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ENVIRONMENTAL IMPACT ASSESSMENT PROCESS: PROPOSED COAL-FIRED POWER STATION AND ASSOCIATED INFRASTRUCTURE IN THE WITBANK AREA

FINAL ENVIRONMENTAL IMPACT REPORT

February 2007

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GLOSSARY OF TERMS

Airshed	An airshed is a part of the atmosphere that behaves in a coherent way with respect to the dispersion of emissions. It typically forms an analytical or management unit and is also a geographic boundary for air quality standards
Base Load	Base load refers to the electricity generated to meet the continuous need for electricity at any hour of the day or night at all times and during all seasons
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 wellbeing;
Environmental Impact Assessment (EIA)	A study of the environmental consequences of a proposed course of action.
Environmental Impact Report (EIR)	A report assessing the potential significant impacts as identified during the Scoping phase.
Environmental impact	An environmental change caused by some human act
Peaking or Peal Load	Peaking refers to the periods between 07:00 and 09:00 in the mornings and 18:00 and 20:00 in the evenings when electricity use "peaks"
Public Participation Process	A process of involving the public in order to identify needs, address concerns, in order to contribute to more informed decision making relating to a proposed project, programme or development
Mothballed	Deactivating a power station for an indefinite period.
Red Data Book (South African)	An inventory of rare, endangered, threatened or vulnerable species of South African plants and animals

Scoping	A procedure for determining the extent of and approach to an EIA, used to focus the EIA to ensure that only the significant issues and reasonable alternatives are examined in detail
Scoping Report	A report describing the issues identified

ABBREVIATIONS

AHP	Analytical Hierarchy Process
BID	Background Information Document
DEAT	Department of Environmental Affairs and Tourism
DME	Department of Minerals and Energy
DWAF	Department of Water Affairs and Forestry
ECA	Environment Conservation Act (No. 73 of 1989)
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMP	Environmental Management Plan
FBC	Fluidised bed combustion
FGD	Flue gas desulphurisation
GA	General Authorisation in terms of the National Water Act
GGP	Gross Geographic Product
HIA	Heritage Impact Assessment
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IEP	Integrated Energy Plan
IGCC	Integrated coal gasification combined cycle
ISEP	Integrated Strategic Electricity Planning
km	Kilometer
kV	Kilovolt
kWH	Kilowatt Hour
m	Metre
m^3	Cubic Metre

MCDA	Multi-criteria Decision Analysis
MPRDA	Mineral and Petroleum Resources Development Act (No. 28 of 2002)
MW	Megawatt
NEMA	National Environmental Management Act (No. 107 of 1998)
NERSA	National Energy Regulator of South Africa
NHRA	National Heritage Resources Act (No. 25 of 1999)
NIRP	National Integrated Resource Planning
NWA	National Water Act (No 36 of 1998)
NWRS	National Water Resources Strategy
OEM	Original Equipment Manufacturer
ppm	Parts per Million
pf	Pulverised fuel
PPP	Public Participation Process
ROD	Record of Decision
SAHRA	South African Heritage Resources Agency
SIA	Social Impact Assessment
UCG	Underground Coal Gasification
TOR	Terms of Reference
VIA	Visual Impact Assessment
VRESAP	Vaal River Eastern Sub-system Augmentation Project
WMA	Water Management Area

UPDATE SUMMARY: FINAL ENVIRONMENTAL IMPACT REPORT: FEBRUARY 2007

This Update Summary describes the process followed since the Draft Environmental Impact Report (dEIR) for Eskom's proposed coal-fired power station and associated infrastructure in the Witbank area was made available to interested and affected parties (I&APs) for their comment. It also indicates how the finalisation of the EIR has responded to public and review input and outlines the way forward in the environmental decision-making process.

PROCESS SINCE RELEASING THE DRAFT ENVIRONMENTAL IMPACT REPORT

The public participation process undertaken during the EIR Phase was as follows:

- Registered I&APs were notified of the imminent release of the dEIR and the details of the Open Houses/ Public Meetings, that would be held to present the report to the public, by means of an email on 8 November 2006 and a letter, dated 13 November 2006.
- The dEIR was released into the public domain (lodged in the Witbank public library, the Nelspruit public library, the Phola public library, the Johannesburg public library and the Kungwini and Delmas municipal offices) on 20 November 2006. In addition it was placed on the Eskom and Ninham Shand websites shortly thereafter.
- Media notices (in English, Afrikaans, Zulu and Pedi) were placed in the Streek News, the Highvelder, the Middleburg Observer and the Witbank News on 17 November 2006 in order to notify the public of the availability of the dEIR and to notify them of the Open Houses and Public Meetings.
- Letters notifying the registered I&APs of the availability of the document and reminding them of the public meetings was sent on 20 November 2006. The letters to I&APs also included a copy of the Executive Summary of the dEIR.
- The dEIR was presented to the public at an Open House and Public Meeting held at the El Toro Conference Centre near Kendal on 28 November 2006, an Open House held in Phola on 29 November 2006, and an Open house and Public Meeting held in Witbank on the evening of 29 November 2006. Attendees were provided with an opportunity to ask questions and provide comment on the report. Minutes of the meetings were posted to the attendees on 14 December 2006 (see Annexure C).
- In addition to the above, a copy of Issues Trail 3, which had been compiled from responses received between the finalisation of the Scoping Report and the release of the dEIR, was posted to all those who submitted written comment (see Annexure D).
- Taking cognisance of the time of year, the public comment period for the submission of written comment on the dEIR was made longer than the usual and ended on 8 January 2007. Additional time was provided to I&APs who requested it and comments received up to 20 February 2007 were captured and responded to in this documentation.
- A focus group meeting was held on 12 January 2007 with two of the landowners neighbouring Site X, to discuss their detailed concerns raised at the November public meetings and in their written submissions. Minutes of the meeting can be found in

Annexure T. The outcome of the meeting informed the updating and compilation of this final report.

- Various authorities were also requested to comment on the dEIR and meetings to elicit this were held with MDALA and Kungwini Local Municipality on 15 January 2007 and with SANRAL, GauTrans, Spoornet and DWAF on 16 January 2007. Minutes of those meetings are included as Annexure R of this report. A meeting with DEAT's Directorate Air Quality Management and Climate Change is due to be held 27 February 2007.

The comments received during the commenting period for the dEIR, together with the study team and applicant's responses thereto, are presented in Issues Trail 4 which is included in this report as Annexure U.

UPDATING OF THE DRAFT ENVIRONMENTAL IMPACT REPORT

Updating of the dEIR to this fEIR has entailed the following:

- Amending typographical and other insignificant errors that appeared in the dEIR;
- Indicating revisions to two specialist studies, namely the air quality and heritage studies. These were necessitated by concerns regarding possible air quality impacts on poultry, and by the heritage resources authorities requiring additional information, respectively. The revised specialists' reports are provided in Annexures V and W and related changes in the main body of this report are underlined;
- Updating the Public Participation Process to reflect the latest round of public engagement (also underlined);
- Eliciting comment on the dEIR from an array of other authorities, as well as from the review specialist (see Annexures R and S);
- Providing explicit recommendations regarding the alternatives and mitigatory measures that we believe should be applied for, namely ~
    - that Site X is preferred;
    - that the refinement of the layout is undertaken, to avoid wetland as far as possible;
    - that direct dry cooling technology is applied;
    - that wet flue gas desulphurisation for SOx control, bag filters or electrostatic precipitators for particulates control, and low NO_X burners for NO_X control, are applied;
    - that above-ground ashing is undertaken, with the subsurface option to be investigated in the future; and
    - that the access and transport routes as indicated are preferred.
- Appending the following additional annexures, *viz*.
    - Annexure R: Responses from commenting authorities and minutes from meetings;
    - Annexure S: Independent review report;
    - Annexure T: Focus group meeting minutes;
    - Annexure U: Issues Trail 4;
    - Annexure V: Revised air quality specialist report; and
    - Annexure W: Revised heritage assessment specialist report.

The dEIR has been updated to the fEIR by means of the inclusion of this Update Summary, the incorporation of the above changes in the text of the report, as well as the additional annexures as listed. Significant amendments to the body of the report are indicated by means of underlining in the final version, to enable readers to track the changes.

THE WAY FORWARD

This finalised EIR has been submitted to DEAT for their consideration.

Once they have considered the document and are satisfied that it provides sufficient information to make an informed decision, DEAT will determine the environmental acceptability of the recommended alternatives and mitigatory measures. Thereafter, DEAT will issue a Record of Decision and any conditions of approval relative to the authorisation, should the proposed activity be approved.

Following the issuing of the Record of Decision, DEAT's decision will be communicated by means of letters to all identified interested and affected parties. A 30-day appeal period follows, during which interested and affected parties will have an opportunity to appeal against the decision to the Minister of Environmental Affairs and Tourism, in terms of the Environment Conservation Act.

We would like to thank all those who have participated in the EIA process for the proposed coal-fired power station and associated infrastructure in the Witbank area

20 February 2007

1 INTRODUCTION AND BACKGROUND

The purpose of this chapter is to provide the context to the project and to this final Environmental Impact Report (fEIR). After a short introduction, it describes the policy and legal framework. Thereafter, the chapter outlines the EIA process to date, assumptions and limitations, and approach to the Environmental Impact Assessment Phase. This chapter ends with a brief section on the context and structure of the remaining chapters of the EIR.

1.1 INTRODUCTION

In order to contribute toward meeting South Africa's growing electricity demand, Eskom proposes constructing a coal fired power station and associated infrastructure[1] in the Witbank geographical area. The power station precinct would include the power station building, administration buildings (administrative, medical, maintenance, services) and the high voltage yard. The likely associated infrastructure includes a water treatment works, a wastewater treatment works, access roads, railway line, water supply pipelines, a coal stockyard, an ash disposal facility, a coal and ash conveyor system, and water storage facilities. **Figure 1.1** is a locality map, illustrating the location of two alternative sites for the proposed power station. In terms of the Environment Conservation Act (ECA) (No. 73 of 1989), the proposed activity requires authorisation from the competent environmental authority before it can be undertaken. Since Eskom is a state-owned enterprise, the competent authority is the national Department of Environmental Affairs and Tourism (DEAT). DEAT's decision will be based on the outcome of this Environmental Impact Assessment (EIA) process. This Final Environmental Impact Report (fEIR) serves to document the EIA Phase of the EIA process. The purpose of this fEIR is to outline the legal and policy framework and national electricity situation, to comprehensively describe the proposed project and its alternatives, to describe the biophysical and socio-economic context of the proposed power station, to describe the Public Participation Process (PPP) undertaken to date and the way forward, and most importantly to assess the significance of the potential impacts that were identified during the Scoping Phase of the EIA process.

A suite of specialist studies were undertaken to better understand some of the potential impacts and to ensure a reasonable confidence in the assessment of significance. Outcomes of the EIA Phase would include:

- The identification of the environmentally preferred site for the proposed coal-fired power station;
- The identification of the environmentally preferred process and technology alternatives; and
- The identification of possible mitigation measures to reduce the significance of potential impacts.

[1] A separate EIA process will be undertaken for the transmission lines that will be required to feed electricity into the national electricity grid. With respect to fuel supply, an EIA is currently being undertaken for the coal mine proposed to supply the coal.

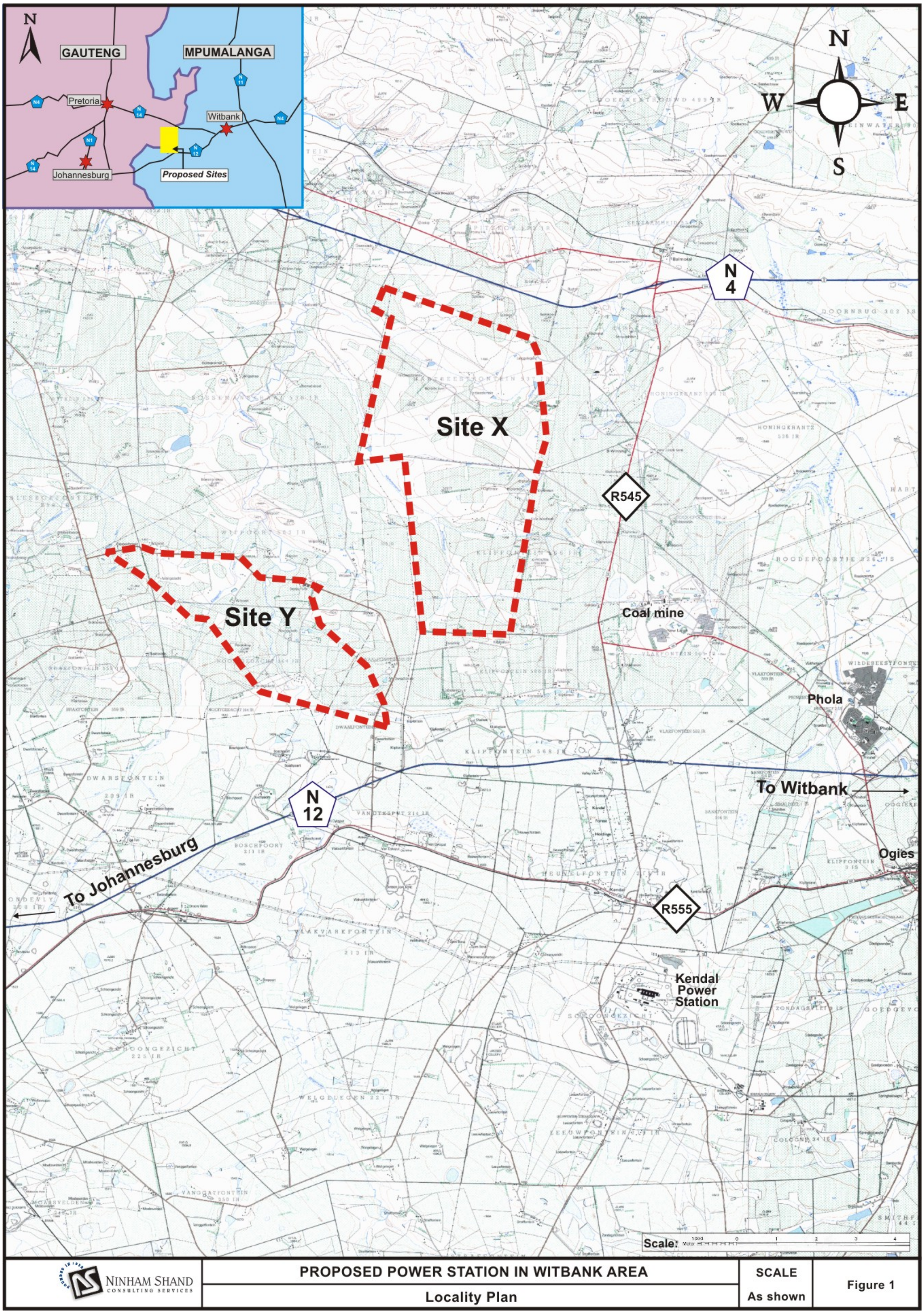

Figure 1.1: Map of the study area

The EIA Phase is the last phase in the EIA Process. Accordingly, this EIR aims to collate, synthesise and analyse information from a range of sources to provide sufficient information for DEAT to make an informed decision on whether or not the proposed power station is acceptable from an environmental perspective. Note that the term "environment" refers to biophysical, social and economic environments.

1.2 POLICY FRAMEWORK FOR THE PROPOSED PROJECT

Eskom is the primary supplier of electricity in South Africa, providing approximately 95% of the electricity consumed. The decision to expand Eskom's electricity generation capacity was based on national policy and informed by on-going strategic planning undertaken by the national Department of Minerals and Energy (DME), the National Energy Regulator of South Africa (NERSA) and Eskom. The hierarchy of policy and planning documentation that reflects this state of affairs is illustrated by **Figure 1.2** and described below.

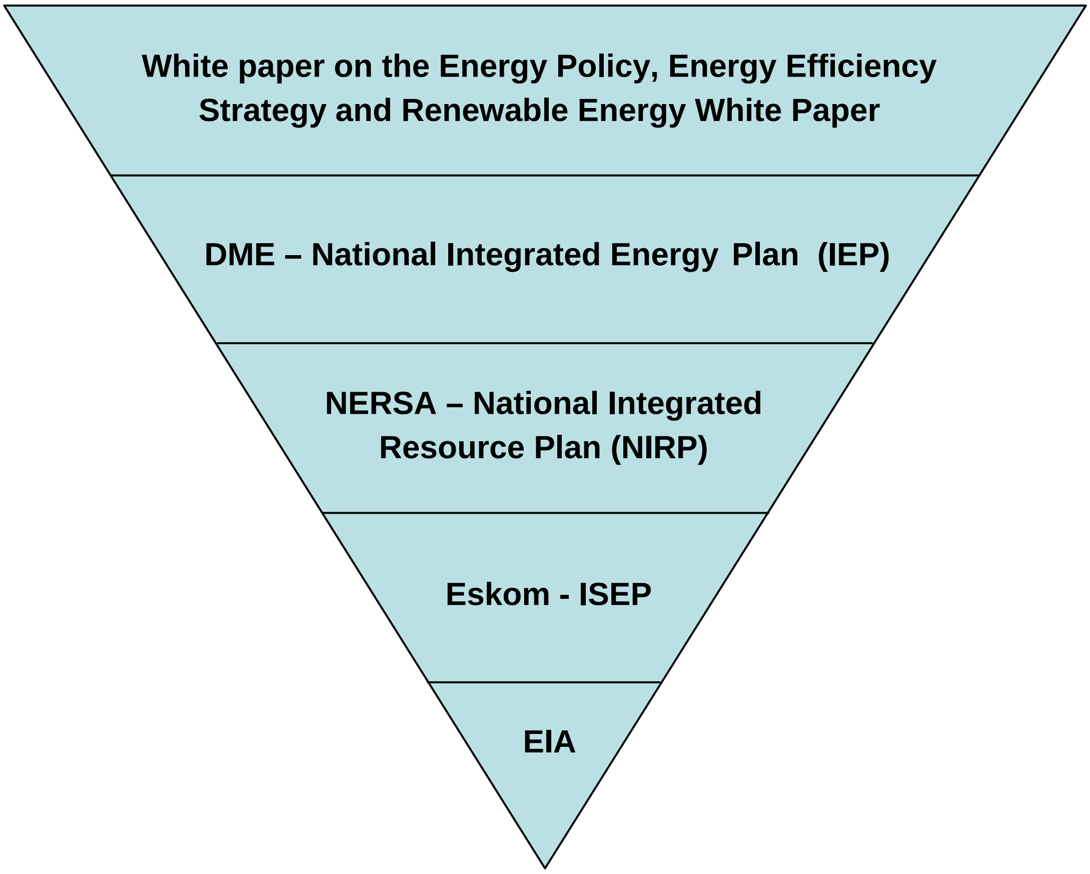

Figure 1.2: Hierarchy of policy and planning documents

1.2.1 White Paper on the Energy Policy of the Republic of South Africa – 1998

Development within the energy sector in South Africa is governed by the White Paper on the Energy Policy of the Republic of South Africa, published by DME in 1998. This White Paper sets out five objectives for the further development of the energy sector. The five objectives are as follows:

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

Furthermore, the Energy Policy identified the need to undertake an Integrated Energy Planning (IEP) process in order to achieve a balance between the energy demand and resource availability, whilst taking into account the health, safety and environmental[2] parameters. In addition, the policy identified the need for the adoption of a National Integrated Resource Planning (NIRP) approach to provide a long-term cost-effective resource plan for meeting electricity demand, which is consistent with reliable electricity supply and environmental, social and economic policies. The Energy Efficiency Strategy of the Republic of South Africa is a document geared towards the development and implementation of energy efficiency practices in South Africa. It gets its mandate from the White Paper, and links energy sector development with national socio-economic development plans. The White Paper on Renewable Energy sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa.

1.2.2 Integrated Energy Plan (IEP) – 2003

DME commissioned the IEP to provide a framework in which specific energy policies, development decisions and energy supply trade-offs can be made on a project-by-project basis. The framework is intended to create a balance in providing low cost electricity for social and economic development, ensuring security of supply and minimising the associated environmental impacts.

The IEP projected that the additional demand in electricity would necessitate an increase in electricity generation capacity in South Africa by 2007. Furthermore, the IEP concluded that, based on energy resources available in South Africa, coal would be the primary fuel source in the planning horizon, which was specified as the years 2000 to 2020 *i.e*. a 20 year planning horizon.

1.2.3 National Integrated Resource Plan (NIRP) – 2003/2004

In response to the White Paper's objective relating to affordable energy services, the National Electricity Regulator (now NERSA) commissioned a NIRP. The objective of the NIRP is to

[2] Environmental parameters include economic and social aspects.

determine the least-cost supply option for the country, provide information on the opportunities for investment into new power stations and evaluate the security of supply.

The national electricity demand forecast took a number of factors into account. They were:

- A 2.8% average annual economic growth;
- The development and expansion of a number of large energy-intensive industrial projects;
- Electrification needs;
- A reduction in electricity-intensive industries over the 20 year planning horizon;
- A reduction in electricity consumers – NIRP anticipates people switching to the direct use of natural gas;
- The supply of electricity to large mining and industrial projects in Namibia and Mozambique; and
- Typical demand profiles.

The outcome of the NIRP determined that while coal would remain the major fuel for generating electricity over the next 20 years, additional energy generation facilities would be required by 2007.

1.2.4 Integrated Strategic Electricity Planning (ISEP) – 2005

Eskom applies an Integrated Strategic Electricity Planning (ISEP) process to identify long-term options regarding both the supply and demand sides of electricity provision in South Africa. The most recently approved ISEP plan (October 2005) identifies the need for increased peaking[3] supply by about 2006/7 and base load[4] by about 2010. **Figure 1.3** below illustrates Eskom's "project funnel", which shows the range of supply options being considered by Eskom to meet the increasing demand for electricity in the country[5]. There are currently 40 projects in the project funnel ranging from research projects to those under construction. Research projects include a demonstration solar power project, underground coal gasification and the pebble bed modular reactor. Three 'mothballed' power stations, viz. the Camden, Komati and Grootvlei, are currently being returned-to-service, two open cycle gas turbines are being constructed in the Western Cape and a pumped storage scheme is being constructed on the border of Kwa-Zulu Natal and the Free State. These are all therefore reflected in the 'build' portion of the funnel diagram. Projects which are currently being investigated include a combined cycle gas turbine at Coega and a wind energy facility in the Western Cape.

In addition, three new coal-fired power stations are being considered; in the Witbank, Lephalale and northern Free State areas. These three new power stations are not alternatives. Should the relevant authorisations be obtained, all three power stations are likely to be constructed in order to meet future electricity demand. The proposed power station in the Witbank area forms the subject of this EIA process.

[3] Peaking refers to the periods between 07:00 and 09:00 in the mornings and 18:00 and 20:00 in the evenings when electricity use is at its greatest.
[4] Base load refers to the electricity generated to meet the continuous need for electricity at any hour of the day or night.
[5] Please note that within each category (e.g. the "prefeasibility" category) of the funnel, the position of a project relative to other projects within that category is not an indication of its state of relative progress.

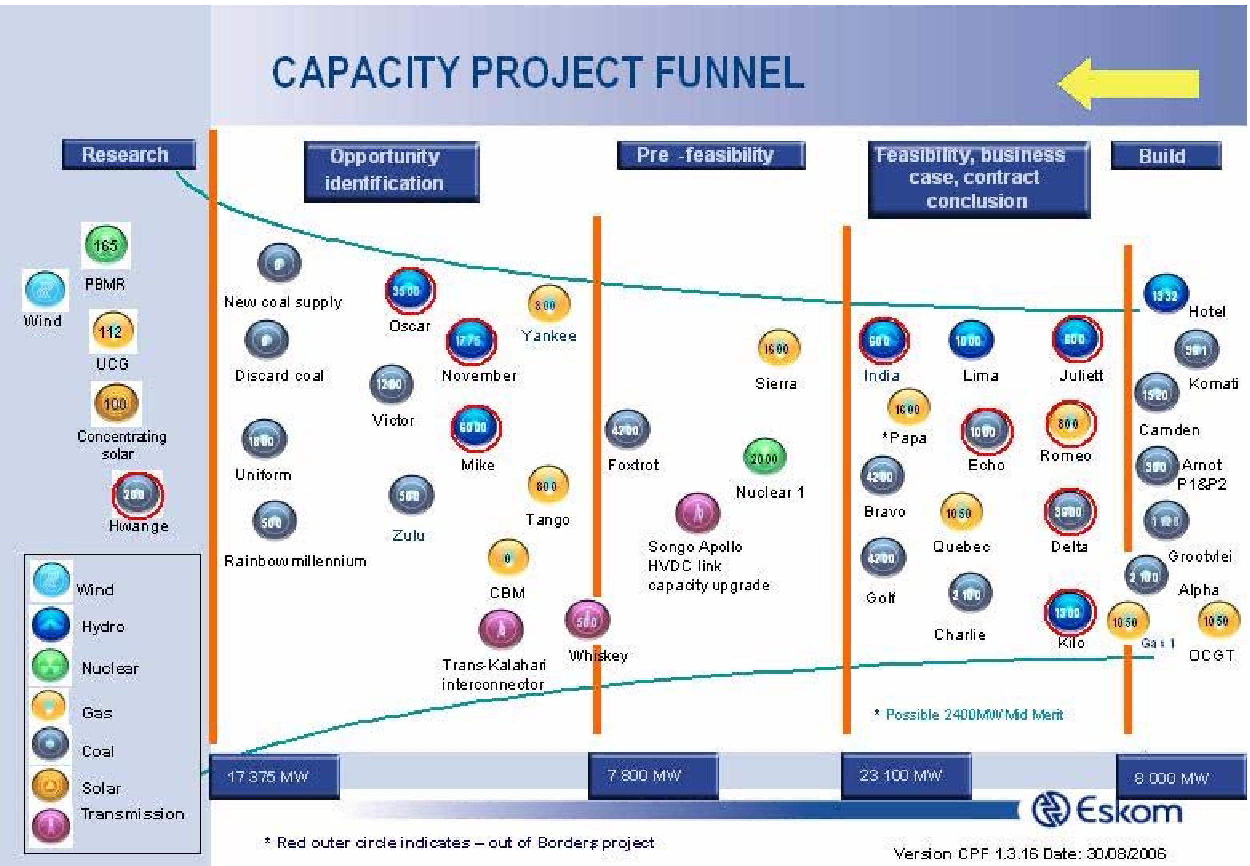

Figure 1.3: Eskom capacity generation programme – 'project funnel' [Note: this figure has been updated since the dEIR was published.]

The selection of the Witbank geographical area for the location of a new coal-fired power station was largely informed at a strategic level by the availability of coal to supply such a power station. From a technical and economic perspective, it is optimal to place a coal-fired power station as close to the coal source as possible. The main body of coal to be utilised by this project is located within an area some 25 km south west of Witbank and generally demarcated by the N4 highway to the north, the N12 highway to the south, and the site of the decommissioned Wilge Power Station on the east. The westerly boundary is generally close to the R545 road or some distance (approximately one kilometre) west thereof.

1.2.5 Site Selection

The Site Selection Report documents the site selection process that was undertaken, including the methodology followed and the results of the selection process. A summary of the site selection process is provided below. Refer to Annexure A of the Final Scoping Report for the full Site Selection Report.

Initially, nine potential sites in the Witbank geographical area were identified. After a preliminary screening, this was reduced to eight potential sites (Sites 2 to 9). These eight sites were inspected (by air and on the ground) and then evaluated by means of an Analytical Hierarchy Process (AHP) Pairwise Comparison Model, which is a multi-criteria decision analysis tool. A workshop was held with a suite of specialists[6] from Eskom and the EIA team in attendance. The purpose of the workshop was to rate the eight candidate sites according to six criteria, in order to derive a priority ranking of the sites. The six criteria used to rate each site against each other site were as follows:

- Operational logistics – distance from coal, reliability of supply;
- Land use – current use, future use, existing infrastructure, tourism potential;
- Geology/ Geomorphology – topography, founding conditions, groundwater contamination potential;
- Ecology – indigenous terrestrial and aquatic habitat;
- Local air quality – proximity and vulnerability of potentially affected communities; and
- Socio-economics – social issues, job creation, tourism, safety and security, aesthetics.

Workshop participants also assigned relative weights to each of the six criteria, in order to rank the candidate sites.

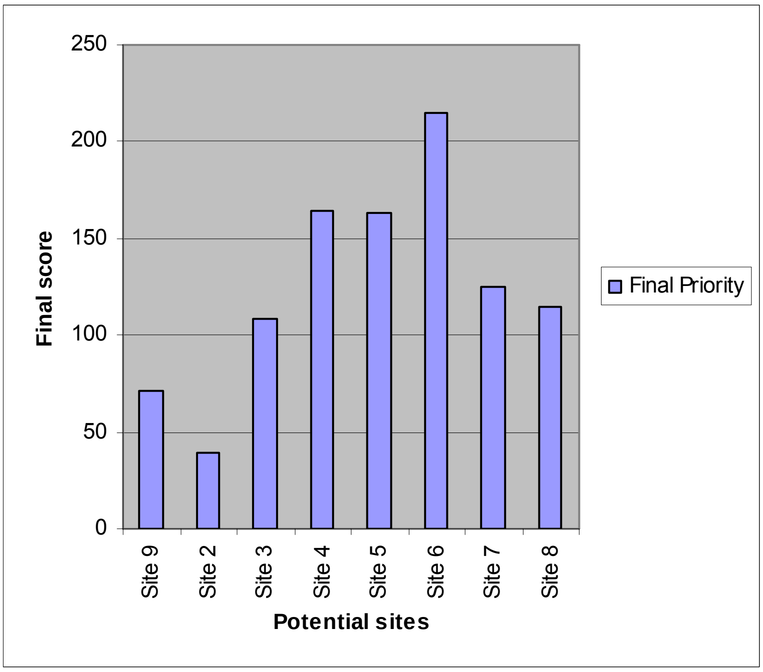

Figure 1.4: Graph of the final prioritisation of potential sites

Figure 1.4 is a graphic presentation of the relative ranking of each site. As can be seen Sites 4, 5 and 6 scored the highest. Based on the findings of the site selection process, it was decided to take two sites into the EIA phase. As Sites 4 and 5 received similar rankings, and are immediately adjacent to each other, it was considered prudent to merge Sites 4 and 5 into a single site. Therefore the two sites that were eventually selected for detailed investigation

[6] Specialists in attendance at the workshop included: Johan Dempers, Suren Rajaruthnam, Bruce Stroud, Alwyn van der Merwe, Tyrone Singleton, Nico Gewers, Tobile Bokwe, Kubentheran Nair, all of Eskom, and Mark Stewart, Johan du Preez, Johan Rall, Yvonne Scorgie, Mader van der Berg, Johnny van Schalkwyk, Elena Broughton, Andries Jordaan, Judy Johnstone, Mike Luger and Brett Lawson of the EIA Team.

during the EIA phase were a combined Site 4 and 5, as well as Site 6, hereinafter referred to as Site X and Site Y respectively (refer to **Figure 1.1**).

1.3 LEGAL CONTEXT

There are three key pieces of legislation that underpin this EIR. They are as follows:

1.3.1 The Constitution of South Africa

Section 24 of the Constitution of South Africa (No. 108 of 1996) states that "…everyone has the right - (a) to an environment that is not harmful to their health or well-being; and (b) to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that …(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in the National Environmental Management Act (No 107 of 1998) and given further expression.

1.3.2 The Environment Conservation Act

Section 21 of the Environment Conservation Act (No. 73 of 1989), per Government Notice R1182 of September 1997, as amended, contains a schedule of activities that may have a substantial detrimental effect on the environment and which require authorisation from the competent environmental authority. The nature of the proposed development includes activities listed in this schedule. The primary scheduled activity for this proposed project is:

1 a) "*The construction, erection and upgrading of facilities for commercial electricity generation with an output of at least 10 megawatts and infrastructure for bulk supply*".

The proposed project may entail various other activities that would also be construed as scheduled activities in terms of Regulation 1182 and thus require authorisation. These include:

1. *"The construction, erection or upgrading of-*
    - *c) with regard to any substance which is dangerous or hazardous and is controlled by national legislation-*
        - *i) infrastructure for the transportation of any such substance; and*
        - *ii) manufacturing, storage, handling, treatment or processing facilities for any such substance;*
    - *d) roads, railways, airfields and associated structures;*
    - *g) structures associated with communication networks, including masts, towers and reflector dishes;*
    - *i) "canals and channels, including structures causing disturbance to the flow of water in a river bed, and water transfer schemes between water catchments and impoundments".*
    - *l) schemes for the abstraction or utilisation of ground or surface water for bulk supply purposes;*

n) sewerage treatment plants and associated infrastructure."

2. "*The change of land use from-*

   c) agricultural or zoned undetermined use or an equivalent zoning to any other land use."

8. *"The disposal of waste as defined in Section 20 of the Act…"*
9. *"Scheduled processes listed in the Second Schedule of the Atmospheric Pollution Prevention Act."*

Accordingly, the proposed power station and associated infrastructure require authorisation from the competent environmental authority based on the findings of the EIA process as described in Regulation 1183. Given that Eskom is a State Owned Enterprise, the relevant provincial environmental department(s) are required in terms of Regulation 1183 to refer the application to the national department, i.e. DEAT. Hence, DEAT is the competent authority for this EIA process.

1.3.3 The National Environmental Management Act

The National Environmental Management Act (No. 107 of 1998) states that the principles of Integrated Environmental Management (IEM) should be adhered to in order to ensure sustainable development. A vital underpinning of the IEM procedure is accountability to the various parties that may be interested in or affected by a proposed development. Public participation is a requirement of the IEM procedure, in terms of the identification of potentially significant environmental impacts during the Scoping Phase. The IEM procedure aims to ensure that the environmental consequences of development proposals are understood and adequately considered during all stages of the project cycle, and that negative aspects are resolved or mitigated and positive aspects enhanced.

Section 2 sets out the National Environmental Management Principles, which apply to all development proponents, including organs of state, where there may be significant affects on the environment. Furthermore, Section 28(1) states that "every person who causes 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". If such pollution cannot be prevented then appropriate measures must be taken to minimise or rectify such pollution. Eskom therefore has the responsibility to ensure that the proposed activity as well as the EIA process conforms to the principles of the National Environmental Management Act. In developing the EIA process, Ninham Shand has been cognisant of this need, and accordingly the EIA process undertaken here has been informed by the underlying National Environmental Management Act principles.

The NEMA EIA regulations, which replaced the ECA EIA regulations, have been promulgated and came into effect on 3 July 2006. However, according to Section 84 (1) of the transitional provisions of the Regulations, this EIA process, having commenced in terms of the ECA, will be dealt with entirely under that legislation.

1.3.4 Legal requirements in terms of other Acts

In addition to the ECA and NEMA, the following Acts have some bearing on the proposed activities:

- **The National Heritage Resources Act** (No. 25 of 1999): The proposed power station and associated infrastructure comprises certain activities (e.g. changing the nature of a site exceeding 5 000 m^2 and linear developments in excess of 300m) that require authorisation in terms of this Section 38(1) of the Act. Section 38(8) of the Act states that if heritage considerations are taken into account as part of an application process undertaken in terms of the ECA, there is no need to undertake a separate application in terms of the National Heritage Resources Act. The requirements of the National Heritage Resources Act have thus been addressed as an element of the EIA process, specifically by the inclusion of a Heritage Assessment. The Gauteng and Mpumalanga Heritage Resource Agencies have been provided with all relevant documentation, since they have a statutory role to play in the decision-making process, acting as commenting authorities. Their comments have been elicited (see **Annexure R**) and will be considered by DEAT in their decision making and are likely to become conditions in the Record of Decision issued by DEAT, if the project is authorised.

- **The National Water Act** (No. 36 of 1998): Sections 21 and 22 of the Act stipulate the water uses that must be licensed, unless considered a permissible use in terms of Schedule 1 or in terms of a General Authorisation. The relevant applications will be submitted by Eskom. However, as part of the EIA process, comments have been sought from the Department of Water Affairs and Forestry (see **Annexure R**), and these are being provided to DEAT to consider during their decision-making process[7].

- **The Minerals and Petroleum Resources Development Act** (No. 28 of 2002): In terms of the Act, the sourcing of material for road construction purposes (i.e. the use of borrow pits) is regarded as mining and accordingly is subject to the requirements of the Act. In terms of the current project, Section 106(3) provides exemption from the Act, if the landowner or lawful occupier is utilising the material to affect changes on the property, and is not selling the material. Comment has been sought from the Department of Minerals and Energy (see **Annexure R**), and these are being provided to DEAT to consider during their decision-making process. Any further authorisations required in terms of this Act are outside of the scope of the current EIA process, and would be undertaken at a later stage, if required.

- **The Air Pollution Prevention Act** (No. 45 of 1965): In terms of the Act, power generation processes, including the combustion of fuel for the generation of electricity for distribution to the public, are classified as Scheduled Processes, requiring a registration certificate or permit from the Department of Environmental Affairs and Tourism: Chief Air Pollution Control Officer. This Act is however scheduled to be repealed shortly, and will be replaced by the National Environmental Management: Air Quality Act.

[7] Note, however, that although comment has been received from their Resource Planning division, comment is still outstanding from their regional office. Considerable effort has been made in eliciting this comment but staff changes and difficulties with accessing documentation has proved challenging.

- **National Environmental Management: Air Quality Act** (No. 39 of 2004): The Act seeks to repeal the Atmospheric Pollution Prevention Act in its entirety. Certain sections of the Act came into force in September 2005. It aims to reform current air quality law and provide national standards regulating the monitoring, management and control of air quality, while at the same time promoting justifiable economic and social development. The Act requires that Eskom applies for an atmospheric emissions licence. However, in the transition period before this Act is completely enacted, Eskom needs to apply for a registration certificate in terms of the Air Pollution Prevention Act.

- **Development Facilitation Act** (No. 67 of 1995): The DFA is the flagship statute which sets the overall framework and administrative structures for planning throughout the country. It is a framework Act with broadly worded provisions to allow individual provinces to enact more detailed planning laws and regulations to meet their own specific needs and circumstances. The DFA and its provincial equivalent may be relevant should Eskom require a rezoning of the land from agricultural to industrial zoning.

- **Expropriation Act** (No. 63 of 1975): Should Eskom decide to construct the proposed power station and associated infrastructure, they will need to acquire the requisite land. Eskom has a policy of "willing buyer, willing seller", and therefore endeavours to purchase land where ever possible. However, the State and State-owned-enterprises can acquire the rights to use or possess the requisite land through the Expropriation Act. The Act requires the determination of compensation based on the principle of market value (i.e. what would the value be in the event of both a willing buyer and a willing seller trading the land). There is a suite of additional legislation, which, in conjunction with the Expropriation Act, would be used to determine the compensation value.

1.3.5 The Kyoto Protocol

The United Nations Framework Convention on Climate Change (UNFCCC) and the subsequent Kyoto Protocol is an attempt to initiate a process to develop a more specific and binding agreement on the reduction of greenhouse gas emissions in an attempt to address the cause of global warming. South Africa ratified the Convention on 29 August 1997 and the Kyoto Protocol was adopted at a Conference of the Parties to the UNFCCC in Kyoto, Japan in December 1997. The conference resulted in a consensus decision to adopt a protocol under which industrialised countries (Annex 1 parties) will reduce their combined greenhouses gas emissions by at least 5% compared to 1990 levels in the period 2008 to 2012. South Africa, being a developing country (non-Annex 1 party) does not have to make any comparable greenhouse gas emission reductions.

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

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

1.4 THE EIA PROCESS TO DATE

The EIA process is illustrated in **Figure 1.5** below. As can be seen, the Application Phase and Scoping Phase have been completed and the EIA Phase is being rounded off. To date, the EIA process has included the following tasks:

- Submission of an application form to the Mpumalanga Provincial Department of Agriculture and Land Affairs (MDALA)[8] and to DEAT. This represented the formal initiation of the EIA process;
- Submission of a Plan of Study for Scoping (PoSS) to DEAT;
- Distribution of Background Information Documents (BIDs) to notify potential Interested and Affected Parties (I&APs) of the initiation of this EIA process;
- Placing adverts in national, regional and local newspapers notifying the broader public of the initiation of the EIA and inviting people to register as I&APs;
- Meeting with key stakeholders (affected landowners, government authorities and NGOs);
- Compilation and subsequent lodging of the Draft Scoping Report in the public domain (various public libraries, local municipal offices and on the Eskom and Ninham Shand websites);
- Hosting a series of Open Houses and Public Meetings where the Draft Scoping Report was presented to I&APs and where comments were elicited;
- Compilation of an Issues Trail that recorded all comments, questions and issues raised and the provision of a response to each question raised;
- Finalisation of the Scoping Report in light of I&AP comment (see Issues Trail 2 in Annexure U of the Final Scoping Report) and submission to DEAT;
- Lodging the Final Scoping Report in the public domain and notifying registered I&APs of its availability;
- Compilation and subsequent lodging of the Draft Environmental Impact Assessment Report (dEIR) in the public domain (various public libraries, local municipal offices and on the Eskom and Ninham Shand websites);

[8] Site Y, part of which is located in the Gauteng Province, was identified and included in the process during the Scoping Phase. The Gauteng Department of Agriculture, Conservation and Environment were subsequently introduced to the project and provided with an opportunity to engage with the consultants and DEAT. DEAT is now working closely with both GDACE and MDALA to review and comment on project documentation and issue a Record of Decision.

- Hosting a series of Open Houses and Public Meetings where the dEIR was presented to I&APs and where comments were elicited;
- Holding a focus group meeting with certain neighbouring landowners and hosting meetings with commenting authorities to elicit their responses to the dEIR;
- Compilation of Issues Trail 3 (see **Annexure D**) that recorded all comments, questions and issues raised between the finalisation of the Scoping Report and the release of the dEIR, and the provision of a response to each question raised;
- Finalisation of the EIR in light of I&AP comment (see Issues Trail 4 in **Annexure U**) and submission to DEAT; and
- Lodging this fEIR in the public domain and notifying registered I&APs of its availability.

The Final Scoping Report outlined the full range of potential environmental impacts and feasible project alternatives and how these were derived. Moreover, it included a Plan of Study for EIA, which outlined the proposed approach to the Environmental Impact Assessment (EIA) phase.

The aforementioned documents were submitted to DEAT, who subsequently ratified the proposed approach to the EIA phase by approving the Plan of Study for EIA in a letter dated 14 December 2006 (refer to **Annexure A**).

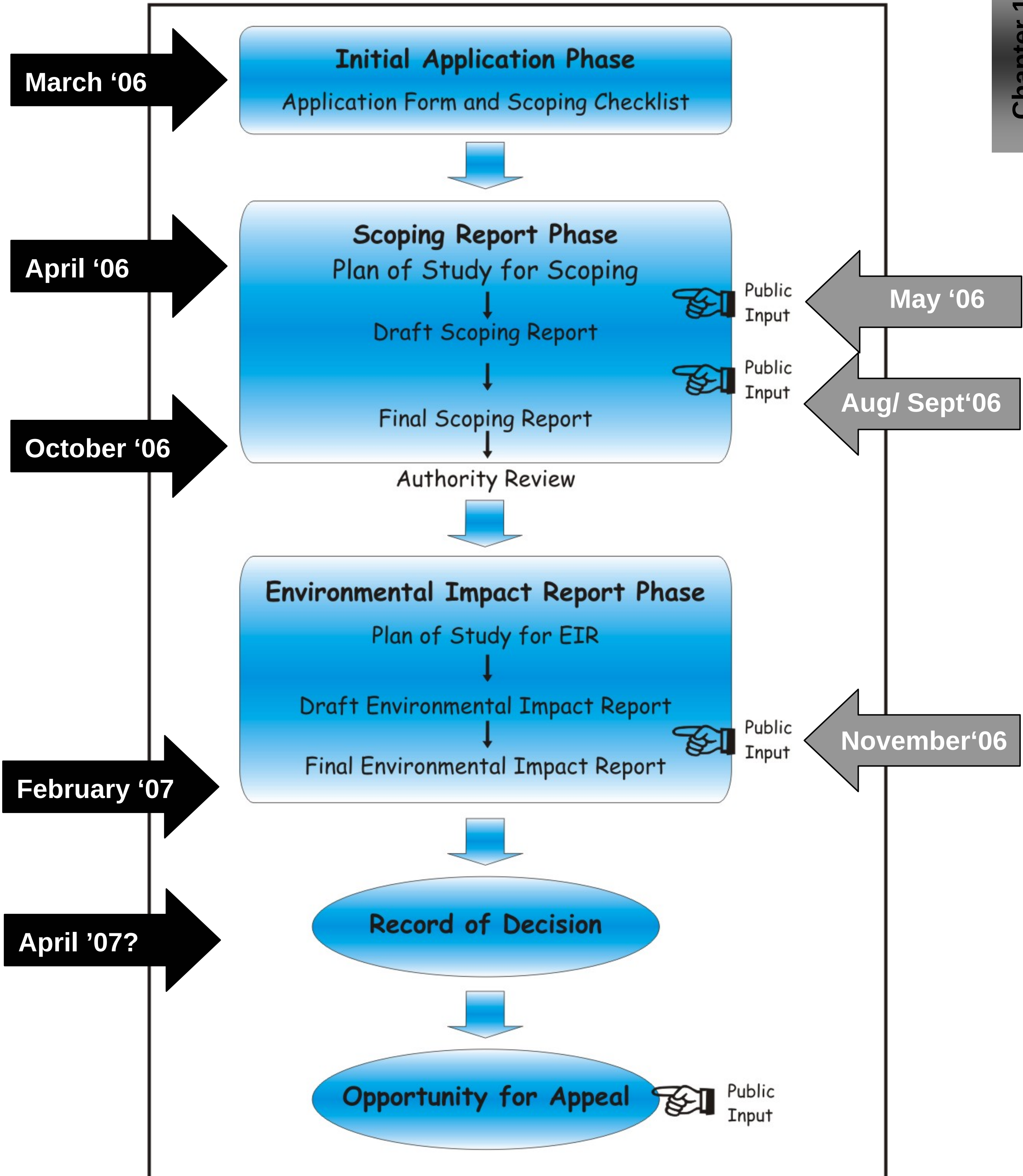

Figure 1.5: Environmental Impact Assessment Process

1.5 ASSUMPTIONS AND LIMITATIONS

1.5.1 Assumptions and study boundaries

In undertaking this investigation and compiling the Environmental Impact Report, the following has been assumed:

- This EIA process is limited to the assessment of the proposed power station and associated infrastructure, as defined in Chapter 2 of this report.
- This EIA process is being undertaken in terms of the Environment Conservation Act (No.73 of 1989), but will satisfy the principles of NEMA.
- This EIA process specifically excludes the coal mining activities, transmission lines from the power station to the national grid and the sorbert mining activities.

1.5.2 Limitations / gaps in knowledge

In undertaking the Environmental Impact Report phase of this EIA process, the EIA team utilised information available to it at the time of the study. Eskom is undertaking further work and investigations in parallel with this EIA process. While this approach is desirable from an environmental perspective, as it allows the findings of the environmental investigations to direct and influence the proposed development, it means that the level of project detail is of necessity less certain. Consequently, this fEIR has assessed the potential environmental impacts associated with the proposed activities as presently understood. The nature and significance of the impacts presented in the dEIR have not changed substantially and Ninham Shand are satisfied that accountable environmental decisions can be made on the basis of this report.

1.6 APPROACH TO THE EIA PHASE

1.6.1 The EIA Phase

As outlined in the Scoping Report, there are three distinct phases in the EIA process, as required in terms of the Environment Conservation Act, namely the Initial Application, the Scoping Report and the EIA phases. **Figure 1.5** above summarises the process followed. This Report covers the final phase, viz. the EIA phase.

The purpose of the EIR is to describe and assess the range of feasible alternatives identified during the Scoping process in terms of the potential environmental impacts identified. The ultimate purpose of the EIR is to provide a basis for informed decision, firstly by the proponent with respect to the option they wish to pursue, and secondly by the environmental authority regarding the environmental acceptability of the proponents' preferred option.

The approach to the EIR phase entailed the following:

- Undertaking further review of relevant literature;

- Appointing various specialists to undertake the specialist studies identified during the Scoping phase, namely:
  - Geotechnical study undertake by Ninham Shand;
  - Traffic study undertaken by Ninham Shand;
  - Air quality assessment undertaken by Airshed Planning Professionals;
  - Visual impact assessment undertaken by Strategic Environmental Focus;
  - Noise impact assessment undertaken by Jongens Keet Associates;
  - Terrestrial ecology assessment undertaken Makecha Development Associates;
  - Aquatic ecosystem assessment undertaken by EcoSun;
  - Groundwater assessment undertaken by Groundwater Consulting Services;
  - Social risk / Vulnerability study undertaken by Riscom;
  - Heritage assessment undertaken by the Northern Flagship Institute;
  - Agricultural potential assessment undertaken by the University of the Free State;
  - Socio-economic assessment undertaken by Urban Econ; and
  - Planning study undertaken by Seaton Thomson & Associates.

The results of these studies have been used to describe and assess the significance of the identified potential impacts associated with the proposed power station and associated infrastructure. This EIR synthesises the key issues arising out of the specialist studies and the Public Participation Process to date, to provide a balanced view of the proposed activity and its implications for the environment.

As discussed in the Scoping Report, the EIA process as well as the reporting has been reviewed by an independent review consultant to ensure that it accords with local and international best practice. The review of the dEIR is presented in this final version in **Annexure S**.

1.6.2 Authority involvement

As indicated earlier, DEAT will fulfil the role of the competent environmental authority and make a decision in light of the information presented in this fEIR. However, given that the sites are located in both the Gauteng and Mpumalanga provinces, DEAT has worked closely with the relevant provincial environmental authorities / departments in the decision-making process.

There are other authorities who have a commenting role to play in the EIA process. Their comments on the EIR will help to inform DEAT's decision making. These authorities include *inter alia*:

- Department of Public Enterprises;
- Department of Minerals and Energy;
- South African Heritage Resources Agency (Mpumalanga and Gauteng provincial offices);
- Department of Water Affairs and Forestry;
- The Department of Environmental Affairs and Tourism: Directorate Air Quality Management and Climate Change;

- Gauteng Department of Agriculture, Conservation and Environment;
- Mpumalanga Department of Agriculture and Land Affairs;
- South African National Roads Agency Limited (SANRAL);
- Mpumalanga Department of Roads and Transport;
- Gauteng Department of Transport (GauTrans);
- Spoornet;
- Kungwini Local Municipality; and
- Delmas Local Municipality.

Comments from these authorities on the dEIR have been elicited as far as possible and the matter is reported on further in Section 6.3 below.

1.6.3 Decision making

Based on the information gathered during the EIA Phase (including the specialist studies, the impact assessment, and the public participation process) and on comments raised by other authorities, DEAT will issue a Record of Decision (ROD). The ROD will either authorise the proposed activity (with certain conditions) or reject the application for the proposed activity. In addition, DEAT has the prerogative to request further information should they believe that insufficient information has been provided on which to base an informed decision.

Following the issuing of the Record of Decision, DEAT's decision will be communicated by means of letters to all registered I&APs and there will be a 30-day appeal period within which I&APs will have an opportunity to appeal to the Minister of Environmental Affairs and Tourism in terms of the Environment Conservation Act.

1.7 CONTEXT AND STRUCTURE OF THIS REPORT

As outlined above, the environmental assessment process undertaken to date included the production of a comprehensive Scoping Report which provided detailed information relevant to the project. However, for the sake of being succinct, information contained within the Scoping Report is not repeated within this EIR unless it has direct bearing on the issues under discussion.

Accordingly, to ensure a holistic understanding of the project, the nature of the activities and the substance of the environmental process, it is critical that this EIR is read in conjunction with the Final Scoping Report (Ninham Shand, 2006).

The structure of this EIR has been informed by the DEAT Environmental Impact Reporting Guideline (DEAT, 2004) and the EIA Regulations Guideline Document (DEAT, 1998) to facilitate informed decision making by the proponent and the competent environmental authority. The EIR contains the following information:

- A description of the feasible alternatives and potential impacts identified during the Scoping Phase;
- A description and assessment of the potential impacts associated with the various feasible alternatives as well as an indication of potential mitigation measures;
- A conclusion and various recommendations with regard to the way forward; and
- A series of annexures containing relevant information, including the various specialist studies and details of the public participation process.

This EIR is structured as follows:

Chapter One	*Provides the introduction, policy and legislative framework and details of the EIA process*
Chapter Two	*Describes the project proposal, including alternatives and identified impacts*
Chapter Three	*Describes the public participation process*
Chapter Four	*Describes the assessment methodology*
Chapter Five	*Discusses and assesses the identified potential impacts and mitigation measures*
Chapter Six	*Concludes the report, describes the recommendations being made and provides a synopsis of the preferred alternative actions that Eskom is applying for authorisation of*

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2 DESCRIPTION OF THE PROJECT PROPOSAL, ALTERNATIVES AND POTENTIAL IMPACTS IDENTIFIED FOR DETAILED ASSESSMENT

The purpose of this chapter is to describe the proposed project, namely the power station itself, the ash handling, air emissions, coal supply, cooling systems, transmission substation and high voltage yard, water use, road access and storage tanks. The chapter then summarises the suite of alternatives that were proposed for further consideration in the Scoping Report.

2.1 INTRODUCTION

The project comprises the construction, commissioning and operation of a coal-fired power station and its associated infrastructure in the Witbank area. The power station itself would comprise six boiler/ turbine sets with a nominal electricity generation capacity of approximately 5 400 MW (900 MW per unit[9]). The project would include the following infrastructure:

Power Station Precinct:

- Power station buildings themselves;
- Administrative buildings (control buildings, medical, security etc.); and
- High voltage yard.

Associated Infrastructure:

- Coal stock yard;
- Coal and ash conveyors;
- Water supply pipelines (temporary and permanent);
- Electricity supply (temporary, during construction[10]);
- Water and wastewater treatment facilities;
- Ash disposal systems;
- Access roads (including haul roads);
- Dams for water storage; and
- Railway siding and/or line for sorbent supply.

The flow diagrams below (**Figures 2.1 and 2.2**) illustrate the process by which electricity is produced.

[9] The station capacity rating is dependant on the selected technology based on various Original Equipment Manufacturer (OEM) proposals, which would be acquired during the technical and commercial evaluation process.
[10] I.e. not for bulk supply.

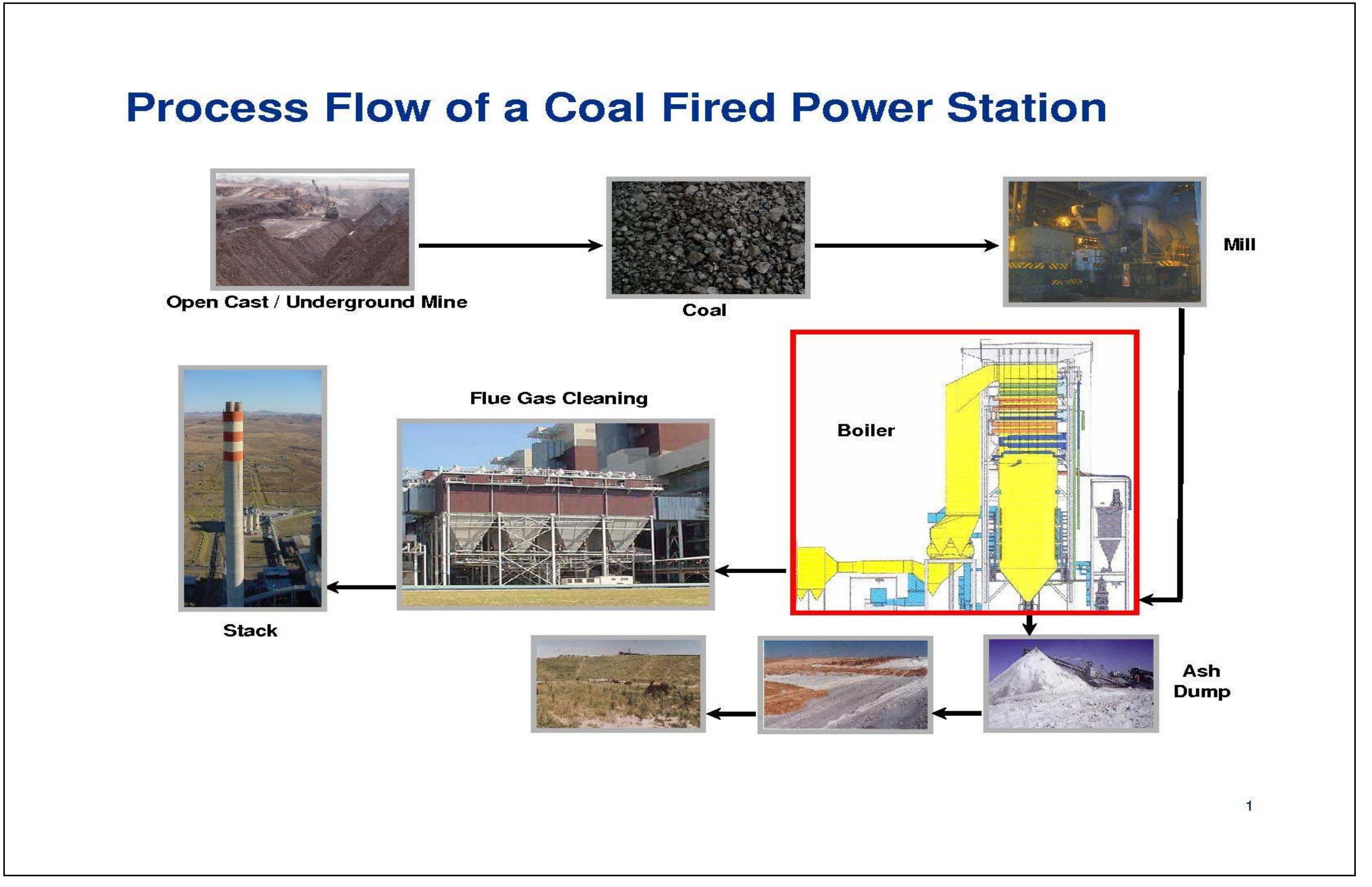


Figure 2.1: Process flow diagram of a typical coal fired power station

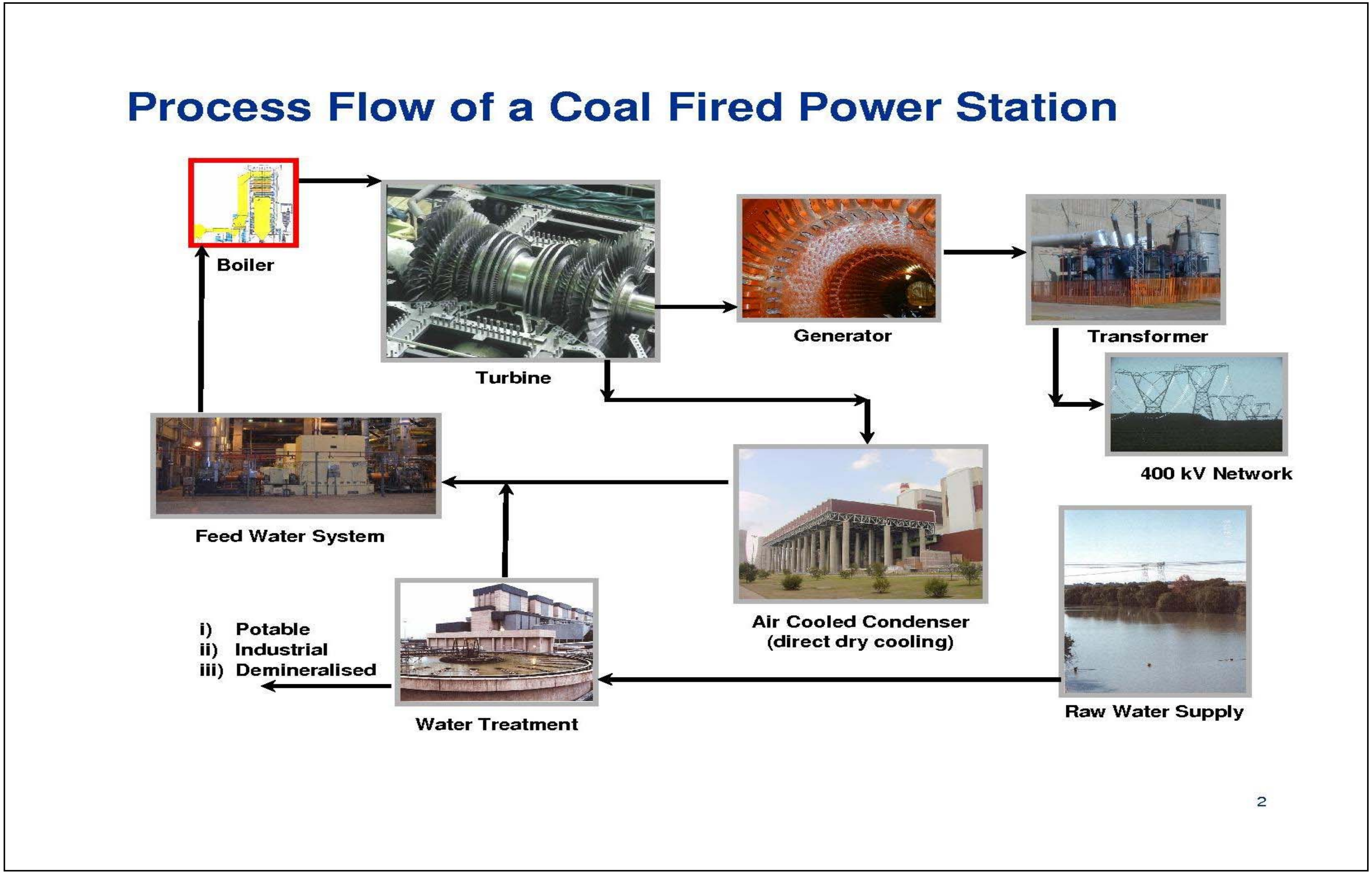


Figure 2.2: Process flow diagram of a typical coal fired power station (continued)

The power station would be fuelled by coal, supplied from a new colliery in the vicinity of the proposed power station. Coal would be transported via conveyor belts from the colliery to the coal stockyard, where it is stockpiled. The stockpile is typically divided into strategic, seasonal and live stockpile areas. Coal from the stockpile is then fed to the power station by means of a stacker/reclaimer and conveyor belts. The coal is pulverised in a milling plant to form 'pulverised fuel' and, with a combination of air, blown into the boiler where it is combusted.

Heat released from burning the pulverised fuel is used to heat water to produce steam within a network of boiler tubing. The final superheated steam exiting the boiler is used to drive turbines coupled to generators, which generate electricity through the use of electromagnets which spin within large copper coils. The generated electricity is then transformed from 22 kV to 400 kV and fed via the high-voltage yard into the transmission network. Once the steam's energy has been exhausted, it is condensed and the water is returned to the boiler to start the process again. The cooling system can use either wet or dry cooling, the dry cooling option being either direct or indirect.

The ash produced through the combustion of the coal is removed from the bottom of the boiler (boiler bottom ash) and fly ash is removed from the top of the boiler together with the flue gas (via electrostatic precipitators or bag filters) and sent to an ash-dumping facility.

Figure 2.3 below shows the layout of a typical coal-fired station and some of its ancillary infrastructure. The layout would be based on the technical and environmental constraints of the chosen site[11].

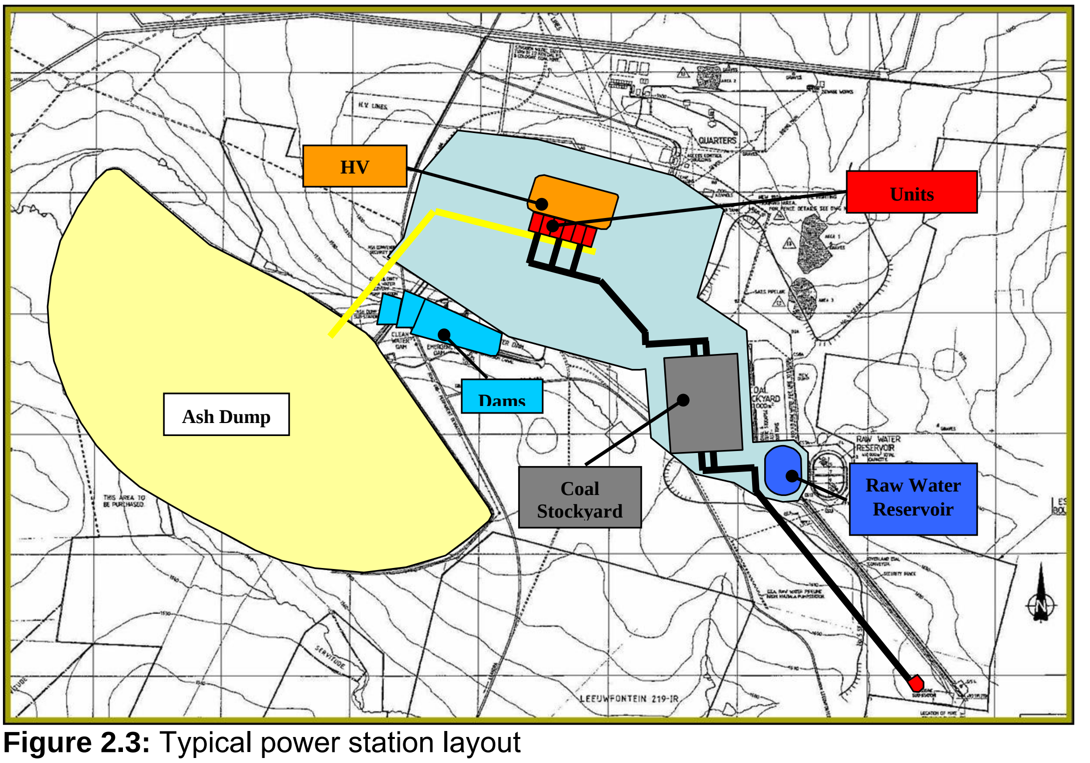


Figure 2.3: Typical power station layout

[11] The layout may be refined by the Technical Design Team at the detailed design phase, after the project has been authorised.

2.2 CONSIDERATION OF ALTERNATIVES

A requirement of Regulation 1183 of the Environment Conservation Act, as well as one of the principles of the National Environmental Management Act, is due consideration of reasonable alternatives. As outlined in the DEAT's "Guideline Document for the Implementation of Sections 21, 22 and 26 of the Environment Conservation Act" (1998), not all alternatives need to be investigated in the same detail. All potential alternatives were identified in the Scoping Report. These included activity alternatives, location alternatives and process alternatives.

The 'no-go' alternative is the option of not establishing a new coal-fired power station at a site in the Witbank geographical area. As described in detail in the Scoping Report, the electricity demand in South Africa is placing increasing demand on the country's existing power generation capacity. South Africa is expected to require additional baseload generating capacity by 2010 and beyond. The 'no-go' alternative is likely to result in these electricity requirements not being met, with concomitant potentially significant impacts from an economic and social perspective for South Africa. This alternative will not be explicitly assessed in this EIR, but it represents the baseline against which all of the potential impacts are assessed.

Once the need for a new coal-fired power station had been established, Eskom undertook a process to identify broad geographic regions within which to site a new power station. As mentioned above, three potential regions were identified for the development of new coal-fired power stations, the Witbank geographical region being one of those. As already mentioned, Eskom is pursing the establishment of new power stations in all three identified regions, and the scope of this EIA process is focused on the Witbank geographic region. With close input from Eskom, Ninham Shand undertook a process to define the boundaries of the Witbank geographical region, to delineate potential candidate sites in the Witbank geographical region, and then to screen the candidate sites. This resulted in two preferred sites being recommended for further detailed investigation during the EIA process (refer to **Figure 1.1** above). This process is described in detail in Annexure A of the Final Scoping Report. Location alternatives are therefore not considered in this assessment.

The purpose of this section of the report is thus to provide an overview of the alternatives identified for the proposed project which will be assessed in the Environmental Impact Report.

2.2.1 Process alternatives

a) Combustion technology alternatives

During the Scoping Phase, three combustion technology alternatives were considered; namely pulverised fuel combustion boiler, fluidised bed combustion (FBC) boiler and coal gasification technologies.

FBC boilers are only technologically proven for up to 400 MW capacity units, and are not technologically proven for 900 MW units as proposed for this power station. Furthermore coal gasification technology has been investigated at a pilot plant scale, but is not technologically proven for a 5400 MW power station. Consequently, pulverised fuel combustion was chosen as the alternative for further investigation.

As can be seen in **Figure 2.1** above, the coal would be transported to the coal stockyard from the mine, before being transported to the coal milling facility. At the mill, coal with a diameter of approximately 35 mm would be milled down into a fine dust (pulverised fuel) of 300 µm[12]. The fine coal dust would then be blown into the boiler and burnt. Each boiler unit typically has five mills, which each have an output of approximately 100 tonnes per hour.

b) Cooling technology alternatives

Three cooling technology alternatives were considered during the Scoping Phase, including wet cooling, indirect dry cooling and direct dry cooling. Given its greater consumption of water than the other technologies, wet cooling was not considered a viable alternative and was thus not assessed further in the EIR.

Indirect and direct dry cooling technology alternatives were chosen as the alternatives for further investigation.

Direct and indirect dry cooling utilise approximately 0.2 l per kWh sent out. A schematic of a direct dry cooling system is illustrated in **Figure 2.4**. Exhaust steam from the turbines flows to the dry cooling elements or heat exchanger. Heat from the steam is removed by air blown over the condenser by forced draught fans, causing the steam to condense to water. The condensate (water) is then pumped back to the boiler, for reuse in the process. Cooling occurs within the main water circuit, by means of the forced draught fans, and there is no need for cooling towers. Approximately 432 fans (~72 fans per generating unit) would be required for the proposed power station.

[12] 1 µm is equal to 0.001 mm

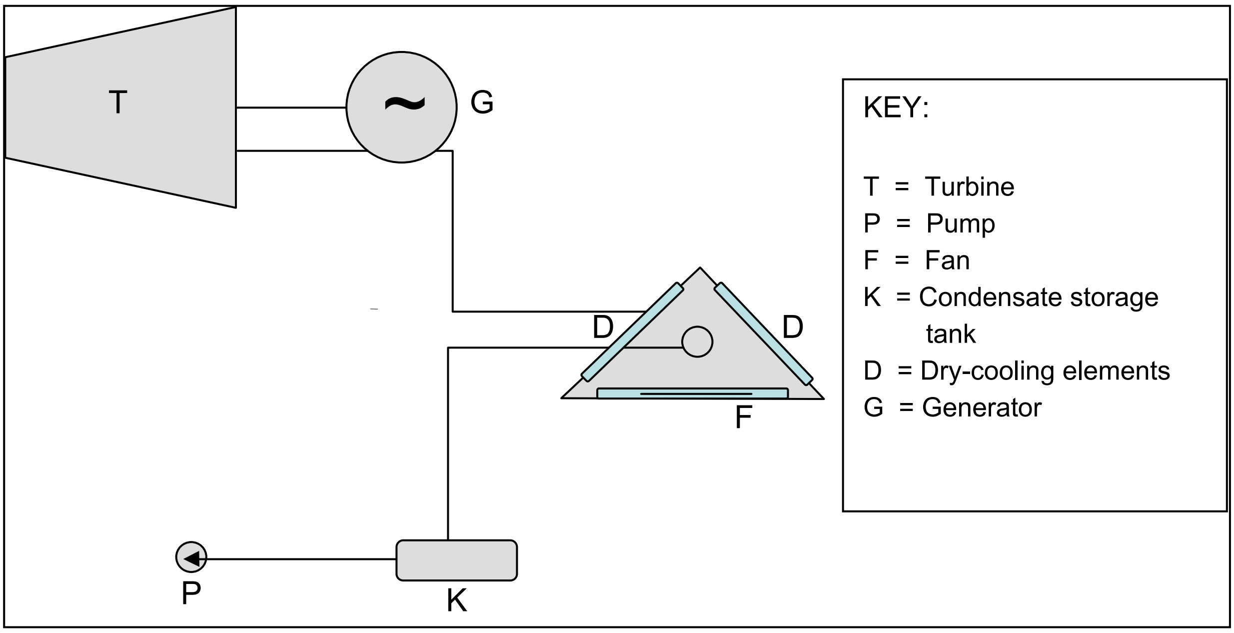


Figure 2.4: Direct dry cooling

Photo 2.1 Indirect dry cooled power station

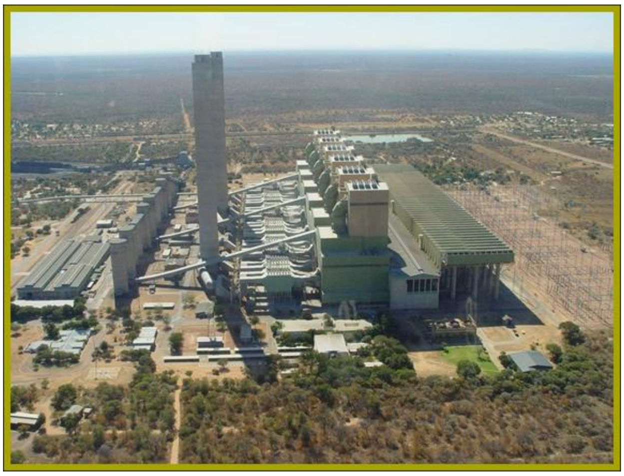


Photo 2.2 Direct dry-cooled power station

For an indirect dry cooling system (illustrated in **Figure 2.5**), cold water from cooling towers flows to the condenser tubes, where steam from the turbines pass over them. The steam is cooled and pumped back to the boilers while the resulting heated water is pumped back to the cooling towers. Heat exchangers inside natural draught cooling towers cool the heated water before it flows back to the condenser tubes. Cooling is achieved via a secondary circuit, resulting in the need for cooling towers.

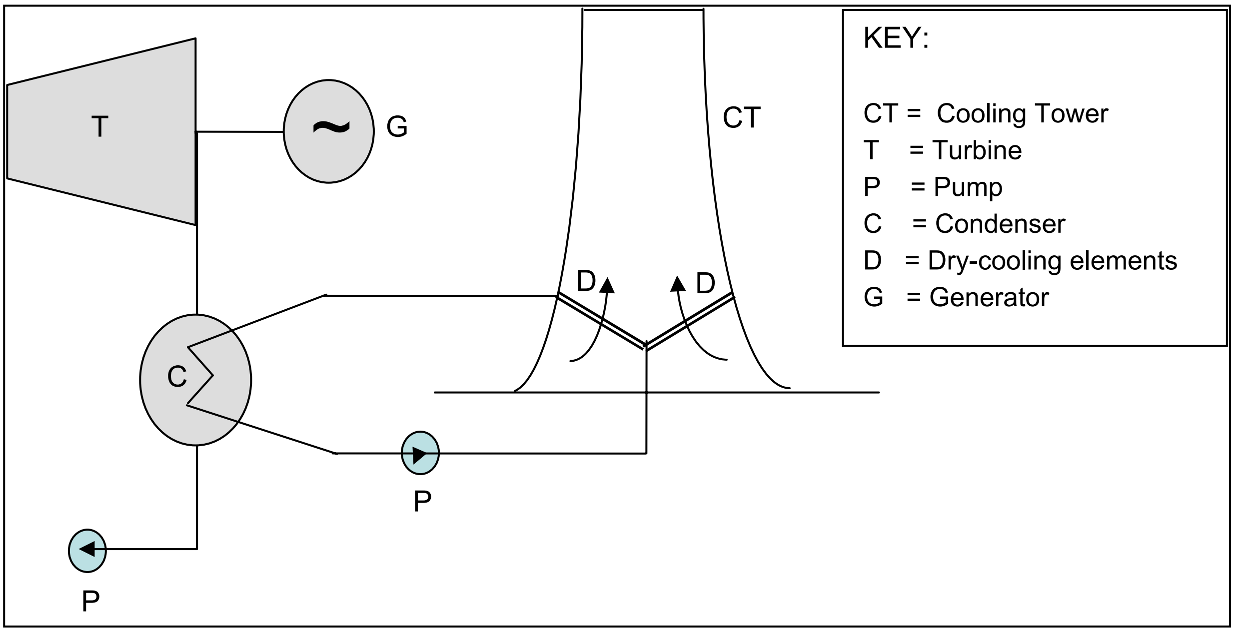


Figure 2.5: Indirect dry cooling

c) Atmospheric emission control technology alternatives

The minimisation of NO_X emissions to the atmosphere is by inherently designing the boilers for low NO_X production. This would be undertaken for the proposed project, and is not considered in any further detail.

The two main technologies available to remove the fly ash or particulate matter from flue gasses are electrostatic precipitators and fabric filter bags. Both these technologies are capable of achieving particulate matter emission reductions/ removal of approximately 99.8%. As the environmental consequences of these technologies do not differ substantively, these will not be investigated in any further detail in the EIA, as the decision of which option to choose is likely to be based on life-cycle costs (including capital and operational expenditure) and operational considerations.

The removal of sulphur dioxide (SO_2) is principally undertaken through flue gas desulphurisation (FGD). Two FGD technologies exist, namely wet FGD and semi-dry FGD. Since each technology has a different life-cycle cost and achieves a different level of SO_2 removal efficiency, both wet and semi-dry FGD were further investigated.

The wet FDG process uses either dolomite or limestone (uncalcined $CaCO_3$) as the sorbent. However, the semi-dry process utilises lime (calcined CaCO) as the sorbent.

Table 2.1 Likely sorbent quantities required

	Sorbent CaO %	Sorbent Consumption (Tons/Year)	Sorbent to coal mass ratio	% SO_2 Removal Req.	Water Req. (ℓ/kWh)
Wet FGD	46%	202 292	0.014	43.28 (WB)[13]	0.069
	46%	550 000	0.030	91.53 (EU)[14]	0.145
Semi- dry FGD	90%	191 910	0.013	43.28 (WB)	0.043
	90%	522 000	0.028	91.53 (EU)	0.091

As can be seen in the table above, approximately 550 000 tonnes per annum of sorbent would be required for the wet FGD process and 522 000 tonnes per annum would be required for the semi-dry FGD process. Assuming a 90% availability and 90% load factor, the wet FGD process would require approximately 5.5 Mm^3 per annum (consuming water at a rate of 0.145 ℓ/kWh produced). Similarly, the semi-dry FGD process would require approximately 3.4 Mm^3 per annum (consuming water at a rate of 0.091 ℓ/kWh produced). Given the findings of the air quality assessment, an SO_2 removal efficiency in excess of 90% is assumed to be the required level of abatement.

d) Ash disposal alternatives

Three types of ash disposal were investigated during the Scoping Phase, namely above-ground ashing, in-pit ashing and back-ashing. In-pit ashing and back-ashing require collaboration with an open cast mining house, in order for these alternatives to be feasible. Above ground ash disposal is the primary method of ash disposal that can be considered in this EIA process, as the other methods require collaboration between Eskom and the relevant mining house, and can not be agreed upon at this point. Consequently, in-pit and back-ashing will be considered in this EIA process at a conceptual level, and to compare these against above-ground ashing. Should Eskom wish to pursue either in-pit or back-ashing in the future, a separate process, including that for environmental authorisation, would have to be undertaken for this, at the time.

Above-ground ash dumping: is the process of disposing of ash by means of stacking and spreading on a piece of ground, so as to create an ash dump. The operational dump site would be continuously rehabilitated with topsoil and re-vegetated as it develops, until it reaches the end of its life. Approximately 1 000 ha of land would be required to accommodate an ash dump for the life of the coal fired power station i.e. 40 – 50 years.

Back ashing involves the dumping of ash over the mine discard i.e. the discard is first placed back into the pit, followed by the overburden and then the ash is dumped on top. Ash dumping occurs above ground, but back over the mined out, disturbed

[13] World Bank standards that require 43% reduction in SO_2 levels
[14] European Union standards, requiring 91% reduction in SO_2 levels

area. Rehabilitation occurs using topsoil, much the same as for above-ground ash disposal. .

In-pit ashing is the process whereby ash is placed directly into the coal mine pit (excavated area). This could be accomplished by either mixing the ash and the mine discard materials (overburden and intraburden) before backfilling into the pit or by backfilling into the pit in alternate layers of ash and mine discards. The layering option requires that the first layer of ash is backfilled on top of the discard above the natural water table level. In using the mixing methodology the ash fills in the voids in the mine discards and hence does not increase the overall volume. Hence, there is little disturbance to the above ground contours. The overburden and topsoil then completes the rehabilitation of the area.

As already mentioned, Eskom may investigate in-pit and back-ashing in the future, and this would be undertaken in conjunction with the relevant mining house.

Photo 4 Above-ground ash dump

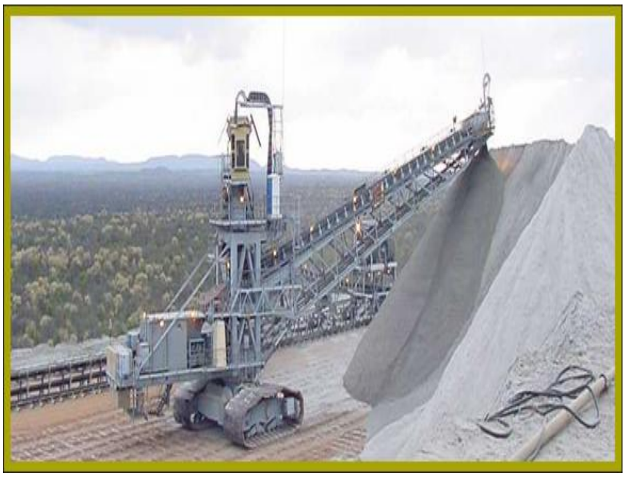


Photo 5 Ash being stacked

2.2.2 High level site layout alternatives

Figure 2.6 illustrates the broader site layout alternatives for assessment during the EIA. One layout alternative was considered for each site with respect to the power station precinct, coal stockyard and ash dump orientation. The power station, coal stockyard and ash dump footprints have been superimposed on Sites X and Y and it was these potential layouts that were assessed in the various specialist studies. **Figure 2.7** indicates the proposed water supply pipeline corridor from the existing Kendal power station as well as proposed corridors for the transport of sorbent by rail or haul road.

a) Coal conveyor alignment

Alternatives related to the sourcing and mining of coal do not form part of this EIA process. However, the alignment of the overland conveyor required to transport the coal from the coal source to the proposed power station will be assessed at a generic level in this EIA process. Alternatives with respect to the alignment of the conveyor belt would depend on the location of the coal source. The proposed corridor for the transport of coal to the alternative sites is indicated in **Figure 2.7**.

The proposed coal mine is the New Largo Number 4 Seam Working, located to the east of Site X. It is proposed that the coal conveyor would run in an east-west direction to the coal stockyards on either Site X or Site Y.

b) **Water supply pipeline**

Water supply to the area will be augmented via the Vaal River Eastern Sub-system Augmentation Project (VRESAP). Water supply to the proposed power station would be via a pipeline from the existing Kendal power station. Alternative alignments of the water supply pipeline, within a proposed corridor, are illustrated in **Figure 2.7**.

The water pipeline corridor is orientated in a south-east to north-west direction and crosses the N12 road in the vicinity of the D960 road interchange. After crossing the N12, it runs in a north-westerly direction to Site Y and a north-easterly direction to Site X.

c) **Railway lines**

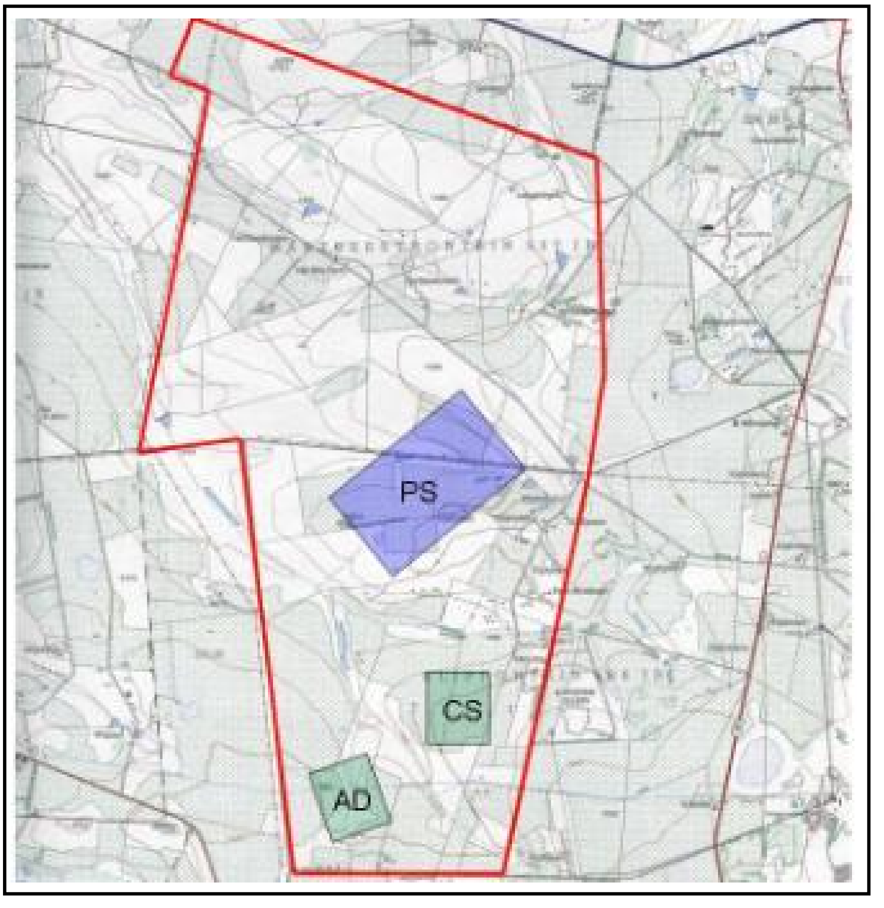
A railway line to supply sorbent to the power station would be required for implementation of FGD technology.. The sorbent could either be railed directly to site, or railed to an existing railway siding and trucked to site, using a dedicated haul road. The railway corridors are illustrated in **Figure 2.7**

Two alternative railway line routings are possible for Site X. The first alternative requires a spur railway line from the Kendal Station on the Johannesburg-Witbank main line across the N12 road in a northerly and westerly direction. The second alternative requires a new spur railway line from Crown Douglas siding on the Pretoria Witbank main line, in a southerly and easterly direction.

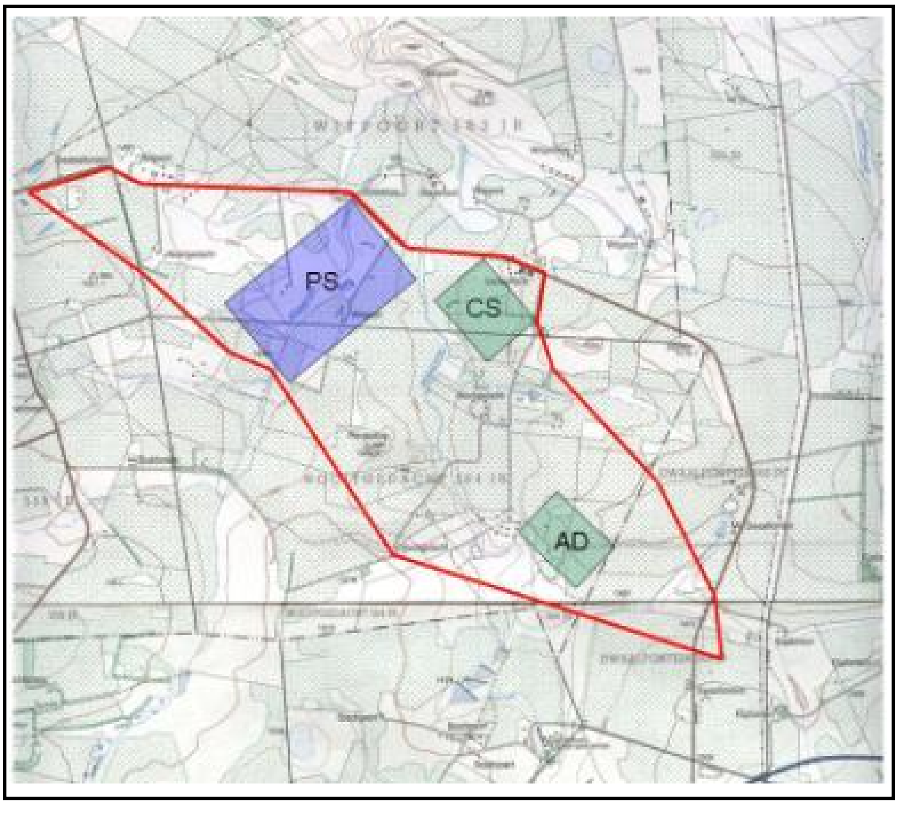
The railway route alternative to Site Y is very similar to the first alternative for Site X, starting at the Kendal Station, following a northerly and westerly alignment to Site Y.

d) **Road access**

There are existing access roads to both Site X and Y. However, new road alignments have been investigated for the access road from the existing road network to the actual site. Access to Site X would be by one of two access road alternatives; namely Option 1: a road linking south from the D2236 (in the vicinity of the Bossemankraal interchange on the N4 road) to the north western corner of the site, then following the site boundary, or Option 2: an access road from the D686 at the intersection with P104 road, to the north-eastern corner of the site. Access to Site Y would be by a similar option to Site X Option 1, but would extend further south to connect to Site Y. The traffic implications of access from the existing road networks are examined and assessed in the traffic specialist study (**Annexure N**) and presented in Chapter 5.



Site X



Site Y

Chapter 2

Figure 2.6: High level site layout for Sites X and Y, indicating the proposed layout of the power station precinct (PS), coal stock yard (CS) and ash dump (AD). Note that these have been further refined. See Section 6.2.2 below.

Figure 2.7: Conceptual layout of linear infrastructure, including conveyors, roads and pipelines

2.3 POTENTIAL IMPACTS IDENTIFIED DURING THE SCOPING PHASE

As discussed in the Scoping Report, the proposed coal-fired power station and associated infrastructure are anticipated to impact on a range of biophysical and socio-economic aspects of the environment. One of the main purposes of the EIA process is to understand the significance of these potential impacts and to determine if the potential impacts can be mitigated or minimised. The impacts identified during the Scoping Phase fall within two phases of power station programme; namely construction phase impacts and operational phase impacts.

2.3.1 Construction phase impacts

Construction phase or short term impacts are those impacts on the biophysical and socio-economic environment that would occur during the construction phase of the proposed project. They are inherently temporary in duration, but may have longer lasting effects e.g. pollution of a wetland during construction could have effects that may last long after construction is over. Construction phase impacts could potentially include:

- Disturbance of flora and fauna;
- Impacts on water resources (sedimentation, impacts on water quality);
- Socio-economic impacts;
- Increase in traffic volumes in the vicinity of the construction site;
- Windblown dust;
- Noise pollution;
- Litter/ waste pollution;
- Interruption of road services;
- Storage and utilisation of hazardous substances on site;
- Risk of fire;
- Disturbance to sense of place, visual aesthetics;
- Security risks;
- Health issues; and
- Light pollution.

Based on the temporary duration of the construction phase and the fact that negative impacts of construction can usually be predicted and mitigated, more attention will be given to the operational phase impacts of the proposed power station than to the construction phase impacts. However, wherever relevant, specialist studies do consider construction phase impacts.

It should be noted that a comprehensive construction phase Environmental Management Plan (EMP) will be developed and implemented to regulate and minimise the impacts during the construction phase. In this regard, a framework EMP will be developed as part of the EIA phase, and is included within this Environmental Impact Report as **Annexure B.**

2.3.2 Operational phase impacts

The potential positive and negative operational phase impacts that were identified in the Scoping Phase can be divided into two categories; namely impacts on the biophysical environment and impacts on the social environment. The following potential impacts are investigated in detail in Chapter 5.

- Impacts on the biophysical environment:
  - Impact of founding conditions on site suitability;
  - Impact on groundwater resources;
  - Impact on terrestrial flora and fauna;
  - Impact on aquatic flora and fauna;
  - Impact on ambient air quality;
  - Impact on global climate change; and
  - Impact on regional water supply.

- Impacts on the social environment:
  - Visual impacts;
  - Impact on ambient noise quality;
  - Impact on health of surrounding communities;
  - Social risks/ vulnerability;
  - Impact on heritage resources;
  - Impact of increased vehicular traffic;
  - Impact on existing landuse and planning;
  - Impact on existing infrastructure;
  - Impact on local socio-economic conditions;
  - Impact on tourism potential;
  - Impact on livelihood security; and
  - Impact on agricultural potential of the region.

Given their long term nature, operational phase impacts are addressed in detail in this EIR, and its associated annexures. The assessment of potential impacts has helped to inform Eskom's selection of preferred alternatives to be submitted to DEAT for consideration. In turn, DEAT's decision on the environmental acceptability of the proposed project and the setting of any conditions will be informed by the specialist studies, amongst other information, contained in this EIR.

It is normal practice that, should the proposed power station and associated infrastructure be authorised, the development and implementation of construction, operational and decommissioning EMPs would be required. These are designed to mitigate negative impacts associated with the various phases of the project and will be informed by the mitigation measures proposed by the specialists.

3 THE PUBLIC PARTICIPATION PROCESS

3.1 INTRODUCTION

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process and enables *inter alia* potentially directly affected landowners, neighbouring landowners and communities, as well as authorities and key stakeholders, to have input into the study. In the Scoping phase, I&APs assisted with the identification of the issues and concerns that need to be addressed, while in this EIA Phase, the main purpose is to provide feedback on the suite of specialist investigations that were undertaken in the EIR, in order to provide a valuable input to decision making. The approach to this phase of the public participation process is contained in the Plan of Study for EIA, attached as **Annexure A.**

Figure 3.1 below illustrates the opportunities for public input into the Public Participation Process (PPP) to date, as well as the remaining opportunities during the EIA and Decision Phases. The various opportunities for I&APs to comment on this dEIR before it is finalised are described in Section 3.4 below.

3.2 SUMMARY OF PUBLIC PARTICIPATION PROCESS TO DATE

The approach to the public participation process for this project was to advertise the project broadly initially, requesting interested parties to register on the I&AP database, and then to focus the remainder of the engagement on registered I&APs and affected parties within the local area. Databases of previously identified stakeholders were also used to develop the I&AP database for this project.

The initiation of the EIA process for the proposed project was advertised in national, regional and local newspapers. English advertisements were published in the *Sunday Times*, the *Sowetan* and *The Star* while Afrikaans advertisements were published in the *Rapport* and *Die Beeld*. In addition, advertisements in English, Afrikaans, Zulu and Pedi were published in a suite of local newspapers; namely the *Middelburg Observer*, the *Highvelder* and the *Witbank News*. The adverts appeared between 26 April and 5 May 2006.

In addition to placing newspaper advertisements, a Background Information Document [15](BID), Response Form and Business Reply envelope were sent to 67 identified stakeholders comprising local landowners, local, provincial and national government departments, environmental organisations and mining houses. All information was available in English, Afrikaans, Zulu and Pedi. The BID was also placed on the Eskom website. These stakeholders were sent an invitation to a Stakeholder Meeting, where the project team presented the proposed project and gave stakeholders the opportunity to raise any comments,

[15] The purpose of the BID was to provide more information about the proposed project so that stakeholders could participate more effectively in the PPP.

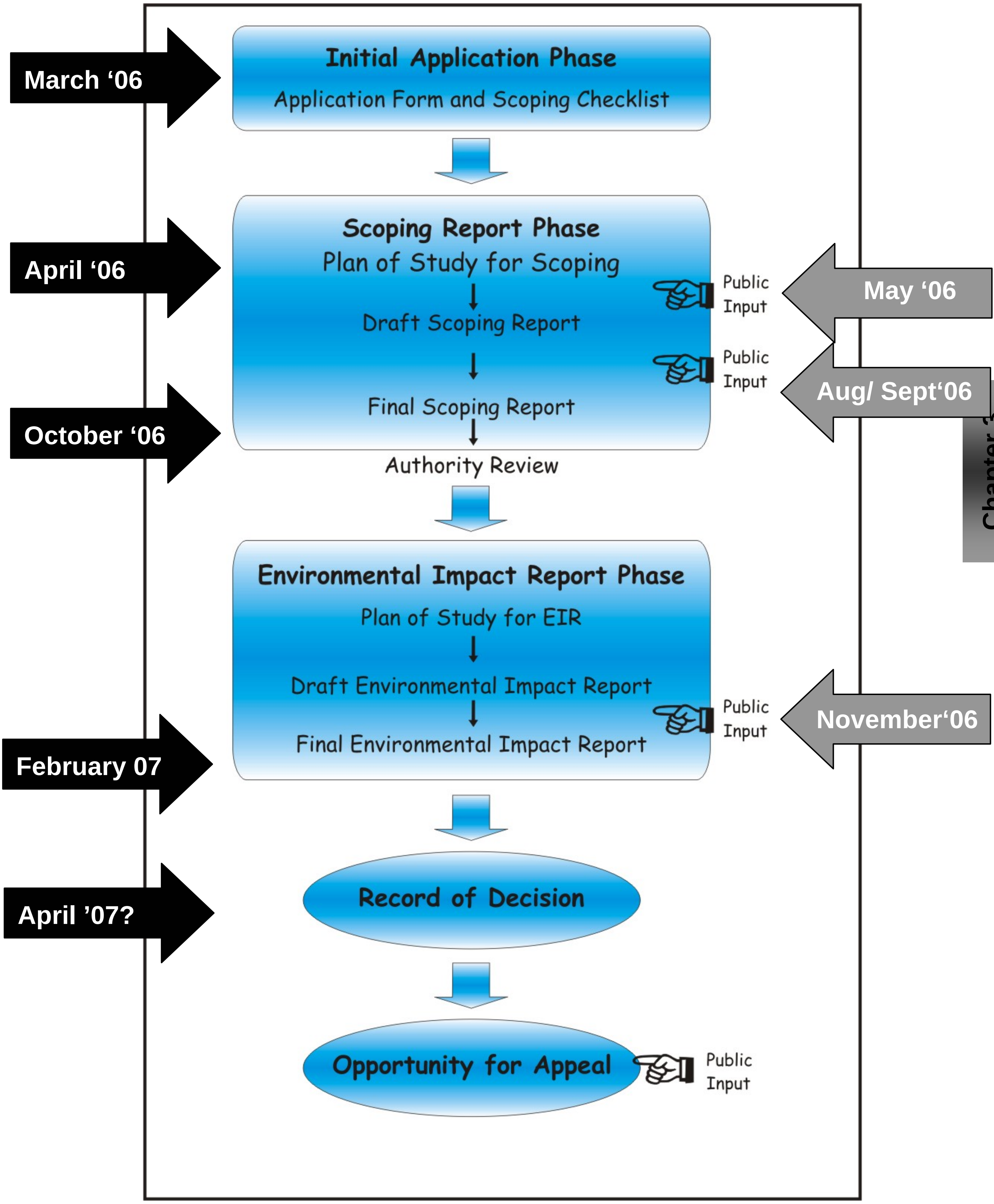


Figure 3.1: The public participation process to date

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questions or issues of concern. The Response Form and Business Reply Envelopes assisted stakeholders who could not attend the meeting to send their concerns, comments or queries to the EIA team. The Stakeholder Meeting was held at the Protea Hotel in Witbank on 8 May 2006 and was attended by 31 people.

In light of information that was obtained subsequent to the distribution of the BID (i.e. knowledge of the full extent of underground coal seams and the existing Kendal power station's expansion plans), the BID was updated and forwarded to I&APs on 8 June 2006. The above documents are available in the Final Scoping Report.

3.2.1 Public participation related to the site selection process

With the advent of the site screening and selection process, I&APs were notified of the delay in the EIA process on 14 July 2006 and were informed of the outcomes of the site screening and selection process on 7 August 2006. Furthermore, the selection of Sites X and Y required that the BID be revised for the second time, and re-distributed to IA&Ps. Additional landowners were also identified and sent the revised BID and a letter of notification.

3.2.2 Public participation related to the Scoping Phase

The Draft Scoping Report was released into the public domain (lodged in the Witbank public library, the Nelspruit public library, the Phola public library, the Johannesburg public library and the Kungwini and Delmas municipal offices) on 21 August 2006. In addition it was placed on the Eskom and Ninham Shand websites shortly thereafter. Media notices (in English, Afrikaans, Zulu and Pedi) were placed in the *Streek News*, the *Highvelder*, the *Middleburg Observer* and the *Witbank News* on 1 September 2006 in order to notify the public of the availability of the Draft Scoping Report and to notify them of the Open Houses and Public Meetings that would be held to present the report to the public. Registered I&APs were notified of the availability of the Draft Scoping Report and the Open Houses/ Public Meetings by means of a letter, dated 21 August 2006. The letters to I&APs also included a copy of the executive summary of the Draft Scoping Report.

The Draft Scoping Report was presented to the public at an Open House and Public Meeting held in Witbank on 4 September 2006, an Open House held in Phola on 5 September 2006, and an Open house and Public Meeting held at the El Toro Conference Centre near Kendal later in evening of 5 September 2006. Attendees were provided with an opportunity to ask questions and provide comment on the report.

The comment period ended on 15 September 2006, but submissions up to 26 September 2006 were accepted for those who requested more time. The comments received after the release of the Draft Scoping Report into the public domain, including those raised during the Public Meetings, are presented in the second Issues Trail.

It must be noted that attaining landowner information and contact details has proven to be exceptionally difficult. A conveyancer was appointed to assist in this regard as soon as it was realised that conventional means of eliciting landowner information (site visits and contact with the deeds office) only yielded partial success. The conveyancer also experienced difficulty in attaining information but was able to supplement the existing database. New landowners in Site X were brought to the team's attention in mid September 2006 and letters of notification and the BID Version 3 and the Executive Summary of the Draft Scoping Report were sent to them on 15 September 2006.

Once the Scoping Report was finalised, it was submitted to DEAT and lodged in the various public libraries and municipal offices that the Final Scoping Report was lodged in and uploaded to the Ninham Shand and Eskom websites. All registered I&APs were informed of this by letter dated 20 October 2006 (refer to **Annexure C**). In addition to the above, minutes of the public meetings were posted to all attendees and a copy of Issues Trail 2 was posted to all those who submitted written comment.

3.2.3 Key issues raised by the public during the Scoping Phase

The issues raised through the public process during the Scoping Phase are recorded in the first and second Issues Trails contained in the final Scoping Report. A summary of the key issues, according to themes, is presented below:

- Water impacts: Source of water for the power station
  Impacts on local surface and groundwater resources

- Air quality impacts: Impacts of the power station on already poor air quality in the region
  Impact of dust from the ash dumps on local air quality
  Implications of the power station for greenhouse gases and global climate change

- Socio-economic impacts: Affect of the power station on property values
  Impact on livelihoods and the economic viability of remaining portions of farms
  Impact on existing businesses in the vicinity of the proposed power station
  Creation of job opportunities and the likely split between skilled, semi-skilled and unskilled labour

- Cumulative impacts: Consideration of the cumulative impacts of the power station and the coal mine integrated

- Strategic decisions: Consideration of alternative means of electricity generation
  Rationale for selecting the Witbank geographical region for a new coal-fired power station.

3.3 PUBLIC PARTICIPATION RELATED TO THE EIA PHASE

As part of the ongoing interaction between the coal mine and power station EIAs, additional I&APs from the coal mine EIA were provided to the public participation team for this EIA process. These 'new' I&APs were sent a letter (dated 20 October 2006, please refer to **Annexure C**) informing them of the power station EIA and offering them the opportunity to register themselves as I&APs for the power station EIA process.

3.4 COMMENT ON THE DRAFT ENVIRONMENTAL IMPACT REPORT

Registered I&APs were notified of the imminent release of the dEIR and the details of the Open Houses/ Public Meetings, that would be held to present the report to the public, by means of an email on 8 November 2006 and a letter, dated 13 November 2006. The dEIR was released into the public domain (lodged in the Witbank public library, the Nelspruit public library, the Phola public library, the Johannesburg public library and the Kungwini and Delmas municipal offices) on 20 November 2006. In addition it was placed on the Eskom and Ninham Shand websites shortly thereafter. Media notices (in English, Afrikaans, Zulu and Pedi) were placed in the *Streek News*, the *Highvelder*, the *Middleburg Observer* and the *Witbank News* on 17 November 2006 in order to notify the public of the availability of the dEIR Report and to notify them of the Open Houses and Public Meetings. Letters notifying the registered I&APs of the availability of the document and reminding them of the public meetings was sent on 20 November 2006. The letters to I&APs also included a copy of the Executive Summary of the dEIR.

The dEIR was presented to the public at an Open House and Public Meeting held at the El Toro Conference Centre near Kendal on 28 November 2006, an Open House held in Phola on 29 November 2006, and an Open house and Public Meeting held in Witbank on the evening of 29 November 2006. Attendees were provided with an opportunity to ask questions and provide comment on the report. Minutes of the meetings were posted to the attendees on 14 December 2006 (see **Annexure C**). In addition to the above, a copy of Issues Trail 3, which had been compiled from responses received between the finalisation of the Scoping Report and the release of the dEIR, was posted to all those who submitted written comment (see **Annexure D**).

Taking cognisance of the time of year, the public comment period for the submission of written comment on the dEIR was made longer than the usual and ended on 8 January 2007. Additional time was provided to any I&AP who requested it and comments received up to mid-February January 2007 were included in Issues Trail 4 together with the study team and applicant's responses thereto (see **Annexure U**).

A focus group meeting was held on 12 January 2007 with two of the landowners neighbouring Site X, to discuss their detailed concerns raised at the November public meetings and in their written submissions. Minutes of the meeting can be found in Annexure T. The outcome of the meeting informed the updating and compilation of this final report. See section 5.3.10 b) above in this regard.

Various authorities were also requested to comment on the dEIR. These included:

- The Department of Public Enterprises;
- The Department of Minerals and Energy;
- The South African Heritage Resources Agency (Mpumalanga and Gauteng provincial offices);
- The Department of Water Affairs and Forestry[16];
- The Department of Environmental Affairs and Tourism: Directorate Air Quality Management and Climate Change;
- The Gauteng Department of Agriculture, Conservation and Environment;
- The Mpumalanga Department of Agriculture and Land Affairs (MDALA);
- Mpumalanga Department of Roads and Transport;
- Gauteng Transport Department (GauTrans);
- South African National Roads Agency Limited;
- Spoornet;
- The Kungwini Local Municipality; and
- The Delmas Local Municipality.

Meetings to elicit comment were held with MDALA and Kungwini Local Municipality on 15 January 2007 and with SANRAL, GauTrans, Spoornet and DWAF on 16 January 2007. Minutes of those meetings are included as Annexure R of this report. A meeting with DEAT's Directorate Air Quality Management and Climate Change is due to be held 27 February 2007, to fully appraise that directorate of the outcome of the air quality study in particular.

See Section 6.3 below for records of the comments received from the authorities listed above.

3.4.1 Key issues raised by the public during the EIR Phase

The issues raised through the public process during the EIR Phase are recorded in the third and fourth Issues Trails contained in the fEIR (see to Annexures D and U). A summary of the key issues, according to themes, is presented below:

- Water impacts: Impacts on local surface and groundwater resources
Impacts on wetlands
- Air quality impacts: Impacts of the power station on already poor air quality in the region

[16] Note, however, that although comment has been received from their Resource Planning division, comment is still outstanding from their regional office. Considerable effort has been made in eliciting this comment but staff changes and difficulties with accessing documentation has proved challenging.

	Impact of dust from the ash dumps on local air quality Impact of heat pollution on the ambient temperatures Efforts to reduce emissions
• Socio-economic Impacts	Affect of the power station on property values Impact on existing businesses in the vicinity of the proposed power station Creation of job opportunities and alleviation of poverty Impact on farm labourers (loss of accommodation & jobs on farms) Visual impact Safety and security concerns during construction Heritage impacts require further inputs Timing of land aquisition Skills survey needed
• Process Issues	Shortcomings in Public Participation ⇒ Lack of engagement on individual level with adjacent landowners ⇒ Comment period over Christmas period ⇒ Lack of appropriate notification whenever specialists and valuators came onto farms
• Construction Impacts	Noise Visual Dust Source of materials Access roads, Jobseekers flooding the area Construction impacts not considered sufficiently
• Cumulative impacts	Consideration of the cumulative impacts of the power station and the coal mining activity Impact on municipal services and infrastructure
• Strategic decisions	Consideration of alternative means of electricity generation Rationale for selecting the Witbank geographical region for a new coal-fired power station. Confirmation of the availability of coal

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3.5 DECISION AND APPEAL PERIOD

The fEIR has now been completed, and all I&AP comments have been incorporated into this report. The document will be lodged with DEAT on 23 February 2007. The registered interested affected parties have been notified of the availability of the final document in the libraries and on the Eskom and Ninham Shand websites. In addition to the above, a copy of the Update Summary of this report and of Issues Trail 4 has been posted to all those who submitted written comments. Should DEAT believe that the final submission contains sufficient information for decision-making, they will issue a Record of Decision (ROD). The ROD would either authorise the proposed activity (including conditions of authorisation) or reject the proposed activity.

It should be noted that if an ROD is issued, a letter will be sent to all registered I&APs informing them of DEAT's decision and the availability of the ROD. There is a 30 day appeal period, commencing on the day that the ROD is issued, in which anyone (a member of the public, registered I&AP or the applicant) can lodge an appeal against DEAT's decision to the Minister of Environment Affairs in terms of the Environment Conservation Act.

4 ASSESSMENT METHODOLOGY

4.1 INTRODUCTION

The purpose of this chapter is to describe the assessment methodology utilised in determining the significance of the construction and operational impacts of the proposed activities on the biophysical and socio-economic environment. The methodology was developed by Ninham Shand in 1995 and has been continually refined, based on our experience of applying it to over 300 EIA processes. The methodology is broadly consistent with that described in DEAT's Guideline Document on the EIA Regulations (1998). The methodology was outlined in the Plan of Study for EIA and in accepting the Final Scoping Report, DEAT has ratified this approach.

4.2 ASSESSMENT METHODOLOGY

This section outlines the methodology used to assess the significance of the potential environmental impacts. For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) are described. These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIR represent the full range of plausible and pragmatic measures but does not necessarily imply that they should or will all be implemented. The decision as to which combination of alternatives and mitigation measures to apply for lies with Eskom as the applicant, and their approval ultimately with DEAT. However, the outcome of the assessment, i.e. the array of alternatives and mitigation measures recommended by Ninham Shand as the EIA practitioners, has been indicated to be acceptable to Eskom. See Section 6 below for more detail in this regard. The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Table 4.1 Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 20 km radius of the power station site
	Local	Within a 20 km radius of the centre of the power station site
	Site specific	On site or within 100 m of the power station site
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	Up to 7 years
	Medium Term	Up to 10 years after construction
	Long Term	More than 10 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in Table 4.2.

Table 4.2 Definition of significance ratings

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact would be determined using the rating systems outlined in Tables 4.3 and 4.4 respectively. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring. Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in Table 4.5.

Table 4.3 Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

Table 4.4 Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 4.5 Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is permanent.
Reversible	The impact is reversible, within a period of 10 years.

4.3 THE ASSESSMENT CONTEXT

Site X occurs within the Delmas Local Municipality, Mpumalanga, and Site Y occurs primarily within Gauteng, in the Kungwini Local Municipality. The region is known for rich deposits of coal reserves and accordingly, several coal mines and associated coal-fired power stations can be found in the area. The region forms part of the Highveld plateau and is characterised by a generally flat topography, grassveld, maize and sunflower farming, coal mines, power stations and other industries. Drainage in the area is generally northward.

Both Sites X and Y are mainly used for agricultural purposes and therefore have been subjected to disturbance historically. There are, however, a suite of wetlands located on both sites that are of importance to the aquatic functioning of the broader area.

4.4 SUBJECTIVITY IN ASSIGNING SIGNIFICANCE

Despite attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, EIA processes can never escape the subjectivity inherent in attempting to define significance. The determination of the significance of an impact depends on both the context (spatial scale and temporal duration) and intensity of that impact. Since the rationalisation of context and intensity will ultimately be prejudiced by the observer, there can be no wholly objective measure by which to judge the components of significance, let alone how they are integrated into a single comparable measure.

This notwithstanding, in order to facilitate informed decision-making, EIAs must endeavour to come to terms with the significance of the potential environmental impacts associated with particular development activities. Recognising this, Ninham Shand have attempted to address potential subjectivity in the current EIA process as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above;
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail in the Plan of Study for EIA and in this EIR. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing towards the determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the EIR with a clear summary of how the assessor derived the assigned significance;
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties; and
- Utilising a team approach and internal review of the assessment to facilitate a more rigorous and defendable system.

Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

4.5 CONSIDERATION OF CUMULATIVE IMPACTS

Section 2 of the National Environmental Management Act requires the consideration of cumulative impacts as part of any environmental assessment process. EIAs have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires co-ordinated institutional arrangements; and
- EIAs are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

However, when assessing the significance of impacts in the next chapter, cumulative effects have been considered as far as possible.

4.5.1 Integration with the coal mine EIA

There have been numerous calls for this EIA process to be integrated with the EIA currently being undertaken for the proposed mine which will supply coal to the powerstation. While the benefits of integration are recognised, there are reasons why the EIA processes are being undertaken separately. Foremost among these is the fact that the underlying legal frameworks and hence competent authorities differ as the coal mine EIA is being undertaken primarily to meet the requirements of the Department of Minerals and Energy, while DEAT is the competent authority for the proposed power station. However, the principle of co-operative governance requires that the two regulatory bodies consult with each other during their respective decision-making processes.

In addition to this, the lead time for the development of the proposed power station is longer than that for the coal mine, especially considering the preliminary coal information (such as quantity and quality of coal) that is already available. Accordingly the power station EIA process commenced before the coal mine EIA process. As a result, absolute synchronicity and integration is difficult to achieve. This notwithstanding, integration is occurring as far as is possible by means of information sharing, including shared I&AP databases and reflecting the outcomes of EIA reporting. Specifically, Ninham Shand has passed on to the coal mine EIA practitioner all queries related to the coal mine, and vice versa. Furthermore, those I&APs who have had queries or concerns related to the coal mine have been added to the coal mine I&AP database and will be kept appraised of the coal mine EIA process, reporting and public engagement opportunities.

It is advised that anyone who wishes to consider the cumulative impacts of both the proposed power station and coal mine involve themselves and participate in both EIA processes.

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5 ASSESSMENT OF POTENTIAL IMPACTS AND POSSIBLE MITIGATION MEASURES

This chapter forms the focus of the EIR. It contains a detailed assessment of the operational (or long-term) impacts as well as the construction phase impacts on the biophysical and socio-economic environment using the methodology described in Chapter 4. The summary of the assessment is contained in Chapter 6.

5.1 INTRODUCTION

Chapter 5 describes the potential impacts on the biophysical and social environments, which may occur due to the proposed activities described in Chapter 2. These include potential impacts which may arise during the operation of the power station and its associated infrastructure (*i.e.* long-term impacts) as well as the potential construction related impacts (*i.e.* short to medium term).

The potential impacts identified during the Scoping phase of this project include the following:

Operational Phase Impacts:

- Impacts on the biophysical environment:
  - Impact of founding conditions on site suitability;
  - Impact on groundwater resources;
  - Impact on terrestrial flora and fauna;
  - Impact on aquatic flora and fauna;
  - Impact on ambient air quality;
  - Impact on global climate change;
  - Impact on regional water supply;

- Impacts on the social environment:
  - Visual impacts;
  - Impact on ambient noise quality;
  - Impact on health of surrounding communities;
  - Social risks/ vulnerability;
  - Impact on heritage resources;
  - Impact of increased vehicular traffic;
  - Impact on existing landuse and planning;
  - Impact on existing infrastructure;
  - Impact on local socio-economic conditions;
  - Impact on tourism potential;
  - Impact on livelihood security; and
  - Impact on agricultural potential of the region.

Construction Phase impacts:

- o Disturbance of flora and fauna;
- o Impacts on water resources (sedimentation and impacts on water quality);
- o Socio-economic impacts;
- o Increase in traffic volumes in the vicinity of the construction site;
- o Windblown dust;
- o Noise pollution;
- o Litter/ waste pollution;
- o Interruption of road services;
- o Storage and utilisation of hazardous substances on site;
- o Disturbance to sense of place and visual aesthetics;
- o Security risks;
- o Health issues; and
- o Light pollution.

Each of these impacts is assessed in detail, and the significance of the impact determined in the following sections. The methodology used to assess the potential impacts is detailed in Chapter 4 of this report. The terms 'No Mit' and 'Mit' reflected in the assessment tables in this chapter refer to the impact with no mitigation and with mitigation respectively.

5.2 OPERATIONAL PHASE IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

5.2.1 Impact of founding conditions on site suitability

a) Impact Statement

Geological conditions at any site could pose a technical constraint, potentially rendering a site non-feasible for the construction of a power station and associated infrastructure, or may necessitate very expensive foundations.

b) Discussion

In order to ascertain the suitability of the two preferred sites, namely Site X and Site Y, and to confirm that no 'fatal flaws' exist at either site from a geotechnical perspective, a high level geological investigation was undertaken by Margaret Wynne of Ninham Shand. The terms of reference for the study included undertaking a desktop-level review of existing information on the sites and region, undertaking a limited ground-truthing exercise, and identifying and assessing the significance of any geotechnical constraints for the power station and its associated infrastructure on Site X or Site Y. The methodology included sourcing and reviewing relevant mapping (topocadastral, geological surveys and aerial photography), sourcing information from relevant bodies/ organisations, and a site visit to confirm findings of the desktop study. The complete description of the methodology and full results of the study are contained in **Annexure E** of this report. A summary is provided below.

The lithology of the area, which includes Sites X and Y, comprises several geological sequences. The oldest rocks are the sedimentary rocks comprising the Transvaal Supergroup, Pretoria Group, Silverton (shales), Magaliesberg (quartzites) and Rayton (quartzites, shales and subgreywacke) Formations. The Loskop Formation comprises tholitic lavas and other igneous or altered sedimentary rocks, including quartz porphyry, rhyolite, dacite, quartzite and tholitic lava.

Overlying the Transvaal Supergroup are the sedimentary rocks of the Karoo Supergroup, Dwyka Group (tillites, shale), the Ecca Group (shales, sandstones, conglomerates and coal beds in places near the base and the top). The other dominant rock type is the rocks collectively referred to as the Transvaal diabase. These are probably related to an early intrusive phase of the Bushveld Complex. They are intrusive into all horizons of the Transvaal Supergroup, and are particularly prolific in the strata of the Pretoria Group.

c) Description and significance of potential impact

Site X is characterised by the presence of Dwyka shales in the southern and western portions, and Ryton Formation shales in the central and northern portions of the site. Soils with a high clay content are expected to be found associated with the Dwyka shales. The Rayton Formation shales' bedding planes can be very smooth and even, which could cause instability with slipping, depending on the angle of dip in relation to the excavations for the power station foundations. There are no recorded major faults crossing the site, and seismic activity in the area would be mostly associated with local mining activities. There is however a low probability of such activity on Site X.

The geology of Site Y is more complex than that of Site X. The northern portion of the site is dominated by extensive diabase sills that have intruded into the Silverton Formation Shales. Loskop formation lavas appear in the southern portion of the site, together with igneous rocks of the Bushveld Igneous Complex and the Rustenberg Layered Suite. There are no recorded major faults crossing the site, and seismic activity in the area would be mostly associated with local mining activities. Similarly as for Site X, there is a low probability of such activity on Site Y.

There are no known obvious geological constraints to the development of a power station and infrastructure on Site X. The clayey impervious soils would be a positive mitigating factor against groundwater contamination for the ash dump and coal stockyard positioning. The most northern section also has favourable geology for foundations (shallow rock), but streams dissect the area, and the topography is not so uniform. There is unlikely to be any sterilization of coal resources by development of a power station on Site X.

Similarly at Site Y, there are no known obvious geological constraints to the development of a power station and associated infrastructure. The power station would be situated on diabase sills, with a combination of both deep weathering and rock outcropping. The possibility of clayey soils would act as a mitigating factor against groundwater contamination. The site is further away to the west of the coal fields, and would therefore not lead to the sterilization of coal resources.

Site X is regarded as marginally better than Site Y, since the geology is more uniform, the diabase/ shale in the central parts of the site would provide suitable founding conditions, the more clayey soils associated with the Dwyka formation would assist in protecting the groundwater and less blasting of very hard rock would be required.

Mitigation measures

It is possible to overcome geotechnical constraints of this type with appropriate geotechnical engineering measures and no specific mitigation measures are applicable. This would however entail some increase in cost, but is unlikely to be significant in the scale of the proposed project.

Impact of founding conditions on site suitability		
	SITE X	
	No mit	**Mit**
Extent	Local	Local
Magnitude	Very low	Very low
Duration	Long	Long
SIGNIFICANCE	**Very low (-)**	**Very low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Local	Local
Magnitude	Low	Very low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**Very low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

5.2.2 Impact on groundwater resources

a) Impact Statement

Raw materials such as process chemicals and liquid fuel used at the proposed power station and liquid waste products from the operation of the power station could contaminate the groundwater resource in the area, having an affect on current and potential groundwater users.

b) Discussion

Initial investigations indicated that groundwater was being utilised in the study area for potable consumption and irrigation purposes. The proposed power station and its associated infrastructure use materials and generate waste that could potentially contaminate groundwater in the region. Materials used include process chemicals (see Section 5.3.4 below for a list of process chemicals used), and waste generated include *inter alia* coarse and fly ash, treated waste water, and run-off from the coal stockyard. Though Eskom operates its power stations on the basis of a 'zero liquid effluent discharge' (ZLED) philosophy, there is still potential for groundwater resources to become contaminated through recharge of the groundwater system with polluted water, especially during the build-up period. Consequently, a groundwater assessment was undertaken by Groundwater Consulting Services, to determine the level of groundwater use in the area and its quality in order to determine the potential impacts on the resource from the power station, to determine how the by-products of atmospheric abatement technologies would affect the groundwater and to recommend mitigation measures to minimise or remove the potential impacts. The approach to the study included:

- Reviewing relevant literature, including published data, mapping and various databases of groundwater utilisation and water quality;
- Undertaking a hydrocensus to determine the actual extent of groundwater utilisation on the two sites;
- Assessing the potential impacts on groundwater as a result of the power station operation and waste generated.

The detailed methodology and results of the groundwater assessment are contained in **Annexure F** of this report.

The geological formations in the region, in their pristine state, do not have a high groundwater potential. It is only when secondary processes like weathering or fracturing occur that groundwater potential is improved. The study area falls within the B20F quaternary catchment, with a total area of 504 km^2 and an average rainfall of 667 mm per year. The rainfall component to groundwater recharge is approximately 32.7 Mm^3 per year over a 504 km^2 area. The groundwater contribution towards surface river flow in the quaternary catchment is approximately 1.8 Mm^3 per year. The depth of groundwater ranges between 10 m and 20 m below the surface.

There are a total of 20 boreholes and three springs located within Site X, of which 15 of the boreholes are currently in use. Flows from two of the springs, located on the eastern portion of Farm Klipfontein 566JR, have historically been diverted into an irrigation dam. The springs are no longer being utilised in this fashion and now flow into an unnamed non-perennial stream. The boreholes are utilised mainly for the supply of domestic water supply and drinking water for livestock. The typical depth to groundwater on Site X ranges from 0 m (two artesian boreholes located on the northern portion of Farm Klipfontein 566JR) to 10.75 m below ground level. However, there are areas where the depth to groundwater exceeds 20 m. The average depth to groundwater level across the site is 7 m. The yield of boreholes on Site X ranges between 0.28 ℓ/ s and 1.39 ℓ/ s. One of the springs on Farm Klipfontein 566JR has a yield of approximately 2.2 ℓ/ s. Total groundwater abstraction for Site X is approximately 43 m^3 per day. This limited groundwater abstraction is due to the low population density and dry land agricultural activities at Site X.

There are 13 boreholes located within Site Y. Nine of the 13 boreholes are currently in use – mainly for domestic water supply and drinking water for livestock. Limited irrigation occurs within Site Y. The typical depth to groundwater ranges from 4.3 m to 7.5 m below ground level with an average depth to groundwater of 5.2 m. Borehole yields vary between 0.56 ℓ/ s and

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11.1 ℓ/ s with the strongest yield located on the Farm Nooitgedacht. The total groundwater abstraction at Site Y ranges between 2.5 m^3/ day and 10 m^3/ day. The low abstraction volumes are indicative of boreholes being used for limited domestic purposes and limited abstraction for irrigation.

With respect to the underlying geology, Site Y is more vulnerable to groundwater pollution as it has a shallower depth to groundwater than Site X. In addition Site Y has a high yielding weathered aquifer that is overlain by highly permeable sand, which would allow for the faster travel time and migration of pollution plumes. With respect to the groundwater resource *per se*, Site Y is more vulnerable than Site X due to:

- The greater recharge by rainfall at Site Y;
- The fact that most of Site Y is classified as a major aquifer (major aquifers are those that have highly permeable formations, are highly productive and are able to support large abstractions for public supply or other purposes. Major aquifers also have fairly good water quality);
- Site Y has the potential to develop large scale sustainable groundwater supplies; and
- The hydrochemistry of groundwater is of potable quality whereas "brack" water, i.e. water with a high concentration of dissolved salts, has been recorded at Site X.

c) Description and significance of potential impact

The proposed power station would comprise several components or processes that may have an impact on groundwater. These potential impacts include:

- Potential acidic leachate generated from the coal stockyard;
- Artificial recharge from raw water dams;
- Contamination from the wastewater treatment facility and its associated dams and sludge drying beds;
- Infiltration and overflow from "dirty" water dams contaminating groundwater;
- Leakage of various grades of oil and infiltration into the groundwater system;
- Artificial recharge of poor quality water from the ash dump; and
- Artificial recharge of poor quality water from runoff and seepage from the ash dump drainage channels and toe dam/s.

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Power station surface infrastructure (including dams, coal stockyard, water and wastewater treatment facilities, bunker oil, chemical storage etc.)

Groundwater monitoring at similar coal-fired power stations indicate that power stations impact on both groundwater levels as well as on hydrochemistry (water quality). Groundwater levels can rise markedly due to artificial recharge from clean and dirty water dams, run-off from the coal stockpiles and from ash dumps and toe dams. Groundwater level data indicate that groundwater contamination could occur, but would migrate at a very slow rate. In addition, pollution plume migration would be retarded due to indirect flows along fractured rock and due to chemical reactions. Evidence from existing similar power stations indicates that it is likely that impacts on groundwater level, due to artificial recharge, would be localised.

Long term monitoring at similar stations indicates that there would be some degree of groundwater quality deterioration over time, notably an increase in salinity. Evidence suggests that the coal stockyard is likely to result in a decrease in groundwater pH (i.e. the groundwater becomes more acidic) due to oxygenation of sulphides.

Based on monitoring undertaken at existing similar power stations, it is likely that the magnitude of the impact at both Site X and Y would be low over a long term. Accordingly a **low (-ve)** significance impact is anticipated for both Site X and Y.

Ash disposal

Ash has the potential to pollute groundwater, generally associated with changes in pH of the groundwater and the leaching of salts and metals into the groundwater. The manner in which ash is disposed of is the single most important factor in predicting potential groundwater impacts. As mentioned in Chapter 2, above-ground ashing is the primary ash disposal solution being considered as part of this EIA process. However in-pit and back-ashing are also potential ash disposal mechanisms that Eskom and the relevant mining house will investigate. The impact of these ash disposal mechanisms on groundwater will be commented on at a high level, but these methods would have to be further investigated in detail by Eskom and the relevant mining house at a later stage.

The rate at which elements are leached from ash dumps depends on the form in which the element is present, the location of the element within the ash matrix and whether the element has been absorbed onto the particle surface or not. Elements in a chemically stable matrix are less readily available to be leached out of the ash dump while elements that have been absorbed onto the surface of ash particles are more readily leached.

The groundwater study suggests that above ground storage of ash may result in impacts on groundwater quality, which may, in turn, impact on users. Initial ash disposal would have high seepage rates due to rapid transport of water and rain. As the ash dump grows, calcium oxide and carbon dioxide would lead to the crystallisation of calcium carbonate, will form a layer of very low permeability in the top 0.5 m of the ash dump, which would reduce leaching from the dump. It is anticipated that the groundwater contamination would become slow and would be localised. At Site X, the slow migration of pollution is likely to result in attenuation and dilution of the pollution plume. At Site Y, the geological structure allows for a more rapid movement of the polluted water. Given that the impact would be felt over a long term, with a medium magnitude and local extent at Site X, an impact of **medium (-ve)** significance is anticipated. At Site Y the extent may reach a regional level, resulting in a **high (-ve)** significance impact. Should in-pit or back-ashing be employed, the significance of the impact of the above ground ash dump would be slightly lower, due to its limited nature and infrequent use as a dump site.

In terms of Section 21(g) of the National Water Act, the storage of ash would be considered a waste product for which a water use licence would have to be applied for. The licence would have a suite of conditions which would seek to provide environmental protection to the groundwater resource. Eskom will undertake the relevant water use licence application during the design phase of the project.

Back ashing and in-pit ashing would occur within the coal mine excavations i.e. not at Site X or Site Y. The rehabilitated areas and material are likely to be slightly more permeable than the surrounding natural rock matrix, which would cause higher rates of recharge into the rehabilitated material from ponded water. Water flow and the movement of salts or contaminants from the ash would be away from the disposal area and into the groundwater resource. Further to the above, if ash is disposed below the natural water table level, extensive leaching from the ash material could take place when the water table rebounds to its natural level, and the acidic mine water causes leaching of salts and other elements from the ash. These options and their environmental impacts would be studied in greater detail in the future, should Eskom and the mining house decide to pursue either back-ashing or in-pit ashing.

Atmospheric emission abatement technology by-products

The potential implementation of flue gas desulphurisation (FGD) technology as an atmospheric emission abatement technology would entail activities that have the potential to impact on groundwater, notably:

- Disposal of wet waste on the waste disposal site; and
- A holding dam to facilitate the separation (dewatering) of the water from the slurry waste and so that that water can be re-used.

The FGD process (whether wet or dry) would result in the production of a wet slurry waste, which is likely to be dewatered before being disposed of on the ash dump. The process will result in more wet waste on site that could potentially act as a source of artificial recharge of the aquifer. The magnitude of this impact is considered to be very low due to a local extent and limited groundwater use. Furthermore, the FGD waste product is also likely to be classified as a waste product in terms of the National Water Act, and would require a water use licence for disposal in a surface dump site (with the ash). The licence is likely to have a suite of conditions that seek to manage the ash dump with the least environmental impact.

The FGD process and associated activities are likely to have a low magnitude coupled with a local extent. Accordingly, a **low (-ve)** significance impact is expected at both Site X and Y.

There is the possibility of treating the FGD slurry to create gypsum, if the wet FGD process is used. The slurry generated through the semi-dry FGD process is already gypsum. Gypsum does have commercial value and could be sold on a commercial basis. This is however unlikely to occur in large volumes, due to the lack of local demand for the product and the low price that gypsum fetches. However, Eskom have initiated an investigation to determine potential opportunities which will result in the use of this resource.

Mitigation measures

Mitigation measures are noted comprehensively in the framework EMP in **Annexure B** They include:

- Establishment of the coal stockyard and ash dump on top of a suitably prepared surface to prevent leaching into the groundwater;
- Appropriate drainage around all waste sites, including the above ground ash dump;
- Siting dams on appropriate underlying geology or lining dams with a higher groundwater pollution risk;
- Establish boreholes to monitor groundwater down gradient of potential threats e.g. wastewater treatment works and ash dump;
- Storing all oil and other hazardous substances in appropriately designed, bunded storage areas; and
- Investigating the development of a market for the use of gypsum and if feasible implementing a process to facilitate the use of this potential resource.

The following tables quantify the discussion above. Site Y has geological structures that enhance groundwater potential in the area and that can act as preferential pathways for groundwater and pollution plume migration. Accordingly, groundwater at Site Y is more vulnerable to external impacts than at Site X. Site X is therefore considered the preferential site from a groundwater perspective. In addition, the groundwater study notes that there is little groundwater usage at Site X.

Proposed power station and associated infrastructure layouts		
	SITE X	
	No mit	**Mit**
Extent	Local	Local
Magnitude	Low	Very low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**Very low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible
	SITE Y	
Extent	Local to regional	Local
Magnitude	Low	Very low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**Very low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Impact of surface-ashing on groundwater

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SITE X		
	No mit	**Mit**
Extent	Local	Site specific
Magnitude	Med	Low
Duration	Long	Long
SIGNIFICANCE	**Med (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible
SITE Y		
Extent	Regional	Local
Magnitude	Med	Low
Duration	Long	Long
SIGNIFICANCE	**High (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Impact of the by-products of the FDG process on groundwater				
	Wet FGD		**Semi-dry FGD**	
SITE X				
	No mit	**Mit**	**No mit**	**Mit**
Extent	Local	Site specific	Local	Site specific
Magnitude	Low	Low	Low	Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**
Probability	Probable	Unlikely	Probable	Unlikely
Confidence	Sure	Sure	Sure	Sure
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible
SITE Y				
Extent	Local	Site specific	Local	Site specific
Magnitude	Low	Low	Low	Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**
Probability	Probable	Unlikely	Probable	Unlikely
Confidence	Sure	Sure	Sure	Sure
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible

5.2.3 Impact on terrestrial fauna and flora

a) Impact Statement

The establishment of the power station and its associated infrastructure could destroy rare or endangered terrestrial plants, reducing the available habitat for terrestrial animals, which could also be rare or endangered.

b) Discussion

The alternative power station sites are located in the highveld, at an altitude of some 1550 to 1800 masl. The topography of the area is complex, as a result of stony hills, ridges, plateaus, plains and deeply weathered drainage lines. The coal-bearing karoo sediments of the area form extensive flat plains with deep soils, which are often ploughed for maize cultivation. A specialist terrestrial ecological investigation was undertaken by Ecosun, to determine the ecological sensitivity of the vegetation and animals in the area, to identify any protected and endangered species on the sites, and to recommend mitigation measures to prevent or reduce the potential impact on sensitive vegetation or animals. The methodology for this investigation included a literature survey of relevant published sources of information, a field survey, where each site was divided into transects and inspected and a comparative assessment of the two sites, based on vegetation characteristics, vegetation condition and presence of terrestrial animals, undertaken. The full report is included in **Annexure G**. A summary of the findings of the investigation is presented below.

The natural vegetation in the area belongs to the Moist Cool Highveld Grassland (Bredenkamp & Van Rooyen, 1996), and is referred to by Acocks (1998) as Eastern Bankenveld veld type. Grasslands of the Highveld are disturbance-driven systems, undergoing periodic flooding, or slow steady change due to human impacts, such as over-grazing and fires. Furthermore, the development of maize, wheat and vegetables destroys the natural vegetation, while overgrazing gradually changes the species composition of the grassland.

Vegetation units typically found in the Moist Cool Highveld Grassland region include the following, and are described in detail below:

- *Hyparrhenia hirta* Anthropogenic Grassland;
- *Eragrostis plana* Moist Grassland;
- *Cymbopogan plurinodis – Themeda triandra* Grassland;
- *Monocymbium ceressiforme – Loudetia simplex* Grassland;
- *Protea roupelliae* Cool Temperate Mountain Bushveld;
- *Themeda triandra – Acacia karroo* Microphyllous Woodland;
- Grassy Pan Veld;
- Riparian shrub on streams and riverbanks;
- Seepage areas and wetland communities; and
- Anthropogenic areas dominated mainly by exotic plants.

  - *Hyparrhenia hirta* Anthropogenic Grassland:

  This tall grassland occurs over vast areas, usually on shallow, leached soils on the Johannesburg granite dome, and on undulating north-facing warm andesitic lava slopes of

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the Suikerbosrand, Witwatersrand and Klipriviersberg areas. Disturbed grassland or other disturbed areas such as road reserves or fallow fields, not cultivated for some years, are also usually *Hyparrhenia* dominated (Coetzee *et al*. 1995; Bredenkamp & Brown 2003).

This *Hyparrhenia* – dominated grassland may appear to be quite natural, but they are mostly associated with an anthropogenic influence from recent or even iron-age times. This grassland is characterised by the tall growing dominant Thatch grass (*Hyparrhenia hirta*), and Bankrupt Bush (*Stoebe vulgaris*), an invader dwarf shrub which usually indicates grassland's degraded condition (Bredenkamp & Brown 2003). This grassland mostly has low species richness, with only a few other species able to establish or survive in the shade of the dense sward of tall grass. Most of these species are relict pioneers or early seral species.

- *Eragrostis plana Moist Grassland:*

The *Eragrostis plana* grassland is well represented occurring mainly in high rainfall parts of the study area. It is usually restricted to flat plains or bottomlands, mostly on moist, deep, clayey and poorly drained, seasonally wet soils, adjacent to wetlands and seasonal as well as perennial rivers. *E.plana* is conspicuous, often dominant member of this grassland type. *Paspalum dilatatum* and *Cynodon dactylon* are often present on degraded sites.

- *Cymbopogon plurinodis-Themeda triandra Grassland:*

The *Cymbopogon plurinodis-Themeda triandra* grassland occurs on flat or undulating plains with deep, non-rocky soils. These grasslands are relatively poor in plant species, though, since due to the arable soils, much has been destroyed for agricultural purposes. This type of grassland is very widely distributed over the interior plateaus of South Africa and is characterised by grasses such as Turpentine grass (*Cymbopogon plurinodis*) and *Trichoneura grandiglumis* and some forbs (O'Connor & Bredenkamp 1997). The dominant grass is mostly Red grass (*Themeda triandra*), with *Eragrostis curvula*, *Heteropogon contortus*, *Setaria sphacelata* and *Aristida congesta* also conspicuous (Coetzee et al. 1995; Bredenkamp & Brown 2003).

- *Monocymbium ceressiforme-Loudetia simplex Grassland:*

This high altitude grassland is found throughout the study area on rocky midslopes of ridges and hills. The soils are often shallow with high rock cover (up to 60% in some cases). This vegetation is found mostly on cooler slopes, but also occurs on the warmer north-facing slopes where scattered individuals of dwarf shrubs are present. This grassland is dominated by a range of grass species including the grasses *Monocymbium ceresiiforme*, *Digitaria monodactyla*, *Loudetia simplex*, *Trachypogon spicatus, Eragrostis racemosa, Andropogon shirensis, Schizachyrium sanguineum, Brachiaria serrata* and *Themeda triandra,* and woody dwarf shrubs such as *Protea welwitschii, Lopholaenia coriifolia*, and the geoxylophyte *Parinari capensis.*

- *Protea roupelliae* Cool Temperate Mountain Bushveld:

This vegetation unit is mainly found on relatively steep southern midslopes and rocky ridges. The slopes normally have a high rock cover with shallow sandy soils. These areas represent the relatively moist and cool habitats (Bredenkamp & Brown 2003). Typical species include the grass *Eragrostis micrantha* and the forbs *Crassula nodulosa, Gnidia sericocephala,* *Graderia subintegra, Indigofera hilaris, Indigofera melanadenia, Lotononis eriantha, Nemesia fruticans, Tephrosia rhodesica, Tritonia nelsonii* and *Selago tenuifolia*.

- *Themeda triandra-Acacia karroo* Microphyllous Woodland:

Acacia karroo-dominated woodlands are found on colluvial soils on footslopes, in bottomland plains and as riparian vegetation along streams and rivers. This vegetation type occurs over a wide range of soil and terrain types with low rock cover, but is mostly associated with moderately deep and often clayey, high nutrient, alluvial soils. This open woodland is characterised by trees such as *Acacia karroo* and *Ziziphus mucronata* dominating the woody layer. Typical grasses include *Themeda triandra* and *Setaria sphacelata*.

- *Grassy Pan Veld:*

This sweet grassland is dominated by White Buffalograss (*Panicum coloratum*), Lovegrass species (*Eragrostis curvula, E. plana*), *Setaria nigrirostris* and *S. spacelata*. Redgrass (*Themeda triandra*), is also present but is not as dominant on the clayey soils as on the deeper red sands. Lovegrass (*Eragrostis spp*.) dominates when overgrazed and in cases of severely degraded veld, Three-awn Rolling grass (*Aristida bipartita*) dominates.

- *Riparian shrub on stream and riverbanks:*

This riparian shrub community dominates the stream and riverbanks. Exotic trees such as Bluegums (*Eucalyptus camaldulensis*, *E. sideroxylon*) and the Weeping Willow (*Salix babylonica*) are present together with indigenous shrubs such as *Salix mucronata*, *Diospyros lycioides, Rhus pyroides, Lycium hirsutum, Acacia karroo, Combretum erythrophyllum* and *Ziziphus mucronata*. Grasses such as white Buffalograss (*Panicum coloratum*), Lovegrass species (*Eragrostis lehmanniana, E. obtusa*), *Setaria nigrirostris* and *S. spacelata* are also present.

- *Seepage areas and wetland communities:*

Seepage areas are seasonally wet areas that occur in sandy areas where water seeps into low-lying drainage lines after rains. These areas are usually covered by sedges and reeds. The dominant sedge in the study area is *Juncus rigidus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occurs. Wetlands are of a more permanent nature and occur in the low-lying areas such as tributaries of streams and rivers. Typical plants are the Orange River Lily (*Crinum bulbispermum*), bulrush (*Typha capensis*) and reeds (*Phragmites australis*), sedges of the *Cyperus, Fuirena* and *Scirpus* genera also occur.

- *Anthropogenic areas dominated mainly by exotic plants:*

These sites are usually highly disturbed. Different types of roads and tracks (secondary, tertiary and tracks) cut through the study area. These areas are cleared of any vegetation but in some areas groves of Bluegums were planted along the roads. Farmsteads are also denuded of any natural vegetation. Large groves of exotic trees, mainly Bluegum trees and Wattle trees, also occur around these sites.

With regard to the specific sites under investigation, Site X is largely transformed by planting of maize fields, and consequently has a low habitat diversity. The remaining patches of grassland are relatively degraded due to pressure from grazing. Vegetation in the vicinity of rocky crops is, to some extent, still intact i.e. consisting of indigenous vegetation, but is becoming degraded due to grazing pressures. *Acacia karroo, Diospyros lycioides* and *Rhus pyroides* are the dominant indigenous shrubs found in low-lying areas, drainage lines and seasonal streams. In areas of rocky outcrops, shrubs such as *Diospyros lycioides, D. austro-africana, Ziziphus mucronata, Celtis africana* and *Rhus pyroides* are present. Clumps of exotic black wattle (*Acacia mearnsii*) and blue gums are found on the site. Two protected species, namely *Cyrtanthus breviflorus* and *Crinum bulbispermum* were identified in the wetland communities on Site X.

With respect to animal life, signs of small and medium sized mammals, including suricate, ground squirrel, white-tailed mongoose, slender mongoose and antbear were noted. Springhare and porcupine were also reported to be present by the landowners. Several insect species were also found on site.

The proposed position of the power station precinct intersects with a seasonal stream that eventually flows into the Wilge River. Two springs flow into the stream, and the protected bulbous plant *C. breviflorus* is located in this vicinity. Should the power station precinct be located in the proposed position, the *C. breviflorus* individuals would be destroyed. The proposed pipeline, conveyor belt and road alignments cross largely transformed land dominated by agricultural activities, and little natural vegetation is expected to be found within these corridors.

Site X is considered to be largely transformed and largely degraded with a low carrying capacity[17], without any large areas that specifically require conservation. The impact of establishing a coal-fired power station and its associated infrastructure on Site X is therefore considered to be **low (-ve)** impact.

Site Y is mainly under maize cultivation, and the remaining grassland areas are in a relatively degraded state, with low species diversity. Vegetation on some rocky outcrops is to some extent still intact, but is showing signs of selective grazing. Dominant plant communities on the rocky outcrops include *Ziziphus mucronata, Diospyros lycioides, D. austro-africana, Celtis africana* and *Rhus pyroides*. *Diospyros lycioides*, *Acacia karroo* and *Rhus pyroides* are the indigenous shrubs found in low-laying areas along drainage lines and seasonal streams. Clumps of exotic black wattle (*Acacia mearnsii*) and blue gums are found on the site. However, four protected species were found in the rocky outcrop area; namely *Xerophyta retinervis, Delosperma herbium, Euphorbia clavaroides* and *Gladiolus crassipes*. The pipeline, conveyor and access road alignments are less disturbed than at Site X, and are more likely to cross sensitive vegetation types.

With respect to animal life, signs of small and medium sized mammals, including suricate, ground squirrel, white-tailed mongoose, slender mongoose and antbear were noted.

The proposed position of the power station precinct and ash dump intersects with rocky outcrops of quartzite and diabase. In both cases, these rocky outcrops support protected

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[17] Carrying capacity in this context refers to the ability of the vegetation to sustain life.

species, as mentioned above. Should the power station precinct be located in the proposed position, the *Xerophyta retinervis, Delosperma herbium, Euphorbia clavaroides* and *Gladiolus crassipes* communities would be destroyed or impacted upon. These are rare and / or endangered species, but the power station layout could be moved to avoid impacting on these species.

Site Y is considered to be largely transformed, and like Site X, is largely degraded with a low carrying capacity, and without any large areas that specifically require conservation. The ecological functioning of the site is significantly hampered, with a little potential for rehabilitation. The significance of the impact of establishing a coal-fired power station and its associated infrastructure on Site Y is therefore considered to be **low (-ve)**.

Since indirect dry cooling would require six cooling towers, which have a large footprint impact in comparison to the direct dry cooling fan bank, the significance of indirect dry cooling on terrestrial fauna and flora is deemed to be **medium (-ve)**.

Mitigation measures

If the position of the power station precinct on Site X were to be moved towards an area mainly under maize cultivation, possibly to the northeast of the proposed area, the stand of *C. breviflorus* would not be destroyed. If the position of the power station precinct and ash dump on Site Y were to be moved slightly, the protected plant species associated with the rocky outcrops could be protected. Furthermore, search, rescue and relocation of the protected species at both sites could be undertaken.

With mitigation measures in place, the significance of the potential impact on both Site X and Site Y would be reduced to **very low (-ve)**.

Impact of power station layout on terrestrial fauna and flora		
	SITE X	
	No mitigation	**Mitigation**
Extent	Site specific	Site specific
Magnitude	Low	V low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Site specific	Site specific
Magnitude	Low	V low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V low (-)**
Probability	Probable	Probable

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Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Footprint impact on terrestrial fauna and flora				
SITE X				
	Direct dry cooling		**Indirect dry cooling**	
	No mit	**Mit**	**No mit**	**Mit**
Extent	Site specific	Site specific	Site specific	Site specific
Magnitude	Low	V low	Medium	Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**V Low (-)**	**Medium (-)**	**Low (-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible
SITE Y				
Extent	Site specific	Site specific	Site specific	Site specific
Magnitude	Low	V low	Medium	Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**V Low (-)**	**Medium (-)**	**Low (-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible

5.2.4 Impact on aquatic fauna and flora

a) Impact Statement

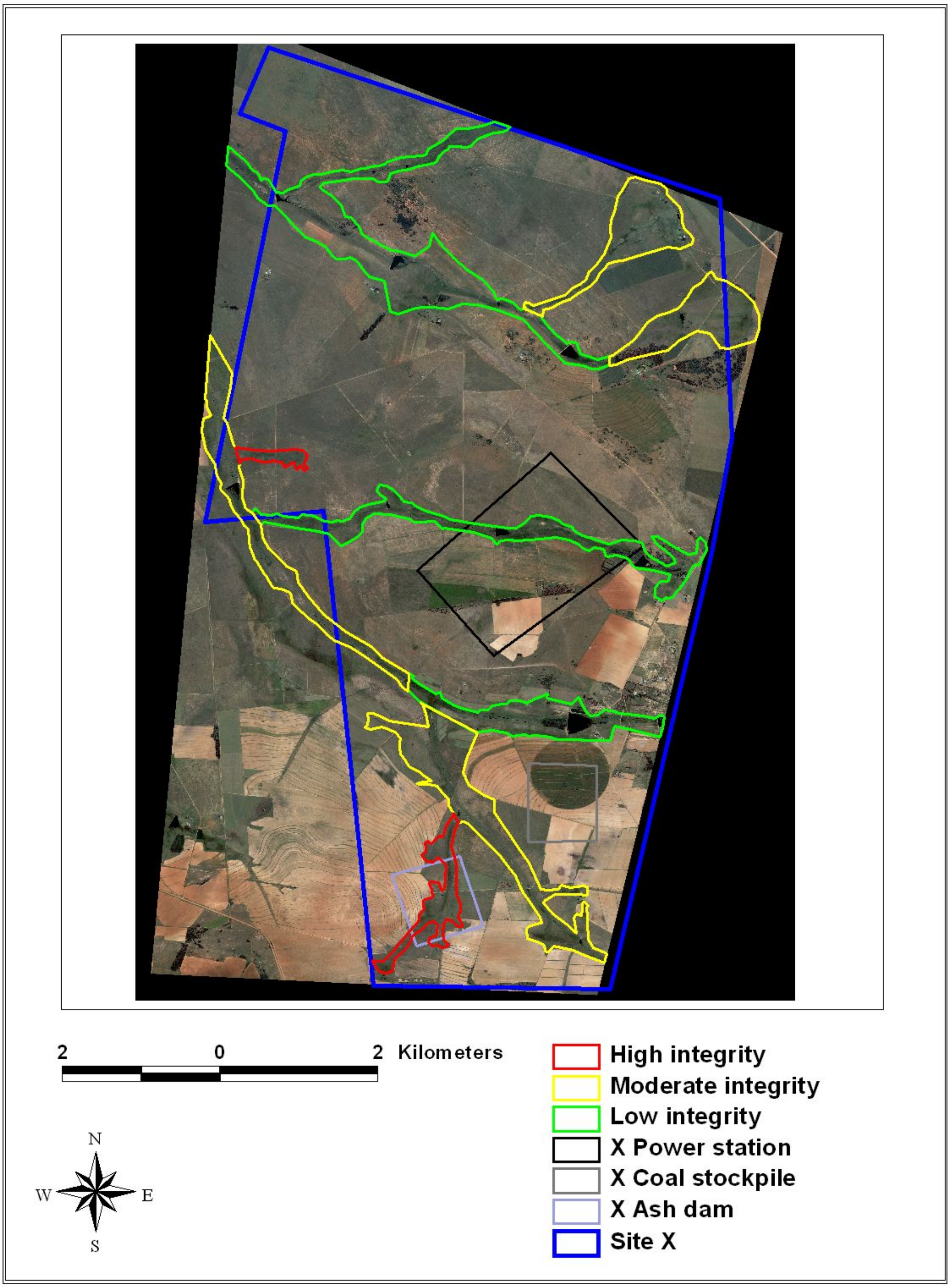
The proposed power station and associated infrastructure/ processes may have impacts on the existing aquatic fauna and flora at either of the alternative sites.

b) Discussion

Both Sites X and Y fall within the Olifants River quaternary catchment (catchment B20F). Various factors that influence overall aquatic ecology were assessed at Sites X and Y. These factors include:

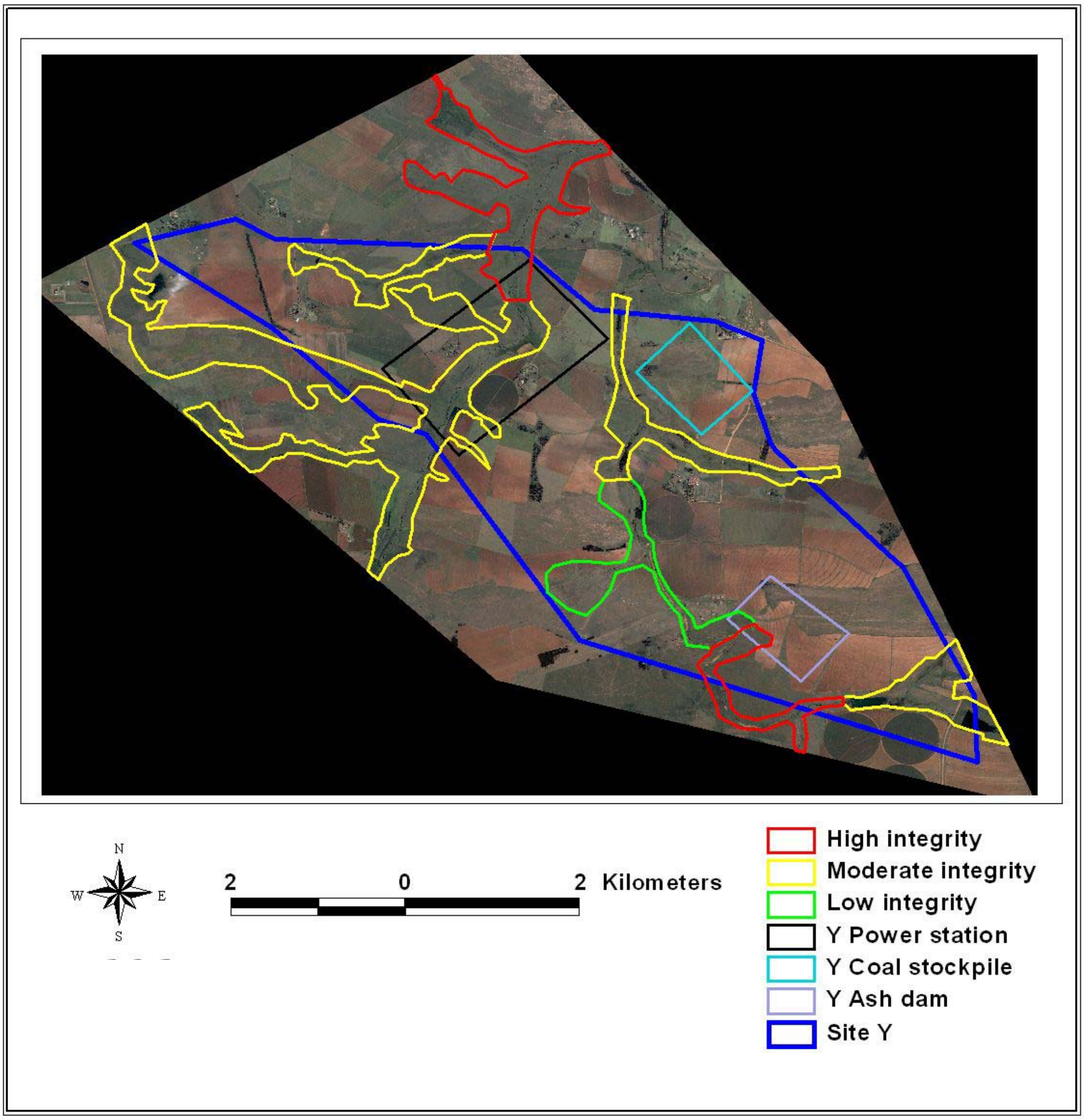
- Suitability of range of habitats;
- Presence of macro-invertebrates;
- The ecological state of the river;
- The presence of fish;
- Wetland integrity; and
- Wetland fauna and flora.

Overall, aquatic flora and fauna in the area have been impacted on by cropping, grazing and burning practices. In addition, the aquatic study was undertaken during winter when species



Source: Ecosun's aquatic report, Annexure H

Figure 5.1: Delineation of wetland integrity within Site X



Source: Ecosun's aquatic report, Annexure H

Figure 5.2: Delineation of wetland integrity within Site Y

richness is known to be reduced. To address this concern, Quickbird satellite imagery was purchased and used in the delineation of the wetlands, and to focus subsequent field work. The relative assessment of Site X versus Y is considered sufficient for this EIA and for informed environmental decision-making.

Habitat availability for macro-invertebrates is good at Site Y (Wilge River and upstream Klipspruit River) and poor at Site X (Klipfonteinspruit). Accordingly, fewer taxa of aquatic species were sampled at Site X than Site Y. Notably, Site X lacked the "stones-in-current" habitat which provides for the majority of macroinvertebrate fauna. The South African Scoring System version 5 (SASS5) is a system for evaluating aquatic systems based on the number of taxa present to determine the overall ecological status of the aquatic system. Site Y has a higher ecological status than Site X, although this is due primarily to the greater number of habitats at Site Y as opposed to a poor water quality at Site X.

Four species of fish were sampled in the study area; *Barbus anoplus* (Chubbyhead barb), *Chiloglanis pretoriae* (Shortspine suckermouth), *Pseudocrenilabrus philander* (Southern mouthbrooder) and *Tilapia sparrmanii* (Banded tilapia). The chubbyhead barb was the most abundant fish species, comprising 71% of the total number of specimens sampled. The presence of the Shortspine suckermouth in the Wilge River is of significance as it is an indicator of good water quality and the presence of specialised habitat requirements. It is anticipated that the Shortspine suckermouth fish population in the Wilge River represents one of the few remaining populations in the upper Olifants River catchment.

Wetland and riparian vegetation at both sites consists of 28 species of wetland grass, 20 species of grass associated with both wetlands and grassland and 30 grass species of grassland/ veld. None of the wetland and riparian flora was known to be a Red Data species.

The grass owl was noted in the study area and is a Red Data species. None of the 45 small mammals recorded were listed as a Red Data species. Of the 12 amphibian species known to occur in the area, four were recorded on site. The 12 amphibian species are common in the region. There are 34 known reptile species in the area, all of which are quite common.

Site X supports six different types of wetland types, while Site Y supports five. Most of the wetland integrity at Site X is considered to be impaired with only two wetland sections of high integrity. **Figure 5.1** illustrates where the wetlands of varying integrity are located within Site X. The wetlands at Site Y appear to have a higher overall integrity (please refer to **Figure 5.2**).

c) Description and significance of potential impact

Power station surface infrastructure (including dams, coal stockyard, water and wastewater treatment facilities)

The proposed layouts could result in a direct impact on the aquatic environment, or could have an indirect impact on the aquatic environment. At both sites the proposed layout would have a direct footprint impact on the aquatic environment, due to being directly on sections of wetland, resulting in loss of wetland extent. However, an indirect impact is linked to the loss of wetland services that results from the loss of the actual wetland. These impacts would be more severe at Site Y, where the proposed layout would impact on wetlands of moderate to high integrity. The coal stockyard, in its current location, would not directly affect any wetlands at Site X or Y, but seepage from the coal stockyard could impact on surrounding aquatic flora and fauna. Site Y has wetlands of higher integrity and offers more wetland services than Site X. Overall there are no endangered aquatic species at either Site X or Y. The power station at Site Y would impact directly on wetlands of moderate to high integrity. Accordingly impacts at Site Y would have a high magnitude over a long term, as opposed to a low magnitude over a long term at Site X. Accordingly a **low (-ve)** significance impact is anticipated at Site X and a **high (-ve)** significance impact at Site Y.

Roads, railway, conveyor and pipeline corridors

The construction of roads, a railway line, conveyors and pipelines will have an impact on a number of wetlands systems on Sites X and Y, as well as outside the study area, making a comprehensive assessment challenging. Buried pipelines crossing wetlands may have a greater impact than above-ground pipelines due to their impact on subterranean water flows. The impacts are likely to be the same on Site X and Site Y, the significance of which is deemed to be **high (-ve)**, given the long-term duration, local extent and high magnitude.

Ash disposal

The proposed above ground disposal of ash could have direct and indirect impacts on the aquatic environment. The ash dump would have a direct footprint impact on the aquatic environment. The proposed location of the ash dump on Site X is the middle of a high integrity wetland. At Site Y, the proposed ash dump would be on the fringe of a high integrity wetland.

Indirect impacts associated with an above ground ash dump on the aquatic ecological environment include the impacts of dust blown from the dump increasing sediment levels of aquatic systems, resulting in loss of habitat due to smothering, increased turbidity, decreased photosynthesis and physiological stress on organisms. The impact at both Site X and Site Y would have a high magnitude and long term duration. Accordingly a **high (-ve)** significance impact is anticipated**.**

Back ashing and in-pit ashing would occur off-site and accordingly a neutral impact is expected at Sites X and Y. Prior to there being sufficient space within the mine workings, a temporary dump would need to be constructed to store ash until it was finally disposed of at the relevant coal mine. The temporary ash dump would also be used in emergency situations, but would be much smaller than the ash dump required for above-ground ashing. The impact of the temporary ash dump at Site Y is likely to be of low magnitude, local extent and medium term duration. At Site X, the impact would be a very low magnitude. Accordingly, a **very low (-ve)** significance impact is anticipated at Site X and a **low (-ve)** significance at Site Y.

Flue gas desulphurisation

The storage of the wet slurry may have some impacts for aquatic fauna and flora, should there be any spillage of the material into the aquatic environment. There is greater concern at Site Y, given the presence of the Shortspine suckermouth fish, which is particularly sensitive to poor water quality. However, as there are DWAF minimum requirements in place regarding the design of the waste disposal site, the magnitude and extent of any impacts at Sites X or Y is anticipated to be very low and local, respectively. The significance of such an impact is anticipated to be **very low (-ve)** at both Sites X and Y.

A full copy of the Aquatic Ecology study is contained in **Annexure H** of this dEIR.

Mitigation measures

Potential mitigation measures that could be implemented include:

- Realigning the proposed layout of the various structures to avoid drainage lines and wetlands:
  - At Site X, moving the power station, coal stockyard and ash dump northwards to lie between the delineated low integrity wetlands;
  - At Site Y, minimal mitigation is possible due to the fact that there are technical reasons (with regard to cooling systems mainly) for specific layouts and there is little space at Site Y to achieve a technically efficient layout without impacting on wetlands and drainage lines;
- Placing the ash dump and coal stock yard on top of a suitably prepared surface to prevent leaching into aquatic ecosystems;
- Siting dams on appropriate underlying geology;
- Ensuring appropriate drainage around all waste sites, including the above ground ash dump;
- Ensuring that construction and operational phase activities steer clear of drainage lines and identified sensitive wetland sections;
- Implementing dust suppression measures on the ash dump; and
- Storing all oil and other hazardous substances in appropriately designed, bunded storage areas.

d) Impact assessment results

Site Y has a higher biodiversity and biotic integrity than at Site X. Site X has a generally poor and degraded biotic integrity. Accordingly Site X is the preferred site from an aquatic flora and fauna perspective.

Impact of the proposed power station and associated infrastructure layout on the aquatic environment		
	SITE X	
	No mit	**Mit**
Extent	Local	Local
Magnitude	Low	V low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Local	Local

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Magnitude	High	Med
Duration	Long	Long
SIGNIFICANCE	**High (-)**	**Med (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible*	Reversible

*Should the Shortspine suckermouth be eradicated in the upper Olifants catchment.

Impact of surface ashing on aquatic environment		
	SITE X	
	No mit	**Mit**
Extent	Local	Local
Magnitude	High	V Low
Duration	Long	Long
SIGNIFICANCE	**High (-)**	**V Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible
	SITE Y	
Extent	Local	Local
Magnitude	High	Low
Duration	Long	Long
SIGNIFICANCE	**High (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

Impact of emission control technologies on the aquatic environment				
	Wet FGD		**Dry FGD**	
		SITE X		
	No mit	**Mit**	**No mit**	**Mit**
Extent	Local	Site specific	Local	Site specific
Magnitude	V low	V Low	V low	V Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**V low (-)**	**V low (-)**	**V low (-)**	**V low (-)**
Probability	Unlikely	Unlikely	Unlikely	Unlikely
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible
		SITE Y		
Extent	Local	Site specific	Local	Site specific
Magnitude	V low	V Low	V low	V Low

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Duration	Long	Long	Long	Long
SIGNIFICANCE	**V low (-)**	**V low (-)**	**V low (-)**	**V low (-)**
Probability	Unlikely	Unlikely	Unlikely	Unlikely
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible

5.2.5 Compliance with ambient air quality legal requirements

a) Impact Statement

The establishment of an approximately 5 400 MW power station in the Witbank geographical area will be associated with emissions of various common pollutants such as SO_X, NO_X, CO_2 and particulate matter and trace emissions of various heavy metals. If uncontrolled, the proposed power station will impact significantly on air quality in the Witbank region and potentially further afield.

Ambient air pollutant concentrations predicted to occur as a result of the proposed power station, taking into account existing air pollution levels, are compared to the legal requirements for ambient air quality. The potential for non-compliance with air quality limits due to emissions of the aforementioned pollutants are discussed in this section. The implications of such emissions in terms of global climate change, vegetation damage and corrosion potential and health risk potentials are discussed in Sections 5.2.6, 5.2.7 and 5.3.3 respectively.

b) Discussion

The two candidate sites are located to the north west of the existing Kendal Power Station, and to the west of Witbank, in the Mpumalanga and Gauteng provinces. Since the power station would be associated with low level emissions from the ashing operations, and elevated emissions from the flue stacks, the power station has the potential to affect sensitive receptors in the near and medium fields. Accordingly, an air quality assessment was undertaken by Airshed Planning Professionals.

The terms of reference for the air quality assessment included the following:

- Reviewing the legislative and regulatory requirements pertaining to air pollution control and air quality management;
- Characterisation of the existing air quality and identification of existing sources of pollution;
- Identification of sensitive receptors in the vicinity of the proposed power station development;
- Application of an atmospheric dispersion model to predict the incremental and cumulative air pollutant concentrations and dustfall rates occurring as a result of the power station; and
- Assessment of air quality impacts with respect to: (i) compliance with local and international limits, (ii) potential for local air quality impacts given the location of sensitive receptors and (iii) with respect to contribution to national greenhouse gas emissions.

The methodology used for the investigation included reviewing and using existing information including air quality measurements, compiling emission inventories for existing and proposed sources, and undertaking atmospheric dispersion modelling using the CALMET/CALPUFF modelling suite. Dispersion modelling was used to project spatial and temporal variations in current and future baseline air pollutant concentrations, in addition to predicting incremental and cumulative air pollutant concentrations likely to occur as a result of the proposed power station. A full explanation of the methodology and the detailed report are included as **Annexure I** but please note that a revision of the report, to adequately address concerns regarding air quality impact on poultry, was subsequently undertaken. The revised report is presented as **Annexure V**.

Legal Context

In South Africa, air pollution control is governed by the Air Pollution Prevention Act (No. 45 of 1965) (APPA) and the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEMAQA). NEMAQA is intended to replace the APPA in its entirety in the foreseeable future. NEMAQA is essentially a framework act with various regulations still requiring development and implementation to meet the objectives laid out in the Act. The national framework comprising the development of systems, procedures and protocols for air quality management, monitoring, and information management etc. has, for example, still to be developed. For this reason, uncertainty currently exists with regard to how various issues are to be dealt with under the NEMAQA. Uncertainties of significance in terms of the current study include:

- Manner in which ambient air quality and emission standards are to be applied;
- Regulatory approaches for existing and new operations; and
- Approach to proposed developments planned for airsheds that are currently potentially in non-compliance with air quality limits.

Ambient air quality standards, included in a schedule to the NEMAQA, represent air pollution concentration levels that are to be attained and maintained though the management of air pollution sources. Cumulative air pollutant concentrations, arising due to the emission of all sources, must be managed to within the required limits.

The air quality standards included in the schedule to the NEMAQA are based primarily on air quality guidelines issued by the Chief Air Pollution Control Officer in the 1990s, with the exception of the limits for sulphur dioxide which were revised in 2000. Given that such standards are intended to protect the health of the majority of the population, and that health effects have subsequently been observed to occur at concentrations below the limits set, the DEAT is currently in the process of revising its air quality limits. In June 2006 the DEAT published for comment revised ambient air quality limits that were based largely on the air quality limits published recently by Standards South Africa (SANS 1929:2004). It is therefore appropriate to compare measured and predicted ambient air pollutant concentrations against both the current SA air quality standards (as documented in the NEMAQA) in addition to the SANS / proposed SA limits (Table 5.1).

Table 5.1 Air quality limits used to assess potential current and future compliance

	10 min max µg/m³	1 hour max µg/m³	24 hour max µg/m³	1 month µg/m³	Annual avg. µg/m³
PM10[18]					
SA standard (NEMAQA)			*180*		*60*
SANS limits (SANS1929:2004)			*75 limit 50 target*		*40 limit 30 target*
Proposed SA standard (gazette 28899, 9 June 2006)			*75*		*40*
SO_2					
SA standard (NEMAQA)	***500***		***125***		***50***
SANS limits (SANS1929:2004)	***500***		***125***		***50***
Proposed SA standard (gazette 28899, 9 June 2006)	***500***	***350***	***125***		***50***
NO_2					
SA standard (NEMAQA)	***940***	***376***	***188***	***150***	***94***
SANS limits (SANS1929:2004)		***200***			***40***
Proposed SA standard (gazette 28899, 9 June 2006)		***200***			***40***

In assessing "compliance" with the air quality limits given in Table 5.1 it is important to note the following:

- Variations in where air quality limits are applicable. The EC, for example, stipulates that air quality limits are applicable in areas where there is a reasonable expectation that public exposures will occur over the averaging period of the limit. In South Africa there is still considerable debate regarding the practical implementation of the air quality standards included in the schedule to the NEMAQA. The Act does however define "ambient air" as excluding air regulated by the Occupational Health and Safety Act of 1993. This implies that air quality limits may be required to be met beyond the fencelines of industries.

- The SA standards included in the schedule to the NEMAQA and those issued by the SANS (and proposed for adoption by DEAT) are incomplete when compared to legal limits issued by other countries. Air quality standards typically comprise: thresholds, averaging periods, monitoring protocols, timeframes for achieving compliance and typically also permissible frequencies of exceedance. (Thresholds are generally set based on health risk criteria, with permissible frequencies and timeframes taking into account the existing air pollutant concentrations and controls required for reducing air pollution to within the defined thresholds.) The practice adopted in Europe is to allow increasingly more limited permissible frequencies of exceedance, thus encouraging the progressive reduction of air pollution levels to meeting limit values.

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[18] PM10 refers to particulate matter with an average aerodynamic diameter of less than 10 µm

Noting the above, a conservative approach to assessing compliance would be to define non-compliance as comprising a single exceedance of the limit value occurring anywhere beyond the "fenceline" of the power station. A less conservative approach would be to make reference to the permissible frequencies of exceedance issued elsewhere, such as by the UK and EC. (The UK and EC short-term limits for sulphur dioxide are comparable to those issued by SA. The UK however permits a number of annual exceedances of these short-term thresholds to account for meteorological extremes and to support progressive air quality improvement.)

In assessing the potential for non-compliance which would occur given the finalisation of the SA air quality standards, reference is made to the following permissible frequencies of exceedance:

- UK and EC stipulates a maximum of 24 exceedances of the hourly SO_2 limit of 350 µg/m³ during one calendar year (compliance by 2005);
- UK and EC stipulates a maximum of 3 exceedances of the daily SO_2 limit of 125 µg/m³ during one calendar year (compliance by 2005);
- UK and EC stipulates a maximum of 18 exceedances of the hourly NO_2 limit of 200 µg/m³ during one calendar year (compliance by 2005).

The SANS (and proposed SA) limit values given in Table 5.1 are predominantly in line with international good practice as reflected though the comparison of such limit values with those published for the *protection of human health* by the World Health Organisation (WHO), the European Community (EC), the World Bank, the United Kingdom (UK), Australia and the United States Environmental Protection Agency (US-EPA). Such limit values are however less stringent when compared to certain international limits designed to protect vegetation or, more broadly, ecosystems. For example, the proposed SA limit for annual average sulphur dioxide is given as 50 µg/m³ for the protection of human health, whereas the EC specifies an annual limit of 20 µg/m³ for the protection of ecosystems. When assessing the potential for vegetation impacts reference is therefore made to dose-response relationships where these exist.

Further to the air quality limits given in Table 5.1, there are also standards for dust deposition, inhalation of non-carcinogenic compounds, cancer risk factors, health-related dose-response thresholds for SO_2 and dose response thresholds indicative of vegetation injury and corrosion potentials.

Status quo of the baseline air quality in the region

Sensitive receptors

Residential areas in the immediate vicinity of the proposed operations include Phola and Ogies, located some 10 to 18 km east of the proposed sites, with smaller areas such as *inter alia* Voltargo, Cologne, Klippoortjie, Madressa, Witcons, Saaiwater, Tweefontein and Klipplaat also in the vicinity. The largest residential concentration with a 30 km radius of the proposed power station is Witbank

Existing sources

The identification of existing sources of emission in the region and the characterisation of existing ambient pollutant concentrations is fundamental to the assessment of the potential for cumulative impacts and synergistic effects.

Sources which contribute to ambient air pollutant concentrations within the study region include:

- Emissions from various Eskom power stations;
- Stack, vent and fugitive emissions from industrial operations;
- Fugitive emissions from mining operations, including mechanically generated dust emissions and gaseous emissions from blasting and spontaneous combustion of discard coal dumps;
- Vehicle entrainment of dust from paved and unpaved roads;
- Vehicle tailpipe emissions;
- Household fuel combustion (particularly use of coal);
- Biomass burning (veld fires); and,
- Various other fugitive dust sources, e.g. agricultural activities and wind erosion of open areas.

Atmospheric emissions were quantified and simulated for the majority of the above-mentioned sources during the air quality impact study.

Industries within the study region include iron and steel, ferro-alloy and brickwork operations. Various underground and open cast coal mining operations occur within the study region. Such operations are associated with significant dust emissions, sources of which include land clearing, blasting and drilling operations, materials handling, vehicle entrainment, and crushing and screening of material.

Measured and Predicted Current Baseline Air Quality

Eskom operates two ambient air quality monitoring stations within the study region, viz. the Kendal 2 monitoring station and recently established (May 2006) Kendal B monitoring station. Ambient SO_2, NO_X and PM_{10} concentrations are recorded at these stations in addition to various meteorological parameters such as wind speed and direction. Reference was made to data from the monitoring stations primarily for the purpose of validating predicted air pollution concentrations from the simulation of estimated emissions due to existing sources.

The Kendal 2 station is located within the zone of maximum ground level concentration (GLC) occurring due to the existing Kendal Power Station's emissions. The Kendal B station is situated in the vicinity of the old Wilge Power Station that is relatively close to the more eastern candidate site (i.e. Site X) for the proposed power station.

From the measured data and modelled baseline ambient SO_2, NO_2 and PM10 concentrations in the study area[19], the following conclusions can be drawn:

- *SO_2 within GLC maximum zones within study area (measured and predicted)* - Ambient SO_2 limits were measured and predicted to be substantially[20] exceeded for hourly and daily averaging periods within zone of maximum ground level concentration of power stations situated in the study region. The exceedances were a factor of 6 times above hourly SO_2 limits, for more than 200 hours per year; and 20 to 30 days per year. The frequencies of exceedance permitted are above those permitted by the EC. The potential for significant exposure is however limited due to there being low density of human settlement in the immediate vicinity.

  Eskom power stations are expected to be the main contributing sources to the ambient SO_2 ground level concentrations in the study area, and responsible for the zones of maximum GLC noted. That these zones tend not to coincide with substantial exposure potentials is due to the power stations being located at relatively remote sites. Other significant sources of SO_2 emissions in the study area include household coal burning, industrial emissions and spontaneous combustion from coal discards.

- *SO_2 within residential areas in study area (predicted)* - Within the residential area of Phola, short-term SO_2 ground level concentrations were predicted to exceed the proposed SA hourly air quality limit and the current SA daily limit on a less frequent basis than within the zones of maximum GLC (i.e. <20 hours/year and ~2 days/year respectively). The frequencies of exceedance within residential areas within the study area are generally predicted to be within those permitted by the EC and UK.

- *Synopsis of spatial extent of SO_2 non-compliance* - Much of the study area (as defined) is predicted to experience exceedances of the hourly SO_2 limit and therefore potentially in non-compliance if non-compliance is conservatively defined as a single exceedance of SA limits (given the absence of permissible frequencies). The maximum frequency of exceedance of the hourly SO_2 limit permitted by the EC is predicted to be exceeded over Site Y and to the south and southeast of this site – extending beyond the 30 km study area. A significant portion of the study area could therefore be classified as being in non-compliance should EC permissible frequencies be taken into account.

- *NO_2 concentrations* - Exceedances of the hourly limit for NO_2 are predicted and measured to occur in the study area including within the zone of maximum GLC of the existing power station in the area. These exceedances are however limited in magnitude and extent and are well within the permissible frequencies permitted by the EC. Predicted annual NO_2 concentrations were also determined and measured to

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[19] Study area defined for the purpose of discussing the extent of existing ambient air pollution concentrations at the area within ~30 km of candidate site Y.
[20] Substantial exceedance defined in terms of the magnitude (i.e. factor 6 times above hourly SO_2 limit) and frequency (>200 hours per year;) of the exceedance.

be well within current and proposed SA air quality limits. No exceedances of the NO_2 air quality limits were predicted to occur within the neighbouring residential area of Phola, despite highest hourly NO_2 levels being predicted to represent ~95% of the limit value.

- *Suspended fine particulate concentrations* - Ambient PM10 concentrations were predicted to exceed current and proposed SA standards, specifically within household fuel burning areas in the study area (e.g. Phola and parts of Delmas, Bronkhorstpruit and Witbank). These elevated concentrations are due to the low-level household fuel burning emissions tending to coincide with periods of poor atmospheric dispersion (night-time, winter-time).

The main conclusion drawn from the baseline air quality compliance assessment is that considerable potential exists for cumulative concentrations and increases in the magnitude and frequency of SO_2 limit exceedances and hence the spatial extent of non-compliance.

Impact of establishing a new coal-fired power station on Site X or Site Y

Sources of emissions associated with the operational phase of the proposed power station include particulate and gaseous emissions from the power station flue stacks as well as low-level fugitive releases from the materials handling and ash-disposal facilities at the power station. Pollutants released would include particulates, sulphur dioxide, oxides of nitrogen, various trace metals, carbon dioxide and nitrous oxide.

In simulating and assessing ambient air pollutant concentrations occurring due to the proposed power station, *cumulative* concentrations arising due to the proposed power station emissions and releases from existing sources were accounted for. In order to more accurately determine the cumulative impact of the proposed power station on ambient air quality, a future base case scenario was simulated taking into account the projected increasing coal consumption, and hence emissions, of certain of the Eskom power stations (as projected for the year 2009).

A total of 12 emission scenarios were simulated and evaluated for the proposed power station as outlined in Table 5.2. All emission scenarios comprise 6 units of 900 MW each, distinguishing between different candidate sites, stack heights (150 m[21], 220 m and 300 m) and sulphur dioxide control efficiencies (0% and 90%). Effective particulate abatement measures were assumed to be implemented for all scenarios.

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[21] Eskom has a 'tall stack policy' and would therefore not construct a power station with a 150 m high stack. The 150 m stack height was however modelled and is included for comparative purposes.

Table 5.2 Description of the 12 proposed power station emission scenarios modelled

Scenario	Site	Stack Height (m)	SO_2 control efficiency
A 1	Site X	150	0%
B 1	Site Y	150	0%
C 1	Site X	220	0%
D 1	Site Y	220	0%
E 1	Site X	300	0%
F 1	Site Y	300	0%
A 2	Site X	150	90%
B 2	Site Y	150	90%
C 2	Site X	220	90%
D 2	Site Y	220	90%
E 2	Site X	300	90%
F 2	Site Y	300	90%

Based on the above scenarios, incremental and cumulative SO_2, NO_2 and PM10 concentrations were predicted for the entire study region. The main conclusions drawn are as follows:

- *Cumulative NO_x concentrations* - Predicted NO and NO_2 hourly concentrations were predicted to infrequently exceed the current SA hourly NO standard and the SANS/proposed SA NO_2 limit respectively for a new power station situated on either Site X or Site Y. The daily and annual average ground level concentrations were however predicted to be within relevant limits. Although the existing and new coal fired power stations in the area contribute to the ambient oxides of nitrogen concentrations, other significant sources of NO_X emissions in the area include domestic fuel burning, vehicle tailpipe emissions and other industrial activity. The magnitude of the power stations contribution to NO_X concentrations is considered to be low, with a long-term duration. The significance of this impact is consequently considered **low (-ve)**.

- *Cumulative PM10 concentrations and dust deposition rates (with mitigation in place)* - It is predicted that the total PM10 concentrations with the proposed new power station on Site X or Site Y would be within the current South African daily and annual standards, but concentrations would exceed the SANS / proposed SA daily limits within the vicinity, and within 10 km east of the ash dump. Public exposure within this area is limited, restricted to scattered farmsteads with an average residential density of approximately 5 persons / km^2. The maximum monthly dustfall rates were typically considered to be 'moderate' (i.e. 250 – 500 mg/m^2/day) immediately downwind of the proposed ash disposal facility and the materials handling facility, decreasing to 'slight' dustfalls (i.e. < 250 mg/m^2/day) beyond this area. The magnitude of this impact is considered to be low, with a long term duration, making this a **low (-ve)** significance impact, given the partial compliance with the standards and the low density of people in the vicinity of the maximum ground level concentration area.

- *Cumulative SO_2 concentrations* – Emissions from existing power stations are predicted to result in substantial exceedances of SA SO_2 limits within parts of the study area making it challenging for cumulative concentrations to be within limits regardless of the site selected, the stack height or the SO_2 control efficiency implemented. The frequency and magnitude of air quality limit exceedances due to the proposed power station will however vary considerably depending on whether or not SO_2 mitigation is implemented.

- *Cumulative SO_2 concentrations without mitigation in place* – Although cumulative concentrations were predicted for the entire study region, predicted ground level concentration maximums within 25 km radius of the proposed power station and at Phola (potentially most impacted residential settlement) are presented in Table 5.3 for each of the emission scenarios (excluding SO_2 mitigation). Substantial exceedances of the SA hourly and daily limits are predicted to occur, not only within the zone of maximum ground level concentration but also within the Phola residential area. Predicted frequencies of exceedance at Phola are above the permissible frequencies specified by the EC irrespective of the power station stack height or location.

Table 5.3 Maximum SO_2 concentrations and frequencies of exceedances of air quality limits predicted to occur due to the base case operations and cumulatively as a result of *uncontrolled* emissions from various power station configurations, within a 25 km radius of the proposed power station.

Location	Scenario	Predicted SO_2 concentrations (µg/m^3)			Compliance Potential	
		Highest Hourly	Highest Daily	Annual Average	Frequency of Exceedance of SANS / proposed SA limit of 350 µg/m³(a)	Freq Exc SA Daily Limit of 125 µg/m³ (b)
GLC max	Current	4603	299	44	**278**	**28**
	Future Base case	4814	324	49	**296**	**35**
	A1	5879	388	73	**446**	**57**
	B1	4814	438	70	**470**	**64**
	C1	4814	346	66	**394**	**51**
	D1	4814	350	67	**429**	**54**
	E1	4814	343	61	**366**	**48**
	F1	5170	348	63	**389**	**47**
Phola	Current	1151	119	29	16	2
	Future Base case	1206	135	34	19	**6**
	A1	1366	222	57	**182**	**28**
	B1	1206	188	49	**110**	**21**
	C1	1279	159	51	**99**	**19**
	D1	1206	153	48	**77**	**16**

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	E1	1206	158	47	**68**	**14**
	F1	1206	158	45	**45**	**10**

(a) EC permits 24 exceedances per calendar year
(b) EC permits 3 exceedances per calendar year

- *Cumulative SO_2 concentrations with mitigation in place* – Predicted ground level concentration maximums within 25 km radius of the proposed power station and at Phola (potentially most impacted residential settlement) are presented in Table 5.8 for each of the emission scenarios (including SO_2 mitigation; 90% control efficiency). The main conclusions reached were as follows:
    - With a 90% SO_2 control efficiency for all proposed power station configurations, cumulative sulphur dioxide concentrations would exceed the South African 10-minute standard and SANS / proposed SA standard in the maximum impact zone and at Phola, and would exceed the SA daily standard. This is mainly due to the high ambient levels.
    - With the addition of the proposed power station, operating with at least 90% SO_2 control efficiency, the magnitude, frequency and spatial extent of non-compliance appears to be within ranges comparable to those projected for the future base case. This is applicable to both the maximum zone of impact and Phola.

Table 5.4 Maximum SO_2 concentrations and frequencies of exceedances of air quality limits predicted to occur due to the base case operations and cumulatively as a result of *controlled emissions* from various power station configurations, within a 25 km radius of the proposed power station.

Location	Scenario	Predicted SO_2 concentrations (μg/m^3)			Compliance Potential	
		Highest Hourly	Highest Daily	Annual Average	Frequency of Exceedance of SANS / proposed SA limit of 350 μg/m³(a)	Freq Exc SA Daily Limit of 125 μg/m^3 (b)
GLC max	Current	4603	299	44	**278**	**28**
	Future Basecase	4814	324	49	**296**	**35**
.	A2	4814	326	51	**302**	**35**
	B2	4814	326	51	**308**	**35**
	C2	4814	326	51	**302**	**35**
	D2	4814	327	51	**308**	**35**
	E2	4814	326	50	**301**	**35**
	F2	4814	326	51	**308**	**35**

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Phola	Current	1151	119	29	16	2
	Future Basecase	1206	135	34	19	**6**
	A2	1206	135	36	19	**7**
	B2	1206	135	35	19	**7**
	C2	1206	135	35	19	**7**
	D2	1206	135	36	19	**7**
	E2	1206	135	35	19	**7**
	F2	1206	135	35	19	**7**

(a) EC permits 24 exceedances per calendar year
(b) EC permits 3 exceedances per calendar year

- *Significance of stack height* – If uncontrolled the proposed power station with a 150 m stack would result in the most significant non-compliance with SO_2 limits and pose the greatest risk to sensitive receptors. Reduced impact potentials can be realised through the extension to ~220 m. Further increments in the stack height were predicted to realise only minor further reductions in ground level concentrations and were associated with potentially more persons being exposed to sulphur dioxide concentrations in excess of air quality limits (due to the larger sphere of influence of the power station). It must be noted that Eskom has a 'tall stack' policy which would preclude the construction of a 150 m stack.

- *Significance of site selection* – Compliance and exposure potential results for the two candidate sites were mixed(22) with neither of the sites being identified as being considerably better than the other site.

As a result of the projected cumulative SO_2 concentrations, the significance of the impact of new power station with *no SO_2 abatement* on ambient air quality is deemed to be **high (-ve)** for both Site X and Site Y. A power station with a 150 m high stack at Site Y appears to result in the worst non-compliance scenario, while a 220 m to 300 m stack height on Site X provides the best case for the uncontrolled situation. However, even for the best case scenario, exceedances still increased by some 30% above the future base case scenario.

With SO_2 abatement in place for the proposed power station the significance of the air quality impact is deemed to be **low (-ve)** for Site X and Site Y, under all stack height scenarios. Site X does however result in smaller increase in exceedances than Site Y for all stack height scenarios.

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[22] For the uncontrolled scenario, a new power station at Site X results in a slightly fewer SO_2 exceedance events with respect to the SA 10-minute and average daily concentrations limits than at Site Y, in the area of maximum ground level concentration. However, when comparing the impact of the power station at Phola, Site Y resulted in fewer exceedances of the SA standards than at Site X. For the controlled scenario, Site X resulted in fewer exceedances than at Site Y, in the area of maximum ground level concentrations, but there was no difference in exceedances at Phola.

Transportation energy costs related to sorbent provision

As mentioned above, the sorbent could be transported to the power station by either rail, road or a combination of both, depending on where the sorbent is sourced. Should rail be utilised, the existing infrastructure makes allowance for electric locomotive transport.

Long haul freight electric locomotives consume approximately 0.03kWh per tonne per kilometre of haulage (based on unit emissions for freight trains in Finland (VVT Technical Research Centre Finland, 2002)).

Table 5.5 Table of sorbent consumption and its associated transportation electricity consumption

	Sorbent CaO %	**Sorbent Consumption** (Tons/Year)	**Average Transport Distance** (km)	**Electricity consumption** (kWh/t/km)	**Electricity Consumed per annum** (GWh)
Wet FGD	46%	550 000	120	0.03	1.98
Semi-dry FGD	90%	522 000	1 000	0.03	15.66

Therefore, the transport of sorbent by rail (electric locomotive) from the relevant mine to the power station would result in the consumption of approximately 1.98 GWh per year for wet FGD and 15.66 GWh per year for semi-dry FGD. According to Eskom's Sustainability Review 2006, the environmental implications of using the energy consumed for the transportation of sorbent can be extrapolated as follows:

Table 5.6 Estimated emissions associated with the transportation of sorbent

	Elec. consumed per annum (GWh)	**Coal used** (tonnes)	**Water used** (Ml)	**Ash produced** (tonnes)	**Particulate emissions** (kg)	**CO_2 emissions** (tonnes)	**SO_X emissions** (tonnes)	**NO_x emissions** (tonnes)
Wet FGD	1.98	1 069	2.77	317	436	1 936	16 757	8 336
Semi-Dry FGD	15.66	8 456	21.92	2 506	3 445	15 315	132 531	65 929

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The above emissions are based on the total energy sold, and are averaged across all Eskom power stations.

The proposed power station would produce some 364 082 tonnes per annum of SO_2 without any SO_2 controls in place. If controls were put into place, the SO_2 emissions are likely to be reduced by 90%, which equates to a reduction of approximately 327 674 tonnes per annum. The SO_2 cost of sorbent transport would therefore range between 16 757 and 132 531 tonnes per annum. This SO_2 cost is insignificant if the sorbent is provided by a local mine, rather than from the Northern Cape. Therefore the effective SO_2 reduction, if one is to factor in the electricity requirements associated with the transport of sorbent from the mine to the power station, is between 54% and 85% depending on where the sorbent is sourced from.

The above energy costs are only valid for the use of electric railway, and are obviously not applicable to other forms of transportation.

Mitigation

NO_X would be further reduced by the inclusion of low NO_X in the design of the boilers. This is the standard technology that is implemented at many power stations in South Africa and globally. This would maintain the significance of the impact at **low (-ve).**

It was assumed that particulate abatement measures such as bag filters or electrostatic precipitators would be implemented at the proposed power station to reduce PM_{10} emissions. The implementation of this abatement technology resulted in a impact significance classification of **low (-ve)**.

Compliance with ambient SO_2 limits cannot be achieved through the implementation of SO_2 abatement technologies for the proposed power station, given that the current non-compliance is due to existing sources. The implementation of SO_2 abatement technologies can however avoid any significant increases in non-compliance from the current situation.

Various abatement technologies could be implemented to achieve the desired control efficiency of at least 90%. These include wet and semi-dry Flue Gas Desulphurisation (FGD), with wet FGD historically achieving higher removal efficiency, in excess of 90%. Semi-dry FDG can achieve a removal efficiency of up to 90%.

With mitigation measures in place, the impact of additional atmospheric emissions on the ambient SO_2 concentrations is deemed to have a **low (-ve)** significance, given that the impact would only be slightly greater than is currently the case.

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	Impact of SO_2 emissions on ambient air quality and legal compliance					
	Site X					
	150m stack		**220m stack**		**300m stack**	
	No mit	**Mit**	**No mit**	**Mit**	**No mit**	**Mit**
Extent	Regional	Local	Regional	Local	Regional	Local
Magnitude	High	V. Low	High	V. Low	High	V. Low
Duration	Long	Long	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**Low (-)**	**High (-)**	**Low (-)**	**High (-)**	**Low (-)**
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible	Reversible	Reversible
	Site Y					
Extent	Regional	Local	Regional	Local	Regional	Local

Magnitude	High	V. Low	High	V. Low	High	V. Low
Duration	Long	Long	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**Low (-)**	**High (-)**	**Low (-)**	**High (-)**	**Low (-)**
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible	Reversible	Reversible

	Impact of NO_X emissions on ambient air quality and legal compliance					
	Site X					
	150m stack		**220m stack**		**300m stack**	
	No mit	**Mit**	**No mit**	**Mit**	**No mit**	**Mit**
Extent	Local	Local	Local	Local	Local	Local
Magnitude	Low	Low	Low	Low	Low	Low
Duration	Long	Long	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible	Reversible	Reversible
Site Y						
Extent	Local	Local	Local	Local	Local	Local
Magnitude	Low	Low	Low	Low	Low	Low
Duration	Long	Long	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible	Reversible	Reversible

	Impact of PM_{10} emissions on ambient air quality and legal compliance					
	Site X					
	150m stack		**220m stack**		**300m stack**	
	No mit	**Mit**	**No mit**	**Mit**	**No mit**	**Mit**
Extent	Local	Local	Local	Local	Local	Local
Magnitude	Low	Low	Low	Low	Low	Low
Duration	Long	Long	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**	**Low (-)**
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible	Reversible	Reversible
Site Y						
Extent	Local	Local	Local	Local	Local	Local
Magnitude	Low	Low	Low	Low	Low	Low
Duration	Long	Long	Long	Long	Long	Long

SIGNIFICANCE	Low (-)	Low (-)	Low (-)	Low (-)	Low (-)	Low (-)
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible	Reversible	Reversible

5.2.6 Impact on global climate change

a) Impact Statement

The establishment of a new coal fired power station will result in an increase in the emission of greenhouse gases to the atmosphere, adding to the greenhouse effect on a regional, national and international scale.

b) Discussion

Gases which contribute to the greenhouse effect are known to include carbon dioxide (CO_2), methane (CH_4), water vapour, nitrous oxide, Chloroflurocarbons (CFC's), halons and peroxyacylnitrate (PAN). All of these gasses are transparent to shortwave radiation coming into the earth's surface, but trap long-wave radiation leaving the earth's surface. This action leads to a warming of the earth's lower atmosphere, with changes in the global and regional climates, rising sea levels and extended desertification. Total greenhouse gas emissions reported to be emitted within South Africa for the year 1994, expressed as CO_2 equivalents, are given in Table 5.7.

Table 5.7 Emissions of CO_2, CH_4 and N_2O in South Africa in 1994

Greenhouse Gas Source	Greenhouse gas CO_2 Equivalent (Gg per annum)			
	CO_2	CH_4	N_2O	Aggregated
Energy	287 851	7 890	1 823	297 564
Industrial Processes	28 106	26	2 254	30 386
Agriculture		19 686	15 776	35 462
Waste		15 605	825	16 430
			Total	379 842

Greenhouse gases released from a coal-fired power stations are primarily CO_2 and nitrous oxide (N_2O). The proposed power station is likely to contribute the following to greenhouse gas emissions:

Table 5.8 Calculated CO_2 equivalent emissions from the proposed power station operation

Power Station Capacity	Coal Consumption (t/a)	Annual Emissions		Annual Emissions
		CO_2	N_2O	CO_2 Equivalent
		kt/a	kt/a	kt/a
5 400 MW	21 088 567	29 895	0.342	36 831

The emissions from the proposed power station would increase the South African energy sector's CO_2 equivalent emissions by some 12.8% and would increase the country's contributions towards the emission of greenhouse gasses by some 9.7%. This is a significant increase in greenhouse gas emissions, given the aims of the Kyoto Protocol, which aims to reduce overall emission levels of the six major greenhouse gasses to 5% below the 1990 levels, between 2008 and 2012. While South Africa, as a developing country, is not obliged to make such reductions, the increase in greenhouse gas emissions must be viewed in light of global trends to reduce these emissions significantly. Global CO_2 emissions in 1994 were approximately 6G t/a, with developing countries contributing approximately 2.8 Gt/a. Even though this emission may seem small when compared to global CO_2 emissions, the potential impact that the power station could have on global climate change is deemed to be **medium (- e)** and will to be the same for both Sites X and Y.

Mitigation measures

There are no feasible directly applicable mitigation measures implementable at the project level. However, strategic mitigation measures and offset mitigation measures to reduce carbon emissions include increasing the mix of renewable energy, nuclear and gas technologies within South Africa's power generation capacity as well as carbon sequestration.

As described in Chapter 1 of the Scoping Report, Eskom is actively pursuing the development of more renewable energy options, nuclear and gas technologies, in order to reduce its total carbon emissions.

Impact of proposed power station on Global Climate Change		
	Sites X & Y	
	No mitigation	**Mitigation**
Extent	Regional	
Magnitude	Low	
Duration	Long	
SIGNIFICANCE	**Medium (-)**	
Probability	Probable	
Confidence	Sure	
Reversibility	Irreversible	

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5.2.7 Impact of SO_2 on vegetation and metal corrosion

a) Impact Statement

Elevated SO_2 concentrations have the potential to damage vegetation and cause corrosion of metal in the area.

b) Discussion

High concentrations of SO_2 over short periods of time may result in acute visible damage to vegetation. This damage can be seen on broad-leafed plants as large bleached areas on the leaf surface. The visible injury may decrease the market value of certain crops and lower the productivity of some plants, due to impaired ability to photosynthesise.

Unfortunately, no dose-response relationships have been derived in South Africa for air pollution exposures by vegetation. Studies of air pollution impacts at the ecosystem scale have not been performed in South Africa. Small scale exploratory studies did not provide conclusive findings. Research was carried out in the study region in the early 1990s when farmers in the industrial highveld speculated that deterioration of the grassland was attributable to air pollution. It was, however, later thought that grazing pressure, fire management and climate play a greater role in influencing vegetation than air pollution impacts (van Tienhoven *et al*., 2002). Given the absence of local dose-response relationships reference was made to dose-response thresholds for vegetation exposure to SO_2 concentrations from the literature in determining the potential which exists for vegetation injury (Table 5.9). It is recognised that this approach may be conservative given that much of the research supporting such thresholds was undertaken in more humid climates.

Table 5.9 Dose-response thresholds of vegetation exposure to SO_2 concentrations

<table>
<tr><th></th><th>Max Hourly Avg SO_2 (µg/m^3)</th><th></th><th>Max Annual Avg SO_2 (µg/m^3)</th><th>Basis(a)</th></tr>
<tr><td>Low</td><td>< 1 300</td><td>AND</td><td><20</td><td rowspan="3">EC annual SO_2 limit given as 20 µg/m^3 for the protection of ecosystems.

WHO guideline for annual SO_2 given as in range of 10 – 30 µg/m^3 depending on sensitivity of the receiving environment.

Hourly average of 1300 µg/m^3 given as being associated with visible effects on the leaves of sensitive plant species.</td></tr>
<tr><td>Moderate</td><td>> 1 300</td><td>OR</td><td>20 – 30</td></tr>
<tr><td>High</td><td>> 1 300</td><td>AND</td><td>>30</td></tr>
</table>

(a) Reference was conservatively made to dose-response thresholds published in the general literature based on research undertaken in other countries given that no such thresholds have been defined for South African ecosystems

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Sulphur and nitrogen compounds being emitted could result in corrosion of metals if they occur in sufficiently high concentrations. Sulphur dioxide is the most investigated atmospheric pollutant with regard to its potential for causing corrosion, as is relatively well documented in the general literature. As for vegetation, no local dose-response thresholds have been developed for corrosion occurring due to sulphur dioxide exposures. Reference was therefore made to cause-effective relationships from the general literature in assessing corrosion potentials (Table 5.10).

Table 5.10 Corrosion potential with respect to SO_2 exposure

Corrosion Potential	Maximum Annual Average SO_2 Concentration (µg/m^3)
Low	< 20
Medium	20 – 657
High	> 657

In the absence of SO_2 controls, the potential for impacts of SO_2 on vegetation is likely to be classified as high, in terms of the potentially conservative dose response thresholds used. Corrosion potential would be classified as medium. Given its long-term duration and high magnitude, the potential for impact on vegetation and metal corrosion is deemed to be **high (-ve).**

However, with mitigation measures in place, the impact of the additional atmospheric emissions on vegetation in the surrounding areas and on the corrosion of metals is deemed to be of a **low (-ve)** significance. SO_2 controls are described in Section 5.2.5 above.

	Impact of emissions from proposed power station on vegetation and metal corrosion			
	Site X		**Site Y**	
	No mit	**Mit**	**No mit**	**Mit**
Extent	Local	Local	Local	Local
Magnitude	High	V. Low	High	V. Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**Low (-)**	**High (-)**	**Low (-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible

5.2.8 Impact on regional water supply

a) Impact Statement

The abstraction of water for the operation of the power station could have an impact on the aquatic environment as well as other users in the Witbank geographical region.

b) Discussion

The proposed power station and associated infrastructure/ processes would require approximately 7.7 million m^3 of water per annum. An additional 3.4 – 5.5 million m^3 would be required if semi-dry and wet FGD were used respectively. Water for the proposed power station would not be sourced from within the Olifants River catchment, but would be supplied from the Vaal River system instead. The power station's water requirements would be fulfilled via the Vaal River Eastern Sub-system Augmentation Project (VRESAP). VRESAP is a project initiated by the Department of Water Affairs and Forestry (DWAF) aimed at transferring approximately 160 million m^3 of water from the Vaal River Dam to supply mainly Eskom's and Sasol's growing water requirements. DWAF has given their assurance that VRESAP would be able to supply all the proposed power station's water requirements. Impacts associated with abstraction from the Vaal River system were considered as part of the VRESAP EIA, for which a positive ROD was issued by DEAT. Construction has begun and VRESAP is due for completion by October 2007.

c) Description and significance of potential impact

Due to the fact that water will be transferred in from the Vaal Dam, no abstraction-related impacts are expected in the Witbank geographical region and associated catchment areas. The environmental impacts on the donor environment have consequently been considered in the abovementioned VRESAP EIA process and subsequent authorisation. It should however be noted that the water that is being transferred out of the Vaal has a lost opportunity cost attached to. The water could have been beneficially utilised in the Vaal River catchment for agricultural purposes or in industry.

The water required for FGD could be used in the Vaal River catchment for the expansion of agriculture, other industry in, for example, the Sasolburg or Vanderbijlpark areas, or could be allocated for domestic use. However, the agricultural industry creates a very limited number of job opportunities, in comparison to the power station. Furthermore, the SO_2 emissions could have negative consequences for vegetation in the Witbank area, if no abatement technology is applied.

The use of 3.4 to 5.5 million m^3 of water on the FGD process is therefore deemed to be acceptable, given the use of the water and the likely positive impact that it would have on regional air quality and health.

The proposed power station would operate under Eskom's Zero Liquid Effluent Discharge policy and accordingly no water or effluent would be discharged into local river systems. The ZLED policy would only become effective once the power station was completely operational i.e. all generating units had been constructed and commissioned. Impacts may, however, arise from seepages and leaching. For an assessment of these potential seepage and leaching impacts, please refer to Sections 5.2.2 and 5.2.4 above.

Given that the power station is unlikely to impact on regional water supply and existing users, a zero magnitude impact is anticipated. Hence, a **neutral** significance impact is expected. However, the choice in emission control technologies will have an effect on the on the water supply of the region. Given that Wet FGD consumed almost twice as much water as semi-dry FGD, the significance of wet FGD is considered to be **medium (-ve)** while semi-dry FGD would have a **low (-ve)** significance.

d) Impact assessment results

The proposed power station would be supplied by VRESAP and accordingly would not impact on regional water supply and existing users.

Impact of emission controls on regional water supply				
SITE X				
	Wet FGD		Semi-dry FGD	
	No mit	Mit	No mit	Mit
Extent	Regional		Regional	
Magnitude	Low		V Low	

Duration	Long		Long	
SIGNIFICANCE	**Medium (-)**		**Low (-)**	
Probability	Probable		Probable	
Confidence	Sure		Sure	
Reversibility	Reversible	-	Reversible	
SITE Y				
Extent	Regional		Regional	
Magnitude	Low		V Low	
Duration	Long		Long	
SIGNIFICANCE	**Medium (-)**		**Low (-)**	
Probability	Probable		Probable	
Confidence	Sure		Sure	
Reversibility	Reversible		Reversible	

5.3 OPERATIONAL PHASE IMPACTS ON THE SOCIAL ENVIRONMENT

5.3.1 Visual impacts

a) Impact Statement

The establishment of the proposed station and its associated infrastructure may have a visual impact for the residents of the area, recreational users and motorists.

b) Discussion

The receiving environment comprises the physical character of the landscape (known as the visual resource) together with the viewers (known as the visual receptors) of the proposed activity. The physical landscape is characterised by a rolling, undulating landscape with little variation in the region. There are several drainage lines that flow in generally a northern direction, creating small incisions in the landscape. Small farm dams are associated with the drainage lines. Agricultural activities dominate the land use. Mining activity is encroaching from the east and is associated with open cast mines, large stockpiles and significant visual intrusion into the landscape. The existing Kendal power station presents an imposing visual structure in the largely undeveloped landscape. Existing mining activities, west of the alternative sites, are also noticeable. The Witbank industrial area is visible when looking north east from the alternative sites and is usually overhung with smog. The study area is generally smoothly textured with uniform grassland vegetation and regularly shaped cultivated fields. Colours are generally green and lush in summer and dull yellow and brown in winter. Overall the area is rural in nature with industrial elements encroaching from the south and east. The visual dominance of the agricultural activities and intruding mining activities means that the existing regional visual quality (which is determined by the composition of landscape components and their influence on scenic attractiveness) is considered to be moderately low. Consequently, a Visual Impact Assessment was undertaken of the proposed power station, by Strategic Environmental Focus. The full report is contained in **Annexure J** of this EIR.

c) Description and significance of potential impact

The overall visual impact is a function of sensitivity of the landscape and severity of the impact. Landscape sensitivity is an indication of the degree to which the landscape can accommodate change from a particular development. The severity of the impact refers to the magnitude of the change to the landscape as a result of the development.

The landscape has been disturbed by agricultural and industrial activities. Air quality is poor and characterised by smog, especially in winter. It appears that the landscape is currently in transition, moving from a traditional rural/ agricultural setting towards becoming a landscape with more industrial elements in it. Accordingly, it is believed that the landscape exhibits a moderate sensitivity with a fair tolerance for change.

The severity of the impact depends on whether the proposed activity would be screened by existing topographical features, vegetation or other structures. Added to this would be the "form" of the power station – its regularity, lines and vertical posture in the landscape. Should surface ashing occur, the ash dump would be a significant impact, due to both its size and to the colour of the ash (light grey) in the active portion of the dump, which would contrast with the surrounding natural colours.

Power station surface infrastructure (including dams, coal stockyard, water and wastewater treatment facilities, etc.)

The above discussion focuses on the visual resource and its ability to accommodate change. Any assessment of significance of visual impact also needs to take cognisance of the sensitivity of visual receptors i.e. the people viewing the proposed development. Residents living in the vicinity would have a high sensitivity. Recreational users, would be less sensitive as they would have temporary views and motorists would have very little sensitivity due to their focus on the road and short time in view of the proposed power station. It stands to reason that the further away one is from the activity, the less the visual impact will be felt. The zone of visual influence for the proposed power station and associated infrastructure would be approximately 20 km.

Due to the fact that the proposed activity would be a large imposing structure in a landscape that does not allow for any great degree of visual absorption, most of the residents within a 20 km radius of either site would be exposed to the visual intrusion. This is ameliorated somewhat by the fact that there is a very low residential density within a 20 km radius. The nearest recreational resource is Bronkhorstspruit Dam, approximately 14 km and 20 km away from Site Y and Site X respectively. The dam is within a topographical incision which would limit the visual impact experienced by recreational users. Motorists especially those travelling on the N4 and N12 would also be minimally impacted upon due to the fact that their exposure would be limited and their focus would be on the road.

The choice of cooling technology further influences the impact of the power station on the landscape. The use of indirect dry cooling, requiring six cooling towers with a height of some 180 m each, would increase the visual intrusion of the power station on the environment. However, if direct dry cooling were to be implemented, the cooling towers would not be required, and would reduce the visibility of the power station to a degree, reducing the significance of the impact marginally.

The use of clad or unclad boilers will also affect the visual intrusiveness of the proposed power station. An unclad boiler will further reduce the visual quality of the region, exacerbating the industrial character of the region. This is especially the case at night, when numerous lights on the structure would be illuminated. Clad boilers however will make the power station appear simpler and less industrial, which may make the development blend into the surrounding landscape better.

The presence of a coal conveyor on the landscape is likely to create a prominent line in the landscape, in contrast to the natural landscape. The conveyor will however have a more localised impact than the power station, and is therefore likely to have a much smaller visual intrusion. The water pipeline would be buried and would therefore have no visual impact during the operation of the power station.

At either site, it is anticipated that the proposed power station would have a high magnitude, with a local extent over a long term. Accordingly a **medium to high (-ve)** significance impact is anticipated at both Site X and Y. The visual impact of indirect dry cooling is slightly higher that direct dry cooling, and similarly, the impact of unclad boilers is marginally higher than the clad boiler option. The difference between Sites X and Y from a visual perspective is marginal. However, it is noted that based on line of sight and topography, Site Y has a larger area within a 10 km radius within which residents would be impacted upon. In addition Site X is further away from Bronkhorstpsruit Dam and closer to the highly disturbed mining areas to the east. Accordingly Site X is slightly preferred from a visual perspective.

Ash disposal

Should surface ashing on site occur, it would represent a visual intrusion. This would be ameliorated by ongoing rehabilitation, shaping and revegetating. With respect to visual impacts, it is inappropriate to consider the type of ashing separately from the power station infrastructure described above. Whereas with other impacts e.g. groundwater or aquatic ecology, the type of ash disposal has its own significant impact separate from the power station infrastructure, for visual impacts the two need to be considered in conjunction. If anything, an ash dump by itself is more of a visual intrusion than an ash dump in close relation to the imposing power station. Accordingly, above-ground ashing would have the same **medium to high (-ve)** significance as the rest of the proposed power station.

The visual impact of back ashing and in-pit ashing would be very similar but would occur within the coal mine precinct. The coal mine activities would themselves be visually significant and the addition of back ashing or in-pit ashing would represent an incrementally small impact, i.e. very low magnitude with a local extent are therefore likely to be of low significance. This would have to be further investigated, should Eskom choose to pursue off-site sub-surface ash disposal in the future.

Flue gas desulphurisation

The implementation of flue gas technology is likely to result in a visible plume arising from the emission stacks, as a consequence of the use of water in the FGD process. While the overall incremental difference in terms of the visual resource is likely to be minimal from a visual receptor point of view, the presence of a visible plume would slightly increase the severity of the impact. As with ash disposal above, FGD has to be considered in conjunction with the power station. With FGD, the visual impact is likely to be of **high (-ve)** significance at both sites. There is unlikely to be any difference between the wet and semi-dry FGD options, from a visual perspective.

Mitigation measures

Given the magnitude of the proposed activity, there is very little that can be done to significantly reduce the significance of the visual impacts. Mitigation in this case is intended to reduce impacts by:

- Adequately designing the power station so as to ensure that the visual intrusion is minimised. This includes:
    - Using mat paint on facades and roofs;
    - Avoid very light or dark finishings;
    - Reduce use of reflective building materials;
    - Screen planting around the power station;
    - Appropriate lighting;
- Using lighting with automatic timers or manual switches, wherever possible;
- Maintaining a high level of landscaping around the power station and other infrastructure;
- Maintaining a neat appearance; and
- Progressively rehabilitating and revegetating the ash dump.

d) Assessment tables

While differences in significance cannot be differentiated at the relatively coarse scale of the tables below, Site X is the preferred site from a visual perspective due to its proximity to the mining activities to the east, its distance from the recreational resource at Bronkhorstspruit Dam and the fact that the topography at Site Y results in a slightly greater visual intrusion.

Impact of the proposed power station and associated infrastructure on visual aesthetics		
	SITE X	
	Direct dry cooling	**Indirect dry cooling**

	No mit	Mit	No mit	Mit
Extent	Local	Local	Local	Local
Magnitude	High	Med	High	Med
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Med - High (-)**	**Med (-)**	**Med - High (-)**	**Med (-)**
Probability	Definite	Definite	Definite	Definite
Confidence	Certain	Certain	Certain	Certain
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible
SITE Y				
Extent	Local	Local	Local	Local
Magnitude	High	Med	High	Med
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Med - High (-)**	**Med (-)**	**Med - High (-)**	**Med (-)**
Probability	Definite	Definite	Definite	Definite
Confidence	Certain	Certain	Certain	Certain
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible

Impact of surface ashing on visual aesthetics		
SITE X		
	No mit	**Mit**
Extent	Local	Local
Magnitude	Med to high	Med
Duration	Long	Long
SIGNIFICANCE	**Med to high (-)**	**Med (-)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible
SITE Y		
Extent	Local	Local
Magnitude	Med to high	Med
Duration	Long	Long
SIGNIFICANCE	**Med to high (-)**	**Med (-)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

Impact of emission control technologies on visual aesthetics				
SITE X				
	Wet FGD		**Semi-dry FGD**	
	No mit	**Mit**	**No mit**	**Mit**
Extent	Local	Local	Local	Local
Magnitude	High	High	High	High

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Duration	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**High (-)**	**High (-)**	**High (-)**
Probability	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible
SITE Y				
Extent	Local	Local	Local	Local
Magnitude	Med to High	Med to High	High	High
Duration	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**High (-)**	**High (-)**	**High (-)**
Probability	Definite	Definite	Definite	Definite
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible

5.3.2 Impact on ambient noise quality

a) Impact Statement

The establishment of a coal-fired power station and its associated infrastructure may elevate the ambient noise levels in the vicinity of the power station site and the surrounding areas to unacceptable levels, as defined in the SANS 10103 standards.

b) Discussion

The area under investigation is located on the boundary between the Gauteng and Mpumalanga provinces, between the N12 and N4 national roads. The general terrain can be described as flat to gently undulating. Built-up areas include Bronkhorstspruit, Witbank, Voltago, and Phola, some 20 km, 30 km, 8.5 km and 18 km from the proposed sites respectively. Furthermore, there are a suite of farmsteads and farm labourers houses located on the farms surrounding the proposed development sites. The landscape is generally devoid of any features that would assist in the attenuation of noise. In order to predict the likely impact that a proposed power station would have on noise levels in the area, and to determine their likely compliance with the relevant South African noise standards, a detailed noise impact assessment study was carried by Jongeens, Keet and Associates. The terms of reference for the study included determining the noise *status quo* of the area, predicting the likely noise levels during and after construction of the power station, assessing the change in the noise climate, and its associated impacts and recommending mitigation measures.

The methodology for the assessment included the following tasks:

- Literature review identifying all aspects of the project that would influence the future noise climate in the study area;
- Identification of potential noise sensitive areas, sources and potential problems;
- Determination of the existing noise climate by collecting noise samples from 13 monitoring sites and the main roads;

- Prediction and assessment of future noise climate in the study area, as a result of the proposed power station and its associated infrastructure.

The assessment was undertaken in accordance with the requirements of the South African National Standards SANS 10328 (SABS 0328) *Methods for Environmental Noise Impact Assessments*. A complete description of the methodology applied and the full findings of the study are included in **Annexure K.**

Current noise climate

The two potential power station sites are located between the N4 National Road, to the north and the N12 National Road in the south. Both of these roads are major link roads between Johannesburg in the west and towns like Witbank, Bronkhorstspruit and Delmas to the east. The D686 road runs in a north-south direction, to the east of the sites, and interchanges with both the N4 and N12. Various other provincial and district roads cross the broader study area. There are two railway lines that run through the study area. The Pretoria-Witbank line, to the north of the N4 carries 12 trains per day. The Johannesburg-Witbank line, to the south of the N12, which passes through Kendal village, carries 11 trains per day.

As mentioned above, the study area is fairly flat, with no natural features to assist in the attenuation of noise. The wind can result in enhancement (downwind) or reduction (upwind) of noise levels. The prevailing daytime wind in the area is the north westerly wind (39%) while the prevailing night time wind is the easterly wind (42%).

In order to determine the current noise levels in the study area, a total of 13 noise sensitive sites were identified and noise levels monitored at each of these sites. A description of the sites is contained in Table 5.11 and their locations are indicated on **Figure 5.3** below:

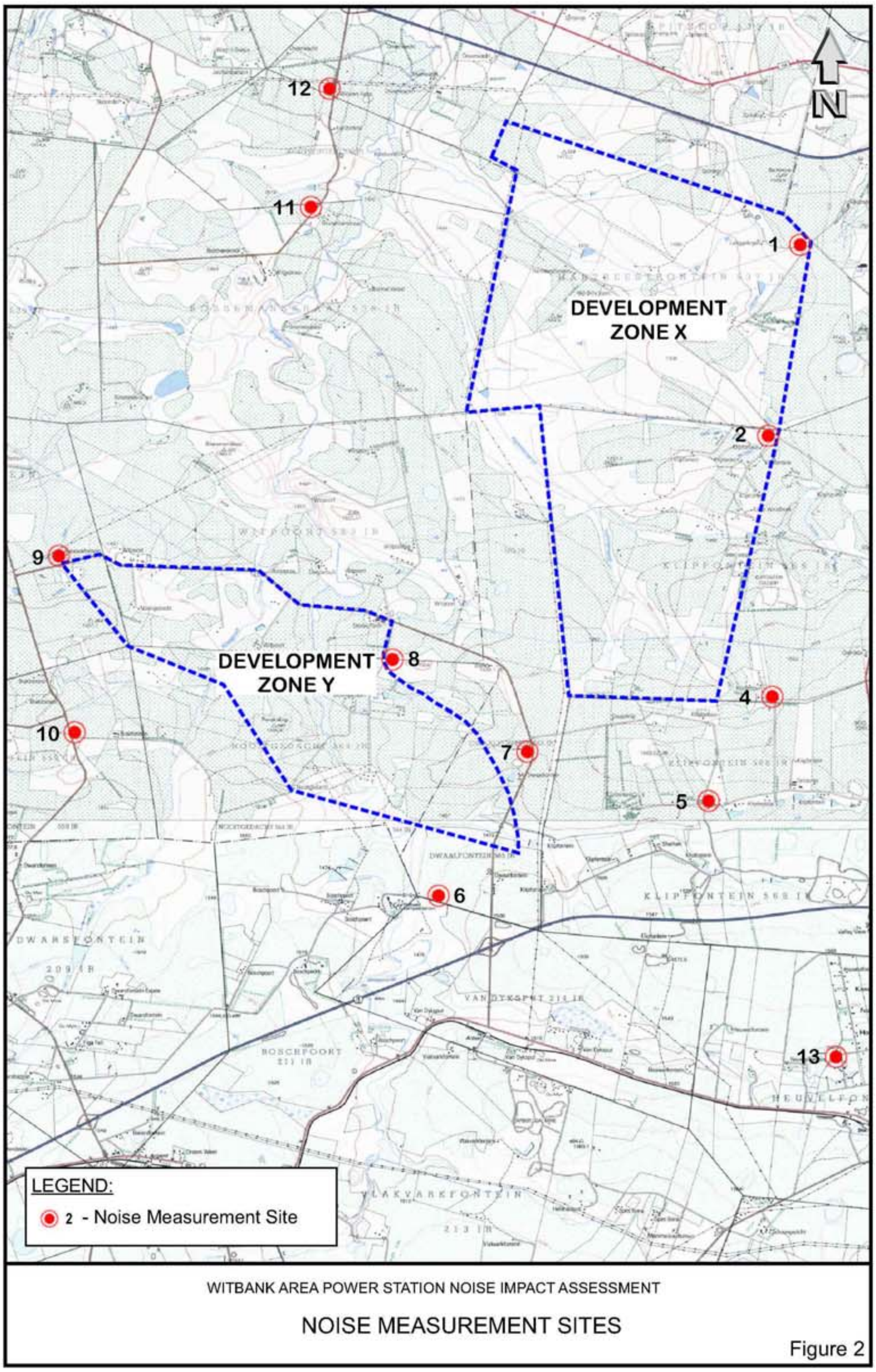

Figure 5.3 Map of the noise measurement sites for Site X and Site Y

Table 5.11 List of sensitive noise receptor sites used for the study

Measurement Site	Description
Site K1	At the entrance gate to Langgelegen (Kaia Thandi) on the north-eastern boundary of Site X.
Site K2	At the entrance gate to Klipfontein (Swanepoel Boerdery) on the eastern boundary of Site X.
Site K3	In the central area of the old Wilge Power Station residential village (Voltargo).
Site K4	At the entrance to Klipfontein, 1000 metres east of the south-eastern corner (boundary) of Site X.
Site K5	In the agricultural holdings on Klipfontein 588-JR.
Site K6	On the farm Dwaalfontein 565-JR approximately 1200 metres west of Road D960 (Blesbokfontein Road).
Site K7	At farmhouse on Dwaalfontein 565-JR on the western side of Road D960 (Blesbokfontein Road).
Site K8	At the Kelvin Primary School on the farm Witpoort 583-JR.
Site K9	At entrance to farmhouse on Blesbokfontein 558-JR on the northern side of Road D960 (Blesbokfontein Road).
Site K10	At the entrance to farmhouse on farm Brakfontein 559-JR on the eastern side of Road D961 (Dwarsfontein-Bronkhorstspruit Road).
Site K11	At the entrance to Bossemanskraal (Topigs), on the eastern side of Road D2236 (Bosmanskraal Road).
Site K12	At the entrance to Willows Farm (Dyke Feld Country Estate), on the eastern side of Road D2236 (Bosmanskraal Road).
Site K13	In the Kendal Forest Holdings.

Noise was also monitored at three sites around the existing Kendal power station, in order to isolate noise emanating directly from the existing power station. The short term average measured noise level over the study area is presented in the table below:

Table 5.12 Existing noise levels in the study area at 13 sensitive receptor sites

Measurement Site	Measured Sound Pressure Level (dBA)					
	Daytime Period[23]			Evening Period[24]		
	L_{Aeq}[25]	L_{max}[26]	L_{min}[27]	L_{Aeq}	L_{max}	L_{min}
SANS 10103 Standard for rural residential ambient noise levels (outdoor)	45			35		
Site K1	39.3	57.8	26.6	41.6	58.9	28.2
Site K2	41.2	58.3	24.1	38.1	52.6	26.1
Site K3	51.7	70.6	40.6	38.7	44.2	30.6
Site K4	41.6	52.2	30.1	31.7	42.1	23.6
Site K5	46.6	62.4	31.3	38.2	46.1	29.3
Site K6	37.5	54.6	27.7	35.9	47.6	28.4
Site K7	46.6	57.4	35.9	33.7	47.1	21.2
Site K8	39.4	50.4	25.7	34.1	45.9	23.6
Site K9	47.2	54.0	39.5	33.2	46.8	24.1
Site K10	40.6	54.9	27.2	36.8	47.7	28.2
Site K11	38.4	50.4	26.3	33.2	48.1	27.2
Site K12	44.4	57.1	35.8	35.4	47.1	28.4
Site K13	42.4	54.4	33.0	39.9	48.9	37.5

In order to complement the short-term noise measurements in the study area, the existing 24-hour residual noise levels related to the average daily traffic flows on the N4 freeway, the N12 freeway, the R545 and R555 were calculated. An unmitigated scenario was considered in order to be conservative. Noise was modelled assuming burnt veld, however the vegetation cover would attenuate the noise levels between the noise source and the person experiencing the noise.

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[23] Daytime period is defined as being from 06h00 to 22h00.
[24] Evening period is defined as being from 22h00 to 06h00
[25] L_{Aeq} referfs to the equivalent sound pressure (noise) level, and can be taken as the average noise level over the given period. It is also referred to as the residual noise level (excluding the impact noise under investigation) or the ambient noise level (if the impacting noise under investigation is included).
[26] Maximum sound pressure (noise) level
[27] Minimum sound pressure (noise) level

Table 5.13 Existing noise climate adjacent to main roads

Road	Noise Levels Alongside Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)							
	100m Offset		250m Offset		500m Offset		1000m Offset	
	L_d	L_n	L_d	L_n	L_d	L_n	L_d	L_n
N4 Freeway	62.5	53.7	58.5	49.7	55.5	46.7	52.5	43.7
N12 Freeway	62.1	53.4	58.1	49.4	55.1	46.4	52.1	43.4
Road D686 N (R545)	57.0	48.2	53.0	44.2	50.0	41.2	47.0	38.2
Road D686 S	55.0	46.2	51.0	42.2	48.0	39.2	45.0	36.2
Road P29/1 (R555)	54.0	45.2	50.0	41.2	47.0	38.2	44.0	35.2

The trains travelling along the two train lines described above have a minor influence on the general noise climate of the area except at noise sensitive sites in very close proximity to the respective railway lines.

Traffic from the existing road network is one of the main sources of noise in the area. Industries in the area that contribute to the noise climate include the Kendal Power Station, including the remote structures like the ash dump, the Brickworks located to the east of Sites X and Y, and the Khutala Colliery located to the south-east of the existing Kendal Power Station. The areas that are relatively far from the main roads and Kendal power station are generally very quiet, and can be described as having a rural noise climate. Noise from the existing Kendal power station adversely affects the daytime noise climate at the many houses in the surrounding area, up to a distance of approximately 1000 m around the facility. At night the radius of impact increases to some 2 300m.

Potential noise impacts of the proposed power station

It is predicted that the main sources of noise in the future, should a new power station be established on either Site X or Site Y, would be from the new power station itself, the Kendal Power Station, road traffic and rail traffic.

The proposed new power station would have a maximum nominal generating capacity of 5 400 MW (6 x 900 MW units). The main source of noise would be the cooling fans, should direct dry cooling be chosen as the cooling technology alternative. Approximately 72 cooling fans would be required per generating unit, totalling 432 fans. The fans would be located approximately 50 m above ground level, on the north-western side of the power station precinct. Other infrastructure that would generate noise includes the conveyor belt system for the coal supply and ash removal (specifically the conveyor belt drive houses), the ash dump spreading operations, the sewage treatment works, and the additional vehicle traffic and rail traffic generated as a result of the power station. The predicted ambient noise levels with the new power station established are presented in Table 5.19 below.

Table 5.14 Predicted noise levels from the power station infrastructure

	Ambient noise levels at various offsets (dBA)						
	500m	**1000m**	**2000m**	**3000m**	**4000m**	**5000m**	**6000m**
PS with direct dry cooling		58	52	46	42	38	34
PS, indirect dry cooling[28]		50.5	42.5	37.5			
Conveyor belt intermediate drive house	51	46	41				
Conveyor belt	37	32					
Ash dump spreader	55	49	43				

From the modelling of noise levels, it is predicted that the noise associated with the condenser fans will range from 58 dBA within 1000 m of the site to 34 dBA within 6000 m of the site. Approximately 34 noise sensitive sites in the vicinity of Site X would be affected to a certain degree by the noise levels from a direct dry cooled power station. An indirect dry cooled power station has a smaller impact on surrounding communities, with noise levels dissipating to acceptable levels within 3000 m of the site. Similarly for Site Y, the noise levels from a direct dry cooled power station will affect up to 40 noise sensitive sites to some degree and would be more severe in the 180 degree arc to the north-west of the site. These values do however reflect the worst case scenario, assuming no mitigation, in the form of ground cover or other structures to reduce the noise levels. The noise from the conveyor belt system specifically refers to the ambient noise levels in the vicinity of the intermediate drive houses.

With respect to vehicle traffic, it is estimated that the proposed power station will generate approximately 900 vehicle trips per day. However, this number would increase to approximately 1 000 vehicle trips per day, if sorbent is used at the power station. Furthermore, if sorbent is required, and railway line is constructed to the power station, approximately one train per day would travel to the site to deliver sorbent, increasing the ambient noise levels. The modelled noise levels have adopted a conservative approach, not taking any mitigation measures into account. The predicted noise climate adjacent to major roads with the power station at Sites X and Y are presented in Table 5.15 and 5.16 below. Furthermore, possible noise sensitive receptors were identified based on a review of 1:50 000 topocadastral map sheets, which may accurately reflect the distribution of infrastructure (and people) in the areas around the power station.

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[28] The noise levels reflected are those of the existing Kendal Power Station, which utilised indirect dry cooling. It is assumed that the proposed power station would have similar noise profile to the existing power station, for the indirect dry cooling alternative.

Table 5.15 Site X: predicted noise climate adjacent to main roads at commissioning of the proposed new power station (year 2015)

Road	Noise Levels Alongside Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)							
	100m Offset		250m Offset		500m Offset		1000m Offset	
	L_d	L_n	L_d	L_n	L_d	L_n	L_d	L_n
N4 Freeway	64.9	56.1	60.9	52.1	57.9	49.1	54.9	46.1
N12 Freeway	64.4	55.6	60.4	51.6	57.4	48.6	54.4	45.6
Road D686 N (R545)	59.0	50.2	55.0	46.2	52.0	43.2	49.0	40.2
Road D686 S	56.9	48.2	52.9	44.2	49.9	41.2	46.9	38.2
Road P29/1 (R555)	55.2	46.4	51.2	42.4	48.2	39.4	45.2	36.4
Access Road	49.7	42.4	45.7	38.4	42.7	35.4	39.7	32.4

Table 5.16 Site Y: predicted noise climate adjacent to main roads at commissioning of the proposed new power station (year 2015)

Road	Noise Levels Alongside Roads at Given Offset from Centreline (SANS 10103 Indicator) (dBA)							
	100m Offset		250m Offset		500m Offset		1000m Offset	
	L_d	L_n	L_d	L_n	L_d	L_n	L_d	L_n
N4 Freeway	64.9	56.1	60.9	52.1	57.9	49.1	54.9	46.1
N12 Freeway	64.4	55.6	60.4	51.6	57.4	48.6	54.4	45.6
Road D686 N (R545)	59.4	50.6	55.4	46.6	52.4	43.6	49.4	40.6
Road D686 S	56.8	48.0	52.8	44.0	49.8	41.0	46.8	38.0
Road P29/1 (R555)	55.2	46.4	51.2	42.4	48.2	39.4	45.2	36.4

For Site X, two access road alternatives have been proposed; namely Option 1: a road linking south from the D2236 (in the vicinity of the Bossemankraal interchange on the N4 road) to the north western corner of the site, then following the site boundary, or Option 2: an access road from the D686 at the intersection with P104 road, to the north-eastern corner of the site. There are seven and six noise sensitive sites along the two alternative access roads respectively. It is suggested that the increase in predicted noise levels would be caused mostly by the natural growth of the traffic in the area, and that the power station traffic component of the increase on Road R686 would only be about 0.6dBA.

For Site Y, the likely access road would be similar to Option 1 above, but extend further south and turn west to link into Site Y. There are nine noise sensitive sites along the proposed road alignment. Once again it is predicted that most of the increase in noise levels would be caused by the natural growth of the traffic to the area, and that the power station traffic component of the increase would account for some 0,6dBA increase.

It is estimated that one train trip would be required per day to supply the requisite volume of sorbent. This equates to approximately 22 trains per month. Noise from a freight train drawn by a diesel locomotive would reach peak levels of approximately 92dBA at 30 m from the track. The maximum noise level would be approximately 70dBA within about 350 m of the train track with every pass of the train. When the train sounds it warning horn, the noise can range from 105 dBA at 30 m to 84dBA at 350 m from the train. The noise levels would however be lower if an electric locomotive was used, but this has not been quantified.

Noise from the conveyor system emanates primarily from the intermediate drive houses of the system. Noise from the system ranges between 51 dBA at 500 m offset to 41dBA at 2000 m offset. Typical noise levels from a water pipeline pumpstation would range from 75 dBA at 10 m to 50 dBA at 200 m. There are noise receptors on both Sites X and Y which could be affected by the pump station noise.

If one compares the predicted noise levels for Sites X and Y against the ambient noise levels (Table 5.12 above), it can be seen that the ambient noise levels seem to increase by some 2 to 5 dBA between present and future scenarios. As noted in SANS 10103, an increase of 0 to 5 dBA in ambient noise levels will result in little response from the community, with sporadic complaints. For a person with average hearing, an increase in the general ambient noise level of 3 dBA would be just detectable, while an increase of 5 dBA would be very noticeable.

In summary, the existing noise levels at Site X are relatively low, and are representative of rural/farming environment. Direct dry cooling could have a significant impact on local communities, only being attenuated to the applicable standards within 6 km of the site, and potentially affecting some 34 noise sensitive sites. However the site is situated some 20 km from Bronkhorstspruit, 18 km from Kendal Power Station and 8.5 km from Voltago village, making it significantly far from the major concentrations of people in the area. The increase in vehicle traffic as a result of the power station is predicted to be only 0.6dBA.

Similarly at Site Y, the existing noise levels are relatively low and are representative of a rural/farming environment. Noise levels associated with direct dry cooling would result in a significant impact on local communities within a 6 km radius of the site, and on 40 noise sensitive sites in the area. However the major concentrations of people are located at Bronkhorstspruit some 18.5 km to the north-west and Voltago village, some 20 km to the east of the site. Vehicular traffic will increase noise levels along the access roads, by some 0.6 dBA, potentially affecting some nine sensitive sites.

In light of the predicted noise levels, the significance of a power station located on Site X or Site Y utilising direct dry cooling is deemed to be **high (-ve)**, whereas implementing indirect dry cooling is likely to have a **low (-ve)** impact. The impact on the noise climate as a result of the additional vehicular traffic generated by the power station is deemed to have **very low (-ve)** significance for both Sites X and Y. The impact on the noise climate from other infrastructure such as the coal conveyor drive house and pipeline pump stations is deemed to have a **low (-ve)** significance.

Mitigation

The most effective measure to reduce noise levels are at the source. It is recommended that strict noise emission specifications be set for all machinery. Buildings housing noisy machinery could be insulated in order to minimise the transmission of noise through the walls and roof (achieving at least 15dBA internal noise reduction). Means to shield off the noise from the cooling fan superstructure could be investigated, which could achieve reductions of up to 10dBA. Lastly, the location and orientation of the ancillary infrastructures such as the ash dump and coal stockyard could be optimised to reduce the noise impact on surrounding receptors. No mitigation measures are proposed for the noise that emanates from the increased vehicular traffic.

With the above mitigation measures in place, the impact of direct dry cooling on Sites X and Y would be reduced to **medium (-ve)**, and the impacts of indirect dry cooling would be reduced **very low (-ve)**. The noise from the pump stations and conveyor drive houses can also be reduced to **very low (-ve)**.

Impact of the power station on noise levels due to increased vehicular traffic		
SITE X		
	No Mit	**Mit**
Extent	Site specific	Site specific
Magnitude	Low	V. Low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V. Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
SITE Y		
Extent	Site specific	Site specific
Magnitude	Low	V. Low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

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Impact of cooling technology alternatives on the ambient noise levels SITE X				
	Direct Dry Cooling		Indirect Dry Cooling	
	No mitigation	**Mitigation**	**No mitigation**	**Mitigation**
Extent	Local	Local	Local	Local
Magnitude	High	Medium	Low	V Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**Medium (-)**	**Low(-)**	**V Low(-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible
SITE Y				
Extent	Local	Local	Local	Local
Magnitude	High	Medium	Low	V Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**High (-)**	**Medium (-)**	**Low(-)**	**V Low(-)**
Probability	Probable	Probable	Probably	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible

5.3.3 Impact on health of surrounding communities

a) Impact Statement

The operation of a new coal-fired power station will result in increased emissions of SO_2, NO_x, particulate matter and various heavy metals including mercury, which may have a detrimental impact on the health of communities in the surrounding areas depending on the extent of cumulative ground level concentrations and the potential for exposure to such concentrations.

b) Discussion

Residential areas in the immediate vicinity of the proposed power station sites include Phola and Ogies, located some 10 to 18 km east of the proposed sites, with smaller areas such as *inter alia* Voltago, Cologne, Klippoortjie, Madressa, Witcons, Saaiwater, Tweefontein and Klipplaat also in the vicinity. The largest residential concentration within a 30 km radius of the proposed power station is Witbank to the east, while Bronkhorstspruit is located further to the west.

Emissions from the proposed power station that could have an impact on the health of surrounding communities include SO_2, NO_X, particulate matter and heavy metals. SO_2 is an irritating gas that is absorbed in the nose and the upper respiratory tract, and is associated with reduced lung function, and increased rate of death or disease. Health impacts include coughing, phlegm, chest discomfort and bronchitis. NO_X is an irritating gas that is absorbed into the mucous membrane of the respiratory tract, in the vicinity of the junction of the airway and

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the gas exchange region of the lungs. Exposure to NO_2 is linked to increased susceptibility to respiratory infection, greater airway resistance in asthmatics and deceased lung functioning. The impact of particulate matter on human health depends on the size and chemical composition of the particles, and the duration, frequency and magnitude of exposure. PM10 and PM2.5 particles (particles with an aerodynamic diameter of less than 10 µm and less than 2.5 µm respectively) are able to be deposited in and can cause damage to the lower airways and gas-exchange region of the lungs. The inhalation of various trace heavy metals such as arsenic and nickel has an associated cancer risk. Mercury is a bio-accumulative toxicant that can be absorbed through the skin, through inhalation, or by eating food with high mercury content. Mercury affects the central nervous system and endocrine system, and exposure of a long period of time could lead to brain damage and death.

In order to determine the potential for human health risks due to baseline and proposed power station development scenarios, emissions were estimated and cumulative air pollutant concentrations predicted for the various criteria pollutants (SO_2, NO_2, PM10) in addition to a number of the trace metals including arsenic, lead, nickel and mercury. Predicted cumulative concentrations were compared to health thresholds published by organisations such as the WHO, US-EPA and the California Office of Environmental Health Hazard Assessment (OEHHA) and cancer risks estimated for carcinogenic pollutants.

Baseline Health Risks

Health risks related to exposures to air pollution concentrations occurring as a result of fuel-burning emissions were recently assessed for several regions including the Mpumalanga Highveld, as part of the NEDLAC "Dirty Fuels" study (Scorgie *et al*., 2004). Fuel burning sources quantified in this study included industrial fuel burning, power generation, vehicle exhaust emissions and household fuel burning. Air pollution exposure related respiratory hospital admissions were predicted to be in the order of ~8700 cases per year within the Mpumalanga Highveld region. Significant risks are associated with indoor exposures within fuel burning households. Exposures to emissions from power generation and industrial emissions were also identified as important sources of risk in this region. The contribution of vehicle exhaust emissions to health risks was less significant in this region.

Indoor exposures within fuel burning households

Household coal and wood burning is a significant source of indoor air pollution and is associated with significant health impacts. Health effects range from acute respiratory infections and upper respiratory tract illnesses to carbon monoxide poisoning, heart disease and cancer. Indoor air pollution from coal burning has been established as one of the risk factors for the development of acute respiratory illnesses (ARI). Data from local epidemiological studies indicate that acute respiratory infections (ARI) are one of the leading causes of death in black South African children (Terblanche *et al*., 1993).

Residential areas within the study region where household fuel burning is prevalent (specifically during the winter time for space heating purposes) include Phola, Botleng (near Delmas), Kungwini / Zithobeni (near Bronkhorstpruit) and Vosman, Hlalanikahle and KwaGuqa (near

Witbank). Elevated health risks are expected to occur in these areas due to inhalation exposures to indoor and ambient air pollutant concentrations, specifically fine particulates, arising due to fuel burning. Maximum highest daily PM10 concentrations (~200 μg/m³) and annual average PM10 concentrations (~80 μg/m³) predicted for these areas are well in excess of air quality and health limits.

Increment in health risks due to sulphur dioxide concentrations

Elevated sulphur dioxide concentrations in the study area are associated with significant health risk potentials, particularly where such concentrations coincide with elevated fine particulate concentrations such as in household fuel burning areas.

Sulphur dioxide concentrations occurring due to base case conditions are predicted to be associated with potentially "high" health risks within the Phola residential area. The California EPA Acute Reference Exposure Level for sulphur dioxide (above which mild respiratory effects may occur) having been predicted to be exceeded in this residential area. Exceedances of the reference exposure level were however infrequent. Whether or not health effects occur is dependent on whether persons sensitive to the impacts of sulphur dioxide are exposed at the time of the exceedance.

Increments in Health Risks given Proposed Power Station Emissions

Sulphur dioxide related exposures

Cumulative sulphur dioxide concentrations given the operation of an additional six 900 MW units at the sites proposed (without SO_2 abatement) is projected to increase maximum hourly sulphur dioxide concentrations at Phola to exceed the California EPA Acute reference exposure by up to 150% for a 150m stack. The reference exposure level would also be exceeded on more occasions increasing the potential for exposure to such risk.

The implementation of sulphur dioxide abatement measures for the proposed power station comprising a ~90% control efficiency would ensure that no significant increases in health threshold exceedances occur above baseline levels.

Health risks due to Trace Metals

Maximum hourly, daily, monthly and annual average heavy metal concentrations occurring due to the existing operations and future operation (from fly ash emissions and the ash dump) were simulated and evaluated. No inhalation-related non-carcinogenic health thresholds are predicted to be exceeded, and the values predicted are generally orders of magnitude less than the relevant health thresholds.

Cancer risks associated with inhalation exposure to predicted lead, arsenic and nickel were calculated based on predicted maximum annual average concentrations occurring due to the existing Kendal power station and the proposed new power station. Cancer risks were calculated to be very low, with the total cancer risk across all carcinogens quantified to be in the range of 1:4.5 million to 1:10 million.

The emission of mercury from the proposed power station has been raised as an issue of particular concern by an I&AP. Maximum hourly, daily and annual average mercury concentrations were predicted with the new power station in place, and compared against the guidelines for public exposure to ambient mercury concentrations issued by various organisations (Table 5.17).

Table 5.17 Predicted mercury concentrations given the existing power station and the proposed power station emissions with reference to applicable guidelines intended to protect human health.

	Predicted mercury concentrations given existing and proposed new power station operations		
	Highest hourly (µg/m^3)	Highest daily (µg/m^3)	Annual Average (µg/m^3)
Predicted maximum Hg GLC	0.18	0.04	0.003
RELEVANT GUIDELINES (µg/m^3)			
WHO guideline value			1.00
US-EPA inhalation ref concentration			0.30
Texas effect screening levels	0.25		0.025
California RELs	1.8		0.09
DEAT Mercury guideline			0.04

Mercury concentrations were predicted to be well within the most stringent of the mercury emission guidelines given for inhalation exposures. A major pathway for mercury exposure is however through ingestion rather than inhalation. The DEAT guideline of 0.04 µg/m^3 was intended to be protective given multiple pathways of exposure. This value was derived from a DEAT health risk study, which concluded that ambient long-term concentrations to mercury of less than 0.04 µg/m^3 would not result in an unacceptable multi-pathway risk. Predicted mercury concentrations were within this threshold.

Synopsis of Health Risk Findings

The potential impacts on human health as the result of increased SO_2 contributions from a new power station are significant. Large numbers of additional people would be exposed to SO_2 concentrations in excess of air quality limits. However, the heavy metal and mercury emissions would be very low, and well within the most stringent guidelines for the protection of human health. Impacts on human health as a result of the additional emissions of SO_2 are therefore deemed to have a **high (-ve)** significance. The impact is similar for both sites, but Site X with a stack height of ~220 m appears to be the option with the lowest incremental impact.

Mitigation

In order to maintain the impacts on human health at the same level as current, sulphur dioxide abatement to 90% would be required. As mentioned in Chapter 2, flue gas desulphurisation technology is preferred alternative for the removal of SO_2. Wet FGD is capable of achieving removal efficiencies in excess of 90% while dry FGD is capable of achieving a removal efficiency of up to 90%.

With FGD in place, the impacts on human health are considered to be **medium (-ve)**, and are likely to be similar for both Sites X and Y.

Impact of the proposed power station and associated infrastructure on human health		
	SITE X	
	No mitigation	**Mitigation**
Extent	Local to regional	Local to regional
Magnitude	High	Low
Duration	Long	Long
SIGNIFICANCE	**High (-ve)**	**Medium (-ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible
	SITE Y	
Extent	Local to regional	Local to regional
Magnitude	High	Low
Duration	Long	Long
SIGNIFICANCE	**High (-ve)**	**Medium (-ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Irreversible	Irreversible

	Impact of emissions on community health with emission controls			
	Wet FGD		**Semi-dry FGD**	
SITE X				
	No mit	**Mit***	**No mit**	**Mit***
Extent	Local to regional		Local to regional	
Magnitude	Low		Low	
Duration	Long		Long	
SIGNIFICANCE	**Low to Medium (-ve)**		**Medium (-ve)**	
Probability	Probable		Probable	
Confidence	Sure		Sure	
Reversibility	Irreversible		Irreversible	
SITE Y				
Extent	Local to regional		Local to regional	
Magnitude	Low		Low	
Duration	Long		Long	

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SIGNIFICANCE	**Low to Medium (-ve)**		**Medium (-ve)**	
Probability	Probable		Probable	
Confidence	Sure		Sure	
Reversibility	Irreversible		Irreversible	

*Note that FGD is the emission control being applied and thus the "mitigation" column is blank.

5.3.4 Social risks / vulnerability

a) Impact Statement

Due to the use and storage of hazardous chemicals on site, there is a risk of accidental fires, explosions or toxic releases emanating from an accident on site. The impacts of such an accident could extend beyond the boundaries of the power station and have an impact on the local or surrounding communities.

b) Discussion

The operation of a coal-fired power station and its associated infrastructure such as a water treatment works, waste water treatment works and a water demineralisation plant requires the use of a suite of hazardous materials. While these materials would have to be stored and handled responsibly, as prescribed by a suite of legislation, including the Occupational Health and Safety Act (No. 85 of 1993), the Major Hazardous Installation Regulations (July 2001) and the Road Transportation Act (No. 74 or 1977), emergency situations may arise if the hazardous material is spilled or explodes. In these emergency situations, there is a possibility that the consequences of such a situation could have an impact on individuals or communities beyond the boundaries of the power station site. It is important to understand the likelihood of such an occurrence taking place, and its affect on people beyond the boundaries of the site. Consequently, a vulnerability assessment by Riscom was commissioned to determine the impact that hazardous process chemical used at the power station could have on the public.

The terms of reference for the study included compiling an inventory of hazardous chemicals that are likely to be used on site, determining the consequences of the 'worst-case' scenario for people beyond the site, and assessing the risks associated with the use of hazardous chemicals on site. The methodology for the assessment included the following tasks:

- Desktop review to compile hazardous substances inventory and to identify the hazards associated with the relevant materials;
- Undertake consequence modelling to predict the likely implications of a release of hazardous substances on humans, fauna, flora and structures;
- Assess the risks of the various identified incidents occurring; and
- Recommend mitigation measures to reduce the risks associated with hazardous material use and storage.

A complete description of the methodology applied and the full findings of the study are included in **Annexure L.**

Hazard Identification

Table 5.18 provides a summary of the primary hazardous materials that are likely to be utilised at the power station. The General Machinery Regulation 8 and its Schedule A on notifiable substances, requires an employer who has substances equal to or exceeding the quantity in the Regulation to notify the divisional director. A site is classified as a Major Hazardous Installation (MHI) if it contains one or more notifiable substances or if the offsite risks are sufficiently high. At this point, there would be no notifiable substances stored on site, but this would have to be re-evaluated at a later stage in the design process, and does not preclude the requirement for a MHI risk assessment. The hazards associated with each of the identified materials are discussed below.

Table 5.18 Summary of potentially hazardous substances stored at the power station

	Hazardous Material	Storage Capacity	Description
1	Chlorine	2 x 925 kg drum	
2	Ammonia	1 x1500 ℓ	
3	Caustic Soda (50%)	Unknown	Bulk storage
4	Sulphuric acid	70 m^3 bulk tank	98% Concentration
5	Petrol/gasoline	50 m^3 bulk tank	Underground tank
6	Bunker oil	275 m^3 total capacity	
7	Diesel	10 m^3	Underground
8	Hydrogen		Low pressure generation or high pressure trailer
9	LPG	1x9 m^3	
10	Illuminating paraffin	7.5 m^3	

Chlorine is a greenish-yellow gas with an irritating and suffocating odour. It is extremely toxic and a powerful oxidising agent, which should be handled and stored with caution. Chlorine is corrosive and will react with other chemicals to cause a fire, explosion or release a toxic component. Short term exposure by humans to concentrations of chlorine can result in chest pain, vomiting, and lung function disorders leading to eventual death. Exposure to lower concentrations is likely to result in irritation to the eyes, airways and lungs. The EPA has not classified Chlorine as a carcinogen. Analysis has shown that fatalities occur within about 400 m of the release, but generally within 250 m of the incident. Chlorine would be delivered to site in 925 kg liquid chlorine drums.

Ammonia is a colourless gas with a pungent, suffocating odour. It is a corrosive substance, and is reactive, resulting in fires, explosions when in contact with calcium, household bleaches, halogens, gold, mercury and silver. Contact with liquid ammonia can cause frostbite and is toxic if swallowed or inhaled. Contact with ammonia will lead to burning of the eyes, nose and throat, coughing and impacts lung functioning. Anhydrous ammonia would be delivered to site in a pressurised 1500 kg vessel.

Sulphur at room temperature is a solid, which may have a ‘rotten egg’ smell if containing trace levels of impurities. It is highly reactive to a broad range of chemical compounds, and combustion results in highly toxic fumes of oxides of sulphur. Sulphur dioxide is a colourless gas or compressed liquefied gas with a suffocating odour. It is considered a very toxic material by the US EPA. Exposure to sulphur and sulphur dioxide may cause irritation to the eyes and airways, and could lead to impacts on lung functioning.

Petrol (gasoline) is a hydrocarbon mixture with a strong petroleum odour, which is highly flammable due to its low flash point of -40°C. It is stable under normal conditions, but can react with strong oxidising agents and nitrate compounds to cause fires and explosions. Contact with gasoline will result in slight irritation to the nose, eyes and skin, while the vapours may cause headaches, dizziness, loss of consciousness and suffocation. If swallowed, it could cause nausea and vomiting, swelling of the abdomen, headaches, coma and death. As mentioned above, Gasoline has a flash point of -40°C and a boiling point of approximately 87°C. Hazardous effects include flash fires, explosions, fireballs, jet fires or pool fires. Small volumes of petrol would be stored on site.

Diesel is a hydrocarbon mixture with a flash point between 38 and 65°C and a boiling point of between 252 and 371°C. Consequently, it is not considered a highly flammable substance, but could ignite under suitable conditions. Diesel is not considered a toxic substance. Contact with the vapour will lead to slight irritation to the nose, eyes and skin, while the vapour may cause headaches, dizziness, loss of consciousness or suffocation and lung disorders. Small volumes of diesel would be stored on site.

Hydrogen is a colourless, odourless gas that is flammable over a wide range of concentrations and conditions. While hydrogen is not toxic, it can displace oxygen in the air leading to asphyxiation and liquid hydrogen can result in frostbite.

Liquid petroleum gas or LPG is mainly constituted of propane. Propane is a colourless natural gas at room temperature, and is a severe fire and explosion hazard. Propane is not considered to be a carcinogenic material. Overexposure may cause dizziness and drowsiness.

Toxic materials are those that could give rise to dispersing vapour clouds, if released to the atmosphere. The ones of relevance to this project include chlorine, ammonia and sulphur dioxide. These can cause harm through inhalation or absorption through the skin.

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Table 5.19 Compounds classified by the US EPA as extremely hazardous

COMPOUND	ERPG-1* (mg/m^3)	ERPG-2* (mg/m^3)	ERPG-3* (mg/m^3)
Chlorine	3	7.5	60
Ammonia	17.6	105	525
Sulphur Dioxide (SO_2)	0.75	7.5	40

Emergency Response Planning Guidelines (ERPG's) as developed by the **American Industrial Hygiene Association**

ERPG-1: Is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odour.
ERPG-2: Is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
ERPG-3: Is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Consequences of an on-site accident involving a hazardous substance

The three likely consequences of an accident involving hazardous materials on the power station site are the development of vapour clouds, fires or vapour cloud explosions. Some of these may have consequences beyond the boundaries of the site, and are discussed below.

A toxic vapour cloud can occur when a toxic gas is released under pressure, through spillage and evaporation of a toxic chemical, through combustion which forms a toxic gas, or when products react to form toxic gasses. With respect to chlorine, the pipes which are connected to the chlorine drum could start to leak at the connection point, which would result in the evaporation of chlorine over time. A total failure of a chlorine drum under worst case meteorological conditions could result in an ERPG-2 concentration at a distance of 5.6 km from the incident. This could have an impact on people beyond the site boundaries.

Vapour clouds as a result of ammonia could arise due to a total failure of the ammonia vessel or a small hole in the pipeline. Based on the proposed vessel size, a catastrophic failure would result in an airborne rate of 2.38 kg/s resulting in dissipation to acceptable level (ERPG-2) within 1800 m of the source. With the more likely ‘5 mm hole’ scenario, the ammonia level decreases to an acceptable level within 130 m of the source. The catastrophic failure scenario could have an impact beyond the site boundaries. Chlorine and ammonia are highly toxic substances, with the potential to have significant impacts on site staff and the surrounding communities. However, this sort of incident is unlikely, and may occur once during the lifetime of the power station. The risk associated with it is considered to be moderate.

While sulphur dioxide would not be stored on site, it could be generated during a sulphur fire. Under worst case conditions, the point of acceptable level of sulphur dioxide could extend to 10 km from the source of the incident. This would have an impact on people beyond the boundaries of the site. Given the severe but highly unlikely nature of such an incidence, the risk associated with sulphur dioxide fires is considered to be low.

Combustible material may catch alight and burn if exposed to an ignition source, which could happen as the result of a leakage or spillage. The effects of thermal radiation on human health have been studied. An intensity of 1.5 kW/m^2 is quoted as the ‘safe’ value where people are exposed for long periods of time, and 5 kW/m^2 for people performing emergency operations. Based on various modelling, a petrol or diesel pool fire could have an impact up to 76.5 m from the edge of the flames. Petrol and diesel fires are unlikely given the current practices and procedures implemented, and the impact on the surrounding community is relatively minor. Consequently this activity is considered to be a low risk.

Hydrogen jet fires could occur from a low or high pressure pipe rupture. A maximum thermal radiation intensity of 26 kW/m^2 and ranging from 47.5 to 56.7 kW/m^2 could be reached for a low pressure and high pressure rupture respectively. The maximum radiation of the jet flames is likely to result in damage to equipment and injury to people. However, this incident is very unlikely to occur at the proposed power station, given the current accepted practices and procedures implemented at other power stations locally and internationally. Consequently this activity is considered to be a low risk.

A vapour cloud of combustible gasses released into the atmosphere could form a fireball or flash fire if ignited. The release of LPG into the atmosphere could result in an unconfined explosion or vapour cloud explosion. The simulated distance to safety for this site was 345 m from the source. While this incidence could result in serious consequences for site staff and the surrounding communities, it is unlikely to occur and is therefore considered to have a low risk.

It must be noted that the assessment undertaken was not a Major Hazardous Installation risk assessment. An MHI risk assessment should be undertaken once the detailed engineering designs and layouts have been developed.

Given the above modelled data and the buffer zone between the power station precinct and surrounding communities, the significance of the social risks of the power station on the site staff and the surrounding local communities in the event of an emergency situation is deemed to be **medium (-ve).** However, **the impact is very unlikely to take place**, due to the safety measures that are implemented at facilities of this nature. The significance of the impact is likely to be the same for both Sites X and Y.

Mitigation measures

In order to reduce the onsite and offsite risks, special attention should be given to the designs, layouts and emergency plans for all identified hazardous materials, during the detailed design phase of the project. Furthermore, it is suggested that safety reviews are undertaken during the various stages of the project, to reduce the risk and therefore the significance of the potential impacts. With mitigation measures in place, the significance of the potential impact would be reduced to **low (-ve).** The probability of this event happening is very unlikely, making the significance of this impact low.

Social risks of the proposed power station		
	SITE X	
	No mitigation	**No Mitigation**
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long	Long

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SIGNIFICANCE	**Medium (-ve)**	**Low (-ve)**
Probability	Unlikely	Unlikely
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
SITE Y		
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long	Long
SIGNIFICANCE	**Medium (-ve)**	**Low (-ve)**
Probability	Unlikely	Unlikely
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

5.3.5 Impact on heritage resources

a) Impact Statement

The establishment of the proposed power station may result in the destruction or damaging of archaeological or cultural (heritage) material located on the chosen development site. Furthermore, the location of the power station may make sites of archaeological or cultural significance more easily accessible to broader range of people, increasing the likelihood that significant sites could be vandalised.

b) Discussion

Heritage sites are fixed features in the environment, occurring within a specific spatial area and context. Consequently any impact upon such a site is permanent and irreversible. However, if a resource is unavoidably impacted upon, the resource could be excavated or recorded and a management plan developed for future action. Similarly, resources that are not directly affected by a development can be managed through a management plan, in order to ensure that the resource is adequately managed in the future.

A phase 1 archaeological survey was undertaken in accordance with the requirements of the National Heritage Resources Act (No. 25 of 1999) in order to identify and evaluate possible archaeological, cultural and historic sites with the proposed development areas, and to recommend appropriate mitigation measures. The methodology included a literature survey, review of existing heritage databases, a field survey and documentation of sites, objects and structures according to the general minimum standards accepted by the archaeological profession. The full report is contained in **Annexure M** of this EIR.

Sites X and Y fall within the Highveld, which did not experience much human occupation in pre-colonial times, partly due to the economic strategies, climate fluctuations and cultural preferences at the time. People of the Early Stone Age (ESA) period didn't inhabit the highveld much, and preferred settling along large water courses. However, by the Late Stone Age (LSA) people had become more technologically advanced, occupying more diverse habitats, with some LSA sites occurring in the broader study region. By the early Iron Age (200 AD to 1000

AD), people started to settle in southern Africa, but still preferred to be in close proximity to the alluvial soils near rivers for agricultural purposes, and also for firewood and water. The occupation of the study area only started in the 1500's, when climatic conditions made occupation of previously unsuitable areas in the Mpumalanga highveld possible.

The Boers trekked into the study area during the 1830's. White settlers also moved into the area during the first half of the 19th century, basing their survival on cattle/sheep farming and hunting. The area remained relatively undeveloped until the discovery of coal and later gold. Coal mining was initially sporadic until the discovery of the Witwatersrand gold fields, and the need for cheap energy developed resulted in coal mining on a large scale. By 1899, at least four collieries were operating in the Middelburg-Witbank area, supplying coal to the gold mines and surrounding areas.

An assessment of Sites X and Y reveal that there are no features or objectives dating to the Stone Age or the Iron Age. However a suite of remains dating to the Historic Period (1840's to present day) were identified. These can be divided into two categories of remains; namely farmsteads/homesteads and cemeteries/ graves. A total of 26 sites were identified, consisting of 5 farmsteads/homesteads, and 21 grave/cemetery sites.

A house constructed in the 1890's is located on farm Hartebeestfontein 537 JR. It is a Late Victorian style house, one of very few houses dating to the period prior to the Anglo-Boer war, in the area. An old farmstead and barn dating to 1904 are located on the same farm. They display Victorian and Edwardian style elements. Both of these structures are located on Site X. Another farmstead also built prior to the Anglo-Boer war displaying Late Victorian style features is located on Nooitgedacht 564 JR. Typical Ndebele-speaking farm labourer houses are located on Witpoort 563 JR. These structures are often ignored, but show great ingenuity and artistry and should therefore be documented. Both of these structures are located on Site Y. Destruction of the Victoria and Edwardian style structures would require a permit from the South African Heritage Resources Agency (SAHRA).

A total of 21 grave/cemetery sites were identified during the field survey, two of which are likely to fall just outside of the boundaries of the Sites X and Y. Of the remaining 19 sites, eight sites definitely contained graves that are 60 years or older. The graves at the remaining sites are either less than 60 years old, or do not have headstones, making their age indeterminable. In order to relocate any graves, a consultation process must be undertaken to identify the relevant family members. Furthermore, a suite of permits would be required to move the graves, specifically from SAHRA for graves older than 60 years. Site X contained seven grave/cemetery sites, while Site Y contains 12 such sites.

Table 5.20 Summary of affected structures on Sites X and Y

	Site X	**Site Y**
Homesteads/Farmsteads	2	3
Grave/cemeteries <60yrs old	1	10
Grave/cemeteries >60yrs old	6	2
Sites outside study area	1	1
Total number of sites	**10**	**16**

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A large number of sites with cultural significance were identified on the two sites. These date from historic times and can be classified as either homesteads/farmsteads or graves/cemeteries. None of these sites are deemed to be of such importance as to prevent the development from proceeding. However, the relevant permits would have to be obtained in order for the structures to be demolished and the graves to be relocated to a cemetery. The significance of the impact of the proposed power station on heritage resources on the both Sites X and Y are therefore deemed to be **low (-ve)** impacts. However, due to the lower number of sites located on Site X, it is preferred over Site Y.

Mitigation

It is proposed that, where possible, the 26 identified sites be preserved. However, if preservation is not possible, then extensive salvage, excavation and or mapping must be undertaken to record the heritage information contained at each of the sites. The impact on Sites X and Y would reduce to **very low (-ve)** with mitigation measures in place.

Impact of the power station and associated infrastructure on heritage resources		
	SITE X	
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Low	V low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Local	Local
Magnitude	Low	V low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**V low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

Additional study

In response to comments received from the South African Heritage Resources Agency (see Annexure R), additional information in the form of photographs of identified sites, the history of certain families and details of oral history was provided in a revision of the specialist's original report that appears in Annexure M. The revised report is presented as **Annexure W**.

5.3.6 Impact of increased vehicular traffic

a) Impact Statement

The operation of the power station may result in a large increase in vehicular traffic on the roads in the region, which may result in increased maintenance requirements or road upgrades being required.

b) Discussion

The study area is located in the Mpumalanga and Gauteng provinces, and bound by the N4 national road in the north, the N12 national road in the south, and the D686 provincial road to the east. From the intersection with the N12, the gravel low-order D960 road borders Site Y to the north, and runs between Sites X and Y on the eastern site of Site Y. Portions of the D686 would have to be rerouted, as it runs through the middle of the New Largo coal resource, and would be affected by the proposed coal mining activities.

Given that the power station would employ between 800 and 900 employees once fully operational, not to mention the supply of raw material to the site, and maintenance operations, a significant amount of additional traffic is likely to be generated. In light of this potential impact, a specialist transport planning study was undertaken by Ninham Shand's Transportation and Roads Discipline Group. The Terms of Reference for the study included the following:

- Undertake a review of existing information and conceptual plans of the study area;
- Liaise with Eskom to determine proposed road alignments and intersections with existing transport infrastructure during both the construction and operational phases;
- Identify and assess the significance of potential impacts of the proposed power station and associated infrastructure on the existing transport network in the study area, and
- Propose mitigation measures that could reduce or eliminate identified impacts.

The full specialist report is contained in **Annexure N** of this dEIR.

Due to the potential rerouting or realignment of the D686, Eskom is proposing an alternative road alignment to gain access to Sites X and Y. These proposed roads would be private access roads and would not carry the traffic that is currently carried by the D686. Refer to **Figure 2.7** above for the proposed access road layouts.

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Access to Site X would be either by a road running in a north eastern direction from the northern boundary of Site X to the D686 intersection with the N4 national road, or in the south from the D960 lower order road to the site. The D960 from this point to the N12 would have to be rebuilt for this option. Access to Site Y would be via the D960 which connects to both the N4 and the N12.

Based on future predicted traffic volumes, it is likely that the power station would generate approximately 500 commuter trips per day, distributed between taxis, busses and cars, and some 260 heavy vehicle trips per day. When compared to predicted annual average daily traffic volumes, an increase of between 0.1 and 2.3% is expected across the existing road networks, for a power station on Site X or Site Y. Some 48% of the heavy vehicle traffic is however directed onto the D960 low order road, which is a poor condition gravel road. It would therefore be inadequate to carry the anticipated volumes of traffic.

Further to the above, due to the proposed phased approach to the operation and construction of the power station, once the initial units (one or two units) are operational, these would be operated while the remaining four units are constructed, resulting in an even greater volume of traffic. During this period, traffic volumes would increase between 0.4 and 5.6 % above the future predicted average annual daily traffic volumes across the existing road network.

The proposed power station would have the effect of increasing the average annual daily traffic volumes on the existing road network, irrespective of which site is chosen. The power station would result in a significant increase in the percentage of heavy vehicles using the D960, and this road would therefore require upgrading to accommodate the high concentration of heavy vehicle traffic. Furthermore, the anticipated increase in heavy vehicles and in the overall annual average daily traffic volumes is likely to further exacerbate the poor condition of the provincial roads in the area, such as the D686.

The power station would have a regional impact on the road network, of medium magnitude, which would probably last for some 10 years after the construction of the power station, before regular road maintenance addresses the degradation of the road network. The significance of this impact is considered to be **medium (-ve)** on both Sites X and Y. Site X is however slightly more preferable than Site Y, due to the requirement for shorter access roads and its closer proximity to the N4 national road, thus requiring that less of the D960 would require reconstruction. The FGD process which uses sorbent could potentially result in an increase in vehicular traffic to the power station. This impact is deemed to be similar to the power station impact itself, and is accordingly assigned a **medium (-ve)** significance.

Mitigation
In order to mitigate the impacts of the power station on the road network, it is proposed that the road network to be used in the area be resurfaced, upgraded or reconstructed, as required. Special attention should be given to providing adequate drainage and subsurface drainage systems on all roads.

With mitigation measures implemented, the significance of this impact would be reduced to **low (-ve)**.

Power station and associated infrastructure		
	SITE X	
	No mit	**Mit**
Extent	Regional	Regional
Magnitude	Low	V Low
Duration	Long	Long
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure

Reversibility	Reversible	Reversible
SITE Y		
Extent	Regional	Regional
Magnitude	Low	V Low
Duration	Long	Long
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

	Impact of emission controls on vehicular traffic			
	Wet FGD		**Semi-dry FGD**	
SITE X				
	No mit	**Mit**	**No mit**	**Mit**
Extent	Regional	Regional	Regional	Regional
Magnitude	Low	V Low	Low	V Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Medium (-ve)**	**Low (-)**	**Medium (-ve)**	**Low (-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible
SITE Y				
Extent	Regional	Regional	Regional	Regional
Magnitude	Low	V Low	Low	V Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Medium (-ve)**	**Low (-)**	**Medium (-ve)**	**Low (-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible

5.3.7 Impact on existing landuse and planning

a) Impact Statement

This refers to the whether the proposed power station activity conflicts with existing land use and proposed land use in the area.

b) Discussion

Site X occurs wholly within the Delmas Local Municipality (LM) in the Nkangala District Municipality (DM) in Mpumalanga Province. The large majority of Site Y lies within the Kungwini LM in the Metsweding DM in the Gauteng Province. A tiny portion of Site Y lies within the Delmas LM.

The Nkangala DM Integrated Development Plan (IDP) is aligned with the Mpumalanga Provincial Growth and Development Strategy, compiled in 2003. According to the Nkangala IDP, Site X occurs within an area classified as “mining and agricultural”. The IDP notes that agricultural activities and promotion of tourism are important for the district. These activities are supported by identifying specific areas for development of large scale urban and rural agricultural ventures and by creating infrastructure and measures to assist new agricultural investors. In terms of the Nkangala DM’s IDP, there are no specific plans, budgets or action plans earmarked for Site X.

There isn’t an IDP for the Metsweding DM but the Kungwini LM has developed an IDP, which identifies priority areas including encouraging development and employment creation as priorities. The Kungwini IDP recognises that the LM is largely rural with an underdeveloped agricultural base. Proposals are made for supporting agriculture and skills training related to agriculture. This said, there are no specific plans, budgets or action plans related to Site Y. Similarly, the Delmas IDP focuses on a range of social, economic and institutional objectives in order to develop and grow the area. It does not outline any specific plans for development at Site X.

The IDPs tend to focus on strategic planning in urban areas where the need for services, infrastructure and social/ community amenities are most required. Plans and budgets are targeted at identified “problem areas”. As a consequence, while the IDPs recognise that the areas identified as alternative sites are farming and mining areas, they do not contain specific plans for the area.

The Nkangala Spatial Development Framework (SDF) notes that the area in which Site X is allocated for commercial agriculture and mining. While the Delmas SDF does consider various spatial elements, including mining and agriculture, it does not cover the area within Site X as located. There are no specific spatial proposals or initiatives identified for Site X. There is currently no SDF for Kungwini LM. The Metsweding SDF notes that the area within which Site Y is located is earmarked as part of the agricultural land holdings and open space areas of the Metsweding DM. While the SDF calls for protection of known high potential agricultural potential soils, it does not identify specific spatial proposals or initiatives for the area within which Site Y is located.

There are no known land claims in the area of the two alternative sites.

c) Description and significance of potential impact

Power station surface infrastructure (including dams, coal stockyard, water and wastewater treatment facilities, chemical storage etc.)

A power station at Site X or Y would not clash with any priority development areas, conservation areas or tourist development areas identified in the above-mentioned IDP and SDF documentation. The IDPs and SDFs do mention economic imperatives and promotion of agricultural activities in their areas of jurisdiction. Socio-economic impacts and impacts on agricultural potential area discussed and assessed in Section 5.3.9 and Section 5.3.12 respectively. Accordingly this assessment focuses solely on whether the proposed activity conflicts with existing land use planning. Sites X and Y are located far away from urban growth nodes and do not occur within areas where specific plans have been developed. As a result, a **neutral** significance impact is expected.

From a planning perspective, there is no significant difference between Sites X and Y. As soon as the preferred site is commercially acquired by Eskom, a process of rezoning of the said property would be initiated

d) Assessment tables

No assessment tables are needed as a neutral impact is anticipated.

5.3.8 Impact on socio-economic conditions

a) Impact Statement

This refers to the impact that the construction and operation of the proposed power station would have on the net welfare of local communities and on economic development in the area.

b) Discussion

The data presented below and in the specialist socio-economic study in **Annexure P** is based on primary research (surveys) and calculations, based on Census 2001 data.

Any examination of socio-economic conditions is rooted in population dynamics. The population is the source of economic growth though provision of labour, skills and demand for products. The Kungwini LM's population grew at an annual rate of 12.9% between 1996 and 2005. During the same period, population in the Delmas LM grew by an annual rate of 1.4%. The 2005 population at Kungwini (approximately 120 095 people) is roughly twice that of Delmas LM (approximately 59 382 people).

According to the Department of Health Statistics and the South African national HIV/ AIDS survey, Mpumalanga Province has a higher HIV/ AIDS prevalence than Gauteng Province. This trend is mirrored by the Kungwini and Delmas statistics i.e. Delmas LM has a higher HIV/ AIDS prevalence than Kungwini LM. It is important to note HIV/ AIDS prevalence as it impacts significantly on population dynamics and accordingly on the socio-economy as well – especially if HIV/ AIDS is most prevalent among the economically active segment of the population. Kungwini LM has an economically active population of 64 464 and Delmas has 24 997. Most of the economically active people in both municipalities work in mining, construction, transportation and agriculture. Kungwini has the higher number of professionals and managers, evident in the higher monthly household income. The average monthly household income in Kungwini LM is more than double that in Delmas LM (R7 889 vs. R3 469). In addition, Delmas LM has a higher percentage of people living below the poverty line [29]than Kungwini LM (71.1% vs. 62.4%).

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The fastest growing sectors in Kungwini LM are the tertiary sectors (finance and services) while mining, electricity and water sectors have been declining. Agriculture is the fastest growing sector in Delmas LM with mining, electricity, water, construction and services sectors in decline. Mining and services sectors, which comprise 26.2 % of Delmas LM's economy, showed a decline between 1996 and 2005, having a significant negative impact on the municipality's economic performance. Overall, the Kungwini LM's economy grew by 3% per year between 1996 and 2005 while the Delmas LM's grew by 2.6% per year for the same period. The biggest employers in Kungwini LM are services, manufacturing, finance and trade. In Delmas LM the agriculture and services sectors employ just over half of the employed population in the municipality, highlighting the fact the Delmas LM is dependant on the performance of the agricultural sector.

Broadly speaking, it can be seen that Delmas LM has a more vulnerable economy than Kungwini LM due to:

- Higher poverty rates;
- Decreasing employment opportunities;
- Poorer quality of life;
- Higher prevalence of HIV/ AIDS;
- Slower economic growth; and
- A higher dependence on the agricultural sector.

The alternative sites

There are approximately 104 people (comprising 27 families) who live within Site X. Of the 64 people of working age, 47 are employed on local farms and are predominantly permanent employees. The unemployment rate is 20.3%. 55% of Site X employees are semi-skilled, 40% are skilled and 5% are highly skilled. Agricultural trades comprise the dominant occupation with a minor portion of employees being involved in elementary occupations and operating plant and machinery.

There are approximately 214 people who live within Site Y, comprising 43 families. Of the 114 people of working age, 43 are employed locally. The unemployment rate is 37% at Site Y. 71% of employees at Site Y are unskilled or semi-skilled, 19% are skilled and 10% are highly skilled. In addition Site Y has a more diversified occupational profile than Site X – 47% are skilled agricultural workers, 20% are machine operators, 13% are craft-related workers and 7% are professional and technical assistants.

An analysis of the above facts and figures indicates that Site Y:

- Has a larger population with a larger number of employed people;
- Has a bigger wage bill and greater turnover than Site X; and
- Has a more diversified, hence less vulnerable, economy than Site X.

c) Description and significance of potential impact

Potential impacts can be broadly categorised as direct or indirect. Direct impacts occur as a consequence of a new development creating jobs and purchasing goods and services. Indirect impacts occur when the suppliers of goods and services are exposed to a larger market as a result of the new development, thus experiencing the potential to expand, creating further economic opportunities.

On a local to regional scale, impacts can be viewed in terms of job creation, personal income and the social lives of local communities. On a national scale impacts can be viewed in terms of effects on the country's balance of payment (a summary of South Africa's transactions with the rest of the world).

The operation of the power station is estimated to create 800 permanent jobs (direct impact). 10% would be highly skilled jobs, 60% would be skilled and 30% would be unskilled. As a consequence of the multiplier effect, the indirect effect of the power station would be an additional estimated 5 430 jobs – mainly in the trade, mining and transportation sectors. The direct and indirect effect on the GGP is a likely increase by R 2.67 billion per year (R 1.18 billion per year being the direct impact of the power station). New business sales are calculated to increase by R 7.06 billion per year via direct and indirect generation.

Gross Geographic Product

Constructing the power station at Site X would result in a loss of R6.048 million to the GGP. At Site Y, the loss to GGP is marginally higher at R6.384 million. Clearly, when compared to the projected contribution to GGP of R1.18 billion (direct effect only) the losses are inconsequential and an overall positive impact would be experienced.

Employment

As discussed the operation of the power station would result in the creation of 800 jobs (direct effect only). At Site X, the power station would result in the loss of 54 jobs and at Site Y, 59 jobs. These existing jobs at Sites X and Y are largely semi-skilled or unskilled and as a result acquiring new jobs in the short term would be difficult. On a local and regional scale there would be an overwhelming positive impact on employment in the region. However, on the micro-scale, the loss of jobs to the workers on Site X or Y would be devastating, unless mitigation measures are put in place to reduce this impact.

Income

Constructing the power station at Site X would lead to a loss of annual income valued at R 720 000, while at Site Y the loss is valued at R 900 000. The annual wage bill of the power station would be approximately R 504 million, once again an overwhelmingly positive impact.

Social lives of local communities

The power station would require the relocation of either 27 families at Site X or 43 families at Site Y. This would represent a negative impact in terms of:

- Potential loss of family ties;
- Disruption of day-to-day lives;
- Potential changes in social interactions and patterns;
- Potential changes in the community value system associated with the movement away from the traditional way of life

For those communities living in the vicinity of the power station there are negative impacts associated with the potential increase in crime and violence.

Balance of payments

The balance of payments is the summary of all economic transactions between South Africa and the rest of the world. The construction of the power station would require the purchase of foreign labour, plant equipment and machinery to the amount of R 15.3 billion. This increase in outflow of money from the country will increase the country's deficit. However, it is envisaged that the investment in latest technology and skills transfer will have positive spin-offs. In addition, the generation of electricity is positively correlated with economic growth in the country. So, while the trade off between increasing the national deficit and future long term economic growth in South Africa is difficult to quantify, it is clear that investment in the energy sector and sustaining economic growth (especially in light of the government's Accelerated and Shared Growth Initiative for South Africa) is imperative. This macro-scale implication of the proposed activity is provided for context and is not assessed below.

Beneficial use of waste products

The FGD process can be designed to produce gypsum, which is considered to be a potentially usable by-product. Gypsum is used in a suite of products that are regularly consumed. Wallboard manufacturing is the predominant user of the gypsum produced in FGD plants. Table 5.21 below contains a list of current commercial uses for gypsum produced from the wet FGD process. The gypsum produced from the semi-dry FGD process have received limited commercial use; however, as noted in Table 5.22, these materials have the potential to be utilised in a variety of applications.

Table 5.21 Commercial uses of the gypsum produced from the wet FGD process

Wallboard	Glass making
Structural Fill	Pharmaceutical filler
Aggregate	Paper
Mining Applications	Plastic
Portland Cement	Floor systems
Plaster	Mortars

Agriculture Uses	Fuel additive
Soil Stabilization	Soil neutralization

Table 5.22 Commercial uses of the gypsum produced from the semi-dry FGD process

High Potential	Moderate Potential	Low Potential
Structural Fill Grout/Mine Backfill Stabilized Roadbase Synthetic Aggregate Lightweight Aggregate Mineral Wool Brick Production	Cement production Cement replacement Soil stabilization Sludge stabilization Mineral filler Agricultural use Ceramic products Liner material	Gypsum/wallboard Metals extraction

It is predicted that during the next few years, the use of mined gypsum will decline significantly in the United States as greater quantities of synthetic gypsum are produced. Today, synthetic gypsum represents about 18% of the gypsum used in the United States. There is potential for Eskom to sell the manufactured gypsum, should a suitable market be developed in South Africa.

The socio-economic study looked at the power station and associated infrastructure as a whole and did not assess impacts associated with alternative means of cooling, ash disposal or air abatement technologies. In terms of a local and regional socio-economic study this is appropriate. Based on the findings of the study, there is a clear overall positive impact that has a high magnitude, long term and regional scale. Accordingly, a **high (+ve)** significance impact is anticipated at Site X or Y.

With respect to a preferred site, the differences between the alternative sites are marginal. However, based on the fact that Site Y has more families, earning a greater annual income and contributes more the GGP than Site X, the preferred site from the socio-economic assessment would be Site X. In addition the Delmas LM is in greater need of an economic boost than the Kungwini LM due to, amongst others higher poverty rates, decreasing employment opportunities, poorer quality of life and a slower economic growth. This strengthens the argument of the selection of Site X as the preferred site.

Mitigation measures

The mitigation measures are intended to reduce the negative impacts associated with loss of jobs and other social impacts. Possible measures include:

- Assist with skills development of those residing and employed on the selected site;
- Where possible employ those who lose their jobs as a direct result of the power station;
- Establish community forums; and
- Establish and maintain communication channels between local communities, construction companies/ contractors and Eskom.

d) Assessment tables

There is an overall high positive impact with Site X emerging as the preferred site.

Power station and associated infrastructure		
SITE X		
	No mit	**Mit**
Extent	Regional	Regional
Magnitude	High	High
Duration	Long	Long
SIGNIFICANCE	**High (+)**	**High (+)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	N/A	N/A
SITE Y		
Extent	Regional	Regional
Magnitude	High	High
Duration	Long	Long
SIGNIFICANCE	**High (+)**	**High (+)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	N/A	N/A

5.3.9 Impact on the tourism potential

a) Impact Statement

The proposed power station and associated infrastructure may have an impact on tourism in the area.

b) Discussion

The study area straddles the border between the Mpumalanga and Gauteng Provinces. The dominant land use in the study area is open grassland and cultivated fields. The area appears to be in a state of transition as mining and other industrial activities approach from the east. The only recognised tourist destination within a 30 km radius of the alternative sites is the Bronkhorstspruit Dam, which lies approximately 14 km north west of Site Y and 20 km north west of Site X. According to the visual impact study, the dam lies within an “incision” in the landscape, which would limit views of the proposed power station from the water. The areas on the perimeter of the dam are being developed as resorts and housing estates, further limiting views of the power station from the surface of the dam. The northern portion of the dam would offer uninhibited views of the proposed power station, but this impact would be minimal due to distance.

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While respective IDPs mention promoting tourism within their areas of jurisdiction, there are no specific plans for the immediate vicinity of the proposed power station.

c) Description and significance of potential impact

The proposed land-take for the proposed power station does not include any land currently being used as a tourist destination. The other manner in which the proposed power station could impact on tourism is in terms of its visual intrusion into the landscape. Given that the proposed power station would be too far away from Bronkhorstpruit Dam to present any real threat to the dam, as a tourist attraction, tourists would only be “affected” by the proposed power station only for a short time as they travel on the N4 or N12 on their way to or from other tourist destinations. The visual study notes that severity of visual impacts on motorists is likely to be relatively low and accordingly, should tourists be of the mindset that the power station is an eyesore, any negative impact they feel would be minimal. Should FGD be implemented at the power station, the visible plume that results from the FGD process may draw attention to the power station, and give the impression of a structure that is polluting the environment, which might be viewed negatively by tourists passing through the area. On the other hand, the power station, being a large imposing structure, would represent a feat of engineering that may be appreciated by tourists utilising the national roads.

This is not an impact that can be easily assessed and is by nature subjective. The direct impact on tourism, in terms of damaging or destroying a tourist attraction, is not anticipated to be significant. Indirect impacts may include:

- Positive or negative impacts on tourists travelling through the area;
- A real, or at least perceived, deterioration in air quality and hence a less healthy and desirable destination, and
- Positive spin-off for tourism as the local economy is boosted.

Conservatively, it is estimated that should there be a negative impact, it would have a very low magnitude with a regional extent and long term. Any impact on tourism is likely to be of **low (-ve)** significance.

d) Assessment tables

With respect to the alternative sites, Site X emerges as being slightly preferred due to it being located further away from Bronkhorstspruit Dam than Site Y.

Power station and associated infrastructure		
	SITE X	
	No mit	Mit
Extent	Regional	Regional
Magnitude	Very low	Very low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**
Probability	Unlikely	Unlikely
Confidence	Uncertain	Uncertain

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Reversibility	Reversible	Reversible
SITE Y		
Extent	Regional	Regional
Magnitude	Very low	Very low
Duration	Long	Long
SIGNIFICANCE	**Low (-)**	**Low (-)**
Probability	Unlikely	Unlikely
Confidence	Uncertain	Uncertain
Reversibility	Reversible	Reversible

5.3.10 Impact on agricultural potential of the region

a) Impact

The establishment of a power station at Site X or Y would result in the loss of approximately 2500 ha of agricultural land, which may have an impact on the economy of the region.

b) Discussion

Agriculture is one of the largest economic sectors in Mpumalanga, producing 15% of the total agricultural output in South Africa. Seventy one percent of the land in the province comprises vast open areas of natural vegetation. Most of the disturbed land is under some form of cultivation (26%), while urban areas only comprise 1.25% of the province. The expansion of agricultural activities results in the clearing of natural vegetation and the associated loss of habitats and ecosystems. This also results in the creation of pathways for alien species invasion.

With land being a limited resource and the demand for land increasing, it was considered important to determine the agricultural potential and value of the two candidate sites. Consequently an agricultural potential assessment was undertaken by Mr Andries Jordaan of the University of the Free State. The terms of reference for the study included determining the soil potential of the candidate sites, in order to determine the loss of agricultural potential at each of the sites. The methodology for the study included the following:

- Literature review, including satellite imagery, to compare agriculture in the region with agriculture on the two sites;
- Site inspections;
- Obtaining farm-level data from farmers through a questionnaire;
- Calculating the agricultural potential, annual agricultural value and loss in agricultural production for each site.

A detailed description of the methodology is contained in the full report, which is contained in **Annexure Q**.

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Table 5.23 Comparison of agricultural information for Sites X and Y

	Site X	Site Y
High potential soil	45 %	32 %
Land cultivated (Dry land)	27 %	39 %
Irrigation land	1 %	8 %
Natural grazing	54 %	48 %
Pastures	18 %	13 %

Based on a site inspection, satellite imagery and discussions with farmers, the data presented in Table 5.23 above was collected. Farmers on Site X indicated a larger percentage of their land as having high potential soils. However, farmers at Site Y undertake much more cultivation (dry land and irrigated) while the farmers on Site X place more emphasis on live stock farming. It is possible that the farmers on Site Y, who are undertaking more cultivation, are better informed of the potential of their soils than the farmers on Site X. Alternatively, it is possible that the farmers on Site Y are able to cultivate medium potential soil more extensively than the farmers at Site X, because of their access to irrigation water, from the Wilge River. Farmers indicated that the Wilge River is a reliable source of irrigation water. Irrigation systems on Site Y are well developed and include pivot irrigation systems, pumps and pipelines.

Under dry land conditions, farmers on Site X and Y obtained similar average yields, with Site X yields varying between 3.5 and 5 tonnes per hectare and Site Y yields varying between 4.4 and 4.8 tonnes per hectare. However farmers who irrigated their maize reported yields of up to 10 tonnes per hectare. Livestock farmers on Site X reported that they required three hectares per livestock unit (LSU) while farmers on Site Y reported a requirement for two hectares per LSU. The recommended carrying capacity for the region is however 5 hectares per LSU.

In order to calculate the loss of agricultural production, gross margins calculations were undertaken. Gross margins provide the gross value of agricultural production after deduction of the direct input costs, and provide a good indication of profit available. The net present value (NPV) for the withdrawal of the land from agriculture over a 40 year period was also calculated using a 10% discount rate.

Table 5.24 Comparison of gross margins and revenues between Sites X and Y

	Site X (~5000 ha)	Site Y (~2500 ha)
Gross income per annum	R 7 239 160	R 6 485 102
Net income per annum	R 3 747 164	R 2 401 404
Gross production 40yrs	R 289 500 000	R 259 000 000
NPV Gross production 40 yrs	R 70 792 000	R 63 418 000
Total net income 40 yrs	R 149 886 500	R 96 056 000
NPV net income 40 yrs	R 36 643 706	R 23 483 500
Gross income per ha	R 1 447	R 2 594
Net income per ha	R 749	R 961
Total net income per ha 40 yr	R 29 977.30	R 38 422.40
Gross production per ha 40 yrs	R 57 900	R 103 600
NPV gross production per ha 40yrs	R 14 158.40	R 25 367.20

NPV net income per ha 40 yrs	R 7 328.74	R 9 393.40

As can be seen from the above table, the gross and net income from Site X annually and over a 40 year period would be higher than that for Site Y. Site X is however almost double the area of Site Y. However, when comparing income per hectare, it can be seen that the gross and net income per hectare for Site Y are R 2 594 and R 961 respectively, while the gross and net income per hectare for Site X is R 1 447 and R 749 respectively. The net income per hectare over 40 year life span of the power station is R 7 328.74 for Site X and R 9 393.40 for Site Y.

The significance of the impact on Site X is therefore deemed to be **medium (-ve)**, due to the impact of the loss of agricultural land on a regional level, which may have a high soil potential. The significance of the impact on Site Y is however deemed to by **high (-ve)** due to the higher yield and production value of the soil per hectare than Site X, and because of the extensive irrigation infrastructure on the site and the access to water from the Wilge River.

Mitigation
In order to return some of the land back to agricultural use, Eskom could consider leasing 'surplus' land acquired back to the farmers in the area, for utilisation for agricultural purposes. This may be more appropriate if Site X were to be chosen, as the actual site is larger than the 2 500 ha required for the power station and its associated infrastructure.

Power station and associated infrastructure		
	SITE X	
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low
Duration	Long	Long
SIGNIFICANCE	**Medium (-)**	**Medium (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Long	Long
SIGNIFICANCE	**High (-)**	**Medium (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

<ins>*Additional study*</ins>

<ins>In response to the release of the dEIR, a poultry farming enterprise located to the south of Site X expressed concern about the possible effects that SO_2 may have on their livestock. The air</ins>

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quality specialists were thus tasked with investigating this issue in more detail and a focus group meeting with the poultry farming enterprise was held. See Annexure T for the proceedings of the meeting. The outcome of this additional study was that the air quality specialist's original report (Annexure I) was revised to reflect the additional information pertaining to poultry. The revised report is presented as **Annexure V**.

In essence, it appears unlikely that significant risks to poultry will result from the proposed powerstation and the significance ratings presented in this section and in Section 5.3.3 above will remain unchanged.

5.3.11 Impact on livelihood security

a) Impact Statement

The displacement of agricultural land by the power station could have a negative impact on those farmers who still wish to continue farming in the area. Furthermore, the loss of agricultural land could have an impact on the farm workers who lose their jobs, if they are unable to find alternative employment.

b) Discussion

There are a suite of farmers that cultivate the land on Site X and Y. The Wilge River runs through Site Y, making irrigation agriculture more feasible for that site. Activities on Site X are mostly related to dry land agriculture and grazing. As indicated in Table 5.22 above, the net income per hectare at Site X is R 749 whereas at Site Y it is R 961. The acquisition of land for the power station could result in certain farmers being compensated for their lost land, but because of the area of land that they have lost, their entire agricultural business could be unviable.

Furthermore, some 86% of the people that live on Site X are also employed on the site. Similarly, at Site Y, approximately 73% of the people that live on the site are employed there. The farm workers are often only skilled for the agricultural sector, and would struggle to find employment outside of that sector, without first gaining additional skills. The establishment of the power station could therefore result in the loss of employment for 54 and 59 people on Sites X and Y respectively.

The impact of the power station on livelihood securities is likely to have a site specific extent, with a medium magnitude and would last for the duration of the construction phase (i.e. seven years), by which point the affected people are likely to have secured alternative employment or gained new skills as a result of the economic spin-offs of the power station development. The significance of this impact is therefore considered to be **low (-ve).**

Mitigation measures

Mitigation measures could include leasing excess land back to farmers whose land has been acquired, undertaking skills transfer activities with the displaced farm workers as well as giving preference to those displaced farm workers.

With mitigation measures in place, the magnitude of the impact would reduce to low with significance dropping to **very low (-ve)**.

Power station and associated infrastructure		
	SITE X	
	No mitigation	**Mitigation**
Extent	Site specific	Regional
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Low (-)**	**V Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Site specific	Regional
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Low (-)**	**V Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

5.4 CONSTRUCTION PHASE IMPACTS ON THE BIOPHYSICAL AND SOCIAL ENVIRONMENTS

5.4.1 Introduction

These impacts relate to the short-term impacts that occur during the construction phase. The proposed power station would be constructed over a period of some six years, with the associated infrastructure and first generating unit being constructed in the first three years, and the remaining five units being constructed thereafter at a rate of two units per year.

The following potential impacts have been identified as relevant to the construction of this project:

- Disturbance of flora and fauna;
- Impacts on water resources (sedimentation and water quality);
- Increase in traffic volumes in the vicinity of the construction site;
- Noise pollution;
- Impact on existing infrastructure;
- Socio-economic impacts;
-

Individual Assessments

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Windblown dust;
- Litter/ waste pollution;
- Interruption of road services;
- Storage and utilisation of hazardous substances on site;
- Risk of fire;
- Disturbance to sense of place, visual aesthetics;
- Security risks;
- Health issues; and
- Light pollution.

Composite Assessment

A framework EMP is contained in **Annexure B** of this report, which broadly outlines the type and range of mitigation measures that could be implemented during the pre-construction, construction, operational and decommissioning phases of the project. The detailed construction, operational and decommissioning EMP specifications would however only be developed should the project gain approval, and would accommodate the recommendations or Conditions of Approval, if specified by DEAT. .

5.4.2 Assessment of construction phase impacts

a) Disturbance of flora and fauna

As noted above, both sites are mostly disturbed through agricultural activities, with little natural vegetation remaining. There are however a range of protected species occurring on both Sites X and Y, including six protected plant species and one red data bird species. The total area of Site X is approximately 5 000 ha, while Site Y is approximately 2 500 ha. During the construction phase, it is possible that the contractor would remove more vegetation cover than is required to establish the power station and its associated infrastructure, with the potential to impact on the identified protected plant species, with knock-on effects for the animals that utilise that habitat.

Given the limited extent of natural vegetation on Site X and the presence of protected plant species, the significance of impacts to terrestrial and aquatic fauna and flora is deemed to be **medium (-ve)**. Similarly on Site Y, the significance of potentially disturbing protected flora and fauna unnecessarily during the construction phase is deemed to be **medium (-ve)**. Furthermore, if indirect dry cooling is the technology that is implemented, the construction of the requisite cooling towers would result in large additional areas of vegetation having to be disturbed for the construction process. This is also deemed to have a **medium (-ve)** significance impact.

Mitigation

Mitigation measures would be included in an Environmental Management Plan, and could include measures such as:

- Defining all areas not directly required for the construction process to be declared 'no-go' areas;

- Cordoning off all 'no-go' areas and ensuring that they remain in an unaltered state for the duration of the construction phase;
- Removal and stockpiling of topsoil for the revegetation process; and
- Utilising natural vegetation found on the site, or that would typically be found on the site for the revegetation process, where possible.

With mitigation measures implemented, the significance of the impacts on Site X and Site Y would be reduced to **low (-ve)**.

Power station and associated infrastructure		
	SITE X	
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Definite	Definite
Confidence	Sure	Certain
Reversibility	Irreversible	Reversible
	SITE Y	
Extent	Local	Local
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Definite	Definite
Confidence	Sure	Certain
Reversibility	Irreversible	Reversible

Construction footprint impact on terrestrial fauna and flora				
	SITE X			
	Direct dry cooling		**Indirect dry cooling**	
	No mit	**Mit**	**No mit**	**Mit**
Extent	Site specific	Site specific	Site specific	Site specific
Magnitude	Low	V low	Medium	Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**V Low (-)**	**Medium (-)**	**Low (-)**
Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible
	SITE Y			
Extent	Site specific	Site specific	Site specific	Site specific
Magnitude	Low	V low	Medium	Low
Duration	Long	Long	Long	Long
SIGNIFICANCE	**Low (-)**	**V Low (-)**	**Medium (-)**	**Low (-)**

Probability	Probable	Probable	Probable	Probable
Confidence	Sure	Sure	Sure	Sure
Reversibility	Reversible	Reversible	Reversible	Reversible

b) Impact on water resources

The sites fall with the Olifants River quaternary catchment B20F. The Klipfonteinspruit River crosses Site X and the Wilge and Klipspruit rivers cross Site Y. Water from the Wilge River is reportedly used for irrigation of crops and pastureland. Large earth moving activities will take place as part of a project of this scale and nature. This will result in the removal of the vegetation covering, with the result that soil erosion is likely to increase. The additional soil is likely to end up in the rivers and streams mentioned above, causing an increase in the sediment load of those rivers. Furthermore, chemicals and materials used on site during the construction phase, such as shutter oil, curing compounds, and diesel, if spilled could end up in the river systems.

Increases in sediment load and pollution of the water through chemical spills would have a negative impact on the fish and invertebrates in the rivers. Furthermore, the farmers who utilise the water for irrigation and consumption would also be negatively affected by the pollution of their water source.

Consequently, the impact on water resources during the construction phase is deemed to have a **medium (-ve)** significance for Site X and Y. It must be noted that the significance of the impact on Site Y is considered to be slightly higher than on Site X since there is broader utilisation of the Wilge River.

Mitigation

Mitigation measures would be included in an Environmental Management Plan, and could include measures such as:

- Installation of silt traps to reduce the sediment loads in the river and streams of concern;
- Strict storage and handling of materials such as diesel, shutter oil and curing compounds;
- Always utilising a drip tray under stationary vehicles and other plant;
- Developing an action plan for dealing with accidental spills of chemicals;

The impact of the construction activities on water resources in the area is deemed to have a **low (-ve)** significance with mitigation measures in place for Site X and Site Y.

Power station and associated infrastructure		
	SITE X	
	No mitigation	Mitigation
Extent	Local	Local
Magnitude	Medium	Low

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Duration	Construction	Construction
SIGNIFICANCE	**Medium (-ve)**	**Low (-ve)**
Probability	Probable	Definite
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible
	SITE Y	
Extent	Local	Local
Magnitude	High	Low
Duration	Construction	Construction
SIGNIFICANCE	**Medium (-ve)**	**Low (-ve)**
Probability	Probable	Definite
Confidence	Sure	Sure
Reversibility	Irreversible	Reversible

c) Increase in traffic volumes

During the construction phase, between 2000 and 6000 people would be employed on site. Employees are likely to travel to work by private car, bus and minibus taxis. Further to the above, it is estimated that some 70 20-tonne trucks would visit the site each day, generating 140 vehicle trips per day. The N4 and N12 national roads would carry the majority of the heavy vehicles. Average annual daily traffic volumes are predicted to increase between 0.6 and 6.7 % across the existing road network above the future predicted traffic volumes for the duration of the construction period.

Further to the above, construction of the remainder of the power station would continue whilst the first unit of the power station is brought online and operated, and operation and construction would continue simultaneously as the additional units are brought on line. Therefore during this period, traffic volumes would increase further due to the simultaneous construction and operation of the powerstation. During this period, annual average daily traffic volumes are predicted to increase by a further 0.4 to 5.6 %.

The impact of construction traffic volumes is likely to have a medium magnitude, with a regional extent, and be limited to the construction phase. Consequently, the impact is likely to have a **medium (-ve)** significance. The impact is likely to the same for both Sites X and Y.

Mitigation
In order to mitigate the impacts of the power station on the road network, it is proposed that the road network in the area be resurfaced, upgraded or reconstructed, as required prior to the construction phase of the power station. Special attention should be given to providing adequate drainage and subsurface drainage systems on all roads. Eskom would need to discuss the above with the Department of Transport and the relevant local authorities.

With mitigation measures implemented, the significance of this impact would be reduced to **low (-ve)**.

Power station and associated infrastructure		
	SITE X	
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

d) Noise Pollution

Since the development of the proposed power station would span some 6 years, noise from the construction activity could become a significant issue. Construction would typically be carried out between 07h00 and 18h00; however some tasks would need to continue 24 hours a day, such as excavation dewatering. Specific activities may also require 24 hour shifts to complete the task.

While it is not possible to determine the exact noise levels at this point, before the final construction site layout has been determined, typical noise levels generated by a construction site range from 64 dBA within a 100 m of the site, decreasing to 41 dBA 1000 m from the site. The noise limit of 45 dBA is likely to be achieved within a distance of 750 m from the site. For the construction of the linear infrastructure such as the internal and external access roads, typical noise levels at a distance of 15 m from the site are in the 75 to 100 dBA range.

Given the size of the site, the likely areas of disturbance and the position of sensitive noise receptors, it is unlikely that the construction phase noise levels will have a significant impact on surrounding residents or settlements. The impact of construction activities on the ambient noise level is therefore deemed to have a **low (-ve)** significance. The significance of the impact would be the same on both Site X and Site Y.

Mitigation

Mitigation measures could include ensuring that all plant is in good working operation, and not making excessive noise. The use of silencers on the plant, where applicable, could also be encouraged. With mitigation measures in place, the impact would reduce to have a **very low (-ve)** significance.

Power station and associated infrastructure		
	SITE X	
	No mitigation	**Mitigation**
Extent	Site specific	Site specific
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Low (-ve)**	**V Low (-ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Local	Local
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Low (-ve)**	**V Low (-ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

e) Impact on existing infrastructure

The proposed power station and associated activities may have implications for existing transport (vehicular traffic, railways as well as transport of water, wastewater, gas or liquid fuel), communication (communication masts or telephone lines) or electricity (power lines) infrastructure. The construction phase could result in intermittent or permanent interruptions in services provided by the above infrastructure,

There are also two known planned infrastructural developments in the area. The first, a proposed New Multi-Products Pipeline (NMPP), is planned to traverse the area between the alternative sites and is an imminent development. The NMPP pipeline would transect the south easternmost corner of Site Y. The second is a proposed road alignment that cuts across the southern portion of Site X, is a long term plan and it is not known if the road will be constructed or when.

This construction phase impact, if unmitigated, has the potential to be of a **medium (-ve)** significance, given its long term duration and site specific extent.

Mitigation measures

Mitigation measures included identifying all potentially affected infrastructure (above ground and buried) during the planning phase, to ensure that any relocation of services or interruptions in service can be planned and executed so as to cause minimal disruption. With mitigation measures in place, the impact is likely to have a **low (-ve)** significance.

Power station and associated infrastructure		
SITE X		
	No mitigation	**Mitigation**
Extent	Site specific	Site specific
Magnitude	Medium	Low
Duration	Long	Long
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible
SITE Y		
Extent	Site specific	Site specific
Magnitude	Medium	Low
Duration	Long	Long
SIGNIFICANCE	**Medium (-)**	**Low (-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

f) Socio-economic impacts

The establishment of a coal-fired power station in the Witbank area is estimated to have a total capital cost of some R42 billion. However approximately 51% of this will be spent on imported equipment and hiring of foreign specialists. Therefore a total of approximately R20 539 million will be spent in South Africa during the construction phase. Furthermore, the construction of infrastructure of this scale and nature requires a large construction force. It is estimated that the project would employ some 3 670 people, 20% of which would be highly skilled, 35% skilled and 45% unskilled labourers. As a spin-off of the construction project, it is estimated that a further 3 275 indirect jobs would be created. Expressed in an alternative manner, the project would create some 55 560 employed person years during the construction phase, through direct and indirect jobs. The majority of the materials supply and labour would be sourced from the Gauteng Province with the remainder sourced from the Mpumalanga Province. Unemployment ranges between 43.8 and 48% in Gauteng and Mpumalanga currently, with the South African average being 48.2%. The addition of some 7 000 job opportunities into the economy would provide a significant boost to the region, and would reduce unemployment by some 0.23% in Gauteng and Mpumalanga.

The establishment of the power station at Site X or Site Y will result in those people who are currently employed on those sites to loose their jobs (54 and 59 workers respectively). They represent semi-skilled or unskilled labour, and may find it challenging to secure new employment in the short-term.

The socio-economic impacts as a result of the construction phase activities are deemed to have **medium (+ve)** significance, due to the large number of jobs that would be created and due to in the injection of capital into the provinces. The significance would be the same irrespective of the site chosen.

Mitigation

It is proposed that Eskom assist the workers who loose their jobs on the chosen site to develop new skills, and furthermore, where possible employ those people during the construction and operation of the power station.

With mitigation measures in place, the significance of the construction phase impacts from a socio-economic perspective would still remain **medium (+ve)**, but the magnitude of the impact would increase slightly from low to low to medium.

Power station and associated infrastructure		
	SITE X	
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Low	Low to medium
Duration	Medium	Medium
SIGNIFICANCE	**Medium (+ve)**	**Medium (+ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Regional	Regional
Magnitude	Low	Low to medium
Duration	Medium	Medium
SIGNIFICANCE	**Medium (+ve)**	**Medium (+ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

g) Windblown dust

The construction activities will result in the large scale clearing of vegetation and earth moving activities, which is likely to result in an increase the amount of dust that is blown off the site. This could have a negative impact for farmers in the area, especially if their crops are sensitive to dust as well for recreational activities in the vicinity of the site.

Dust suppression techniques such as regular dampening of the construction or haul roads could be employed to control the amount of dust that is blown off site.

h) Litter/ waste pollution

The effect of litter and waste pollution on the biophysical environment in the vicinity of the power station site and road corridors is likely to be relatively small.

i) Interruption of road services

Prior and/ or during the construction period, the D960 may require upgrading to ensure that construction vehicles and staff can access the site from the N4 and N12 national roads. There is very little or no vehicle traffic on this low order poor condition gravel road, so there is unlikely to be any major impact on existing users, while the road is being upgraded. Eskom would have to enter into discussions with the Department of Transport and the relevant local authority to ensure that the relevant upgrading takes place.

j) Storage and utilisation of hazardous substances on site

During the construction period the use and storage of substances such as shutter oil, curing compounds and diesel on site could have a negative impact on the surrounding environment, if the material is spilled.

Typical mitigation measures include storage of the material in a bunded area, with a volume of 150% of the storage container, refuelling of vehicles in designated areas that have a protective surface covering and the utilisation of drip trays for stationary plant.

k) Disturbance to sense of place and visual aesthetics;

Given that the construction period would last up to six years, with fairly intensive construction activity taking place for more than 50% of the period, there will be a large increase in the number of people and vehicles travelling through and around the area. This is likely to have an impact on the current rural nature of the surrounding area.

l) Security risks

There is a perception that large construction contracts of this nature will result in numerous job opportunities and therefore there is typically an influx of job seekers to the area. However many will not find employment and may eventually turn to crime as means of income. Furthermore, after the construction phase, many people may not leave the area, and therefore unemployment may increase substantially immediately after the construction phase.

Eskom would need to develop and implement a comprehensive labour plan to manage and maximise employment opportunities to local communities, ensure preferential employment to local people, and minimise the influx of job seekers. Training and transfer skills to people employed on the site would empower the local communities and maximise their employment opportunities post construction phase.

m) Health issues

HIV/AIDS has reached pandemic proportions, with approximately 6 million HIV positive people in South Africa in 2005. In Gauteng and Mpumalanga, the number of HIV/AIDS infected people grows at a rate of 22% and 16% per annum respectively. The influx of job seekers into the area, may bring with it a greater rate of HIV infections and greater pressure on the Gauteng and Mpumalanga Health departments to manage and care for HIV infected people in their areas.

Further to the above, more health care facilities will be required, such as clinics, and staff such as doctors and nurses will be required to staff these facilities in the area. However the government's roll-out of essential services is likely to be very slow, resulting in greater impact for those established in the area, and the new arrivals.

n) Changes to the social fabric of the area

With a construction project of this scale and duration, there will be a large influx of highly skilled people from elsewhere in South Africa and from abroad moving into the Witbank region, bringing with them more disposable income than perhaps the locals. People will be looking for property to buy or rent, which could push the prices up in the area, making the market inaccessible for the locals.

Furthermore the influx of highly skilled people into the area may create tension between the locals and some of the construction staff, due to *inter alia* differing cultures and different amounts of disposable income. These issues are likely to change the social fabric of the area.

o) Light pollution

The construction site is likely to be well lit, especially when activities are scheduled to run for 24 hours a day. This additional light intrusion is likely to change the rural nature of the area, and have an impact for the residents on the surrounding farms. It is however unlikely to affect the surrounding residential areas, such as Phola or Voltago, as they are too far from the site to be affected by the light pollution.

All of the above construction phase impacts would be managed through the implementation of a construction phase Environmental Management Plan. The purpose of the EMP would be to protect sensitive onsite and offsite features through controlling construction activities that could have a detrimental effect on the environment. The framework EMP is contained in **Annexure B** of this report. A construction specific EMP would be developed if the project is approved, and would be designed to incorporate the specific conditions required in terms of DEAT's Record of Decision.

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Power station and associated infrastructure – construction phase impacts		
	SITE X	
	No mitigation	**Mitigation**
Extent	Site to local	Site to local
Magnitude	Medium	Low
Duration	Construction	Construction
SIGNIFICANCE	**Low to Medium (-ve)**	**Low (-ve)**

Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible
	SITE Y	
Extent	Site to local	Regional
Magnitude	Medium	Low to medium
Duration	Construction	Medium
SIGNIFICANCE	**Low to Medium (-ve)**	**Low (-ve)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

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Chapter 5

6 CONCLUSIONS AND RECOMMENDATIONS

This chapter concludes the report, describes the recommendations that have emerged from the assessment of identified potential impacts and mitigation measures, and provides a synopsis of the preferred alternative actions that Eskom is applying for authorisation of. Comments received from responsible authorities to date are also described, to establish the broader context for accountable decision-making on the part of DEAT.

6.1 CONCLUSIONS

The proposed project consists of the establishment of the following components:

Power Station Precinct:

- Power station buildings themselves;
- Administrative buildings (control buildings, medical, security etc.); and
- High voltage yard.

Associated Infrastructure:

- Coal stock yard;
- Coal and ash conveyors;
- Water supply pipelines (temporary and permanent);
- Water and wastewater treatment facilities;
- Ash disposal systems;
- Access roads (including haul roads);
- Dams for water storage; and
- Railway siding and/or line for sorbent supply.

We submit that this Final Environmental Impact Report provides a sufficiently comprehensive assessment of the environmental issues raised during the Scoping phase by I&APs, National, Provincial and Local authorities, Eskom and the EIA project team. Table 6.2 provides a summary of the significance of the environmental impacts associated with this proposed project. The following key is applicable to Table 6.2:

Table 6.1 Key for summary Table 6.2 indicating the colour coding for the significance of the various impacts

High	Red
Medium	Orange
Low	Blue
Very Low	Green
Neutral / NA	Not shaded
Positive Impact	Yellow

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Table 6.2 Summary table of impact significance

6.1.1 Level of confidence in assessment

With reference to the information available at this stage of the project planning cycle, the confidence in the environmental assessment undertaken is regarded as acceptable for decision making.

It is acknowledged that the project details may evolve during the detailed design and construction phases. However, these are unlikely to change the overall environmental acceptability of the proposed project. Furthermore, any significant deviation from that assessed in this EIR should be subject to further assessment and may require an amendment to the Record of Decision, after due process has been met.

6.1.2 Operational phase impacts on the biophysical and social environment

Table 6.2 shows the impacts of the operation of the proposed power station and its associated infrastructure on the biophysical and social environment. The most significant negative impacts ***without mitigation*** included the following:

- Impact of surface ash disposal on aquatic flora and fauna;
- Impact of surface ash disposal on Site X;
- Impact of air emissions on ambient air quality in the area;
- Impact on aquatic fauna and flora at Site Y
- Impact of SO_2 emitted on vegetation and metal corrosion;
- Impact of CO_2 emissions on global climate change;
- Visual impact of using FGD;
- Noise impact as a result of direct dry cooling;
- Impact of air pollution on community health; and
- Impact on agricultural potential at Site Y and poultry farming adjacent to Site X.

6.1.3 Construction phase impacts

None of the construction phase impacts were deemed to have a highly significant impact on the environment, given their relatively short duration and localised extent. However, many of the construction phase impacts are of medium significance and require a suite of mitigation interventions in order to avoid and minimise impacts on the biophysical and especially the human environment.

6.1.4 Framework EMP

A framework EMP (fEMP) has been developed to guide the construction and operational phases of the proposed project, and is contained in **Annexure B** of this report. The implementation of the fEMP would minimise possible negative impacts on construction and operation and assigns responsibility for environmental controls. The more detailed project specifications, for inclusion in the various construction contracts, would be based on the fEMP and would only be developed should the project be approved. The detailed project specification would also take cognisance of any Conditions of Approval as specified by DEAT.

6.2 RECOMMENDATIONS

With reference to the assessment described in the Chapter 5 of this report, it can be noted that the significance levels of the identified impacts could generally be reduced by implementing the identified mitigatory measures. The following section describes the various project alternatives in terms of their biophysical and socio-economic impacts, assuming that the mitigation measures described in Chapter 5 are implemented.

6.2.1 Site

In comparing Site X to Site Y, there is no clear distinction between the two sites, as their environmental impacts are very similar. However, Site X appears to be marginally preferable to Site Y for the following reasons:

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

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

6.2.2 Site layouts

The earlier recommendation that the proposed layout for the power station precinct on Site Y be refined to avoid impacting on moderate to high integrity wetlands now falls away, with Site X being recommended as the preferred site. However, the specific location of the power station, coal stockyard and above-ground ash dump as initially identified on Site X have been refined, to avoid impacting on high integrity wetlands. **Figure 5.4** illustrates the recommended layout. Note that the proposed coal stockyard will receive coal directly from the mine workings, i.e. there will not be a separate coal stockyard within the mine precinct.

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6.2.3 Cooling technology alternatives

Indirect dry cooling, which utilises cooling towers, greatly increases the disturbance footprint and visual prominence of the power station, making it a more imposing structure. However, direct dry cooling, utilising the bank of fans for each boiler unit, increases the ambient noise levels significantly, which only reduce to the requisite limits 6 km from the power station precinct.

Given the potential mitigation measures for noise impacts, such as noise abatement technology, insulation, and increasing the buffer zone between the power station and adjacent farmers, direct dry cooling is recommended as the most environmentally acceptable option, despite the increased noise impact.

6.2.4 Air emission abatement technology

Eskom has made a firm commitment to the implementation of Flue Gas Desulphurisation (FGD) with at least 90% removal efficiency for the proposed new coal-fired power station in the Witbank area. Without FGD in place, exceedances of the SO_2 standards increases significantly and a large number of additional people are likely to be exposed to SO_2 levels that are detrimental to human health.

The implementation of FGD with at least 90% removal efficiency is recommended for the proposed project. Bag filters or electrostatic precipitators are recommended for the control of particulate matter. Low NO_X burners are recommended for the control of NO_X emissions.

Eskom has indicated that wet FGD technology will be applied, which will result in the concomitant benefits of a shorter transport distance, less transport energy consumption and fewer transport emissions, as well as a greater removal efficiency than semi-dry FGD technology.

6.2.5 Ash disposal methods

Above ground ashing will result in a large footprint being disturbed over the lifespan of the project and beyond. The impacts with respect to particulate matter and groundwater contamination are however manageable, and it is therefore considered an acceptable means of ash disposal.

For comparative purposes, back-ashing and in-pit ashing were considered, and require the ash to be conveyed off-site and may result in groundwater contamination, which is possibly less manageable. Further investigation regarding sub-surface ash disposal are required should Eskom wish to pursue this option.

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6.2.6 Access and transport routes

Access and transport corridors to provide for water supply, vehicles access, coal conveyance and sorbent supply were assessed by the relevant specialists and applicable recommendations were made. **Figure 5.4** provides an illustration of the recommended routes for such linear infrastructure, as follows:

- An access road that links the power station to both the N4 to the north-east and the N12 to the south-west, the former requiring a new section of road to the vicinity of the N4/R545 intersection and the latter requiring the upgrading of a section of the D960 to its intersection with the N12;
- A railway line from the north for the importing of sorbent that connects with the Crown Douglas siding on the Pretoria - Witbank main line, and that would require crossings over the N4 and under the Apollo – Kendal 400kV transmission line;
- A water supply pipeline from the existing Kendal power station, running due north-west to a point in the vicinity of the N12/D969 intersection, turning north parallel to the Kendal – Duvha 400kV transmission line and then proceeding along the western boundary of Site X before turning to the east towards the proposed power station. Several crossings of a railway line, roads and the proposed Petronet multi-products pipeline would be necessary; and
- A short section of coal conveyor from the coal stockyard to the proposed power station, immediately to the east of the envisaged site.

6.2.7 Summary of recommended alternatives

ALTERNATIVE	RECOMMENDATION	REFERENCE IN EIR
Site	Site X	Sections 1.2.5 & 6.2.1
Site layout	Refined as per Figure 5.4	Sections 2.2.2 & 6.2.2
Cooling technology	Direct dry cooling	Sections 2.2.1.b) & 6.2.3
Air emission abatement	° Wet FGD for SOx ° Bag filters or electrostatic precipitators for particulates ° Low NO_X burners for NO_X	Sections 2.2.1.c) & 6.2.4
Ash disposal	Above ground (subsurface ashing to be investigated with the mining house in the future)	Sections 2.2.1.d) & 6.2.5
Access & transport routes	Refined as per Figure 5.4	Sections 2.2.2 & 6.2.6

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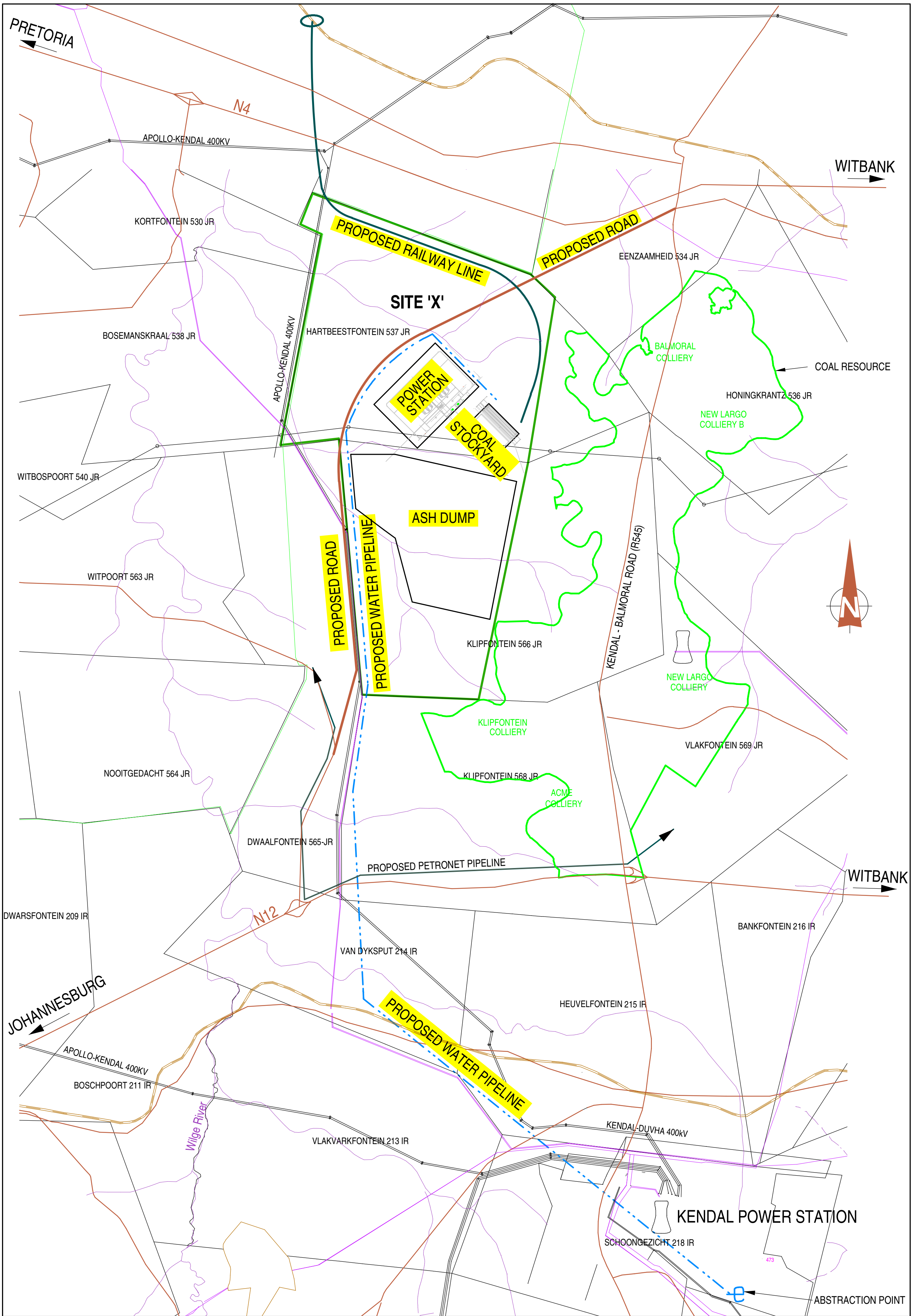

WITH ACKNOWLEDGEMENTS TO ESKOM & ANGLO COAL	PROJECT MANAGER :	PROJECT DIRECTOR : Pr Eng	DATE: 20 Feb. 2007
NINHAM SHAND CONSULTING SERVICES GEORGE	PROPOSED COAL-FIRED POWER STATION IN THE WITBANK AREA		SCALE: 1 : 120 000
	FIGURE 5.4 : RECOMMENDED LAYOUT OF POWER STATION COMPONENTS AND LINEAR INFRASTRUCTURE (Highlighted in yellow)		DRAWING No. 401281

6.3 SUPPORTIVE DOCUMENTATION

As indicated in Section 1.6.2 above, there are other authorities who have a commenting role to play in the EIA process. Their comments on the EIR will help to inform DEAT's decision-making. These authorities include:

- Department of Public Enterprises;
- Department of Minerals and Energy;
- South African Heritage Resources Agency (Mpumalanga and Gauteng provincial offices);
- Department of Water Affairs and Forestry, Resource Planning;
- Department of Water Affairs and Forestry, Regional Office;
- The Department of Environmental Affairs and Tourism: Directorate Air Quality Management and Climate Change[30];
- Gauteng Department of Agriculture, Conservation and Environment;
- Mpumalanga Department of Agriculture and Land Affairs;
- South African National Roads Agency Limited (SANRAL);
- Mpumalanga Department of Roads and Transport;
- Gauteng Department of Transport (GauTrans);
- Spoornet;
- Kungwini Local Municipality; and
- Delmas Local Municipality.

Comments from these authorities on the dEIR have been elicited and are presented in **Annexure R**, together with the minutes of two meetings specifically held with the authorities to facilitate their inputs.

To date, however, comment has not been received from the Department of Water Affairs and Forestry's Regional Office in Bronkhorstspruit. Considerable effort has been made in eliciting this comment but staff changes and difficulties with accessing documentation has proved challenging. However, once these comments have been received, they will be forwarded to DEAT.

As referred to in Section 1.6.1 above, an independent review consultant was appointed to undertake a review of the EIA process and documentation in question. The reviewer's report is presented in **Annexure S**, as additional supportive documentation.

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[30] A meeting is due to be held 27 February 2007, to fully appraise this directorate of the outcome of the air quality study in particular.

6.4 THE WAY FORWARD

This finalised EIR for Eskom's proposed coal-fired power station and associated infrastructure in the Witbank area is now being submitted to the DEAT for their consideration. It incorporates the comments on the draft version received from I&APs, from other authorities and from the EIA team members. It is being submitted under cover of a letter that indicates the applicant's acceptance of the recommendations derived from the EIA undertaken and reflected in this fEIR.

All registered I&APs are being notified of the availability of the fEIR by means of a letter which includes a copy of the Update Summary and Issues Trail 4, the latter reflecting on comments received after the dEIR was made public. Copies of the fEIR are being lodged at the Witbank public library, the Nelspruit public library, the Phola public library, the Johannesburg public library and the Kungwini and Delmas municipal offices, as well as being placed on the Eskom (www.eskom.co.za/eia) and Ninham Shand (www.ninhamshand.co.za) websites.

Once DEAT has reviewed the fEIR, they will need to ascertain whether the process undertake is acceptable and whether there is adequate information to allow for an informed decision. Should the above be acceptable, then they will need to decide on the environmental acceptability of the proposed project. There decision will be documented in a Record of Decision (ROD) which will detail the decision, the reasons therefore and any conditions. Following the issuing of the ROD, DEAT's decision will be communicated by means of a letter to all registered I&APs and there will be a 30-day appeal period within which Eskom or I&APs will have the opportunity to appeal the decision to the Minister of Environmental Affairs and Tourism in terms of the Environment Conservation Act.

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