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Desktop Palaeontological Impact Assessment for the Proposed Medupi Power Station Flue Gas Desulphurisation Retrofit Project and the Existing Medupi Power Station Ash Disposal Facility, Lephalale, Limpopo Province, South Africa

REVISION: 02

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ACKNOWLEDGEMENT OF RECEIPT

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DECLARATION OF INDEPENDENCE

This report has been compiled by Professor Marion Bamford for NGT. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the project.

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EXECUTIVE SUMMARY

NGT has been appointed by Zitholele to make amendments to the desktop PIA study conducted for site selection process for the Medupi Waste Disposal Facility which was submitted to Zitholele in February 2016. The site selection process focused on three sites, namely Site 2, Site 12 and Site 13, and it aimed at selecting the most suitable site for the handling and disposal of various waste streams that are a by-product of the proposed Flue Gas Desulpherisation (FGD) technology at Medupi, which is proposed to be retrofitted in the six units currently being constructed at Medupi Power Station. The aim of the FGD technology is to reduce the amount of Sulphur Dioxide (SO_2) emitted from coal fired power stations; Medupi with its six units as a coal fired powered station.

In 2017, however, there were amendment to the project scope of works; Eskom decided on utilising the existing and licensed Ash Disposal Facility to dispose of ash and gypsum. Eskom proposed a railway yard within the Medupi footprint for offtake of lime and handling of commercial gypsum. Within the footprint temporary hazardous storage facilities for salts and sludge have also been proposed. These new developments prompted the amendments to Revision 01 PIA and the development of the current PIA report (Revision 02). This HIA is site-specific HIA to the Medupi footprint which also contain the site for the proposed railway yard and the existing and licensed ADF (***Annexure 1*** *– Revised Project Scope of Works*). This study assesses the potential impact to palaeontological resources within the proposed development area.

The area to be developed lies on the Sandriviersberg and Mokalakwena Formations, (Kransberg Subgroup, Waterberg Group) which are sandstones and conglomerates 1700 to 2000 million years old and so pre-date any large bodied fossil plant and any vertebrate fossil. Micro-organisms such as algae had evolved by this time but they do not preserve in conglomerates. Sandstones are usually too coarse to preserve such small fossils.

Conclusions and Recommendations

- It is concluded that, there is an extremely small chance of finding any fossils of any kind in the three development areas.
- As far as the palaeontology is concerned the development can proceed and no further palaeontological impact assessment is required

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1. BACKGROUND

Eskom has initiated a program to reduce emissions of Sulphur Dioxide into the environment by installing Flue Gas Desulphurisation (FGD) technology on the 6 power-generating units at Medupi Power Station This FGD process will allow Eskom to ensure cleaner air and meet air quality standards. The study area is located in Medupi PS in Lephalale Local Municipality, Waterberg District, Limpopo Province (*Figure 1*).

The waste by-products (including Sludge and Salts –Type 1 wastes) will be disposed of in an approved facility. A site selection process was undertaken to recommend a site for the waste disposal (Revision 01 PIA). The current assessment if for the proposed railway yard (*Figure 2*), the area for the proposed FGD technology facility (*Figure 3*) and the existing and licensed ADF (*Figure 4*) all located within the region previously assessed for the site selection process (Revision 01 PIA – see Annexure 2 for the map of Revision 01 assessment).

In accordance with the national legislation (National Heritage Resources Act (No. 25 of 1999)) the sites to be developed must be assessed for the occurrence of any palaeontological material. If any fossils are likely to be present then their importance and rarity must be gauged and if they are important then plans must be put in place to remove the fossils (under a SAHRA permit and housed in an recognized institution), protect them and/or divert the proposed construction.

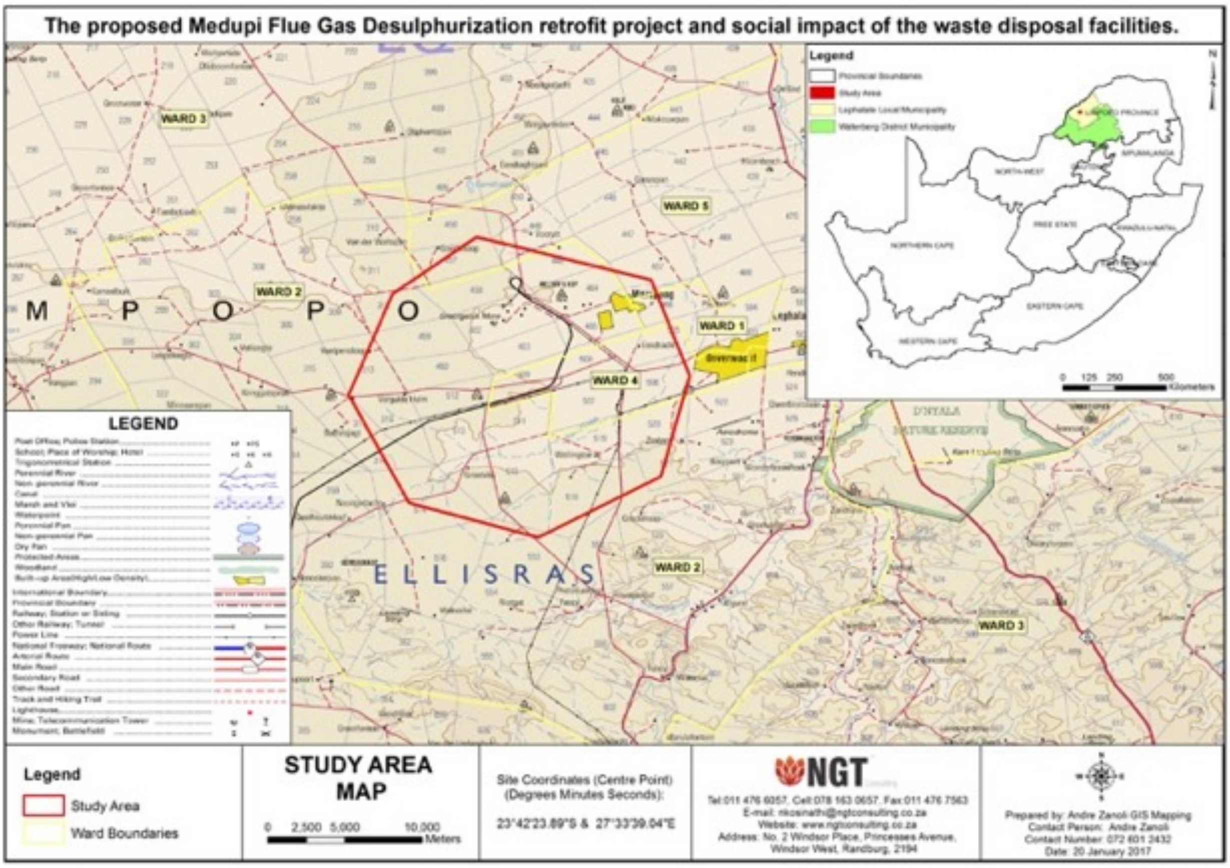

Figure 1 Location of the project area in Lephalale Local Municipality within Waterberg District Municipality, Limpopo Province, South Africa.

The following images show the location and the design of the proposed railway yard (*Figure 2*), the proposed Medupi PS FGD technology construction site (*Figure 3*) as well as the existing and licensed ADF site (*Figure 4*).

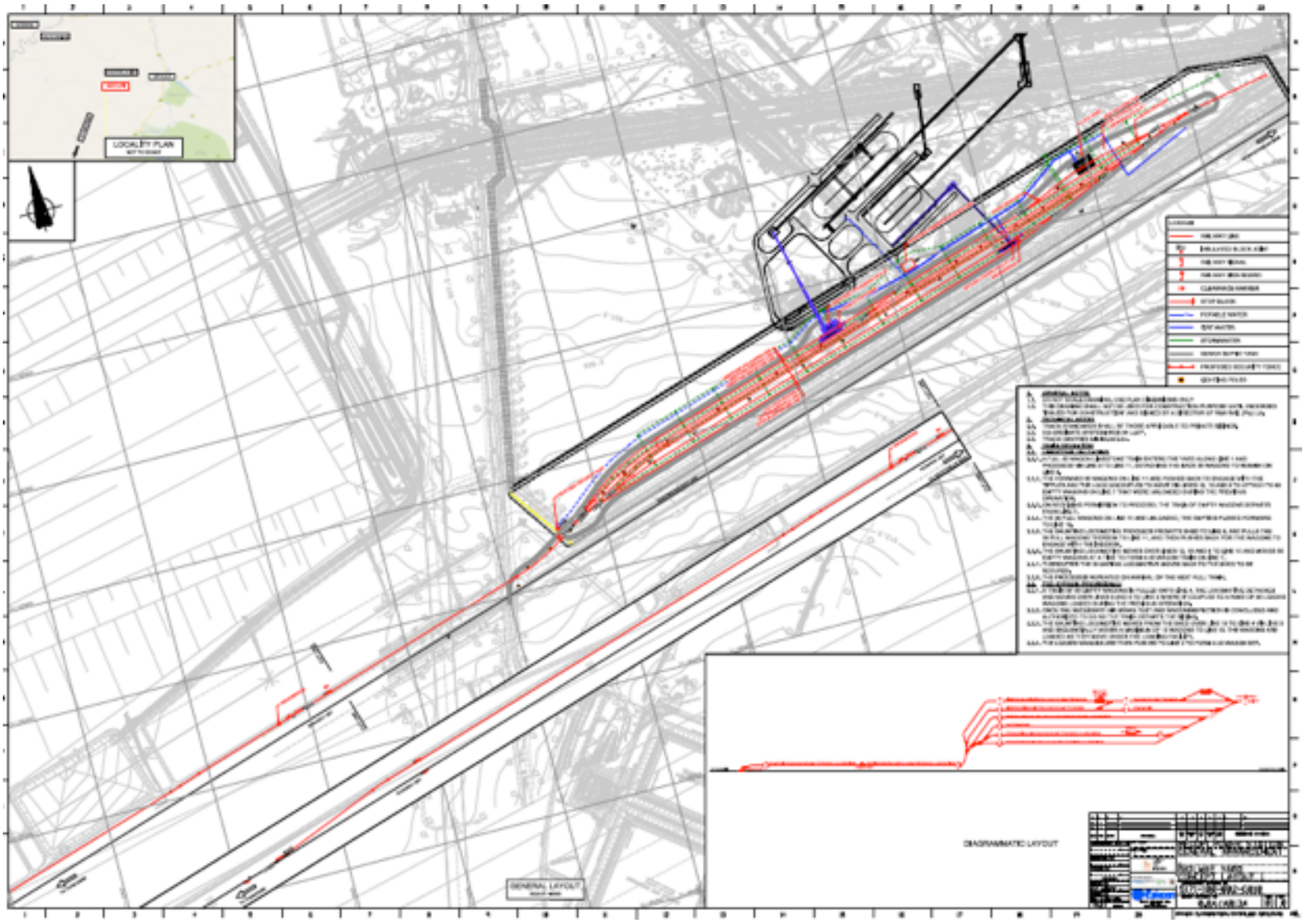

Figure 2- The proposed railway yard south-west of Medupi six units and south east of the existing and licensed ADF

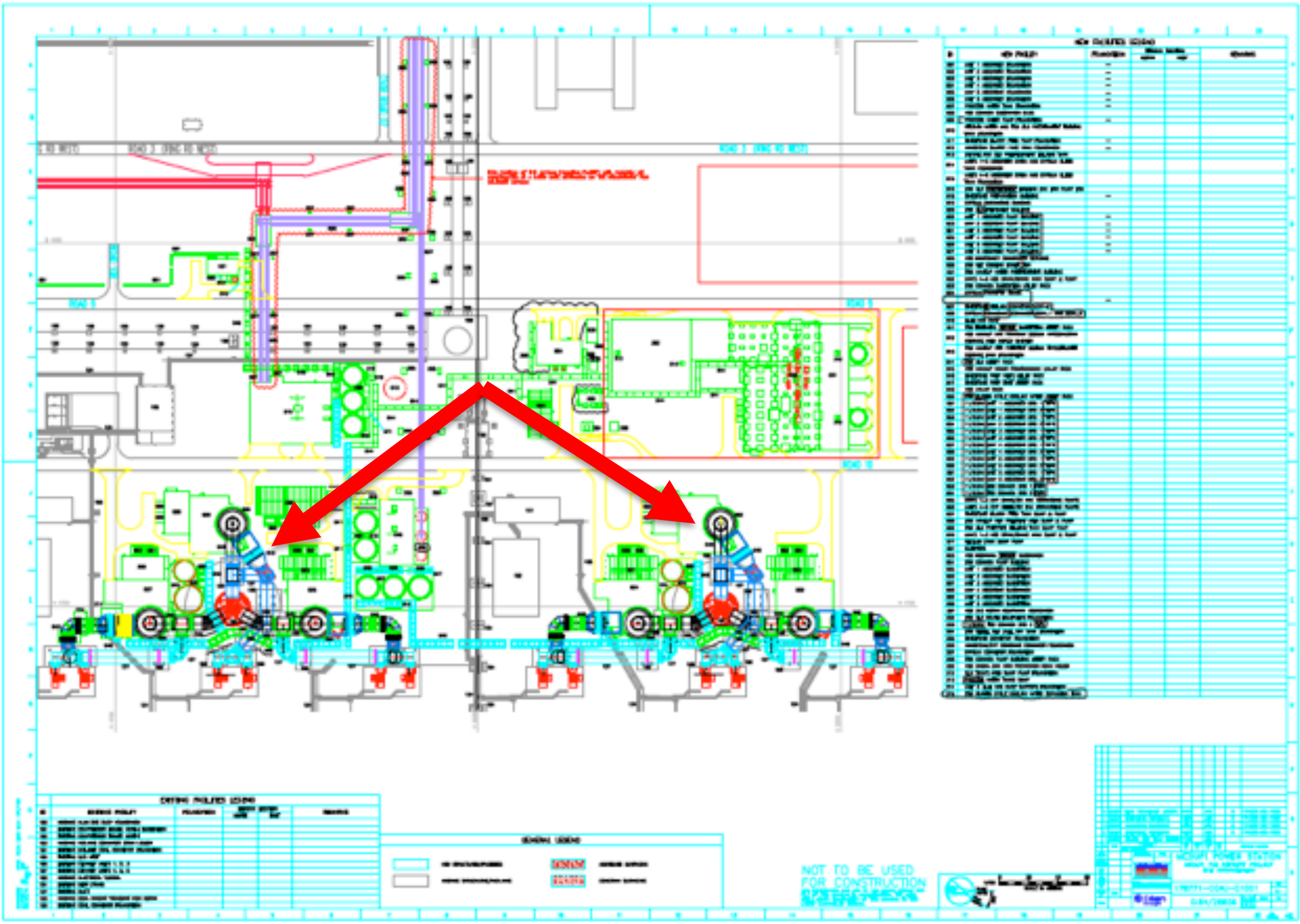

Figure 3- Location of the proposed FGD technology construction sites (red arrows)

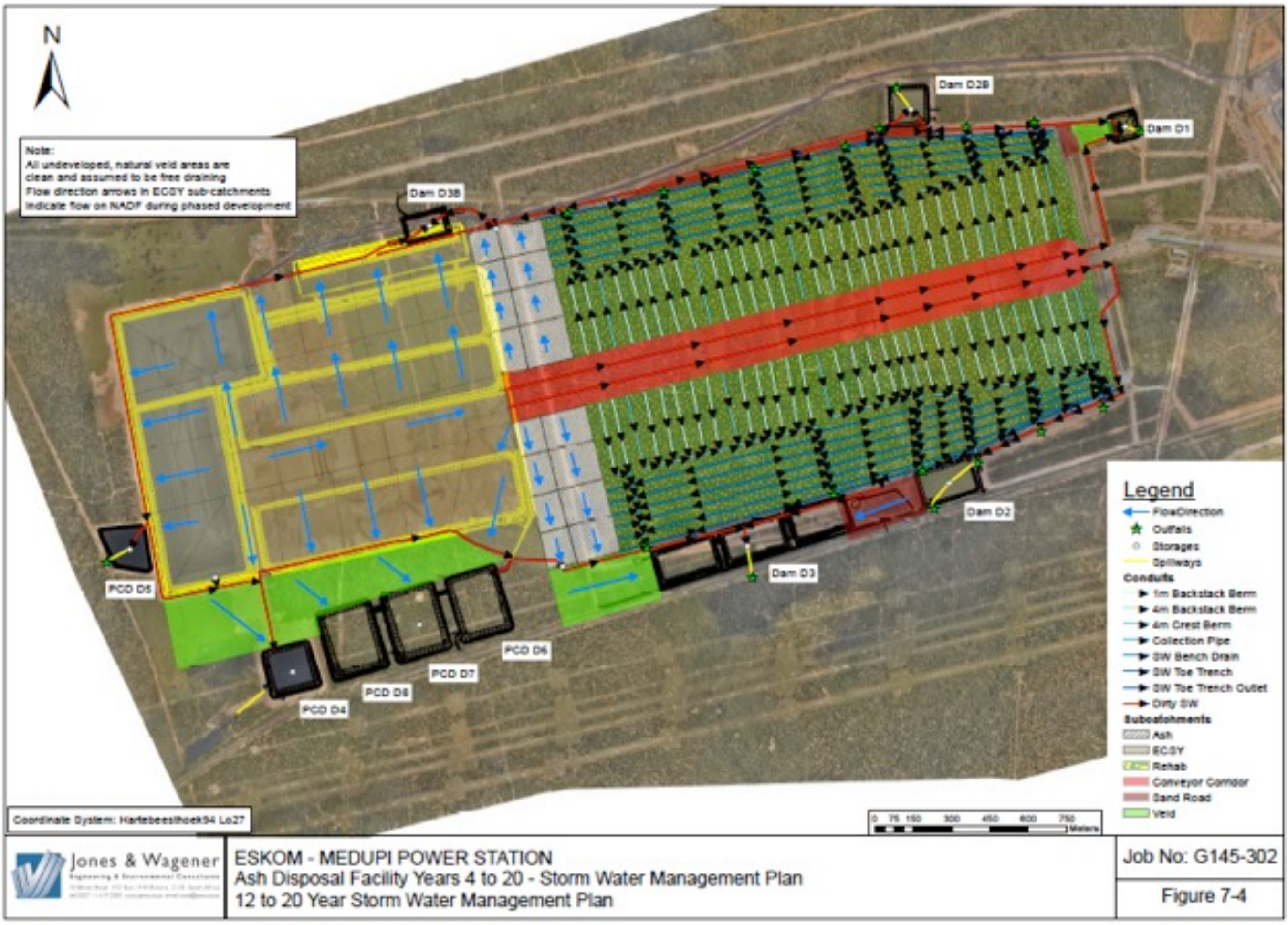

Figure 4- Existing and licensed ADF as well as the associated dams and proposed storm was management plan

2. METHODS

The published geological and palaeontological literature, unpublished records and databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.

3. A GEOLOGICAL AND PALAEONTOLOGICAL CONTEXT OF THE STUDY AREA

The Ellisras Basin is important economically for coal, especially the Grootgeluk Formation and interfingering Goedgedacht Formation, which are being mined by Exxaro for export and for the Matimba Power Station. According to the maps by the Geological Survey the site lies in the undifferentiated Permian and Triassic deposits, with very old rocks to the south and east of Lephalale (Fig 2, Table 1). From more detailed studies of the coal deposits in South Africa (Snyman 1998) the Grootgeluk Mine lies on the southern edge of the Ecca deposits, adjacent to Beaufort Group sediments (*Figure 5*).

The proposed development area lie to the south of the Ellisrus Coal Basin and the Karoo sediments and are on the Sandriviersberg and Mokalakwena Formations, Kransberg Subgroup, Waterberg Group (Msm, green on the geological map, Fig 2). These rocks are sandstones and conglomerates and are 1700 – 2000 million years old and so pre-date any large bodied fossil plant and any vertebrate fossil (Cowan, 1995). Micro-organisms such as algae had evolved by this time but they do not preserve in conglomerates and sandstones are usually too coarse to preserve such small fossils. Therefore, there is an extremely small chance of finding any fossils of any kind in the four development areas.

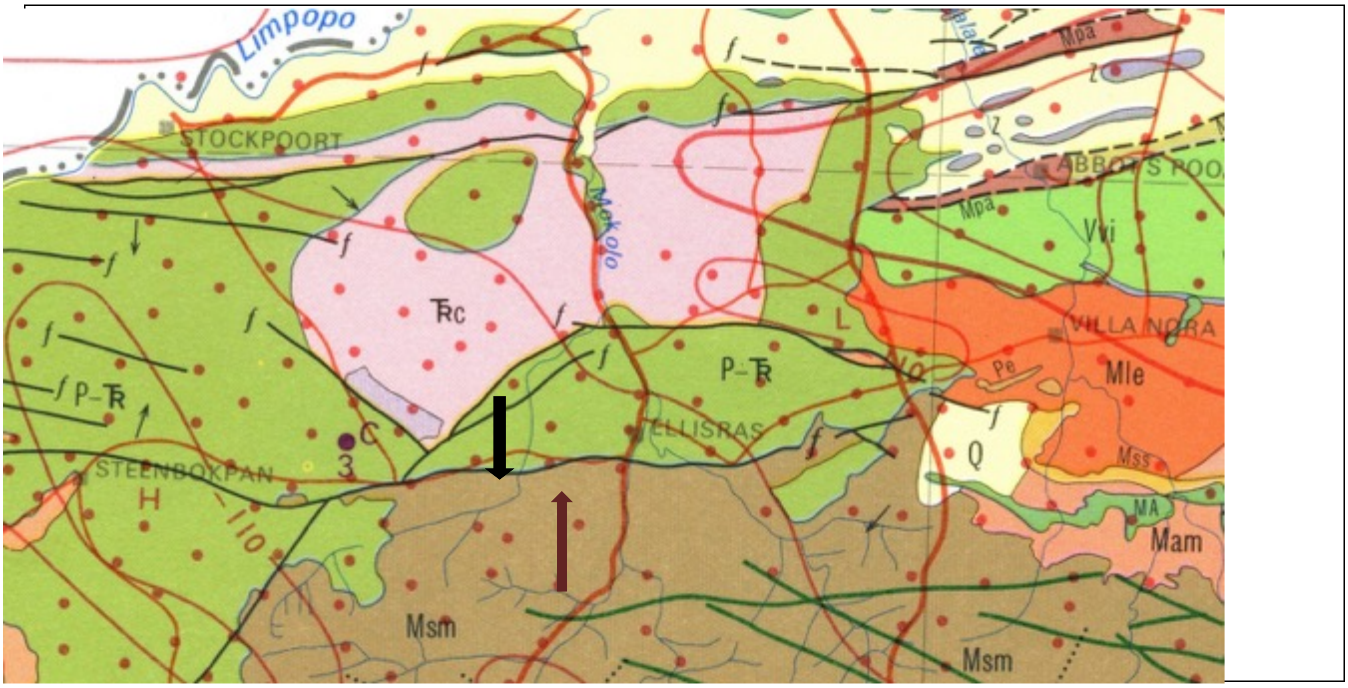

Figure 5- Geological map of northwestern Limpopo showing the proposed area for the Medupi FGD waste dispoal site alternatives to the west of Lephalale (Ellisras). Arrows show approximate location of development areas 2, 12 and 13 to the west. Abbreviations of the rock types are explained in Table 1. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 1- Explanation of symbols for the geological map and approximate ages with the references: Brandl et al., 2006. Barker et al., 2006; Buchanan, 2006; Cawthorn et el., 2006.

Symbol	**Group/Formation**	**Lithology**	**Approximate Age**
Q	Quaternary	Alluvium, sand, calcrete	Last ca 20 Ma
Trc	Clarens Formation	Sandstone, siltstone	Upper Triassic-Jurassic ca 220-180 Ma
P-Tr	Undifferentiated Permian and Triassic	Shale, sandstone, mudstone, coal	Ca 300-200 Ma
Msm	Sandriviersberg and Mokalakwena Fms, Kransberg Subgroup, Waterberg Group	Sandstones, conglomerates	1700-2000 Ma
Mam	Aasvoëlkop and Makgabeng Formations, Matlabas subgroup, Waterberg Group	Sandstones, mudstones	1700-2000 Ma
Mle	Lebowa Granite Suite	Hornblende and biotite granites	>2000 Ma

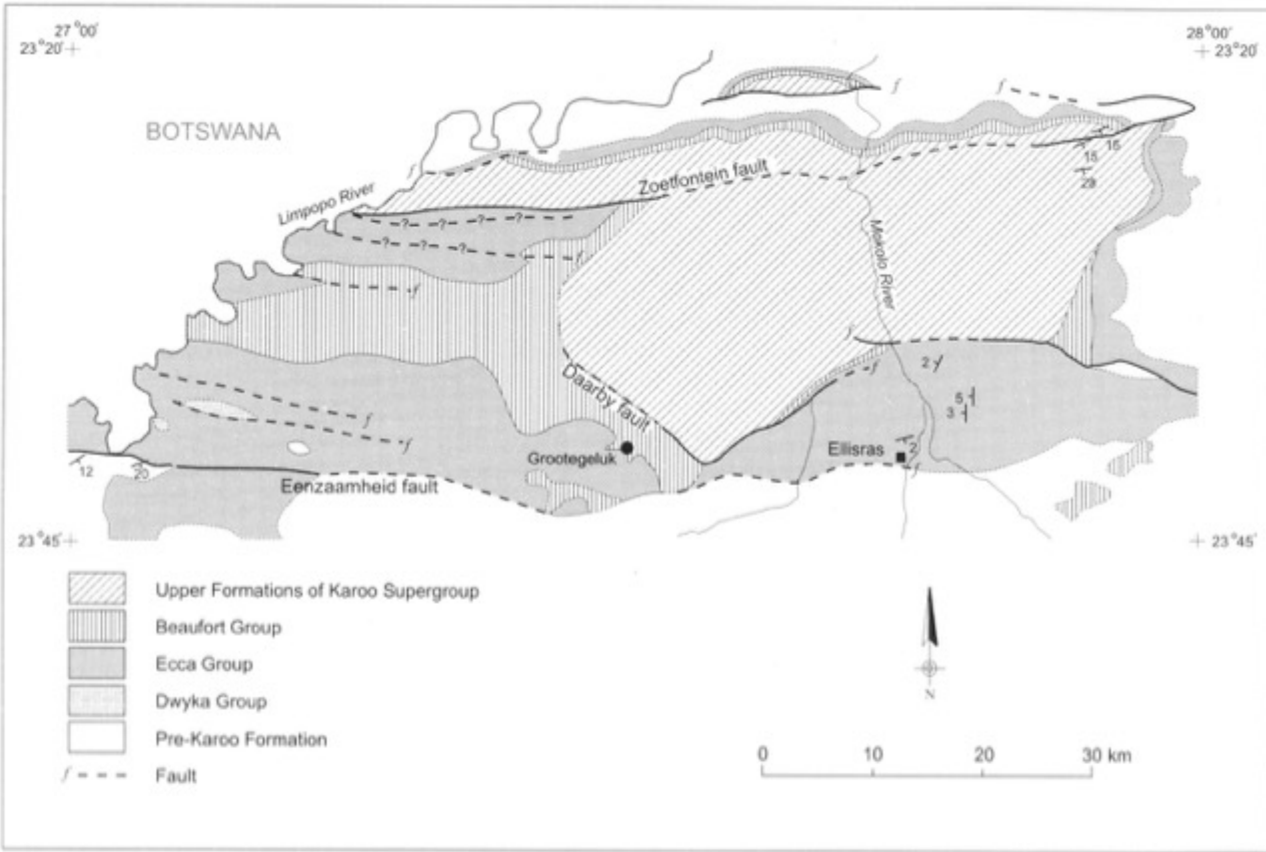

Figure 6- more detailed geological map of the area taken from Snyman 1998 who based it on the unpublished MSc thesis of Botha 1984). Grootegeluk is the name of the Exxaro Mine close to Matimba and Medupi Power Stations.

4. CONCLUSIONS

The area to be developed lies on the Sandriviersberg and Mokalakwena Formations, (Kransberg Subgroup, Waterberg Group) which are sandstones and conglomerates 1700 to 2000 million years old and so pre-date any large bodied fossil plant and any vertebrate fossil. Micro-organisms such as algae had evolved by this time but they do not preserve in conglomerates. Sandstones are usually too coarse to preserve such small fossils. Therefore, there is an extremely small chance of finding any fossils of any kind in the four development areas. As far as the palaeontology is concerned the development can proceed and no further palaeontological impact assessment is required.

5. RECOMMENDATIONS

- If in the extremely unlikely event that any fossils are discovered during the construction of the waste disposal site, then it is strongly recommended that a palaeontologist be called to assess their importance and rescue them if necessary.
- As far as the palaeontology is concerned the proposed development can go ahead and no further impact assessment is required.

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ANNEXURE 1: PROPOSED NEW SCOPE OF WORK AT MEDUPI POWER STATION FOR THE CONSTRUCTION OF THE PROPOSED FGD TECHNOLOGY RETROFIT PROGRAMME, THE PROPOSED RAILWAY YARD AND THE IMPLEMENTATION OF THE EXISTING ADF AS A MULTI-WASTE STORAGE FACILITY

1 INTRODUCTION

This project focuses on the environmental authorisation process for the Medupi Power Station Flue Gas Desulphurisation (FGD) Retrofit. Medupi Power Station is a coal-fired power station that forms part of the Eskom New Build Programme. Medupi Power Station is located about 15km west of the town of Lephalale in the Limpopo Province.

2 CHANGES TO AUTHORISATION AND LICENCING APPROACH IN 2017

Towards the middle of 2017 changes to the authorisation and licensing approach for the Medupi FGD Retrofit Project applications were proposed in order to streamline the application processes to ensure compliance with the NEMAQA compliance requirements by the year 2021. The following changes were subsequently implemented:

- Confirmation that the assessment of an additional multiuse disposal facilities, which would be used for the disposal of ash and gypsum, and salts and sludge have been removed from this current application scope and will be undertaken as a separate authorisation process.
- The application for a Waste Management Licence (WML) for the existing ADF was removed from the integrated Environmental Impact Assessment process hence the EIA application will not be an integrated Environmental Impact Assessment application. The proposed disposal of gypsum together with ash on the existing authorised ADF footprint will be dealt with through a separate amendment process to the existing ADF WML.

- The EIA application in terms of the National Environmental Management Act, 107 of 1998, as amended, will include application for activities associated with the construction and operation of the FGD system within the Medupi PS footprint and the railway yard and siding, including limestone and gypsum handling facilities, diesel storage facilities new access roads, Waste Water Treatment plant, facilities for temporary storage of salts and sludge.

- A Water Use Licence Application will focus on water uses triggered by the construction and operation of the FGD system, railway yard and limestone / gypsum handling areas, and within 500m of the approved ADF footprint.

3 DETAILED SCOPE OF WORK

The detailed scope of work for each of these applications is described in terms of the simplified process flow diagram in Figure 1 and listed in the sections below. The overall site layout encompassing the railway yard, limestone and gypsum handling areas and FGD system is provided in Appendix A to this technical memo. General layout of the existing ADF and storm water management philosophy is provided in Appendix B to this technical memo.

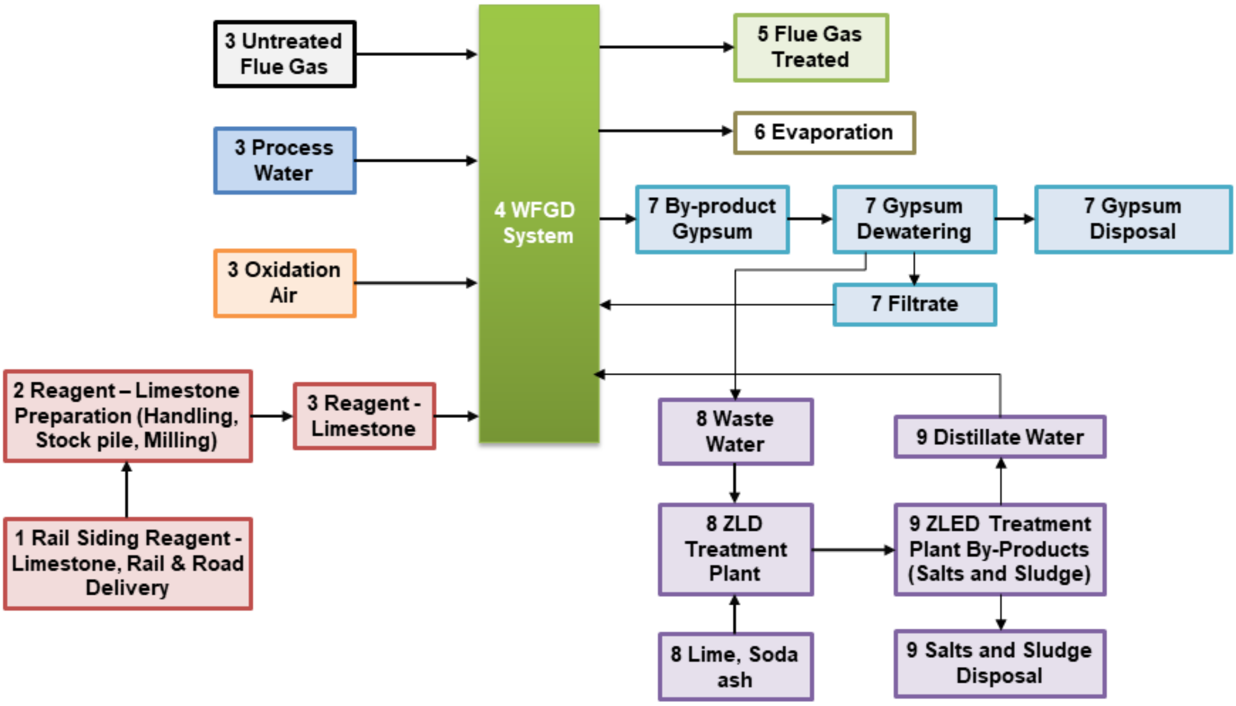

Figure 7-Basic process Flow Diagram for the FGD process at Medupi Power Station

3.1 Railway yard (Block 1 & 2)

Limestone is purchased off-site and is transported to the Medupi Power Station by rail and/or road. The limestone is offloaded at the proposed limestone storage facility, which includes a rail siding and road access, located south-west of the 6 power generation units within the Medupi Power Station footprint. The rail siding and access roads are a component of this environmental authorisation (EIA) process.

Infrastructure associated with the railway yard and limestone / gypsum handling area include:

- Limestone will be initially delivered by road and will be delivered to a truck offloading facility in close proximity to the Limestone Stockyard.
- Rail infrastructure proposed parallel to the existing Thabazimbi – Lephalale railway with a proposed siding take-off point situated at kilometre point 107+250m. The general arrangement of the railway yard and take-off point is provided in Appendix C.
- Linear-type yard layout configuration with six lines parallel to each other, and split into two separate yards (limestone offloading and gypsum loading) linked by means of a locomotive run-around line.
- Limestone offloading facility: Tippler Area building will include side dispensing tippler, a limestone rail, truck offloading area and separate receiving area, Tippler for "tipping" limestone onto an underground inclined conveyor, limestone transfer house and emergency limestone offloading area at the stockyard. Excavations up to 15m deep will be undertaken during construction of the Tippler facility.
- Gypsum could be routed to the Gypsum storage facility in close proximity to the railyard. Gypsum storage loading facility will include gypsum reclaim hoppers that receive gypsum from the mobile reclaim equipment and discharge to the gypsum reclaim belt conveyor, which in turn discharges to the inclined gypsum belt conveyor. The inclined gypsum belt conveyor then discharges to the bin at the loading facility that feed the rail wagons with a controlled discharge.
- Administration building and operations tower for Eskom and a Services Provider's personnel.
- Diesel locomotive workshop, utilities rooms and ablutions. This workshop area will have approximately 600m^2 service space for the shunting locomotive, various offices and store rooms (180m^2) attached to one end of the building.
- Two Diesel Storage Facilities (each can be approximately 3.6m in diameter and 3.0m in height) with a maximum installed storage capacity of 28 000 litres each, in two above-ground horizontal storage tanks, and will be bunded. One of these tanks will service the shunting locomotives while the other will service the Emergency Generator, and located at the rail siding area and the FGD

complex area, respectively. A covered road tanker decanting area will be located alongside the bunded area. There is a third diesel tank in the FGD common pump building, the capacity of which is significantly less than 28 000 litres.

- Security office and infrastructure: A security office will be located adjacent to the fence line at the western extent of the proposed rail yard where the proposed rail infrastructure ties in with the existing rail network. The existing service road fence will be used as the boundary fence to the rail yard.
- Conveyor infrastructure.
- Sewerage and effluent management infrastructure: The security office, locomotive workshop and administration building will be served with ablution facilities with a sewerage conservancy tank system with capacities of 3200ℓ, 8500ℓ and 8500ℓ, respectively.
- Associated infrastructure (water, storm water, and lighting): Storm water channels and structures are designed to provide a division between storm water and the dirty water from the gypsum loading facility. Dirty storm water from the gypsum loading facility will be collected into an independent concrete channel and underground pipe network that will drain to the proposed Pollution Control Dam (PCD) that will form part of the FGD infrastructure. The estimated run off contribution to the PCD is expected to be $0.05 m^3/s$ for a 1:20 year return period. Eskom will provide the required power supply, while the rail yard mini substations will be constructed in accordance with Eskom's specification. PCDs will also be provided for the salts and sludge storage facility. The Medupi plant operates with two separate water networks supplying fire water and potable water. The water network required for the rail yard was designed to tie into connection points within the existing water network of the MPS.

3.2 Limestone preparation (Block 2)

An overview of the limestone handling and preparation infrastructure is presented below. The proposed limestone handling and conveyance infrastructure is shown in Appendix C. The limestone handling and conveyance will include the following infrastructure:

- Limestone stacking conveyor;
- Limestone storage area;

- Emergency limestone offloading area;
- Limestone reclaim conveyor;
- Limestone and gypsum handling substation;
- Storm Water Pollution Control Dams. The conceptual storm water management design has resulted in two separate PCDs being proposed in this area. It is also proposed that each of these PCDs is portioned to cater to maintenance activities in the future. A layout of proposed PCDs are presented in Appendix E;
- Lined channels for diversion of dirty water to Pollution Control Dams.
- Limestone is conveyed to the limestone preparation building where it is milled and combined with water to form limestone slurry for input into the FGD system. Limestone slurry is pumped to a limestone slurry feed tank from where it is pumped, via piping, on the elevated FGD utility rack to each absorber for utilisation in the FGD system. Infrastructure thus includes:
- Limestone preparation building;
- Limestone slurry feed tank; and
- Piping and elevated FGD utility rack.
-

3.3 Input materials and processes (Block 3)

Input materials to the FGD process will include:

- SO2 laden flue gas received from the each generation unit. Untreated flue gas leaving the existing ID fans will be diverted to the absorber inlet, via additional ducting system;
- Process water received from process water tanks (two operational and one backup for redundancy);
- Oxidisation air; and
- Limestone slurry received from the limestone milling and preparation plant.

3.4 WFGD system (Block 4)

The site arrangement of the FGD system for the Medupi Power Station is provided in Appendix D. The FGD system includes infrastructure that is located within the previously cleared and transformed footprint of the power station. Infrastructure includes:

- An absorber unit associated with each of the 6 x generation units;
- Each absorber unit will include a flue gas duct, absorber tower, absorber pump building and absorber substation;

- Absorber drain and gypsum bleed tanks associated with each cluster of 3 absorber units, i.e. absorber units 1 – 3 and absorber units 4 – 6;
- FGD above-ground elevated utility racks containing piping to direct fluid from and to relevant systems within the absorber area.

3.5 Treated Flue Gas (Block 5) and evaporation (Block 6)

Treated flue gas is redirected from the absorbers via the flue gas ducts back to the chimneys for release with much reduced SO_2 content. During the process evaporation losses are incurred.

3.6 Gypsum dewatering, re-use or disposal (Block 7)

3.6.1 Gypsum dewatering and conveyance

Gypsum will be produced from the FGD process as a by-product of the wet scrubbing process. Slurry will comprise gypsum, a mixture of salts (Magnesium Sulphate ($MgSO_4$) and Calcium Chloride ($CaCl_2$)), limestone, Calcium Fluoride (CaF_2), and dust particles. A refinement process is carried out to separate and dewater the gypsum. Effluent is directed to the Waste Water Treatment Plant (WWTP), the overflow of the gypsum dewatering hydro cyclones goes to the waste water hydrocyclone (WWHC) feed tanks. The tanks are located in the gypsum dewatering building. From the WWHC feed tanks, the water goes through the WWHC where the underflow is directed to the reclaim tanks and the overflow to the Zero Liquid Discharge (ZLD) holding tanks. The ZLD holding tanks feed the WWTP.

Dewatered gypsum is transported via conveyor either to the existing ADF or to an offtake point where it is diverted to a storage facility from which it may be transported by rail or road to users. The gypsum storage building will be used in conjunction with the rail siding only. The storage building is a future use facility that will be built with the rail siding. There will be no facilities for gypsum recovery from the storage building to be loaded onto trucks. Road transport is used for immediate offtake for gypsum exploitation.

Use of gypsum will be subjected to quality assessments, which will be done at the storage facility. If the quality is not usable, the gypsum will be taken for disposal.

The site arrangement of the FGD system for the Medupi Power Station is provided in Appendix D and shows the infrastructure associated with the gypsum dewatering and conveyance. Infrastructure associated with the gypsum dewatering and conveyance includes:

- Gypsum bleed tanks and forwarding pumps;
- Piping and elevated FGD utility rack;
- Gypsum dewatering building containing gypsum hydrocyclones and waste water hydrocyclones ;
- Belt filter and reclaim tank;
- Gypsum conveyer belt system;
- Gypsum truck loading facility;
- Gypsum storage building and offtake via rail

3.6.2 Gypsum re-use or disposal

Initially, gypsum will be conveyed from the gypsum dewatering building via a gypsum link conveyor to a gypsum transfer house where it will be loaded onto the existing overland ash conveyor. In this conveyor system, the gypsum will be mixed with ash and will subsequently disposed together on the footprint of the existing authorised ADF. The conveyor route and transfer houses for gypsum onto the overland ash conveyor are shown in Appendix A. If there is a market for gypsum, the project has catered for an offtake point, wherein, the gypsum will be collected by trucks from overhead conveyor system. At this point, the ground will be prepared for management of any gypsum that is not contained and the trucks will be washed before leaving this area. The washing is a means to minimise the spreading of the gypsum.

In terms of the previous ash classification processes, i.e. the Minimum Requirements Documents Series, ash was considered to be hazardous and thus the 0 to 2 year area was designed and authorised according to the Department of Water and Sanitation (DWS) Minimum Requirements, resulting in a H:h liner system being installed, at the ADF. However, regulations were promulgated by the DEA in terms of NEM:WA on the 23 August 2013. In terms of the NEMWA regulations, ash and gypsum now classify as Type 3 wastes, and require to be disposed of on a Class C barrier system. This barrier will be implemented at the facility from the 4 to 19.2 year area.

An application to amend the existing ADF Waste Management Licence is being undertaken for disposal of gypsum and ash together on the existing footprint of the authorised ADF. Requirements to reduce impact on the wetlands in the southwest corner of the authorised ADF footprint have, furthermore, resulted in the re-design of the ADF. The proposed ADF amended design has the following attributes:

- The final layout of the ash and gypsum facility has side slopes at 1:5.
- The final layout of the ash and gypsum facility has a long fall of 1:300.
- The final height of the facility will be increased by 12 m from an original design height of 60 m, to 72 m above ground.
- The revised ADF design caters for the storage of a volume of 193 315 105 m3 which converts to a total life of 19.2 years.
- Storm water management caters for clean and contaminated storm water infrastructure, and includes berms, geocell lined trenches and pollution control dams.
- On-going rehabilitation will occur behind the advancing face as the facility develops to ensure a relatively small window of ash and gypsum being exposed to the environment.
- The proposed revised ADF design overlaid over the authorised ADF footprint is provided in Figure 2 below. Proposed PCDs are indicated in the bottom aerial image in Figure 2.

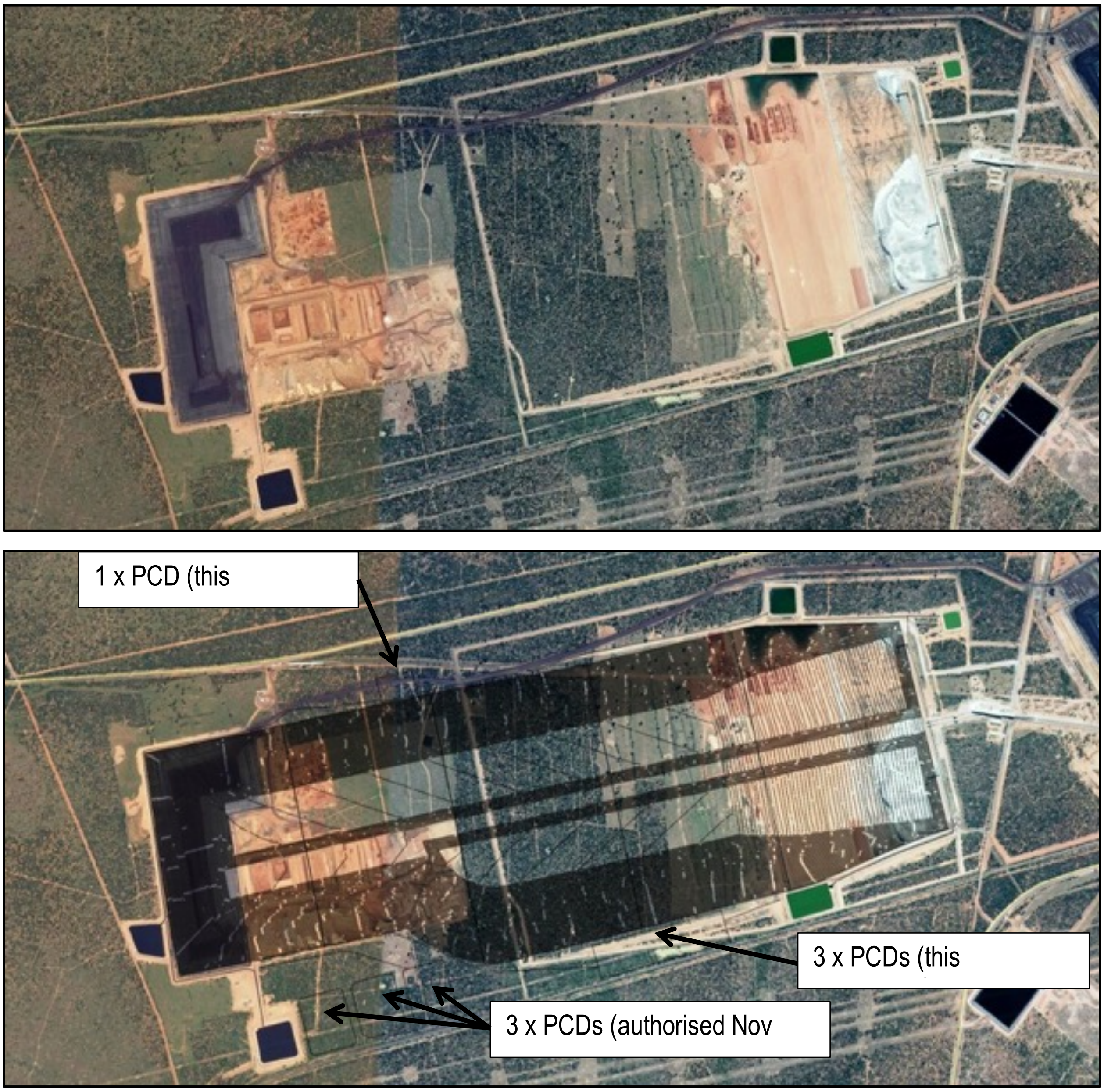

Figure 8-Authorised ADF area (top) with updated ADF design overlay (bottom) indicating layout of amended ADF design

3.7 Waste Water Treatment (Block 8)

The Medupi FGD Waste Water Treatment Plant is located directly west opposite generation units 1 to 3 at the Medupi Power Station. FGD chloride bleed stream and FGD auxiliary cooling tower blowdown stream are diverted to the ZLD holding tanks. The total organic carbon (TOC) scavenger regeneration wastewater from the filter press system / existing water treatment plant (WTP) will be directed to FGD WWTP located next to the gypsum dewatering plant.

From the ZLD holding tank the wastewater is transported via pipes on the elevated FGD utility rack to the WWTP. The pre-treatment process will include physical/chemical treatment to precipitate solids and heavy metals from the water by making use of lime and soda ash in a softening clarification process. At the WWTP lime and soda ash are added to the wastewater to convert the dissolved calcium and magnesium into salts so that the clarified water can be effectively treated in the brine concentrators and crystallisers. Due to the large amounts of lime and soda ash required it is estimated that one 18 000kg capacity truck of lime will be required every 8 hours and one 18 000kg capacity truck of soda ash will be required every 5 hours. Lime and soda ash will be stored in lime silos and soda ash silos, respectively, at the chemical storage area.

The precipitates from this pre-treatment process are settled out in clarifiers as sludge, 50% of which is sent to a filter press dewatering system. The other 50% of the sludge is returned to the clarifier. The filter press filtrate will be returned to the pre-treatment holding tank. This pre-treatment process produces approximately 488t of sludge from 85% limestone, or approximately 243t of sludge from 96% limestone, which is expected to be generated during the pre-treatment process. After chemical treatment, the precipitates are settled out in clarifiers as slurry, 50% of which is sent to a filter press dewatering system. The other 50% of the slurry is returned to the clarifier. The filter press filtrate will be returned to the pre-treatment holding tank. The overflow from the softening clarifier is sent to the brine concentrator and crystalliser processes for further salt removal. Salts are settled out and crystallised during this process. Approximately 127t of salts are expected to be generated from 85% or 96% limestone, and will require environmentally responsible management. The distillate water produced from the brine concentrator and crystallisation process is returned to reclaim tanks for reuse in the process. Chemical storage is likely to exceed 955m3 to provide sufficient capacity for storage of chemicals in the FGD process.

The distillate emanating from the process will be diverted back to the FGD system for re-use in the FGD process, while dirty water run-off will be utilised in the FGD process to improve water usage.

3.8 Storage and disposal of salts and sludge (Block 9)

Sludge and salts will be temporarily stored in appropriately designed storage facilities next to the WWTP. The storage facilities will have a 7-day storage capacity. Two storage areas will be provided for, with Salts and Sludge Storage Area 1 and 2 sized to approximately 4800m2 and 16000m2 in size, respectively. The storage areas will conform to the Norms and Standards for the Storage of Waste (GN926 of 29 November 2013) and will be registered as a waste storage facility in terms of these Norms and Standards.

Salts and Sludge will, subsequent to storage, be transported (trucked) and disposed of at a registered waste disposal facility for the first 5 years of operation. The waste disposal service provider has not been confirmed yet, although disposal at Holfontein has been considered as a suitable waste disposal service provider, among others. For transportation of this waste to a disposal site, Eskom will utilise the services of a service provider who has all required authorisations and systems to manage from the temporary storage to disposal facility.

Mathys Vosloo
Project Manager

ANNEXURE 2: AREAS ASSESSED IN REVISION 01 DESTUDY PIA STUDY

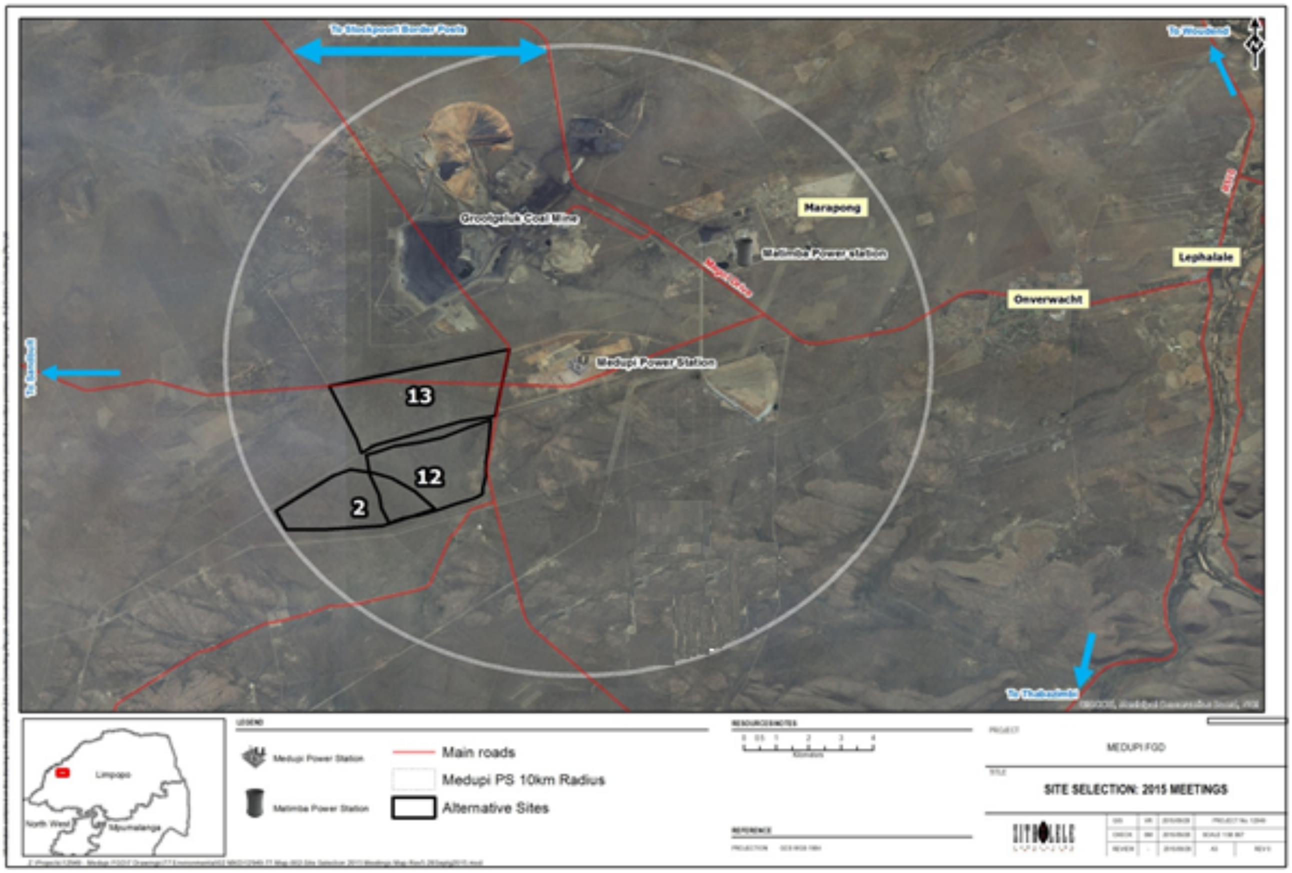

Figure 9 -Map from Google Earth showing the proposed site alternatives for the waste disposal facility for the FGD retrofit project. Map supplied by NGT Consulting; Limpopo Province