assessment

8.3.1.1 Flora

The proposed activity implies the loss of natural habitat and no impacts of a beneficial nature on the floristic environment are likely to result. The largest extent of impacts within the floristic environment is likely to result due to direct (physical) effects of land clearing activities and losses of vegetation. Direct impacts include any effect on the vegetation, including locally endemic species, populations or individual species of conservation importance, as well as on overall species richness, diversity and abundance. These effects include impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of conservation consideration. Impacts on sensitive, restricted or protected habitat types are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof are immediately visible and can be determined to an acceptable level of certainty.

Impacts of a direct nature include the following:

- Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plant taxa of conservation concern (declining status, provincially protected taxa), including habitat that is regarded highly suitable for the persistence of these species.
- Loss of natural vegetation (physical modifications, removal, damage) including the loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance.
- Local depletion of plant taxa and reduction of phytodiversity.

Indirect impacts typically results in adverse effects or deterioration of surrounding areas due to uncontrolled development related activities. In addition, the ecological functionality of the immediate and surrounding area could be adversely affected by development, with particular reference to the ecological interaction between plants and animals. The aesthetic appeal of the region, although a subjective and highly debatable attribute, is regarded a potential receiver of landscape changes through the addition of industrial developments, ashing facilities, linear infrastructures, etc. One of the most important impacts of indirect measures is represented by the alteration of floristic characteristics of the surrounding areas through the introduction and proliferation of plants with an exotic nature or encroachment characteristics.

Impacts of an indirect nature include the following:

- » Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.
- » Reduced or severely altered ecological functionality (including fire, erosion).
- » Decreased aesthetic appeal of the landscape.
- » Introduction of invasive, exotic and encroacher plant species.

8.3.1.2 Fauna

The construction and operation of the proposed coal-fired power plant and associated infrastructure is not expected to have any positive or advantageous impacts as far as the faunal communities of the study area and surrounds are concerned. Direct, indirect and cumulative adverse impacts on the fauna are expected during the construction and operation of the proposed power station.

Anticipated direct impacts of the proposed project on the fauna of the study area include:

- » Impacts on / losses of fauna taxa of conservation importance and habitat associated with conservation important (CI) species.
- » Loss of natural habitat, including essential habitat refugia.
- » Depletion of faunal diversity, human/ animal conflict situations.

Anticipated indirect impacts of the proposed project on the fauna of the study area and surrounds include:

- » Degradation of untransformed habitat in areas surrounding the project area.
- » Indirect impacts on movement / migration patterns of animals, ecological interaction and processes, including the introduction of invasive and non-endemic species.
- » An increase in edge effects in the ecological region in which the project is located.

8.3.1.3 Avifauna

The construction and operation of the proposed power plant and associated infrastructure is expected to have negative impacts on the avifaunal community of the study area and its immediate surroundings. Direct, indirect and cumulative adverse impacts on the bird community are expected during the construction and operation of the proposed power station.

Anticipated direct impacts include:

i. Loss of habitat and displacement of bird species, especially large-bodied birds of prey and large terrestrial bird species requiring large home ranges (so-called K-selected species).
ii. Loss of sensitive habitat (e.g. trees used as breeding platforms, pans and depressions) and subsequent loss of threatened and near-threatened species.
iii. Loss of habitat containing high avifaunal diversity and unique species compositions.
iv. Subsequent habitat transformation and loss in habitat quality of adjacent habitat due to inappropriate management procedures.
v. Changes in the bird community structure due to habitat fragmentation (e.g. roads, loss of continuous woodland patches) and habitat loss.
vi. Bird collisions with fence structures and proposed overhead power lines (anticipated).
vii. Electrocution of large-bodied birds due to the use of inappropriate tower design.

viii. Loss of daily migration/foraging corridors.

Anticipated indirect impacts include:

» Loss of dispersal corridors owing to habitat alteration.
» Subsequent habitat changes and changes to the local avifaunal community structure and composition (colonisation by generalists and secondary species).
» Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa.

Indirect impacts are often related to the "after-effect" when the project is decommissioned. It mainly pertains to rehabilitation effort, and how this relates to the residing avifaunal communities. Therefore, it is often witnessed that early successional habitat contributes to the establishment of a transient avifaunal community.

8.3.2 Quantification of Impacts on Ecology

8.3.2.1 <u>Flora</u>

The quantification of impacts on the receiving environment considers the development and operation of the proposed power plant in its entirety.

Nature: Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plant taxa of conservation concern (declining status, provincially protected taxa), including habitat that is regarded highly suitable for the persistence of these species.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very high (10)	Moderate (6)
Probability	Definite (5)	Highly probable (4)
Significance	**High (85)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible, although smaller individuals and localised plants can be restored to nearby, suitable habitat	
Irreplaceable loss of resources?	Yes, the loss of conservation important plants, which are generally strongly associated with the habitat.	
Can impacts be mitigated?	Yes, to some extent. Unavoidable impacts on protected trees / conservation important plants will occur because of land clearance activities within the footprint; success of mitigation measures is extremely limited and will be restricted to localised events of relocation of certain individuals. Relocation of large *Adansonia* individuals will be hugely expensive and unlikely successful, reasonable success has been achieved with smaller individuals.	
Mitigation: » Extent of impact likely to be restricted to site / development footprint only with minimal impacts outside development footprint. Selected species and individuals should be rescued and replanted at suitable localities, with specific reference to required landscaping and rehabilitation of development areas.		

» Permitting requirements need to be met prior to destruction of any protected / conservation important plant species.		
Residual Impacts: Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability, exacerbated pressure on conservation important and protected plant species.		

Nature: Loss of natural vegetation (physical modifications, removal, damage) including the loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Site only (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Highly probable (4)
Significance	**High (75)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible, rehabilitation procedures are generally unable to restore vegetation to the previous status.	
Irreplaceable loss of resources?	Yes, to some extent. Regional vegetation (due to low transformation and fragmentation levels) is abundantly represented and characterised by minor habitat diversity. Main threat is presented by the cumulative losses caused by associated developments, linear infrastructures, settlements, and increase in human population with associated impacts on ecology.	
Can impacts be mitigated?	Yes, to some extent, the development of the proposed power station will cause unavoidable losses and associated impacts on the receiving floristic environment. Implementation of generic mitigation measures will prevent (mostly) direct impacts on surrounding areas and habitat, and rehabilitation of altered landscapes will restores some form of vegetation after cessation of the activity, although not entirely similar to the original vegetation.	
Mitigation: » Restrict losses of natural vegetation to footprints. » Avoid peripheral or unnecessary losses of natural vegetation. » Ensure proper rehabilitation and landscaping practices. » Ensure nodal developments by grouping development's structures. » Avoid the uncontrolled spread of infrastructure. » Ensure that appurtenant infrastructure and developments are effected with minimal exacerbation of existing impacts, i.e. nodal developments.		
Residual Impacts: Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, and increased fragmentation of habitat.		

Nature: Local depletion of plant taxa and reduction of phytodiversity.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)

Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Unsure, natural successional processes could potentially account for some recovery.	
Irreplaceable loss of resources?	Yes, decimation of localised species might include species of conservation concern, localised areas of high phytodiversity and importance.	
Can impacts be mitigated?	Yes, to some extent, rehabilitation procedures during and subsequent to the activity will restore the presence of some species, although not to previous status and abundance.	

Mitigation:

» Restrict footprints to preferred development areas, avoid areas of higher floristic sensitivity.
» Avoid peripheral or unnecessary losses of natural vegetation.
» Ensure proper rehabilitation and landscaping practices.
» Ensure nodal developments by grouping developments structures.
» Avoid the uncontrolled spread of infrastructure; access roads, power lines, conveyor lines, etc.

Residual Impacts:

Increase in habitat fragmentation and isolation, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, and increased fragmentation of habitat.

Nature:

Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Highly probable (4)
Significance	**High (60)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderately reversible; the nature of impacts is such that activities on the development site can be adapted to avoid impacts in surrounding areas, restrict human movement and development footprint through generic mitigation measures, implement biodiversity monitoring and audit programmes to evaluate and ensure compliance.	
Irreplaceable loss of resources?	Yes, to some extent as impacts on conservation important species that persist in adjacent habitat could result.	
Can impacts be mitigated?	Yes	

Mitigation:

» Ensure compliance to the EMPr.
» Avoid unnecessary impacts within adjacent habitat.
» Prevent unwanted spread of physical impacts outside footprint areas.
» Implement generic monitoring and audit programme aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat.

Residual Impacts:

Increase in habitat fragmentation and isolation, loss of natural habitat, decrease in habitat quality.

Nature: Reduced or severely altered ecological functionality (including fire, erosion).		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Highly probable (4)
Significance	**High (80)**	**Medium (52)**
Status (positive or negative)	Negative	Negative
Reversibility	Low reversibility; development of the power station may cause irreversible and unavoidable impacts within surrounding natural areas. Evidence from similar developments proved that a decrease in ecological functionality of surrounding areas is unavoidable, but the implementation of dedicated management and subsequent rehabilitation procedures will restore habitat and common / typical ecological functionality to some extent, although not to the same level as untransformed and natural (existing) habitat.	
Irreplaceable loss of resources?	Yes, loss and deterioration of remaining natural habitat will likely cause irreversible impacts on a local scale, impacts will likely include adverse effects on conservation important species and habitat, with reference to isolated and linear habitat types.	
Can impacts be mitigated?	Yes, to some extent with the implementation of a dedicated management plan and rehabilitation procedures.	
Mitigation: » Limit development to footprint area. » Avoid impacts in adjacent habitat. » Implement biodiversity monitoring programmes, alien and invasive management programmes. » Although outside the scope of this assessment, uncontrolled anthropogenic encroachment should be prevented and mitigated through worker programmes, settlement developments, etc.		
Residual Impacts: Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources.		

Nature: Decreased aesthetic appeal of the landscape.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**High (60)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent. The use of locally indigenous vegetation, taking cognisance of the visual impact assessment recommendations, dedicated	

	landscaping programmes and rehabilitation programmes will avoid the high visibility of the proposed development from vast distances.

Mitigation:

- Implement biodiversity monitoring programmes, alien and invasive management programmes, early detection and eradication programmes.
- Prevent/control anthropogenic encroachment to avoid exacerbation of habitat transformation and cumulative impacts.
- Ensure appropriate restoration and rehabilitation programmes by using locally indigenous species.
- Llitter and refuse control programmes, particularly around human abodes and transportation routes.

Residual Impacts:

Degraded landscapes, loss of aesthetic appeal, poor species diversity, loss of 'sense of place', visual impacts, light pollution, etc.

Nature:

Introduction of invasive, exotic and encroacher plant species.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**High (60)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible (mostly)	Irreversible (mostly)
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes. The immediate and dedicated implementation of an Alien and Invasive management programme.	

Mitigation:

- Implement early detection and control measures as part of Alien and Invasive Management Plan.
- Development and implementation of a biodiversity monitoring plan.
- Rehabilitation and landscaping that aims to simulate the surrounding environment.
- Use of locally indigenous species.

Residual Impacts:

Deterioration of remaining natural habitat, decreased aesthetic appeal, loss of phytodiversity.

Nature:

Increased exploitation of natural resources due to increased human presence and resource requirements.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (64)**	**Low (22)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible, particularly since exploitation of resources are generally aimed at restricted environments and species.	
Irreplaceable loss of resources?	Yes, but only on a local scale.	

Can impacts be mitigated?	Yes, to some extent.

Mitigation:
- » Public awareness programmes.
- » Implementation of biodiversity monitoring protocols.
- » Search and rescue operations.
- » Landscaping programmes making use of locally indigenous species from the development footprint.
- » Prevent personnel from entering adjacent properties and remaining natural land in the immediate surrounds.

Residual Impacts:
Decreased floristic diversity and aesthetic, potential increase in threat status to certain taxa, exacerbated losses of phytodiversity, changes to local flora patterns.

8.3.2.2 Fauna

Nature:
Direct impacts on / losses of fauna species of conservation importance and concern and habitat associated with these species. Impacts are unavoidable because of land clearing activities but are generally restricted to the immediate area. This impact is restricted to the construction phase but is permanent. Animals are generally mobile and will evacuate towards other suitable areas, but losses are expected.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Medium-term (3)
Magnitude	Very high (10)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (72)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent. Unavoidable impacts on conservation important animals will occur, irrespective of mitigation measures, albeit restricted to the local footprint. Implementation of mitigation measures will curtail losses to some extent. The extent of the impact is likely to be restricted to the site only.	

Mitigation:
- » Ensure the absence of, particularly, sessile species, through a thorough walk-down (search and rescue) of development areas.
- » Ensure the absence of larger animals through frequent patrols, particularly prior to development.

Residual Impacts:
Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability.

Nature:
Losses of natural habitat through physical transformation, modifications, removals and damage. Also includes the losses of natural refugia, such as termitaria, dead trees, etc.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)

Significance	**High (65)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, to some extent	Yes, to some extent
Can impacts be mitigated?	Yes, within areas surrounding the footprint.	

Mitigation:

- Restrict losses of natural habitat to footprints.
- Avoid peripheral or unnecessary losses of natural habitat.
- Ensure proper rehabilitation of areas outside development footprints should accidental habitat degradation occur.
- Promote nodal developments by grouping developments structures.
- Avoid the uncontrolled spread of infrastructure.

Residual Impacts:

Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, and increased fragmentation of habitat.

Nature:

Depletion of faunal diversity through direct losses, evacuation of unfavourable habitat by animals, including the introduction of invasive and non-endemic species. Construction and operation creates opportunities for human / animal conflict situations, with reference to potentially dangerous animal encounters, snaring, trapping and killing (vehicular events).

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Medium term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- Awareness programmes, ensuring minimal conflict situation.
- Control of human movement in adjacent natural habitat.
- Frequent patrols.
- Biological monitoring programmes.
- Animal control (vervet monkeys, feral cats, rats, baboons, dogs, etc.).
- Ecological sound management of construction areas, with reference to waste management, food sources, etc.

Residual Impacts:

Depletion of faunal diversity, presence of invasive species, genetic modification of population, increased presence of unwanted (opportunistic) species.

Nature:

Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.

	Without Mitigation	With Mitigation
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Minor (2)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (48)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderately reversible, the nature of impacts is such that activities on the development site can be adapted to avoid impacts in surrounding areas.	
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

» Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat.

Residual Impacts:

Increase in habitat fragmentation and isolation, loss of natural habitat.

Nature:

Indirect impacts on movement / migration patterns of animals and ecological interaction and processes.

	Without Mitigation	With Mitigation
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Highly probable (4)
Significance	**High (70)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes, to some extent.	

Mitigation:

» Limit development to footprint area.

» Avoid impacts in adjacent habitat.

» Implement biodiversity monitoring programmes, alien and invasive management programmes.

Residual Impacts:

Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources, changes to normal migration patterns on a local scale.

Nature:

Exacerbated increases of edge effects of the project areas.

	Without Mitigation	With Mitigation
Extent	Regional (3)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)

Significance	**Medium (52)**	**Medium (30)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale	Yes, but only on a local scale
Can impacts be mitigated?	Yes	

Mitigation:

» Implement biodiversity monitoring programmes.

» Ensure proper restoration and rehabilitation of construction areas subsequent to construction.

Residual Impacts:

Degraded landscapes, loss of aesthetic appeal, poor species diversity.

Nature: Accelerated development patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale	Yes, but only on a local scale
Can impacts be mitigated?	Yes, to some extent. Avoidance of this impact will be through the relocation of the proposed project to existing populated areas and avoidance of areas situated far from populated areas; however this is no longer considered an option.	
Mitigation: » These impacts are generally addressed on other platforms, such as regional councils and authority involvement and generally lies outside the scope of this particularly project. Avoidance of this impact will be through the relocation of the proposed project to existing populated areas and avoidance of areas situated far from populated areas; however this is no longer considered an option.		
Residual Impacts: Increase in habitat fragmentation and isolation, loss of natural habitat.		

8.3.2.3 Avifauna

Nature: Direct impacts on / losses and displacement of bird species of conservation importance and concern, and habitat associated with these species, with particular reference to large-bodied birds of prey and large terrestrial bird species. Impacts are unavoidable because of land clearing activities and the particular large home range size of focal bird species. This impact is restricted to the construction and operational phase, but is permanent.		
	Without Mitigation	**With Mitigation**
Extent	National (4)	Regional (3)
Duration	Permanent (5)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Definitive (5)	Definitive (5)
Significance	**High (85)**	**High (65)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, however unavoidable impacts on bird species will occur, irrespective of mitigation measures, albeit restricted to local footprint. Aim to avoid construction on important and sensitive bird habitat (e.g. habitat with high and medium-high avifaunal sensitivities).	
Mitigation: » Extent of impact likely to be restricted to site only, restrict impacts to development footprint. » Avoid areas of very high, high or medium-high avifaunal sensitivities by applying changes to the layout plan where necessary.		

Residual Impacts:
Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability.

Nature:
Losses of natural habitat through physical transformation, modifications, removals and land clearance. Also includes the loss of habitat containing high avifaunal diversity on a local scale and reduction in species richness and diversity.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Definitive (5)	Definitive (5)
Significance	**High (65)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, to some extent	Yes, to some extent
Can impacts be mitigated?	Yes, to a limited extent, representative habitat types are widespread and cover large surface area of proposed site.	

Mitigation:
- Restrict losses of natural habitat to footprints.
- Avoid peripheral or unnecessary losses of natural habitat.
- Ensure proper rehabilitation and landscaping practices.
- Ensure nodal/clustering of developments by grouping developments structures, avoid the uncontrolled spread of infrastructure.

Residual Impacts:
Decreased species richness, low evenness values, subsequent loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat.

Nature:
Direct impacts on / losses of azonal habitat types or ecosystems of particularly restricted occurrence containing unique avifaunal compositions on a local scale - many of these areas also provide habitat for threatened and near threatened bird species.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (60)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
- Restrict losses of natural habitat to footprints.

- Avoid placement of infrastructure at or in close proximity to habitat with very high avifaunal sensitivities - for examples pans and dams.
- Avoid peripheral or unnecessary losses of natural habitat.
- Ensure proper rehabilitation and landscaping practices.
- Ensure nodal / clustering of developments by grouping developments structures, and avoid the uncontrolled spread of infrastructure.
- Allow infrastructure on areas of low sensitivity.
- Remove prominent large dead trees and reinstate during rehabilitation (where necessary).
- Reinstate and re-locate artificial watering holes / points if impacted by the project.

Residual Impacts:
Increase in habitat fragmentation and isolation, local decrease in bird richness, increased competition between bird species and individuals of the same species for natural resources, sterilised landscapes, and increased fragmentation of habitat.

Nature:
Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of moderate significance due to a moderate sensitivity of surrounding areas; although areas of high / medium-high sensitivity occur nearby (drainage lines and open woodland).

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (56)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:
- Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat.
- Avoid an overspill of activities into adjacent habitat by creating exclusion zones which are off limits to personnel.
- Implement awareness programmes to inform labour and personnel about the biodiversity of the area.

Residual Impacts:
Increase in habitat fragmentation and isolation, loss of natural habitat.

Nature:
Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing the life requirements for many bird species and bird associations along drainage lines.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Long term (4)
Magnitude	Moderate (6)	Low (4)

Probability	Definitive (5)	Probable (3)
Significance	**High (70)**	**Medium (30)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent	

Mitigation:

» Limit development to footprint area.
» Avoid impacts in adjacent habitat.
» Implement biodiversity monitoring programmes and maintain ecological connectivity with habitat of similar structure.

Residual Impacts:

Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources and reduced species richness relating to loss of specialised species and increased colonisation by unspecialised (generalist) species.

Nature:

Increased exploitation of natural resources due to increased human presence and resource requirements.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (42)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale	Yes, but only on a local scale
Can impacts be mitigated?	Yes, to some extent	

Mitigation:

» Create and implement public awareness programmes with the aim to protect natural resources. Apply measures which include penalties to personnel if found with "bush meat".
» Implement biodiversity monitoring protocols.
» Avoid development on areas of very high, high and medium- high avifaunal sensitivity.
» Implement monitoring initiatives to monitor area for snares and illegal firewood collection.
» Cluster development and avoid "spread" of settlements across landscape.

Residual Impacts:

Low bird diversity, and continued displacement of bird species. Potential colonisation of feral (alien) species resulting in increased competition and localised displacement of native bird species.

Nature:

Bird collisions with proposed overhead power lines.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Long term (4)
Magnitude	High (8)	Moderate (6)

Probability	Definite (5)	Probable (3)
Significance	**High (80)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, to some extent	

Mitigation:

» Avoid spanning of watercourses and open woodland habitat where a high incidence of large bodied terrestrial birds or birds of prey are evident.

» Avoid spanning areas in close proximity to pans, dams or artificial watering holes or areas where game tend to congregate, or areas holding large trees that are used for roosting sites.

» Fit "Double loop flight diverter (BFD) to earth wire at the following:
  * Spanning drainage lines, dams or depressions.
  * When in close proximity (within 100m of alignment) to dams, depressions or drainage lines.
  * Spanning arable lands, old cultivated land or open woodland.

» Where possible, placement of the power line alongside existing power lines will increase the visibility of the earth wires.

Residual Impacts:

Increase in habitat fragmentation and isolation, loss of natural habitat.

Nature:

Electrocution of large-bodied birds due to the use of inappropriate tower design.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (64)**	**Medium (39)**
Status (positive or negative)	Yes	Yes
Reversibility	No	No
Irreplaceable loss of resources?	Yes, to some extent	Yes, to some extent
Can impacts be mitigated?	Yes	

Mitigation:

» For transmission lines (275 kV or more), use cross rope suspension towers as far as possible.

» For distribution lines (<275 kV, use a monopole design that allows for enough clearance between the live conductors (being positioned in an offset manner to each other) to eliminate the risk of electrocution. In addition, perching of large bird species should be discouraged by the addition of diagonal crossbars or by doing away with the crossbars that holds the conductors in place. Bird "streamers" are also eliminated by fitting the poles with bird guards/spikes above the insulators. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors).

» Fit metal bird guards above the insulators of self-supporting towers.

» The conductors at each tower shall be spaced more than 140 cm apart (this increases to the clearances between the live components). In case spacing of 140 cm is not possible, it is assumed that power lines shall be insulated with thick plastic/metal tubing at least 130 cm in length on both sides of the insulators. This will prevent birds with large wingspans (e.g. Martial eagles, vultures) from "bridging" the gap between the live components when flying off, or attempting to perch on the tower structure, thereby reducing the risk of electrocution. It is also advised to minimise potential bird "streamers" (e.g. when a perching bird is excreting) by discouraging birds from perching directly above the insulators.

» Re-align alignment away from large drainage lines or areas where roosting is eminent.

Residual Impacts:
Increase in habitat fragmentation and isolation, loss of natural habitat.

8.3.3 Analysis of Layout Alternatives

8.3.3.1 Flora

i. Comparison of Alternatives

The respective project alternatives are evaluated in terms of the expected impact on floristic sensitivity units and mostly relate to the expected effects of direct impacts. The evaluation of the estimated suitability of the respective impacts also took notice of the location of large *Adansonia digitata* individuals.

The homogeneity of the receiving environment largely determines that none of the project alternatives are spatially situated within areas of particularly high floristic sensitivity, apart from the proposed access road and pipeline servitude which remains as a constant for all the layout alternatives, which will adversely affect floristic habitat of medium-high sensitivity. The placement of the Eskom 400kV substation could be reconsidered as it is placed immediately adjacent to the Quartzitic outcrop that is deemed to exhibit floristic sensitivity attributes of medium-high sensitivity. A suitable buffer zone (approximately 100m) should be allowed for this feature.

The significance of most of the impacts are impossible to negate simply by means of the spatial placement of the proposed development; as impacts such as loss of natural vegetation, depletion of phytodiversity, decreased aesthetic appeal, local and regional cumulative impacts relating to habitat fragmentation, etc., will occur irrespective of site variations. Consideration is therefore given to site-specific aspects, such as the location of plant individuals of local importance, local fragmentation factors, habitat variability on a local scale, etc.

Preferred Alternative:
The positioning of the proposed development entirely within the boundaries of the Farm Vrienden is regarded a beneficial aspect in terms of ecological fragmentation and habitat isolation. Although only minor variability was recorded between the typical terrestrial woodland habitat of the two farms, limiting the impacts to only one of the farms is regarded a more suitable alternative as the road and railway line between the properties will act as an artificial buffer. Furthermore, preventing the spread of the proposed development across the road will somewhat lessen the impact of indirect spread of impacts, such as habitat deterioration, spread of unwanted species, peripheral impacts, as the road and railway line presents a 'boundary' to the development. Taking cognisance of the location of plants of local importance, it is estimated that 2 large *Adansonia* individuals will be directly affected. The avoidance of these individuals in the final layout is strongly advised. Concerns regarding this option include the drainage patterns of the immediate region as it corresponds to seasonal water courses that could contribute to pollution of downstream habitat. This option is regarded as the preferred option from a botanical perspective.

Alternative A

As the habitat diversity (with reference to atypical and physiognomic variations) is higher on the Farm Du Toit 563, the placement of part of the development footprint on this property is expected to result in marginally higher impacts. These direct impacts will be exacerbated by an increase in effects that will contribute to exacerbated habitat fragmentation. It is considered more ideal to limit the footprint of the proposed development to a single property, not allowing it to be situated on both sides of the road. The length of the conveyor between the power station and the ash dump is also a negative consideration. Impacts on plants of interest indicate that at least three significant *Adansonia* individuals will be affected by this option as these are situated within the development footprint. This alternative is therefore regarded as the least preferred option in terms of the floristic environment.

Alternative B

As with the Preferred Alternative, limiting the placement of the footprint to a single property is regarded beneficial and will largely limit most of the impacts to some extent. However, the spatial placement of the ash dump in Alternative B implies direct losses of at least 2 large individuals of *Adansonia*. The placement of the ash dump adjacent to the road also implies significant effect on the aesthetic appearance of the natural environment. Floristic habitat affected by this alternative comprises of moderate sensitivities and no aspect of elevated floristic importance will be affected adversely. Concerns regarding this option include the drainage patterns of the immediate region as it corresponds to seasonal water courses that could contributed to pollution of downstream habitat. This option is therefore regarded as the second preferred alternative in terms of impacts on the floristic environment.

ii. Nomination of Preferred Alternative

The three project alternatives are regarded to be highly similar in layout and estimated footprint sensitivity regarding the botanical receiving environment. Anticipated impacts on the floristic environment, surrounds and region are not expected to vary significantly between the three proposed alternatives; discussions on anticipated impacts are therefore applicable to the three alternative layouts. Despite the similarity in sensitivity aspects, minor (localised) attributes are considered important in the preferability of the proposed alternative layouts. The following order of preferability is presented:

» The Preferred Alternative is regarded the preferred option in terms of the floristic environment.
» Alternative A is regarded the least preferred option in terms of the floristic environment.
» Alternative B is regarded as the second preferred alternative in terms of impacts on the floristic environment.

8.3.3.2 Fauna

i. Comparison of Alternatives

The three layout alternatives identified for the project were rated in terms of estimated suitability based on differences in anticipated impacts on the animal communities of the study area and surrounding areas. The Preferred Alternative and Alternative B are restricted to the Farm Vrienden 589 with most of the proposed project's footprint planned on faunal habitat with a medium sensitivity. Alternative A will comprise selected portions of both farms.

Preferred Alternative:

Faunal habitat within the proposed footprint of the Preferred Alternative has been indicated to contravene mostly habitat with a medium faunal sensitivity, this is excluding the proposed access road and pipeline servitude that will comprise portions of medium-high faunal sensitivity (which remains constant for all three alternatives). Locating the proposed project within a single property is regarded a beneficial option as the road and railway line between the properties will act as an artificial barrier for impacts. Lastly, the location of the proposed ash dump away from the seasonal water courses renders this alternative preferable, in contrast to Alterative B where the ash dump will be placed between the watercourses of the Farm Vrienden 589.

Alternative A:

As with the Preferred Alternative, Alternative A comprises habitat that exhibits a moderate faunal sensitivity. However, the spatial placement of appurtenant infrastructure across the border / road between the farms, the length of the required conveyor between the power station and the ash dump, and the potential impact on localised and sensitive faunal receptors, ultimately renders this alternative the second preferred alternative.

Alternative B:

The footprint of Alternative B is mostly restricted to habitats of a medium faunal sensitivity on the Farm Vrienden 589; however, most of the footprint is situated in close proximity to faunal habitats with high faunal sensitivities, i.e. between the seasonal water courses. This alternative is therefore regarded the least preferred alternative as far as potential and likely impacts on the faunal receiving environment is concerned.

ii. Nomination of Preferred Alternative

The three alternatives are very similar in layout and estimated footprint sensitivity regarding the faunal receiving environment and, particularly, conservation important animal species. The evaluation of anticipated impacts on the faunal receiving environment of the study area did not indicate any significant difference between the three alternatives. The faunal discipline is therefore not likely to represent a significant driver in the selection process between the layout alternatives as only minor advantages / disadvantages are indicated between the variations.

8.3.3.3 Avifauna

i. Comparison of Alternatives

Bird richness and sensitivity

The habitat diversity on the Farm Du Toit 563 is higher when compared to the Farm Vrienden 589, which also contains more azonal habitat types in the form of dams and ephemeral depressions. The latter were rare or absent on the Farm Vrienden 589. The higher number of habitat types is directly proportional to bird richness as evidenced by the higher number of bird species present on the Farm Du Toit 563 in comparison to the Farm Vrienden 589.

In addition, the Farm Du Toit 563 also provides habitat for more habitat specialists (e.g. waterbirds and storks) and foraging birds of prey, therefore the surface area of sensitive habitat on the Farm Du Toit 563 is regarded to exceed that on the Farm Vrienden 589. Therefore, Alternative A is less preferred from an avifaunal perspective since part of the ash dump is located on the Farm Du Toit 563.

Concerns regarding each of the identified alternatives include the geographic placement of the new access road. The new access road will transverse an area of calcrete plains that are often utilised by Kori Bustards (*Ardeotis kori*) during foraging bouts. In addition, the road will also displace the nesting site / breeding success of a Dark Chanting Goshawk (*Melierax metabates*). In addition, the road will facilitate habitat fragmentation. The location of the road is constant across all three alternatives and the impacts related to the road will remain the same for all three alternatives

<u>Preferred Alternative:</u>
The infrastructure is contained on the Farm Vrienden 589 (as opposed to the Farm Du Toit 563) and contravenes mainly natural habitat of medium avifaunal sensitivity. However, concerns regarding the Preferred Alternative include the natural drainage patterns of the ash dump area. The proposed ash dump locality corresponds to a number of ill-defined drainage lines which could contribute towards accidental pollution of the main drainage line located west of the proposed ash dump locality.

<u>Alternative A:</u>
The infrastructure is contained on the Farm Vrienden 589 with part of the ash dump located on the Farm Du Toit 563. The ash conveyer encompasses a large surface area, which also traverses natural open woodland. Assuming that the conveyer is to be fenced, it is possible that the fence will induce a "barrier effect" on animal dispersal while large terrestrial bird species such as bustards may even collide with the fence structure. This option is least preferred from an avifaunal perspective, mainly due to the high richness of birds and habitat types on the Farm Du Toit 563, and also owing to the potential loss of a small pan corresponding to the ash dump locality on the Farm Du Toit 589.

<u>Alternative B:</u>
The infrastructure is contained on the Farm Vrienden 589 (as opposed to the Farm Du Toit 563) and contravenes mainly natural habitat of medium avifaunal sensitivity. The proposed ash dump is located between two drainage lines of which the ash conveyer will be positioned on the ash dump, thereby limiting potential fragmentation and barrier effects.

<u>Avifauna Richness and Abundance</u>

<u>Preferred Alternative:</u>
The Preferred Alternative corresponds to an area / habitat with lower richness and abundance values when compared to Alternative A and Alternative B.

<u>Alternative A:</u>
Alternative A cumulatively corresponds to an area / habitat with higher richness and abundance values when compared to the Preferred Alternative and Alternative B.

<u>Alternative B:</u>
Alternative B corresponds to an area / habitat with higher richness and abundance values when compared to the Preferred Alternative although cumulative values are less when compared to Alternative A.

ii. Nomination of Preferred Alternative

From the analysis of alternatives, in particular when taking bird richness and abundance into account, the Preferred Alternative is regarded as being more feasible when compared to Alternative A and Alternative B. However, the Preferred Alternative is not failsafe from other impacts related to potential pollution run-off and localised fragmentation. In addition, the location of the service road remains perpetual on all three alternatives. To minimise potential impacts of the service road, it is proposed that all linear infrastructure be consolidated.

8.4 Potential Impacts on Air Quality

8.4.1 Results of Impact Assessment

8.4.1.1 Analysis of Emissions Impact on Human Health

To assess the atmospheric impact of the Mutsho Power Project on human health, a dispersion modelling study was undertaken in accordance with the regulations regarding air dispersion modelling specified for regulatory purposes – developed in terms of Section 53 of the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEM:AQA). The impact assessment only takes the emissions of the facility under consideration as well as prevailing ambient air concentrations into account. A compliance assessment was undertaken using the national dustfall standard and National Ambient Air Quality Standards (NAAQS), specifically in residential areas and other areas where human exposure could occur.

The effects of air pollutants on human health occur in a number of ways with short-term, or acute effects, and chronic, or long-term, effects. Different groups of people are affected differently, depending on their level of sensitivity, with the elderly and young children being more susceptible. Factors that link the concentration of an air pollutant to an observed health effect are the concentration and the duration of the exposure to that particular air pollutant.

Criteria pollutants occur ubiquitously in urban and industrial environments. Their effects on human health and the environment are well documented by the World Health Organisation (WHO) (e.g. WHO, 1999; 2003; 2005). South Africa has accordingly established NAAQS for the criteria pollutants, i.e. SO_2, NO_2, CO, respirable particulate matter (PM_{10}), ozone (O_3), Pb and benzene (C_6H_6) (DEA, 2009) and $PM_{2.5}$ (DEA, 2012). National dust control regulations were published on 1 November 2013 (DEA, 2013b), setting limits for acceptable dustfall rates for residential and non-residential areas.

The NAAQS consists of a 'limit' value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the acceptable number of exceedances of the limit value expressed as the 99th percentile. Compliance with the ambient standard implies that the frequency of exceedance of the limit value does not exceed the permitted tolerance. Being a health-based standard, ambient concentrations below the standard imply that air quality poses an acceptable risk to human health, while exposure to ambient concentrations above the standard implies that there is an unacceptable risk to human health.

Particulate Matter (PM

Particulate Matter (PM) is a broad term used to describe the fine particles found in the atmosphere, including soil dust, dirt, soot, smoke, pollen, ash, aerosols and liquid droplets. With PM, it is not just the chemical composition that is important but also the particle size. Particle size has the greatest influence on the behaviour of PM in the atmosphere with smaller particles tending to have longer residence times than larger ones. PM is categorised, according to particle size, into TSP, PM_{10} and $PM_{2.5}$.

Total suspended particulates (TSP) consist of all particles smaller than 100 µm suspended within the air. TSP is useful for understanding nuisance effects of PM, e.g. settling on houses, deposition on and discolouration of buildings, and reduction in visibility.

PM_{10} describes all particulate matter in the atmosphere with a diameter equal to or less than 10 µm. Sometimes referred to simply as coarse particles, they are generally emitted from motor vehicles, factory and utility smokestacks, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Natural sources include sea spray, windblown dust and volcanoes. Coarse particles tend to have relatively short residence times as they settle out rapidly and PM_{10} is generally found relatively close to the source except in strong winds.

$PM_{2.5}$ describes all particulate matter in the atmosphere with a diameter equal to or less than 2.5 µm. They are often called fine particles, and are mostly related to combustion (motor vehicles, smelting, incinerators), rather than mechanical processes as is the case with PM_{10}. $PM_{2.5}$ may be suspended in the atmosphere for long periods and can be transported over large distances. Fine particles can form in the atmosphere in three ways: when particles form from the gas phase, when gas molecules aggregate or cluster together without the aid of an existing surface to form a new particle, or from reactions of gases to form vapours that nucleate to form particles.

Particulate matter may contain both organic and inorganic pollutants. The extent to which particulates are considered harmful depends on their chemical composition and size, e.g. particulates emitted from diesel vehicle exhausts mainly contain unburned fuel oil and hydrocarbons that are known to be carcinogenic. Very fine particulates pose the greatest health risk as they can penetrate deep into the lung, as opposed to larger particles that may be filtered out through the airways' natural mechanisms.

In normal nasal breathing, particles larger than 10 µm are typically removed from the air stream as it passes through the nose and upper respiratory airways, and particles between 3 µm and 10 µm are deposited on the mucociliary escalator in the upper airways. Only particles in the range of 1 µm to 2 µm penetrate deeper where deposition in the alveoli of the lung can occur (WHO, 2003). Coarse particles (PM_{10} to $PM_{2.5}$) can accumulate in the respiratory system and aggravate health problems such as asthma. $PM_{2.5}$, which can penetrate deeply into the lungs, are more likely to contribute to the health effects (e.g. premature mortality and hospital admissions) than coarse particles (WHO, 2003).

The WHO has reviewed many studies since 2005 to update information on health effects on PM (WHO, 2013). Studies have once again confirmed that PM (not only PM_{10} but fine and ultra-fine PM as well), has short and long-term (both immediate and delayed) adverse health effects such as cardiovascular effects, but new associations with diseases such as atherosclerosis (thickening of artery walls), birth defects and respiratory illness in children have also been found (WHO, 2013). In addition, some studies have suggested a possible link between PM and diabetes and effects on the central nervous system (WHO, 2013). The increase in daily mortality (between 0.4% and 1%) from exposure to PM_{10} was also confirmed in several studies since 2005 (WHO, 2013).

Sulphur Dioxide (SO_2)

Dominant sources of SO_2 include fossil fuel combustion from industry and power plants. SO_2 is emitted when coal is burnt for energy. The combustion of fuel oil also results in high SO_2 emissions. Domestic coal or kerosene burning can thus also result in the release of SO_2. Motor vehicles also emit SO_2, in particular diesel vehicles due to the higher sulphur content of diesel fuel. Smelting of mineral ores can also result in the production of SO_2, because metals usually exist as sulphides within the ore.

On inhalation, most SO_2 only penetrates as far as the nose and throat, with minimal amounts reaching the lungs, unless the person is breathing heavily, breathing only through the mouth, or if the concentration of SO_2 is high (CCINFO, 1998). The acute response to SO_2 is rapid, within 10 minutes in people suffering from asthma (WHO, 2005). Effects such as a reduction in lung function, an increase in airway resistance, wheezing and shortness of breath, are enhanced by exercise that increases the volume of air inspired, as it allows SO_2 to penetrate further into the respiratory tract (WHO, 1999). SO_2 reacts with cell moisture in the respiratory system to form sulphuric acid. This can lead to impaired cell function and effects such as coughing, broncho-constriction, exacerbation of asthma and reduced lung function. For example, an exposure of 5 to 10 min to 200 to 300 ppb (520 to 780 µg/m³) may reduce lung function (measured as Forced Expiratory Volume in the first second (FEV_1)) by more than 15% (US-EPA, 2009). There is however, uncertainty about exposure-response effects below concentrations of 200 ppb (520 µg/m³). For SO_2 exposure short-term peak concentrations are therefore important (US-EPA, 2009). Re-analysis of the effects of SO_2 done post-2005 has found evidence to suggest that the point of departure for setting the 10-minute guideline needs an additional uncertainty factor, which indicates that the guideline may have to be lowered when it is re-evaluated (WHO, 2013).

Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) and nitric oxide (NO) are formed simultaneously in combustion processes and other high temperature operations such as metallurgical furnaces, blast furnaces, plasma furnaces, and kilns. NO_X is a term commonly used to refer to the combination of NO and NO_2. NO_X can also be released from nitric acid plants and other types of industrial processes involving the generation and / or use of nitric acid. NO_X also forms naturally through de-nitrification by anaerobic bacteria in soils and plants. Lightning is also a source of NO_X.

The route of exposure to NO_2 is inhalation and the seriousness of the effects depend more on the concentration than on the length of exposure. The site of deposition for NO_2 is the distal lung where NO_2 reacts with moisture in the fluids of the respiratory tract to form nitrous and nitric acids. About 80 to 90% of inhaled nitrogen dioxide is absorbed through the lungs (CCINFO, 1998). Nitrogen dioxide (present in the blood as the nitrite ion) oxidises unsaturated membrane lipids and proteins, which then results in the loss of control of cell permeability. Nitrogen dioxide causes decrements in lung function, particularly increased airway resistance. Inflammatory reactions were observed at NO_2 concentrations between 200 and 1 000 ppb (380 to 1 880 µg/m³) when individuals were exposed under controlled conditions for periods that varied between 15 minutes and six hours (WHO, 2013). However, the results had been inconsistent below 1 000 ppb but were much more evident at concentrations higher than 1 000 ppb (1 880 µg/m³) (WHO, 2013). Below 1 000 ppb healthy individuals did not show inflammatory reactions and for those with respiratory diseases (asthma and chronic obstructive pulmonary disease), inflammation was not induced below 600 ppb, except for one study that reported individuals responded at 260 ppb (500 µg/m^3) (Hesterberg et al., 2009). A review study (on 50 publications) published in 2009 by Hesterberg et al. focussed on short-term exposure to NO_2 and adverse health effects on humans. The authors came to the conclusion that a short-term exposure standard of not more than 200 ppb would protect all individuals, including sensitive individuals. People with chronic respiratory problems and people who work or exercise outside will be more at risk to NO_2 exposure. Chronic exposure to NO_2 increases susceptibility to respiratory infections (WHO, 1997). However, a review study of 50 publications found no consistent evidence that short-term exposure below 200 ppb increased susceptibility to viral infections (Hesterberg et al., 2009).

The WHO has reviewed hundreds of studies published between 2004 and 2011 on adverse health effects after short-term and long-term exposure to NO_2 (WHO, 2013). The health effects from short-term exposure are more evident than those from long-term (chronic) exposure, because in many studies a high correlation was found between NO_2 and other pollutants (WHO, 2013). However, some epidemiology studies suggested an association between NO_2 and respiratory mortality and an association with respiratory effects in children, including effects on children's lung function (WHO, 2013).

Carbon Monoxide (CO)

CO is an odourless, colourless and toxic gas. People with pre-existing heart and respiratory conditions, blood disorders and anaemia are sensitive to the effects of CO. Health effects of CO are mainly experienced in the neurological system and the cardiovascular system (WHO, 1999). The binding of CO with haemoglobin reduces the oxygen-carrying capacity of the blood and impairs the release of oxygen from haemoglobin to extravascular tissues. These are the main causes of tissue hypoxia produced by CO at low exposure levels. The toxic effects of CO become evident in organs and tissues with high oxygen consumption such as the brain, the heart, exercising skeletal muscle and the developing foetus.

8.4.1.2 Current Status of Ambient Air Quality

There are no major sources of air pollution near the proposed Mutsho Power Project. Similarly, there is no ambient air quality monitoring. Ambient air quality is however expected to be good and may be influenced at times by wind entrained dust.

8.4.1.3 Dispersion Modelling

Dispersion modelling is used to predict dustfall and ambient concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_X and CO emitted from the proposed Mutsho Power Project. The approach to the dispersion modelling is based on the requirements of the DEA guideline for dispersion modelling (DEA, 2014). According to the DEA guideline for dispersion modelling, a Level 3 air quality assessment is conducted in situations where the purpose of the assessment requires a detailed understanding of the air quality impacts (time and space variation of the concentrations) and when it is important to account for causality effects, calms, non-linear plume trajectories, spatial variations in turbulent mixing, multiple source types and chemical transformations. A Level 3 assessment may be used in situations where there is a need to evaluate air quality consequences under a permitting or environmental assessment process for large industrial developments that have considerable social, economic and environmental consequences.

8.4.1.4 Operating Scenarios for Emission Units

Emissions from the proposed Mutsho Power Project includes the single stack, the coal stockpile, ash dump and roads. The primary pollutants that are assessed are dust, PM_{10}, $PM_{2.5}$, SO_2, NO_X and CO. Two emission scenarios are assessed. In Scenario 1, the boiler stack is assessed in isolation and in Scenario 2, the boiler stack, the coal stockpile, ash dump and unpaved site access road are assessed cumulatively. These scenarios provide an understanding of the effect of emissions for normal operations in the ambient environment.

8.4.1.5 Background Concentrations and Other Sources

A background concentration is the portion of the ambient concentration of a pollutant due to sources, both natural and anthropogenic, other than the source being assessed. Background concentrations are not considered. Other sources of dust, PM_{10}, $PM_{2.5}$, SO_2, NO_X and CO will not be characterised and included in the model run. The proposed Mutsho Power Project is therefore modelled in isolation of other sources. As there are currently no major air pollution sources in the area, ambient background concentrations are expected to be low. Excluding these from the modelling will not have significant implications.

8.4.1.6 Sensitive Receptors

According to the USEPA, sensitive receptors include, but are not limited to, hospitals, schools, day care facilities, elderly housing and convalescent facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants. Extra care must be taken when dealing with contaminants and pollutants in close proximity to areas recognised as sensitive receptors. In this assessment, all neighbouring residential and commercial areas, including small farmsteads are treated as sensitive areas as they as expected to include sensitive areas as identified by the USEPA.

8.4.1.7 Dispersion Modelling Results

The dispersion modelling results for the predicted dustfall, 1-hour, 24-hour and annual average ambient concentrations of PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO resulting from emissions from the proposed Mutsho Power Project were calculated. The predicted dustfall is assessed against South African dustfall standard while ambient concentrations are assessed against the National Ambient Air Quality Standard for PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO.

Two Scenarios are considered in this assessment:

» Scenario 1: Boiler stack in isolation
» Scenario 2: All Sources –Boiler stack, coal stockpile, ash dump and unpaved site access road

Dustfall

The source of dust from the proposed Mutsho Power Project includes the boiler stack, the coal stockpile, ash dump and the unpaved site access road. It is assumed that 100% of the area for the coal stockpile and 25% of the area for the ash dump is exposed to wind erosion. Predicted dustfall is compared with the South

African dustfall standard for the residential area and non-residential area category of 600 mg/m^2/day and 1 200 mg/m^2/day respectively.

30-days average

Scenario 1: Boiler Stack in Isolation
At the point of maximum ground-level impact, the predicted 30-days average dustfall is 0.014 mg/m^2/day for the Boiler Stack in isolation. The highest dustfall is predicted about 1.5km to the south-west of the boiler stack, which is within the boundary of the proposed Mutsho Power Project site. The predicted dustfall is well below the dustfall standard for the residential area and non-residential area category of 600 mg/m^2/day and 1 200 mg/m^2/day respectively; and no exceedance of the standard is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted dustfall therefore complies with the South African dustfall standard in the ambient environment.

Scenario 2: All Sources
At the point of maximum ground-level impact, the predicted 30-days average dustfall is 1 060 mg/m^2/day for all sources (i.e. boiler stack, coal stockpile, ash dump and unpaved site access road). The highest dustfall is predicted along the unpaved site access road, which is within the boundary of the proposed Mutsho Power Project site. The predicted dustfall exceeds the dustfall standard for the residential area category of 600 mg/m^2/day over a very small area along the access road but is below the non-residential area category of 1 200 mg/m^2/day. There are no predicted exceedances of the standard in residential and sensitive receptor areas around the site. The predicted dustfall therefore complies with the South African dustfall standard in the ambient environment.

Particulate Matter (PM_{10})

The source of PM_{10} from the proposed Mutsho Power Project includes the boiler stack, the coal stockpile, ash dump and the unpaved site access road. It is assumed that 100% of the area for the coal stockpile and 25% of the area for the ash dump is exposed to wind erosion. Predicted PM_{10} concentrations are compared with the 24-hour and annual NAAQS.

99th percentile 24-hour concentrations

Scenario 1: Boiler Stack in Isolation
At the point of maximum ground-level impact, the predicted 99th percentile 24-hour PM_{10} concentration is 0.03 μg/m^3 for the Boiler Stack in isolation. The highest concentrations are predicted about 1.5km to the south-west of the boiler stack, which is within the boundary of the proposed Mutsho Power Project site. The predicted ambient concentrations are well below the NAAQS of 75 μg/m^3; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted PM_{10} concentrations therefore comply with the NAAQS in the ambient environment.

Scenario 2: All Sources
At the point of maximum ground-level impact, the predicted 99th percentile 24-hour PM_{10} concentration is 667 μg/m^3 for all sources. The highest concentrations are predicted along the unpaved site access road, which is within the boundary of the proposed Mutsho Power Project site. The predicted ambient concentrations exceed the NAAQS of 75 μg/m^3 over a very small area along the access road. The NAAQS

permits 4 exceedances of the 24-hour limit value per annum, so-called tolerance, implying 12 permitted exceedances in the three-year modelling period. Exceedances of the NAAQS are predicted on 968 days in the 3-year modelling period (~88% of the days for each year). Areas where the tolerance is exceeded include areas that coincide with areas where exceedances of the NAAQS are predicted. The predicted 24-hour PM_{10} concentrations in these areas do not comply with the NAAQS. There are no predicted exceedances of the NAAQS in residential and sensitive receptor areas around the site. The predicted PM_{10} concentrations therefore comply with the NAAQS in the ambient environment.

Annual average

Scenario 1: Boiler Stack in Isolation

At the point of maximum ground-level impact, the predicted annual average PM_{10} concentration is 0.002 μg/m³ for the boiler stack in isolation. The highest concentrations are predicted about 4 km to the southwest of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 40 μg/m³; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted PM_{10} concentrations therefore comply with the NAAQS in the ambient environment.

Scenario 2: All Sources

At the point of maximum ground-level impact, the predicted annual average PM_{10} concentration is 202 μg/m³ for all sources. The highest concentrations are predicted along the unpaved site access road, which is within the boundary of the proposed Mutsho Power Project site. The predicted ambient concentrations exceed the NAAQS of 40 μg/m³ over a very small area along the access road. The predicted concentrations in this area do not comply with the NAAQS. There are no predicted exceedances of the NAAQS in residential and sensitive receptor areas around the site. The predicted PM_{10} concentrations therefore comply with the NAAQS in the ambient environment.

Particulate Matter ($PM_{2.5}$)

The source of $PM_{2.5}$ from the proposed Mutsho Power Project includes the coal stockpile, ash dump and the unpaved site access road (i.e. Scenario 2). It is assumed that 100% of the area for the coal stockpile and 25% of the area for the ash dump is exposed to wind erosion. Predicted $PM_{2.5}$ concentrations are compared with the 24-hour and annual NAAQS.

99th percentile 24-hour concentrations

At the point of maximum ground-level impact, the predicted 99th percentile 24-hour $PM_{2.5}$ concentration is 71 μg/m³ for all sources. The highest concentrations are located within the boundary of the proposed Mutsho Power Project site. The predicted ambient concentrations exceed the NAAQS of 40 μg/m³ over a very small area along the access road. The predicted 24-hour PM_{10} concentrations in these areas do not comply with the NAAQS. There are no predicted exceedances of the NAAQS in residential and sensitive receptor areas around the site. The predicted $PM_{2.5}$ concentrations therefore comply with the NAAQS in the ambient environment.

Annual average

At the point of maximum ground-level impact, the predicted annual average $PM_{2.5}$ concentration is 22.2 μg/m³ for all sources. The highest concentrations are predicted along the unpaved site access road, which is within the boundary of the proposed Mutsho Power Project site. The predicted ambient concentrations exceed the NAAQS of 20 µg/m^3 over a very small area along the access road. The predicted concentrations in this area do not comply with the NAAQS. There are no predicted exceedances of the NAAQS in residential and sensitive receptor areas around the site. The predicted $PM_{2.5}$ concentrations therefore comply with the NAAQS in the ambient environment.

Sulphur Dioxide (SO_2)

The source of SO_2 from the proposed Mutsho Power Project includes the boiler stack only (i.e. Scenario 1). Predicted SO_2 concentrations are compared with the 1-hour, 24-hour and annual NAAQS.

99th percentile 1-hour concentrations

At the point of maximum ground-level impact, the predicted 99th percentile 1-hour SO_2 concentration is 33 µg/m^3 for the boiler stack in isolation. The highest concentrations are predicted about 3.5km to the south-west of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 350 µg/m^3; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted SO_2 concentrations therefore comply with the NAAQS in the ambient environment.

99th percentile 24-hour concentrations

At the point of maximum ground-level impact, the predicted 99th percentile 24-hour SO_2 concentration is 15 µg/m^3 for the boiler stack in isolation. The highest concentrations are predicted about 1.5km to the south-west of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 125 µg/m^3; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted SO_2 concentrations therefore comply with the NAAQS in the ambient environment.

Annual average

At the point of maximum ground-level impact, the highest predicted annual average SO_2 concentration is 1.3 µg/m^3 for the Boiler Stack in isolation. The highest concentrations are predicted about 1.5km to the south-west of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 50 µg/m^3; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted SO_2 concentrations therefore comply with the NAAQS in the ambient environment.

Nitrogen Dioxide (NO_2)

The source of NO_2 from the proposed Mutsho Power Project includes the boiler stack only (i.e. Scenario 1). Predicted NO_2 concentrations are compared with the 1-hour and annual NAAQS. Since not all NO converts to NO_2, this approach is conservative and should be recognised when comparison is made against the NAAQS. In addition, a default NO_2 conversion factor of 0.8 is applied (DEA, 2014).

99th percentile 1-hour concentrations

At the point of maximum ground-level impact, the predicted 99th percentile 1-hour NO_2 concentration is 21 µg/m^3 for the boiler stack in isolation. The highest concentrations are predicted about 3.5km to the south-west of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 200 µg/m^3; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted NO_2 concentrations therefore comply with the NAAQS in the ambient environment.

Annual average

At the point of maximum ground-level impact, the highest predicted annual average NO_2 concentration is 0.8 µg/m³ for the boiler stack in isolation. The highest concentrations are predicted about 4km to the south-west of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 40 µg/m³; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted NO_2 concentrations therefore comply with the NAAQS in the ambient environment.

Carbon Monoxide (CO)

The source of CO from the proposed Mutsho Power Project includes the boiler stack only (i.e. Scenario 1). Predicted CO concentrations are compared with the 1-hour and 8-hour NAAQS.

99th percentile 1-hour concentrations

At the point of maximum ground-level impact, the predicted 99th percentile 1-hour CO concentration is 94 µg/m³ for the boiler stack in isolation. The highest concentrations are predicted about 3.5km to the south-west of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 30 000 µg/m³; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted CO concentrations therefore comply with the NAAQS in the ambient environment.

99th percentile 8-hour concentrations

At the point of maximum ground-level impact, the predicted 99th percentile 8-hour CO concentration is 72 µg/m³ for the boiler stack in isolation. The highest concentrations are predicted about 1.5km to the southwest of the boiler stack. The predicted ambient concentrations are well below the NAAQS of 10 000 µg/m³; and no exceedance of the NAAQS is predicted within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted CO concentrations therefore comply with the NAAQS in the ambient environment.

8.4.1.8 Construction and Decommissioning

Construction work will entail building of new infrastructure and heavy construction work with concrete, steel, piping, etc. Dust emissions during construction result mainly from earth moving activities (scraping, compacting, excavation, grading), movement of construction vehicles and back-fill operations. Dust emissions during decommissioning result from the demolition of structures, earth moving activities (scraping, compacting, excavation, grading), movement of construction vehicles and back-fill operations. All aspects of the construction inherently generate dust, but the movement of construction vehicles on paved and unpaved surfaces at the construction site are generally the largest source of dust. Construction vehicles will be in operation for the duration of the construction and decommissioning. Dust is also easily entrained from exposed areas by the wind.

8.4.2 Quantification of Impacts on Air Quality

8.4.2.1 Construction Phase

The impact of dust associated with construction and decommissioning activities is more of a nuisance related type of impact and does not typically pose a health risk due to its typically coarse size. Nuisance impacts of dust generated during construction and decommissioning are likely to be limited to the project site, and are possible for the duration of construction and decommissioning activities only. Dust generated during construction and decommissioning activities is likely to have a small and temporary effect on environmental functions and processes, possibly through dust accumulation on surfaces. There is some possibility of impacts from dust during construction and decommissioning, but the likelihood is low. Nuisance impacts are regarded as negative but can be reversed once the activity stops.

Nature: The nature of the impact of dust associated with construction and decommissioning activities is of a nuisance nature.		
	Without Mitigation	**With Mitigation**
Extent	Site (1)	Site (1)
Duration	Short (2)	Short (2)
Magnitude	Minor (2)	Small (1)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (10)**	**Low (4)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » On-site dust generation can be mitigated by limiting vehicle access to the site, imposing vehicle speed restrictions and routine wetting of site roads and other exposed areas.		
Residual Impacts: Despite the implementation of dust control measures, some dust will be generated during construction and decommissioning. The residual risk is however low.		

8.4.2.2 Operation Phase

Emissions from operations of the proposed Mutsho Power Project will result in an increase in ambient concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO in the surrounding ambient environment. The relative difference in the location of emission sources in the three layout options is small and will have little effect on the spatial distribution of predicted ambient concentrations of air pollutants. The nature of the impact will be the same for the three site layout alternatives. Predicted dustfall and ambient PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO concentrations are well below the respective national dust regulations and NAAQS in the ambient environment throughout the modelling domain for the Preferred Alternative layout. This will be the same for Alternative A and Alternative B (i.e. there are no predicted exceedances of the NAAQS). The impact will endure for as long as the proposed plant is in operation and is the same for all three alternative layouts. For the Preferred Alternative, predicted dustfall and ambient PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO concentrations are relatively low in the ambient environment and a slight impact on environmental functions and processes is possible. This will be the same for Alternative A and Alternative B.

Predicted dustfall and ambient PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO concentrations are relatively low and impacts are improbable in the ambient environment, i.e. beyond the boundary of the proposed Mutsho Power Project site. There is some possibility but the likelihood is low due to low predicted concentrations and the sparsely populated receiving environment. Air pollution impacts on human health may be negative despite the low predicted dustfall and ambient PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO concentrations in the ambient environment, i.e. beyond the boundary of the proposed Mutsho Power Project site. This applies to all three site layout options. The impacts can be reversed if the emission of air pollutants stops.

Nature:
Increase in ambient concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO in the surrounding ambient environment.

	Without Mitigation	**With Mitigation**[16]
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (16)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

» The Mutsho Power Project proposes to implement Circulating Fluidized Bed (CFB) technology with the ability to achieve lower emission of pollutants. In addition, a Cottrell ESP will be fitted to each boiler to remove particulates from the flue gas. The design efficiency is 99.92%. Each boiler unit is fitted with flue gas desulphurisation to remove SO_2. Collectively these technologies reduce emissions so predicted ambient air pollution concentrations are very low.

Residual Impacts:
Despite the proposed generation and emission abatement technology, there are residual effects, i.e. while emissions are low they are not zero. The predicted ambient air pollution concentrations are very low, and the residual risk is therefore low.

Emissions from the coal stockpile, the ash dump and the site roads during operations of the proposed Mutsho Power Project will result in an increase in ambient concentrations of PM_{10} and $PM_{2.5}$ and dust fallout in the surrounding ambient environment. The relative difference in the location of emission sources across the three layout alternatives is small and will have little effect on the spatial distribution of predicted ambient concentrations of air pollutants. The nature of the impact will be the same for the three site layout alternatives. Exceedance of the dust standard for the residential area category, PM_{10} and $PM_{2.5}$ are predicted over a very small area within the boundary of the proposed Mutsho Power Project site for the Preferred Alternative site layout. This will be the same for Alternative A and Alternative B (i.e. no predicted exceedances of the NAAQS). The impact will endure for as long as the proposed plant is in operation and is the same for all three site layout alternatives. Exceedance of the dust standard for the residential area category, PM_{10} and $PM_{2.5}$ are all predicted over a very small area within the boundary of the proposed Mutsho Power Project site, and a slight impact on environmental functions and processes is possible. This will be the same for site layout Alternative A and Alternative B. The predicted dustfall and ambient PM_{10} and

[16] For power generation, mitigation is affected through the CFB technology and the emission abatement technology, and no other mitigation applies to the boiler emissions

$PM_{2.5}$ concentrations are relatively low and impacts are improbable in the ambient environment, i.e. beyond the boundary of the proposed Mutsho Power Project site. There is some possibility but likelihood is low due to low predicted concentrations and the sparsely populated receiving environment. Air pollution impacts on human health may be negative despite the low predicted dustfall and ambient PM_{10}, $PM_{2.5}$ concentrations in the ambient environment, i.e. beyond the boundary of the proposed Mutsho Power Project site. The impacts can be reversed if the emission of air pollutants stops.

Nature: Increase in ambient concentrations of PM10 and PM2.5 and dust fallout in the surrounding ambient environment.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Small (1)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (16)**	**Low (7)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » The impact of dust generated at the coal stockpile, the ash dump and from site roads can be mitigated by the implementation of dust control technologies and measures, including dust suppression on conveyor transfer points, vegetating of the ash dump and wetting of site roads, amongst others.		
Residual Impacts: Despite implementing dust control measures, emissions will be reduced but will not be zero. The residual risk is therefore low.		

8.4.3 Analysis of Layout Alternatives

According to the dispersion modelling results and air quality impact assessment, emissions from the Mutsho Power Project site operations are expected to result in dustfall and ambient concentrations of air pollutants that are well below the respective national dust standard and NAAQS in the ambient environment. Impacts will not differ between the three layout alternatives considered. Air quality impacts are therefore considered to have a low significance regardless of the site configuration.

8.5 Potential Impacts on Climate Change

8.5.1 Results of Impact Assessment

A coal fired power plant's contribution to global climate change is dependent on the greenhouse gas emissions produced by the plant and its value chain. The value chain extends from the coal mine to the consumer of electricity. However, the greenhouse gas emissions from any individual source cannot be attributed directly or indirectly with any specific environmental impacts as a consequence of climate change. The Climate Change Impact Assessment focused on calculating the greenhouse gas emissions and investigating the consequent climate change impacts of the combustion technologies and mitigation options available to the project developer.

The impact of the project is analysed in terms of global emissions, South Africa's National Greenhouse Gas Inventory, the grid trajectory, and the project alternatives.

Impact of project emissions on South Africa's National Greenhouse Gas Inventory and Climate Change:
The Mutsho Power Project's lifetime greenhouse gas emissions are summarised in **Table 8.1**. The emissions are grouped into direct and indirect sources for both the construction and operational phases of the plant's lifetime.

Table 8.1: Summary of the carbon emissions calculated for the 600MW Mutsho Power Project.

	Construction Annual Emissions	Construction Cumulative Emissions (4 – 5 years)
Direct (scope 1)	6 500 tCO_2e/year	32 700 tCO_2e
Energy indirect (scope 2)	1 300 tCO_2e/year	6 800 tCO_2e
Other indirect (scope 3) – upstream	9 200 tCO_2e/year	46 200 tCO_2e
	Operation Annual Emissions	**Operation Cumulative Emissions (30 years)**
Direct (scope 1)	4 000 000 tCO_2e/year	121 000 000 tCO_2e
Energy indirect (scope 2)	-	-
Other indirect (scope 3) – upstream	15 300 tCO_2e/year	460 000 tCO_2e

Based on the estimated annual MWhs of electricity that the plant will generate and assuming a plant lifetime of 30 years, the Mutsho Power Project is expected to directly emit approximately 121 million tonnes CO_2e into the atmosphere over its lifetime as a result of coal combustion alone. The carbon emissions from the combustion of fuel (coal) dwarf the emissions from all other sources.

Once operational the Mutsho Power Project will be required to report its direct emissions from electricity production to the Department of Environmental Affairs, as per the National Greenhouse Gas Reporting Regulations. The Mutsho Power Project's direct emissions would be classified as IPCC code: 1A1a *Main Activity Electricity and Heat Production*. The emissions calculated as per the Tier 1 methodologies set out in the Technical Guidelines equate to 4 million tCO_2e for electricity production.

The estimated carbon emissions from the combustion of fossil fuels for the proposed coal fired power plant were calculated based on the coal and energy estimates provided. The greenhouse gas emissions can also be quoted as an intensity figure in tonnes of CO_2e per MWh of electricity produced as presented in **Table 8.2**.

Table 8.2: Summary of the direct carbon emissions for the circulating fluidised bed (CFB) technology compared to the pulverised fuel (PF) technology alternative.

Source of Carbon Emissions			
Technology	**Coal Combustion**	**Limestone Desulphurisation**	**Total**
Circulating Fluidised Bed Supercritical	0.864 tCO_2e/MWh	0.004 tCO_2e/MWh	0.868 tCO_2e/MWh
Circulating Fluidised Bed Subcritical	0.960 tCO_2e/MWh	0.005 tCO_2e/MWh	0.965 tCO_2e/MWh

Pulverised Fuel	0.831 tCO_2e/MWh	0.002 tCO_2e/MWh	0.833 tCO_2e/MWh

It is calculated that the Mutsho Power Project will produce 0.87 tonnes CO_2e per net MWh of electricity generated.[17] This equates to the emission of 4 million tonnes CO_2e per year based on the expected annual MWhs of electricity to be generated by the plant. Considering South Africa's most recent Greenhouse Gas National Inventory Report 2000 – 2010 (2014) the power plant's annual emissions would account for 0.8 % of South Africa's national emissions (excluding sinks from forestry and other land use).

South Africa's Intended Nationally Determined Contribution (INDC) submitted in Paris in 2015 sets out a national emissions trajectory up to 2050. South Africa's emissions are expected to peak between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter. Based on this trajectory the project's annual emissions would remain within a range of 0.68% - 1.05% of national emissions over the period between 2025 and 2030. With national emissions forecast to decline after 2035, the plant could account for 0.97% - 1.96% of national emissions if it is still operational in 2050.

In addition to the INDC,

[17] The Mutsho Power Projects efficiency was calculated assuming a heat rate of 9.26 MJ/kWh and a load factor of 88.5%. The project developer supplied the coal calorific value of 23.76 GJ/tonne and a net efficiency of 40%.

Table 8.5 outlines the carbon dioxide emissions constraint considered in the base case of the draft IRP Update from November 2016[18]. In line with Government policy to reduce greenhouse gas emissions, the IRP update applies the moderate decline annual constraints as an instrument to reduce national emissions. This might change in the future in line with the Department of Environmental Affairs' (DEA's) mitigation system and climate change act.

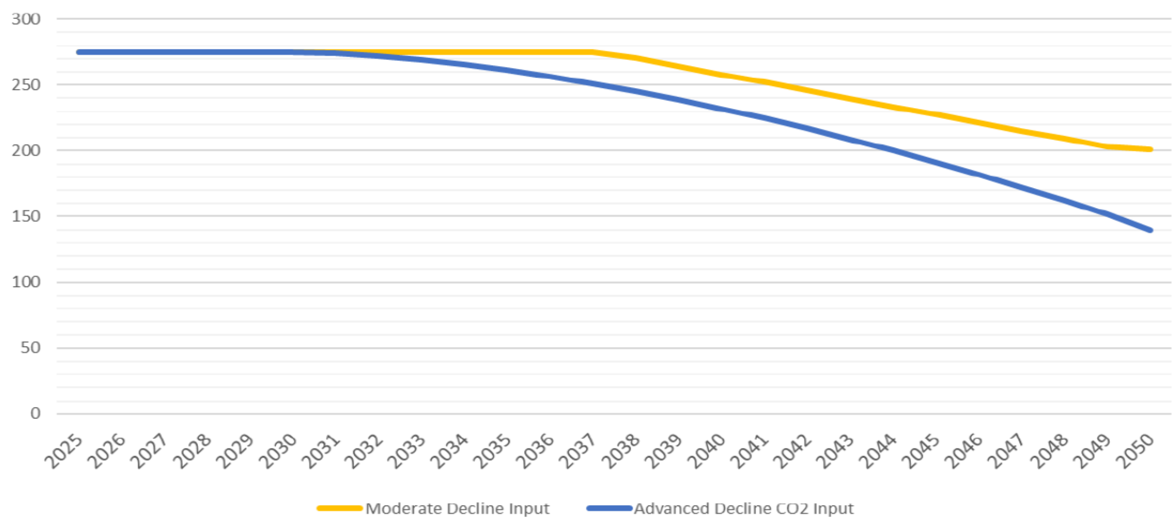

Figure 8.5: The moderate and advanced emissions decline trajectory 2015 – 2050.

Anthropogenic climate change as a global phenomenon is caused by the accumulated greenhouse gas emissions from global emitting sources. The greenhouse gas emissions from the Mutsho Power Project, when considered in isolation, are unlikely to have any specific significant impact on global climate change. The specific greenhouse gas emissions from the power plant cannot be linked directly to any particular climate change effects. Despite this there is a collective responsibility to address the global challenge of climate change and each actor has an individual responsibility to minimise its own negative contribution to the issue. As such the environmental impact of the project can be considered in terms of its contribution to national greenhouse gas emissions.

As a single source the impact of the Mutsho Power Project's greenhouse emissions during operation is considered to be minor in magnitude due to its 0.8% contribution to national emissions. In 2015, South Africa's national emissions (490 million tCO_2e) contributed 1.45 % towards global emissions of 33.83 billion tCO_2e[19].

8.5.2 Quantification of Impacts on Climate Change

8.5.2.1 Construction Phase

Nature:
The Greenhouse gas emissions produced as a result of constructing the proposed coal power plant contribute to the global phenomenon of anthropogenic climate change. Numerous global changes are likely to manifest as a consequence of climate change, although none that can be attributed directly or indirectly to the specific greenhouse gas emissions of any individual source, such as the construction of the Mutsho Power Project. The annual

[18] Department of Energy. 2016a. Integrated Resource Plan Update Assumptions, Base Case Results and Observations [Online]. Available at: http://www.energy.gov.za/IRP/2016/Draft-IRP-2016-Assumptions-Base-Case-and-Observations-Revision1.pdf
[19] https://ourworldindata.org

emissions from the construction of the power plant represent less than 0.01% of global emissions (based on 2015 figures) and 0.01% of South Africa's National Greenhouse Gas Inventory (based on 2010 figures).		
	Without Mitigation	**With Mitigation**
Extent	Global (5)	Global (5)
Duration	Permanent (5)	Permanent (5)
Magnitude	Small (0)	Small (0)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (50)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Mitigating emissions from the construction of this power plant would reduce its contribution to national emissions and climate change. » Mitigation options could include the use of biodiesel in construction vehicles.		
Residual Impacts: The risks associated with climate change will still be prevalent even with efforts to mitigate the project's greenhouse gas emissions during the construction phase. This is due to the vast number of other sources of greenhouse gas emissions around the world.		

8.5.2.2 Operation Phase

It is certain that the combustion of coal will produce greenhouse gas emissions and that the greenhouse gas emissions will contribute to the national inventory and climate change which will negatively affect the world's population. Based upon these criteria, the proposed power plant is likely to have an impact with a medium significance score. The duration that greenhouse gases are assumed to remain in the atmosphere renders the impact effectively irreversible with the impacts of anthropogenic climate change in many cases resulting in the irreversible loss of resources.

The context within which the EIA reporting requirements were developed to describe and assess environmental impacts, have yet to be applied to greenhouse gas emissions that have a global impact. For this reason a materiality threshold was defined. The magnitude of a project is considered high if the emissions are equivalent to 0.1% (34 million tCO2e based on 2015 figures of global emissions) and small if below 0.01% (3.4 million tCO2e based on 2015 figures) of global emissions.

Nature: The Greenhouse gas emissions produced as a result of coal combustion in the power plant contribute to the global phenomenon of anthropogenic climate change. Numerous global environmental changes are likely to manifest as a consequence of climate change, although none that can be attributed directly to the specific greenhouse gas emissions of any individual source, such as the Mutsho Power Project. The annual emissions from the operational phase of the power plant represent 0.012% of global emissions (based on 2015 figures) and 0.76% of South Africa's National Greenhouse Gas Inventory (based on 2010 figures).		
	Without Mitigation	**With Mitigation**
Extent	Global (5)	Global (5)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Small (0)

Probability	Definite (5)	Definite (5)
Significance	**Medium (60)**	**Medium (50)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

» The power plant would need to mitigate its greenhouse gas emissions in order to mitigate its contribution to national emissions and climate change.

» Options for mitigating the power plant's greenhouse gas emissions primarily involve hybridising the power plant by substituting the source of thermal energy away from coal towards more carbon neutral sources.

Residual Impacts:

The risks associated with climate change will still be prevalent even with efforts to mitigate the project's greenhouse gas emissions. This is due to the vast number of other sources of greenhouse gas emissions around the world.

There are options to mitigate the greenhouse gas emissions from the construction and operation phases of the power plant; however these options are not able to alter the impact that the greenhouse emissions will have on climate change in terms of the extent, duration or probability. It is only the magnitude of the greenhouse gas emissions impact that can be reduced by reducing the quantity of emissions.

The mitigation options presented can to some extent reduce the magnitude of the plant's emissions impact in terms of the power plant's contribution to the national greenhouse gas emissions. The plants emissions (magnitude) during operation, with and without mitigation, are both classified as small as per the impact assessment methodology. This methodology was developed to describe and assess environmental impacts, and has yet to be applied to greenhouse gas emissions that have a global impact. Therefore while mitigation projects for the Mutsho Power Project are intended to reduce emissions, the current methodology to assess the magnitude of emissions does not provide granular detail for the project's emissions which are considered as small. Therefore the impact assessment tables above record the same significance score for the project with and without mitigation

There will still be risks associated with climate change even if the emissions from the Mutsho Power Project are mitigated due to the cumulative nature of climate change impacts resulting from the greenhouse gas emissions from all the world's sources. In light of this and the collective responsibility to reduce global greenhouse gas emissions it is also useful to consider the impact of the power plant's greenhouse gas emissions (mitigated and unmitigated) compared against the technology alternative and national baseline.

8.5.3 Analysis of Layout Alternatives

The global and collective nature of climate change also makes it impossible to link the emissions from any one power station to any particular climate change effects. The Mutsho Power Project's environmental impact can therefore be understood as its contribution to the national GHG emissions. As a result of the nature of climate change impacts, the impacts associated with each layout alternative are considered equal and uniform to each other.

8.6 Potential Impacts on Hydrology and Geohydrology

8.6.1 Results of Impact Assessment

8.1.1.1 Aquatic Ecology

Due to the highly dynamic nature of lotic (or flowing) systems, water quality conditions have been known to vary substantially on a temporal scale (e.g. seasonality) and along the longitudinal profile of the watercourse (Dallas and Day, 2004). Despite these variations, the assessment of *in situ* water quality variables is important for the interpretation of results obtained during biological investigations, as aquatic organisms are influenced by the environment in which they live. With the exception of Site DU3, each of the selected sampling sites was observed to be dry at the time of the site survey despite the expected rains throughout the summer months. This was to be attributed to the semi-arid nature of the study area and further amplified by the drought experienced across much of the country during the previous two years. Consequently, only selected in situ parameters could be measured at the time of the survey.

Based on the *in situ* water quality variables recorded, each of the respective variables were deemed to be within expected ranges and as a result, these conditions were not expected to deter the colonisation and / or inhabitation of these watercourses by indigenous aquatic biota. However, in light of the low water levels within the impoundment at the time of the survey, it was suspected that the conditions observed were largely as a result of an improved 'dilution capacity,' which was attributed to the recent rainfall received approximately three days prior to the site survey (i.e. 14mm recorded within the catchment area).

It should also be noted that some water had also recently accumulated within the larger impoundment further upstream (i.e. directly upstream of Site DU4). However, this site was not assessed at the time of the survey, as it was suspected that the conditions would be largely comparable to Site DU3, as well as its location outside of the proposed development area and its lentic (or standing) nature.

Aquatic and Riparian Habitat:
Assessment of aquatic habitat within the study area was based largely on the application of recognised assessment indices at each of the selected sampling points, as well as associated reach) within the assessed watercourses, namely the Index for Habitat Integrity (or IHI) and the Invertebrate Habitat Assessment System (or IHAS). While the IHI is a rapid, field-based, visual assessment of modifications to a number of pre-selected biophysical drivers (i.e. semi-quantitative) used to determine the Present Ecological State (PES, or Ecological Category) of associated instream and riparian habitats, the use of the IHAS presents an indication of the representativeness of "ideal" habitat availability for supporting diverse aquatic macroinvertebrates at each of the assessed sites.

Index for Habitat Integrity
In light of the predominant presence of highly dynamic, ill-defined, temporary (or ephemeral) drainage lines through the proposed development area and small-to-moderate earthen impoundments, these systems were not deemed to be suitable for the application of the IHI at the time of the current survey. Nonetheless, a low confidence assessment was undertaken along the associated portion of the mainstem Sand River, as access to the river was very limited by extensive fence lines within the study area and difficulty in contacting the relevant stakeholders at the time of the survey.

For the purposes of the study, the habitat assessment unit was referred to as the portion of the mainstem Sand River between the town of Waterpoort and the downstream site SR2. The perceived ecological condition of the instream and riparian habitat is described in **Table 8.3**.

Table 8.3: Index for Habitat Integrity (IHI) values obtained for associated reach.

Reach	Component	IHI (%)	Ecological Category	Major Impacts
Sand River	Instream Habitat	Site Dry		» Water abstraction was flagged as a *large* impact due to weirs and/or irrigation schemes (i.e. pivot arms) in close proximity to the river. » *Moderate* overgrazing and/or trampling by livestock and wild game within isolated areas was believed to facilitate erosive processes within these soils.
	Riparian Habitat	73.1	C	

Typical habitat of the Sand River within the A71K-00031 SQR was confirmed to be dominated by sandy substrates within a wide seasonal channel (mostly alluvial) with anastomosing sections, pools and shallow areas. While the instream habitat conditions along the main-stem Sand River was not determined due to its dry state at the time of the survey, the riparian component was determined to represent moderately modified conditions. Only the water abstraction metric was tentatively scored at a largely modified component due to the notable concentration of agricultural croplands within the upper reaches of the associated portion of the watercourse, which was only expected to amplify the highly dynamic nature of this alluvial system. Also, the presence of livestock and wild game was believed to have facilitated the erosive processes along the banks of the river due to overgrazing and trampling during periods of flow, as these animals are expected to use the river as a watering point wherever possible.

Invertebrate Habitat Assessment System

The Invertebrate Habitat Assessment System (IHAS, Version 2.2), developed by McMillan (1998), has routinely been used in conjunction with the SASS approach as a measure of variability in the quantity and quality of representative aquatic macroinvertebrate biotopes available during sampling. However, according to a study conducted within the Mpumalanga and Western Cape regions, the IHAS method does not produce reliable scores at assessed sampling sites, as its performance appears to vary between geomorphologic zones and biotope groups (Ollis et al., 2006). While no final conclusion can be made regarding the accuracy of the index until further testing has been conducted, these potential limitations and / or shortfalls should be noted.

Unfortunately, the IHAS could not be applied at the time of the survey, as it is restricted for application within flowing systems and therefore, it was not deemed to be appropriate at Site DU3, which was classified as a lentic (or standing) system.

In light of the semi-arid nature of the associated catchment area, as well as the limited surrounding basal vegetation cover, any rainfall received within the study area was expected to quickly drain the surrounding area and rapidly re-inundate (or 'flush') the adjoining drainage lines and / or tributaries of the Sand River. However, given the alluvial nature of these systems, the smaller systems would quickly infiltrate into the water table below the surface of these systems. These highly dynamic conditions were likely to limit the continued establishment of sensitive aquatic biota within the study area. Consequently, it can be concluded that the representativeness of the biological composition along these systems would be directly related to the inundation period and the re-colonisation strategy of established taxa, which in principle is believed to take approximately 4 – 6 weeks within permanent systems (Rossouw et al., 2005).

Aquatic Macroinvertebrates

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

Non-perennial rivers are ecosystems that place extreme stress on the organisms inhabiting them by exhibiting highly variable physical and chemical attributes, of which the most obvious is the unpredictable and highly variable flow patterns of the watercourses themselves (Rossouw et al., 2005). Consequently, only biota with specific coping mechanisms and / or a wide tolerance of water quality impairment can survive in these systems, particularly when critical phases of their lifecycles occur at a time when spates and droughts are probable. The ability to rapidly recolonise a dry system once re-inundation has occurred is one such mechanism that many macroinvertebrate taxa have developed to help to ensure survival. These specialised strategies vary widely between families, but the three main sources of re-colonisation originate from previously laid resting eggs, invertebrate forms capable of aestivation, and eggs laid by flying adults immediately after re-inundation (Harrison, 1966). However, in systems with constructed dams or weirs, sections of this system remain inundated for extended periods (i.e. Site DU3) and as a result, these systems often serve as refugia for previously established aquatic biota during the dry season and facilitate a more efficient re-colonisation process.

Studies on the re-colonisation of non-perennial watercourses by aquatic macroinvertebrates families are few, but it appears that *Chironomidae* (Midges), *Oligochaeta* (Earthworms) and *Simulidae* (Black Flies; only in true-running streams) are some of the early colonizers (Rossouw *et al.*, 2005). This was supported by observation in a study by Harrison (1966), as other early-colonisers (i.e. within the first ten days) were also noted to be oligochaetes, small crustaceans and small insect larvae. However, it should be noted that species typical of permanent streams only returned within one month of re-inundation in lentic (or standing) pools and within 4 – 6 weeks in lotic (or flowing) streams (Rossouw *et al.*, 2005).

Benthic Community

Of the 34 different macroinvertebrate taxa highly likely to occur within the study area (Department of Water and Sanitation, 2014), only a total of seven families were collected at Site DU3, which were further noted to be dominated by six air-breathing taxa (shown in **Bold** in **Table 8.4**). This was largely typical of lentic (or standing) systems, which was a direct result of a lack of hydraulic diversity and varied surface substrates for colonisation (e.g. cobbles, bedrock, etc.).

Table 8.4: Expected aquatic macroinvertebrate taxa in the Sand River.

Family Names		
Turbellaria	**Corixidae**	**Hydrophilidae**
Oligochaeta	Gerridae	Ceratopogonidae

Hirudinea	Hydrometridae	Chironomidae
Potamonautidae	Naucoridae	Culicidae
Atyidae	Nepidae	Muscidae
Baetidae	**Notonectidae**	Tabanidae
Caenidae	Pleidae	Tipulidae
Ceonagrionidae	Veliidae	Ancylidae
Aeshnidae	Hydropsychidae	Lymnaeidae
Gomphidae	Leptoceridae	**Physidae**
Libellulidae	**Dytiscidae**	
Belostomatidae	**Gyrinidae**	

In addition to these tolerant, air-breathing, early-colonising macroinvertebrates families observed at the time of the survey, various branchiopod crustacean families were also observed to be present at the time of the survey. These organisms have developed life strategies and unique adaptations that allow them to cope with harsh environments (i.e. regular desiccation) and as a result, their opportunistic life cycle allows them to use the short inundation periods to their maximum benefit, as these groups hatch, grow to sexual maturity and reproduce within an extremely short period of time (Ferreira et al., 2011). Consequently, it was an opportune occasion to collect and observe these groups, of which included large numbers of Anostraca (Fairy Shrimps) and Conchostraca (Clam Shrimps) and as a result, a greater level of biodiversity was shown to be supported within the egg banks contained within the sediment of the assessed impoundment.

Present Ecological State (PES)

Due to the dry conditions observed at the time of the survey and the inappropriate application of SASS within the assessed impoundment, no Present Ecological State (PES) could be determined, as the MIRAI is exclusively for application within flowing systems.

Ichthyofauna

18 different macroinvertebrate taxa are expected to occur within the study area (Department of Water and Sanitation, 2014). However, no fish were collected at the time of the field survey (refer to

Table 8.5).

Table 8.5: Expected fish species in the Sand River.

Fish Species	Common Name	Conservation Status (Darwall et al., 2009)
Enteromius mattozi	Papermouth	Least Concern
Enteromius paludinosus	Straightfin Barb	Least Concern
Enteromius toppini	East Coast Barb	Least Concern
Enteromius trimaculatus	Threespot barb	Least Concern
Enteromius unitaeniatus	Longbeard Barb	Least Concern
Enteromius viviparus	Bowstripe Barb	Least Concern
Clarias gariepinus	African Catfish	Least Concern
Chiloglanis paratus	Sawfin Suckermouth	Least Concern
Labeo cylindricus	Redeye Labeo	Least Concern
Labeo molybdinus	Leaden Labeo	Least Concern
Labeo rosae	Rednose Labeo	Least Concern
Labeo ruddi	Silver Labeo	Least Concern
Labeobarbus marequensis	Lowveld largescale Yellowfish	Least Concern
Micralestes acutidens	Sharptooth Tetra	Least Concern
Mesobola brevianalis	River Sardine	Least Concern
Oreochromis mossambicus	Mozambique Tilapia	Near Threatened
Pseudocrenilabrus philander	Southern Mouthbrooder	N/A
Schilbe intermedius	Butter Catfish	Least Concern

While it is envisaged the a notable number of the aforementioned fish species will be present during periods of elevated flows and sufficient habitat cover, it is suspected that all remaining fish species present within the system have most likely migrated further downstream (where possible) to find refuge within isolated pools and/or inundated impoundments, or alternatively have died due to a lack of available habitat. Following cursory discussions with the residents within the area, this was supported by the fact that the only other rainfall received within the area within the past 6 – 9 months occurred in November 2017 (approx. 82 mm within the catchment area).

<u>*Present Ecological State*</u>
In light of the dry conditions of the associated watercourses, the application of the FRAI was not deemed to be necessary and as such, no Present Ecological State could be determined.

<u>*Integrated EcoStatus Determination*</u>
The EcoStatus is defined as: *The totality of the features and characteristics of the river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services*" (Iversen et al., 2000). In essence, the EcoStatus represents an integrated ecological state representing the drivers (hydrology, geomorphology, physico-chemical) and responses (fish, aquatic invertebrates and riparian vegetation; Kleynhans & Louw, 2008).

Since no PES was determined for each of the biological components at the time of the survey, no Instream Biological Integrity could be determined within the EcoStatus Model and no integrated EcoStatus could be determined. Nonetheless, it should be noted that the conditions observed at the time of the survey were deemed to be normal for the region and as such, the biological communities are expected to quickly re-inhabit the associated watercourses following the establishment of favourable conditions.

For the purpose of determining a PES at the time of the survey, the only available desktop data indicates that the mainstem Sand River is representative of a moderately modified condition (i.e. Ecological Category C). This was largely attributed to the small to large impacts originating from surrounding land-use activities, including the most notable agricultural activities (i.e. crop cultivation and livestock watering).

Ecological Importance and Ecological Sensitivity

Essentially, the ecological importance of a particular riverine reach is assessed to obtain an indication of its representativeness (or rarity) of any inherent biophysical attributes (e.g. unique systems, rare species, etc.) in relation to a larger framework, while an assessment of the corresponding ecological sensitivity provides an indication of the vulnerability of a system to environmental modification (e.g. flow, physico-chemical and geomorphic modifications) within the context of the Present Ecological State (PES, or Ecological Category). In terms of a regional scale, this would relate to the ability of the sub-quaternary reach to endure, resist and recover from various forms of anthropogenic utilisation (Department of Water and Sanitation, 2014).

Although conducted at a desktop level, the assessment of ecological importance and sensitivity by Department of Water and Sanitation (2014) for the associated reach of the Sand River (Sub-Quaternary Reach A71K-00031) provided a catchment level perspective and context for professional judgement (or expert opinion). Only limited site-based information collected during the present study (i.e. riparian condition) was used to supplement the desktop approach to provide a more accurate depiction of the specified watercourse under study (refer to **Table 8.6**).

Table 8.6: Ecological Importance and Sensitivity for the Sand River and adjoining tributaries.

Site	Ecological Importance	Ecological Sensitivity
Sand River	**High** » *Oreochromis mossambicus* (listed as Near Threatened) exhibited a moderate -to-high likelihood of occurrence during periods of improved flow. » Representivity and rarity within the secondary catchment was defined to be *moderate-to-high* for each of the expected biota. » Sub-quaternary catchment was identified as *Freshwater Ecosystem Priority Area* and classified as a provincially determined *Ecological Support Area 1* and/or *Critical Biodiversity Area 2*.	**Moderate-to-High** » A number of *highly* sensitive flow-dependent species were expected to occur within the associated reach during periods of elevated flows. » A number of species that were regarded as *moderate-to-highly* sensitive to water quality impairment were expected to occur during periods of elevated flows. » Riparian vegetation are well adapted to the fluctuating water levels within the river, which implied that riparian component is regarded to exhibit a *low* sensitivity.

Consequently, the Ecological Importance was defined to be high and the Ecological Sensitivity determined to be moderate-to-high during periods of elevated flow. This emphasises the biodiversity values of the associated watercourses within the study area, especially during periods outside of drought conditions.

8.1.1.2 Wetlands

Background information available from national and provincial databases indicates that the wetland and other freshwater features of the local area are relatively sensitive and ecologically important. The wetlands and freshwater features within the project area consist mostly of ephemeral drainage lines that cannot be defined as wetland or riparian resources. Fewer larger linear features that convey sufficient water to be defined as true watercourses with an associated riparian zone are located to the north of the proposed project area. Two pans and a number of earth dams were also identified within the project area. These fresh water features cover an approximate 147.5 ha.

Zones of Regulation of 32m around each wetland have been assigned according to NEMA (Act No. 107 of 1998).

HGM Unit 1 (Pan):
This pan is situated on the north-western border of the Farm Du Toit 563. The pan covers an area of 0.68ha and is characterised by a large expanse of bare patches of sandy soil. *Panicum maximum* colonises the edges with trees such as *Colophospermum mopane* and *Combretum imberbe* (protected) on the edges. Various drainage lines supply the pan with water and sandy alluvial deposits can be seen where the drainage lines enter the pan. Very few impacts were identified at this pan, and overgrazing by herbivores was not observed. Additionally, no alien and invasive plants (AIPs) were noted.

HGM Unit 2 (Pan):
This wetland is situated on the north-western border of the Farm Du Toit 563, to the east of HGM Unit 1. The pan covers an area of 0.41ha and is also characterised by an expanse of bare patches of sandy soil. *Panicum maximum* colonises the edges with trees such as *Acacia erubescens*, *Combretum imberbe* (protected) and *Colophospermum mopane*.

Ephemeral drainage Lines:
The ephemeral drainage lines (146.41 ha) are characterised by sandy beds and thicker and taller vegetation on the edges than in the surrounds with *Colophospermum mopane* being the dominant species. Impacts to these drainage lines include:

- Preferential flowpaths have been created where vegetation has been cleared for roads.
- Some erosion and fragmentation is observable due to the creation of roads across and along the drainage lines.
- The damming of the drainage lines for water storage purposes has impacted on the wetland integrity of the site (many earthen dams were observed).

Present Ecological State (PES):
Table 8.7 indicates the PES scores for the various HGM Units observed. The wetlands within the project area exhibit Category B (*Largely Natural*) and Category C (*Moderately Modified*) PES values. The pans have not been impacted on to a great extent aside from grazing which alters the vegetation structure and composition. The geomorphological and Hydrological health has been altered minimally. The pans therefore both exhibit Category B values.

The ephemeral drainage lines are considered to be Category C. They are mostly impacted on hydrologically due to the presence of earthen dams, which restrict the flow of water downstream. The geomorphological score was not impacted on greatly as the only impact was sediment deposition in the dams. Vegetation scores were not altered to a great extent.

Table 8.7: Present Ecological Health Scores.

HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score	PES Score
1	0	0.2	4	1.2	B
2	0	0	6.5	1.9	B
*3	6.5	0.2	3.3	3.8	C

*Method is not intended for drainage lines, however it was applied as an indicator of functionality.

Ecological Importance and Sensitivity:

Table 8.8 indicates the EIS scores for the various HGM Units with the final EIS scores ranging from Very High (3.7) to High (2.5). Hydrological / Functional Importance' values were low as the pans don't perform well for streamflow regulation, erosion control, sediment trapping or phosphate assimilation. The drainage lines also have limited hydrological function in terms of true wetland systems. However, in terms of catchment yield and surface water recharge to the systems further downstream, as well is in the maintenance of healthy stormwater regulation, these systems are considered invaluable.

'Ecological Importance & Sensitivity' for the HGM unit 2 and 3 is *Very High* as various protected species are present within them or in close proximity.

'Direct Human Benefits' were not high in general. These features are not used culturally or recreationally. The HGM units are utilised for grazing and for watering of cattle and game. The score is higher for the drainage lines as some are dammed and the water is utilised by the farm owners.

Table 8.8: EIS Scores.

HGM Unit	Ecological Importance & Sensitivity	Hydrological/Functional Importance	Direct Human Benefits	Final EIS Score	Final EIS Category
1	2.3	0.5	1	2.3	B
2	3.3	0.6	1	3.3	A
3*	3.7	0.4	1.3	3.7	A

*Method is not intended for drainage lines, however it was applied as an indicator of functionality.

EcoServices:

The EcoServices scores for the various HGM Units range from 1.3 to 1.6 (Intermediate). The HGM units provide similar EcoServices. Biodiversity maintenance through the harbouring of protected species, the provision of water sources, and the provision of grazing land are important EcoServices. The drainage lines provide surface water recharge and trap sediment. The farms are not accessible for tourism, educational and cultural purposes and as such are not used for these purposes. Historical hunting activities were evident, however, through communication with ground staff, this is no longer common. Due to the nature of the systems, flood attenuation and streamflow regulation is low.

8.1.1.3 Surface Water

The predominant present land use in the wider area is agriculture with potential for mining, whilst the main use of surface water in the area is agricultural (irrigation) and possibly limited abstraction for mining activity. The water requirements within the Sand catchment are large compared to the rest of the WMA, with irrigation comprising the largest water user. The majority of the irrigation sector's water requirements are met by the extraction of groundwater reserves via boreholes in the Sand / Limpopo Rivers which have been over-exploited. Although the urban requirements are high, a large portion of water is supplied through transfers from other WMAs (Savannah Environmental, March 2017).

According to the Water Resource Situation Assessment (DWA, 2002), the upper and central Sand River receive "large quantities" of industrial and domestic effluent from large towns and high density rural towns along its banks. The mineralogical water quality of the whole of the catchment was thus classified as "marginal". In contrast to this assessment, the ISP study (DWA, 2004) states that apart from problems with groundwater quality in the Vivo and Dendron areas there are no major water quality problems in the Sand River Key Area (the Key area includes the Sand River Basin and other smaller rivers draining to the Limpopo River).

A Baseline Study of the water chemistry of the Limpopo Basin (Univ. of Zimbabwe, 2009) found that in the Vhembe District, which includes the Sand River, nitrate levels increased with groundwater flow towards the Sand River and high levels of nitrate were recorded in both the river and alluvial groundwater during the raining season. It was suggested that the nitrate is from dry land cropping, overgrazed pastures and, in some areas, pit latrines. High fluoride was noted in the area north of the Soutpansberg and has been attributed to high evaporation.

From the historical monitoring along the Sand River, elevated levels of pH, Electrical Conductivity (EC), chloride, magnesium and sodium were observed. This could be attributed to the upstream irrigation activities. The same elevated levels were observed after the extreme flood of 2000 and also in the following year and this could have resulted in higher wash-off from contaminated and / or agricultural areas.

A site assessment was conducted to verify the hydrological characteristics of the area together with the collection of surface water samples to determine the baseline water quality on the surrounding area prior to the commencement of the project. Water samples were collected from site and their physical and chemical parameters analysed. The predominant water use around the project area is for agriculture (irrigation) and livestock watering. For this reason, the results were benchmarked against the South African Water Quality Guidelines for Agricultural Use: Irrigation and Livestock (DWAF, 1996) which describes the "fitness for use" of a water resource. The fitness for use of water defines how suitable the quality of water is for its intended use.

The surface water quality results are presented in

Table 8.9.

Table 8.9: Water Quality Results benchmarked against the South African Water Quality Guidelines.

Sample ID		pH	EC (mS/m)	Cl (mg/l)	SO_4 (mg/l)	NO_3 (mg/l)	NH_4 (mg/l)	Mn (mg/l)	F (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Pb (mg/l)	Fe (mg/l)	Al (mg/l)	As (mg/l)
SWQG: Agriculture Use: livestock Watering (Target Water Qaulity Range)				6000	1000	100		10	2	1000	500	2000	0.1	10	5	1
SWQG: Agriculture Use: Irrigation (Target Water Qaulity Range)		<6.5 - >8.4	40	100	N/A	N/A	N/A	0.02	2	N/A	N/A	70	0.2	5	5	0.1
SW1-Dam 4	18/01/2018	8.6	23.0	3.0	13.7	0.21	0.04	0.02	<0.263	44.1	7.0	2.8	0.014	<0.004	0.014	<0.006

The water quality results from a sampled point can be summarised as follows:

» An elevated level of pH (8.6) that exceeds the South African Water Quality Guidelines for Agricultural Use (Irrigation) was observed. No specific target water quality range has been set for livestock watering.
» All the other parameters were within both the SAWQG Irrigation and livestock standards.

Hydrological Sensitivity

A preliminary or desktop sensitivity analysis on the project site indicates that there are few well-defined drainage lines and several runoff pathways or washes. Washes can be defined as those areas which show visible signs of occasional water movement and sediment transport, but which do not receive sufficient run-off to develop characteristic soils or vegetation associated with wetlands or drainage lines. These are a characteristic feature of arid and semi-arid environments and are related to the occurrence of occasional intense rainfall events within areas of low total rainfall.

A defined drainage line on the north-western part of the Farm Du Toit 563 comprises a significant floodplain in which an artificial impoundment has also been constructed. This drainage line flows northwards towards the Sand River, and exhibits typical vegetation attributes. The presence and ecological contribution of these attributes increases the habitat diversity of the farms and, ultimately, the perceived sensitivity (Savannah Environmental, March 2017).

A portion of the Farm Vrienden 589 is mainly comprised of washes. The identified drainage line in the study area has been classified as highly sensitive whilst all the washes are considered moderate or less sensitive. All the identified washes, drainage lines, and the main Sand River, were found to be dry during the site assessment.

The flow in the lower Sand River, its tributaries and minor streams or washes is highly ephemeral. Run-off occurs after rainfall events, with flow in the main stem of longer duration after major, wide-spread rainfall within the catchment.

8.1.1.4 Geohydrology

Regional Hydrogeology

Regional groundwater flow is oriented north-west towards the Sand River. Flow volumes are extremely low due to the low permeability and low recharge, especially in the northern half of the catchment underlain by the Limpopo Mobile Belt and overlain by alluvium. In the south, where the catchment is underlain by Karoo and Soutpansberg rocks, a local northward hydraulic gradient is present due to high recharge in the Soutpansberg Mountains with the groundwater following the topography down towards the Limpopo River in the north.

A significant cone of depression exists around the Sand River directly north of the Soutpansberg Mountains due to large scale irrigation from groundwater.

Under natural conditions, groundwater drains via localised springs, as baseflow to the perennial tributaries flowing from the Soutpansberg, and by evapotranspiration by riverine vegetation along the main river channels.

Groundwater is of good quality in the Soutpansberg rocks, which is the main recharge zone; however, increased salinity occurs northwards as groundwater flows through saline Karoo sediments, accumulating salts which mostly characterises the water facies as Na / Cl / Mg-Bicarbonate water. Low recharge rates in the drier terrain north of the Soutpansberg also results in low recharge rates to dilute these salts. The movement of groundwater passing through saline deposits of the Karoo rocks, and subsequent evapotranspiration by riverine vegetation, causes a rapid salt accumulation northward, with a peak salt load along the fringes of the channels lying over Karoo rocks, like the Mutamba, the Brak and Sand Rivers, resulting in poor natural water quality.

Groundwater is abstracted for irrigation on the farms Windhoek, Grootgeluk and Overwinning along the Kandanama, and irrigation boreholes along the Sand River on Sterkstroom, Sitapo, Sutherland, and Waterpoort; or utilised by riparian vegetation. Very little surface runoff is believed to recharge the regional aquifers north of the Soutpansberg, since high salinity levels in the Karoo aquifers suggest it is not recharged by fresh water from the river. In comparison, groundwater is of good quality in the Karoo aquifer along the southern tributaries such as the Kandanama River, where river losses take place.

Groundwater Quality and Characterisation

To acquire site specific groundwater conditions and to develop a conceptual model of the project area; a hydrocensus was conducted. During the hydrocensus a total of 6 boreholes were identified. Water levels were measured and water samples collected from 5 of those boreholes; the outstanding borehole was dry (DUTBH4). All boreholes were equipped and operational with the exception of DUTBH4.

The groundwater quality results from the samples have been compared to the South African Water Quality Guidelines (SAWQG) (1996) for livestock and domestic use. All boreholes exceed the SAWQG for domestic use. Evaluations indicate the following:

- VRIBH1 has fluoride concentrations of 1.55 mg/L, which exceed standards for domestic use (1.5 mg/L). The consumption of water with elevated fluoride concentrations may cause discolouration of dental enamel and mottling, and gives rise to the possibility of the development of skeletal fluorosis. High fluoride concentrations are likely due to the local geology; the local geology is associated with the LMB gneisses which are made up of some volcanics and volcanic rocks are often enriched with fluoride.
- VRIBH2, DUTBH1, DUTBH2 and DUTBH3 have sulphate concentration of 280, 275, 463 and 319 mg/L, which exceed standards for domestic use (200 mg/L). The consumption of water with elevated sulphate concentrations may cause diarrhoea. The elevated concentrations of sulphate can be attributed to mining related impacts.
- VRIBH1, VRIBH2, DUTBH1 and DUTBH2 have magnesium concentrations of 98.8, 313, 109 and 125 mg/L respectively, which exceed standards for domestic use (70 mg/L). The consumption of water with elevated magnesium concentrations may cause diarrhoea. The elevated concentrations of magnesium can be attributed to the presence of igneous.

The current water quality conditions at the project area are not pristine; this is consistent with the description of the regional hydrogeology. The region is expected to have poor water quality naturally because groundwater passes through saline deposits of the Karoo rocks. Salt accumulation is intensified by high evaporation and evapotranspiration by riverine vegetation, which is evident from the elevated chloride found in the groundwater. Additionally excessive sulphate is indicative of mining related impacts to the local groundwater quality.

Groundwater characterisation was conducted according to the Piper Diagram and the groundwater quality at VRIBH1 and DUTBH3 are identified to be calcium-magnesium-bicarbonate type which is typically found at freshly recharged aquifers. VRIBH2, DUTBH1 and DUTBH2 are characteristic of calcium / sodium sulphate waters which are associated with mining activities, mining activities are present within 25km of the project area and are likely to be the source of impact observed from the groundwater chemistry at the project area.

Aquifer Classification

The aquifers of South Africa are defined according to their water supply potential, water quality and local importance for strategic purposes within an aquifer classification scheme and map. The aquifer classification map (DWA, 2012) identifies aquifers in the project area as minor aquifer systems which are moderately-yielding with variable water quality. Aquifer vulnerability is defined as the tendency or likelihood for contamination to reach a specified position in the aquifer system after introduction at some location above the uppermost aquifer. The aquifer vulnerability map (DWA, 2013) identifies the local aquifers as possessing the least vulnerability.

Local Aquifers

The groundwater systems at the project area are defined by the local geology. The Karoo sediments were deposited onto basement granite gneisses. The lowermost sediments of the Karoo include Dykwa tillites, superimposed by the Ecca Group. The Ecca Group sediments comprises of sandstones and shales. It is observed that there is a distribution of igneous and sedimentary rocks.

Weathering occurs within the shallow aquifer, extending approximately 38m. Below that, relatively consolidated material is expected to be fractured. The shallow aquifer is of interest, as no underground activities will be taking place, whatever impact occurs will be mostly to the shallow aquifer and the nature of water to migrate horizontally under natural conditions will retain any impact to the shallow aquifer. Additionally no drilling and aquifer testing was conducted at the project area therefore the description is kept as simple as possible.

The Weathered Aquifer

This aquifer is recharged by rainfall; at a recharge percentage in the order of 1% to 3% of the annual rainfall (Hodgson and Krantz, 1998). It should, however, be emphasised that in a weathered system, such as the Ecca sediments, highly variable recharge values can be found from one area to the next. This is attributed to the composition of the weathered sediments, which range from coarse-grained sand to fine clay. The sandstone contained in Ecca formation is generally of very low permeability and therefore contains low-yielding aquifers (Botha et al., 1998).

Dwyka Group

The formation consists predominantly of diamictite in a matrix of clay and silt, and to a lesser extent there are shale, sandstone, and conglomerate. Diamictite and shale are of very low hydraulic conductivity, ranging between 0.075 and 0.0075 m/d. The few sandstone bodies are of minimal extent and are bounded by diamictite. The water quality of the few aquifers present is saline due to the depositional environment which was on beaches or areas of high significant fracturing (Botha et al., 1998).

Water Level and Flow Direction

The groundwater levels at the project area were acquired from the hydrocensus. The groundwater hydraulic heads ranged between 23.25 and 35.68 mbgl, showing a strong correlation (97% according Pearson correlation coefficient) to the surface topography. All boreholes identified on site were operational. The local groundwater flow direction may be influenced by the gradient created by abstraction; however observing the correlation between the topography and water levels it can be assumed that the natural groundwater flow patterns follow a similar trend to the topography. The groundwater flow direction is towards the north-west.

Potential Contaminant sources

The main potential impact to the groundwater environment identified at the power station site is groundwater contamination from the ash dump. Typical ash water chemistries within ash disposal sites include:

- A drop in pH (from > 12 to approximately 8) and precipitation of calcium carbonate, in the presence of air.
- Generally high base potential.
- High leachability of heavy metals under acid conditions.

As rainwater infiltrates through the disposed ash, leachate is formed. The leachate then seeps to the groundwater and migrates by advection in the groundwater environment in the form of a contamination plume. With regards to the chemical behaviour of ash being of high leachability under acid conditions; impact to the groundwater may be negligible if the ash dump is compacted and lined. Additionally, seepage rates at ash dumps reduce over time naturally.

Potential Receptors

Potential receptors are all the entities that are part of the system that may be impacted negatively if the groundwater quality is depleted as a result of the proposed power plant and associated infrastructure. The potential receptors are identified as humans aand livestock (consuming groundwater from private boreholes), surface water bodies that are fed by groundwater (baseflow) and natural ecosystems that depend on the groundwater (baseflow) and natural ecosystems that depend on the groundwater. High priority potential receptors are those located downstream of the potential contamination source, namely; VRIBH1, DUTBH, DUTBH2, DUTBH3 and non- perennial streams. This is due to the nature of the contamination plume to migrate by advection as opposed to dispersion.

The non-perennial streams at the project are expected to be losing streams due to the water levels at the project area ranging between the depths of 23.25 (DUTBH1) and 35.68 mbgl (DUTBH3). Losing streams are streams that lose water to the groundwater, basically a portion of their flow infiltrates into the subsurface, as opposed to gaining streams which are fed water by groundwater through base flow.

Analytical Model
An analytical groundwater model was used to predict the potential impact of the proposed ash dump associated with the preferred option from a groundwater perspective.

The analytical model is based on Darcy's Law which is:

q	=	Ki	(1)
K	=	T/b	(2)
i	=	dh/dl	(3)

Where:

q	=	seepage rate, also referred to as the outflow rate (m/d).
K	=	hydraulic conductivity (m/d), (assumed to be 0.01 m/d from literature review).
T	=	aquifer transmissivity (m^2/d).
i	=	hydraulic gradient.
b	=	aquifer thickness (m).
dh	=	change in head (the change in head between VRIBH1 and DUTBH3 is 34.5m).
dl	=	change in length (distance between VRIBH1 and DUTBH3 is 34.81m).

Leachate is expected to seep from the ash dump, migrate through the unsaturated zone. When it reaches the aquifer (saturated zone) it then migrates horizontally. This assumes that no liner is installed.

Seepage into the Groundwater Environment
The Karoo sediments occur predominantly throughout the project area and are weathered. An average hydraulic conductivity of 0.01 m/d has been assumed; taking into consideration that the aquifer is expected to be of low permeability and based on the expected hydraulic conductivity of unconsolidated sedimentary according to Thomas (2013). The applied hydraulic conductivity is solely based on estimation (taking into consideration literature review of the available background information of the region). Aquifer tests are recommended in order to understand the local aquifer(s). Aquifer tests are conducted by stressing the aquifer and observing aquifer responses, the test results serve to quantify hydraulic parameters. For model update; aquifer hydraulic parameters at the project area need to be investigated in order to acquire site specific aquifer properties which will serve as input to improve modelling predictions.

The water level of the closest borehole to the ash dump (300m) has been assumed to be the water level at the ash dump area, therefore the watertable is expected to be at 26 mgbl (VRIBH1).

The hydraulic gradient from the ash dump is assumed to be one since the flow will mainly be vertical. Therefore the magnitude of the seepage rate would be equal to the hydraulic conductivity (q = 0.01 m/d x 1) =0.01 m/d.

The equation of time, distance and speed (time = distance/speed) becomes relevant with regards to estimating the time it will take seepage to reach the watertable. Based on the assumptions mentioned above seepage is expected to reach the watertable after approximately 7 years of operation. An additional assumption of the study is that the estimated hydraulic conductivity is consistent throughout the project area as a homogeneous aquifer is assumed within the project area. Therefore, seepage rate is expected to be the same from both the ash dump area and the coal stockpile, with the exception of area where the fault is located. Structures such as faults and fractures potentially act as preferential pathways and are expected to have high hydraulic conductivity, site specific investigations are required to acquire hydraulic properties of such structure as they vary vastly from site to site.

Based on the current lack of geochemical data it is recommended that a liner is installed prior to ash placement unless tests are done on the ash resulting in a relaxation of the liner requirements. From experience, typical ash material requires a Class C liner as defined in Regulation 634 of August 2013, however this is subject to change based on the outcomes of the recommended geochemical studies that should be done before any ash placement / dumping takes place on surface. It is stipulated that seepage from a Class C liner does not exceed 8.64 x 10-4 m/d (DWAF, 1998). A conceptual design for a Class C liner as given by the NEM:WA Guidelines (GNR 634 of August 2013) is shown in **Figure 8**.6.

For the analytical model:

- A liner thickness of 700mm is applied as seen in **Figure 8**.6.
- For conservative prediction the maximum seepage rate for a Class C liner (8.64 x 10-4 m/d) is applied.

Analytical calculations conducted for a liner with these specifications conclude that seepage is expected to migrate through the liner over approximately 800 years. The liner can therefore be regarded as impermeable and it can be concluded that the installation of the liner will restrict seepage. As long as the water table does not rise, any seepage that may pass through will be minimal and is not expected to reach the groundwater environment.

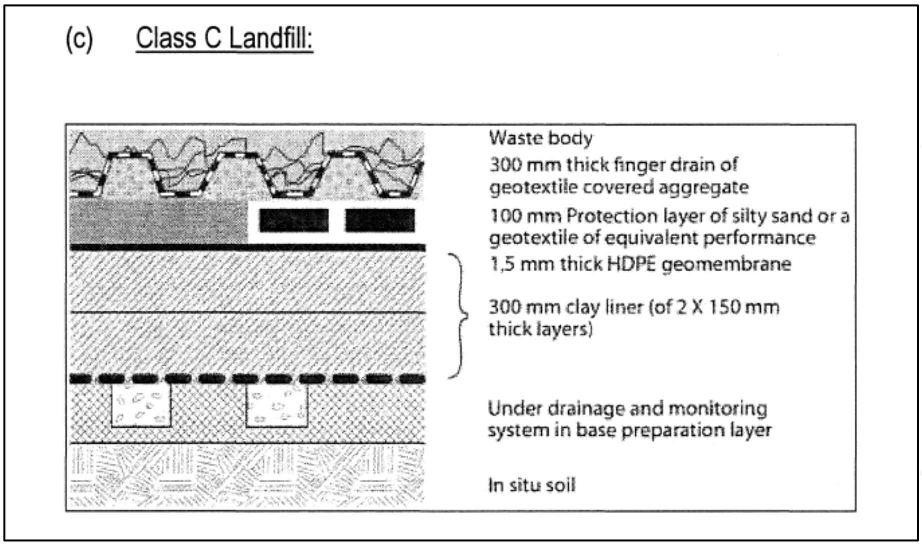

Figure 8.6: Minimum design requirement for a Class C liner (GNR 636, 2013).

8.1.2 Quantification of Impacts on Hydrology and Geohydrology

8.1.2.1 Construction Phase

Aquatic Ecology

Nature:
Site clearing and associated construction activities within the proposed development areas is likely to facilitate erosive potential of the vulnerable soils observed at the time of the survey and as such, increase sedimentation within the receiving watercourses is to be expected. In addition, the direct loss of vegetation and the replacement of less permeable surfaces (e.g. compacted soils) is likely to result in an elevated surface runoff velocity from these areas into the surrounding watercourses, which further expected to amplify the erosive potential of the area.

Accidental spillage of hydro-carbon based fuels and associated habits from construction vehicles (e.g. oil leaks), materials (e.g. corrosive chemicals) and personnel (e.g. litter) are likely to contaminate the surface runoff and in turn the receiving watercourses. This will have a direct implication of the sensitive aquatic biota occurring within the study area.

	Without Mitigation	**With Mitigation**
Extent	Surrounding farms (2)	Site only (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Large (8)	Low (4)
Probability	High (4)	Low (2)
Significance	**Medium (48)**	**Low (14)**
Status (positive or negative)	Negative	Neutral
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- » Develop soil management measures for the construction area/s that will prevent an increased runoff into the associated watercourses, such as the construction of trenches and/or the use of silt curtains.
- » Erosion control structures and mechanisms, such as surface stormwater drainage systems, should be implemented so as to reduce the potential occurrence of erosion and sedimentation within and adjacent to the associated watercourses.
- » The disturbance of instream channels and riparian zones must be minimized, where possible.
- » Surface water draining off contaminated areas containing oil and petrol would need to be channelled towards a sump which will separate these chemicals and oils.
- » Portable septic toilets are to be provided and maintained (including their removal without sewage spillage) for construction crews outside of the 1:100 year floodline.
- » Store all litter and waste carefully so it cannot be washed or blown into any of the watercourses within the study area.
- » No-go areas (or options) applicable where watercourses are to be avoided (see Wetland Assessment Report for delineated areas).

Residual Impacts:
No residual impacts have been identified during the construction phase.

Wetlands

The main activities during the construction phase that could result in impacts to the freshwater ecology of the area are associated with the site clearing and construction of the various parts of the power station infrastructure. Both the drainage features, as well as the two pans identified on the Farm Du Toit 563, are considered relatively sensitive and ecologically important based on the findings of both the desktop and field assessments. Any site clearing or construction activities are likely to have a potential impact on the freshwater ecology in terms of the ephemeral drainage lines and wetland systems in the vicinity of the project area as well as further downstream. Based on the assessment conducted, the two pans may not be impacted upon, however there will be impacts to the ephemeral drainage lines.

Impacts include erosion and sedimentation, the potential loss of biodiversity and habitat, fragmentation of the systems present and potential loss of catchment yields and surface water recharge to the systems further downstream. Among the impacts associated with the proposed construction phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons. Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the vicinity of any cleared areas and resulting in impacts further downstream. Removal of vegetation and disturbance of soils in the vicinity of the construction footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and AIPs, further altering the natural vegetation profiles of the freshwater resources encountered in the vicinity of the project footprint.

Nature:
Site clearing and increased vehicular movement within the Project area resulting in:

- Potential contamination of soils as a result of the ingress of hydrocarbons.
- Compaction of soils.
- Loss of natural vegetation.
- Loss of catchment yield.
- Increased sedimentation.
- Increased potential for onset of erosion.

	Without Mitigation	**With Mitigation**
Extent	Regional (4)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Medium (33)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation.
- Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction.
- Implement and maintain an alien vegetation management programme. This must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones.
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in freshwater areas).
- If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated.
- Ensure that no incision and canalisation of the ephemeral drainage lines present takes place.
- All erosion noted within the construction footprint should be remedied immediately and included as part of an ongoing rehabilitation plan.

- Permit only essential personnel within the 32m zone of regulation for all freshwater features identified.
- All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel.
- No unnecessary crossing of the freshwater features and their associated buffers should take place and the substrate conditions of the ephemeral drainage lines and downstream stream connectivity must be maintained.
- No material may be dumped or stockpiled within any freshwater features.
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the construction footprint.
- All vehicles must be regularly inspected for leaks.
- Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil.
- All spills should be immediately cleaned up and treated accordingly.
- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility.

Residual Impacts:
No residual impacts have been identified during the construction phase.

Surface Water

During the construction phase, there are activities that could potentially have an impact on the natural water resources. These include but are not limited to site clearing, stripping of topsoil, establishment of runoff dams, storage of hazardous material (fuel), generation and removal of domestic and hazardous waste, vehicular movement etc.

Nature:
Clearing or removal of vegetation leaves the soils prone to erosion during rainfall events, and as a result runoff from these areas which will be high in suspended solids will cause an increase in turbidity in the natural water resources. This could also result from the stockpiled topsoil if not vegetated.

Dust generated during the construction activities and increased vehicular movements can also be deposited into the nearby natural streams during rainfall events thereby contributing to the accumulation of suspended solids in these water resources leading to the siltation of the water bodies.

	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Short term (1)	Short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:
- Clearing of vegetation must be limited to the development footprint area and the use of existing access roads must be prioritized so as to minimise construction of new access roads in these areas.
- If possible, construction should be undertaken during the low rainfall season (April to September) to minimise erosion and sedimentation/siltation of the water course.

» Any construction work that involves site clearance, digging, excavation or trenching during construction services should be suspended during heavy rains to avoid erosion and sedimentation of the water course.
» When wet season construction cannot be avoided, sedimentation control measures, such as hay bales, sedimentation basins or any silt trap method should be in place during construction activities.
» Dust suppression measures must be undertaken on the cleared areas during construction.
» Dirt roads must be well compacted to avoid erosion of the soil into the natural water course.

Residual Impacts:
Risk of erosion on the developed area that may lead to siltation of the nearby streams.

Nature:
Dirty water runoff from the contaminated areas (general and hazardous waste storage facilities, disposal sites) has the potential to contaminate the natural water resources if the storm water management plan is not implemented.

These impacts will lead to the deterioration of the water quality and hence impact the downstream water users, as well as the aquatic life. However, these impacts can greatly be prevented and / or reduced if the recommended measures are implemented.

	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Short term (1)	Short term (1)
Magnitude	High (8)	High (8)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:
» All runoff emanating from the dirty water areas which include hazardous storage facilities will need to be diverted to the containment facility e.g. a sump prior to construction of the run-off / stormwater dams.
» All spillages must be contained to the smallest possible area and must be cleaned immediately.
» All construction equipment shall be put onto a maintenance program, including daily inspection of the equipment.

Residual Impacts:
There is a risk of hydrocarbon spills, general and hazardous material spillages during construction. This may lead to contamination of the water course when run-off from such areas reports into the streams.

Geohydrology

The main activities during the construction phase that could result in groundwater impacts are associated with the site clearing and construction of the various parts of the power station infrastructure, including the ash dump and coal stockyard and associated infrastructure.

The water table at the project area ranges between 23.25 mbgl (DUTBH1) and 35.68 mbgl (DUTBH3). Any site clearing or construction activities that would involve excavation below the water table depth may have a potential impact on the groundwater quantity and quality.

Nature: Potential lowering of the water table associated with foundations that are going to be constructed.		
	Without Mitigation	**With Mitigation**
Extent	Low (1)	Low (1)
Duration	Short-term (1)	Short-term (1)
Magnitude	Minor (2)	Low (1)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (8)**	**Low (3)**
Status (positive or negative)	Negative	Neutral
Reversibility	Medium	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » There will be no impact to the groundwater if excavation does not exceed the depth of the water table at the location of excavation. Local water levels range from 23.25 mbgl to 35.68 mbgl. If it does exceed the depth of the water table, the impact significance will depend on the depth of excavation below the water table. In areas where the foundation of structures is to be installed below the water level, dewatering of the aquifer to locally lower the water table can be considered. The abstracted water can be utilised for dust suppression, vegetation or discharged to the storm water dams.		
Residual Impacts: No residual impacts identified during the construction phase.		

8.1.2.2 Operation Phase

Freshwater Ecology

Nature: Potential contamination of the surrounding watercourses can potentially originate either from the mismanagement of the ash originating from the operational activities at the power plant (e.g. improper disposal of ash, inadequate compaction of the ash dump, etc.), and / or the inappropriate storage and separation of coal received or 'dirty' water situated within the proposed development area. In the event that pollutant levels become elevated within the receiving watercourses, inhabiting aquatic biota become physiologically stressed and migrate away from the affected area, if possible.		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Surrounding farms (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	High (8)
Probability	High (4)	Low (2)
Significance	**Medium (60)**	**Low (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » A dirty water system (including the proposed PCD) should be engineered and maintained on a regular basis to ensure efficacy.		

- Management of any accumulated water within the operational area should be regularly monitored and pumped to the PCD, so as to prevent the accumulation of dirty water within the operational area.
- The proposed design of the PCD should be over-engineered to include lining the facility with an impermeable membrane to prevent any potential seepage.
- Water within the PCD should be utilized within the operational area to facilitate the evaporation of the accumulated dirty water (e.g. dust suppression activities).

Residual Impacts:
Following decommissioning of the plant, it is envisaged that only the ash dump will remain and as such, it is recommended that other methods to safely dispose of excess ash be explored and implemented (e.g. additive to cement production). Also, sound and proper management practices are encouraged to maintain the shape of the dump and to engineer the subsequent rehabilitation (if possible) in a way that complements and emulates the baseline topography.

Wetlands

During operation, the ash dump is identified as the main facility that may potentially impact the freshwater resources present. Additional impacts associated with the proposed project are potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for transport of coal and ash, compaction of soils, the potential loss of natural vegetation and the increased potential for erosion and sedimentation in the operational footprint.

Any potential dumping or stockpiling within freshwater areas, and more significantly, any spills from the ash dump, has the potential to result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.

Nature:
Sedimentation and loss of flow connectivity; Potential ingress of hydrocarbons and other pollutants to the freshwater resources present; Altered hydrology, loss of biodiversity and fragmentation of freshwater systems; Loss of catchment yield; Increased vehicular movement along river crossings and within wetland / riparian zones resulting in:

- Potential contamination of soils as a result of the ingress of hydrocarbons.
- Compaction of soils.
- Loss of natural vegetation.
- Loss of surface water recharge to the systems further downstream.
- Fragmentation of the systems present.
- Increased sedimentation.
- Increased potential for onset of erosion.

	Without Mitigation	**With Mitigation**
Extent	Regional (4)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Very High (10)	High (8)
Probability	Highly Probable (4)	Probable (3)
Significance	**High (72)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	Yes

Mitigation:

- » Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the life of the proposed project.
- » Ensure that as far as possible all operational infrastructures are placed outside of freshwater areas and their associated 32m zone of regulation.
- » Limit the footprint area of the operational activities to what is absolutely essential in order to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas).
- » If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated.
- » Ensure that no incision and canalisation of the freshwater features present takes place as a result of the proposed operational activities.
- » All erosion noted within the operational footprint as a result of any potential surface activities should be remedied immediately and included as part of the ongoing rehabilitation plan.
- » During the operational phase, erosion berms should be installed on roadways and downstream of stockpiles to prevent gully formation and siltation of the freshwater resources. The following points should serve to guide the placement of erosion berms:
  - Where the track has slope of less than 2%, berms every 50m should be installed.
  - Where the track slopes between 2% and 10%, berms every 25m should be installed.
  - Where the track slopes between 10% - 15%, berms every 20m should be installed.
  - Where the track has slope greater than 15%, berms every 10m should be installed.
- » A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones.
- » Permit only essential personnel within the 32m zone of regulation for all freshwater features identified.
- » All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel.
- » No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained.
- » No material may be dumped or stockpiled within any of the ephemeral drainage lines in the vicinity of the proposed operational footprint.
- » No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads.
- » All vehicles must be regularly inspected for leaks.
- » Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil.
- » All spills should be immediately cleaned up and treated accordingly.
- » Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate waste facility.
- » Monitor all systems for erosion and incision.

Residual Impacts:

The ash dump is not expected to have a significant impact on the freshwater ecology further north of the project area, however, if suitable mitigation measures are not implemented, impacts associated with the ash dump may result in sedimentation of the aquatic resources downstream.

Surface Water

Activities that may have surface water impacts during the operational phase include plant operations, maintenance, storage of fuel, storage of coal, operation of run-off / stormwater dams and stormwater management systems, operational use of ash dump.

Nature: Dirty water runoff from the contaminated surfaces and the infrastructure within the project area (power plant area, coal stockyard, hazardous storage facilities, and ash dump) has the potential to contaminate and silt up the existing pans if the stormwater management plan is not in place / implemented. These impacts will lead to deterioration of the water quality and hence impact the downstream water users, as well as the aquatic life. However, these impacts can greatly be prevented and / or reduced if the recommended measures are implemented.		
	Without Mitigation	**With Mitigation**
Extent	Regional (4)	Regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (64)**	**Medium (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

» All the dirty water runoff emanating from dirty areas (ash dump, plant and coal stockpile areas) should be contained within the dirty water dams. This water should be stored for re-use within the power plant so as to prevent unnecessary discharge into the environment.

» Should the contained water be more than the water use requirement, Best Practice Guidelines advise that the water be recycled or as the last resort be treated to acceptable levels and discharged to the natural environment or be supplied to other industries as a lower grade water.

» Development of a stormwater management infrastructure should be in line with Regulation 704 of the NWA (36 of 1998) (GNR 704).

» Clean water emanating from upstream of the project area must be diverted away and discharged to the nearby watercourse or environment.

» All spillages must be contained to the smallest possible area and must be cleaned immediately.

Residual Impacts:

There is a risk of dam overflows, risk of hydrocarbon spills, general and hazardous material spillages. This may lead to contamination of the water course when runoff from such areas reports into the streams.

Nature:

Containment of dirty water run-off within the dams prevents contamination of the natural stream. However, this run-off had been contributing to the natural catchment and streams prior to commencement of the project as clean water.

Containment of this water (now as dirty water) reduces the amount of run-off reporting to the natural environment. A decrease in the catchment yield may have an impact on the downstream water users as they may not have sufficient water for their needs, while also decreasing the flows required for the ecological reserve.

However, the project boundary layout where all three alternative infrastructure layouts are located amounts to approximately 12km² which makes up less than 1% of total quaternary catchment area of 1 668km² (A71K).

The percentage decrease in MAR amounts to 0.7% of the total mean annual runoff within this quaternary catchment and this is considered to be insignificant.

	Without Mitigation	With Mitigation
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Low (2)	Low (2)
Probability	Definite (5)	Definite (5)
Significance	**Medium (40)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation: » Although there is no mitigation for this loss of catchment yield, the extent or overall potential loss (less than 1%) will be insignificant. » Clean water from upstream catchment will be diverted around site and report to natural environment or streams.		
Residual Impacts: There is a risk of dam overflows and dirty water finds its way into the natural streams, thereby contaminating the natural watercourse.		

Geohydrology

During operation, the ash dump and coal stockpile are identified as the main facilities that may potentially impact the groundwater environment.

In order to provide site specific detail on the chemistry expected from the contamination which could emanate from the ash dump and coal stockpile and recommend a suitable liner, it is recommended that geochemistry and waste classification studies be conducted prior to any activities taking place. Based on experience it is highly likely that the ash dump will need to be lined. This will be required for the Water Use Licence Application (WULA), and thus would be legally required to be undertaken. Applying a liner is expected to significantly reduce seepage of contaminants (leachate) from the ash dump into the receiving environment. Dry ash disposal has been proposed for the project site, whereby the ash is partially wetted to contain approximately 15% moisture. Dry ashing has an advantage over wet ashing as it minimises the quantity of leachate that will be generated.

Nature: Groundwater contamination from the ash dump.		
	Without Mitigation	**With Mitigation**
Extent	Low (1)	Low (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Moderate (6)	Small (2)
Probability	Probable (3)	Improbable (1)
Significance	**Medium (33)**	**Low (4)**
Status (positive or negative)	Negative	Neutral
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- If the groundwater is contaminated, the plume from the ash dump may reach the identified potential receptors (such as groundwater users using surrounding boreholes for drinking and livestock, and local streams). The local streams may receive the groundwater as baseflow; however the likelihood of this is low due to the relatively deep water levels currently observed on site (28 mbgl on average). Groundwater-surface water interaction is expected to be of losing-streams and base flow feeding the local streams with groundwater is not expected.
- With the implementation of an appropriately designed ash dump liner and dry ash deposition, seepage into the groundwater environment is not expected and impacts are regarded as negligible.
- Should an impact be detected through monitoring, affected receptors should be compensated.

Residual Impacts:

The potential contamination plume is not expected to migrate into the groundwater environment with the installation of a liner; however if not installed there may be an impact to the potential receptors and the local groundwater quality may deteriorate.

Nature:

Groundwater contamination from the coal stockpile.

	Without Mitigation	**With Mitigation**
Extent	Low (1)	Low (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Moderate (6)	Small (2)
Probability	Probable (3)	Improbable (1)
Significance	**Medium (33)**	**Low (4)**
Status (positive or negative)	Negative	Neutral
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- If the groundwater is contaminated, the plume from the coal stockpile reaches the groundwater, local receptors may be affected. Due to the relatively deep water levels (28 mbgl on average) currently observed on site the likelihood of this impact to the local streams is minimal. Groundwater-surface water interaction is expected to be of losing-streams and base flow feeding the local streams with groundwater is not expected locally.
- With the implementation of an appropriately designed coal stockpile liner, seepage into the groundwater environment is not expected and impacts are regarded as negligible.
- Should an impact be detected through monitoring, affected receptors should be compensated.

Residual Impacts:

The coal stockpile is not expected to release leachate into the groundwater environment with the installation of a liner. However if not installed there may be an impact to the private boreholes located downstream (used for drinking and livestock) as the local groundwater quality may deteriorate.

8.1.2.3 Decommissioning Phase

Aquatic Ecology

Nature:

Demolition and removal of the power plant infrastructure is intended to restore the baseline conditions to some extent (e.g. original topography, restored catchment yield, re-establish connectivity between fragmented watercourses). However, the increased movement of heavy machinery and vehicles during the particular phase is expected to

increase the risk of potential water quality impairment (i.e. hydrocarbon leaks) and / or loss of riparian habitat through increased operational footprint.		
	Without Mitigation	**With Mitigation**
Extent	Surrounding farms (2)	Surrounding farms (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Small (2)
Probability	Probable (3)	Very improbable (1)
Significance	**Medium (30)**	**Low (8)**
Status (positive or negative)	Negative	Neutral
Reversibility	Medium	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » Care should be taken not to impact areas that have remained un-affected throughout the life of the power plant and associated infrastructure. » On-going rehabilitation should be conducted throughout the Operational phase. Only the removal of remaining infrastructure and reshaping the final topography should occur during the closure phase.		
Residual Impacts: No residual impacts associated with decommissioning, closure and rehabilitation.		

Wetlands

This phase is characterised by the decommissioning and closure of the power plant and associated infrastructure, the ash dump however is planned to remain on surface, which is likely to result in ongoing impacts to the freshwater ecology over time. Among the impacts associated with the proposed decommissioning phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities.

Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.

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

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

The largest impact during the decommissioning and closure phases of this proposed project is related to the ash dump which will remain once the project is completed. There is a high potential for ongoing impacts to the freshwater ecology of the area as a result of ash spills, poor maintenance of erosion berms and poor dust control, resulting in erosion and sedimentation of the freshwater resources present. Some measures may be implemented to gradually reclaim ash for the production of cement, thereby reducing ash volume over time. The ash dump may also be sealed by the placement of soil over it and the planting of vegetation in order to reduce ash runoff and to prevent erosion and sedimentation and the generation of dust.

Nature:

Potential dumping of decommissioned infrastructure in freshwater areas; Potential incomplete removal of infrastructure; Disturbance of natural vegetation structures; Erosion and sedimentation related to inadequate maintenance of erosion berms and clean and dirty water separation systems; Spread of AIPs; Increased vehicular movement along within freshwater zones, resulting in:

» Potential contamination of soils as a result of the ingress of hydrocarbons.
» Compaction of soils.
» Loss of natural vegetation.
» Increased sedimentation.
» Increased potential for onset of erosion.

	Without Mitigation	**With Mitigation**
Extent	Regional (4)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Slight (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Low (14)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

» Ensure that sound environmental management is in place during the proposed decommissioning phase.
» Ensure that as far as possible all decommissioned infrastructures are placed outside of freshwater areas and their associated 32m zone regulation.
» Limit the footprint area of the decommissioning activities to what is absolutely essential in order to minimise impacts as a result of disturbances to soils, compaction of soils and loss of natural vegetation.
» If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated.
» Ensure that no incision and canalisation of the freshwater resources present takes place as a result of the proposed decommissioning activities.
» All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation plan.
» A suitable AIP control programme must be put in place for both the decommissioning and closure phases so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones.
» Permit only essential personnel within the zones of regulation for all freshwater features identified.
» All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel.
» No unnecessary crossing of the freshwater features and their associated buffers should take place and the substrate conditions of the ephemeral drainage lines and downstream stream connectivity must be maintained.
» Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream.
» No material may be dumped or stockpiled within any freshwater areas (or the buffers) in the vicinity of the proposed decommissioning footprint.

- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the decommissioning area footprint.
- All vehicles must be regularly inspected for leaks.
- Re-fuelling must take place on a sealed surface area away from freshwater systems to prevent ingress of hydrocarbons into topsoil.
- All spills should be immediately cleaned up and treated accordingly.
- Appropriate sanitary facilities must be provided for the duration of the decommissioning activities and all waste must be removed to an appropriate waste facility.
- Monitor all systems for erosion and incision.

Residual Impacts:
The remaining ash dump is not expected to have a significant impact on the freshwater ecology further north of the Project area, however, if suitable mitigation measures are not implemented, impacts associated with the ash dump may result in sedimentation of the aquatic resources downstream.

Surface Water

Activities during this phase include disassembly of production units and ancillary infrastructure, the demolishing of buildings, the removal of hazardous waste, and the rehabilitation of the ash dump and project site.

Although decommissioning activities have the potential to impact on the streams, the outcome of the rehabilitation will ensure that the site is rehabilitated to a state that is reflective of anticipated future use.

Nature:
Dismantling of infrastructure will again expose the surface and leave the soils prone to erosion during high rainfall events. As a result, run-off from these areas (which will be high in suspended solids) can lead to an increase in turbidity in the natural water course.

	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Short term (1)	Short term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:
- The constructed storm water infrastructure will have to remain until post closure. This will ensure that dirty water is captured and contained during removal of infrastructure and thereby prevent siltation and contamination of the river.
- All rehabilitated areas must be vegetated. Until vegetation has successfully been established, sedimentation should be mitigated by installing silt traps at areas where the surface runoff enters the surface water resources.
- The surface profile of the rehabilitated area should resemble the natural conditions prior to the project. This should ensure that the surface profile encourages natural drainage, such that no ponding or standing water occurs after a rainfall event.

- Dust suppression measures must be undertaken during this phase to prevent deposition of dust particle into the stream.
- Use of accredited contractors for removal or demolition of infrastructures.

Residual Impacts:
Risk of erosion on the exposed areas during decommissioning, this may lead to siltation of the nearby streams.

Geohydrology

The closure phase is characterised by the decommissioning of the power plant and associated infrastructure. The ash dump however is planned to remain on surface even after closure. Infiltration of rainwater and leachate formation will continue from the operational phase through to the post-closure phase. However, this is unlikely to pollute the groundwater with the application of the proposed liner and post-closure dump rehabilitation. Ash dump rehabilitation is recommended to include reshaping, compacting, capping and revegetating.

At dry ash dumps, carbon dioxide moves into the ash with the rain water. The carbon dioxide reacts with the calcium oxide in the ash and lime ($CaCO_3$) precipitates forming a hard layer known as pozzolanic layer. Hodgson et al. (1998) reported that pozzolanic layer at a dry ash dump is typically up to 500mm thick. As the crystallisation of lime continues, the top portion of the ash becomes less and less permeable. A stage should therefore be reached where the hydraulic conductivity of the pozzolanic layer has been reduced to such an extent, that rainwater can no longer effectively penetrate into the ash. The ability of pozzolanic ash to successfully act as a sealant, has also been demonstrated by Edil et al. (1992) in the US, in which they state that ash permeabilities are reduced to less than 10^{-7} m/s with time. The ash dump may also be sealed by the placement of soil over it and the planting of vegetation in order to reduce water ingression and to prevent erosion and the generation of dust.

It is possible that uses for the ash such as cement filler may be found and the dump can then be gradually removed. The feasibility of this option would however need to be confirmed based on demand for such materials.

Nature:
Groundwater contamination from the ash dump.

	Without Mitigation	**With Mitigation**
Extent	Low (1)	Low (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Moderate (6)	Small (2)
Probability	Probable (3)	Very improbable (1)
Significance	**Medium (36)**	**Low (4)**
Status (positive or negative)	Negative	Neutral
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:

- Depending on the integrity of the liner and rehabilitation maintenance in the post-closure phase, the impact could be moderate. Formation of the pozzolanic layer is also additional mitigation that occurs naturally over time, and therefore leachate formation is expected to cease at a certain point therefore reducing the risk to the groundwater over time post-closure.

» Continuous post-closure monitoring is required so that drastic deterioration in groundwater quality is detected as soon as it occurs, allowing for mitigation measures to be implemented early. Monitoring is recommended to be conducted until satisfactory groundwater quality is reached (through the implementation of monitoring and comparing this to standards and objectives set in the Water Use License (WUL)) and thereafter signed off by the relevant authorities.
» Should an impact be detected through monitoring, affected receptors should be compensated.

Residual Impacts:
The contamination plume is not expected to migrate into the groundwater environment with the installation of a liner; however if not installed or if the integrity thereof is compromised, there may be an impact to the private boreholes located downstream (used for drinking and livestock) and the local groundwater quality will deteriorate.

8.1.3 Analysis of Layout Alternatives

The Mutsho Power Project has three alternative infrastructure locations which are all within the demarcated project area. Considering the nature and activities of this project, the main impacts on water resources could relate to contamination of the natural streams as a result of runoff from the ash dump and coal stockyard, reporting into these natural streams, which could have implications on biota and cause degradation of these systems. In addition to this the potential contamination to groundwater needs to be considered as an impact of concern and needs to be taken into consideration when placing infrastructure.

Therefore, to assess the most suitable location of infrastructure, the suitability of the proposed infrastructure location was completed based on the following criterion:

» Criteria 1: Presence of natural water features on the proposed site.
» Criteria 2: Proximity / Distance of the water resources to the ash dump and coal stockyard – a shorter distance to the river / stream will result in a higher risk of impacting to the water resource.
» Criteria 3: Dirty water runoff likely to report in to the natural water resources.
» Criteria 4: Sensitivity of natural water features within the proposed site.
» Criteria 5: Location of fault lines within the proposed site.

These criteria were rated on a scale from 1 (unsuitable), 2 (less suitable), 3 (negligible / insignificant), 4 (suitable) to 5 (most suitable) to quantifiably compare the suitability of the various infrastructure siting, based on the various water specialist assessments. Once the ratings were determined based on the above criteria, these were calculated to determine the overall suitability ranking of the proposed ash dump and coal stockyard areas. The results of this assessment are presented in **Table 8.10** and described below.

Table 8.10: Rating of criteria for the consideration of infrastructure alternatives.

Options	C1	C2	C3	C4	C5	Total %	Rating	
							Score	Definition
Preferred Alternative	2	3	2	3	5	60%	3	Negligible
Alternative A	2	2	1	1	1	20%	1	Unsuitable
Alternative B	2	2	3	2	2	40%	2	Less suitable

*Rating = Rounded average (Criteria 1 value + Criteria 2 value + Criteria 3 value + Criteria 4 value + Criterial 5 value)/5

If each specialist study (i.e. freshwater ecology, wetlands, surface water, and geohydrology) is rated in isolation, without considering the other specialist studies the following was determined.

From a surface water perspective, Alternative A and Alternative B are the most suitable infrastructure areas with negligible or insignificant impacts on the natural surface water resources whilst the Preferred Alternative is the least suitable since the ash dump is located on top of the drainage lines, however the drainage lines that may be affected by the Preferred Alternative have been classified as moderately sensitive, and thus the potential impacts on these would not have great or significant impact.

From a wetlands perspective the following was concluded:

» Based on the utilisation of areas of existing anthropogenic disturbance, such as an existing road, fence-lines and power line servitude, preference is given to Alternative A.
» In terms of the extent of the freshwater resources likely to be impacted both in terms of direct loss of surface water drainage areas, as well as due to potential loss of ecological integrity in the downstream aquatic resources, preference is given to the Preferred Alternative, followed by Alternative A.
» In addition, Alternative A is considered the least invasive in terms of hard surface crossings as the access road is constructed from the existing gravel road between the Farm Du Toit 563 and the Farm Vrienden 589.
» Both Alternative A and Alternative B, involve a more compact infrastructure footprint, which is likely to result in fewer impacts to the freshwater resources present and will aid in the management and mitigation of impacts during the life of the proposed project.

It is concluded that Alternative A is the most suitable in terms of wetland and freshwater ecological integrity.

Looking at aquatics as the driving factor would be to place infrastructure as far as possible from the Sand River system, thus the Preferred Alternative was considered as the most feasible option.

Lastly for groundwater sensitive receptors, such as boreholes and fault lines, were taken into consideration. Private boreholes are located downstream from the proposed ash dump and coal stockpile (with the exception of VRIBH2, for all layout options), the nearest perennial river is located 8km north-west of the project area (Sand River); local streams within the project area are non-perennial, and they flow seasonally.

Considering environmental sensitivity a fault located in the northern part of the Farm Du Toit 563 was identified. Based on that observation, the Preferred Alternative is recommended as the most suitable layout as the location of the ash dump for this option is located furthest from the fault. The ash dump and coal stockpile location is most critical as these facilities are the main concern regarding impacts to groundwater. Structures that could potentially act as preferential pathways, such as faults should be avoided with regards to the placement of the facilities. No groundwater sensitive areas were identified for the proposed locations of the coal stockpile for all layout options.

Once each specialist assessment (i.e. freshwater ecology, wetlands, surface water, and geohydrology) considered the respective sensitivities in isolation, all the findings were integrated into one scoring system (refer to **Table 8.10**). Based on the scoring system, the best option to consider would be the Preferred Alternative. None of the options avoid impacts completely, however based on the sensitivities and recurring impacts, the Preferred Alternative should be considered as the preferred option.

8.2. Potential Impacts on Soils, Land Use and Agricultural Potential

8.2.1 Results of Impact Assessment

Geology

Within the broader study area, the geology of the survey area consists largely of marble of the Gumbu Formation, with arenite (sandstone) Ecca Group in the north (Geological Survey, 1988).

Reconnaissance scale

As far as pre-existing soil information is concerned, the area is covered by the national Land Type Survey at a scale of 1:250 000, which has been digitized using ArcGIS. The study area falls within the map sheet 2228 Alldays. Each specific land type is a unique combination of broad soil pattern, terrain type and macroclimate. Where any of these changes, a new land type occurs. Within any specific land type, the soil forms occurring (MacVicar *et al*, 1977) have been summarized according to their dominance, but the locality or distribution of the various soils within a land type cannot be further determined.

Semi-detailed field survey

The portion of the study area covered by the various options for proposed infrastructure was investigated in the field. The survey concentrated on the proposed sites for the power station and ash disposal facility. The soils were grouped into mapping units. Samples of topsoil and subsoil were collected at three localities (S1 to S3), and the soil analysed for particle size (sand, silt and clay), exchangeable cations and CEC, and pH.

Land types

Within the study area, only one land type occurs, as follows:

» **Ah89** Yellow-brown and red, apedal, freely drained soils.

The main characteristics of the soils occurring in the land type are red and yellow-brown, sandy loam to sandy clay loams of varying depths, along with some areas of shallow lithosols.

Soil mapping

The soils occurring in the survey area are brown to reddish-brown, sandy loam to sandy clay loams of the Hutton and Glenrosa forms, underlain by weathering rock. They are generally shallow (<400mm), although deeper, red soils occur along the non-perennial stream beds in the area.

Table 8.11: Soils occurring within the study area.

Map Unit	Dominant Soils	Depth (mm)	Description	Agricultural Potential
Hu/Oa	Hutton, Oakleaf	400 – 1 000	Red, structureless, sandy clay loam, apedal soils on rock. Occurs in lower parts of the landscape, along stream channels.	Wetland

Map Unit	Dominant Soils	Depth (mm)	Description	Agricultural Potential
Gs/Hu	Glenrosa, Hutton	150 – 450	Reddish-brown to brown, loamy sand to sandy loam, apedal soils on weathering rock. Isolated deeper patches of soil may occur	Low
Gs	Glenrosa, Mispah	100 – 350	Brown, loamy sand to sandy loam, apedal soils on weathering rock. Surface stones and rocks occur in places.	Low
S/R	Mispah, Rock	50 – 150	Brown, apedal soils on hard to weathering rock. Surface stones and rocks occur.	Very Low

Soil analyses

The results of the soil analyses are shown in **Table 8.12**.

Table 8.12: Results of the Soil Sample Analyses.

Sample No.	S1 (Gs)		S2 (Gs)		S3 (Hu)	
	0 – 250mm	250 – 500mm	0 – 150mm	150 – 450mm	0 – 250mm	300 – 700mm
Co-ordinates	22° 41' 29.3" S 29° 48' 56.3" E		22° 41' 29.3" S 29° 49' 51.5" E		22° 41' 14.7" S 29° 49' 20.0" E	
Sand (%)	76	72	80	80	64	58
Silt (%)	6	6	6	4	8	8
Clay (%)	18	22	14	16	28	34
Na (cmol (+) kg $^{-1}$)	0.039	0.056	0.037	0.046	0.042	0.087
K (cmol (+) kg $^{-1}$)	0.381	0.302	0.297	0.251	0.455	0.460
Ca (cmol (+) kg $^{-1}$)	3.189	2.715	3.044	3.533	4.251	5.389
Mg (cmol (+) kg $^{-1}$)	1.555	1.613	1.325	1.728	2.361	3.093
CEC* (cmol (+) kg $^{-1}$)	9.487	9.843	3.230	6.969	12.558	11.923
pH (WATER)	6.26	6.31	6.33	6.35	6.57	6.43
Org Carbon (%)	0.57	0.55	0.46	0.42	0.51	0.46

* Cation Exchange Capacity.

The analysis results show the difference between the shallower Glenrosa soils (sites S1 and S2), which have sandy loam texture, and the deeper Hutton soils along the drainage channels (S3), which have a sandy clay loam texture. The soils are generally neutral, with pH values between 6 and 6.5, with very low organic carbon levels, as might be expected in a hot, dry climate. The CEC values are what could be expected from the underlying geology, mainly due to the Ca and Mg content of the soils. The Hutton soil has a higher value, which agrees with the higher clay content.

No abnormal or unusual values were obtained.

Agricultural Potential

The survey area is dominated by shallow (<450 mm), apedal soils of the Glenrosa and Hutton forms. Very few soils deeper than 900mm occur. These soils are not suited for cultivation due to the shallow rooting depth, along with their stoniness in many parts. An additional limiting factor is the dry, hot climate. The low annual rainfall, coupled with the hot summer temperatures, means that the only practical means of cultivation would be by means of irrigation, and there is little or no evidence of any cultivated lands in the area.

The deeper soils along the stream bed should be avoided for any sort of development. Although the study area is a dry environment, and these zones will remain dry in most years, occasional periods of heavy rain will cause water to accumulate, even at intervals of several years. Such zones must be left in their natural state, as they can be regarded as temporary wetlands.

Erodibility

The soils do not have a high susceptibility to erosion, either by wind or water. The topsoils have a light to medium texture but are not excessively sandy. However, normal precautions regarding soil conservation should be taken in any construction phase, so that removal of vegetation cover is kept to a minimum and where activities that occur close to any stream bed should be avoided. Once a facility is established where sites for waste materials are established, these should be kept wet to avoid wind erosion of the surface, especially in the drier winter months.

8.2.2 Quantification of Impacts on Soils, Land Use and Agricultural Potential

The main potential impact will be the loss of agricultural soil due to the establishment of permanent infrastructure, including the power station and associated waste material sites.

Nature: Loss of agricultural potential.		
	Without Mitigation	**With Mitigation**
Extent	Low (2)	Low (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (8)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (42)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: » The prevailing agricultural potential is low, so loss of agricultural potential will not be of huge significance. The main mitigation measure will be to avoid developing the facility on or close to the wetland zones across the study area, to avoid any potential seepage or other problems. » For any area/s where a permanent waste facility is established, the existing topsoil (at least to approximately 300mm depth, should be removed and stockpiled, where it can be used to a cover soil or fill material at a later stage, as required.		
Residual Impacts: Little or none, as long as proper rehabilitation measures are carried out. This would include ensuring that any soils where vegetation is cleared for construction are re-vegetated as soon as possible and ensuring that no excessive surface runoff is permitted to occur.		

8.2.3 Analysis of Layout Alternatives

The soils in the study area are not a limiting factor in terms of the establishment of a power station. However, the wetland distribution even if it involves temporary or seasonal wetlands, and associated recommendations such as buffer distances, should be very carefully applied.

8.3. Potential Impacts on Heritage and Archaeology

8.3.1 Results of Impact Assessment

The most significant findings from the heritage assessment include Site V04, the Baobab Room, graded IIIa on the Farm Vrienden 589, and Sites D04 to D07, which should be read as one site, also graded IIIA on the Farm Du Toit 563.

Living Heritage
The Baobab Room, Site V04, is an interesting example of living heritage that continues to be used today. The baobab, which has an entirely hollow trunk at ground level, has a number of windows that allow light into the shelter provided within the trunk. Pegs have been hammered into the external bark to facilitate access to inside the tree through one of these windows. There appears to be deposit of unknown depth inside the trunk. It is proposed that this site is graded IIIa.

Archaeology
Sites D04 to D07 appear to be a Middle Stone Age artefact manufacturing site. These sites extend and blend into one another, forming one large site. The density of flakes and flaked pieces that occur within this larger site is very high, with the ground surface littered with Middle Stone Age artefacts and individual instances of manufacture. The highest density appears around site D06. Such open air Middle Stone Age sites are rare and provide a unique window into the origins of modern humans. It is proposed that this larger artefact manufacturing site be graded IIIA due to its high level of scientific cultural significance.

Mapping and spatialisation of heritage resources
A number of heritage resources of varied significance were identified on the Farms Vrienden 589 and Du Toit 563. These sites included isolated archaeological artefacts, larger, coherent archaeological sites, recent agricultural infrastructure and a single living heritage site, all ranging from a IIIa grading to Not Conservation Worthy. All sites are detailed in table.

Table 8.13: Heritage resources identified during the foot survey.

SAHRIS Site ID	Site Number	Site Name	Site Description	Grading
105144	V01	Vrienden 1	Archaeological, 1 stone artefact	NCW
105145	V02	Vrienden 2	Archaeological, 1 stone artefact	NCW
105146	V03	Vrienden 3	Modern disused agricultural infrastructure	NCW
105147	V04	Vrienden 4	Living Heritage/Sacred sites, the "Baobab Room"	Grade IIIa
105149	V05	Vrienden 5	Archaeological, 1 stone artefact	NCW
105150	V06	Vrienden 6	Ruin of agricultural infrastructure	NCW
105151	D01	Du Toit 1	Modern agricultural infrastructure	NCW
105152	D02	Du Toit 2	Archaeological, 1 potsherd	NCW
105153	D03	Du Toit 3	Archaeological, potsherd and some stone tools, low density	Grade IIIc

SAHRIS Site ID	Site Number	Site Name	Site Description	Grading
105154	D04	Du Toit 4	Archaeological, MSA stone tools identified emerging from 1x4m hole previously dug, Additional artefacts and raw material scattered on surface. High density	Grade IIIa
105155	D05	Du Toit 5	Archaeological, MSA stone tools raw material scattered on surface. High density	Grade IIIa
105156	D06	Du Toit 6	Archaeological, MSA stone tools raw material scattered on surface. Highest density	Grade IIIa
105157	D07	Du Toit 7	Archaeological, MSA stone tools raw material scattered on surface including hammerstone. High density	Grade IIIa
105159	D08	Du Toit 8	Archaeological, isolated artefacts. Low density	Grade IIIc
105160	D09	Du Toit 9	Archaeological, artefacts and ochre. Moderate density	Grade IIIc
105161	D10	Du Toit 10	Remains of modern disused agricultural infrastructure	NCW
105162	D11	Du Toit 11	Archaeological, small dam with sporadic artefacts in spoil heap	Grade IIIc
105163	D12	Du Toit 12	Archaeological, near to the boundary of Vriendin. Area cleared for powerline construction. Piece of iron slag identified.	NCW
105164	D13	Du Toit 13	Ruin of disused modern agricultural infrastructure	NCW

Table 8.14: All significant known heritage resources within the proposed development areas.

SAHRIS Site ID	Site Number	Site Name	Site Description	Grading
37458	MOP033	Mopane 033	Burial Grounds & Graves	Grade IIIa
37459	MOP034	Mopane 034	Building	Grade IIIa
37565	MOP112	Mopane 112	Burial Grounds & Graves	Grade IIIa
37567	MOP114	Mopane 114	Structures	Grade IIIa
37568	MOP115	Mopane 115	Structure	Grade IIIb
105147	V04	Vrienden 4	Living Heritage/Sacred sites, the "Baobab Room"	Grade IIIa
105154	D04	Du Toit 4	Archaeological, MSA stone tools identified emerging from 1x4m hole previously dug, Additional artefacts and raw material scattered on surface. High density	Grade IIIa
105155	D05	Du Toit 5	Archaeological, MSA stone tools raw material scattered on surface. High density	Grade IIIa
105156	D06	Du Toit 6	Archaeological, MSA stone tools raw material scattered on surface. Highest density	Grade IIIa
105157	D07	Du Toit 7	Archaeological, MSA stone tools raw material scattered on surface including hammerstone. High density	Grade IIIa

8.3.2 Quantification of Impacts on Heritage and Archaeology

The construction of the new Mutsho Power Project will have significant, permanent and irreversible impacts on any heritage resources that occur within its footprint, and with a minimum development footprint of 350ha, the area of disturbance is extensive. This impact is cumulative, given the number of coal mines and power plants in the area. Once the site is built, it is likely that safety and security concerns will limit the movement of people near the site, thereby reducing the likely impacts to the construction phase only.

8.3.2.1 Construction Phase

Nature:
The construction of the **Preferred Alternative** will directly impact on, and destroy, archaeological sites that have been identified as Not Conservation-Worthy and sites contributing to the cultural landscape, including those identified as part of the archaeological assessment, and those as yet unidentified, or located subsurface. Palaeontological resources are unlikely to be impacted.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**Medium (50)**	**Medium (50)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	

Mitigation:
» The impacts for this alternative are to archaeological resources that are not conservation-worthy and therefore do not require any mitigation. Impacts to the cultural landscape through the demolition of the structure at MOP115 speak to the changing nature of this landscape from agricultural to industrial. No mitigation is possible.

Residual Impacts:
Impact to unknown or buried heritage resources. Indirect impacts to other known heritage resources.

Nature:
The construction of **Alternative A** will not impact on any known heritage resources, and it provides a sufficient buffer of more than 100m around site Vrienden 04 (SID 105147), the "Baobab Room".

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Small (0)	Small (0)
Probability	Improbable (1)	Improbable (1)
Significance	**Low (6)**	**Low (6)**
Status (positive or negative)	Neutral	Neutral
Reversibility	None	None
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	

Mitigation:
» None. Impacts to the cultural landscape through the establishment of the power station speak to the changing nature of this landscape from agricultural to industrial. No mitigation is possible. It is recommended that a management plan for potential impacts to buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.

Residual Impacts:
Impact to unknown or buried heritage resources. Indirect impacts to other known heritage resources.

Nature: The construction of **Alternative B** will impact on the very significant site Vrienden 04 (SID 105147), the "Baobab Room". Insufficient buffer space is provided around the site.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very High (10)	Very High (10)
Probability	Definite (5)	Definite (5)
Significance	**High (80)**	**High (80)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » None, any impacts to the buffer zone around Site V04 will permanently and negatively impact the living heritage site. Impacts to the cultural landscape through the establishment of the power station speak to the changing nature of this landscape from agricultural to industrial. No mitigation is possible. It is recommended that a management plan for potential impacts to buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.		
Residual Impacts: Impact to unknown or buried heritage resources. Indirect impacts to other known heritage resources.		

8.3.2.2 Operation Phase

Nature: The operational phase of the **Preferred Alternative** will have no impact on any archaeological, palaeontological, or living heritage resources.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short term (1)	Short term (1)
Magnitude	Small (0)	Small (0)
Probability	Improbable (1)	Improbable (1)
Significance	**Low (2)**	**Low (2)**
Status (positive or negative)	Neutral	Neutral
Reversibility	None	None
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation: » It is recommended that a management plan for potential impacts to buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.		
Residual Impacts: Impact to unknown or buried heritage resources. Indirect impacts to other known heritage resources.		

Nature:

The operational phase of **Alternative A** may impact indirectly on site Vrienden 04 (SID 105147), the "Baobab Room" as a result of increased activity in the vicinity.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)
Magnitude	Very high (10)	Moderate (6)
Probability	Highly probable (4)	Improbable (2)
Significance	**High (60)**	**Low (22)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » It is recommended that a management plan for potential impacts to the "Baobab Room" and buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.		
Residual Impacts: Impact to unknown or buried heritage resources. Indirect impacts to other known heritage resources.		

Nature: The operational phase of **Alternative B** will impact on the very significant site Vrienden 04 (SID 105147), the "Baobab Room". Insufficient buffer space is provided around the site.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very High (10)	Very High (10)
Probability	Definite (5)	Definite (5)
Significance	**High (80)**	**High (80)**
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » None, any impacts to the buffer zone around Site V04 will permanently and negatively impact the living heritage site. No mitigation is possible. It is recommended that a management plan for potential impacts to buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.		
Residual Impacts: Impact to unknown or buried heritage resources. Indirect impacts to other known heritage resources.		

8.3.2.3 Decommissioning Phase

No impacts are anticipated during the Decommissioning Phase and as such, no tables have been provided for this phase.

8.3.3 Analysis of Layout Alternatives

i. Comparison of Alternatives

<u>Preferred Alternative:</u>
This alternative will impact one site MOP115 (SID 37568), graded IIIb, and two stone artefacts that have been described as Not Conservation-Worthy directly. Should this Alternative proceed, MOP115 would need to be demolished. According to SAHRIS, MOP115 is a modern gabled building situated in an open flat area with a baobab and garden trees and shrubs. As this structure is modern, its heritage significance lies not in its fabric, but in its contribution to the cultural landscape. No Section 34 permit application is required for its demolition.

<u>Alternative A:</u>
This alternative will not directly impact on any known heritage resources, and it provides a sufficient buffer of more than 100m around site Vrienden 04 (SID 105147), the "Baobab Room". However, despite the proposed buffer, Alternative A is likely to have indirect impacts on the "Baobab Room" site and is therefore not preferred from a heritage perspective.

<u>Alternative B:</u>
This alternative does impact on the very significant site Vrienden 04 (SID 105147), the "Baobab Room". Insufficient buffer space is provided around the site.

ii. Nomination of Preferred Alternative

The Preferred Alternative will have a limited impact on known heritage resources, only impacting two archaeological stone flakes and one modern farmhouse during the Construction Phase. No impacts are anticipated during the operational phase. Alternative A will have no impact to known heritage resources, however impacts to a significant living heritage site, the "Baobab Room" are likely during the operational phase. Alternative B will have the greatest impact to known heritage resources during both the construction and operational phases of development. Irrespective of which Alternative is implemented, it is recommended that Site V04, the Baobab Room, must not be impacted by any proposed development and any proposed development on this farm must adhere to a buffer area of 100m around this site. Similarly, MOP114, the ruined structure, should be avoided, and a 25m buffer placed around the site. The graves at MOP112 should be fenced, with the fence placed 5m from the visible graves, and a buffer should be instituted 15m from the fence line.

8.4. Potential Impacts on Palaeontology

8.4.1 Results of Impact Assessment

The proposed footprint is underlain by sediments of:

» Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation.
» Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement.

Fossil heritage could be present in the Undifferentiated Karoo as well as the Solitude Formation which has a high to very high Palaeontological Sensitivity. The Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group is metamorphic rocks which is unfossiliferous and with a very low palaeontological sensitivity.

The Farm Du Toit 563 is entirely underlain by the Undifferentiated Karoo and the Solitude Formation. The north-eastern part of the Farm Vrienden 589 falls in the potentially fossiliferous Undifferentiated Karoo and the unfossiliferous Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group.

Palaeontological Sensitivity*	**Group**	**Group / Formation**	**Lithology**	**Period**	**Fossils / Exposures**
High to very high Palaeontological sensitivity/ vulnerability	Undifferentiated Karoo		Sandstone conglomerateshale, mudstone and **coal deposits**	Permian-Triassic	Very poor levels of surface exposure (most data obtained from borehole cores
High to very high Palaeontological sensitivity/ vulnerability	Karoo	Solitude	Reddish and grey mudrocks, sandstones and minor coals, meandering fluvial setting	Upper part possibly = Elliot Lower part probably = Molteno	Upper part possibly = Elliot Lower part probably = Molteno Coal floras including *Dicroidium* in basal Solitude succession. Dinosaur remains supposedly
Very Low Palaeontological sensitivity/vulnerability grey	Archaean Granite-Gneiss Basement	Malala Drift Suite Beit Bridge Complex	Leucogneiss with metaquartzite, hornblende granitoid gneiss, amphibolite, metapelite and calc-silicate rocks	Early to Late Archaean (3.6 –2.4 Ga) (Swazian / Randian)	No fossils recorded
Very Low Palaeontological sensitivity/vulnerability grey	Archaean Granite-Gneiss Basement	Beit Bridge Complex; Gumbu Group	Calc-silicate rocks and marble, together with leucogneisses and subordinate pink hornblende granitoid gneiss, metaquartzite and amphibolite	Early to Late Archaean (3.6 –2.4 Ga) (Swazian / Randian)	No fossils recorded

*Almond et al (2008) and Groenewald et al., (2014).

8.4.2 Quantification of Impacts on Palaeontology

The excavations and site clearance of vegetation will consist of significant excavations into the uppermost sediment cover as well as into the underlying bedrock. These excavations will transform the present topography and may disrupt, destroy or permanently close-in fossils that are then unavailable for research. Geographical extent of impact. The impact on fossil materials and thus palaeontological heritage will be restricted to the construction phase when new excavations into fresh bedrock take place. The extent of the area of potential impact is thus limited to the project site and categorised as local.

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent.

The site is underlain by the Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation; and Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement. The Archaean Granite-Gneiss Basement is metamorphic in origin and thus unfossiliferous while the Undifferentiated Karoo Basin and Solitude Formation has a high to very high palaeontological Sensitivity. During a field survey of the project site, no fossiliferous outcrops were found. For this reason, a low palaeontological sensitivity is allocated to the development footprint.

If the project progresses without care to the chance of fossils being present at the proposed site with the resultant damage and destruction of any affected fossils will be permanent and irreversible. Thus, any fossils occurring within the study area are potentially scientifically and culturally significant and any negative impact on them would be of high significance.

A potential secondary advantage of the construction of the project would be that the excavations may uncover fossils and would have remained unknown to science.

There is a possibility that fossil heritage will be recorded in the study area. Probable significant impacts on palaeontological heritage during the construction phase are high. The intensity of the impact on fossil heritage is rated as medium.

In the event that fossil material does exist within the area proposed for the development, any negative impact upon it could be mitigated by recording and sampling of well-preserved fossils by a professional palaeontologist. This should precede vegetation clearance and occur before the ground is levelled for construction. A collecting permit from SAHRA is required before any fossil heritage may be excavated and the material must be housed in an accredited institution.

The site is underlain by the Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation; and Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement.). The Archaean Granite-Gneiss Basement is metamorphic in origin and thus unfossiliferous, while the Undifferentiated Karoo Basin and Solitude Formation has a high to very high palaeontological Sensitivity. Suggested mitigation of the unavoidable damage and destruction of fossil heritage within the proposed site would involve the recording, and sampling of well-preserved fossils within the development footprint by a professional palaeontologist. This should precede vegetation clearance and occur before the ground is levelled for construction. Due to the expected low occurrence of fossils on the site, the significance of the impact following the mitigation will remain low.

Impacts on fossil heritage are generally irreversible. Well-documented records and other palaeontological studies of any fossils uncovered during construction would signify a positive impact from a scientific view. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of suitable mitigation procedures. With proper mitigation the benefit scale for the project will lie within the beneficial category. It is possible that extraordinary fossil material is present on the development area. By taking a cautionary approach, an insignificant loss of fossil resources is expected.

8.4.2.1 Construction Phase

Impacts on Palaeontological Heritage are likely to happen only within the construction phase. No impacts are expected to occur during the operation phase.

Nature:
The excavations and clearing of vegetation during the construction phase will consist of digging into the superficial sediment cover as well as underlying deeper bedrock. These excavations will change the existing topography and may possibly disturb, destroy or permanently close-in fossils at or below the ground surface. These fossils will then be lost for research.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long term / permanent (5)	Long term /permanent (5)
Magnitude	Minor (2)	Minor (1)
Probability	Improbable (1)	Improbable (1)
Significance	**Low (8)**	**Low (7)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

» The site is underlain by the Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation; and Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement. The Archaean Granite-Gneiss Basement is metamorphic in origin and thus unfossiliferous while the Undifferentiated Karoo Basin and Solitude Formation has a high to very high palaeontological sensitivity. The lack of appropriate exposure at the proposed development footprint (including all three alternative sites) indicates that the impact of the development is of low significance in palaeontological terms.

Residual Impacts:
Loss of palaeontological resources if impacts are not avoided.

8.4.3 Analysis of Layout Alternatives

According to the geology of the development footprint, fossil heritage could be present in the Undifferentiated Karoo which has a very high Palaeontological Sensitivity as well as the Solitude Formation with a high Palaeontological Sensitivity. The Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group is metamorphic rocks which is unfossiliferous and has a very low palaeontological sensitivity. The Farm Du Toit 563 is entirely underlain by the Undifferentiated Karoo and the Solitude Formation. The north-eastern part of the Farm Vrienden 589 falls in the potentially fossiliferous Undifferentiated Karoo and the unfossiliferous Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group. During a field survey (including all three alternative layouts) of the development footprint, no fossiliferous outcrops were found. For this reason, a low palaeontological sensitivity is allocated to the development footprint.

The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Mutsho Power Project, associated infrastructure and all three preferred layout plans will be of a low significance in palaeontological terms. It is therefore considered that the construction and operation of the Mutsho Power Project, associated infrastructure as well as all three alternative layout plans (and with all three alternatives equal) is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

8.5. Potential Noise Impacts

8.5.1 Results of Impact Assessment

Increased noise levels are directly linked to various activities associated with the construction of the facility and related infrastructure as well as the operational phase of the activity.

8.5.1.1 Potential Noise Sources: Construction Phase

Construction equipment
Construction activities include:

» Development of access roads.
» Site establishment (contractor's camp, equipment and material storage, security and access control, security fence).
» Vegetation and topsoil removal.
» Establishment of the waste disposal facilities.
» Establishment of storage (coal stockpile footprints) and material handling facilities.
» Construction of infrastructure (foundations to completed structure).

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15dBA the noise can increase annoyance levels and may ultimately result in noise complaints. The potential extent depends on a number of factors, including the prevailing ambient sound levels during the instance the maximum noise event occurred, as well as the spectral character of the noise and the ambient soundscape in the surroundings.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience.

Commissioning of the Power Station
Significant but temporary noises will be generated during the start-up and commissioning phase of the power plant:

» High energy noises are generated during hot commissioning and clean-out of the heat exchanger and in particular the super-heater piping, using high pressure high temperature steam in order to clean the pipe internals of all welding debris and mill scale. The high pressure steam would be vented to atmosphere, generating high energy noise for a few hours per day over a number of days.
» Testing of high pressure steam safety valves during commissioning could generate very high noise levels. This however is a very temporary event only lasting for a few minutes at a time.

Traffic
An additional source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include heavy and light vehicles transporting equipment, building materials as well as contractors to and from the site. More difficult to define are noises generated due to the development of other commercial activities that provide formal and informal services to the project, employees and contractors.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Considering peak traffic volumes observed at the construction site of the Medupi and Kusile Power Stations, this study assumed 40 heavy and 300 light vehicles (per hour) moving to and from the construction area (travelling at an average of 60 km/h) using the existing road (half of this traffic at night, precautious approach). 20 heavy and 150 light vehicles (per hour) moving around the construction area (half of this traffic at night).

Blasting
Blasting may be required as part of the civil works to clear obstacles. However, blasting has not been considered during the EIA phase for the following reasons:

» Blasting is a highly specialised field, and various management options are available to the blasting specialist. Options available to minimise the risk to equipment, people and infrastructure includes:
  * The use of different explosives that have a lower detonation speed, which reduces vibration, sound pressure levels as well as air blasts.
  * Blasting techniques such as blast direction and/or blast timings (both blasting intervals and sequence).
  * Reducing the total size of the blast.
  * Damping materials used to cover the explosives.
» People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. This is normally associated with close proximity mining/quarrying.
» Blasts will be an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties normally receive sufficient notice (siren), and the knowledge that the duration of the siren noise as well as the blast will be over relatively fast resulting in a higher acceptance of the noise.

8.5.1.2 Potential Noise Sources: Operation Phase

The following is a basic description of the process flow (equipment or processes that generate noise indicated in ***bold italics***) for the generation of electricity:

1. Fuel: When required by the boiler, a ***stacker-reclaimer*** serves coal onto a conveyor system which transports the coal to the ***day silos (material handling)*** next to the ***boiler***. The coal is ***crushed*** and drawn directly into the ***furnace*** for combustion.
2. CFB Boiler ***(air intake fans (induced and forced draft fans), blowers, steam venting, etc.)***: Fluidised beds consist of a bed of sand which is heated up and fluidised by passing streams of air through the sand. Solid fuel (such as coal) is introduced to the hot suspended sand on upward-blowing jets of air and the solid fuels start to combust. The result is a turbulent mixing of gas and solids. The tumbling action provides effective chemical reactions and heat transfer. The CFB has a ***filter system (cyclones typically)*** to separate the sand and coarse particles from the hot flue gases which leave the exhaust of the furnace. Due to the design of the CFB, limestone can be injected directly into the bed where it neutralises most of the sulphur which is released from the fuel during combustion leading to very low Sulphur Dioxide emissions. Intake fans generate significant noises.
3. Smoke stacks ***(Electrostatic Precipitator (ESP)***): Gases that are released from combustion in the furnaces, are filtered and then released into the atmosphere through a smoke stack.
4. ***Ash disposal***: Ash is removed from the exhaust gasses and will be disposed on an ash-dump near the power station. Disposal will be via a ***conveyor belt system*** where spreaders will distribute the ash over the residue deposit.
5. Cooling ***(large cooling fans)***: The proposed power plant will be designed with dry cooling technology in order to significantly reduce water consumption. This is generally the most significant identifiable noise source at a power station.
6. Flue Gas Desulphurisation: SO_2 emissions from the power plant will be controlled by means of limestone injection in the combustion zone of the CFB boilers. Limestone is ***dried***, ***crushed*** and ***injected*** into the boiler using compressed air or blowers.
7. Turbine and generator ***(steam turbine generators)***: The high pressure steam is piped to turbines where it passes through the turbine blades, causing the blades to turn. The movement of the steam through the turbines causes the thermal (heat) energy to be converted to mechanical energy as the turbine is linked to the rotor of the generator. The rotor is an electromagnet which spins inside large coils of copper to generate electricity (alternating current (AC), which is essentially what is produced by a power station.
8. Ancillary services: There are numerous equipment and activities that generate noise. These include the various ***motors*** that drive pumps, ***air compressors***, aerodynamic noises from the various fans and blowers, noises from piping and ducts. This equipment is associated with the larger systems such as ***cyclones***, ***electrostatic precipitators***, ***condenser***, ***heat-exchangers*** etc. and the cumulative effect of these pieces of equipment can have a profound effect on far-field noise levels.

The main sources of noise are associated with the intake and cooling fans as well as material handling activities at the coal stockpile. Boilers, steam turbines and generators are generally constructed within fixed structures that will attenuate the noise from this equipment. Noise from ancillary services and activities such as pumps (boiler feed, water, chemical, condensate and vacuum), air compressors and onsite traffic generally is far less than the noise from the main sources, but, due to cumulative effect can have an impact in the far-field. The addition of the "general noise" noise source represents these noises.

Traffic and Rail

It is assumed that coal will be transported to the site using either road or a new railway connection. Potential noise levels from the railway connection have not be covered as it is excluded in terms Clause 29(c) of the Noise Control Regulations (NCR) (under Section 25 of the ECA).

Potential delivery of coal and limestone using road traffic will use the N1, turning onto the D1021. The D1021 is currently a dirt road, but it is proposed that the road will be tarred as part of the project. Assuming that 11 000 Tons of coal and 263 Tons of limestone are transported by road each day, it would require approximately 74 x peak hour trips (split 50% in / 50% out) for 10 hours per day (32t trucks).

8.5.1.3 Potential Noise Sources: Decommissioning Phase

Decommissioning starts when power generation at the facility stops, signalling the beginning of the dismantling of the equipment. Activities that can take place include:

» Dismantling of the remaining equipment and infrastructure. This includes the following:
  * Dismantling of all equipment.
  * Removal of all remaining redundant infrastructure (buildings, dams, workshop, access roads, possibly the offices and other buildings, etc.).
  * Removal of any contaminated soil.
  * The rehabilitation of disturbed areas including the necessary ripping of compacted soils and the shaping of rehabilitated areas to ensure free drainage.
  * Seeding of disturbed areas (if necessary to re-establish vegetation).
  * Monitoring and maintenance of the rehabilitated areas.

However, while there are numerous activities that can take place during the decommissioning stage, the potential noise impact will only be discussed in general. This is because the noise impacts associated with the decommissioning phase are normally less than both the construction and operational phases for the following reasons:

» Final decommissioning normally takes place only during the day, a time period when existing ambient sound levels are higher, generally masking most external noises for surrounding receptors.
» There is a lower urgency of completing this phase and less equipment remains onsite (and are used simultaneously) to effect the final decommissioning.

8.5.1.4 Construction Phase Noise Impact

A conceptual layout was provided and a scenario was envisaged as discussed below. The potential noise impact from construction activities would be similar for all alternative layouts. This is because the potential noise impact is from increased construction traffic and not construction activities

» Surface development at the location of the Power Station site. Activities include the stripping of vegetation using a bulldozer or grader. Topsoil will be excavated (excavator) and loaded onto a haul truck and stockpiled in the vicinity of the construction site. Construction activities taking place at the four corners and the centre of the project site.
» Surface development at the location of the Residue Deposit Area (ash dump). Activities include the stripping of vegetation (bulldozer or grader). Topsoil will be excavated (excavator) and loaded onto a haul truck and stockpiled just west of the gravel road.
» Access road development using a Grader.
» An estimated 300 light passenger vehicles and 40 heavy vehicles per hour travelling on the access road to and from the construction site (N1 road to Huntleigh station) during the day, with half that travelling at night.

- An estimated 150 light passenger vehicles and 20 heavy vehicles per hour travelling around the construction site during the day, with half that travelling at night.
- Night-time temperature averages 15°C with humidity at 70% (very good conditions for sound propagation).
- Relative soft ground absorption conditions, with 50% of sound waves hitting the ground being absorb by vegetation.

The impact of the noisiest activity (i.e. 110 dBA noise emission level – various construction activities/equipment taking place simultaneously) was modelled at a number of locations.

Results of Modelling – Conceptual Construction Activities

While there are numerous uncertainties, **Table 8.15** illustrates likely distances (potential buffers) between certain activities and potential noise-sensitive developments where noise rating levels may be exceeded.

Table 8.15: Distances from construction activities for set noise rating levels.

Noise Rating level	Distance from numerous simultaneous construction activities (m)	Distance from single construction activity (m)	Distance from conceptualized construction traffic route (m)
35 dBA	1 350m	1 000m	950m
40 dBA	1 050m	600m	500m
45 dBA	680m	340m	220m

8.5.1.5 Operation Phase Noise Impact

Daytime (06:00 – 22:00) and night-time (22:00 – 06:00) future operations were assessed. Most critical investigational times would be the night-time hours when a quiet environment is desired (at night for sleeping, weekends etc. when a quieter environment is desired).

The following assumptions are considered in the conceptual models:

- A preferred scenario as well as two alternatives.
- Noise sources was conceptualised and includes.
  - 2 x Air cooled condensers.
  - Boiler electrical Buildings.
  - 2 x Steam turbine halls.
  - 2 x Intake Fans.
  - 2 x Chimney stacks.
  - A number of material transfer locations (located on turns in conveyor).
  - Limestone and coal crusher houses.
  - Coal day bins.
- No penalties have been added for potential noise sources with an impulsive or tonal character as this is unlikely to occur at the power station.
- Potential delivery of coal and limestone using road traffic will use the N1, turning onto the D1021. The D1021 is currently a dirt road, but it is proposed that the road will be tarred as part of the project. Assuming that 11 000 tons of coal and 263 tons of limestone are transported by road each day, it would require approximately 74 x peak hour trips (split 50% in / 50% out) for 10 hours per day (32t trucks, daytime only).

» Intervening ground conditions of a medium-hard ground nature, i.e. no dense flora etc. (acoustically 50% absorbent).
» Activities functioning during wind-still conditions, in good sound propagation conditions (15°C temperature and 70% humidity).

Results of Modelling – Conceptual Operational Activities

While there are numerous uncertainties, **Table 8.16** illustrates the likely distances (potential buffers) between certain activities and potential noise-sensitive developments where noise levels may be exceeded.

Table 8.16: Distances from conceptual operational for set noise rating levels.

Noise Rating level	Distance from power station (m)	Distance from conveyor belt (m)	Distance from ash dump spreader (m)	Distance from road (m)
35 dBA	2 000 – 2 100m	800 – 900m	600 – 650m	1 700 – 1 300m
40 dBA	1 000 – 1 500m	350 – 400m	250 – 350m	1 000 – 800m
45 dBA	800 – 900m	50 – 100m	150 – 200m	530 – 400m

Currently there are no industrial noise sources within 5 km from the proposed project site and there is therefore no potential for cumulative noise impacts.

8.5.1.6 Decommissioning and Closure Phase Noise Impact

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the construction and operational phases, and noise from decommissioning and closure phases will therefore not be investigated further.

8.5.2 Quantification of Noise Impacts of the Mutsho Power Project

8.5.2.1 Construction Phase

Considering the projected noise rating levels as well as the expected daytime ambient sound level, there is a potential risk for a noise impact during the construction phase for the scenario as evaluated.

Nature: Various construction activities taking place simultaneously during the day.		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Short (2)	Short (2)
Magnitude	Medium (6)	Low (2)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (22)**	**Low (7)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation:		

» No mitigation is required or recommended.
Residual Impacts: No residual noise impacts are expected.

Nature: Various construction activities taking place simultaneously at night.		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Short (2)	Short (2)
Magnitude	Very High (10)	Low (2)
Probability	Highly probable (4)	Very improbable (1)
Significance	**Medium (52)**	**Low (7)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » The reason for the noise impact would be due to increased night-time traffic. Minimizing night-time traffic, the temporary development of a noise barrier (between the access road and the NSD) or the relocation of the access route further from this NSD would reduce the noise level (further than 330m).		
Residual Impacts: No residual noise impacts are expected.		

8.5.2.2 Operation Phase

It is assumed that receptor (NSD10) located on the proposed project site (i.e. the Farm Vrienden 589 which is owned by Fumaria Property Holdings (Pty) Ltd, a Special Purpose Vehicle (SPV) which is wholly owned by MC Mining Ltd (MCM)) will be relocated before the construction phase and the potential noise impact on NSD10 will not be considered.

The significance of the noise impact is considered to be low on all receptors for the scenario as evaluated (subject that the dwelling at NSD10 is not used or the NSD is relocated).

Nature: Various power generating activities taking place simultaneously during the day (applicable to all layout alternatives)		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (2)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (9)**	**Low (9)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No

Can impacts be mitigated?	Not required for daytime activities.	

Mitigation:

» No mitigation required.

Residual Impacts:

No residual noise impacts are expected.

Nature:

Delivery of coal and limestone using road traffic during the day.

	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Very High (10)	Medium (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (51)**	**Low (26)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Possible to mitigate the noise impact.	

Mitigation:

» Options to reduce noise levels at NSD04 includes:
  * The road can be relocated further than 330m from the NSD04.
  * The developer can develop an acoustic barrier (wall or soil berm) between the road and NSD04.

Residual Impacts:

No residual noise impacts are expected.

Nature:

Various power generating activities taking place simultaneously at night (applicable to the Preferred Alternative).

	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (6)	Medium (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (26)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Possible to mitigate the noise impact but not required.	

Mitigation:

» The layout can be designed to ensure that the noisiest activities and equipment are located further than 1 500m from the closest dwellings.

» Continued communication with the surrounding NSDs to ensure acceptable neighbour relations.

» Design of layout to use buildings as potential sound barriers.

Residual Impacts:

No residual noise impacts are expected.

Nature: Various power generating activities taking place simultaneously at night (applicable to Alternative A).		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low-medium (5)	Low-medium (5)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (24)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Possible to mitigate the noise impact but not required.	
Mitigation: » No mitigation required with the second alternative layout.		
Residual Impacts: No residual noise impacts are expected.		

Nature: Various power generating activities taking place simultaneously at night (applicable to Alternative B).		
	Without Mitigation	**With Mitigation**
Extent	Local (3)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (6)	Medium (6)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (26)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Possible to mitigate the noise impact.	
Mitigation: » The layout can be designed to ensure that the noisiest activities and equipment are located further than 1 500m from the closest dwellings. » Continued communication with the surrounding NSDs to ensure acceptable neighbour relations. » Design of layout to use buildings as potential sound barriers.		
Residual Impacts: No residual noise impacts are expected.		

8.5.2.3 Decommissioning Phase

Final decommissioning activities will have a noise impact lower than either the construction or operational phases. This is because decommissioning and closure activities normally take place during the day using minimal equipment (due to the decreased urgency of the decommissioning phase). While there may be various activities, there is a very small risk for a noise impact.

8.5.3 Analysis of Layout Alternatives

The proposed power generation activities (worse-case evaluated) will raise the noise levels in the direct vicinity of the power station with a potential to increase the noise levels slightly at the closest receptors (the Preferred Alternative and Alternative A). The significance of the potential noise impact will be medium without mitigation but can be mitigated to low significance for these layouts. Alternative A will have a noise impact of low significance and would be the preferred option, although it should be noted that all the layout options are acceptable with mitigation.

Due to low ambient sound levels in the area, construction and operational activities will be audible at most NSDs in the area (up to 5 000m during quiet periods).

However, the project will greatly assist in the provision of energy, which will allow further economic growth and development in South Africa. The project will generate short and long-term employment and other business opportunities. People in the area that are not directly affected by increased noises could have a positive perception of the project and will see the need and desirability of the project.

8.6. Potential Visual Impacts

8.6.1 Results of Impact Assessment

Receptors within the landscape which due to use could be sensitive to landscape change include:

Area Receptors:

» Settlement Areas, particularly Mopane which is the closest settlement to the proposed development.
» A number of Protected Areas to the north and east of the proposed site. The closest include the Baobab Tree Reserve which is approximately 34km to the north east of the proposed site, and the Honnet Nature reserve which is approximately 34km to the east of the proposed site.

Linear Receptors:

Linear receptors generally include routes through the area. Because there is such a focus on eco-tourism activities, both major and minor routes are important. It might be argued that minor un-surfaced roads are more important than major surfaced roads as they are likely to provide access to the eco-tourism attractions. Major routes include:

» The N1 which is the main regional arterial route that carries traffic from the Zimbabwe border crossing at Beitbridge and Gauteng. At its closest the N1 runs approximately 6km from the proposed site.
» Regional roads including the R525, the R572, the R508 and the R523. The closest regional road is the R525 which at its closest is approximately 10km from the proposed site.
» Local Roads that are largely un-surfaced. A number of local roads run in close proximity to the proposed site area including one that runs between the two properties that make up the site area and one that runs immediately to the south of the proposed development through the Farm Vrienden 589 linking directly to the N1.

In addition to roads, there is a railway line that runs between the two properties that make up the site. This section of the railway is likely to be largely carrying freight between Zimbabwe and South Africa. Passenger services in South Africa currently terminate at Messina and commence on the Zimbabwe side of the border at Beitbridge so it is also likely to carry passengers. Research indicates that no major tourist trains such as the Blue Train use this route. The importance of the railway as a receptor is therefore likely to be relatively low.

Point Receptors:
More than 370 point receptors have been identified from mapping and aerial photography within the approximate visual limit of the proposed development (50km). These include:

» Individual buildings that are likely to be mainly rural homesteads and farms. It is likely that a proportion of these include tourist lodges and accommodation.
» Small groups of dwellings that are likely to include small settlement areas and larger farm establishments which may also include tourist bush camps.

8.6.1.1.1 The Nature of Potential Visual Impacts

Impacts could include general landscape change due to the development as it could detract from the existing character as well as change of view for affected people and / or activities.

» General landscape change or degradation. This is particularly important for protected areas where the landscape character might be deemed to be exceptional or rare. However it can also be important in non-protected areas particularly where landscape character is critical to a specific broad-scale use such as tourism or just for general enjoyment of an area. This is generally assessed by the breaking down of a landscape into components that make up the overall character and understanding of how proposed elements may change the balance of the various elements. The height, mass, form and colour of new elements all help to make new elements more or less obvious as does the structure of an existing landscape which can provide screening ability or texture that helps to assimilate new elements. This effect is known as visual absorption capacity.
» Change in specific views within the affected area from which the character of a view may be important for a specific use or enjoyment of the area.
  * Visual intrusion is a change in a view of a landscape that reduces the quality of the view. This can be a highly subjective judgement. Subjectivity has however been removed as far as is possible by classifying the landscape character of each area and providing a description of the change in the landscape that will occur due to the proposed development. The subjective part of the assessment is to define whether the impact is negative or positive. To make the assessment as objective as possible, the judgement is based on the level of dependency of the use in question on existing landscape characteristics.
  * Visual obstruction is the blocking of views or foreshortening of views. This can generally be measured in terms of extent.

Due to the nature of the proposed development, visual impacts are expected to relate largely to intrusion.

8.6.1.1.2 Possible Visual Implications of Development

The approximate limit of visibility is based on a universally accepted navigational formula that is used to calculate the distance to the visual horizon. This formula has been used to provide an indication of the likely distance that the proposed structures might be visible over. This indicates that in a flat landscape the proposed structures may be visible for the following distances:

ASSUMED HEIGHT OF ELEMENTS	APPROXIMATE LIMIT OF VISIBILITY
Extremely tall elements which include the stack which is up to 150m high.	50.5km
Moderately tall elements including the power generation units, silos and ash dump up to 60m high.	27.7km
Low elements including the coal stockpile, conveyors, offices and substation up to 20m high.	16km

In reality these distances could be reduced by:

» Weather conditions that limit visibility. This would include hazy conditions during fine weather as well as mist and rain.
» Scale and colour of individual elements making it difficult to differentiate structures from background.

The general nature of the landscape in which the proposed development will be set comprises of gently undulating topography and natural vegetation that generally extends above the head height of a person. The height of the proposed development is likely to result in the development being potentially visible over a relatively wide area. However, the natural vegetation cover combined with relatively flat topography is likely to limit visibility even of the tallest elements. The development is likely to be most obvious from the tops of local ridgelines and be increasingly screened as the viewer moves into lower areas.

The dumps associated with the existing Syerfontein Mine which is located approximately 6km to the north of the proposed development were relatively well hidden even from close quarters due to their position below a minor ridgeline that provides screening from the east and due to existing vegetation which provides screening from most roads. The exception to this was from an elevated viewpoint where views were possible over the tree line. This indicates that the Visual Absorption Capacity of the existing landscape is likely to be such that even moderately tall elements are likely to be largely screened with the exception of the immediate vicinity, from cleared areas such as along roads and from elevated areas.

8.6.1.1.3 Visibility of the Proposed Development

<u>Zones of Theoretical Visibility (ZTV) of Extremely Tall Elements (Stacks)</u>
The tallest structures associated with the proposed development, are likely to be visible over the widest area. From the majority of receptors including homesteads, roads and protected areas, the natural vegetation cover will screen these elements. Exceptions to this include elevated areas where views are possible over adjacent vegetation, cleared areas such as VP1 where the stacks will be visible across a cleared field, along cleared road alignments and from immediately adjacent areas.

It is highly unlikely that these extremely tall elements will be obvious from protected areas. The stack associated with all options will be visible over very similar areas. They will be visible to:

» The R523 at a distance of approximately 31km (VP1). Views to this road will be intermittent over approximately 5km of road in the vicinity of Waterpoort. Given the distance, it is unlikely that the development will be obvious.
» The ZTV analysis indicates that the stacks of all options could be visible from the N1 at a distance in excess of 9.7km. It was not possible to find a viewpoint from which the alternative stacks are likely to be visible due to the extent of screening provided by natural vegetation immediately adjacent to the road (VP2).

It is possible however that views of the top of the stack could be visible over short sections of the road over approximately 15km. These views are however unlikely to be obvious.

» Local roads to the southwest, the west-north-west, north, the south and north-east of the development. One local road runs through the proposed site between the Farm Du Toit 563 and the Farm Vrienden 589. Whilst the ZTV analysis indicates that the stacks may be visible over extensive sections of these roads, clear views of the alternative stacks are likely to be largely limited to small sections of these roads and particularly to the Mopane to Waterpoort road that runs through the site, largely due to existing natural vegetation. It is estimated that the alternative stack position will be visible to approximately 6km of the road to the north of the site and approximately 20km to the south of the site. This extent of visibility is due to the fact that cleared areas beside and along the road are aligned directly on the site (VPs 4, 5 and 7).
» Approximately 370 point receptors that are likely to be largely comprised of homesteads have been identified within the approximate limit of visibility. However only those that are elevated on minor ridgelines and overlooking the site and those within the immediate vicinity of the proposed site are likely to be affected to a significant degree. These include three homesteads that lie within 2.5km of the proposed development, a further two homesteads within 5km of the proposed development and one homestead which is elevated on a ridgeline and approximately 7km to the north, north-east of the proposed development.

<u>The ZTV of Moderately Tall Elements</u>

As all alternative layouts the Power Generating Units are located to the south of the ash heaps, it is likely that as the ash heaps grow they will start to screen views of other elements from receptors to the north. The ZTV analysis indicates that these elements may be largely visible from a band that is approximately 11km wide extending approximately 13km to the north-east and approximately 13km to the south-west. Views may also be possible from the north-western quadrant at distances generally in excess of 20km.

From the majority of receptors including homesteads, roads and protected areas, the natural vegetation cover will screen these elements. Exceptions to this include elevated areas where views are possible over adjacent vegetation, cleared areas such as VP1 where the alternative stack will be visible across a cleared field, along cleared road alignments and from immediately adjacent areas.

These elements will not be visible from protected areas. This section of the development will not be visible from the R523. They are likely to be visible to:

» The ZTV analysis indicates that the alternative stacks could be visible from the N1 at a distance in excess of 9.7km. Due to the extent of screening provided by natural vegetation immediately adjacent to the road (VP2) it was not possible to find a viewpoint from which the alternative stack likely to be visible. It is possible however that views of the tops of stacks could be visible over short sections of the road over approximately 15km. These views are unlikely to be obvious however.
» Local roads to the south-west, the west-north-west, north and north-east of the development. One local road runs to the west of the proposed development through the proposed site between the Farm Du Toit 563 and the Farm Vrienden 589 and one road runs to the south of the proposed development through the Farm Vrienden 589. Whilst the ZTV analysis indicates that the moderately tall elements may be visible over extensive sections of these roads, clear views of these elements are likely to be largely limited to small sections of these roads and particularly to the Mopane to Waterpoort road that runs through the site largely due to existing natural vegetation. It is estimated that they will be visible to approximately 6km of the road to the north of the site and approximately 6km to the south of the site.

This extent of visibility is due to the fact that cleared areas beside and along the road are aligned directly on the site (VPs 4 and 5).

» Approximately 370 point receptors that are likely to be largely comprised of homesteads have been identified within the approximate limit of visibility. However only those that are elevated on minor ridgelines and overlooking the site and those within the immediate vicinity of the proposed site are likely to be affected to a significant degree. These include three homesteads that lie within 2.5km of the proposed development, a further two homesteads within 5km of the proposed development and one homestead which is elevated on a ridgeline and approximately 7km to the north, north-east of the proposed development.

<u>The ZTV of Low Elements</u>

Low elements including the coal stockpile, buildings, conveyors and the substation will possibly be visible up to approximately 16km. In reality however they will be screened by larger and more obvious elements and the screening effect of existing natural vegetation is likely to hide them from all but from areas immediately to the development. These elements therefore largely have the potential to exacerbate impacts of taller elements particularly from immediately adjacent areas. The nature of the impact will be subject to the nature of the element visible. The following possible impacts are noted:

» All low elements associated with the Preferred Alternative are further from the Mopane to Waterpoort Road than the elements associated with Alternative A and Alternative B. This option therefore has the potential to minimise impacts associated with low elements on local roads.
» The substation associated with all alternatives is located close to the Mopane to Waterpoort Road. This element is likely to have the greatest impact on local roads.
» Approximately 370 point receptors that are likely to be largely comprised of homesteads have been identified within the approximate limit of visibility. However only those that are within the immediate vicinity of the proposed site are likely to be affected to a significant degree. There are three homesteads to the south and in close proximity of the proposed alternative layouts:
  * The closest homestead is within approximately 1.2km of both the Preferred Alternative and Alternative B and approximately 1.6km of Alternative A.
  * The next closest homestead is within 1.6km of all alternatives.
  * The next closest homestead is within 1.6km of both the Preferred Alternative and Alternative B and 2.1km of Alternative A respectively.

  It should be noted that over these distances it would be possible to augment existing natural vegetation to ensure that sufficient screening is provided to hide lower elements from these homesteads.

8.6.1.1.4 Implications for Landscape Character Areas

The proposed development will impact on a relatively natural rural landscape. The landscape in the vicinity of the proposed development has not been subject to major modification. Whilst there are mining activities and settlements in relatively close proximity, these activities have not changed the broader natural landscape experience because of their relatively low level and limited extent. Largely due to its height, the proposed development has the potential to introduce an industrial feeling into a wide area. However, due to the relatively flat topography and the amount of screening that is currently provided by natural vegetation, the wholesale change in character is likely to be experienced over a relatively limited area only extremely tall elements (i.e. the stacks) having a lesser influence over a more extensive area.

8.6.2 Quantification of Visual Impacts

Impacts identified will all gradually increase from the current situation to the impact level indicated during the construction phase, be consistent at the impact levels indicated during the operational phase and decrease again from the levels indicated to close to the current situation during the decommissioning phase.

Nature:
Industrialisation of the surrounding Rural Landscape.

- » The proposed development could negatively impact on the character of the Undulating Plain LCA which is largely a natural landscape which may be an important tourism resource.
- » The proposed development could impact negatively on the Valley Ridgeline and the Soutpansberg upland areas that overlook the Undulating Plain. Levels of impact will be subject to distance and there being viewpoints overlooking the site.

The affected landscape has a relatively cohesive natural character that is valuable for local tourism activities.

The contrast between the undulating natural plain and the Soutpansberg range approximately 30km to the south of the proposed development has been highlighted as a characteristic that provides an important regional identity. The distance between the proposed development and the Soutpansberg should be sufficient buffer to ensure that this regional importance is not placed at risk.

This main impact relates to industrialisation of the rural landscape surrounding the proposed site. This will occur if views of the proposed power station and associated infrastructure become visible and obvious from areas that are currently natural in character. Given the VAC of the existing landscape, major impacts are likely to be limited to roads and homesteads in the immediate vicinity of the proposed development. There is also likely to be a small impact potentially extending to the limit of visibility of the tallest elements associated with the development.

All alternative layouts are likely to have a similar level of impact.

	Without Mitigation	**With Mitigation**
Extent	Local Impact Site and Immediate Surroundings (2) Regional Impact Regional (3)	Local Impact Site and Immediate Surroundings (2) Regional Impact Regional (3)
Duration	Local Impact Long Term (4) Regional Impact Long Term (4)	Local Impact Long Term (4) Regional Impact Long Term (4)
Magnitude	Local Impact Moderate (6) Regional Impact Minor (2)	Local Impact Low to Moderate (5) Regional Impact Small to Minor (1)
Probability	Local Impact Highly Probable (4) Regional Impact Probable (3)	Local Impact Highly Probable (4) Regional Impact Improbable to Probable (2)

Significance	**<u>Local Impact</u>** **Medium (48)** **<u>Regional Impact</u>** **Low (27)**	**<u>Local Impact</u>** **Medium (44)** **<u>Regional Impact</u>** **Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes, to a degree	

Mitigation:

Planning:

» Plan to maintain the height of structures as low as possible.
» Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.
» Plan screen planting to soften views of the development particularly for closest receptors (local roads and homesteads).
» Plan grassing of ash dump.
» Plan contouring of ash dump to integrate with the local landform.
» Use dust suppression on the ash dump and coal yard.
» Plan colours of structures to visually blend with the local landscape.

Construction:

» Minimise disturbance and loss of existing vegetation.
» Undertake rehabilitation of disturbed areas.
» Undertake screen planting.
» Undertake dust suppression and management.

Operations:

» Monitor rehabilitated areas and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
» Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
» Dust suppression and management at the ashing facility must be implemented and maintained.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.
» Return all possible areas to their original state.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Residual Impacts:

The residual impact relates to loss of rural landscape being obvious on decommissioning of the proposed project. In order to minimise this impact, it is critical that existing rural landscape areas in and around the development are maintained and protected and that effective rehabilitation is undertaken during and after construction as well as on closure of the plant.

Nature:

The proposed development could be visible from and impact negatively on tourist routes in the area.

The N1 and the R523 are the main tourist routes that run through the area and have potential to be affected. The development is unlikely to be obvious from the N1, it will however be visible from short sections of the R523. Views are likely to be from a distance in the order of 33km and are likely to be comprised of a section of a single stack that is will be seen extending above the adjacent ridgeline.

All options are likely to have a similar level of impact on these strategic routes.

A number of local, un-surfaced roads run through the area close to the project. These are important for local tourism activities.

Views of the proposed development from the majority of these roads are likely to be limited largely due to existing natural vegetation. One road (Mopane / Waterpoort) runs through the proposed site and whilst elements of all options alternatives are likely to be visible, the least preferred optional alternative layout has an ash tip dump located close and to the east of this road and the alternative layout option has an ash tip dump located on either side of the road with a conveyor crossing above the road.

The project will also be visible from a short section (approximately 250m) of a local road to the west of Mopane as it traverses a minor ridgeline.

All options also have the substation located adjacent and to the south of the road.

	Without Mitigation	**With Mitigation**
Extent	N1 & R523 Regional (3) Local Roads Local (2)	N1 & R523 Regional, (3) Local Roads Local (2)
Duration	N1 & R523 Long term (4) Local Roads Long term (4)	N1 & R523 Long term (4) Local Roads Long term (4)
Magnitude	N1 & R523 Small to Minor (2) Local Roads / Preferred Option Moderate (6) Local Roads / Alternative Option High (8) Local Roads / Least Preferred Option Moderate to High (7)	N1 & R523 Minor (0) Local Roads / Preferred Option Low to Moderate (5) Local Roads / Alternative Option High (8) Local Roads / Least Preferred Option Moderate to High (7)
Probability	N1 & R523 Improbable (2) Local Roads / Preferred Option Definite (5) Local Roads / Alternative Option Definite (5) Local Roads / Least Preferred Option Definite (5)	N1 & R523 Improbable (2) Local Roads / Preferred Option Highly Probable (4) Local Roads / Alternative Option Definite (5) Local Roads / Least Preferred Option Definite (5)
Significance	**N1 & R523** **Low (18)**	**N1 & R523** **Low (14)**

	Local Roads / Preferred Option **Medium (60)** **Local Roads / Alternative Option** **High (70)** **Local Roads / Least Preferred Option** **High (65)**	**Local Roads / Preferred Option** **Medium (44)** **Local Roads / Alternative Option** **High (70)** **Local Roads / Least Preferred Option** **High (65)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss
Can impacts be mitigated?	Yes, to a small degree	

Mitigation:

Planning:

» Move the location of the substation to allow an effective buffer area between the Mopane / Waterpoort Road and the substation. The width of the buffer will be subject to screen planting proposals, however, a minimum width of 30m should be sufficient to provide a relatively dense visual screen.
» Plan to maintain the height of structures as low as possible.
» Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:

» Minimise disturbance and loss of vegetation.
» Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
» Undertake rehabilitation of disturbed areas.
» Undertake screen planting between the substation and the Mopane / Waterpoort Road.

Operations:

» Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment , thereafter at the middle and end of every growing season).
» Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
» Control dust on the ashing facility.
» Contour the ashing facility to reflect the surrounding natural landform.
» Establish grass on the ashing facility as filling proceeds.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.
» Return all possible areas to their original state.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Residual Impacts:

The residual impact relates to loss of rural landscape being obvious on decommissioning of the proposed project. In order to minimise this impact, it is critical that existing rural landscape areas in and around the development are maintained and protected and that effective rehabilitation is undertaken during and after construction as well as on closure of the plant.

Nature:

The proposed development could impact on tourist's views from trains.

The proposed development is likely to be highly obvious from trains as they pass through the area.

The degree of impact is likely to be similar as that experienced from the Mopane / Waterpoort Road. However because the railway is not likely to carry any significant number of tourists, the probability of impacts is relatively low.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	<u>Preferred Option</u> Moderate (6) <u>Alternative Option</u> High (8) <u>Least Preferred Option</u> Moderate to High (7)	<u>Preferred Option</u> Low to Moderate (5) <u>Alternative Option</u> High (8) <u>Least Preferred Option</u> Moderate to High (7)
Probability	<u>Preferred Option</u> Improbable (2) <u>Alternative Option</u> Improbable (2) <u>Least Preferred Option</u> Improbable (2)	<u>Preferred Option</u> Improbable (2) <u>Alternative Option</u> Improbable (2) <u>Least Preferred Option</u> Improbable (2)
Significance	**<u>Preferred Option</u>** **Low (24)** **<u>Alternative Option</u>** **Low (28)** **<u>Least Preferred Option</u>** **Low (26)**	**<u>Preferred Option</u>** **Low (22)** **<u>Alternative Option</u>** **Low (28)** **<u>Least Preferred Option</u>** **Low (26)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss
Can impacts be mitigated?	Yes, to a small degree	

Mitigation:

Planning:

» Move the location of the substation to allow an effective buffer area between the railway and the substation. The width of the buffer will be subject to screen planting proposals, however, a minimum width of 30m should be sufficient to provide a relatively dense visual screen.
» Plan to maintain the height of structures as low as possible.
» Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:

» Minimise disturbance and loss of vegetation.
» Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
» Undertake rehabilitation of disturbed areas.
» Undertake screen planting between the substation and the Railway.

Operations:

» Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
» Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
» Control dust on the ashing facility.

» Contour the ashing facility to reflect the surrounding natural landform.
» Establish grass on the ashing facility as filling proceeds.

Decommissioning:
» Remove infrastructure not required for the post-decommissioning use of the site.
» Return all possible areas to their original state.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Residual Impacts:
The residual impact relates to loss of rural landscape being obvious on decommissioning of the proposed project. In order to minimise this impact, it is critical that existing rural landscape areas in and around the development are maintained and protected and that effective rehabilitation is undertaken during and after construction as well as on closure of the plant.

Nature:
Industrialisation of Views from Protected Areas.

The assessment has indicated that the development is highly unlikely to be obvious from protected areas.

The ZTV analysis indicates that the Honnet Reserve is the only protected area that could potentially be affected. It is likely however that distance and existing natural vegetation will largely mitigate any impact.

All layout options alternatives are likely to result in the same level of impact.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Small to minor (1)	Small (0)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (16)**	**Low (7)**
Status (positive or negative)	Neutral	Neutral
Reversibility	Low	Low
Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss
Can impacts be mitigated?	Yes, to a very small degree	

Mitigation:
Planning:
» Plan to maintain the height of structures as low as possible.

Construction:
» Colouring of taller structures should be such that they are not made prominent and preferably visually recede.

Operations:
» Control dust on the ashing facility.
» Contour the ashing facility to reflect the surrounding natural landform.
» Establish grass on the ashing facility as filling proceeds.

Decommissioning:
» Remove infrastructure not required for the post-decommissioning use of the site.

Residual Impacts:

The residual impact relates to loss of rural landscape being obvious on decommissioning of the proposed project. In order to minimise this impact, it is critical that existing natural landscape areas in and around the development are maintained and protected and that effective rehabilitation is undertaken during and after construction as well as on closure of the plant.

Nature:
The proposed development could impact negatively on settlements.

Mopane is the only settlement that is likely to be affected.

The ZTV analysis indicates that both the Extremely Tall and Moderately Tall elements may be visible from Mopane.

From the site visit however, it seems likely that vegetation both within and surrounding the settlement will largely screen the proposed development. It is possible that the top of the stack associated with each layout alternative may be visible. This is unlikely to significantly influence landscape character as experienced from within this small settlement.

Levels of impact are therefore anticipated to be relatively low.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Small to minor (1)	Small (0)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (14)**	**Low (12)**
Status (positive or negative)	Neutral to Negative	Neutral
Reversibility	Low	Low
Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss
Can impacts be mitigated?	Yes, to a small degree	

Mitigation:
Planning:
» Plan to maintain the height of structures as low as possible.
» Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:
» Minimise disturbance and loss of vegetation.
» Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
» Undertake rehabilitation of disturbed areas.

Operations:
» Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
» Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
» Control dust on the ashing facility.
» Contour the ashing facility to reflect the surrounding natural landform.
» Establish grass on the ashing facility as filling proceeds.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.
» Return all possible areas to their original state.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Residual Impacts:
The residual impact relates to loss of rural landscape being obvious on decommissioning of the proposed project. In order to minimise this impact, it is critical that existing natural landscape areas in and around the development are maintained and protected and that effective rehabilitation is undertaken during and after construction as well as on closure of the plant.

Nature:
Industrialisation of Views from Homesteads and recreational / local tourism facilities.

Homesteads and recreational / local tourism facilities are assessed together because both are point receptors and it is likely that some farms in the area may have a secondary or primary tourism use.

Due to the high level of VAC of the landscape, the majority of properties that are indicated as being affected by the ZTV analysis and within the approximate limit of visibility of the various elements are unlikely to be affected.

Approximately 370 point receptors that are likely to be largely comprised of homesteads have been identified within the approximate limit of visibility. However only those that are elevated on minor ridgelines and overlooking the site and those within the immediate vicinity of the proposed site are likely to be affected to a significant degree. These include three homesteads that lie within 2.5km of the proposed development, a further two homesteads within 5km of the proposed development and one homestead which is elevated on a ridgeline and approximately 7km to the north, north east of the proposed development.

It is noted that all alternative layouts have the ash dump to the north of the main area of development. A possible partial mitigation particularly for views from the homestead on the elevated ridge to the north would be to dump material from north to south and rehabilitating the northern face of the dump at an early stage. This is likely to help provide screening and would minimise the impact of the ash dump. The ash dump associated with the least preferred option appears likely to provide the greatest degree of screening.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate to high (7)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**High (65)**	**Medium (60)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Irreplaceable loss	Irreplaceable loss
Can impacts be mitigated?	Yes, to a small degree	

Mitigation:
Planning:

» Plan to fill the ashing facility from north to south.
» Plan to maintain the height of structures as low as possible.
» Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:

» Minimise disturbance and loss of vegetation.
» Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
» Undertake rehabilitation of disturbed areas.

Operations:
» Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
» Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
» Control dust on the ashing facility.
» Contour the ashing facility to reflect the surrounding natural landform.
» Establish grass on the ashing facility as filling proceeds.

Decommissioning:
» Remove infrastructure not required for the post-decommissioning use of the site.
» Return all possible areas to their original state.
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Residual Impacts:
The residual impact relates to loss of rural landscape being obvious on decommissioning of the proposed project. In order to minimise this impact, it is critical that existing natural landscape areas in and around the development are maintained and protected and that effective rehabilitation is undertaken during and after construction as well as on closure of the plant.

Nature:
Lighting impacts.

The area is currently relatively dark at night with relatively low level light sources generally being located at each local homestead, at each house within the settlement of Mopane and relatively intense but localised security lighting at the Syerfontein Mine.

Lighting on the project is likely to include:

» Aviation warning lights are required on the top of the stack. This is highly unlikely to cause nuisance for neighbours.
» Operational lighting will be required at buildings.
» Floodlighting is likely to be required for key operational areas including the sub-station. This may be required to ensure that maintenance work can be undertaken during hours of darkness.
» Internal road lighting is likely to be required.
» Security lighting is likely to be required. This may be high mast lighting or boundary lighting along the fence line.

The largest risk of nuisance is likely to be associated with flood lit areas, boundary security lighting and high mast lighting.

Receptors at greatest risk of impact include:

» The adjacent Mopane / Waterpoort local road.
» The closest homesteads.

	Without Mitigation	**With Mitigation**
Extent	Site and immediate surroundings (2)	Site and immediate surroundings (2)

Duration	Long term (4)	Long term (4)
Magnitude	Low (4)	Minor to Small (1)
Probability	Probable (3)	Improbable (2)
Significance	**Low (30)**	**Low (14)**
Status (positive or negative)	Negative	Neutral
Reversibility	High	High
Irreplaceable loss of resources?	No irreplaceable loss	No irreplaceable loss
Can impacts be mitigated?	Yes	

Mitigation:

Domestic level lighting within the office and control room area can be mitigated by:

» Minimising lighting of the facility as far as possible.
» The use of sensors to ensure that when there is no one present, lighting automatically switches off.
» Careful choice of external fittings to ensure that light is focused on relevant areas and does not spill into un-necessary areas.
» Shielding of all external lights.

Security / Maintenance lighting at the substation can be mitigated by:

» The use of infra-red technology for security purposes.
» Ensuring that maintenance is scheduled for daylight hours where possible.
» Where maintenance may be required during the hours of darkness lighting should only be activated for the areas required.
» Ensure that all lighting is focused on the area of interest and that light spill is minimised.
» Using light shields to minimise light spill.

Residual Impacts:

No residual impacts have been identified.

8.6.3 Analysis of Layout Alternatives

i. Comparison of Alternatives

<u>Preferred Alternative:</u>

The Preferred Alternative would be developed completely on the Farm Vrienden. The power island would be developed approximately 0.2km to the north of the un-surfaced road that runs through the Farm Vrienden 589 and approximately 1km to the east of the un-surfaced Mopane to Waterpoort Road. The proposed location for the ash dump is approximately 0.9km to the north of the un-surfaced road that runs through the property and approximately 1.2km to the east of the un-surfaced Mopane to Waterpoort Road.

<u>Alternative A:</u>

Alternative A would be developed on both the Farm Vrienden 589 and the Farm Du Toit 563. The power island would be developed approximately 0.8km to the north of the un-surfaced road that runs through the Farm Vrienden 589 and approximately 0.6km to the east of the un-surfaced Mopane to Waterpoort Road. The proposed location for the ash dump is approximately 1.7km to the north of the un-surfaced road that runs through the property and it would be split and close to either side of the un-surfaced Mopane to Waterpoort Road. This would require a conveyor structure to cross this road and railway.

<u>Alternative B:</u>

Alternative B would be developed completely on the Farm Vrienden 589. The power island would be developed approximately 0.2km to the north of the un-surfaced road that runs through the Farm Vrienden

589 and approximately 1km to the east of the un-surfaced Mopane to Waterpoort Road. The proposed location for the ash dump is approximately 0.8km to the north of the un-surfaced road that runs through the property and to the east and immediately adjacent to the un-surfaced Mopane to Waterpoort Road.

ii. Nomination of Preferred Alternative

The Preferred Alternative is favoured from a visual perspective. It helps to minimise local impacts on the adjacent Mopane / Waterpoort Road when compared with the other layout alternatives. The retention of existing vegetation and implementation of localised screen planting should help to minimise visual impacts from this road.

8.7. Potential Socio-economic Impacts

8.7.1 Results of Impact Assessment

The north-western portion of the proposed project site has erosion dongas. Directly south and north-west from the project site are cultivated orchards. In addition, north to the project site, erosion dongas and plantations are found. Furthermore, tourism offerings are prevalent in the region.

The Mopane area is located 7km to the north-east of the project site. Here, a small residential area is located as well as mining activity. In addition, a residential settlement called Mudimeli is located 18km south-east from the proposed project site.

In terms of land capability, the project site and its surroundings have largely non-arable land, with a low to moderate potential for grazing, which was also noted by landowners during interviews. In addition, there are portions of wilderness in the direct zone of influence. Directly south from the project site is arable land with marginal potential. The Farm Du Toit 563 is located in a mineral region, which expands from the west to the east of the farm.

Table 8.17 summarises the existing socio-economic activities observed on the farms that may directly or indirectly be impacted by the proposed project, based on the responses received during the initial engagement with the stakeholders. Nine of thirteen adjacent land owners could not be contacted due to no response to email questionnaires and telephones. Two repeat attempts were made to follow up on emailed questionnaires with no success. Therefore, their views are not represented in this study.

During the engagement with the landowners, the following concerns were also raised with respect to the proposed project:

- » Disturbance of daily activities: increased crime, air pollution and noise pollution.
- » Losses to be incurred: income loss, loss of tranquillity, loss of habitat, loss of flora and fauna and job losses.
- » Drought: increase in livestock mortality, further strain on scarce water resource.
- » Visual impact: visual change in a tourism rich and dependent area.

Table 8.17: Economic activity information per farm portion.

Farm Portion and size	Agricultural/Economic activity	Yield/ Number	Number of employees
Farm Du Toit 563 0/563	<u>Game Farm:</u>	No accurate figure	1 permanent employee

Farm Portion and size	Agricultural/Economic activity	Yield/ Number	Number of employees
	Kudus, Impalas, Waterbucks, Roes, Blue Wildebeest, Eland		
	<u>Livestock farming:</u> Cattle	Approximately 40 cattle	
Farm Vrienden 589 0/589	No data is available.	No data is available.	No data is available.
Farm Verdun 535 RE/535	<u>Crop farming:</u> Lucerne Bale	18 ha/month 120 bales/ha/month	5 permanent employees
	<u>Game Farm:</u> Kudus, Impalas, Waterbucks, Roes, Blue Wildebeest and Eland	180 animals	
Farm Hermanus 533 0/533	<u>Game farm:</u> Kudus, Impalas, Waterbucks, Roes, Blue Wildebeest, Eland and Giraffe	1 000 animals	3 permanent employees
Farm Goosen 530 1/539 (2 000ha)	<u>Tourist attraction:</u> Lodge		3 permanent employees
	<u>Game farm:</u> Kudu, Eland, Waterbuck, Gemsbuck, Impala, Zebra, Giraffe, Steenbuck, Grey Duiker, Klipspringer, Sharpe's Honeycomb, Bushbuck, Warthog, Bush Pig, Brown Hyena, Civit, Genet, Caracal, Honey Badger, Aardwolf, Banded Mongoose, Leopard, Baboon, Vervet Monkey, Lynx, Guinea Fowl, Crested Guinea Fowl, Pheasant, Partridge, Eagles, Birds of Prey, 250+ recorded species of Birds, various Snakes and other Reptiles	No accurate figure	3 temporary (5 months) employees
	<u>Livestock farming:</u> Bonsmara cattle Donkeys Goats	120 heads 7 heads 15 heads	
Farm Vrienden 589 5/589	<u>Game farm:</u> 15 species of plain game		7 permanent employees
	<u>Tourist attraction</u> <u>Mopane worm farming</u>		
	<u>Livestock farming:</u> Boer goats		
	<u>Crop farming:</u> Lucerne	6 ha 2-3 tonnes/ha	

8.7.2 Quantification of Socio-economic Impacts

8.7.2.1 Construction Phase

Increase in production and GDP-R

Economic production is defined as any activity that uses inputs such as labour and capital to produce outputs in the form of services or goods. The construction phase of the project will involve activities such as engineering and design, site and infrastructure development, construction of buildings and facilities, civil engineering works, and other business activities related to the construction of the power station.

The economic impact arising from the initial investment will be felt throughout the national economy with windfall effects benefitting related sectors in the economy. These various impacts or spill-over effects spread throughout the economy, contributing to heightened production levels. The initial investment will give rise to a production effect where manufacturers and suppliers of goods and services would experience the need to expand current production levels by ramping up employee numbers and operations. Down-the-line effects will produce a consumption-induced effect on the wider economy - as total salaries paid-out rises, consumer expenditure will lift, thereby raising the sales of goods and services in the surrounding economy.

The Musina Local Municipality's economy was valued at R7 405 million in 2016 (current prices). About R15 billion could be expected to be invested during the construction phase. Considering the requirement stipulated by the Department of Energy, at least 40% of capital expenditure (CAPEX) on the proposed power station will need to be localised. This includes among others, procurement of the majority of steel power pylons, electrical and telecom cables, as well as valves and actuators from within South Africa. While it will not be possible to source all materials locally, if effort is made to use local suppliers as far as possible, the positive impact on the local economy will be enhanced. Given that numerous similar projects have been established in the province, a possibility of up-stream businesses may have proliferated in support of the industry.

Nature: Expenditure associated with the construction of the proposed development will impact on the production of the local economy.		
	Without Mitigation	**With Mitigation**
Extent	National (5)	National (5)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Definite (5)
Significance	**Medium (52)**	**High (65)**
Status (positive or negative)	Positive	Positive
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	

Mitigation:

» The project developer should use locally sourced inputs where feasible in order to maximize the benefit to the local economy.

» Sub-contracting local construction companies should occur, where possible.

» Local Small and Medium Enterprises should be approached to investigate the opportunities for supplying inputs required for the construction of the facility, as far as feasible.
Residual Impacts: Production in the economy will continue.

Employment Creation

A third of the working age population in the Musina LM are unemployed. The development of the Mutsho Power Project will improve this situation and positively impact the community by creating a number of temporary job opportunities. An estimated 3 500 job opportunities could be created for the construction of the coal-fired power station. This will improve the socio-economic well-being of the benefitting population, albeit for a temporary period.

Nature: The construction of the Mutsho Power Project will positively impact on the community by creating a number of job opportunities (albeit temporary).		
	Without Mitigation	**With Mitigation**
Extent	National (5)	National (5)
Duration	Short-term (2)	Short-term (2)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Definite (5)
Significance	**High (75)**	**High (75)**
Status (positive or negative)	Positive	Positive
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation: » Organise local community meetings to advise the local labour on the project that is planned to be established and the jobs that can potentially be applied for and establish information desk at local municipality offices. » Where feasible, effort must be made to employ locally in order to create maximum benefit for the communities.		
Residual Impacts: No residual impacts have been identified.		

Positive impact on skills development

Skills are imperative for satisfying job requirements and adequately performing tasks that ultimately boost the economy. The construction of the coal-fired power station requires a variation of skill sets ranging from semi-skilled construction workers to highly skilled engineers. Employees who are new to the market will develop and attain new skills, whilst workers adept in particular skills will sharpen their abilities. In addition, the employees will improve their marketability for future employment and will be perceived positively by future employers. The plant construction will improve the current status of 46% low-skilled employees and 15% skilled employees in the Musina Local Municipality. Although the construction phase will be temporary, the impact on skills is sustainable and notable.

Nature: Employees will develop and enhance skills thereby increasing experience and knowledge.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)

Magnitude	Moderate (6)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**High (70)**	**High (70)**
Status (positive or negative)	Positive	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	

Mitigation:

- In order to maximise the positive impact, it is suggested that the project company provide training courses for employees where feasible to ensure that employees notably gain from the work experience.
- Facilitation of the transfer of knowledge between experienced employees and lower-skilled staff is recommended.
- Performance of a skills audit to determine the potential skills that could be sourced in the area is proposed during the planning phase.

Residual Impacts:
The skills obtained by the employed labour force are permanent and will thus be retained.

Positive impact on household income

Over half of the population of the Musina LM are classified as low-income earners. An increase in disposable income often means that benefiting households (who are also consumers) have the opportunity to make a wider variety of lifestyle choices. In the context of the proposed power station, workers employed in the construction as well as their households can expect an improvement in their quality of life and standard of living. The increase in income will assist in access to health care, recreational facilities and leisure.

Nature:
Employed individuals will increase the income of their respective households and therefore improve their standard of living.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (52)**	**Medium (52)**
Status (positive or negative)	Positive	Positive
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- Local employment will benefit local households and the local area. Therefore, preference should be given to employment of local community members as far as possible.

Residual Impacts:
No residual impacts have been identified.

Demographic shifts due to influx of migrant labour

The current population size in the Musina Local Municipality is over 172 000, and the population growth has been gradually growing at an average of close to 2% over the past five years. The job opportunities will most likely trigger in-migration and, therefore, it can be suggested that a slight positive shift in the demographics will ensue as a result of the proposed project. Resultantly, migrant workers and job seekers will increase the current population size and possibly increase the male population if an expected male-dominated influx occurs. Furthermore, the municipality currently draws in numerous people; thus, the proposed project will exacerbate this status.

This change in demographics can bring about social ills such as increased alcoholism, but can also stimulate the economy due to increased purchasing power from migrant labour. In the advent that unemployment increases due to unfulfilled hopes of migrant job seekers, criminal incidents may proliferate.

Nature:
An impact on the demographics of the area as a result of in-migration in response to job opportunities will occur.

	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Medium term (3)	Medium term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Medium (30)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- Where feasible, effort must be made to employ local labour in order to create maximum benefit for the communities and limit in-migration.
- Provide training for unemployed local community members with insufficient skills and thus increase absorption of local labour thereby decreasing in-migration.
- In collaboration with the local municipality, manage recruitment and marketing for vacancies with a preference of residents within the municipality.

Residual Impacts:
A negligible amount of migrant job seekers will not be employed by the proposed project.

Change in sense of place

According to Relph (2001), a place is a territory of meanings. Therefore, a sense of place is the distinctiveness of place embedded with the cultural transformations and traditions associated with the historic use and habitation of the area (Young & Martin, 2016). Place attachment is the symbolic relationship formed by people attributing culturally shared emotional meanings to a particular piece of land. It is thus an affective bond between people and place. This personal orientation towards place assists in understanding a place, which informs environmental meaning. It is a subjective matter and is dependent on the perceptions of the user and viewer of an area.

The proposed coal-fired power station will lead to the transformation of land use and subsequently the economic activities on the affected property. These changes bring new opportunities and resources but also shift the sense of place. The current sense of place, as attested by locals, is a tourism region with commercial farming and is thus rural and tranquil. It is envisaged that the possible noise and visual impacts during construction will alter the sense of place and negatively impact on the living conditions of the people residing and working on the neighbouring land.

A noise impact is expected. Perhaps the most significant source of noise during the construction phase is the increase in traffic on local roads due to the need for transportation of construction materials and workers. The increase in road traffic will affect the local communities and tourism facilities by adding to the number of vehicles utilising the local road network on a daily basis, thus disrupting movement patterns.

A negative visual impact will result. Given the current natural aesthetic, a change will result as clearance of trees and shrubs take place. This changes the original pictorial essence of a place, which may negatively or positively affect an individual's sense of place.

According to the interviewed landowners, the current state of safety in the study area is a concern. Consistent with crime statistics, the most reported incidents include burglary at residential premises, commercial crimes, assault and culpable homicide. Between 1 002 and 1 547 incidents were reported in the zone of influence. In addition, the closest police station is about 30km south-west from the project area.

These impacts are not fatal flaws but are more of a nuisance to the individuals experiencing them.

Nature:
A change in the sense of place will take place due to the construction of the coal fired power station.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (40)**	**Medium (32)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
- Implement mitigation measures proposed by the various specialists, including traffic, visual, and noise specialists.
- The provision of public transport alternatives for workers so as to decrease the number of vehicles on the road during peak hours is recommended.
- Partner with local municipal authorities and other prominent users of the local roads to upgrade them to meet the required capacity and intensity of the vehicles related to the construction of this component of the proposed project.
- Ensure strict security checks to and from the construction site, as well as proper fencing around the site to deter illegal entry.

Residual Impacts:
No residual impacts are anticipated.

Increased demand for housing

The construction of the coal-fired power station is expected to draw migrant workers and job seekers into the area. Therefore, an increase in the demand for housing may follow. However, the current challenge in the supply of housing at required quantities due to the shortage of available land for human settlement is a grave concern. This was iterated in the Musina LM IDP 2017-2021, which stated that one of the major challenges in the local municipality is the "land availability for new developments" and specifically land for housing development (Musina LM, 2016). Therefore, additional strain will be placed on the housing market. This denotes further strain on the local authorities.

Nature: The construction of the coal-fired power station may have a negative impact on the physical capital of the area by placing strain on the housing market.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Medium term (3)	Medium term (3)
Magnitude	Low (4)	Minor (2)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (40)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » The recruitment of people who reside within the area will decrease demand for new houses by migrant labour. » The utilisation of existing housing from the completion of other construction in the area (the greater Soutpansberg Project) would minimise the impact. » The SEZ development, Musina Local Municipality, and Mutsho Power could in collaboration, construct temporary housing for migrant workers for both projects given the close proximity of both projects.		
Residual Impacts: Additional housing will be supplied in the municipality.		

Pressure on basic services, social facilities and economic infrastructure

The state of service delivery is moderate with notable backlogs in the Musina Local Municipality. Secondary data indicates that the key issues include access to sanitation and electricity. Furthermore, landowners assert that water scarcity is a momentous concern and that there is a lack of groundwater. They further argue that the drought has affected their livestock and their ability to farm as they did previously. It is perceived that the construction of the power plant will intensify the strain on the water reserves if it is sourced by the local supply.

Key challenges revealed in the secondary data are access to health care facilities and crime. Moreover, inadequate education facilities and resultant low levels of education in the area impair socio-economic development in the region. Given this context, the influx of migrant labour and job seekers will evidently place further pressure on the demand for basic services and social services. Thus, should the expectation of job creation not be adequately managed, the development will increase current backlogs for local government and service providers.

With regard to economic infrastructure, it is known that large-scale projects such as power plants require the movement of significant volumes of construction material as well as machinery and equipment. The transportation of these items places stress on road infrastructure – potentially causing roads to deteriorate. The current state of roads in the area is poor. Consequently, the construction phase activities will contribute to the further deterioration of roads should the roads not receive the required maintenance. It is noted that the access roads to the proposed project site are gravel roads.

Nature: Pressure on basic services, social facilities and economic infrastructure may occur due to construction activities.		
	Without Mitigation	**With Mitigation**
Extent	Regional (3)	Regional (3)
Duration	Short term (2)	Short term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » The local municipality should be informed of the potential impact of the proposed project on services in order for the necessary preparations to take place in a timely manner. » Provision of public transportation service for workers in order to reduce congestion on roads is recommended. » A partnership with local municipalities and other prominent users of the local roads to upgrade them to meet the required capacity and intensity of the vehicles related to the planned construction activities is recommended.		
Residual Impacts: Improved state of services in the municipality.		

8.7.2.2 Operation Phase

Impact on production and GDP-R

During operation, the constant demand for services and products which the power station requires will continuously have a positive impact on the local economy. Furthermore, the operations of the proposed power station will increase the value of the utility sector in the local municipality, positively affecting its growth. Since the project is remotely located it is likely that much of the supporting services will need to be established within the local areas. Therefore, demand for transport services, catering, accommodation, personal services, and some construction-related activities is likely to ensue as a result of both indirect and induced effects, which would result in the establishment of new businesses and expansion of existing activities. Considering the existing stagnating state of the local municipality this project could be highly beneficial for the local economy.

Nature: Expenditure associated with the operation of the proposed development will impact on the production of the local economy.		
	Without Mitigation	**With Mitigation**
Extent	National (5)	National (5)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	High (8)
Probability	Definite (5)	Definite (5)
Significance	**High (75)**	**High (85)**
Status (positive or negative)	Positive	Positive
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No

Can impacts be mitigated?	Yes (enhance)

Mitigation:
- The project developer should make effort to use locally sourced inputs where feasible in order to maximize the benefit to the local economy.
- Local Small and Medium Enterprises should be approached to investigate the opportunities for supplying inputs required for the maintenance and operation of the facility, as far as feasible.

Residual Impacts:
Developed business will continue to operate.

Employment creation

The energy sector currently employs the least number of people in the Musina LM. The operation of the coal-fired power station will improve this situation as about 300 to 350 jobs may be created for a long-term period (i.e. more than 25 years). Further, employment opportunities will be created within the local municipality and across South Africa as a result of the project's multipliers and the additional electricity supply to the national grid. Considering that there are currently about 15 000 unemployed people in the municipality, the created sustainable employment opportunities may reduce this number and improve the employment statistics. The demand for supporting services and other goods and services to be created as a result of multiplier effects will also lead to the creation of additional indirect jobs of up to 500 to 1 000, increasing the positive effect on employment in the region.

Nature:
The operation of the Mutsho Power Project will positively impact on the community by creating a number of job opportunities.

	Without Mitigation	**With Mitigation**
Extent	National (5)	National (5)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**High (75)**	**High (75)**
Status (positive or negative)	Positive	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhance)	

Mitigation:
- Where feasible, effort must be made to employ locally in order to create maximum benefit for the communities.

Residual Impacts:
The indirect and induced employment created will possibly continue post the project operations period.

Positive impact on skills development

The employment opportunities are for a long-term period and are thus sustainable and will have a positive impact on skills for benefitting employees. Furthermore, as production and consumption effects filter through the economy creating a demand for additional labour, human resources will be trained and skilled within aligned industries. Ultimately, the power station's operation will lead to enhanced skills through training and experience in the wider national economy.

Nature:
Employees will develop and enhance skills thereby increasing experience and knowledge.

	Without Mitigation	With Mitigation
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	High (8)
Probability	Definite (5)	Definite (5)
Significance	**High (70)**	**High (80)**
Status (positive or negative)	Positive	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhance)	

Mitigation:

» In order to maximise the positive impact, it is suggested that the project company provide training courses for employees where feasible to ensure that employees gain as much as possible from the work experience.
» The transfer of knowledge between experienced employees and the local staff should be facilitated.
» A skills audit to determine the potential skills that could be sourced in the area should be performed during the planning phase.
» Where possible, training and empowerment of local communities for employment in the operations of the power plant should occur.

Residual Impacts:
The beneficiaries will retain the skills for periods beyond the project life.

Positive impact on household income

The new jobs that will be created as a result of the operation of the coal-fired power station will result in increased household income for benefitting individuals. Employed individuals will increase the income of their respective households and therefore improve their standards of living. It is likely that households benefitting from the increased income as a result of the multiplier effects which will be spread across South Africa will also experience this benefit; however, some of the benefits will be concentrated locally.

Nature:
Employed individuals will increase the income of their respective households and therefore improve their standard of living.

	Without Mitigation	With Mitigation
Extent	Regional (3)	Regional (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Definite (5)
Significance	**Medium (52)**	**High (65)**
Status (positive or negative)	Positive	Positive
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

» Employing locally will increase benefit to local households and the local area.

Residual Impacts:
No residual impacts have been identified.

Negative impact on eco-tourism offering

The Volharding Game Ranch and Lodge is located on Farm Goosen, 14km north from the proposed project site. As a result of the operation of the coal-fired power station, this tourism offering will potentially no longer be as viable or will be strongly disrupted, however, the existence and operation of the nearby open-pit Mopane dolomite mine and processing and beneficiation plant belonging to Syferfontein Carbonates (Pty) Ltd, has to date not shown this as occurring. The proposed project could thus result in a potential loss for the tourism industry directly linked to the operations at the lodge.

The eco-tourism offering includes hunting and accommodation. Due to the abundance of various flora and fauna, Farm Goosen attracts international and local hunters, photographers and nature lovers. According to Environmental Planning and Design (2018), the proposed development could be visible from tourist routes in the area and could negatively impact homesteads for tourism purposes. Therefore, a possible deterrence of said tourists may occur due to the changed sense of place that the coal-fired power station will develop. Tourists looking for an escape from modern cities and human intervention are less likely to visit areas with major industrial developments such as power stations, mines or other industrial developments close by as these developments alter the experience. A limestone mine, is however already present and also has a visual impact from the lodge.

Three people are permanently employed and might potentially lose their employment. This loss of income will further have an impact on their dependants. Nonetheless, this impact is envisaged to be moderate within the context of the area, due to the existing mining facility to the east of the proposed project site, which is located significantly closer than the proposed project site, which is located significantly closer than the proposed project. According to Mutsho Power, an off-set to the potential loss of eco-tourists will be through booking the lodge for accommodation purposes during the construction phase and periodically during the operations phase.

Nature: The operation of a coal-fired power station will change the sense of place of the surrounding area which will reduce its attractiveness as a tourist destination.		
	Without Mitigation	**With Mitigation**
Extent	Limited (2)	Limited (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	High (8)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Medium (42)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » Mitigation proposed by visual and noise experts should be implemented as far as feasibly possible. » Efforts should be made to minimise the negative impact on the eco-tourism operations, where feasible through the proposed project's use of the lodge for accommodation purposes. » Increase communication to those in the zone of influence with regards to environmental management issues.		
Residual Impacts: A reduced number of tourists visiting surrounding tourism offerings could be a persistent problem.		

Loss of economic activity on directly impacted farm

Portion 0 of the Farm Du Toit 563 is one of the directly impacted farm portions, where the power station is proposed to be located (specifically Layout Option 2). The farm portion is located on non-arable land and therefore crop farming does not take place. It is however located on a mineral region, and is underlain by coal reserves. The status quo of the farm is as follows:

» Wild animals are prevalent on the farm.
» Approximately 40 cattle are present on the farm.
» The farm has one permanent employee (aged over 65).

Given the above status of economic activity on the farm, it is deduced that the farm is large in size but is a small-scale commercial farm. The landowner due to his age (80) prefers to sell the farm. The employee will not continue to work any longer due to his age. Therefore, the impact on the landowner is moderate.

Nature: Loss of small-scale commercial farming activity on the Farm Du Toit 563.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (2)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**Medium (35)**	**Medium (55)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » The landowner prefers to sell the farm therefore relocating the animals to alternative land will aid the continuation of economic activities.		
Residual Impacts: Flora and fauna will be permanently removed on a portion of the farm (if Alternative A is selected).		

Contribution towards increased government revenue

The proposed development will provide a sustainable increased revenue to the local government in the form of property rates and taxes. It will further supplement the revenue derived from national government. Moreover, national government will derive tax-related revenue such as Value-Added Tax (VAT), payroll and income taxes. This is as a result of the employment that will be created and the resultant income that will be earned, thus increasing spending power.

As stated previously, the housing backlog and service delivery require attention. Therefore, the increased revenue from the proposed project may assist the municipality, whereby constituencies may utilise it for public services. Overall, the allocation of government revenue should improve socio-economic conditions of the population.

Nature: Government revenue will be derived from the proposed development.

	Without Mitigation	With Mitigation
Extent	Municipal (3)	Municipal (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**High (65)**	**High (65)**
Status (positive or negative)	Positive	Positive
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation: » No mitigation measures required.		
Residual Impacts: No residual impacts have been identified.		

The power station will provide the important national service of providing new electricity capacity into the national grid. Strategically, the proposed project will assist in ensuring electricity security in the long-term. Access to energy would have a profound effect on curbing poverty and unemployment, attracting investment such as the Musina and Makhado SEZs and essentially promoting socio-economic development.

The Mutsho Power Project could come on line around 2025/6 at the earliest, dependent on national policy and the timing of the IPP procurement programme. As such it will start to provide power when Eskom's current fleet of some 44 000MW has decreased to about half of its generating capacity. As such developing the proposed project will meet a future need for baseload power that cannot be met by intermittent renewable energy sources.

Nature: Improved energy security and energy sector will result due to the development of the coal-fired power station.		
	Without Mitigation	**With Mitigation**
Extent	National (5)	National (5)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Moderate (6)
Probability	Highly probable (4)	Highly probable (4)
Significance	**High (60)**	**High (60)**
Status (positive or negative)	Positive	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Mitigation: » No mitigation measures are required.		
Residual Impacts: No residual impacts have been identified.		

8.7.3 Analysis of Layout Alternatives

There is no differentiation between the three alternatives in terms of most socio-economic impacts considered. However, preference is given to the Preferred Alternative with regard to the loss of economic activity as the footprint of the project will not affect the farm, compared to Alternative A and Alternative B wherein the footprint proximity will most likely affect the economic activities. Similarly, the effect on eco-tourism will be most exacerbated by Alternative A, due to the project footprint on the Farm Du Toit 563, where tourism activities take place. Alternative A is further least preferred due to the increased change in sense of place it presents.

Overall therefore, the Preferred Alternative is preferred, followed by Alternative A but Alternative B is not preferred.

Table 8.18: Comparison of Layout Alternatives.

Impact	Preferred Alternative	Alternative A	Alternative B
	Construction Phase		
Increase in production and GDP-R	No Preference	No Preference	No Preference
Employment Creation	No Preference	No Preference	No Preference
Skills Development	No Preference	No Preference	No Preference
Household Income	No Preference	No Preference	No Preference
Influx of Migrant Labour	No Preference	No Preference	No Preference
Sense of Place	No Preference	Least Preferred	No Preference
Increased Demand for housing	No Preference	No Preference	No Preference
Pressure on services	No Preference	No Preference	No Preference
	Operations Phase		
Increase in production and GDP-R	No Preference	No Preference	No Preference
Employment Creation	No Preference	No Preference	No Preference
Skills Development	No Preference	No Preference	No Preference
Household Income	No Preference	No Preference	No Preference
Negative impact on eco-tourism	Slightly Preferred	Least Preferred	Slightly Preferred
Loss of economic activity	Preferred	Least Preferred	Slightly Preferred
Government Revenue	No Preference	No Preference	No Preference
Energy Security	No Preference	No Preference	No Preference

8.8. Potential Traffic Impacts

8.8.1 Results of Impact Assessment

The Construction Phase Traffic and Operation Phase Traffic impact is determined based on the Plant build and operations staffing and transport needs. Trip generation and modal split are determined and Plant trips distributed and assigned to the road network with reference to the staff origins/places of residence. Critical road elements/intersections are identified for capacity analysis.

8.8.1.1 Construction Phase Traffic

This traffic relates directly to the traffic expected during the construction of the Mutsho Power Project and the ash dump facility which is expected to take place over a period of 4 to 5 years including testing and commissioning of the units. It is expected that the plant will begin operations around Year 2025, 4 to 5 years from the start of site preparation. With construction completed the plant trips will be substantially reduced.

It is estimated that a peak number of construction staff will peak at 2 500 persons per month. The worst-case scenario would be when the same number of staff arrives on site each day. As a conservative approach (i.e. worst-case scenario), it was therefore assumed that all 2 500 workers will be on site each day. The majority of the workforce is expected to be local from Makhado and nearby towns and a small portion from Musina.

10% of the construction personnel are expected to use private cars while the remainder is expected to make use of a bus shuttle service provided for by the contractor. A total of 250 people is expected to use private vehicles and the remaining 2 250 will use buses from local residential areas. Assuming a vehicle occupancy of 1.2 staff per vehicle, 208 light vehicle trips are expected to be generated by mostly management, specialists, engineers, etc. It is expected that 20 seater, 40 seater, and 60 seater buses will be used to shuttle the construction staff from various township in close proximity to the site. For staff transport to site, 20% are assumed to use 20 seater buses; 30% to use 40 seaters and the remaining 40% to use 60 seater buses. These trips are expected to arrive in the morning and leave in the afternoon. The contractor is expected to provide a secure holding area for the buses.

The peak construction period is expected to generate about 40 trucks per day with 50% expected to arrive during the morning (AM) peak hour and depart during afternoon (PM) peak hour. The total peak hour trips expected to be generated by the construction phase is shown in **Table 8.19**. For the AM peak hour an 80/20% in/out split for all vehicles is assumed (and vice-versa in the PM).

Table 8.19: Construction Traffic.

Vehicle Trips (AM and PM Peak Hr)						
Description	**% or #**	**Peak Hr Trips**				
Vehicle Classification		Light Veh	Heavy Vehicles			
Vehicle Type		Passenger	Buses			Trucks
Vehicle Occupancy		1.2	20	40	60	
% by Mode	100%	10%	20%	30%	40%	
# Staff	2500	250	500	750	1000	
# Vehicles	269	208	25	19	17	20
SUM		**208**	**80**			
To and From South	85%	177	68			
To and From North	15%	31	12			

The impact of heavy vehicle traffic in terms of road capacity is expected to be minimal.

It is difficult to determine the heavy vehicle traffic to the site, in the absence of a project program and transport logistics. The sources of construction materials, supply of material components and the construction programme all influence the nature and frequency of road-based vehicle transport to and from the site. The main source of construction material is assumed to be from Gauteng. The raw materials for the plant will be transported either by rail or by road transport.

8.8.1.2 Transport of Abnormal Load Components during Construction

The estimated dimensions and gross weights of heavy and oversize equipment and components to be delivered to the Plant site are a function of the project build planning, which details are not yet disclosed. These items typically comprise Cranes, Deaerators and Deaerator Tanks, Transformers, Generators, Turbines, Boiler Drums, etc. Abnormal load transport permits are required for the transport of abnormal loads.

Abnormal loads would need to be transported to the site from Durban harbour or possibly Richards Bay.

The most likely route from Durban harbour follows National Route N3 and turns off at the N11, travelling through Ladysmith and Newcastle and then turning onto the N1 near Mokopane. On the N1 it travels north through Polokwane and through Louis Trichardt, eventually turning off at the D1021 to access the proposed power station site some 12.5 km to the west.

Although the tonnage is expected to be significant the low frequency of the trips means that the traffic loading impact is negligible. Turning radii of 15m are required for the large super-link loads and the access gate should be set back sufficiently to accommodate vehicles standing off the public road.

8.8.1.3 Operational Phase Traffic

The facility will operate 24 hours a day. An estimated total number of Operation and Maintenance staff is 200 working on four shifts rotations. It is assumed that 50 staff at the end of a shift will not leave the site until the next 50 shift workers have assumed duty. It is assumed that most of the operations staff will be transported via a taxi shuttle service. A 10% / 90% modal split between private cars and shuttle taxis respectively was assumed. It is expected that a taxi shuttle service will be provided for the Operations Phase. The modal split will see approximately 8 light vehicles and 4 taxis during the operations phase. The staff relate generation during this phase is insignificant.

Assuming that 11 000 tons of coal and 263 tons of limestone, are transported by road each day it would equate to some 74 x 32 Ton peak hour trips (split 50% in/50% out) for 10 hours per day. Including staff peak hour trips, the Operations Phase peak period generates less traffic than during the Construction Phase. The Operations Phase traffic impact is however considered for year 2035 with a 4% compounded traffic growth per annum applied to background traffic.

This intersection performance should be monitored on an annual basis and a traffic roundabout should be considered where priority control results in a poor Level of Service for vehicles on D1077 approach to N1. It is anticipated that this form of intersection control would be required during the operations phase around year 2050.

8.8.1.4 Decommissioning Phase Traffic

It is expected that the Plant will be decommissioned around Year 2055, after 30 years operations. It is not realistic to project traffic over such a lengthy time period for intersection analysis. If traffic continues to increase at 4% per annum, then the intersection of N1 and D1021 would require traffic roundabout control around Year 2050. Once the Mutsho Power Plant is decommissioned the traffic roundabout should not be required for the intersection.

8.8.1.5 Critical Peak Period

The critical peak hour from a road capacity point of view, occurs when the traffic generated by the Plant is at a maximum or when the highest combination of road traffic and traffic generated by the Plant occurs.

This critical peak hour is during the Construction Phase and the Operations Phase are as follows:

- Weekday AM peak hour.
- Weekday PM peak hour.

8.8.1.6 Trip Distribution and Trip Assignment

The new trips that are expected to be generated by the proposed Plant were distributed and assigned to the adjacent road network based on the road layout and likely routing and with reference to the observed size of townships to the south and north of the site that will supply staff for the Plant build and operations.

The following trip distribution was assumed for the Plant:

- 85% to / from the south.
- 15% to / from the north.

Construction Phase Trips:

The expected Construction Phase trip assignment for the critical peak hours are shown in **Table 8.20**.

Table 8.20: Construction Peak Hour Trip Distribution.

Peak Hour Trip Distribution							
To and From South				To and From North			
Light Vehicles		Heavy Vehicles		Light Vehicles		Heavy Vehicles	
AM in / PM Out	AM Out / PM In	AM in / PM Out	AM Out / PM In	AM in / PM Out	AM Out / PM In	AM in / PM Out	AM Out / PM In
85%	15%	85%	15%	85%	15%	85%	15%
151	27	58	10	27	5	10	2
177		**68**		**31**		**12**	

Operations Phase Trips

The expected Operations Phase trip assignment for the critical peak hours are shown in

Table 8.21.

Table 8.21: Operations Peak Hour Trip Distribution.

Peak Hour Trip Distribution							
To and From South				To and From North			
Light Vehicles		Heavy Vehicles		Light Vehicles		Heavy Vehicles	
AM in / PM Out	AM Out/PM In	AM in / PM Out	AM Out/PM In	AM in / PM Out	AM Out/PM In	AM in / PM Out	AM Out/PM In
9	9	37	37	3	3	0	0
18		**74**		**6**		**0**	

Decommissioning Phase Trips

It is anticipated that the Decommissioning Phase trips will be less than 50% of the Construction trips. For the intersection analysis 50% is assumed.

Latent Traffic Demand and Traffic Growth

No similar Power Plants are anticipated to be constructed in the immediate area. An average growth rate of 4% per annum was assumed for the N1 for the Project Life-cycle.

8.8.2 Quantification of Impacts on Traffic

8.8.2.1 Construction Phase

Traffic impacts anticipated during the construction phase include impacts associated with traffic safety, road integrity and dust, and pedestrian road safety.

Nature: Increase in traffic volumes (heavy and light vehicles) on the N1, between affected staff residential areas and the Mutsho Power Plant, increasing the probability of accidents.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Low (5)
Probability	High (4)	High (4)
Significance	**Medium (40)**	**Low (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Place signage on the affected section of the N1 warning of possible presence of construction vehicles. » Ensure construction related vehicles are adequately maintained and are roadworthy.		
Residual Impacts: No residual impacts have been identified.		

Nature: Increase in traffic volumes (heavy and light vehicles) on low volume gravel roads (D744 and D1021) resulting in deterioration of the road and increased dust.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Low (3)
Probability	High (4)	High (4)
Significance	**Medium (32)**	**Low (28)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » Gravel roads (relevant section of D744 and D1021) used for access to the Plant should be hard surfaced to accommodate increased vehicle traffic and to reduce dust. » Speed restrictions signage should be provided to promote safe travelled speeds appropriate to the road design.		
Residual Impacts: Hard surfaced roads may lead to speeding.		

Nature: Increase in traffic volumes (heavy and light vehicles) impacts on road safety, particularly in Mopane and along gravel roads D744 and D1021 with no clear space for pedestrians. Presence of cattle / animals in the travelled way also compromises road safety.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (2)	Long-term (2)
Magnitude	Low (4)	Low (2)
Probability	High (4)	High (4)
Significance	**Medium (32)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Sidewalks should be provided along D777 in Mopane to separate pedestrians from Plant / through traffic. » Gravel roads (relevant section of D744 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic. » A raised sidewalk should be provided along at least one side of the roadway to accommodate pedestrians. » Signage alerting motorists to pedestrians and possible animals should also be erected along these routes.		
Residual Impacts: Increased traffic volumes will increase road safety risk to pedestrians crossing / walking in the roadway.		

8.8.2.2 Operation Phase

Traffic impacts anticipated during the operation phase include impacts associated with traffic safety, road maintenance, road integrity and dust, and pedestrian road safety.

Nature:
Increase in traffic volumes (heavy and light vehicles) on the N1, between affected staff residential areas and the Mutsho Power Plant, increasing the probability of accidents.

	Without Mitigation	With Mitigation
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	High (4)	High (4)
Significance	**Medium (48)**	**Medium (32]**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:
- Ensure that construction vehicles are maintained and in a roadworthy condition.
- Preferably transport coal and limestone by rail to drastically reduce heavy vehicle numbers and reduce risk of vehicle collisions.

Residual Impacts:
No residual impacts have been identified.

Nature:
Increase in traffic volumes (heavy vehicles) on the N1 and more particularly the northbound lane between affected staff residential areas and the Mutsho Power Plant, will impact on road pavement and require increased road maintenance.

	Without Mitigation	With Mitigation
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (2)
Probability	High (4)	Improbable (2)
Significance	**Medium (48)**	**Low (16)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:
- Transport coal by rail to reduce numbers of heavy vehicles on the N1.

Residual Impacts:
No residual impacts have been identified.

Nature: Increase in traffic volumes (heavy and light vehicles) on low volume gravel roads results in deterioration of the low order gravel roads (D744 and D1021) and causes increased dust (nuisance and road safety issue).		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	High (4)	High (4)
Significance	**Medium (40)**	**Medium (32)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » Gravel roads (relevant section of D744 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic and to cut down on dust. » Speed restriction signage should be provided to promote safe travelled speeds appropriate to the road design.		
Residual Impacts: Hard surfaced roads may lead to speeding.		

Nature: Increase in traffic volumes (heavy and light vehicles) impacts on road safety, particularly in Mopane and along gravel roads with no clear space for pedestrians. Presence of cattle / animals in the travelled way also compromises road safety.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	High (4)	High (4)
Significance	**Medium (40)**	**Medium (32)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Sidewalks should be provided along D777 in Mopane to separate pedestrians from Plant / through traffic. » Gravel roads (relevant section of D744 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic and to cut down on dust. » A raised sidewalk should be provided along at least one side of the roadway to accommodate pedestrians. » Signage alerting motorists to pedestrians and possible animals should also be erected along these routes.		
Residual Impacts: Increased traffic volumes will increase road safety risk to pedestrians in the roadway.		

8.8.2.3 Decommissioning Phase

Traffic impacts anticipated during the decommissioning phase include impacts associated with pedestrian road safety.

Nature: Increased traffic volumes on N1 due to traffic growth will make exit from the D1021 priority-controlled junction with the N1 problematic and will impact on road safety with increased risk of vehicle collisions.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Short-term (1)	Short-term (1)
Magnitude	Medium (6)	Low (2)
Probability	High (4)	High (4)
Significance	**Medium (36)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Transport equipment and materials off-site by rail to reduce numbers of heavy vehicles entering the N1 from D1021.		
Residual Impacts: No residual impacts have been identified.		

8.8.3 Analysis of Layout Alternatives

Three design alternatives are considered for the Power Plant, and each incorporates a new access road servitude and a new rail siding. The main access to the Plant will be via D1022. The proposed new railway loop that forms part of the Makhado Colliery development could be used to transport and deliver sorbent and other raw materials to the Plant.

The properties are in close proximity to one another, with the same access routes leading to the main road network. Consequently, the sites are identical from a traffic and transport perspective and traffic and transport related impacts apply equally to all three layout alternatives. The only difference is that an access from D744 to the Farm Du Toit 563 would be required for Layout Alternative A. This access is insignificant and would be used very infrequently to attend to the coal ash dump. Coal ash will be dumped by conveyor belt system and the conveyor will be directed to new sectors as needed. The coal ash would remain on-site and would be rehabilitated in time.

8.9. Assessment of the Do Nothing Alternative

The 'Do-Nothing' alternative is the option of not constructing the Mutsho Power Project. Should this alternative be selected, there would be no environmental impacts on the site due to the project as the facility would not be constructed. In addition, any benefits associated with the development of the project will not be realised.

South Africa's per capita greenhouse gas emissions are amongst the highest in the world due to reliance on fossil fuels using old technologies. The decommissioning of aged Eskom power stations currently utilising outdated technology, and replacing them with newer more advanced facilities will have a positive impact on reducing current pollution levels. The IRP 2010 – 2030 states that "Beyond the return to service stations the coal-fired power stations are all expected to be decommissioned at the end of 50 year plant life". While the opportunity exists for such facilities to have their plant life expanded, this would require retrofitting such plants with FGD and additional upgrades to be made. The proposed project provides an opportunity for the implementation of newer technology power generation for baseload / mid-merit power generation from coal sources (as required in terms of the IRP 2010 (and draft IRP 2016), with the potential to reduce emissions in the future through appropriate planning and design.

At both a provincial and national level, it should be noted that the Mutsho Power Project is not unique in that a number of coal-fired power station developments are currently proposed. Therefore, when considering the desirability of the no go option for the specific project, the costs and benefits of the proposed project must be considered.

The implementation of the project at the proposed site is expected to result in a number of environmental costs, as detailed within this report. This could include:

» Direct loss of biodiversity, flora and fauna due to the clearing of land for the construction and utilisation of land for the project (which is limited to the development footprint). Areas of ecological sensitivity have been identified onsite and have been included in an environmental sensitivity map prepared for the project. The cost of loss of biodiversity is therefore expected to be limited with the implementation of appropriate mitigation measures and the appropriate placement of infrastructure to avoid areas of ecological sensitivity identified on site.
» Visual impacts associated with the project. The Preferred Alternative is favoured from a visual perspective, as it helps to minimise local impacts on the adjacent Mopane / Waterpoort Road when compared with the other layout alternatives.
» Change in land-use and loss of land available for agriculture on the development footprint. The cost in this regard is expected to be limited due to the low agricultural potential of the property and the limited use of the footprint associated with the preferred alternative.
» Impacts in terms of GHG emissions. Options to improve the emissions intensity of CFB combustion such as the future co-firing of biomass in the CFB combustor, and incorporating solar thermal energy from CSP units are available. Impacts in this regard can therefore be managed through appropriate planning and design of the facility to meet the South African targets beyond 2025.

Apart from impacts associated with GHG emissions, the majority of costs likely to be associated with the development of the Mutsho Power Project are expected to occur at a local and site level and are considered acceptable provided that the mitigation measures as outlined in this EIA and the EMPr are implemented. The Mutsho Power Project's higher emissions intensity than the forecasted national baseline is to some extent acceptable as the national baseline includes intermittent RE generation.

The positive implications of establishing the project on the demarcated site include:

» The project will result in important socio-economic benefits at the local and regional scale through job creation, procurement of materials and provision of services and other associated downstream economic development. These will persist during the preconstruction, construction and operational phases of the project.

» The development of the facility will require the implementation of appropriate management actions which could have positive impacts on the surrounding areas specifically in terms of alien vegetation and erosion management.
» The implementation of the proposed project would utilise coal from the Makhado Colliery which is in the process of being established approximately 20km south-east of the project site and in doing so will make optimal use of mining related infrastructure, while negating the need for the mining of a new coal resource that was not already planned to be mined for power generation purposes.
» The project contributes towards the development of additional power generation sources as outlined in the IRP 2010. The project will start to provide power when Eskom's current fleet of some 44 000MW has decreased to about half of its generating capacity. As such developing the proposed project will meet a future need for baseload power that cannot be met by intermittent renewable energy sources.

The benefits of the project are expected to occur at a national, regional and local level. As the costs to the environment at a site specific level can largely be limited through the appropriate placement of infrastructure on the site within lower sensitivity areas, and impacts associated with GHG emissions can be managed through appropriate planning and design of the facility to meet the South African targets in this regard, the expected benefits of the project are expected to partially offset the localised environmental costs of the project.

The following impacts are anticipated with the implementation of the Do Nothing option:

South African Policy and electricity need: The National Integrated Resource Plan (IRP) developed by the Department of Energy (DoE) has identified the need for new power generation from coal as part of the technology mix for power generation in the country in the next 20 years (i.e. up to 2030). The need for the project at a national scale has therefore been determined at a policy level. The "do nothing" option will, therefore, not address this national need and may result in the electricity demands in the country not being met in the medium- to long-term. This has serious implications for socio-economic development in South Africa.

Without the proposed new coal-fired power station, an alternative means of generating an additional 600MW of baseload capacity could be required from other power generation sources or a similar source in another area. This could result in the establishment of new coal mines which would significantly increase the impacts associated with the project. Not developing the project on the proposed site would see the opportunity of utilising coal to be mined at the Makhado Colliery being lost. At a local level, the level of unemployment will remain the same and there will not be any transfer of skills to people in terms of the construction and operation of the power station.

The Mutsho Power Project is intended to be an IPP project to contribute to power generation within the country beyond 2020. Without the implementation of this project, this will not be achieved, and the greater power supply in the country could be compromised in the near future. This has potentially significant negative impacts on economic growth and social well-being. In addition, limitations on electricity supply may impact the environment in general due to local air quality impacts due to use of low quality coal for domestic purposes, collection of wood from natural areas, etc. Therefore, the no-go option is not considered as a preferred option from this perspective.

Land use: The project site is situated in a predominantly rural area which is characterised by agriculture. However the project site itself has been assessed as not comprising viable agricultural land. The power station will make better economic use of the land because it will provide relatively higher socio-economic returns than the current land use. In addition, the location of the power station in close proximity to the Makhado Colliery and adjacent to the Mopane site designated as part of the Makhado-Musina SEZ will contain the impacts associated with such developments within a node. The proposed development is therefore not considered to be an unfavourable use of the land within the proposed site from a socio-economic and technical perspective for the time-period of the development.

Socio-economic impact: The no-go alternative will result in the economic benefits discussed in this report not being realised and a subsequent loss of income and opportunities to local people and the municipality. From this perspective the no-go alternative is not preferred.

At a broader scale, the benefits of additional capacity to the electricity grid and those associated with the introduction of energy would not be realised with the implementation of the no go option. The facility is proposed to contribute up to 600MW which would have a positive effect on the electricity supply for the country. The generation of this electricity offers a range of potential socio-economic benefits at a regional and national scale.

In conclusion, the implementation of the no go option would not contribute to the electricity needs of the country and would not assist in job creation at a local and regional scale. This option is therefore not preferred.

CHAPTER 9 ASSESSMENT OF CUMULATIVE IMPACTS

Cumulative impacts in relation to an activity are defined in the 2014 EIA Regulations (GNR 326) as "the past, current and reasonably future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities."

The need to assess cumulative impacts associated with a proposed development is therefore a legislated requirement. This Chapter considers whether the potential impacts associated with the development of the Mutsho Power Project become more significant when considered in combination with other similar type projects known or proposed within the area which may have cumulative environmental impacts.

9.1. Approach Taken to Assess Cumulative Impacts

Cumulative impacts that have the potential to be compounded through the development of the Mutsho Power Project and its associated infrastructure in proximity to other similar developments include those impacts listed below. The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location when considered together with other similar developments:

- Unacceptable loss of threatened or protected vegetation types or species through clearing, resulting in an impact on the conservation status of such flora or ecological functioning.
- Unacceptable loss of threatened or protected faunal species, and loss or destruction of suitable habitat.
- Unacceptable loss of threatened or protected avifaunal species, and loss or destruction of suitable habitat.
- Unacceptable risk to human health through impacts on air quality.
- Contribution to climate change.
- Unacceptable risk to hydrological and geohydrological resources resulting due to the increase in the extent of hard or impermeable surfaces in the greater area as well as additional potential pollutants in the area; and as a result of seepage or contamination.
- Unacceptable loss of soils or land of high agricultural potential.
- Unacceptable loss of heritage resources.
- Unacceptable loss of palaeontological resources.
- Unacceptable noise impacts on the surrounding areas.
- Complete or whole-scale change in sense of place and character of an area and unacceptable visual intrusion.
- Positive and negative contribution from a socio-economic perspective.
- Unacceptable traffic impacts.

The scale at which the cumulative impacts are assessed is important. For example the significance of the cumulative impact on the regional or national economy will be influenced by similar developments throughout South Africa, while the significance of the cumulative impact at a local scale will only be influenced by similar developments that are in close proximity to each other (i.e. up to 30km apart). For practical purposes a sub-regional scale has been selected for this cumulative evaluation.

The potential cumulative impacts of other large scale industrial-type developments proposed and operational within the region are explored in the sections below. The discussion and associated conclusions must be understood in the context of the uncertainty associated with the proposed development and the qualitative nature of the assessment.

9.2. Projects within the Study Area

Historically approximately 83% of the coal mined in South Africa was mined in Mpumalanga Province, with significant coal reserves comprising the Witbank, Highveld, and Ermelo coal fields. As a result of the high number of coal reserves within the area, Mpumalanga Province also became home to the majority of South Africa's coal mines and coal-fired power stations. **Figure 9**.1 provides an overview of the location of Eskom's existing coal-fired power stations, which correlate heavily with the location of coal mines within South Africa.

There are no other coal-fired power station projects which are currently operational within, or proposed within the area surrounding the proposed development site. The closest coal-fired power station to the project comprises Eskom's 3 990MW Matimba Power Station which is currently operational, and 4 764MW Medupi Power Station which is currently under construction near Lephalale in the Waterberg District, Limpopo Province, approximately 250km south-west of the project site. The 600MW Thabametsi Power Station which was selected as a Preferred Bidder under Round 1 of the CBIPPPP is also proposed for development near Lephalale. The Mutsho Power Project is therefore proposed a considerable distance away from existing (and proposed) coal-fired power stations.

Other industrial type activities which are operational within proximity of the project area include a number of mining operations, such as the Syerfontein Mine, approximately 7km north-east of the project site, with unspecified mining activities located approximately 12km south-east of the project area. In addition, the Makhado Colliery is to be developed approximately 20km south-east of the project site, while it is also understood that there are a few proposed mining areas currently being evaluated and reviewed for Environmental Authorisation in support of a Mining Right due to the high number of coal deposits within the area (e.g. the Duel Colliery along the Mutamba River approximately 20km east of the project site).

The project is proposed in close proximity to the designated Musina-Makhado Special Economic Zone (SEZ). The SEZ programme is one of the tools identified by National Government to boost the country's industrialisation and manufacturing capacity. The development of the SEZ is intended to accelerate economic growth, attract foreign and domestic direct investment, expand the manufacturing sector and mineral beneficiation, as well as create employment in the region. Once developed the SEZ will include several energy intensive industrial users, including mineral beneficiation and base metal refineries. The Musina-Makhado SEZ comprises two development sites, namely an 8 000ha site at Mopane, and a 3 250ha site located between Musina and the Zimbabwean border. The proposed Mopane site borders the proposed project site to the east.

The Mutsho Power Project is proposed in a largely rural, undeveloped, agricultural area. The greater study area appears to be predominantly operated as private game reserves, provincial nature reserves (e.g. Nzehelele Nature Reserve) and/or agricultural holdings for either livestock rearing or crop cultivation, especially further upstream in the catchment area (near Waterpoort).

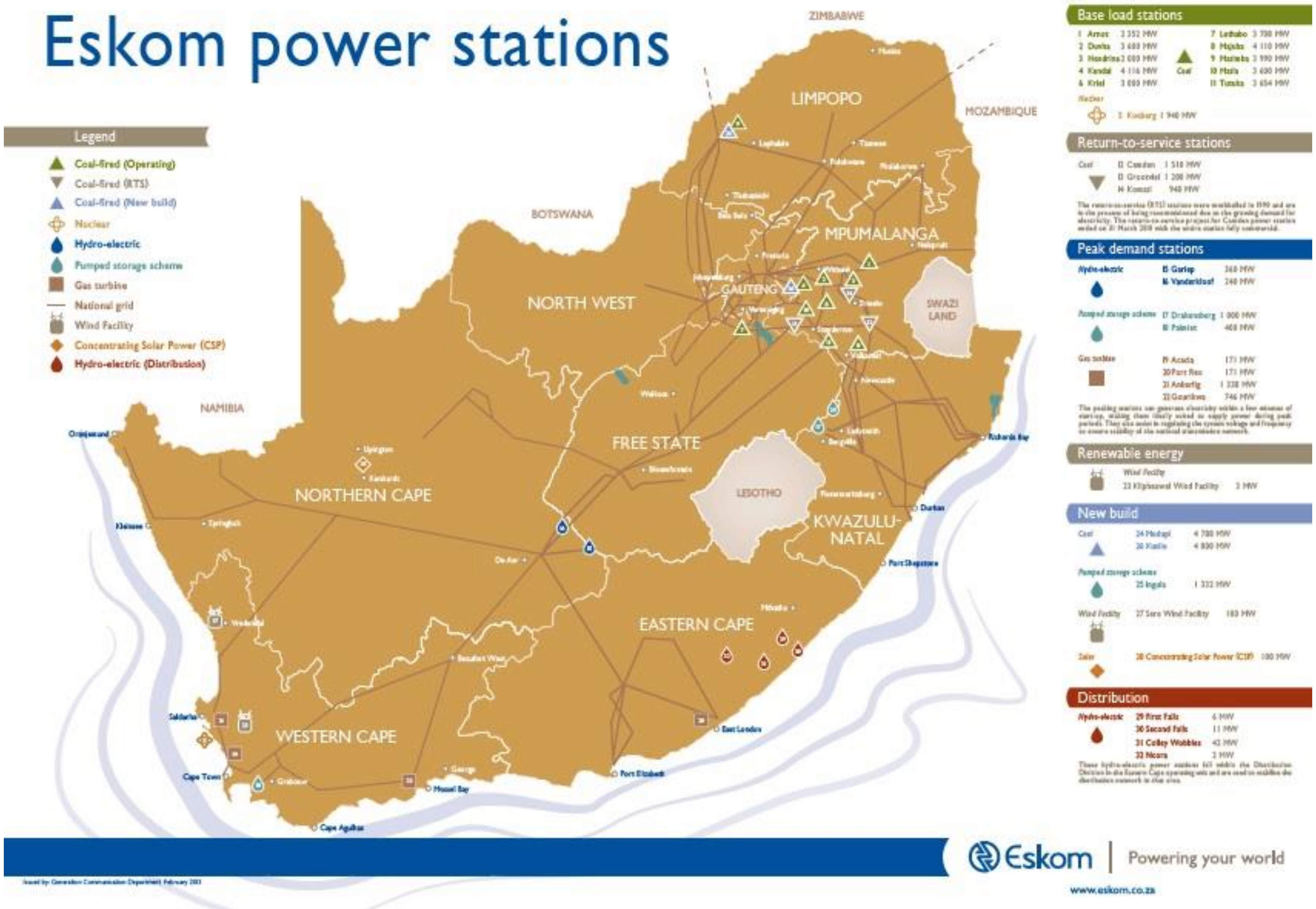

Figure 9.1: Location of Eskom Power Generation Facilities (Eskom, 2011).

There are no high density settlements within proximity of the project site. The closest relatively high density settlement to the project site include Makhado (Louis Trichardt) located approximately 40km south-east of the project site; and Musina located approximately 43km north of the project site.

9.3. Assessment of Potential Cumulative Impacts

Significant cumulative impacts that could occur due to the development of the Mutsho Power Project and its associated infrastructure in proximity to other similar proposed and operational developments include impacts such as:

- Impacts on Ecology (Flora, Fauna, and avifauna)
- Impacts on Air Quality
- Impacts on Climate Change
- Impacts on Hydrology and Geohydrology
- Impacts on Soils, Land Use and Agricultural Potential
- Impacts on Heritage
- Impacts on Palaeontology
- Noise Impacts
- Visual Impacts
- Socio-economics Impacts
- Traffic Impacts

The sections which follow provide an assessment of the potential environmental impacts of the proposed project as well as an assessment of the cumulative impact of the project and other projects within the area. More detail is available within the specialist assessment reports contained within **Appendices D – N**. As the developer has no influence over other developments, mitigation measures reflected are applicable only to the Mutsho Power Project.

9.3.1 Potential Cumulative Impacts on Ecology

9.3.1.1 Flora

Impacts of a cumulative nature places direct and indirect impacts of the project into a regional and national context, particularly in view of similar or resultant developments and activities in the region. These impacts cause adverse effects on the local and regional conservation status of plant taxa and protected habitat types as well as local and regional fragmentation levels. These impacts are notoriously problematic to control or prevent and frequently require huge financial commitments to mitigate.

Impacts of a cumulative nature typically include the following:

- Exacerbation of existing levels of habitat fragmentation and isolation.
- Cumulative impacts on local / regional and national conservation targets and obligations.

Nature:
Exacerbation of existing levels of habitat fragmentation and isolation (Loss of natural habitat outside the development footprint caused by peripheral developments such as local townships, increased density of road and other linear

infrastructures, increased anthropogenic encroachment and exploitation of natural resources, loss of aesthetic appeal and 'sense of place', habitat fragmentation and degradation).

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**High (64)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, considered a regional impact	
Can impacts be mitigated?	Yes, but extremely limited success	
Confidence in findings:	High	

Mitigation:

» These impacts are generally addressed on other platforms, such as regional councils and authority involvement and generally lies outside the scope of this particularly project.

Nature:

Cumulative impacts on local/ regional and national conservation targets and obligations (Loss of natural habitat, habitat fragmentation and degradation, loss of phytodiversity, decreased aesthetic appeal).

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	National (4)	Local (2)
Duration	Permanent (5)	Local (2)
Magnitude	Low (4)	Minor (2)
Probability	Improbable (2)	Very improbable (1)
Significance	**Low (26)**	**Low (6)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, all anthropogenic developments result in sterile habitat and devastation of natural vegetation, causing linear and nodal losses of habitat, disruption of continuous habitat, increased fragmentation and isolation of natural habitat	
Can impacts be mitigated?	Yes, but with extremely little success	
Confidence in findings:	High	

Mitigation:

» Implement mitigation measures recommended within this EIA Report within the area under the developer's control.

» Containment, prevention of spread of cumulative impacts.

» Possible development of an Offset Programme / conservation programme. This would be on a regional scale and should be addressed on other platforms, such as regional councils and authority involvement.

9.3.1.2 Fauna

Anticipated cumulative impacts of the proposed project on the fauna of the region include:

- Cumulative losses and degradation of natural faunal habitat.
- Cumulative depletion of faunal taxa, assemblages and communities on a regional scale, with specific reference to the conservation status of certain fauna taxa.

Nature:

Direct impacts on / losses of fauna species of conservation importance and concern and habitat associated with these species. Impacts are unavoidable because of land clearing activities but are generally restricted to the immediate area. This impact is restricted to the construction phase but is permanent. Animals are generally mobile and will evacuate towards other suitable areas, but losses are reasonably expected.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Medium-term (3)
Magnitude	Very high (10)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**High (72)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent. Unavoidable impacts on conservation important animals will occur, irrespective of mitigation measures, albeit restricted to the local footprint. Implementation of mitigation measures will curtail losses to some extent.	
Confidence in findings:	High	

Mitigation:

- Extent of impact likely to be restricted to site only.
- Ensure the absence of, particularly, sessile species, through a thorough walk-down (search and rescue) of development areas.
- Ensure the absence of larger animals through frequent patrols, particularly prior to development.

Nature:

Losses of natural habitat through physical transformation, modifications, removals and damage. Also includes the losses of natural refugia, such as termitaria, dead trees, etc.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**High (65)**	**Medium (55)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, to some extent	

Can impacts be mitigated?	Yes, within areas surrounding the footprint.
Confidence in findings:	High

Mitigation:

- » Restrict losses of natural habitat to footprints, avoid peripheral or unnecessary losses of natural habitat.
- » Ensure proper rehabilitation of areas outside development footprints should accidental habitat degradation occur.
- » Promote nodal developments by grouping developments structures.
- » Avoid the uncontrolled spread of infrastructure.

Nature:

Depletion of faunal diversity through direct losses, evacuation of unfavourable habitat by animals, including the introduction of invasive and non-endemic species. Construction and operation creates opportunities for human / animal conflict situations, with reference to potentially dangerous animal encounters, snaring, trapping and killing (vehicular events)

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Medium term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Low (27)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

- » Awareness programmes, ensuring minimal conflict situation.
- » Control of human movement in adjacent natural habitat, frequent patrols, biological monitoring programmes, animal control (vervet monkeys, feral cats, rats, baboons, dogs, etc.).
- » Ecological sound management of construction areas, with reference to waste management, food sources, etc.

Nature:

Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Minor (2)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (48)**	**Low (27)**
Status	Negative	Negative

Reversibility	Moderately reversible, the nature of impacts is such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Confidence in findings:	High	
Mitigation: » Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat.		

Nature: Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (3)	Local (2)
Duration	Permanent (5)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Highly probable (4)
Significance	**High (70)**	**Medium (40)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes, to some extent	
Confidence in findings:	High	
Mitigation: » Limit development to footprint area. » Avoid impacts in adjacent habitat. » Implement biodiversity monitoring programmes. » Alien and invasive management programmes.		

Nature: Exacerbated increases of edge effects of the project areas.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (3)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Medium (30)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale.	
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

- Implement biodiversity monitoring programmes.
- Ensure proper restoration and rehabilitation of construction areas subsequent to construction.

Nature:

Accelerated development patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (48)**	**Medium (48)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale.	
Can impacts be mitigated?	Yes, to some extent	
Confidence in findings:	High	

Mitigation:

- These impacts are generally addressed on other platforms, such as regional councils and authority involvement and generally lies outside the scope of this particularly project.

Nature:

Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Regional (3)	Regional (3)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (24)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale.	
Can impacts be mitigated?	Yes, to some extent	
Confidence in findings:	High	

Mitigation:

- Public awareness programmes.
- Implementation of biodiversity monitoring protocols.
- Search and rescue operations.

9.3.1.3 Avifauna

Considering the interest and expansion of power plants in South Africa, especially in the Limpopo Province, it is anticipated that these structures could cumulatively have an impact on the surrounding ecological integrity and bird compositions. Therefore, it is anticipated that an increase in surface activity and infrastructure, herewith composed of power plant infrastructure, could result in additional ecological impacts. The magnitude and severity of the impacts are elevated (or enhanced) due to the addition of these structures to the landscape. Therefore, more surface area will become lost, entailing the following:

» Additional loss of dispersal corridors owing to habitat alteration.
» Subsequent habitat changes and changes to the local avifaunal community structure and composition (colonisation by generalists and secondary species).
» Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa.

Of these, the latter is the most important impact anticipated in the region, and any major loss of habitat is likely to affect the home range size of large-bodied bird species especially where the ranges of these species overlap with the proposed activities. In addition, a cumulative increase in the surface area of associated electrical infrastructure could also increase the risk of bird collisions with overhead power lines.

Nature:
Additional loss of bird dispersal corridors owing to habitat alteration.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (4)	Regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**High (64)**	**High (64)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to some extent	
Confidence in findings:	Moderate	

Mitigation:
» Avoid development near major drainage lines and in close proximity to rivers, streams and topographical features.
» Provide buffers to habitat with a high potential to be used as dispersal corridors in the landscape.

Nature:
Subsequent habitat changes and changes to the local avifaunal community structure and composition (colonisation by generalists and secondary species) owing to rehabilitation practice.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)

Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (2)
Significance	**Medium (36)**	**Low (20)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Moderate	Low
Can impacts be mitigated?	Yes, to some extent	
Confidence in findings:	Moderate	

Mitigation:

» Implement rehabilitation strategies to enhance habitat structure and habitat diversity on pertubated landscapes.

» Monitoring should be conducted to evaluate rehabilitation effort (where it occurs).

Nature:

Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (4)	Regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Probable (3)
Significance	**High (80)**	**Medium (48)**
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	High	Low
Can impacts be mitigated?	Yes, to some extent	
Confidence in findings:	High	

Mitigation:

» The most feasible solution is to develop and implement a regional programme / framework at local government and Provincial level that identifies areas of concern, typically such as an Environmental Management Framework, that takes development opportunities and constraints into consideration on a regional scale and aims to identify ecological sensitive areas of local diversity.

» Consider nodal development on land with low ecological sensitivity and preferably in close proximity to existing urban areas. However scattered and widespread township development, including potential widespread nodal development at the landscape scale should be avoided, especially when coinciding with rural areas or remote locations.

9.3.2 *Potential Cumulative Impacts on Air Quality*

There are no significant sources of air pollutants in the area where the Mutsho Power Project will be developed. The air shed is therefore not currently degraded and emissions from the Mutsho Power Project will not add to an existing air pollution loading. There is therefore no cumulative impact associated with the Mutsho Power Project and other sources. The cumulative assessment here therefore refers to the combination of all sources at the Mutsho Power Project (i.e. boiler, stack, coal stockpile, ash dump and site access roads).

Nature:
Increase in ambient concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO and dust fallout in the surrounding ambient environment.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Local (2)	Local (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (16)**	**Low (16)**
Status	Negative	Negative
Reversibility	Yes	Yes
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

» The Mutsho Power Project proposes to implement Circulating Fluidized Bed (CFB) technology with the ability to achieve lower emission of pollutants. In addition, a Cottrell ESP will be fitted to each boiler to remove particulates from the flue gas. The design efficiency is 99.92%. Each boiler unit is fitted with flue gas desulphurisation to remove SO_2. Collectively these technologies reduce emissions so predicted ambient air pollution concentrations are very low.

» The impact of dust generated at the coal stockpile, the ash dump and from site roads can be mitigated by the implementation of dust control technologies and measures, including dust suppression on conveyor transfer points, vegetating of the ash dump and wetting of site roads, amongst others.

9.3.3 *Potential Cumulative Impacts on Climate Change*

The emissions from the project are cumulative with the emissions from other similar fossil fuel power stations, and greenhouse gas emitting installations globally. The emissions from the project will contribute to South Africa's national greenhouse gas inventory. Due to the global scope of climate change and the long durations that greenhouse gas and carbon emissions are expected to remain in the atmosphere, the emissions from the construction and operation of the power plant are globally cumulative in their impact. Climate change is likely to be accelerated and sustained as emissions accumulate in the atmosphere.

As a single source the impact of the Mutsho Power Project's greenhouse emissions during operation is considered to be minor in magnitude due to its 0.8% contribution to national emissions. In 2015, South Africa's national emissions (490 million tCO_2e) contributed 1.45 % towards global emissions of 33.83 billion tCO_2e[20].

9.3.4 *Potential Cumulative Impacts on Hydrology and Geohydrology*

Cumulative impacts have been considered for the proposed project, taking into account existing mine related projects within the area, which are anticipated to have a similar impact on hydrology and geohydrology resources.

[20] https://ourworldindata.org

9.3.4.1 Freshwater Ecology

While there is a notable number of existing mining-related areas within the associated quaternary catchment (including Mopane operations situated approximately 7km due north-east), it is understood that there are also a few proposed mining areas currently being evaluated and reviewed for Environmental Authorisation due to the high number of coal deposits within the area (e.g. the Duel Colliery along the Mutamba River 20km east). Consequently, while the cumulative impact associated with the power generation industry following the commissioning of the proposed power plant is currently regarded as minimal, there is a potential for a number of imminent impacts that might be overlooked.

On the other hand, the greater study area appears to be predominantly operated as private game reserves, provincial nature reserves (e.g. Nzehelele Nature Reserve) and / or agricultural holdings for either livestock rearing or crop cultivation, especially further upstream in the catchment area (near Waterpoort).

Nature:

The numerous impacts associated with the power generation industry (including mining operations), especially toward contamination of surrounding watercourses is a well-documented phenomenon and this is expected to be amplified should a number of complexes be operating in close proximity.

In addition, the potential impacts of surrounding agricultural activities upon the receiving watercourses are known to alter the characteristics of the system and the biological composition is subsequently affected. While the effects of game farming and trophy hunting lodges are not likely to present severe impacts upon the associated systems, the conventional farming practices, such as livestock rearing and crop cultivation concentrated closer to Waterpoort, are expected to affect water availability and quality (e.g. abstraction, nutrient runoff, etc.).

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (3)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Medium (33)**
Status	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

» Unless the overall density of mining and agricultural activities can be reduced (e.g. decommissioning of surrounding collieries), no feasible mitigation measures were proposed at the time of writing. It is envisaged the cumulative impacts will only be amplified within the near future should all pending authorisations be granted.

While the cumulative impact associated with the power generation industry following the commissioning of the proposed power plant is currently regarded as minimal to low, there is a potential for a number of imminent impacts that might be overlooked. Despite the temporary nature of many of the associated watercourses within the study area, there remains sufficient evidence of notable impacts upon the flow regulation within the Sand River (e.g. abstraction points, weirs, impoundments, etc.). In light of the semi-arid nature of the study area and the water scarcity within the catchment, hence the elevated impact score of Medium significance. This is a cause for potential concern and other available water-friendly technologies should be implemented wherever possible. Where available opportunities to reduce the projects water requirements have been proposed, these include making use of CFB technology as opposed to PC boiler technology, dry cooling as opposed t wet cooling, and dry ashing as opposed to wet ashing methods. The favoured option for bulk water supply for the project entails the re-use of water from the Makhado Rietvly WWTW, while the transfer of water from dams in Zimbabwe has been identified as a potential, and the direct abstraction from the Limpopo River being identified as the least preferred option.

The proposed ash dump is an expected source of notable potential contamination, as any contamination is likely to accumulate within the downstream impoundments and potentially reach the main stem Sand River over time, especially if Alternative A is implemented. However the significance of this potential impact is reduced to negligible in the event that the ash dump is lined, compacted, and rehabilitated post-closure, as well as an additional ash dump run-off dam is installed at all potential seepage points (e.g. north-west of the northern portion of the ash dump in Alternative A).

9.3.4.2 Wetlands

The freshwater resources in this quaternary catchment are currently under pressure as a result of mining related activities observed north-east of the Project area, with the closest located approximately 6km north-east. Approximately 12km south-east of the project area there are more mining activities. In addition, extensive farming and irrigation activities along the Limpopo and Sand Rivers are placing increasing strain on the aquatic resources present.

The ash dump at the project area is an expected source of contamination. The project footprint for all three infrastructure layouts is likely to reduce the catchment yield, which is likely to affect surface water recharge to the systems further downstream. In addition impacts such as sedimentation and impaired water quality as a result of surface water runoff, has the potential to reduce the biodiversity and loss of habitat of the freshwater and wetland systems present. Cumulative losses in biodiversity and habitat will result in a loss of sensitive systems as a whole within the greater catchment.

Nature:
Cumulative catchment-wide impacts include the following:

- Loss of catchment yield.
- Contamination of water quality.
- Loss of habitat and biodiversity.
- Loss of surface water recharge.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (4)	Regional (4)
Duration	Long-term (4)	Long-term (4)
Magnitude	Very High (10)	High (8)
Probability	Probable (3)	Probable (3)
Significance	**High (54)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Confidence in findings:	High

Mitigation:

The following mitigation and management measures have been prescribed to prevent and minimise cumulative impacts as a result of the loss of the ephemeral systems which occur in the vicinity of the three proposed infrastructure layout options:

- » Optimise the placement of infrastructure to minimise impacts to the freshwater resources present.
- » Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the life of the proposed project.
- » Ensure that as far as possible all infrastructures are placed outside of freshwater areas and their associated 32m zone of regulation.
- » Limit the footprint area of any project related activities to what is absolutely essential in order to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas).
- » If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated.
- » Ensure that no incision and canalisation of the freshwater features present takes place as a result of the proposed project activities.
- » All erosion noted within the project footprint as a result of any potential surface activities should be remedied immediately and included as part of the ongoing rehabilitation plan.
- » Erosion berms should be installed on roadways and downstream of stockpiles to prevent gully formation and siltation of the freshwater resources. The following points should serve to guide the placement of erosion berms:
  - ∗ Where the track has slope of less than 2%, berms every 50m should be installed.
  - ∗ Where the track slopes between 2% and 10%, berms every 25m should be installed.
  - ∗ Where the track slopes between 10% - 15%, berms every 20m should be installed.
  - ∗ Where the track has slope greater than 15%, berms every 10m should be installed.
- » A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones.
- » Permit only essential personnel within the 32m zone of regulation for all freshwater features identified.
- » All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel.
- » No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained.
- » No material may be dumped or stockpiled within any of the ephemeral drainage lines in the vicinity of the proposed project footprint.
- » No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads.
- » All vehicles must be regularly inspected for leaks.
- » Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil.
- » All spills should be immediately cleaned up and treated accordingly.
- » Appropriate sanitary facilities must be provided for the duration of the proposed project and all waste must be removed to an appropriate waste facility.

9.3.4.3 Surface Water

Water quality along the Sand River, which is the main river within the affected quaternary catchment, has shown elevated levels of pH, Electrical Conductivity (EC), chloride, magnesium and sodium resulting from irrigational runoff associated activities. Impacts from the proposed project may contribute to a further degradation of water quality in this WMA with the current and proposed project for the area.

Nature:
Although the affected quaternary catchments have limited industrial and mining activities, water quality monitoring along the Sand River indicates elevated levels of various salts which were above the SAWQG limits. Impact from the proposed coal-fired power station may contribute to a further deterioration of water quality in the Limpopo WMA unless appropriate mitigation is implemented.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (4)	Regional (4)
Duration	Short term (1)	Short term (1)
Magnitude	High (8)	Moderate (6)
Probability	Highly probable (4)	Probable (3)
Significance	**Medium (52)**	**Medium (33)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:
This cumulative impact can be prevented or minimised by implantation of the measures. These include but are not limited to:

» All runoff emanating from the dirty water areas which include hazardous storage facilities will need to be diverted to the containment facility e.g. a sump prior to construction of the runoff/storm water dams.
» All spillages must be contained to the smallest possible area and must be cleaned immediately.
» All construction equipment shall be put onto a maintenance program, including daily inspection of the equipment.
» The constructed storm water infrastructure will have to remain until post closure. This will ensure that dirty water is captured and contained during removal of infrastructure and thereby prevent siltation and contamination of the river.
» All the dirty water runoff emanating from dirty areas (ash dump, plant and coal stockpile areas) should be contained within the dirty water dams. This water should be stored for re-use within the power plant so as to prevent unnecessary discharge into the environment.
» Clean water emanating from upstream of the project area must be diverted away and discharged to the nearby watercourse or environment.
» All spillages must be contained to the smallest possible area and must be cleaned immediately. Although there is no mitigation for this loss of catchment yield, the extent or overall loss for the two catchments (less than 1%) will be insignificant.
» Clean water from the upstream catchment will be diverted around site and report to the natural environment or streams.
» All rehabilitated areas must be vegetated. Until vegetation has successfully been established, sedimentation should be mitigated by installing silt traps at areas where the surface runoff enters the surface water resources.
» The surface profile of the rehabilitated area should try and resemble the natural conditions prior to the project, this should ensure that the surface profile encourages natural drainage, such that no ponding or standing water occurs after a rainfall event.

9.3.4.4 Geohydrology

The area falls within the Limpopo WMA within quaternary catchment A71K. The groundwater quality of the broader study area currently indicates impact by mining related activities. Unspecified mining related activities are present predominantly in the north-east quadrant in relation to the project area, with the closest located approximately 6km east of the proposed project site. More mining activities are located approximately 12 km south-east of the project area.

The ash dump and coal stockpile at the project area are expected sources of contamination. Private borehole users and surface water bodies (through baseflow) are potential receptors. The ash dump and coal stockpile may contribute to the groundwater quality deterioration, however, the significance of this potential impact to the groundwater is reduced to negligible, if:

» The ash dump is lined, compacted and rehabilitated post-closure.
» The coal stockpile is lined and compacted.

Nature: Groundwater contamination from the ash dump.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Moderate (6)	Small (2)
Probability	Probable (3)	Improbable (1)
Significance	**Medium (33)**	**Low (4)**
Status (positive or negative)	Negative	Neutral
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

» If the groundwater is contaminated, the plume from the ash dump may reach the identified potential receptors (such as groundwater users using surrounding boreholes for drinking and livestock, and local streams). The local streams may receive the groundwater as baseflow; however the likelihood of this is low due to the relatively deep water levels currently observed on site (28 mbgl on average). Groundwater-surface water interaction is expected to be of losing-streams and base flow feeding the local streams with groundwater is not expected.
» With the implementation of an appropriately designed ash dump liner and dry ash deposition, seepage into the groundwater environment is not expected and impacts are regarded as negligible.
» Continuous post-closure monitoring is required so that drastic deterioration in groundwater quality is detected as soon as it occurs, allowing for mitigation measures to be implemented early. Monitoring is recommended to be conducted until satisfactory groundwater quality is reached (through the implementation of monitoring and comparing this to standards and objectives set in the Water Use License (WUL)) and thereafter signed off by the relevant authorities.
» Should an impact be detected through monitoring, affected receptors should be compensated.

9.3.5 Potential Cumulative Impacts on Soils, Land Use and Agricultural Potential

Little or no cumulative impacts are foreseen at this time. If a power station is established on the site, from the soils aspect there will not be a large off-site impact. However, there could be an increased wind erosion hazard from any ash disposal facilities if not properly handled and controlled.

Nature:
Loss of agricultural potential

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Low (2)	Low (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (20)**
Status	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

» The prevailing agricultural potential is low, so loss of agricultural potential will not be of huge significance. The main mitigation measure will be to avoid developing the facility on or close to the wetland zones across the study area, to avoid any potential seepage or other problems.

9.3.6 *Potential Cumulative Impacts on Heritage and Archaeology*

Cumulative impacts on heritage and archaeological resources can result in large-scale losses of sites of significance. Given the development footprint and area of disturbance associated with the project, the Mutsho Power Project is anticipated to have a potential cumulative impact on heritage and archaeological resources given the number of coal mines proposed in the region. Cumulative impacts are therefore expected to be of moderate to high significance.

Nature:
The construction of the new Mutsho Power Project will have significant, permanent and irreversible impacts on any heritage resources. This impact is cumulative, given the number of coal mines and power plants in the area.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Regional (4)	Regional (4)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Highly probable (4)	Highly probable (4)
Significance	**Medium (52)**	**Medium (52)**
Status	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	No	
Confidence in findings:	High	

Mitigation:
» Impacts to the cultural landscape speak to the changing nature of this landscape from agricultural to industrial. No mitigation is possible.

9.3.7 *Potential Cumulative Impacts on Palaeontology*

The site is underlain by the Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation; and Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement). The Archaean Granite-Gneiss Basement is metamorphic in origin and thus unfossiliferous while the Undifferentiated Karoo Basin and Solitude Formation has a high to very high palaeontological Sensitivity. The lack of appropriate exposure at the proposed development footprint (including all three alternative sites) indicates that the impact of the development is of low significance in palaeontological terms.

The cumulative effect of the development is low as there is no other similar developments in the area.

Nature:
Cumulative impacts on fossil remains preserved at or beneath the ground surface.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (1)	Low (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (1)
Significance	**Low (16)**	**Low (8)**
Status	Positive	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:
» Not necessary. The site is underlain by the Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation; and Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement. The Archaean Granite-Gneiss Basement is metamorphic in origin and thus unfossiliferous while the Undifferentiated Karoo Basin and Solitude Formation has a high to very high palaeontological Sensitivity. The lack of appropriate exposure at the proposed development footprint (including all three alternative sites) indicates that the impact of the development is of low significance in palaeontological terms.

9.3.8 *Potential Cumulative Noise Impacts*

Currently there are no industrial noise sources within 5km from the proposed project site and there is therefore no potential for cumulative noise impacts.

Nature:
- Various noise generating activities taking place simultaneously.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (3)	Local (3)

Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (2)
Probability	Very improbable (1)	Very improbable (1)
Significance	**Low (9)**	**Low (9)**
Status (positive or negative)	Negative	Negative
Reversibility	Very High	Very High
Irreplaceable loss of resources?	No	No
Confidence in findings:	High. The location of the power station is defined and a worst-case scenario was used.	
Mitigation: » No mitigation required.		

9.3.9 *Potential Cumulative Visual Impacts*

The proposed development is located within an area that has a generally cohesive natural rural character although there one other existing major industrial operation (Syerfontein Mine) approximately 7km to the north of the proposed project. Other influencing elements include a railway line that runs through the site. In terms of possibly adding to the impression of industrialisation, the visibility of the majority of the proposed development will be relatively limited due to the high level of Visual Absorption Capacity (VAC) of the existing landscape. The bulk of the development is highly unlikely to be seen at the same time as other existing industrial elements.

The exception to this is a minor ridgeline to the north of the development which enables views over the natural tree canopy and the development. There is a local road and a homestead located on this ridgeline.

Nature:
Adding to the industrialisation of the area.

There is currently one other industrial site in the vicinity of the proposed project (Syerfontein Mine) which is approximately 6km to the north of the proposed development. This mine is only obvious from a local road that traverses a ridgeline to the north of the proposed site. Should the proposed power station be developed both the mine and the power station would be visible from the same sections of road as well as from a homestead that is located on the ridgeline.

The proposed project will increase the extent of disturbance due to industrial development in a landscape that otherwise appears natural.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Site and immediate surrounds (2)	Site and immediate surrounds (2)
Duration	Long term (4)	Long term(4)
Magnitude	Moderate (6)	Low to moderate (5)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Medium (33)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No

Can impacts be mitigated?	Yes
Confidence in findings:	High

Mitigation:

Planning:

- Plan to maintain the height of structures as low as possible.
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.
- Plan screen planting to soften views of the development particularly for closest receptors (local roads and homesteads).
- Plan grassing of ash dump.
- Plan contouring of ash dump to integrate with the local landform.
- Use dust suppression on ash dump and coal yard.
- Plan colours of structures to visually blend with the local landscape.

Construction:

- Minimise disturbance and loss of existing vegetation.
- Undertake rehabilitation of disturbed areas.
- Undertake screen planting.
- Undertake dust control.

Operations:

- Monitor rehabilitated areas and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
- Dust control at the ashing facility must be implemented and maintained.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site.
- Return all possible areas to their original state.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Nature:

The only other large scale industrial site within the vicinity of the proposed project that may be experienced from roads is the Syerfontein Mine.

Neither the existing mine or the proposed development are likely to be obvious from major roads (N1 and R523) to the south and east of the development area.

The proposed development will be highly obvious from the one minor road that runs between the two properties that comprise the possible site area (Mopane to Waterpoort Road). The proposed development will be obvious from this road. The existing mine site however will not be visible from this road.

The existing mine site is obvious from the N1 to Mopane local road largely due to signage. The proposed development will also be visible from this road in that the stack will be visible for a short section (approximately 500m).

Both sites will also be visible from a short section of a local road (approximately 250m) that traverses the minor ridgeline to the north of the proposed development site.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**

Extent	Site and immediate surrounds (2)	Site and immediate surrounds (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Probable(3)
Significance	**Medium (60)**	**Low (30)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes to a small degree	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

Planning:

- Move the location of the substation to allow an effective buffer area between the Mopane / Waterpoort Road and the substation.
- Plan to maintain the height of structures as low as possible.
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:

- Minimise disturbance and loss of vegetation.
- Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
- Undertake rehabilitation of disturbed areas.
- Undertake screen planting between the substation and the Mopane / Waterpoort Road.

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
- Control dust on the ashing facility.
- Contour the ashing facility to reflect the surrounding natural landform.
- Establish grass on the ashing facility as filling proceeds.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site.
- Return all possible areas to their original state.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Nature:

The proposed development is likely to be highly obvious from trains as they pass through the area.

The degree of impact is likely to be similar as that experienced from the Mopane / Waterpoort Road. However because this is not likely to carry any significant number of tourists, the probability of impacts is relatively low.

There are no other major industrial operations that will be visible from the train between the Soutpansberg and the terminus of the railway at Musina other than the Syerfontein Mine small sections of which may be visible.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Site and immediate surrounds, (2)	Site and immediate surrounds (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (24)**	**Low (16)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes to a small degree	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

Planning:

- Move the location of the substation to allow an effective buffer area between the Mopane / Waterpoort Road and the substation.
- Plan to maintain the height of structures as low as possible.
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:

- Minimise disturbance and loss of vegetation.
- Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
- Undertake rehabilitation of disturbed areas.
- Undertake screen planting between the substation and the Mopane / Waterpoort Road.

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
- Control dust on the ashing facility.
- Contour the ashing facility to reflect the surrounding natural landform.
- Establish grass on the ashing facility as filling proceeds.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site.
- Return all possible areas to their original state.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Nature:

The assessment shows that impacts on protected areas are likely to be negligible. Existing impacts of industry on protected areas are also negligible.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Small (0)	Small (0)
Probability	Very improbable(1)	Very improbable (1)
Significance	**Low (7)**	**Low (7)**
Status	Neutral	Neutral
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

Planning:

» Plan to maintain the height of structures as low as possible.

Construction:

» Colouring of taller structures should be such that they are not made prominent and preferably visually recede.

Operations:

» Control dust on the ashing facility.
» Contour the ashing facility to reflect the surrounding natural landform.
» Establish grass on the ashing facility as filling proceeds.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site.

Nature:

Mopane is the only settlement that is likely to be affected.

The ZTV analysis indicates that both the Extremely Tall and Moderately Tall elements may be visible from Mopane.

From the site visit however, it seems likely that vegetation both within and surrounding the settlement will largely screen the proposed development. It is possible that the top of the stack associated with each option may be visible. This is unlikely to significantly influence landscape character as experienced from within this small settlement.

Also from the site visit it was found that sections of the existing Syerfontein Mine are visible to and impact on the eastern edge of the settlement.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Site and immediate surroundings (2)	Site and immediate surroundings (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (2)	Small (0)
Probability	Probable (3)	Improbable (2)
Significance	**Low (24)**	**Low (12)**
Status	Negative	Neutral to negative

Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes to a small degree	
Confidence in findings:	High	

Mitigation:

Planning:

» Plan to maintain the height of structures as low as possible.
» Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.
» Plan screen planting to soften views of the development particularly for closest receptors (local roads and homesteads).
» Plan grassing of ash dump.
» Plan contouring of ash dump to integrate with the local landform.
» Use dust suppression on ash dump and coal yard.
» Plan colours of structures to visually blend with the local landscape.

Construction:

» Minimise disturbance and loss of existing vegetation.
» Undertake rehabilitation of disturbed areas.
» Undertake screen planting.
» Undertake dust control.

Operations:

» Monitor rehabilitated areas and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
» Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
» Dust control at the ashing facility must be implemented and maintained.

Decommissioning:

» Remove infrastructure not required for the post-decommissioning use of the site;
» Return all possible areas to their original state; and
» Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Nature:

Only receptors that are elevated on minor ridgelines and overlooking the site and those within the immediate vicinity of the proposed site are likely to be affected to a significant degree. These include three homesteads that lie within 2.5km of the proposed development, a further two homesteads within 5km of the proposed development and one homestead which is elevated on a ridgeline and approximately 7km to the north, north east of the proposed development.

Only the homestead that is located on the elevated on the ridgeline to the north of the proposed development is likely to be affected by both the existing Syerfontein Mine and the proposed development.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Site and immediate surroundings (2)	Site and immediate surroundings (2)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate to high (7)	Moderate to low (5)

Probability	Definite (5)	Definite (5)
Significance	**High (65)**	**Medium (55)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, to a small degree	
Confidence in findings:	High	

Mitigation:

Planning:

- Plan to fill the ashing facility from north to south.
- Plan to maintain the height of structures as low as possible.
- Minimise disturbance of the surrounding landscape and maintain existing vegetation around the development.

Construction:

- Minimise disturbance and loss of vegetation.
- Colouring of taller structures should be such that they are not made prominent and preferably visually recede.
- Undertake rehabilitation of disturbed areas.

Operations:

- Reinstate any areas of vegetation that have been disturbed during construction and on the ashing facility as work proceeds.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions (monthly until establishment, thereafter at the middle and end of every growing season).
- Minimise disturbance and maintain existing vegetation as far as is possible both within and surrounding the development area.
- Control dust on the ashing facility.
- Contour the ashing facility to reflect the surrounding natural landform.
- Establish grass on the ashing facility as filling proceeds.

Decommissioning:

- Remove infrastructure not required for the post-decommissioning use of the site.
- Return all possible areas to their original state.
- Monitor rehabilitated areas post-decommissioning and implement remedial actions.

Nature:

This impact relates to an increase in levels of nuisance created by lighting in the area particularly for neighbouring homesteads and travellers on local roads.

The area is generally reasonably dark during the night. Only the Syerfontein Mine exhibits security and operational lights at night.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Site and immediate surroundings (2)	Site and immediate surroundings (2)
Duration	Long term (4)	Long term (4)
Magnitude	Minor to Small (1)	Minor to Small (1)
Probability	Probable (3)	Improbable (2)

Significance	**Low (21)**	**Low (14)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

Domestic level lighting within the office and control room area can be mitigated by:

» Minimising lighting.
» The use of censors to ensure that when there is no one present, lighting automatically switches off.
» Careful choice of external fittings to ensure that light is focused on relevant areas and does not spill into un-necessary areas.
» Shielding of all external lights.

Security / Maintenance lighting at the substation can be mitigated by:

» The use of infra-red technology for security purposes.
» Ensuring that maintenance is scheduled for daylight hours where possible.
» Where maintenance may be required during the hours of darkness lighting should only be activated for the areas required.
» Ensure that all lighting is focused on the area of interest and that light spill is minimised.
» Using light shields to minimise light spill.

9.3.10 Potential Cumulative Socio-economic Impacts

The extent to which a proposed project will influence the zone of influence is based on the baseline conditions of that environment, which includes other proposed projects in the zone. Such projects, depending on their timing in relation to the project may influence the manifestation and significance of socio-economic impacts that could result from the current project. As such, knowledge of such projects is required in order to accurately predict and rate socio-economic impacts.

Six developments have been identified in the District that might contribute to the accumulation of impacts in the region. These are the:

» Musina-Makhado Special Economic Zone.
» Musina Copper Mine.
» Limpopo Eco Industrial Park.
» 440MT and 442MT Prospecting Right.
» Venetia Mine.
» Syerfontein Mine.
» Makhado Colliery.
» Additional coal fields in the larger area.

Table 9.1 summarises the key economic impacts that were identified and analysed by other specialists for the above-mentioned projects. The table indicates the rating of the identified socio-economic impacts as proposed by the other specialists in their respective studies, and based on the combination of these ratings – indicates the importance of the socio-economic impact from a cumulative effect perspective.

Table 9.1: Reviewed literature of existing and planned developments and impact rating.

Economic Parameter	Description/Impact	Rating by Specialist	Identified Importance
Increase in production and GDP	**Musina-Makhado Special Economic Zone** GDP contribution expected to fluctuate between R308m and R709m (Limpopo Economic Development Agency, 2015).	-	High Positive
	Musina Copper Mine Positive production induced (Golder Associates, 2017).	Moderate positive	
	Limpopo Eco Industrial Park ± 20 billion per annum (Limpopo Eco Industrial Park, 2016)	-	
Employment creation	**Musina-Makhado Special Economic Zone** 172 – 345 direct jobs will be created.	-	Moderate Positive
	Musina Copper Mine Employment creation.	Moderate positive	
	Limpopo Eco Industrial Park 90 000 direct and indirect jobs to be created	High positive	
	440MT and 442MT Prospecting Right Increased noise levels (Naledzi Environmental Consultants, 2018)	-	
Change is sense of place: noise levels	**Venetia Mine** Noise generation expected (De Beers, 2015).	Low negative	Low Negative
	Musina Special Economic Zone Intensified shift to industrial sense of place.	-	
	Syerfontein Mine Existing mine contributing to shift to industrial sense of place from natural.	-	
	Musina Special Economic Zone Skills upgrading, and knowledge transfer will take place.	-	
Skills development	**Venetia Mine** Aesthetic changes will occur.	Low negative	Moderate Positive
Visual Impact	**Syerfontein Mine** Stacks visible.	Negative	Negative
Energy Security	**Musina Special Economic Zone** South African Energy Metallurgical Base	Positive	Positive

Additional impacts that were not covered in the literature reviewed but were thought to be of significance are the influx of migrant labour.

Nature:
Increase in production and creation of employment opportunities.

	Cumulative Contribution of Proposed Project	Cumulative Impact without Proposed Project
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)

Probability	Highly probable (4)	Highly probable (4)
Significance	**High (60)**	**Medium (52)**
Status	Positive	Positive
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	
Mitigation:		
» No mitigation measures are required.		

Two strong positive impacts will ensue due to the joint employment and production.

Nature: Change in sense of place in the form of visual impact and noise.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (1)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (39)**	**Medium (39)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Confidence in findings:	High	
Mitigation:		
» Adhere to noise and visual specialists' recommendations.		

Nature: Influx of migrant labour and job seekers due to job opportunities presented by numerous projects.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Medium term (3)
Magnitude	Moderate (6)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Medium (39)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	
Mitigation:		

- » Where feasible, effort must be made to employ local labour in order to create maximum benefit for the communities and limit in-migration.
- » Provide training for unemployed local community members with insufficient skills and thus increase absorption of local labour thereby decreasing in-migration.
- » Manage recruitment and marketing for vacancies with a preference of residents within the municipality.

9.3.11 *Potential Cumulative Traffic Impacts*

Nature:

The potential cumulative impacts of other industrial-type developments proposed and operational within the region are explored. The Syerfontein Mine traffic is already included in the traffic count. Increase in background traffic volumes (heavy and light vehicles) at 4% per annum are considered in the N1/D1021 intersection analysis. This accounts for increase in traffic from new developments wider afield.

The additional traffic associated with the Mutsho Power Project is acceptable and the cumulative impact of the Mutsho Power Project is of low significance. The impact of growth in background traffic will impact on the D1021/N1 intersection in time.

	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (3)	Low (1)
Probability	High (4)	Probable (3)
Significance	**Medium (36)**	**Low (21)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings:	High	

Mitigation:

- » Upgrade the D1021/N1 intersection to a traffic roundabout when warranted or transport raw materials to site by rail during the Operational Phase.
- » Transport some materials off-site by rail during the Decommissioning Phase.

9.4. Conclusions Regarding Cumulative Impacts

Considering the findings of the specialist assessments undertaken for the project, the cumulative impacts for the Mutsho Power Project are anticipated to be within acceptable limits with the opportunity to reduce the significance of the majority of impacts with the implementation of appropriate mitigation measures.

The following conclusions can be drawn when considering the cumulative impacts associated with the Mutsho Power Project and associated infrastructure:

- » The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected vegetation types, faunal habitats or species through clearing, resulting in an impact on the conservation status of such flora or ecological functioning. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an ecological perspective.

- The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected faunal species, and loss or destruction of suitable habitat. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a faunal perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected avifaunal species, and loss or destruction of suitable habitat. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an avifaunal perspective.
- The construction and operation of the proposed project will not result in an unacceptable risk to human health through impacts on air quality. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an air quality perspective.
- The construction and operation of the proposed project will result in a large contribution to climate change as a result of its GHG emissions. However mitigation measures are available which if implemented may assist in reducing the emissions and climate change impact of the project.
- The construction and operation of the proposed project will not result in an unacceptable risk to hydrological and / or geohydrological resources resulting due to the increase in the extent of hard or impermeable surfaces in the greater area as well as additional potential pollutants in the area; and as a result of seepage or contamination. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a hydrological and geohydrological perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of soils or land of high agricultural potential. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a soils, land use, and agricultural potential perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of archaeological or heritage resources. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an archaeological and heritage perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of palaeontological resources. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a palaeontological perspective.
- The construction and operation of the proposed project will not result in an unacceptable noise impacts on the surrounding areas. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a noise perspective.
- The construction and operation of the proposed project will not result in a complete or whole-scale change in sense of place and character of the area and unacceptable visual intrusion largely due to the screening provided by the local topography and vegetation cover. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a visual perspective.
- The construction and operation of the proposed project will result in positive and negative contributions from a socio-economic perspective. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a socio-economic perspective.
- The construction and operation of the proposed project will not result in unacceptable traffic impacts on road users. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a traffic perspective.

Based on the assessment provided within this chapter, it is concluded that the development of the proposed Mutsho Power Project and associated infrastructure on the proposed project site will not result in unacceptable levels of cumulative impacts within the area.

CHAPTER 10 CONCLUSIONS AND RECOMMENDATIONS

Mutsho Power proposes the development of the Mutsho Power Project and associated infrastructure on a site near Makhado (Louis Trichardt) in Limpopo Province. The Mutsho Power Project comprises a new 600MW coal-fired power station, which once developed is intended to form part of the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP).

The project site is located approximately 43km south-west of Musina, approximately 41km north of Makhado (Louis Trichardt), and approximately 7km south of Mopane. The area under investigation is approximately 2 161ha in extent and comprises 2 agricultural properties, namely the Farm Du Toit 563 belonging to Mr. Souis Hendrie Van Der Walt; and the remainder of the Farm Vrienden 589 belonging to Fumaria Property Holdings (Pty) Ltd, a Special Purpose Vehicle (SPV) which is wholly owned by MC Mining Ltd (MCM). A minimum development footprint of 350ha in extent is required, and will be suitably located within the greater project site so as to avoid areas of sensitivity which have been identified on site.

Coal required for the project will be sourced from MCM's Makhado Project to be developed approximately 20km south-east of the project site. MCM's Makhado Project comprises a new coal mine (i.e. the Makhado Colliery) to be located north of the Soutpansberg Mountains in the Makhado Local Municipality of Vhembe District. It has been estimated that the Makhado Project has 344.8Mt mineable tonnes of coal in situ (MTIS), and once developed is expected to produce coal for domestic and/or export markets. The Makhado Colliery is estimated to operate for 16 years at full capacity (supplying approximately 2.3 million tons hard coking coal and 3.2 million tons thermal coal per annum). In 2017 MCM announced that it would initiate mining via the Makhado Lite Project. This will result in decreased volumes being mined initially, which will extend the life of the colliery. Additional life extension is further possible through the use of adjacent pits and surrounding coal fields as part of the GSP Project. The Mutsho Power Project will have a lifespan of approximately 30 years and will utilise approximately 2 million tons of coal per annum. Should the Mutsho Power Project be selected as a preferred bidder under the CBIPPPP, a coal supply agreement would need to be entered into which satisfies the power station project's financing and CBIPPPP requirements. The Makhado Project is anticipated to commence operation in mid-2018.

Coal will be transported to site either via a new 22km railway loop proposed for development between the Makhado Colliery and existing Huntleigh railway siding, or via road transport. The proposed new railway loop forms part of the Makhado Colliery development which was assessed through a separate application, and is therefore excluded from the current scope of work. In the event that coal is transported via the proposed new railway loop a railway spur would need to be developed onsite for the offloading of coal and other raw materials (i.e. limestone).

The Mutsho Power Project will have a generation capacity of up to 600MW and will comprise 2 x boilers (suitably rated at approximately 300MW each), 2 x steam turbine generators (STGs), a flue / smoke stack, an ash dump, packaged Water Treatment Plant (WTP) and storage or discard ponds and vessels, an ash dump run-off dam, main plant run-off dam, raw water storage dam, strategic and working coal stockpiles and lime supply. The project will make use of direct or indirect dry cooling systems; dry ash disposal methods; and will be developed as a Zero Liquid Effluent Discharge (ZLED) facility.

The key project components proposed as part of the Mutsho Power Project are summarised in **Table 2.3**.

Table 10.1: Key Project Components.

	600MW SC CFB Plant
Power island consisting of:	» 2 x 300MW Supercritical (SC) Circulating Fluidised Bed (CFB) boilers.
	» Electrostatic Precipitator (ESP)
	» Flue / smoke stack up to 150m in height.
	» Direct dry-cooling (air-cooling) systems.
	» Balance of plant components (including steam turbines and generators etc.).
Raw materials storage and handling:	» Coal and Limestone / Lime Rail Spur and / or Road off-loading systems.
	» Upgrading or establishment of a rail siding.
	» Coal crusher and raw material handling equipment.
	» Strategic and working coal stockpile.
	» Limestone or Lime storage and handling area.
Ash handling and disposal:	» Ash dump (dry-ashing is proposed in order to reduce the project's water requirements in alignment with the recommendations of the National Development Plan (NDP) and Integrated Energy Plan (IEP)).
Water infrastructure:	» Raw water storage dam (up to 5ha).
	» Water supply pipelines and booster stations.
	» Pollution control / run-off dams (up to 2.5ha each).
	» Packaged Water treatment plant (WTP).
	» Wastewater treatment plant (WWTP).
	» Storm water management systems.
Electrical infrastructure:	» HV Yard and substation components with HV overhead transmission lines connecting to Eskom infrastructure.
Associated infrastructure:	» Control room, office / administration, workshop, storage and logistics buildings.
	» On-site critical staff accommodation required during construction (up to 1.5ha).
	» Temporary site office, laydown and assembly areas, and batching plant (up to 5ha in total).
	» Upgrading of external roads and establishment of internal access roads.
	» Security fencing and lighting, and access control with guardhouse.
Services required:	» Refuse Material Disposal – During construction all refuse material generated by the proposed development will be collected by a contractor to be disposed of off-site at a licensed waste disposal facility. Solid wastes and sludge arising during operation will be collected, and transported to the ash dump. Chemical wastes will be collected and stored separately in a safe manner, and will be transported off-site via road where they will be disposed of according to the local and national standards.
	» Sanitation – During construction, all sewage waste will be collected by a contractor to be disposed of at a licensed waste disposal site. During operation, 2 x 5m³/h buried sanitary sewage treatment systems will be provided for discharge from staff showers, flushing, toilets, canteen, etc. The sanitary sewage will be treated by secondary biological contact oxidation process, filtered, disinfected, and flow into clean water basin for reuse.
	» Water – Between 800 000m³/a and 1.2 million m³/a of water is required during the construction phase, while approximately 1 million m³/a is required to support the operation of the project. A number of bulk water supply options are currently being investigated for the project. The most promising of these include: ∗ Transfer of treated effluent from the Makhado Rietvly Wastewater Treatment Works (WWTW) ∗ Transfer from dams in Zimbabwe (alternative to above). ∗ Direct abstraction from the Limpopo River.

	» Electricity – A power supply will be required during both construction and operation of the project. It is anticipated that electricity required to support the construction will be provided by the Musina Local Municipality.

This Environmental Impact Assessment (EIA) has been undertaken in support of an Integrated Application for Environmental Authorisation (EA) and a Waste Management License (WML) required for the project. The EIA process has been conducted in accordance with Section 24(5) of the National Environmental Management Act (No. 107 of 1998) (NEMA), and the 2014 Environmental Impact Assessment (EIA) Regulations (GNR 326); and Section 19(2) of the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA), and the List of Waste Management Activities (GNR 921).

The EIA Phase aimed to:

- » Provide an overall assessment of the social and biophysical environments affected by the construction, operation, and decommissioning of the proposed project.
- » Assess potentially significant direct, indirect, and cumulative impacts associated with the project.
- » Recommend appropriate mitigation measures to avoid, reduce, or minimise the significance of potentially significant environmental impacts.
- » Undertake a fully inclusive Public Participation process to ensure that Interested and Affected Parties (I&APs) are afforded the opportunity to participate in the EIA process, and that their issues and concerns regarding the project are recorded.

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by a team of independent specialist consultants, and the parallel Public Participation process. The Public Participation process has been extensive and every effort has been made to include representatives of all stakeholders in the study area.

10.1. Evaluation of the Proposed Project

The preceding chapters together with the independent specialist studies contained within **Appendices D – N** provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of the proposed project. This Chapter concludes the EIA process by providing a summary of the conclusions of the assessment of the Mutsho Power Project and associated infrastructure. In doing so, it draws on information gathered as part of the EIA process and the knowledge gained by the environmental consultants during the course of the EIA, and presents an informed opinion of the environmental impacts associated with the project, as assessed by the team of independent specialist consultants.

Impacts associated with the project relate to the following:

- » Impacts associated with the power station and associated infrastructure.
- » Impacts associated with waste treatment and management activities.

Several areas of sensitivity were identified from the specialist studies undertaken. These are represented on sensitivity maps which have been prepared for the project, and which are intended to inform the micro-siting of project infrastructure (refer to **Figure 10**.1**, Figure 10**.2, and **Figure 10**.3).

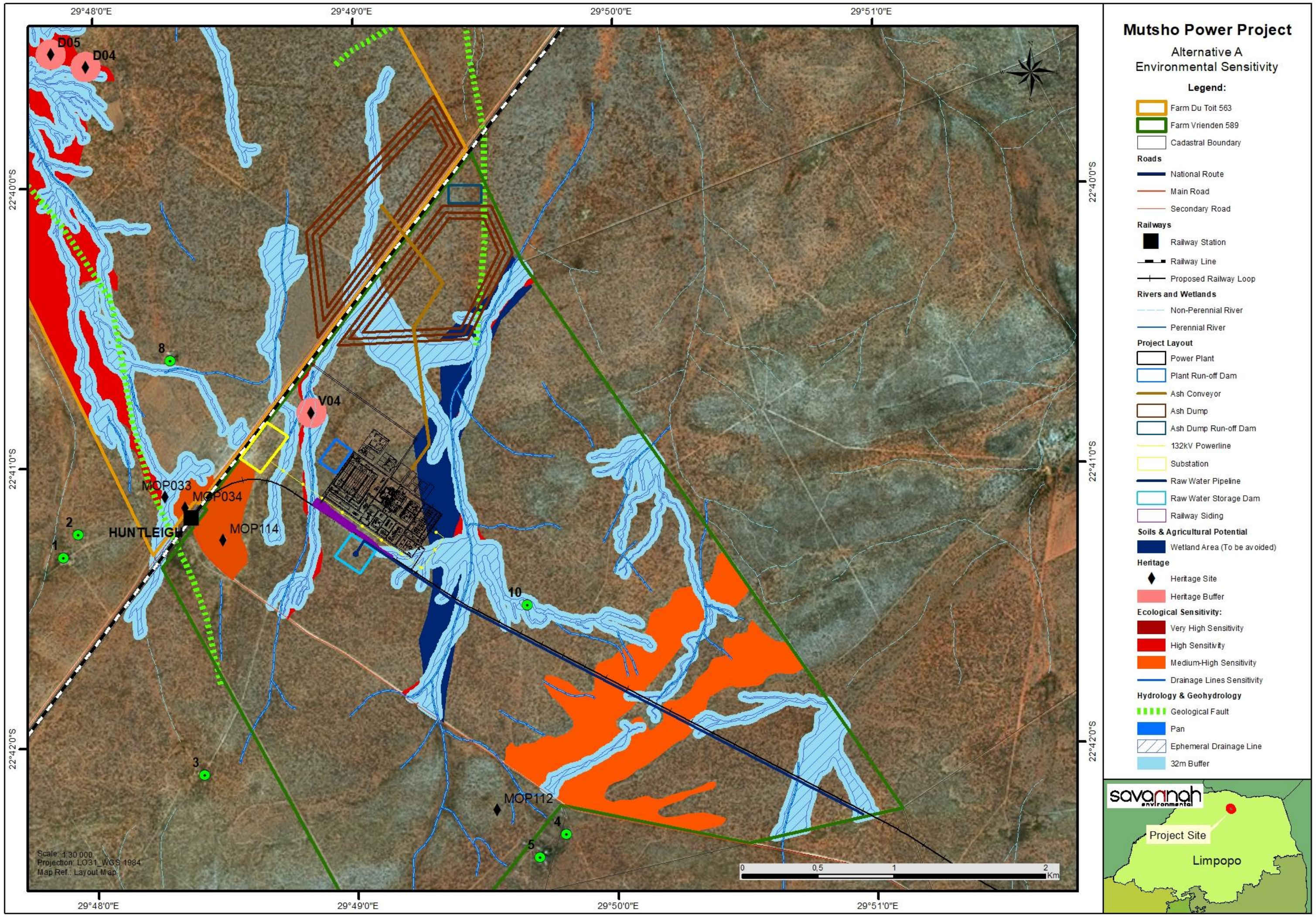

Figure 10.1: Environmental Sensitivity map for the project site (Preferred Alternative).

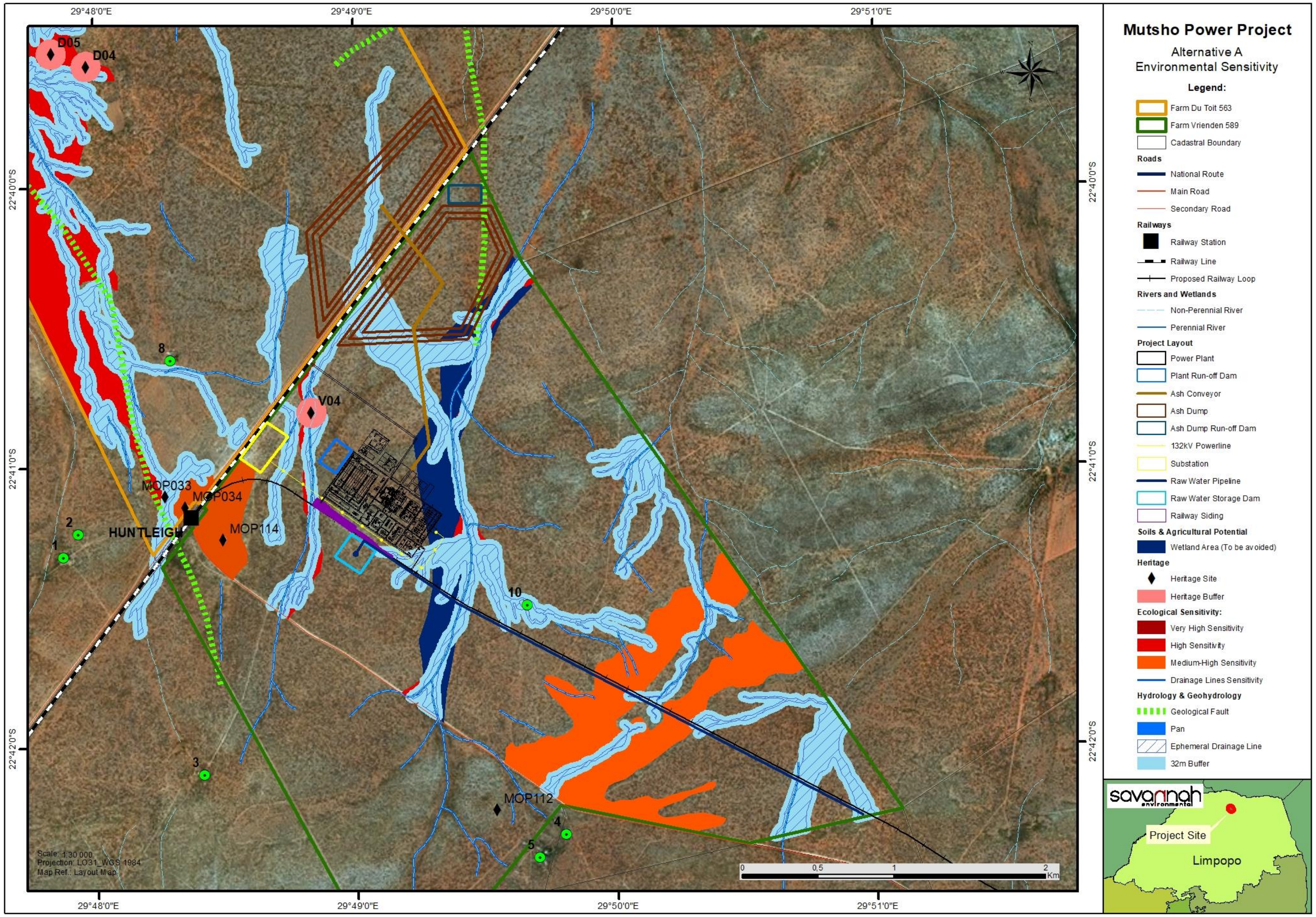

Figure 10.2: Environmental Sensitivity map for the project site (Alternative A).

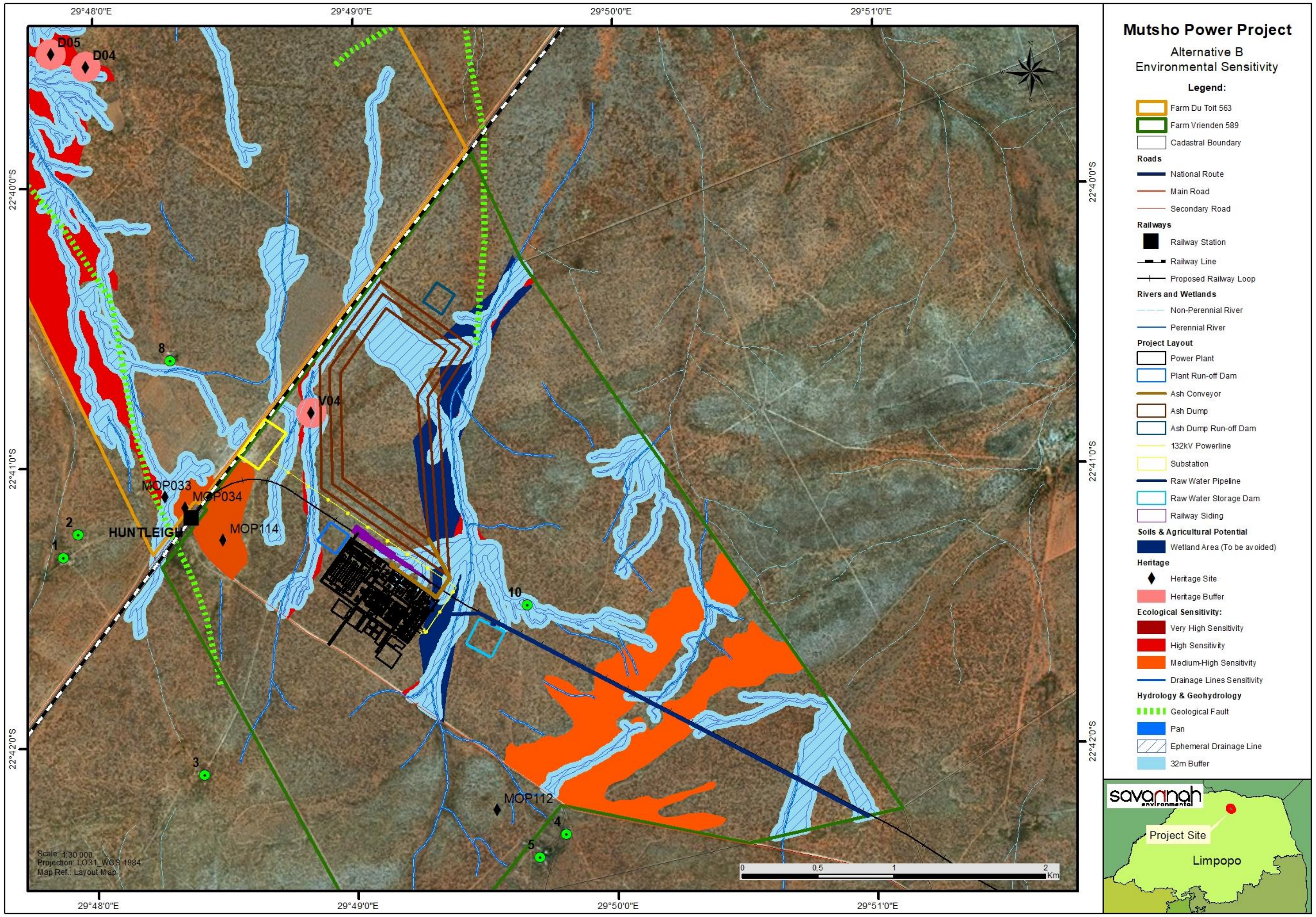

Figure 10.3: **Environmental Sensitivity map for the project site (Alternative B).**

Based on the environmental sensitivities identified and represented in **Figure 10**.1**, Figure 10**.2, and **Figure 10**.3, the Preferred Alternative site layout (refer to **Figure 10**.1) is considered to be most favourable from a technical micro-siting perspective, in that the opportunity exists for applicable project infrastructure components which may currently impact on environmental sensitivities (i.e. the 32m buffer of the ephemeral drainage line) to be resized or micro-sited so that such features can be avoided. The opportunities for resizing or micro-siting infrastructure components associated with Alternative A (refer to **Figure 10**.2) and Alternative B (refer to **Figure 10**.3) have the potential to negatively impact on the overall viability of the Mutsho Power Project at the proposed project site.

10.2. Impacts associated with the proposed power station and associated infrastructure

Potential impacts associated with the Mutsho Power Project are expected to occur primarily during the construction and operational phases, and to a lesser extent during the decommissioning phase.

Impact sources associated with the proposed project are discussed under the respective subheadings below.

10.2.1 Impacts on Ecology

The following conclusions and recommendations were made as part of the independent specialist Ecological Impact Assessment conducted as part of the EIA for the project (refer to **Appendix D**).

10.2.1.1 <u>Flora</u>

The study area corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006), comprising an ecological type known as the Musina Mopane Bushveld, of which the conservation status is currently set at Least Threatened.

The following key findings and considerations are noted for the floristic environment:

» No plant species with IUCN status were recorded during the site survey. However, taking cognisance of the habitat variability and existing status of the environment, the likelihood of plants of conservation concern persisting within the study area cannot be excluded.
» Four tree species that are protected under the National Forest Act (1998) were recorded in abundant numbers across the sites:
  * *Adansonia digitata* L. (Baobab).
  * *Boscia albitrunca* (Burch.) Gilg & Gilg-Ben. (Shepard's tree).
  * *Combretum imberbe* Wawra (Leadwood).
  * *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro (Marula).
» The localised presence of massive *Adansonia digitata* is regarded an important consideration in determining the final placement of infrastructure.
» The average number of species recorded in releveès during the site survey is 23.5 per sampling bout (std. dev. = ±6.0), reflecting a poor floristic species richness of the vegetation on a local and regional scale.
» Typical woodland vegetation of the sites strongly reflects regional ecological attributes (Musina Mopane Bushveld).
» Twinspan analysis revealed a major community that accounts for the typical savanna woodland vegetation. Minor communities were recognised that accounts for ephemeral pans, anthropogenically

transformed woodland (old fields), and emergence of calcareous washes and plains that is a typical and natural occurrence in the immediate region.

» Although not proven to be floristically distinct in the Twinspan analysis, physiognomic variations are regarded as important units on a local and regional scale, contributing to the ecological infrastructure and functionality of the region and are therefore described as physiognomic variations within the typical woodland habitat.
» The following communities and variations were recognised from the TWINSPAN classification:
  * *Community 1 – Combretum imberbe – Phyllanthus reticulatus ephemeral pans.*
  * *Community 2 – Vachellia grandicornuta – Boscia foetida eroded watercourses and calcareous plains/ washes, including the variations:*
    - Quartzitic washes and sandy floodplains.
    - Calcareous outcrops and washes.
  * *Communities 3 and 4 – Combretum apiculatum Grewia flavescens – Colophospermum mopane Woodland, including the physiognomic variations:*
    - Closed Woodland.
    - Open Woodland.
    - Closed Woodland Watercourses.
    - Open Woodland Watercourses.
    - Quartzitic Outcrop.
  * *Community 5 – Vachellia tortilis – Cienfuegosia – digitata old fields.*
» Vegetation of the study area conforms to a uniform, but mixed, undifferentiated broadleaf woodland that comprises mostly of deep, highly leached sandy soils. Results of the floristic surveys reflect the proportional and notable prominence of typical woodland constituents such as *Vachellia tortilis*, *Dichrostachys cinerea* and *Colophospermum mopane*.

The proposed activity implies the loss of natural habitat and no impacts of a beneficial nature on the floristic environment are likely to result. Based on a generic list of impacts associated with this type of development, three categories of impacts are likely to result, namely, direct impacts, indirect impacts and impacts of a cumulative nature, namely:

11) Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plant taxa of conservation concern (declining status, provincially protected taxa), including habitat that is regarded highly suitable for the persistence of these species.
12) Loss of natural vegetation (physical modifications, removal, damage) including the loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance.
13) Local depletion of plant taxa and reduction of phytodiversity.
14) Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.
15) Reduced or severely altered ecological functionality (including fire, erosion).
16) Decreased aesthetic appeal of the landscape.
17) Introduction of invasive, exotic and encroacher plant species.
18) Increased exploitation of natural resources due to increased human presence and resource requirements.
19) Exacerbation of existing levels of habitat fragmentation and isolation.
20) Cumulative impacts on local / regional and national conservation targets and obligations.

The three project alternatives are regarded as highly similar in layout and estimated footprint sensitivity regarding the botanical receiving environment. Anticipated impacts on the floristic environment, surrounds and region is not expected to vary significantly between the three proposed alternatives; discussions on anticipated impacts are therefore applicable to the three alternative layouts. Despite the similarity in sensitivity aspects, minor (localised) attributes are considered important in the preferability of the proposed alternative layouts. The following order of preferability is presented:

» The Preferred Alternative (Option 1) is regarded the preferred option.
» Alternative A (Option 2) is regarded the least preferred option in terms of the floristic environment.
» Alternative B (Option 3) is regarded as the second preferred alternative in terms of impacts on the floristic environment.

The receiving floristic environment is regarded natural and pristine, with extremely limited anthropogenic transformative and disruptive characteristics; uninterrupted woodland characterises the site and larger region. Despite the regional ecological type not being regarded to be under any immediate and significant threat (Musina Mopane Bushveld, Least Threatened), the proposed sites are characterised by locally sensitive areas, also comprising locally scarce species and protected tree species that have attained significant physical stature. The presence of these individuals and localised sensitive areas does not represent any Red Flag (No-Go option) to the proposed development as similar areas and species are most likely to be encountered on a scale local to the surrounding area, but due care is strongly advised to avoid impacting on these features by means of layout planning and selected relocation activities wherever possible.

The loss of these portions of woodland (on a regional scale) is not expected to result in significant and unacceptable impacts on the ecological type. It could also not be demonstrated that unacceptable impacts on any conservation important (threatened) plant species is expected. An evaluation of potential and likely impacts on the receiving environment has demonstrated that cumulative impacts associated with the project are expected to be severe and will likely affect the receiving environment beyond the boundaries of the site on a permanent basis. Anthropogenic encroachment and the associated social issues, such as creation of informal settlements, densification of roads and other infrastructure, influx of job-seekers, expansion of the industrial and economic zones and the added pressure that these effects create on the natural environment (on a regional scale) is expected to cause significant environmental impacts. It is unfortunate that the management and effective mitigation of these impacts are mostly beyond the control and management of the project, apart from preventing the project altogether. However, anthropogenic densification (caused by other industrial developments within the region / surrounds) is likely to occur irrespectively and cannot solely be attributed to the proposed development, although the contribution of the project cannot be ignored.

Despite severe cumulative impacts that can reasonably be expected, the proposed project does not pose an unacceptable threat to sensitive environs and species on a local scale. It is strongly advised that impacts on the botanical receiving environment should be managed according to the proposed mitigation strategy described in the specialist Ecology Impact Assessment, but care should also be taken to identify ad hoc impacts which were not necessarily highlighted in the assessment and administer suitable and appropriate mitigation measures during the life of the project.

Based on results and recommendations presented in the botanical component of the Ecology Impact Assessment the project is regarded as acceptable, but recommends the use of a dedicated, acceptable and appropriate mitigation strategy to prevent undue and unnecessary impacts within the floristic environment.

10.2.1.2 Fauna

The project site was surveyed for mammals, herpetofauna and invertebrates with specific focus on potential red data listed inhabitants. Mammals, reptiles and frogs were surveyed with the use of ecological indicators such as tracks, dung, diggings, nests and calls. Visual sightings of both diurnal and nocturnal species (night-time surveys were also included) were also used to identify both small and medium to large mammal species as well as frogs and reptiles. Bats were surveyed with the use of a handheld bat detector and frog's species-specific calls were recorded with the use of a field sound recorder. Carrion-baited infrared camera traps were used to attract and photograph carnivores and other species passing by.

The plant communities described for the study area are considered representative of the macro faunal habitat types. The study area is located within the Q-grid 2229DB. Ninety-five animals were listed for 2229DB - including three red data species. One hundred and twenty-two (122) animal species were recorded in the study area, representing twenty-two orders (22) and fifty-five (55) families. Of these 122 species, 111 were recorded on the Farm Du Toit 563 and 82 species on the Farm Vrienden 589. The species confirmed for the study area included six red data listed species, namely:

- *Copris cambeforti* Nguyen-Phung, 1988a (Dung Beetle) – Data Deficient;
- *Onthophagus quadrimaculatus* Raffray, 1877 (Dung Beetle) – Data Deficient;
- *Rhinolophus smithersi* Taylor, Stoffberg, Monadjem, 2012 (Smither's Horseshoe Bat) – Near Threatened;
- *Acinonyx jubatus* (Schreber, 1775) (Cheetah) – Vulnerable;
- *Panthera pardus* (Linnaeus, 1758) (Leopard) – Vulnerable; and
- *Parahyaena brunnea* (Thunberg, 1820) (Brown Hyaena) – Near Threatened.

The species inventory results of the field investigation on the Farms Du Toit 563 and Vrienden 589 compared well to the known inhabitants of the Q-grid 2229DB. In total, 14 more species were confirmed for the study area than are listed for the Q-grid. Groups that were better represented during the field investigation included spiders, dung beetles, frogs and mammals.

The three project alternatives are regarded highly similar in layout and estimated footprint sensitivity regarding the faunal communities and especially conservation important species. The anticipated impacts on the fauna of the study area, surrounds and region is not expected to vary significantly between the three proposed alternatives; discussions on anticipated impacts are therefore applicable to the three alternative layouts.

Based on the results obtained during the field investigation and data analyses performed, and the assessment of perceived and anticipated impacts of the activities associated with the construction, operation and closure phases of the proposed project, it is the opinion of the faunal specialist that no reason exists to deem the project as unsuitable. If the mitigation measures proposed are included in the EMPr and adhered to, no reason can be provided to oppose the authorisation of the proposed project, including all proposed activities and portions thereof.

10.2.1.3 Avifauna

An avifaunal survey was conducted on the Farms Du Toit 563 and Vrienden 589. The following key considerations were identified and noted:

- Various sampling techniques (including bird point counts) were employed to evaluate the bird composition, richness and ecological sensitivity on the study area.
- Two dominant habitat types were identified, which included undifferentiated mixed closed woodland on sandy soils and secondary microphyllous woodland. In addition, six important azonal habitat types were also present: calcareus plans and outcrops, natural depressions and impoundments, seasonal drainage lines, artificial game watering holes, large *Adansonia digitata* canopy constituents and large dead trees. The undifferentiated woodland and microphyllous woodland were identified with high bird species richness, while the natural depressions and impoundments (when inundated) provided habitat for "specialised" bird species (waterbirds and shorebirds).
- A total of 270 bird species were expected to occur, of which 176 species were confirmed during the surveys.
- The avifaunal community on the study area was poorly represented by South African endemics, while the dominant composition is widespread in the region although it consisted of many species with high affinities to the Kalahari-Highveld biome.
- Fourteen (14) threatened and near threatened bird species were expected to be present (with four species confirmed during the surveys). Observed species included the regionally near threatened Kori Bustard (*Ardeotis kori*), critically endangered White-backed Vulture (*Gyps africanus*), endangered Saddle-billed Stork (*Ephippiorhynchus senegalensis*) and the vulnerable Black Stork (*Ciconia nigra*).
- The study area was represented by five ill-defined avifaunal assemblages consisting of:
  (1) An association confined to undifferentiated mixed woodland.
  (2) An association confined to areas with surface water.
  (3) An association confined to homogenous stands of *Colophospermum mopani*
  (4) An association confined to stunted *Colophospermum mopani* along seasonal watercourses.
  (5) An association confined to natural pans with large *Combretum imberbe*.
  (6) An association confined to calcrete plains and outcrops.
- The avifaunal importance of the proposed study area for bird species is summarised below:
  - Part of the undifferentiated mixed woodland, calcrete plains and microphyllous woodland habitat consisted of an open canopy structure, which provided potential foraging habitat for terrestrial large-bodied bird species (e.g. Kori Bustard - *Ardeotis kori* and Secretarybird *Sagittarius serpentarius*).
  - The natural depressions and dams have benefitted the colonisation of "specialised" bird taxa (mainly wader and wading bird species) that were of local importance and contributed towards the regional avifaunal diversity when inundated.
  - The natural depressions and dams provided foraging habitat for threatened stork taxa.
  - The large *Adansonia digitata* trees provided breeding and roosting habitat for the Brown-headed Parrot (*Poicephalus cryptoxanthus*) which is restricted to the East Coast Biome and reached its western distributional limit on the study area.

An evaluation of the expected and likely impacts on the avifaunal component of the study area revealed that certain sensitive parts of the study area should be excluded from the proposed development (these have been included in the Environmental Sensitivity map prepraared for the project). Furthermore, the application of detailed and site-specific mitigation measures is required to ameliorate significant impacts to an acceptable significance level.

From the analysis of alternatives, in particular when taking bird richness and abundance into account, it would appear that the Preferred Alternative (Option 1) is regarded as being more feasible when compared to Alternatives A and B (Option 2 and 3). However, Option 1 is not failsafe from other impacts related to potential pollution run-off and localised fragmentation. In addition, the location of the service road remains perpetual on all three of the proposed Options. In order to minimise potential impacts of the service road, it is proposed that alternatives be put in place to evaluate an alignment which may have a lower impact on the current environment.

Although the general habitat heterogeneity of the area is to be low with very few specialised habitat features (e.g. pans and dams) in occurrence, the perceived overall impact of a power station in a relatively non-urbanised environment appears to be marginal. In this case, it is not necessarily the direct impacts on the avifaunal community that are critical, but the cumulative impacts which inter alia could facilitate unnecessary urban sprawl and the spread of informal settlements in the area resulting in the potential loss of natural resources. In addition, the construction of additional linear electrical networks over time may attain higher impact ratings due to the potential for increased mortalities for birds, caused by collision with overhead powerlines.

10.2.2 Impacts on Air Quality

An Atmospheric Impact Assessment was conducted in support of both the Environmental Impact Assessment (EIA) and Atmospheric Emission License (AEL) application for the proposed project (refer to **Appendix E**).

The main source of emissions from the proposed Mutsho Power Project includes the boiler stack, the coal stockpile, ash dump and the unpaved site access road. Two Scenarios are considered in this assessment: Scenario 1 - boiler stack in isolation and Scenario 2 - all sources (which include the boiler stack, coal stockpile, ash dump and unpaved site access road).

In Scenario 1, the predicted dustfall and ambient concentrations of PM_{10}, SO_2, NO_X and CO are considerably less than the respective national dust standard and NAAQS for all averaging periods throughout the modelling domain. There are no predicted exceedances of the national dust standard or NAAQS within the proposed Mutsho Power Project site or in residential and sensitive receptor areas around the site. The predicted dustfall and ambient concentrations are therefore compliant in the ambient environment.

In Scenario 2, exceedance of the dust standard for the residential area category, PM_{10} and $PM_{2.5}$ resulting from all sources at the Mutsho Power Project are predicted over a very small area along the unpaved site access road, which is within the boundary of the proposed Mutsho Power Project site. Predicted dustfall and ambient PM_{10} and $PM_{2.5}$ concentrations are well below the respective national dust standard and NAAQS beyond the Mutsho Power Project site and are therefore compliant in the ambient environment.

According to the dispersion modelling results and air quality impact assessment, emissions from the Mutsho Power Project site operations are expected to result in dustfall and ambient concentrations of air pollutants that are well below the respective national dust standard and NAAQS in the ambient environment. Air quality impacts are therefore considered to have a **low significance** regardless of the site configuration. From an air quality perspective, it is therefore a reasonable opinion that the project should be authorised considering the outcomes of this study for the preferred site layout option.

10.2.3 Impacts on Climate Change

The following conclusions and recommendations were made as part of the independent specialist Climate Change Impact Assessment conducted as part of the EIA for the project (refer to **Appendix F**).

The proposed power plant will produce greenhouse gas emissions that will contribute to anthropogenic climate change and its ensuing impacts. The extent, duration and probability of the plant's greenhouse gas emissions impacts on climate change will be considerable. The magnitude of the construction phase is considered small and the operational phase considered minor. The overall significance from the single source power plant's impact during construction and operational phases, on global emissions and thus climate change is rated as medium. As with any issue of common concern to humanity, it is important that each actor makes an effort to minimise its own negative contribution to the issue so as to take a shared responsibility, particularly in the cases of coal fired power plants, such as the Mutsho Power Project.

The Mutsho Power Project has the potential to contribute almost 2% of the forecasted national inventory for 2050. However, the plant is only likely to contribute 0.75% of the national electricity supply forecasted for 2050. Considering the overall significance of the impact of the greenhouse gas emissions it is important to explore the possible technological alternatives for the plant as well as mitigation options.

CFB and Pulverised Coal (PC) are the technology alternatives available to the project developer under the Coal Baseload Programme. Both technologies will produce emissions intensities above the 2025 forecasted national baseline of greenhouse gas emissions from electricity generation. The limited water resources in the area of operation are unlikely to support the wet scrubbing systems required for pulverised fuel combustion.

The power plant's higher emissions intensity than the forecasted national baseline is to some extent acceptable as the national baseline includes intermitted renewable energy generation. Stable baseload power generation can support higher levels of intermittent renewable energy generation. Therefore even with a higher emission intensity (CO_2e/MWh) of baseload, the overall emission intensity of the grid can be reduced.

The scale at which greenhouse gas emissions will be produced by the plant does warrant that the emissions are mitigated where possible. It was demonstrated in the Climate Change Impact Assessment that there are options to improve the emissions intensity of circulating fluidised bed combustion. These options include the design of the facility to allow for the future co-firing of alternative fuels (such as biomass) in the circulating fluidised bed combustor and incorporating solar thermal energy from CSP units, should this be required. While these options are beyond the scope of the bid requirements and are not currently possible under the CBIPPPP, they present useful insight for the project developer and possible future hybridisations for the plant.

The most effective technological option to reduce the power plant's carbon emissions and consequent impact on climate change is co-firing with an alternative fuel (such as biomass) in the circulating fluidised bed. However the transport distance, cultivation and source of alternative fuel needs to be considered with respect to financial feasibility. Incorporating thermal energy from an additional CSP plant, although comparatively expensive in capital, is similarly effective. A 142 MW CSP plant (without storage facilities) would be required to augment 10% of the power station's thermal energy demands.

The emission intensity of the power plant can be reduced to below the projected national baseline of emissions intensity for electricity generation through co-firing with 25% of an alternative fuel (such as biomass) in the fuel mix. It is possible to calibrate circulating fluidised combustors to use varying mixes of fuels and thus biomass could be incorporated into the fuel mix gradually so as to decrease the plant's emissions in line with the projected national grid or other emissions obligations.

Under current costs of technology and fuel the expected net present value (NPV) of the costs for circulating fluidised bed which co-fires with 25% high cost biomass is approximately 31% higher than a circulating fluidised bed plant without co-firing. This is primarily due to the higher purchase costs of biomass although these can be significantly reduced through self-cultivation and harvesting, where third-party profit margins are avoided. Co-firing with 25% low cost (self-cultivated) biomass actually increases the NPV of the power plant by 12%. Co-firing biomass in a power plant such as the Mutsho Power Project may encourage development and growth in the local biomass market which may lower future costs and stimulate the future uptake of biomass based combustion technologies. A similar process could be considered for the inclusion of solar thermal energy from CSP. From this perspective, the Mutsho Power Project could reduce the emission intensity of national electricity grid.

The Mutsho Power Project could also maintain the opportunity to significantly reduce its future carbon emissions and consequent climatic impact by making provisions for the future instalment of carbon capture and storage (CCS) technology. In addition the options for future mitigation efforts, the development and implementation of an effective carbon management plan and emissions monitoring system will assist in tracking and minimising GHG emissions on a daily basis.

The Climate Change Impact Assessment concludes that the use of circulating fluidised bed combustion technology in the Mutsho Power Project is likely to be the most suitable option based on the technological requirements of the Coal Baseload Programme. The circulating fluidised bed combustion technology does present opportunities for emissions reductions through the design of the facility in such a way that the future co-firing with alternative fuels (such as biomass) can be considered. It is therefore recommended here that the future mitigation opportunities of; co-firing with low carbon fuels, incorporating of solar thermal energy, capturing and storing carbon and implementing management and monitoring plans are considered in detail by the project developer depending on financial feasibility and water availability. However the Department of Energy's Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP) does not currently account for hybridisation.

10.2.4 Impacts on Hydrology and Geohydrology

The following conclusions and recommendations were made as part of the independent specialist Hydrology and Geohydrology Impact Assessment conducted as part of the EIA for the project (refer to **Appendix G**).

10.2.4.1 Aquatic Ecology

With the exception of Site DU3, each of the selected sampling sites was observed to be dry at the time of the site survey despite the rains expected throughout the summer months. While this was to be expected as a result of the semi-arid nature of the study area and in light of the drought experienced across much of the country during the previous two years, only selected parameters could subsequently be measured and a limited number of assessment indices could be applied at the time of the survey. This was a notable limitation to the baseline assessment, as the only site that could be assessed was characteristic of a lentic (or standing) system, which inherently supports a lower diversity of aquatic biota, and as such, provides no insight regarding the Present Ecological State (PES) of two of the biological components (i.e. aquatic macroinvertebrates and fish) of the associated watercourses, as well as in the overall integrated EcoStatus. Consequently, for the purpose of determining a PES at the time of the survey, the only available desktop data indicated that the mainstem Sand River is representative of a moderately modified condition (i.e. Ecological Category C). This was largely confirmed by the small- to large- impacts originating from surrounding land-use activities, including the most notable agricultural activities (i.e. crop cultivation and livestock watering).

With regards to the mainstem Sand River, the Ecological Importance was defined to be high due to a moderate-to-high likelihood of occurrence for *Oreochromis mossambicus* (listed as Near Threatened) during periods of flow, a moderate-to-high representivity and rarity within the secondary catchment, as well as the occurrence of the study area within a Fresh Water Ecosystem Priority Area and provincially determined Ecological Support Area 1. Also, the Ecological Sensitivity was defined to be moderate-to-high, which was attributed to an elevated number of highly sensitive flow-dependent species, a number of species that were regarded as moderate-to-highly sensitive to water quality impairment, and a riparian vegetation component is well adapted to the fluctuating water levels within the associated alluvial system.

A number of moderately significant potential impacts were to be expected within the associated ephemeral drainage areas, as well as further downstream along the Sand River and adjoining tributaries. However, in general, the impact is expected to be limited to the proposed development area following the application of the proposed mitigation and minimisation measures, which results in only rare potential effect upon the mainstem portion of the Sand River, pending an extended contamination event. With regards to cumulative impacts, the proposed development is not likely to detrimentally impact the associated catchment, but it is acknowledged that a number of activities already place additional stress on the study area in terms of surface water availability (e.g. mining-related impacts, crop cultivation and livestock watering).

Should each of the recommended mitigation measures be implemented, it is the opinion of the aquatic ecologist that there will be a limited (or low) impact upon the associated aquatic biodiversity of the surrounding watercourses. However, changes to the inherent flow and / or inundation dynamics of the associated watercourses in direct vicinity of the project are to be expected, which is likely to affect the presence of confirmed microfauna within these system (including seed bank for branchiopod crustaceans).

Also, should the Mutsho Power Project be authorised pending reasoned opinions from other Specialist Studies (especially groundwater investigation), a suitable aquatic biomonitoring programme should be drafted and implemented to determine seasonal (or annual) variation and to identify any causes for potential concern during the operational and post-closure phases of the operation.

Based on the largely desktop-determined baseline condition of the associated watercourses, the Aquatic Ecology Specialist is in agreement that the preferred development area should be concentrated upon the Farm Vrienden 589 due to the presence of a denser network of ephemeral system within the Farm Du Toit 563, especially concentrated within the north-western portion. Furthermore, in light of each of the proposed infrastructure layouts, the Aquatic Ecology Specialist is of the opinion that the impacts upon the associated watercourses (or ephemeral drainage lines) would be least affected by the implementation of the Preferred Alternative. The major infrastructure (i.e. the ash dump and the proposed access route) will then be situated within the smaller eastern catchment and as a result, less likely to impact upon the mainstem Sand River should potential contamination occur. While it is acknowledged that a limited extent of fragmentation is to be expected with any of the proposed design layouts, the inherent nature of the upper reaches of these systems is not likely to support notable macro-fauna (i.e. macroinvertebrates and fish).

10.2.4.2 Wetlands

Two HGM units were identified in the vicinity of the project area, both characterised as pan wetlands. However, most of the freshwater features within project area consist of ephemeral drainage lines that cannot be defined as wetland or riparian resources. The freshwater features cover an approximate 147.5 ha.

The wetlands within the project area exhibit Category B (Largely Natural) and Category C (Moderately Modified) PES values. The pans have not been impacted on to a great extent aside for grazing which alters the vegetation structure and composition. The geomorphological and Hydrological health has been altered minimally. The ephemeral drainage lines are considered to be Category C. They are mostly impacted on hydrologically due to the presence of earthen dams, which restrict the flow of water downstream. The geomorphological score was not impacted on greatly as the only impact was sediment deposition in the dams. Vegetation scores were not altered to a great extent.

EIS scores range from Very High (3.7) to High (2.5). Hydrological/Functional Importance' values were low as the pans don't perform well for streamflow regulation, erosion control, sediment trapping or phosphate assimilation. The drainage lines also have limited hydrological function in terms of true wetland systems. However, in terms of catchment yield and surface water recharge to the systems further downstream, as well as in the maintenance of healthy stormwater regulation, these systems are considered invaluable. 'Ecological Importance & Sensitivity' for the HGM unit 2 and 3 is Very High as various protected species are present within them or in close proximity. 'Direct Human Benefits' were not high in general. These features are not used culturally or recreationally. The HGM units are utilised for grazing and for watering of cattle and game. The score is higher for the drainage lines as some are dammed and the water is utilised by the farm owners.

EcoServices scores for the various HGM Units range from 1.3 to 1.6 (Intermediate). The HGM units provide similar EcoServices. Biodiversity maintenance through the harbouring of protected species, the provision of water sources and the provision of grazing land are important EcoServices. The drainage lines provide surface water recharge and trap sediment. The farms are not accessible for tourism, educational and cultural purposes and as such are not used for these purposes. Historical hunting activities were evident; however, through communication with ground staff, this is no longer common. Due to the nature of the systems, flood attenuation and streamflow regulation is low.

The proposed project has the potential to result in a number of impacts that can be considered to be 'medium' once appropriate mitigation measures are implemented.

10.2.4.3 Geohydrology

The outcomes of the groundwater impact assessment and associated investigations are as follows:

» During the hydrocensus water levels on site were recorded to range between 23.25 and 35.68 mgbl. Groundwater flow direction on site is found to be towards the north-west.
» Samples were collected and taken to the laboratory for chemical analysis and compared against SAWQG for irrigation and domestic use. All boreholes (5) do not exceed the SAWQG for irrigation however all exceed domestic use standards. Evaluations indicate the following:
  * VRIBH1 exceeds domestic use standards for fluoride.
  * VRIBH2, DUTBH1, DUTBH2 and DUTBH3 exceed domestic use standards for sulphate.
  * VRIBH1, VRIBH2, DUTBH1 and DUTBH2 exceed domestic use standards for magnesium.
» No boreholes were found to be in excess of the SAWQG for irrigation which is the local groundwater use of all the boreholes with the exception of DUTBH1.
» Groundwater characterisation was conducted and the groundwater quality at VRIBH1 and DUTBH3 are identified to be calcium-magnesium-bicarbonate type which is typically found at freshly recharged aquifers. VRIBH2, DUTBH1 and DUTBH2 are characteristic of calcium / sodium sulphate waters associated with mining activities (mining activities are present within a 25 km of the project area).
» The current water quality conditions at the project area are not pristine; this is consistent with the description of the regional hydrogeology. The region is expected to have poor water quality naturally. Additionally, impacts from mining activities are also observed in the water chemistry.
» All private boreholes with the exception of VRIBH2 are located downstream of the ash dump and should be monitored. Losing stream groundwater-surface water interaction is expected at the project area therefore the local non-perennial streams aren't expected to receive the contamination plume via baseflow.
» Analytical model predictions indicate that seepage from both the ash dump and coal stockpile is expected to reach the watertable after approximately 7 years of operation without a liner.
» The liner simulated in the model scenario is a Class C liner, this is assumed based on experience from expected ash material geochemistry. This may vary based on the outcomes of the recommended geochemical studies to be conducted.
» The installation of a liner is observed to restrict leachate seepage significantly and therefore negligible impacts to the groundwater are expected with the installation of a liner.
» Formation of the pozzolanic layer is additional mitigation (to the installation of a liner) and it occurs naturally over time, therefore leachate formation is expected to cease at a certain point therefore reducing the risk to the groundwater over time post-closure.

Based on the groundwater impact assessment conducted for the proposed Mutsho Power Project the following recommendations are made to mitigate and manage any potential impacts to the groundwater:

- Drilling and aquifer testing of boreholes is recommended to obtain site-specific hydraulic parameters to improve model accuracy with respect to groundwater related impacts. This data would be required in order to accurately simulate what will happen with contamination plumes and the type of liner that would be required for the ash dump and coal stockpile.
- Geochemical studies and waste classification is recommended to determine the elements of concerns and expected leachate quality from the ash material. This will be the basis on which liner recommendations can be made during final design.
- Construction phase mitigation:
  - No impact to the groundwater is expected if excavation does not exceed the depth of the watertable at the location of excavation. Local water levels range from 23.25 to 35.68 mbgl. If excavations exceed the depth of the watertable, the impact significance will depend on the depth of excavation below the watertable. In areas where the foundation of structures is to be installed below the water level, dewatering of the aquifer to locally lower the watertable is recommended. The abstracted water can be utilised for dust suppression, vegetation or discharged to the storm water dams.
  - Installation of suitable liner for the ash dump and coal stockpile to significantly reduce potential impacts to the groundwater environment during the construction phase and then determine capping requirements for the closure phase.
- Operational phase mitigation:
  - Coal compaction prior to deposition onto the coal stockpile.
  - Groundwater monitoring.
  - Should an impact be detected through monitoring, affected receptors should be compensated, with an alternative water supply.
- Decommissioning phase mitigation:
  - Continuous post-closure monitoring is required so that drastic deterioration in groundwater quality is detected soon as it occurs, allowing for mitigation measures to implemented early. Monitoring is recommended to be conducted until satisfactory groundwater quality is reached and thereafter signed off by the relevant authorities.
  - Should an impact be detected through monitoring, affected receptors should be compensated, with an alternative water supply.
- Three layout alternatives are considered for the Mutsho Power Project. Considering environmental sensitivity a fault located in the northern part of the Farm Du Toit 563 was identified. Based on that observation, the Preferred Alternative is recommended as the most suitable as the location of the ash dump for this alternative is located furthest from the fault. The ash dump and coal stockpile location is most critical as these facilities are the main concern regarding impacts to the groundwater. Structures that could potentially act as preferential pathways, such as the fault, should be avoided with regards to the placement of the facilities. No groundwater sensitive areas were identified for the proposed locations of the coal stockpile for all layout alternatives.
- A total of 5 monitoring locations are recommended for groundwater monitoring; 2 existing and 3 to be drilled.

10.2.4.4 Surface Water

The Sand River is the only major river (ephemeral) within the A71K quaternary catchment (approximately 8km from the western side of the project area). The Sand River flows from the south-west side of the project area towards the north-east side where it eventually joins the Limpopo River approximately 50km away from the project area.

Few drainage lines exist within the demarcated project area and runoff from the site drains from the southern side in a north-western direction via these drainage lines and finally reports to the Sand River approximately 8km west of the project site.

Water quality in this region or along the Sand River has existing monitoring data which indicated elevated levels of various salts which exceed the South African Water Quality Guidelines for irrigation and livestock use. This is mostly attributed to upstream irrigation activities and domestic effluent from the upper Sand River catchment.

The identified potential surface water/hydrological impacts that could emanate from the project and its associated activities include:

- » Siltation of surface water resources leading to a poor water quality as a result of eroded material reporting into the streams.
- » Contamination of surface water resources when dirty water runoff from the power station reports into the nearby streams.
- » Reduction in runoff to the natural streams when all the dirty water runoff is contained within the power station footprint.

The following mitigation / management measures to prevent, and / or minimise the identified potential surface water impacts have been recommended. These include but are not limited to:

- » Clearing of vegetation must be limited to the development footprint and the use of existing access roads must be prioritized so as to minimise construction of new access roads in these areas.
- » If possible, construction should be undertaken during the low rainfall season (April to September) to minimise erosion and sedimentation / siltation of the water course.
- » Any construction work that involves site clearance, digging, excavation or trenching during construction services should be suspended during heavy rains to avoid erosion and sedimentation of the water course.
- » Dust suppression measures must be undertaken on the cleared areas during construction.
- » Dirt roads must be well compacted to avoid erosion of the soil into the natural water course.
- » All the dirty water runoff emanating from dirty areas (such as the ash dump, plant and coal stockpile areas) should be contained within the dirty water dams. This water should be stored for re-use within the power plant so as to prevent unnecessary discharge into the environment.
- » Should the contained water be more than the water use requirement, the Best Practice Guidelines (BPGs) advise that the water be recycled or as the last resort be treated to acceptable levels and discharged to the natural environment.
- » Development of storm water management infrastructure should be in line with Regulation 704 of the NWA, 1998 (GN 704).
- » Clean water emanating from upstream of the project area must be diverted away into the natural catchment.
- » All spillages must be contained to the smallest possible area and must be cleaned immediately.
- » The constructed storm water infrastructure will have to remain until post closure. This will ensure that dirty water is captured and contained during removal of infrastructure and thereby prevent siltation and contamination of the identified streams / drainages.

- All rehabilitated areas must be vegetated. Until vegetation has successfully been established, sedimentation should be mitigated by installing silt traps at areas where the surface runoff enters the surface water resources.
- The surface profile of the rehabilitated area should try and resemble the natural conditions prior to the project, this should ensure that the surface profile encourages natural drainage, such that no ponding or standing water occurs after a rainfall event.
- Dust suppression measures must be undertaken during this phase to prevent deposition of dust particle into the stream.
- Use of accredited contractors for removal or demolition of infrastructures.

The Surface Water Impact Assessment identified Alternative A and Alternative B as the most suitable infrastructure areas with negligible or insignificant impacts on the natural surface water resources whilst the Preferred Alternative is the least suitable since the ash dump is located on top of the drainage lines. It should be noted however that the drainage lines that may be affected by the Preferred Alternative have been classified as moderately sensitive, and thus the potential impacts on these would not have great or highly-significant impact on the hydrology of the area.

This assessment has also provided the appropriate mitigation / management measures to prevent, and / or minimise the identified potential surface water impacts, should they occur. With all the mitigation and management measures in place, the Mutsho Power Project is unlikely to pose a significant threat to the natural water courses and the hydrological features within and around the project area. The proposed establishment of the Mutsho Power Project and associated infrastructure can therefore go ahead.

10.2.4.5 Overall Conclusion

Each of the proposed infrastructures alternatives affect portions of the ephemeral drainage lines identified within the project area. Based on the ecological integrity of the ephemeral drainage lines observed on site, as well as the extent of the catchment potentially affected as a result of the proposed infrastructures, preference is given to the Preferred Alternative taking into account the findings of each specialist assessment. The Groundwater Assessment took into consideration the location of the faults within the project area and also contributed to recommending the Preferred Alternative as the preferred alternative.

In terms of reduced impacts to the ephemeral drainage lines present, Alternative A is also considered a reasonable alternative, as this option utilises the existing road for construction of the new railway line, is more compact in terms of footprint area and is likely to result in less fragmentation of the systems present as fewer crossings of the freshwater resources present are required.

Should the Mutsho Power Project proceed, further impacts to the freshwater ecology of the greater area are deemed likely, with special mention of loss of catchment yield, loss of biodiversity, potential groundwater impacts and impacts associated with the ash dump and associated infrastructure. It is thus the opinion of the specialists that the Mutsho Power Project be granted authorisation only with appropriate implementation and strict adherence to the mitigation measures provided in this report. It is the opinion of the ecologist that further investigation and if possible optimisation of the proposed infrastructure layouts is necessary during final design to avoid impacts to the water resources further downstream, which are already being placed under increasing pressure as a result of cumulative impacts within the greater catchment.

10.2.5 Impacts on Soil, Land Use and Agricultural Potential

The following conclusions and recommendations were made as part of the independent specialist Soils, Land use, and Agricultural Potential Impact Assessment conducted as part of the EIA for the project (refer to **Appendix H**).

The geology of the survey area consists largely of marble of the Gumbu Formation, with arenite (sandstone) Ecca Group in the north (Geological Survey, 1988). Only one land type occurs within the study area, namely Ah89 (Yellow-brown and red, apedal, freely drained soils). The main characteristics of the soils occurring in land type Ah89 are red and yellow-brown, sandy loam to sandy clay loams of varying depths, along with some areas of shallow lithosols. The soils occurring in the survey area are brown to reddish-brown, sandy loam to sandy clay loams of the Hutton and Glenrosa forms, underlain by weathering rock. They are generally shallow (<400 mm), although deeper, red soils occur along the non-perennial stream beds in the area.

The soils are generally neutral, with pH values between 6 and 6.5, with very low organic carbon levels, as might be expected in a hot, dry climate. The CEC values are what could be expected from the underlying geology, mainly due to the Ca and Mg content of the soils. The Hutton soil has a higher value, which agrees with the higher clay content.

In terms of agricultural potential the soils of the survey area are not suited for cultivation due to the shallow rooting depth, along with their stoniness in many parts. An additional limiting factor is the dry, hot climate. The low annual rainfall, coupled with the hot summer temperatures, means that the only practical means of cultivation would be by means of irrigation, and there is little or no evidence of any cultivated lands in the area.

The deeper soils along the stream bed should be avoided for any sort of development. Although the study area is a dry environment, and these zones will remain dry in most years, occasional periods of heavy rain will cause water to accumulate, even at intervals of several years. Such zones must be left in their natural state, as they can be regarded as temporary wetlands.

The soils do not have a high susceptibility to erosion, either by wind or water. The topsoils have a light to medium texture but are not excessively sandy. However, normal precautions regarding soil conservation should be taken in any construction phase, so that removal of vegetation cover is kept to a minimum and where activities that occur close to any stream bed should be avoided.

Once a facility is established where sites for waste materials are established, appropriate measures should be implemented to avoid wind erosion of the surface, especially in the drier winter months.

The main potential impact will be the loss of agricultural soil due to the establishment of permanent infrastructure, including the power station and associated waste material sites. This impact was assessed as having **medium significance** without, and **low significance** with, the application of appropriate mitigation measures.

10.2.6 Impacts on Heritage

The following conclusions and recommendations were made as part of the independent specialist Heritage Impact Assessment conducted as part of the EIA for the project (refer to **Appendix I**).

The proposed development footprint may impact on the Farms Vrienden 589 and Du Toit 563. Numerous heritage resources have been identified on these properties. As such, the development of the proposed Mutsho Power Project will have permanent and irreversible impacts on the natural and cultural resources of the region. These impacts require evaluation in light of the contribution the development can make of 600MW of electricity to the national grid.

Three layout alternatives have been identified for the proposed project. The Preferred Alternative will have a limited impact on known heritage resources, only impacting two archaeological stone flakes and one modern farmhouse during the Construction Phase. No impacts are anticipated during the Operational Phase. The Construction Phase of Alternative A will have no impact to known heritage resources, however impacts to a significant living heritage site, the "Baobab Room" are likely during the Operational Phase of Alternative A. Alternative B will have the greatest impact to known heritage resources during both the Construction and Operational Phases of development.

Irrespective of which Alternative is implemented, it is recommended that Site V04, the Baobab Room, must not be impacted by any activity and any proposed activity on the Farm Vrienden 589 must adhere to a buffer of 100m around this site. Similarly, MOP114, the ruined structure, should be avoided, and a 25m buffer placed around the site. The graves at MOP112 should be fenced, with the fence placed 5m from the visible graves, and a buffer should be instituted 15m from the fence line.

The Farm Du Toit 563 has areas that are very significant in terms of archaeological resources, with sites D04 to D07 representing one large Middle Stone Age artefact manufacturing site that has high archaeological significance and valuable research potential. This site must not be impacted, directly or indirectly, by any proposed power station, and mitigation by excavation is not recommended as this would result in loss of significant archaeological information. The exact boundaries of the extent of this larger manufacturing site are not clearly determined and as such, a buffer of 100m around the visible extent of this large site be implemented for any proposed activity the close proximity to this site.

In summary, it is recommended that:

» Site V04, on the Farm Vrienden 589, must not be impacted by any proposed development. A buffer of 100m around this site must be implemented.
» Graves at MOP112, on the Farm Vrienden 589, must be avoided. A fence should be erected 5m from the three visible graves, and a buffer of 15m around the fence line must be observed.
» The structure at MOP114, on the Farm Vrienden 589, must be avoided. A buffer of 25m around this site must be implemented.
» Sites D04 to D07, on the Farm Du Toit 563, likely represents one large MSA artefact manufacturing site and must not be impacted by any proposed development. A buffer of 100m around this large artefact manufacturing site must be implemented.
» Graves at MOP033, on the Farm Du Toit 563, must be avoided, and a buffer of 15m around the existing fence line must be observed.

- » The structure at MOP034, on the Farm Du Toit 563, must be avoided. A buffer of 25m around this site must be implemented.
- » A management plan for potential impacts to Site V04, the "Baobab Room" and buried heritage resources be drafted as part of the EMPr, including a Fossil Finds Procedure.
- » Should any buried heritage resources be uncovered during the construction or operational phases, work must cease and SAHRA must be contacted to advise on the best way to proceed.

10.2.7 Impacts on Palaeontology

The following conclusions and recommendations were made as part of the independent specialist Palaeontology Impact Assessment conducted as part of the EIA for the project (refer to **Appendix J**).

The proposed footprint is underlain by sediments of the:

- » Undifferentiated Karoo Basin; Tshipise and Tuli Sedimentary Basin and Solitude Formation.
- » Malala drift Gneiss and Gumbu Group of the Beit Bridge Complex, Archaean Granite-Gneiss Basement.

According to the geology of the development footprint, fossil heritage could be present in the Undifferentiated Karoo which has a very high Palaeontological Sensitivity as well as the Solitude Formation with a high Palaeontological Sensitivity. The Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group is metamorphic rocks which is unfossiliferous and has a very low palaeontological sensitivity. The Farm Du Toit 563 is entirely underlain by the Undifferentiated Karoo and the Solitude Formation. The north-eastern part of the Farm Vrienden 589 falls in the potentially fossiliferous Undifferentiated Karoo and the unfossiliferous Archaean Granite-Gneiss Basement, Beit Bridge Complex and Malala Drift Suite, Gumbu Group. During a field survey of the development footprint (including all three alternative layouts), no fossiliferous outcrops were found. For this reason, a low palaeontological sensitivity is allocated to the development footprint. Irrespective of the uncommon occurrence of fossils a solitary fossil may be of scientific value as many fossil taxa are known from a single fossil. The recording of fossils will expand our knowledge of the Palaeontological Heritage of the development area.

The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Mutsho Power Project, associated infrastructure applicable to all three layout alternatives will be of **low significance** in palaeontological terms. It is therefore considered that the construction and operation of the Mutsho Power Project, associated infrastructure (with the impacts on palaeontology associated with all three alternatives considered equal) is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the facility may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

In the event that fossil remains are discovered during any phase of construction, either on the surface or unearthed by fresh excavations, the Environmental Control Officer (ECO) in charge of these developments ought to be alerted immediately. These discoveries ought to be protected (preferably in situ) and the ECO must report to SAHRA so that appropriate mitigation (e.g. recording, collection) can be carried out by a professional palaeontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an approved collection which comprises a museum or university collection, while all fieldwork and reports should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

10.2.8 Noise Impacts

The following conclusions and recommendations were made as part of the independent specialist Noise Impact Assessment conducted as part of the EIA for the project (refer to **Appendix K**).

The area has a rural character in terms of appearance and development with ambient sound level measurements indicating significant variation in equivalent sound levels from location to location. All the measurement locations experienced noisy single events (wind-induced and from birds) that impacted on the ambient sound levels although the LA90 levels indicate an area with significant potential to be very quiet.

The quiet environment was considered when selecting the appropriate zone sound levels (noise limits). Ideal sound levels would be as can be found in a typical rural noise district and the proposed project should not change the ambient sound levels with more than 7dBA. Acceptable noise limits were set to 42 and 45dBA during the night and daytime respectively.

The projected noise rating levels were calculated using an acoustical propagation model for the construction and operational phase, as well as considering the cumulative situation. Noise generating activities and locations were conceptualized considering the preferred and alternative layouts provided.

Night-time construction activities may have a noise impact of medium significance on NSD04 due to potential traffic noises that would result in a noise impact of medium significance during the operational phase. Mitigation is however available that could reduce the significance to a more acceptable low.

Night-time operational activities may have a noise impact of medium significance on NSD03 for the Preferred Alternative and Alternative B layouts, though mitigation measures are available that could reduce the significance of the noise impact. There is a low potential for a noise impact during the operational phase for Alternative A.

Due to economic advantages, power generation does provide valuable employment, business opportunities and green energy. It must be noted when such projects are close to potential noise-sensitive receptors, consideration must be given to ensuring a compatible co-existence. This does not suggest that the sound from the facility should not be audible under all circumstances as this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source, but rather that the sound due to the power generation activities should be at a reasonable level in relation to the ambient sound levels. While the Mutsho Power Project will have a noise impact of a number of the closest noise-sensitive receptors (associated with the Preferred Alternative and Alternative B layout), the noise impact can be mitigated to a low significance. It is however important that the potential noise impact be evaluated should the location of the power station or any associated systems be moved closer to any confirmed NSD's. In terms of acoustics, Alternative A is preferred, although it should be noted that it would be possible to mitigate the potential noise impacts of the other layouts.

It is therefore the opinion of the Noise Specialist that the increases in noise levels can be managed to a **low significance**. It is therefore the recommendation that the project can be authorised (from a noise impact perspective).

10.2.9 Visual Impacts

The following conclusions and recommendations were made as part of the independent specialist Visual Impact Assessment conducted as part of the EIA for the project (refer to **Appendix L**).

The Preferred Alternative is favoured from a visual perspective. It helps to minimise local impacts on the adjacent Mopane / Waterpoort Road when compared with the other layout alternatives. The retention of existing vegetation and implementation of localised screen planting should help to minimise visual impacts from this road. The location of the proposed substation will create a localised visual impact on the Mopane / Waterpoort Road that might be avoided by offsetting this infrastructure slightly from the road sufficiently to provide reasonably dense screen planting (30m). The impact on views from major roads and from protected areas is likely to be negligible. These impacts are largely mitigated by distance and natural vegetation which provides a large degree of screening.

The one impact for which significant mitigation is not possible is the industrialisation of the landscape as viewed from the minor ridge to the north and particularly to a homestead that is located on it. A small degree of mitigation will be possible through management of the ash dump, however the overall impression of large scale industry will remain. Considering the scale and nature of the proposed development, the visual impact that is likely to be experienced by the majority of potential sensitive receptors is anticipated to be low due to the nature of the surrounding landscape. As indicated however, there is also potential for relatively high but localised visual impacts.

The Visual Impact Assessment has confirmed that there are no broad scale visual impacts that will preclude development. However the localised impact that is likely to be experienced by residents of a small number of local homesteads, particularly the one located on the ridgeline to the north (i.e. Plaas Erasmus) of the proposed site is a concern. It is possible that the development could compromise uses. It is recommended that discussion is undertaken with these landowners to investigate detailed mitigation measures that might include localised screen planting within their properties.

10.2.10 Socio-Economic Impacts

The following conclusions and recommendations were made as part of the independent Socio-Economic Impact Assessment conducted as part of the EIA process for the project (refer to **Appendix M**).

The review of key national, provincial, and local policy documents indicates that the development of coal-fired power stations is supported at all levels, from a socio-economic perspective. The national policies are in sync with the view that coal dependence will continue in the long term; thus, the contribution of coal-fired power stations towards the energy mix in the country will remain. However, a proposal for research and development for cleaner coal technology with reduced emission rates is put forward (Department of Energy, 2016). In addition, at lower levels, service delivery is a key issue to be addressed, including electricity provision. After considering the reviewed documentation, no fatal flaws or contraventions from a socio-economic policy perspective exist for the implementation of the proposed project.

However, the need for additional baseload generation capacity needs to be assessed in the context of the current and envisaged future supply and demand of electricity. South Africa's electricity-intensity is declining, while new generating capacities are being developed. The country is already producing more electricity than it can currently consume; therefore, the need for new generating capacities in the near future is not as dire as it was experienced a few years back. The eagerly awaited updated IRP, hopefully to be released during 2018, will inform this path.

The Mutale LM was merged with the Musina LM in August 2016. This amalgamation has resulted in the GDP contribution of the Musina LM to Vhembe DM to be 16%. The municipality is well connected regionally and internationally. It is comprised mainly of mining activities, tourism, and largely undeveloped land. Overall, the economy has a small base despite its relatively large contribution to the district's economy, and in the past few years has been stagnating, showing a need for additional investment and diversification of its base.

Just over a third of the population in the local economy is employed and the unemployment rate is 26%. Key concerns are the low education levels and the skills shortage in the region. These are perpetuated by the vast backlog of classrooms and learner support material, particularly in rural areas. Furthermore, the communities where labour can potentially be sourced are not in close propinquity to the project site.

The above suggests that the economy can utilise the investment to diversify its economic base and lead to the improvement of standards of living among local households through the increased income levels and access to improved services, which can be achieved by raising the local municipality's revenue base through taxes and rates paid by new businesses. The proposed project is, therefore, likely to create a positive impact on the local economic development and the socio-economic environment in the municipality in general; however, some negative effects associated with the influx of people and migrant workers can be expected. Of concern is the possible depreciation of the tourism offering in close proximity to the proposed site.

Overall, it is clear that the local economy is in need of an investment that will provide for a long-term growth and development of the economy. The proposed project is likely to contribute to positive economic development, particularly considering the fact that there are also a number of other mining and industrial developments planned for the region, which may likely lead to the development of a new economic node similar to Lephalale. However, the proposed project without doubt will forever change the aesthetics and tranquil sense of the area, which could negatively impact on some other economic activities in the region such as tourism and agriculture.

10.2.11 Traffic Impacts

The following conclusions and recommendations were made as part of the independent Traffic Impact Assessment conducted as part of the EIA process for the project (refer to **Appendix N**).

It is concluded that:

- The proposed Mutsho Power Plant trip generation will peak during the 4 to 5 years Construction Phase.
- Abnormal Load vehicles will be required to transport various components to the site during the construction phase.
- Overland conveyor system will transport coal and conditioned ash on the project site.

» Gravel service roads (on-site) will be used for maintenance purposes and will also serve as back up should conveyors fail on occasion.
» The N1, D777 and D744 will provide access to the site from the north (Musina).
» The N1 and D1021 will provide access from the south to the site (from Makhado and surrounding towns).
» The bulk of the Mutsho Power Project traffic will route along the D1021 and along the N1 towards Makhado in the south.
» The critical N1/D1021 intersection approaches will yield acceptable Levels of Service in the Construction Phase (and also during the Operations Phase until Year 2045, as assessed). Thereafter the intersection should be re-evaluated and possibly a traffic roundabout would need to be considered to improve the Level of Service on the D1021 approach to the N1.
» The gravel roads (D744 and D1021) will need to be hard surfaced to prevent dust (environmental, road safety and pedestrian safety issues) and to provide an acceptable road surface for the plant traffic (road maintenance, vehicle accessibility, road safety issues).
» A raised sidewalk on at least one side of the D1021 and D777, should be provided for pedestrian safety.
» Signage should be erected along the D1021 and D744 warning motorists of possible pedestrians and cattle / animals along the road.
» Increase in heavy vehicles (transporting coal) on the N1 during the 30 years Operations Phase will result in deterioration of the N1 pavement structure and will require more regular maintenance.
» Increase in heavy vehicles (transporting coal) on the N1 during the 30 years Operations Phase will increase the probability of accidents on the N1.
» Considering the traffic impact on the N1 during the Operations Phase it is preferable that coal be transported to the Mutsho Power Plant by rail.
» The critical N1/D1021 intersection approaches will yield poor Levels of Service in the Decommissioning Phase (and also during the Operations Phase around Year 2050, as assessed). At this point in time, the intersection should be re-evaluated and possibly a traffic roundabout would need to be considered to improve the Level of Service on the D1021 approach to the N1.

It is recommended that:

» Site access design be submitted for approval when the development planning is undertaken.
» The gravel roads (D744 and D1021) be hard surfaced to prevent dust and to provide an acceptable road surface for the Plant traffic.
» A raised sidewalk be provided on at least one side of the D1021 and D777, for pedestrian safety.
» Signage be erected along the D1021 and D744 warning motorists of possible pedestrians and cattle / animals along the roads.
» Appropriate speed restriction signage be erected along the D1021 and D744 to inform motorists of safe operating speed.
» Signage be erected along the N1 warning motorists of increased higher numbers of construction related vehicles on the affected section of road during the Construction period.
» Construction and transport vehicles be maintained and kept in roadworthy condition.
» Monitor vehicle queues on the D1021 approach to the N1, and upgrade the intersection to a traffic roundabout where required.
» Consideration be given to transporting fuel (coal) to the Plant by rail instead of road. Fewer heavy vehicles on the N1 would reduce risk of traffic accidents. Reduced Heavy Vehicle axle loading on the N1 would also reduce road maintenance costs. The D1021 approach to N1 should then operate acceptably over the plant life-cycle and obviate the possible need for a traffic roundabout towards the end of the plant operational period.

Traffic impacts identified for the project were assessed as being of **medium significance**, without mitigation with the majority being reduced to a lower valued **medium significance** or **low significance** with the application of mitigation measures. No fatal flaws were identified for the project from a traffic impact perspective.

10.2.12 Cumulative impacts

Considering the findings of the specialist assessments undertaken for the project, the cumulative impacts for the Mutsho Power Project are anticipated to be within acceptable limits with the majority rated as being of **low to medium significance** with the implementation of appropriate mitigation. The cumulative impact of the proposed project on climate change is the only impact which was rated as being of **high significance** due to the global nature of the impact. It should be noted however that the opportunity does exist for future mitigation measures to be implemented which if implemented could assist in reducing the projects GHG emissions.

The following conclusions can be drawn when considering the proposed Mutsho Power Project and associated infrastructure:

- The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected vegetation types or species through clearing, resulting in an impact on the conservation status of such flora or ecological functioning. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an ecological perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected faunal species, and loss or destruction of suitable habitat. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a faunal perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of threatened or protected avifauna species, and loss or destruction of suitable habitat. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an avifaunal perspective.
- The construction and operation of the proposed project will not result in an unacceptable risk to human health through impacts on air quality. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from an air quality perspective.
- The construction and operation of the proposed project will result in a contribution to climate change as a result of its GHG emissions. However mitigation measures are available which if implemented may assist in reducing the emissions and climate change impact of the project.
- The construction and operation of the proposed project will not result in an unacceptable risk to hydrology or geohydrology resources resulting due to the increase in the extent of hard or impermeable surfaces in the greater area, additional potential pollutants, and seepage or contamination in the area. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a hydrology or geohydrology perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of soils or land of high agricultural potential. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a soils, land use, and agricultural potential perspective.

- The construction and operation of the proposed project will not result in an unacceptable loss of heritage resources. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a heritage perspective.
- The construction and operation of the proposed project will not result in an unacceptable loss of palaeontological resources. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a palaeontological perspective.
- The construction and operation of the proposed project will not result in an unacceptable noise impacts on the surrounding areas. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a noise perspective.
- The construction and operation of the proposed project will not result in a complete or whole-scale change in sense of place and character of an area and unacceptable visual intrusion. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a visual perspective.
- The construction and operation of the proposed project will result in positive and negative contributions from a socio-economic perspective. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a socio-economic perspective.
- The construction and operation of the proposed project will not result in an unacceptable traffic related impacts. The anticipated cumulative impacts of the proposed project are therefore considered to be within acceptable limits from a traffic impact perspective.

Based on a detailed evaluation, the development of the proposed Mutsho Power Project and associated infrastructure on the proposed project site will not result in a significant contribution to cumulative impacts of similar projects within the area.

From the above conclusions of the specialist studies undertaken, it is concluded that apart from climate change impacts which are expected to be of **moderate to high significance**, the majority of impacts associated with the construction and operation of the Mutsho Power Project and associated infrastructure are expected to be of **medium to low significance** with the implementation of appropriate mitigation measures. No environmental fatal flaws were identified to be associated with the proposed project.

10.3. Impacts associated with waste treatment and management activities

Impacts associated with waste treatment and management activities relate to those associated with the ash dump and wastewater treatment works (WWTW). Potential impacts on surface and groundwater are anticipated should appropriate mitigation measures not be implemented. In terms of the assessment of impacts undertaken within this EIA study, impacts on water resources are expected to be of **medium to low significance** post-mitigation. On-going water quality monitoring throughout the operational phase is required to be undertaken. A borehole monitoring network should be established for the site in order to monitor groundwater quality. In addition, an appropriate Integrated Water and Waste Management Plan (IWWMP) must be developed and implemented for all phases of the proposed project.

The detail design of the Mutsho Power Project, which will include the ash dump, coal stockyard, as well as Pollution Control Dams (PCDs), will be undertaken post-feasibility and will need to demonstrate compliance with Regulation 3(2) of GNR 636, by confirming compliance with a Class C barrier performance. The barrier system for the dry ash disposal facility and placement by mechanical means will include a 1.5mm HDPE geomembrane compliant with SANS 1526(2015) and will be installed in accordance with SANS 10409 on a compacted clay liner of 300mm thickness compliant with SANS 1200, and Subsection D in particular.

Drainage will ensure atmospheric pressure and construction quality assurance compliant with the relevant SANS considerations.

The layout of the facility would need to ensure compliance with GNR 704 through the placement of the ash dump (as well as other infrastructure associated with the power station) outside of the 1:100 year floodline. A geotechnical study will need to be undertaken on the site to confirm suitability of the material for construction of the power station and associated infrastructure. The outcomes of this study will inform the final design. The final designs will be submitted in support of the final Waste Management License (WML) as well as the Water Use License Application (WULA) required for the project.

10.4. Assessment of Layout Alternatives

The results of the specialist investigations in terms of the assessment of the three layout alternatives are provided in **Table 10.2**. Each of the layout alternatives have been assigned a value to indicate their perceived preference as follows:

- » A value of 1 indicates the preferred alternative.
- » A value of 2 indicates the second preferred alternative.
- » A value of 3 indicates the third preferred (or least preferred) alternative.
- » A value of 0 represents no preference.

Where all three alternatives are considered as having the same preference (i.e. none of the alternatives are considered to be either more or less favourable than any of the other alternatives) a value of 0 is assigned.

The assigned values were then totalled to indicate an overall preferred alternative (.e. the layout alternative with the lowest value is considered to be the preferred alternative, while the layout alternative with the highest value is considered to be the least preferred alternative).

Table 10.2: Outcome of Specialist Investigation of the three Layout Alternatives.

Specialist	Preferred Alternative	Alternative A	Alternative B
Ecology: » *Flora*	1	3	2
» *Fauna*	1	2	3
» *Avifauna*	1	3	2
Air Quality	0	0	0
Climate Change	0	0	0
Hydrology and Geohydrology	3	1	1
Soils, Land Use, and Agricultural Potential	0	0	0
Heritage and Archaeology	2	1	3
Palaeontology	0	0	0
Noise	2	1	3
Visual	1	2	2
Socio-Economic	1	2	2
Traffic	0	0	0

Specialist	Preferred Alternative	Alternative A	Alternative B
TOTAL	12	15	18

Based on the outcomes of the specialist investigations, the Preferred Alternative has been confirmed as the preferred layout alternative from an environmental perspective.

10.5. Assessment of the No-go Alternative

The implementation of the Mutsho Power Project at the proposed site is expected to result in a number of social and environmental costs and benefits.

Environmental costs identified for the project include:

» Direct loss of biodiversity, flora and fauna due to the clearing of land for the construction and utilisation of land for the project (which is limited to the development footprint). Areas of ecological sensitivity have been identified onsite and have been included in an environmental sensitivity map prepared for the project. The cost of loss of biodiversity is therefore expected to be limited with the implementation of appropriate mitigation measures and the appropriate placement of infrastructure to avoid areas of ecological sensitivity identified on site.
» Visual impacts associated with the project. The Preferred Alternative is favoured from a visual perspective, as it helps to minimise local impacts on the adjacent Mopane / Waterpoort Road when compared with the other layout alternatives.
» Change in land-use and loss of land available for agriculture on the development footprint. The cost in this regard is expected to be limited due to the low agricultural potential of the property and the limited use of the footprint associated with the preferred alternative.
» Impacts in terms of GHG emissions. Options to improve the emissions intensity of CFB combustion such as the future co-firing of biomass in the CFB combustor, and incorporating solar thermal energy from CSP units are available. Impacts in this regard can therefore be managed through appropriate planning and design of the facility to meet the South African targets beyond 2025.

Apart from impacts associated with GHG emissions, these costs are largely expected to occur at a local and site level and are considered acceptable provided the mitigation measures as outlined in this EIA and contained within the EMPr are implemented. The Mutsho Power Project's higher emissions intensity than the forecasted national baseline is to some extent acceptable as the national baseline includes intermittent RE generation.

The positive implications of establishing the project on the demarcated site include:

» The project will result in important socio-economic benefits at the local and regional scale through job creation, procurement of materials and provision of services and other associated downstream economic development. These will persist during the pre-construction, construction and operational phases of development.
» The project is considered to be a suitable land use for the proposed site due to the low potential for commercial agriculture and the proximity to an existing coal resource (i.e. MCM's Makhado Colliery). Development of the facility will require the implementation of appropriate management actions which could have positive impacts on the surrounding areas specifically in terms of alien vegetation and erosion management.

- The project site is considered favourable given its proximity to 8 000ha Mopane site which comprises one of two sites which make up the designated Musina-Makhado SEZ. Once developed the SEZ will include several energy intensive industrial users, including mineral beneficiation and base metal refineries.
- The project contributes towards the development of additional power generation sources as outlined in the IRP 2010. The project will start to provide power when Eskom's current fleet of some 44 000MW has decreased to about half of its generating capacity. As such developing the proposed project will meet a future need for baseload power that cannot be met by intermittent renewable energy sources.

The costs associated with the project are anticipated to occur at a site specific level, the significance of which can be largely reduced through the application of appropriate mitigation measures, and through the appropriate placement of infrastructure within areas of lower sensitivity identified on site. Impacts associated with GHG emissions can be managed through appropriate planning and design of the facility to meet the South African targets. Due to the fact that the benefits of the project are expected to occur at a larger (i.e. national, regional and local level), the expected benefits of the project are expected to partially offset the localised environmental costs of the project.

The following impacts are anticipated with the implementation of the "Do Nothing" option:

- Failure to provide additional coal-fired power generation capacity in accordance with the Department of Energy's (DoE's) National Integrated Resource Plan (IRP), which has identified the need for power generation from coal as part of the technology mix for power generation in the country in the next 20 years.
- Failure to provide an additional 600MW of baseload electricity to the national electricity grid through means of a government led IPP Procurement Programme, which in turn has the opportunity to stimulate economic growth and development
- Failure to realise the potential local economic development and social upliftment benefits associated with the implementation of projects under one of the DoE's IPP Procurement Programme's.

10.6. Overall Conclusion (Impact Statement)

The findings of the independent specialist studies undertaken as part of this EIA process to assess both the benefits and potential negative impacts anticipated as a result of the project conclude that:

- The Preferred Alternative should be authorised for implementation.
- Although some impacts of high significance were identified, these can be mitigated to acceptable levels. No environmental fatal flaws were identified to be associated with the proposed project provided that the recommended mitigation measures are implemented.
- The majority of impacts associated with the construction and operation of the Mutsho Power Project and associated infrastructure are expected to be of medium significance, most of which can be reduced to lower medium or low significance with the implementation of appropriate mitigation measures.
- Several areas of sensitivity were identified within the project development area (refer to **Figure 10**.1). These areas must be taken into consideration when Mutsho Power plan their detailed on-site layouts during the final design phase of the project.
- CFB Technology is considered preferable over conventional PC technology due to the potential to utilise alternative fuel sources, and the reduction of emissions such as SO_2 and NO_x. While CFB technology is more emissions intensive than PC technology in terms of carbon emissions, it should be noted that CFB

combustion is more efficient than PC combustion. The more efficient fuel to energy conversion achieved by the proposed CFB combustion technology therefore results in lower fuel costs than the PC alternative when firing coal. The facility should be designed as per the requirements of future bidding rounds of the CBIPPPP. Should future bidding rounds provide for the potential addition of alternative fuel sources (such as biomass) or solar thermal hybrid technology, then the facility should be designed with the potential to accommodate these in accordance with the bidding requirements of the CBIPPPP.

» Dry cooling and dry ashing are proposed as the preferred options as these will minimise the requirements for water.
» An appropriate liner must be implemented at both the ash dump and coal stockpile in order to minimise the potential for impacts on groundwater resources.

10.7. Overall Recommendation

Based on the nature and extent of the proposed project, the local level of disturbance, the benefits expected at a regional and national scale, the findings of the EIA, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team that the project can proceed on condition that all supporting authorisations, licenses, and permits are obtained prior to development commencing; and that the mitigation measures specified in **Chapters 8** and **9** of this EIA Report, the independent specialist Impact Assessments contained within **Appendix D – N**, and those provided within the EMPr contained within **Appendix O** of this EIA Report are observed and implemented.

Upon authorisation of the proposed project by the DEA, the following conditions must be included within the authorisation issued:

<u>Management and Compliance Monitoring:</u>

» All mitigation measures detailed within this EIA Report and the independent specialist reports contained within **Appendix D – N** must be implemented.
» The Environmental Management Programme (EMPr) as contained within **Appendix O** of this EIA Report must be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases of the proposed project is considered to be key in achieving the appropriate environmental management standards as detailed for this project.
» An independent Environmental Control Officer (ECO) must be appointed by the project developer prior to the commencement of any authorised activities (which include site clearing and site preparation activities). The ECO must monitor compliance with all applicable environmental legislation and requirements throughout the construction phase.

<u>Design:</u>

» Following the final design of the facility, a final layout indicating all relevant infrastructure and affected areas (permanent and temporary) must be submitted to DEA for review and approval prior to commencing with construction. This layout must consider all sensitive areas identified within the site.
» Prepare and finalise a Stormwater Management Plan (SWMP) for the project considering all stormwater and water pollution control facilities such as Pollution Control Dams (PCDs) and storm water drainage system. Pollution control infrastructure is required to be designed in accordance with the National Norms and Standards for Disposal of Waste to Landfill (GNR 636) published in terms of the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA).
» Final approval of the Waste Management License (WML) must be obtained subject to the presentation of detail design drawings for waste management infrastructure (i.e. the ash dump, coal stockpile,

Pollution Control Dams (PCDs), etc.) for approval by the Department of Water and Sanitation's (DWS's) design engineers.

- An appropriate liner system must be installed at the ash dump and coal stockpile area. The liner is to be designed in accordance with the National Norms and Standards for Disposal of Waste to Landfill (GNR 636) published in terms of NEM:WA.
- During construction, unnecessary disturbance to habitats should be strictly controlled and the footprint of the impact should be kept to a minimum.

Biodiversity Maintenance and Integrity:

- Conduct an ecological walk through survey for the power station and all associated infrastructure. Results of this survey must guide permitting requirements for the removal of protected trees from the property.
- A detailed Alien and Invasive Plant Management Plan must be developed and implemented throughout the project life-cycle up to the decommissioning phase.
- A rehabilitation programme that makes use of locally endemic or indigenous species must be developed and implemented.
- Site rehabilitation of temporary laydown and construction areas to be undertaken immediately after construction is completed in an area.
- Limit the development to the facility footprint area and avoid impacts in adjacent habitats.
- Suitable areas for development must be demarcated (mainly on habitat with low sensitivity) prior to commencement of construction.
- Undertake Search and Rescue of protected species within the development footprint prior to the undertaking of construction activities. All search and rescue must be undertaken in terms of a relevant permit obtained from the relevant conservation authority.

Air Quality Management:

- An Air Quality Management Plan (AQMP) must be prepared for the project and implemented for the operation phase of the power station.
- It is important that an emission control and reduction strategy for dust is designed and implemented, ensuring that the contribution to ambient concentrations is minimised. Roads should be tarred or traffic control measures implemented to limit vehicle-entrained dust from unpaved roads. The sidewalls of the ash dump should be vegetated as they rise, and the vegetation cover should be maintained to reduce the exposed area and limit wind entrainment. Open areas should be stabilised with dust palliative, gravel or similar.
- An Atmospheric Emissions License (AEL) must be obtained for the project prior to commencement of construction.

Surface Water and Wetlands:

- Where wetlands are impacted by the project, a rehabilitation programme must be prepared and implemented.
- A stormwater management plan demonstrating the separation of clean and dirty stormwater flows must be prepared and implemented.
- An Integrated Water and Waste Management Plan (IWWMP) must be developed and implemented for all phases of the proposed project.
- An Integrated Water Use License must be obtained from the Department of Water and Sanitation (DWS) for all relevant water uses.

Groundwater:

- Prepare and maintain a numerical model against monitored data during operations.
- Water quantity and quality data should be collected on a regular, ongoing basis during operation. These data must be used to recalibrate and update the water management model, to prepare monitoring and audit reports, to report to the regulatory authorities against the requirements of the IWUL and other authorisations and as feedback to stakeholders in the catchment.
- Borehole drilling and aquifer testing is required to determine the rock permeability and groundwater flow speed. A geochemical study is required to determine the expected leachate quality from the ash material and coal stockpile. A numerical model is finally required to predict the size of the contamination plume and the risk of private borehole and rivers from contamination.
- Continuous post-closure monitoring is required to ensure that no drastic water quality changes are recorded. The monitoring should continue until such time that a steady state of water quality is achieved. The numerical model needs to be updated and should be calibrated with the recorded monitoring data. Once the model is calibrated, it should be used to predict the shape and size of the contamination plume up to 100 years after closure.
- The monitoring as recommended in the specialist geohydrology report should be established prior to operation. Geochemical analyses and modelling must be conducted on the material during operations to update the transport model and refine geochemical predictions.

Management of Heritage Features:

- Conduct a heritage walk through survey for the power station and associated infrastructure. Any heritage sites recorded during this survey could be mitigated by micro adjustments of the layout or through the recording of the site prior to destruction.
- Include a chance finds procedure within the EMPr for the project to address the procedures to follow in the event of unearthing archaeological or palaeontological material or graves during the construction process.

Waste Management:

- Monitoring of waste treatment and management facilities throughout all phases of the project should be undertaken.
- Develop and implement an Integrated Water and Waste Management Plan (IWWMP) for all phases of the project.

Noise Monitoring:

- No mitigation or routine noise monitoring is required in the operation phase of the facility. However, if noise measurements are conducted, annual feedback should be presented to all stakeholders and other Interested and Affected Parties (I&APs) in the area.

Climate Change:

- The facility should be designed with the potential addition of alternative fuel sources (such as biomass for example) or solar thermal hybrid technology in mind in order to reduce carbon emissions beyond 2025. Making provisions for the future addition of carbon capture and storage systems presents another opportunity to reduce carbon emissions.

Social impacts:

- During the design and construction phase the developer should meet with local communities to determine their concerns and take into consideration any mitigating proposals. An appropriate grievance mechanism and communications plan should be designed and implemented for the project.
- Increase the local procurement practices and employment of people from local communities as far as feasible to maximize the benefits to the local economies.
- Develop and implement a traffic management plan for the construction and operational phases of the power station.

Mineral consent:

- A Section 53 Application should be submitted to the Department of Mineral Resources (DMR) to ensure that proposed activities do not sterilise a mineral resource that might occur on site.

Rehabilitation and Operations:

- Site rehabilitation of temporary laydown and construction areas are to be undertaken immediately after construction.
- The process of communication and consultation with the community representatives must be maintained after the closure of this EIA process, and, in particular, during the construction phase associated with the proposed project.

Other permits:

- All relevant environmental permits must be obtained prior to the commencement of the activities triggering the need for these permits.

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