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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
ECONOMIC DEVELOPMENT, ENVIRONMENT & TOURISM

Reference: 12/4/12L-W2/A3 **Enquiries**: Thivhafuni PO **Telephone**: 015 290 7022 **Fax**: 015 295 4836 **Email**: thivhafunipo@ledet.gov.za

Eskom Holding SOC Limited
PO Box 1091
JOHANNESBURG
2000

Fax: 013 230 4973

Dear License Holder

PROVISIONAL ATMOSPHERIC EMISSION LICENSE: ESKOM HOLDING SOC LIMITED – MEDUPI POWER STATION

Please find herewith a Provisional Atmospheric Emission License amendment issued in terms of section 40(1)(a) of the National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) ("the Act") and on the basis of a decision taken with respect to an application for postponement of compliance timeframes with minimum emission limits identified in terms section 21 of the Act.

This Provisional Atmospheric Emission License supersedes Provisional Atmospheric Emission License Number 12/4/12L-W2/A2 and authorizes Eskom Holding SOC Limited – Medupi Power Station to carry out the solid fuel combustion installation (electricity generation), storage and handling of ore and coal, and storage and handling of petroleum products activities with the equipment as described in the Provisional Atmospheric Emission License (License Number 12/4/12L–W2/A3), on the premises at farms Naauwontkomen 509 LQ and Eenzaamheid 687 LQ in Lephalale Local Municipality, Waterberg District Municipality, Limpopo Province.

This License does not relieve Eskom Holding SOC Limited – Medupi Power Station from the obligation to comply with any other applicable statutory requirements or legislation.

You are welcome to contact the Department should you have any queries in this respect.

Sincerely,

MPHAHLELE TM
SENIOR MANAGER
INTEGRATED POLLUTION AND WASTE MANAGEMENT

DATE: 01/04/2015

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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
ECONOMIC DEVELOPMENT, ENVIRONMENT & TOURISM

PROVISIONAL ATMOSPHERIC EMISSION LICENSE AS CONTEMPLATED IN CHAPTER 5 OF THE NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004, (ACT NO. 39 OF 2004)

The Provisional Atmospheric Emission License issued to **Eskom Holdings SOC Limited – Medupi Power Station** in terms of section 40(1)(a) of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) ("the Act"), in respect of Listed Activities No. 1.1, 2.4 and 5.1. The Provisional Atmospheric Emission License has been issued on the basis of a decision taken with respect to an application for postponement of compliance timeframes with minimum emission limits identified in terms section 21 of the Act and information that became available during processing of the application.

The Provisional Atmospheric Emission License is issued subject to the conditions and requirements set out below which form part of the Provisional Atmospheric Emission License and which are binding on the holder of the Provisional Atmospheric Emission License ("the License Holder").

This Provisional Atmospheric Emission License is valid for a period of five (05) years from the date of issuance. The Provisional Atmospheric Emission License expiration terminates the License Holder's right to operate the Listed Activities unless a complete Renewal application has been submitted to the relevant Licensing Authority no later than six (06) months prior to the expiration date of this License. If a complete renewal application has been submitted by the renewal application due date, this Provisional Atmospheric Emission License and all conditions contained therein shall not expire until the renewal License has been issued or denied. This protection shall cease to apply if, subsequent to a renewal application completeness determination, the applicant fails to submit by the deadline any additional information identified by the Licensing Authority as necessary to process the application.

The Provisional Atmospheric Emission License is valid until 01 April 2020

1. ATMOSPHERIC EMISSION LICENSE ADMINISTRATION

Name of the Licensing Authority	Department of Economic Development, Environment and Tourism
Atmospheric Emission License Number	12/4/12L-W2/A3
Atmospheric Emission Licence Issue Date	31 March 2015
Expiry date	01 April 2020
Atmospheric Emission License Type	***Provisional***
Review Date, not later than	When deemed necessary by the Licensing Authority

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2. ATMOSPHERIC EMISSION LICENSE HOLDER DETAILS

Enterprise Name	Eskom Holdings SOC Limited
Trading as	Medupi Power Station
Enterprise Registration Number (Registration Numbers if Joint Venture)	2002/015527/06
Registered Address	Megawatt Park, Maxwell Drive, Sunninghill, Sandton
Postal Address	PO Box 1091 Johannesburg 2000
Telephone Number (General)	011 800 3861
Industry Sector	Electricity Generation
Name of Responsible Officer/ Emission Control Officer	Johan Prinsloo
Telephone Number	013 656 4061
Cell Phone Number	083 655 9140
Fax Number	013 656 4973
Email Address	CJ.Prinsloo@eskom.co.za
After Hours Contact Details	083 655 9140
Land Use Zoning as per Town Planning Scheme	N/A

3. LOCATION AND EXTENT OF POWER STATION

3.1 Location and Extent of Plant

Physical Address of the Premises/Plant	Lephalale
Description of Site (Erf)	Farm Naauwontkomen; Farm Eenzaamheid
Coordinates of Approximate Centre of Operations	Latitude: 23.7038316°S Longitude: 27.5617951°E
Extent (km²)	6.3
Elevation Above Mean Sea Level (m)	900
Province	Limpopo
District Municipality	Waterberg District Municipality
Local Municipality	Lephalale Local Municipality
Designated Priority Area	Waterberg – Bojanala Priority Area

3.2 Description of Surrounding Land Use (within 5 km radius)

Figure 1: Location of premises in relation to surrounding community

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4. GENERAL CONDITIONS

4.1 Process and ownership changes

The holder of the atmospheric emission License must ensure that all unit processes and apparatus used for the purpose of undertaking the listed activity in question, and all appliances and mitigation measures for preventing or reducing atmospheric emissions, are at all times properly maintained and operated.

No facilities (building, plant or site of works) related to the listed activity or activities shall be extended, altered or added to the listed activity without prior approval by the Licensing Authority. The investigation, assessment and communication of potential impact of such an activity must follow the basic assessment procedure as prescribed in the Environmental Impact Assessment Regulations published in terms of section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended.

Any changes in processes or production increases, by the License Holder, will require prior approval by the licensing authority.

Any changes to the type and quantities of input materials and products, or to production equipment and treatment facilities will require prior written approval by the licensing authority.

The License Holder must, in writing, inform the Licensing Authority of any change of ownership of the enterprise. The Licensing Authority must be informed within thirty (30) days after the change of ownership.

The License Holder must immediately on cessation or decommissioning of the listed activity inform, in writing, inform the licensing authority.

4.2 General duty of care

The License Holder must, when undertaking the listed activity, adhere to the duty of care obligations as set out in section 28 of the NEMA.

The License Holder must undertake the necessary measures to minimize or contain the atmospheric emissions. The measures are set out in section 28(3) of the NEMA.

Failure to comply with the above condition is a breach of the duty of care, and the License Holder will be subject to the sanctions set out in section 28 of the NEMA.

4.3 Sampling and or analysis requirements

Measurement, calculation and or sampling and analysis shall be carried out in accordance with any nationally or internationally acceptable standard. A different method may be acceptable to the Licensing Authority as long as it has been consulted and agreed to the satisfactory documentation necessary in confirming the equivalent test reliability, quality and equivalence of analyses.

The License Holder is responsible for quality assurance of methods and performance. Where the License Holder uses external laboratories for sampling or analysis, accredited laboratories shall be used.

4.4 General requirements for License Holder

The License Holder is responsible for ensuring compliance with the conditions of this License by any person acting on his, her or its behalf, including but not limited to, an employee, agent, sub-contractor or person rendering a service to the holder of the License.

The License does not relieve the License Holder to comply with any other statutory requirements that may be applicable to the carrying on of the listed activity.

A copy of the License must be kept at the premises where the listed activity is undertaken. The License must be made available to the environmental management inspector representing the Licensing Authority who requests to see it.

The License Holder must inform, in writing, the Licensing Authority of any change to its details including the name of the emission control officer, postal address and/or telephonic details.

4.5 Statutory obligations

The License Holder must comply with the obligations as set out in Chapter 5 of the Act.

4.6 Payment of atmospheric emission License processing fee

The License Holder must pay the processing fee to the Licensing Authority within 30 days of receipt of atmospheric emission License processing fee invoice.

4.7 License Revisions, Termination and Reissuance

The License Holder may request the Licensing Authority to revise the conditions of this License by submitting an application that contains the information specified in Section 46 of the Act. The Licensing Authority will revise the License using the same procedures that apply to initial License issuance.

If the License Holder wishes to terminate the License, a written request must be submitted to the Licensing Authority explaining the reasons for the request and, if necessary for continued operation, submitting applications for any License or approvals that the License Holder avoided by establishment of the limits contained in this License.

This License may be terminated, revised, or revoked and reissued by the Licensing Authority for cause. Cause exists to terminate, revise, or revoke and reissue this License under the following circumstances:

a) This License contains a material mistake;
b) Inaccurate statements were made in establishing the terms or conditions of this License;
c) Newly discovered material information or material change in environmental conditions, environmental technology or applicable law or regulations since the issuance of the existing License;
d) The License Holder fails to comply with any condition of this License; or
e) This License must be terminated, revised, or reopened and reissued to assure compliance with Air Quality Act requirements.

The Licensing Authority will use the same proceedings to terminate, revise, or revoke and reissue a License for cause as for initial License issuance. Before initiating proceedings to terminate, revise, or revoke and reissue a License, the Licensing Authority will provide the License Holder at least 30 days' advance written notice of Licensing Authority's intent to terminate, revise, or revoke and reissue the permit, except that the Licensing Authority may provide a shorter notice period in the case of an emergency.

4.8 Non-Compliance with Conditions

If the License Holder fails to comply with the conditions or requirements of the License, the Licensing Authority may by notice in writing call upon such holder to comply with such conditions or requirement within a reasonable period specified in the notice, and in the event of failure on the part of such holder to comply with the said conditions or requirement within the period so specified, the Licensing Authority may cancel the License or suspend the operation thereof for such period as he or she may deem fit.

4.9 Appeal of Licence

A. The License Holder must, within seven (07) calendar days of receipt of this license, inform all interested and affected parties and at least include the following:
   (i) That an Atmospheric Emission License has been issued to the applicant to proceed with the operation of the activities. If requested provide copies of this license.
   (ii) That any appeals against the issuing of the license must be lodged with the Member of the Executive Council of Limpopo Department of Economic Development Environment and Tourism ("the MEC") as per chapter 2 of National Appeal Regulations Government Notice No. R.594 in Government Gazette No. 38303 of 8 December 2014.
   (iii) The date on which the license was issued to the applicant in terms of section 40 of the Act and the date by which appeals must reach the MEC.

B. Failure to inform interested and affected parties within the stipulated time period may result in the MEC considering requests from such parties for permission to submit late appeal favourably.

C. An appeal lodged with the MEC must be submitted to the Department of Limpopo Department of Economic Development Environment and Tourism by means of one of the following methods:
   By post: Private Bag X 9484, **POLOKWANE,** 0700
   By fax: (015) 291 5809
   By hand: Evridiki Towers, 19 Biccard Street, Polokwane 0700

D. An appeal must be
   (i) submitted in writing
   (ii) accompanied by:
   - a statement setting out the grounds of appeal;
   - supporting documentation which is referred to in the appeal and is not available to the relevant Licensing Authority
   - a statement that the appellant has complied with regulation 60(2) or (3) of NEMA EIA Regulations

5. NATURE OF PROCESS

5.1 Process description

The Station comprises six 800 MW units or boiler-turbine-generator sets. The total station capacity is 4 800 MW. Each boiler has five (05) mills allocated to it and nominally, four (04) are required for the boiler to reach full load. All the mills are vertical spindle mills and are fed from a common coal storage bunker. The bunker is supplied by two incline conveyors coming from the coal stock yard/staithes which are fed from the open coal stockyard. The coal stockyard is located on the Station.

From the mills which grind the coal into fine particles known as pulverized fuel (PF), PF is fed into the boilers via PF burners. To bring the boiler up to maximum operation, the boiler temperature has to be high enough to facilitate efficient combustion of PF. Correct boiler temperatures are achieved by starting-up the boiler using heavy fuel oil. The boiler is brought up to high temperature using oil burners before PF is injected into the boiler. During start-up, due to the fact that fuel oil is being burnt, exit emissions will greatly exceed those produced under normal operating conditions i.e. when PF is burnt.

Within the boiler, demineralised water is heated to form superheated steam which is sent to the turbines to turn the turbine blades. The turbine blades are attached to a shaft which rotates within the generator. The cooled steam from the turbine is sent to the condenser. In the condenser, spent steam is fed through a series of tubes which are isolated from the cooling water which is passed over the tubes. A heat exchange takes place and the spent steam condenses back into demineralised water or condensate, which is sent back to the boiler. The now heated cooling water is sent to the three (03) northern cooling towers where it is cooled through convection using a wet cooling system. The cooled cooling water is re-circulated back to the condenser. All units utilise a dry cooling system circulating the total condensate as the cooling medium in an indirect dry cooling system.

Once PF has been combusted in the boilers, two types of ash result: fly ash which stays buoyant in the exit flue gas stream and coarse ash (or bottom ash) which is too heavy to remain airborne and falls into the hopper at the bottom of the boiler. Once in the boiler hoppers, coarse ash is quenched using water in a submerged scrapper conveyor and sent to a common ash slurry sump. From the ash slurry sump, the coarse ash is sent via steel pipes to the ashing facility. Fly ash, or particulate matter (PM), is captured using a pulse jet fabric filter plant (PJFF) abatement technologies, before the flue gas exits the stacks, at a height of 220m above ground level.

5.2 Listed activity or activities

List of all Listed Activities, as published in terms of Section 21 of the AQA, authorised to be conducted at the premises by the License Holder:

Category of Listed Activity	Sub-category of the Listed Activity	Description of the Listed Activity
1 – Combustion Installations	1.1 – Solid Fuel Combustion Installations	Solid fuels combustion installations used primarily for steam raising or electricity generation
2 – Petroleum Industry	2.4 – Storage and Handling of Petroleum Products	Petroleum product storage tanks and product transfer facilities, except those under liquefied petroleum gas
5 –Mineral Processing, Storage and Handling	5.1 – Storage and Handling of Ore and Coal	Storage and handling of ore and coal not situated on the premises of a mine or works as defined in the Mines Health and Safety Act 29/1996

5.3 Unit process or processes

List of all unit processes associated with the listed activities to be undertaken at the premises.

Unit Process	Unit Process Function	Batch or Continuous Process
Boiler - Unit 1	Electricity Generation – 800 MW	Continuous
Boiler - Unit 2	Electricity Generation – 800 MW	Continuous
Boiler - Unit 3	Electricity Generation – 800 MW	Continuous
Boiler - Unit 4	Electricity Generation – 800 MW	Continuous
Boiler - Unit 5	Electricity Generation – 800 MW	Continuous
Boiler - Unit 6	Electricity Generation – 800 MW	Continuous
Coal stockyard	Coal Storage	Continuous
Excess coal stockyard	Coal Storage	Continuous
Fuel Oil Storage Tanks	Fuel Oil Storage	Continuous
Ashing facility	Ash Dump	Continuous

5.4 Hours of operations

Hours of operation of all unit processes associated with the listed activities at the premises.

Unit Process	Operating Hours	Days of Operation per Year
Boiler - Unit 1	00:00 – 24:00	366
Boiler - Unit 2	00:00 – 24:00	366
Boiler - Unit 3	00:00 – 24:00	366
Boiler - Unit 4	00:00 – 24:00	366
Boiler - Unit 5	00:00 – 24:00	366
Boiler - Unit 6	00:00 – 24:00	366
Coal stockyard	00:00 – 24:00	366
Excess coal stockyard	00:00 – 24:00	366
Fuel Oil Storage Tanks	00:00 – 24:00	366
Ashing facility	00:00 – 24:00	366

5.5 Graphical Process Information

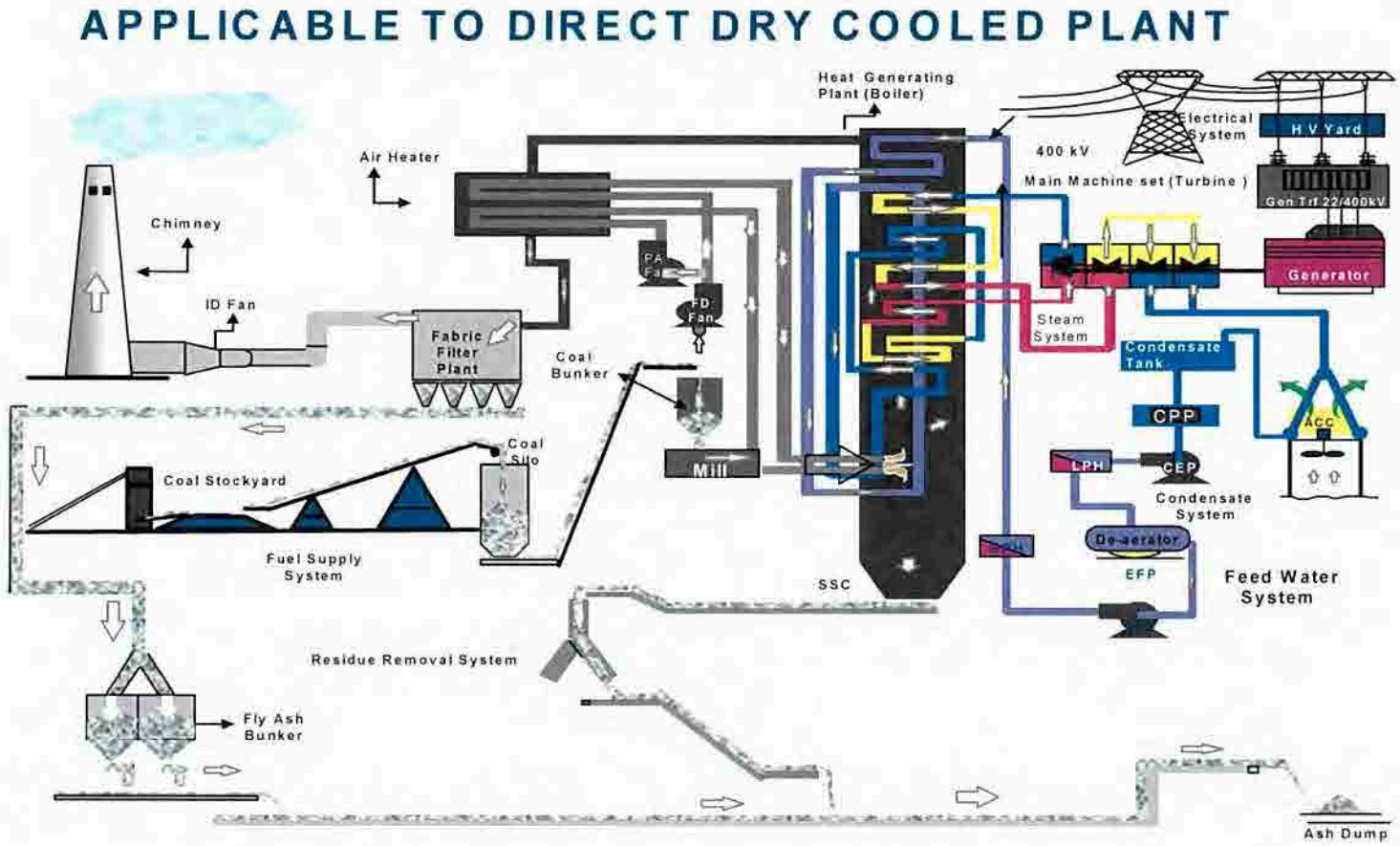

Figure 2: Process Flow Diagram Applicable to Direct Dry Cooled Plant

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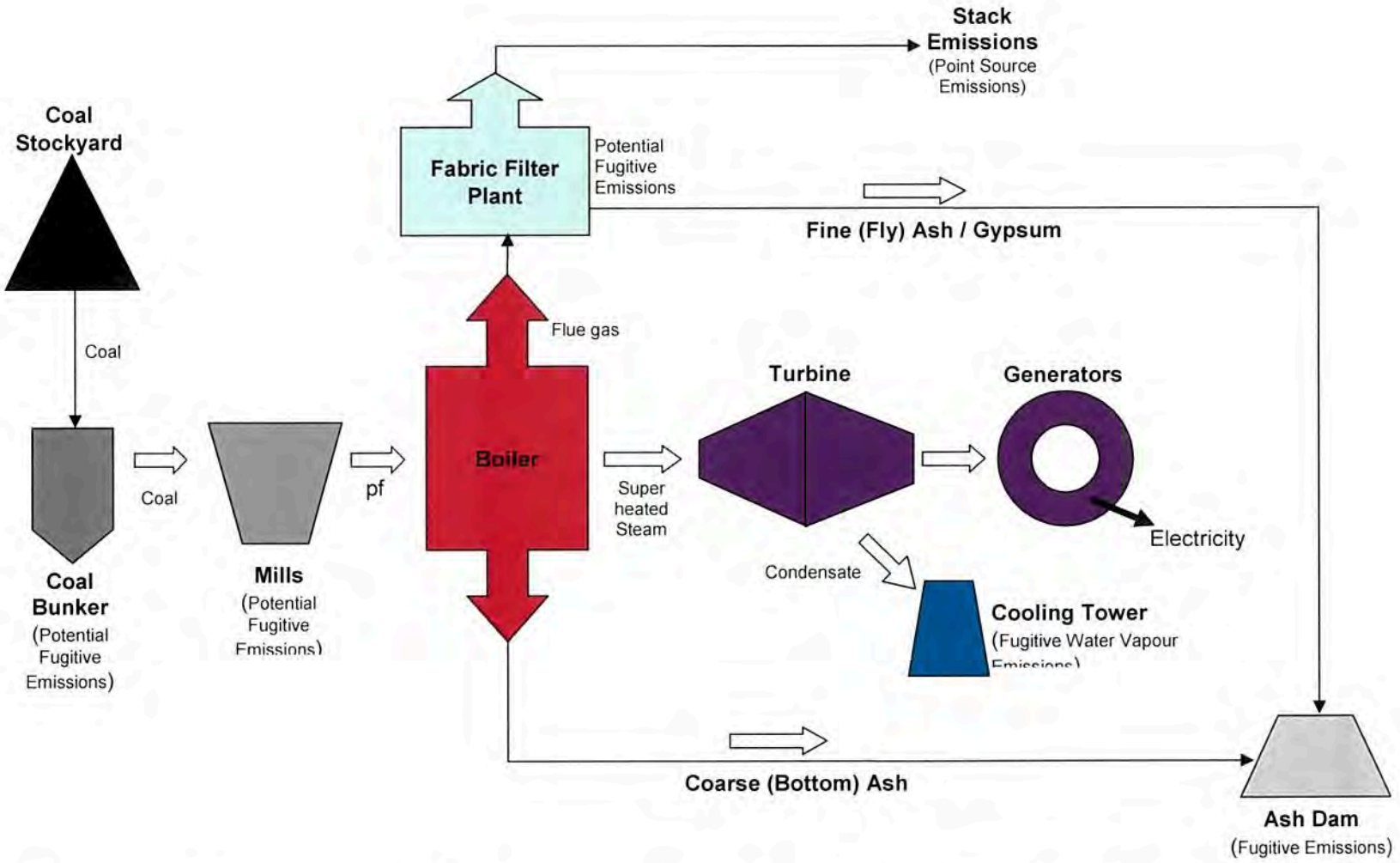

Figure 3: Process flow chart indicating inputs,outputs and emissions at the site of works,including points of potential fugutive emissions

6. RAW MATERIALS AND PRODUCTS

6.1 Raw materials used

Regulated Raw Materials		
Raw Material Type	**Maximum Permitted Consumption Rate (Quantity)**	**Units (quantity/period)**
Coal	1 875 000	tons/month
Fuel oil*	40 000	tons/month
Non-regulated Raw Materials		
Raw Material Type	**Maximum Permitted Consumption Rate (Quantity)**	**Units (quantity/period)**
Water	1 429 000	litres/month

* **Regulated raw materials** refers to those materials when increased or decreased may result in the change of air emissions output.
* **Non-regulated raw materials** refers to those materials when increased or decreased may not result in any change of air emissions output.

Limitations and Standards

6.1.1 The Coal consumption rate shall not exceed 1 875 000 tons per month.

6.1.2 The Fuel Oil consumption rate shall not exceed 40 000 tons per month

6.2 Production rates

Product Name	Maximum Permitted Production Capacity (Quantity)	Units (quantity/period)
Electricity	4 800	MW

6.3 Materials used in energy sources

Materials for Energy Source	Actual Consumption Rate (Quantity)	Units (quantity/period)	Materials Characteristics (Monthly Average)
Coal	1 875 000	Tons/month	Sulphur Content: 1.3 – 2.2% Ash Content: 35 – 39%
Fuel oil	40 000	Tons/month	Sulphur Content: 0.5 - 3.5% Ash Content: 0.02 - 0.1%

6.3.1 No fuel must be used with material characteristics with an exceedance of the largest value by over 10% without the approval by the Licensing Authority.

6.4 Sources of atmospheric emission

6.4.1 Point source parameters

Point Source Code	Source Name	Latitude (decimal degrees)	Longitude (decimal degrees)	Height of Release Above Ground (m)	Height Above Nearby Building (m)	Effective Diameter at Stack Tip/Vent Exit (m)*	Actual Gas Exit Temperature (°C)	Actual Gas Volumetric Flow (m^3/hr)	Actual Gas Exit Velocity (m/s)	Emission Hours	Type of Emission (Continuous / Batch)
		South	East								
Stack 1	Stack 1	23.7028928°S	27.5614339°E	220	100	21.9	140	4 000 000	18 -24	24 hours	Continuous
Stack 2	Stack 2	23.7047792°S	27.5617951°E	220	100	21.9	140	4 000 000	18 -24	24 hours	Continuous

6.4.2 Area and or line source parameters

Area and or Line Source Code	Source Name	Source Description	Latitude (decimal degrees) of SW corner	Longitude (decimal degrees) of SW corner	Height of Release Above Ground (m)	Length of Area (m)	Width of Area (m)	Emission Hours	Type of Emission (Continuous / Intermittent)
A1	Coal stockyard	Storage and handling of coal	23.710818°S	27.550252°E	12	897	616.6	24	Continuous
A2	Excess coal stockyard	Storage and handling of coal	23.70941°S	27.52924°E	20	2000	2000	24	Continuous
A3	Ash disposal facility	Storage of ash	23.748821°S	27.515143°E	60	4200	4000	24	Continuous
A4	Fuel oil tank 2	Fuel oil storage	2623173.400 SW	57523.252 SW	12.7	12m	12m	24	Continuous
A5	Fuel oil tank 1	Fuel oil storage	2623235.4449 SW	57559.027 SW	12.7	12m	12m	24	Continuous

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7. APPLIANCES AND MEASURES TO PREVENT AIR POLLUTION

7.1 Appliances and control measures

Associated Source Code	Appliances			Abatement Equipment Control Technology						
	Appliance /Process Equipment Number	Appliance serial number	Appliance Type / Description	Abatement Equipment Technology Name and Model	Abatement Equipment Technology Manufacture Date	Commission Date	Technology Type	Design Capacity	Minimum Control Efficiency (%)	Minimum Utilisation (%)
Stack 1	Boiler 1	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 2	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 3	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%

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Associated Source Code	Appliances			Abatement Equipment Control Technology						
	Appliance /Process Equipment Number	Appliance serial number	Appliance Type / Description	Abatement Equipment Technology Name and Model	Abatement Equipment Technology Manufacture Date	Commission Date	Technology Type	Design Capacity	Minimum Control Efficiency (%)	Minimum Utilisation (%)
Stack 2	Boiler 4	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 5	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%
	Boiler 6	To be provided as per Condition 7.1.1	Fabric filter plant	Fabric filter plant	2013 – 2017	2013 – 2017	Fabric filter plant	To be provided as per Condition 7.1.1	99.0%	100%
			Low NOx burners and Overfire air	Low NOx burners and Overfire air	2013 – 2017	2013 – 2017	Low NOx burners and Overfire air	To be provided as per Condition 7.1.1	70%	100%

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Appliances and control measures requirements:

7.1.1 The control devices' details must be forwarded to the Licensing Authority thirty (30) days prior to commissioning of the equipment/technology.
7.1.2 Off-gases from each heat generating plant (Boiler) shall be vented via a fabric filter plant to a stack at all times the emissions unit is in process. Low NOX burners Overfire air must be utilized to control NOX emissions.
7.1.3 The License Holder must inspect all control systems, specified in the Appliances and Control Measures Table 7.1 above for the plant, weekly to ensure that they are operated and maintained in conformance with their designs.
7.1.4. The License Holder shall, continuously operate, and maintain a flue gas desulphurization (FGD) plant for control of SO_2 on all six units. The Flue Gas Desulphurisation plant shall be retrofitted in each unit within Six (06) years after the first commissioning of each unit and during the General Overhaul outages.

7.2. Point source – maximum emission rates (under normal conditions)

Point Source Code	Pollutant Name	Maximum Release Rate			Duration of Emissions
		(mg/Nm³)	Date to be Achieved By	Average Period	
Stack 1	SO_2	3500 mg/Nm³	01 April 2015	Daily	Continuous
		500 mg/Nm³	01 April 2025	Daily	Continuous
	NOx	750 mg/Nm³	01 April 2015	Daily	Continuous
	PM	50 mg/Nm³	01 April 2015	Daily	Continuous
Stack 2	SO_2	3500 mg/Nm³	01 April 2015	Daily	Continuous
		500 mg/Nm³	01 April 2025	Daily	Continuous
	NOx	750 mg/Nm³	01 April 2015	Daily	Continuous
	PM	50 mg/Nm³	01 April 2015	Daily	Continuous

Point source – maximum emission rates and requirements

7.2.1 Emissions to the atmosphere from each unit shall be limited as set out in the Table 7.2 when the processes are in operation. The License Holder must be in compliance with the emissions limitations in Table 7.2 at all times, except during periods of start-up, maintenance, and shutdown.

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7.2.2 PM10 emissions shall not exceed 50 mg/Nm^3, NO_X emissions shall not exceed 750 mg/Nm^3, and SO_2 emissions shall not exceed 3500 mg/Nm^3 during the period 01 April 2015 to 31 March 2025 and shall not exceed 500 mg/Nm^3 from 01 April 2025, averaged daily under normal conditions of 273 K, 101.3 kPa and 10% oxygen (O_2).

7.2.3 The License Holder must prevent deviations from normal operating conditions that would result in emissions exceeding specified limit values, and shall scale back or halt its operations under excessive emissions if it is likely that the permitted levels of emissions would otherwise be exceeded.

7.2.4 The License Holder must develop a written start-up, maintenance, and shutdown plan that describe, in detail, procedures for operating and maintaining each boiler during periods of start-up, maintenance, and shutdown; and a program of corrective action for malfunctioning process, air pollution control, and monitoring equipment used to comply with the emission limitations in Table 7.2. The start-up, maintenance, and shutdown plan does not need to address any scenario that would not cause either unit to exceed an emission limitation. During periods of start-up, maintenance, and shutdown, the License Holder must operate each unit in accordance with the start-up, maintenance, and shutdown plan.

7.2.5 Deviations that occur during a period of start-up, maintenance, and shutdown are not violations if the License Holder demonstrates to the Licensing Authority satisfaction that the License Holder was operating in accordance with the start-up, maintenance, and shutdown plan. The Licensing Authority will determine whether deviations that occur during a period of start-up, maintenance, and shutdown are violations in accordance with Section 51 of the Act.

7.2.6 The License Holder must apply for an exemption from the conditions of the License in the event of equipment malfunction or breakdown within twenty four (24) hours of the incident. Should the normal start-up, maintenance, upset and shutdown conditions exceed 48 hours, Section 30 of the National Environmental Management Act (Act No. 107 of 1998), as amended, shall apply.

7.2.7 The duration of start-up (number of hours from fires in to synchronization) and shut down must be reported in the report required in terms of Condition 7.7.1. The number of hours for which emissions exceed the limit during Emergency Generation, and the number of hours declared as Emergency Generation by National Control, must be included in the report required in terms of Condition 7.7.1.

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7.3. Point source – emission monitoring and reporting requirements

Point Source Code	Emission Sampling / Monitoring Method	Sampling Frequency	Parameters to be Measured	Parameters to be Reported	Reporting Frequency	Conditions Under Which Monitoring Could Be Stopped
Stack 1	Continuous emission monitoring (in-stack)	Continuous	Continuous (90% of hours in a year)	PM, SO_2, NO_x, CO_2	As per Condition 7.7 of the License	Upon written approval by the Licensing Authority
Stack 2	Continuous emission monitoring (in-stack)	Continuous	Continuous (90% of hours in a year)	PM, SO_2, NO_x, CO_2	As per Condition 7.7 of the License	Upon written approval by the Licensing Authority

Point source – monitoring and reporting requirements

7.3.1 The License Holder shall install, calibrate, and operate a Continuous Emissions Monitoring System (CEMS) each for Stack 1 and Stack 2 that measures Particulate Matter (PM10), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Dioxide (CO_2). The concentrations of the gaseous pollutants shall be corrected to 10% O_2 on a dry basis. The averaging period for the purposes of compliance monitoring shall be expressed on a daily average basis.

7.3.2 The CEMS shall be operated, calibrated and maintained continuously, dependent of the units' operation. The License Holder must measure and record valid continuous emission data for the parameters listed in Condition 7.3 during all periods of the units' operation including periods of unit start-up, shutdown, malfunction or emergency conditions, except for periods of CEMS quality assurance/quality control ("QA/QC"), routine maintenance, or uncontrolled malfunction. Nevertheless, the CEMS must be maintained to yield a minimum of 90% valid hourly average values during the reporting period. CEMS must be audited by a SANAS accredited laboratory at least once every two (02) years.

7.3.3 The License Holder shall conduct spot measurement or correlation stack tests to verify the accuracy of the continuous emission measurement. The Licensing Authority, or the Licensing Authority's duly authorized representative, may witness or conduct such test(s). Should the Licensing Authority opt to conduct such test(s), the operator shall provide all necessary sampling connections and sampling ports to be located in such manner as the Licensing Authority may require, power for test equipment and the required safety equipment, such as scaffolding, railings and ladders, to comply with generally accepted good safety practices. Such tests shall be conducted in accordance with the methods and procedures set out in this License or as otherwise approved or specified by the Licensing Authority.

7.3.4 All spot measurement or correlation stack tests to verify the accuracy of the continuous emission measurement and such other tests as specified in this License shall be conducted in accordance with an approved test method as contained in Schedule A of Section 21 Notice (Government Notice No. 893). Methods other than those contained in Schedule A may be used with the written consent of the National Air Quality Officer. Such methods shall be submitted to the Licensing Authority in writing at least thirty (30) days prior to any testing and shall contain the information set out by the Licensing Authority or as per Condition 7.8(A)(iii).

7.3.5 The License Holder shall notify the Licensing Authority prior to any isokinetic sampling, spot measurement or correlation stack tests, in accordance with Condition 7.8, so the Licensing Authority may have the opportunity to observe such tests. This notification shall include the actual date and time during which the test will be conducted and, if appropriate, verification that the tests will fully conform to a referenced method previously approved by the Licensing Authority.

7.3.6 In addition to installing, operating and maintaining a CEMS for monitoring and reporting of emissions, the License Holder shall install, maintain and operate an ambient air quality [Sulphur Dioxide (SO_2); Nitrogen Dioxide (NO_2), Carbon Monoxide(CO); Particulate Matter(PM10 and PM 2.5); Ozone(O_3); and Mercury(H g)] monitoring and associated meteorological stations in the Marapong residential area as well as at relevant areas upwind and downwind of the facility. An ambient air quality monitoring plan must be submitted to the Licensing Authority for approval as per Condition 7.9.

7.3.7 The License Holder shall also conduct public education and awareness campaigns focusing on air quality improvements and shall implement a program of support for initiatives aimed at improving air quality in the surrounding communities and performance reports must be submitted to the Licensing Authority as per Condition 7.7.1(V). A five year public education and awareness plan must be developed and submitted to the Licensing Authority for review and approval by the Licensing Authority as per Condition 7.9.

Appendix 3.1-20

7.4. Area and or line source – management and mitigation measures

Area and/or Line Source Code	Source Name	Source Description	Description of specific measures	Required control efficiency (%)	Timeframe for achieving required efficiency	Method of monitoring measures' effectiveness
A1	Coal stockyard	Storage and handling of coal	- Compaction of strategic stockpile - Spraying of water for dust suppression	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A2	Excess coal stockyard	Storage and handling of coal	- Compaction of strategic stockpile - Spraying of water for dust suppression	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A3	Ash dump	Storage of ash	- Spraying of water for dust suppression - Rehabilitation of ash dump by planting vegetation	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A4	Fuel oil tank 1	Fuel oil storage	- Monthly visual inspection of the exterior walls of the tank - Perform inventory reconciliation and annual leak detection tests	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring
A5	Fuel oil tank 2	Fuel oil storage	- Monthly visual inspection of the exterior walls of the tank - Perform inventory reconciliation and annual leak detection tests	Fallout dust not to exceed dust fallout standards set out in Regulation 3 of the National Dust Control Regulation, 2013	Immediately	Dust fallout and PM10 monitoring

Appendix 3.1-21

Area and or line source management and mitigation measures

7.4.1 The License Holder shall perform all necessary operations to minimize emissions arising from the coal stockpile, ash dump, coal and ash handling equipment, and any other associated infrastructure or activity. Measures including good housekeeping, compaction of stockpile, rehabilitation of ash dump by planting vegetation and spraying of water for dust suppression shall be implemented at all times as shall be necessary to minimize the generation of dust from the works and to prevent detrimental impacts on adjacent receptors.

7.4.2 The License Holder shall perform all necessary operations to minimize emissions arising from the fuel oil storage area, fuel oil handling equipment, and any other associated infrastructure or activity. The area shall be bunded to cater for double the volume of each tank at the minimum (i.e. 2400m^3 per tank) with an additional freeboard of 300mm so that each tank has its own bunded area with a double volume bund and spare change. The bund shall be constructed of concrete with all joints sealed, excess water shall be discharged through a drain-off facility within the bunded area and oil traps shall be used to separate oil from water prior to release into the wastewater system. A sand-bitumen mix placed at the bottom of the tank shall be used to prevent leaking. Fuel oil tanks shall be fitted with a breather pipe with flame arrestor, full fire-water system and fire blanket system installed along the top of the bunker walls.

7.4.3 Periodic evaluation of the coal, ash dump and fuel oil storage sites' implemented control measures must be undertaken to identify the success of those measures, in-line with the requirements of the Fugitive Emissions Management Plan contemplated in Condition 7.9.

7.4.4 The License Holder shall conduct dust fallout monitoring/measurements in accordance with an approved test method at sites around the stockyard area, ash dump area as well as along the site boundary (at least upwind and downwind) to determine contributions from background sources.

7.4.5 Monitoring systems and control measures must be implemented to ensure prevention or mitigation of spontaneous combustion of coal stockpiles

7.4.6 Reviews of the monitoring results and effectiveness of implemented mitigation measures shall be carried out. Results of such reviews (including calibration data, monitoring protocol, measured dust concentrations, and data analysis) must be submitted to the Department in accordance with Condition 7.7.1. Records of specific dust events, dust complaints and site conditions including prevailing meteorology must be included in the report.

7.4.7 The License Holder shall keep readily accessible records showing the dimension of each storage vessel, an analysis showing the capacity of each storage tank and the maximum true vapor pressure of the stored liquid. Records shall be retained for the life of the facility. The License Holder shall also keep records sufficient to determine the throughput of fuel oil for each storage tank for use in the report as per Condition 7.7.1.

7.4.8 Emissions of Total Volatile Organic Compounds (TVOC) from fuel oil storage tanks' venting and working loss shall be estimated using methods approved by the Licensing Authority. Visual inspection of the exterior walls of the tanks results, fuel oil inventory reconciliation data, fuel oil throughput data and TVOC emission estimation results shall be submitted to the Licensing Authority as per Condition 7.7.1.

7.4.9 The License Holder must install and maintain appropriately designed stormwater management and treatment infrastructure to control and prevent pollution of water resources. Any runoff from the coal stockyard, ash dump and fuel oil storage area must be directed to the treatment system.

7.4.10 The License Holder must revise and submit a fugitive emission management plan as per Condition 7.9. The plan must identify all significant sources of fugitive emission and measures that will be implemented to address these fugitive sources. The plan must include detailed control methodologies/techniques, contingency plans, timeframes for implementation, assessment of efficiency, and regular monitoring and reporting systems/criteria.

Appendix 3.1-22

7.5. Energy Conservation Measures

The License Holder shall evaluate its activities to improve energy utilization and efficiency. This information should be provided to the Licensing Authority upon request.

7.6. Cleaner Production Targets

The License Holder must investigate cleaner production processes and practices that are relevant to its operations with a view towards reducing energy consumption and atmospheric emissions related to the processes. This information should be provided to the Licensing Authority upon request.

7.7. Routine Reporting and Record-keeping

7.7.1 Monthly Reporting

The License Holder must complete and submit to the Licensing Authority a Monthly Report no later than thirty (30) days after the end of each reporting period. The report must include information for the period under review. The Monthly Report must include, but not limited to, the following:

I. Complaints Register

The License Holder must maintain a Complaints Register at its premises, and such register must be made available for inspections. The Complaints Register must include the following information on the complainant, namely, the name, physical address, telephone number, date and the time when the complaint was registered. The register should also provide space for noise, dust and offensive odours complaints. Furthermore, the License Holder is to investigate and, monthly, report to the Licensing Authority in a summarised format on the total number of complaints lodged. The complaints must be reported in the following format with each component indicated as may be necessary:

a) Air pollution complaints received;
b) Date the complaint was received and the date the facility responded,
c) Investigations to determine the cause of the complaint;
d) Results of the investigation, and
e) Any actions taken to resolve the complaint.

The Licensing Authority must also be provided with a copy of the Complaints Register upon request.

Evridiki Towers, 20 Hans van Rensburg Street, POLOKWANE, 0700, Private Bag X9484, POLOKWANE, 0700
Tel: 015 293 8300, Fax: 015 295 5297, website: http\\www.Limpopo.gov.za

II. Operation and Production Records

The License Holder must track and record the operation and production such that source-wide emissions can be estimated on a daily basis. Records must include, but not be limited to:

a) Daily hours of operation
b) Daily production Rate
c) Daily fuel consumption rate
d) Ash and sulphur content (%) of any Coal
e) Sulphur content (%) of fuel oil combusted;
f) Coal, Ash and Fuel oil throughput data
g) Visual inspection of the exterior walls of the fuel oil tanks results and fuel oil inventory reconciliation data
h) Documentation of any time periods when the unit process is operational and the Fabric filter plant and/or low NO_x burners are not fully operational

III. Emissions monitoring and measurements and performance against limits

The License Holder must record and report, in a summarised format, any performance and/or compliance testing of machinery and equipment that has a direct or indirect impact on the atmospheric emissions to the Licensing Authority. Any non-compliance must be described thoroughly in the report. The performance tests and compliance testing report should include (but not be limited to) the following information:

a) Point sources monitoring and measurements results indicating performance against the specified emission limits in Table 7.2;
b) Pollutant emissions trend including Greenhouse gas emissions;
c) Fugitive emissions estimation/measurement information
d) Start-up, maintenance, shutdowns or malfunction occurrence and duration;
e) Major upgrades projects (i.e. abatement equipment or process equipment);
f) Excess emissions, source code or name, emission standard exceeded, root cause analysis;
g) Calculation of impacts/emissions associated with the non-compliance incidents and dispersion modelling of pollutants where applicable;
h) Measures implemented or to be implemented to prevent recurrence; and
i) Date by which measures were or will be implemented.

IV. Spot/correlation stack tests

Records of all required compliance testing shall include the following:

a) The date, place, and time of sampling or measurements;
b) The date analyses were performed;
c) The company or entity that performed the analyses;
d) The analytical techniques or methods used;
e) The results of all such analyses; and
f) The operating conditions existing at the time of sampling or measurement

V. Air Quality Improvement and Social Responsibility

a) Ambient air quality monitoring results;
b) Air quality improvement initiatives;
c) Public education and awareness campaigns;

7.7.2 Bi-annual Reporting

The License Holder must complete and submit to the Licensing Authority a Bi-annual Report no later than thirty (30) days after the end of each reporting period. The report must include information for the period under review. The Bi-annual Report must include, amongst others, the following items:

a) Compliance with regard to each AEL condition
b) Interpretation of all available data, tests and monitoring results regarding operation of the plant and all impacts on the environment
c) Recommendations regarding non-compliance or potential non-compliance
d) Target dates for the implementation of recommendations by the License Holder to achieve compliance
e) Impact of implemented corrective action taken for identified non-compliance

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7.7.3 Annual Reporting

The License Holder must complete and submit to the Licensing Authority, an Annual Report as contemplated in paragraph 17 of Section 21 Notice (Government Notice No. 893) no later than thirty (30) days after the end of each reporting period. The report must include information for the year under review. The Annual Report must include, amongst others, the following items:

a) Information specified in paragraph 18 of Section 21 Notice (Government Notice No. 893)
b) Emissions performance (emissions trend including Greenhouse gas emissions), compliance statistics and Spot/verification tests annual data summaries
c) Start-up, maintenance, shutdowns or malfunction occurrence and duration annual summary statistics
d) Operation and production annual data summaries
e) Annual summaries of deviations from License conditions or operations and maintenance plan and actions taken to resolve the problem

7.8. License Notification Requirements

A. The License Holder shall notify the Licensing Authority by letter or by electronic mail of the:

i. Actual date of initial start-up of each unit, not less than fourteen (14) days prior to such date;
ii. Actual date of commencement of commercial operation of each unit, not less than fourteen (14) days prior to such date;
iii. Date upon which isokinetic stack sampling, spot measurement or correlation stack tests will commence, in accordance with Condition 7.3.5, within fourteen (14) days prior to such date. Notification may be provided with the submittal of the performance test protocol required in terms Condition 7.3.3 and 7.3.4. The notice must state the source to be tested, the proposed time of the test, the testing date(s) and the proposed testing methods and procedures.

B. The License Holder shall notify the Licensing Authority within twenty four (24) hours following the discovery of any failure of air pollution control equipment, process equipment, or of a process to operate in a normal manner, which results in an increase in emissions above the allowable emission limits set in Section 7.2 of this License.

C. In addition, the License Holder shall provide an additional notification to the Licensing Authority in writing or electronic mail within fourteen (14) days of any such failure described under Condition 7.8 (B). This notification shall include a description of the malfunctioning equipment or abnormal operation, the date of the initial malfunction, the period of time over which emissions were increased due to the failure, the cause of the failure, the estimated resultant emissions in excess of those allowed in Section 7.2, and the methods utilized to mitigate emissions and restore normal operations.

D. The License Holder is to notify the Licensing Authority within twenty four (24) hours of any other significant incidences (i.e. spillages, fires, leakages or other similar situations). Should such incidences pose a significant health risk or nuisance, notification of the incident is to be immediate. Where excessive emissions occur, which could cause adverse health or environmental impacts or nuisance, urgent corrective measures must be taken, by the License Holder, to contain or minimise the emissions through operational interventions. Remediation, if required shall be carried out to the satisfaction of the Licensing

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Authority and/or any other governmental agencies. Any incident that has the potential to create significant health, safety or environmental risk or nuisance needs to be reported immediately to the relevant authority, Section 30 of the National Environmental Management Act (Act No. 107 of 1998), as amended, shall apply.

E. Compliance with the notification provision shall in no way serve to excuse, otherwise justify, or in any manner affect any potential liability or enforcement action resulting from the occurrence.

7.9. Investigation and Reviews

The following investigations are required:

Location	License Conditions	Minimum Requirements	Timeframe
Plant Wide	Fugitive Emissions Management (revised)	Fugitive Emissions Management Plan developed, approved and under implementation as per the schedule agreed in the plan, to minimize nuisance impacts off-site	Six (06) months from the date of issue of this License.
Plant Wide	Operations and Maintenance Plan (revised)	A written start-up, maintenance, and shutdown plan that describe, in detail, procedures for operating and maintaining each unit during periods of start-up, maintenance, and shutdown; and a program of corrective action for malfunctioning process must be developed. The Maintenance Plan must illustrate how the facility will be operated and maintained in order to comply with the emission limits as specified in this License.	Six (06) months from the date of issue of this License.
Neighborhood	Five Year Public Education and Awareness Plan	Public Education and Awareness Plan must include strategies for reaching out to selected audiences, messages that promote maintenance/achievements of ambient air quality goals and messages tailored to make people from all walks of life aware of specific issues related to the facility's operations taking into account emissions to the atmosphere, their impacts on health and surroundings/environment as well as preventative measures. The plan must also include aspect of monitoring and evaluation (M&E).	Six (06) months from the date of issue of this License.
Neighborhood	Ambient Air Quality Monitoring Plan	An Ambient Air Quality Monitoring Plan must provide specifics of the monitoring network to be established including details of the monitoring sites considerations, location including street address and geographical coordinates of the identified sites, pollutants and meteorological parameters to be monitored, sampling and analysis method(s) for each parameter to be measured, monitoring objectives and spatial scale of representativeness for each monitoring site, data acquisition, management and reporting procedures, as well as necessary protocols, procedures and work instructions for effective management of the monitoring network.	Six (06) months from the date of issue of this License.

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7.10. Start up, Maintenance and Shut-down Conditions

Unit Process	Description of Occurrence of Potential Releases (e.g. leakage, technology outage, etc.)	Pollutants and Associated Amount of Emissions	Briefly Outline Back Up Plan
Start-up	Fuel oil-assisted start-up to get the unit up to temperature	Particulate emissions in excess of 50 mg/Nm^3	Start-up is of limited duration
Shut-down	Plant failure /breakdown	Particulate emissions in excess of 50 mg/Nm^3	To be provided as per Condition 7.2.4
Bag leakages	Leaks in fabric filter plant bags will result in higher emissions of ash	Particulate emissions in excess of 50 mg/Nm^3	Leaking bags will be replaced
On-load rebags	Bags will be replaced if leaking or as part of normal maintenance cycle while unit is operating	Particulate emissions in excess of 50 mg/Nm^3	Bags will be replaced to maintain emissions performance

Appendix 3.1-28

7.10.1 The License Holder shall, to the extent practicable, maintain and operate the facility including associated air pollution control equipment in a manner consistent with g practice for minimizing emissions.

7.10.2 Leaking bags must be replaced during bag leakages and as part of normal maintenance cycle in order to maintain emissions performance at all times, including periods of start-up, shutdown, shakedown, and malfunction.

7.10.3 During a period of start-up, shutdown, or malfunction, the License Holder shall operate all unit processes (including associated air pollution control equipment) in accordance with the procedure specified in the start-up, shutdown, maintenance and malfunction plan.

7.10.4 Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Licensing Authority, which may include, but is not limited to, monitoring results, review of operating maintenance procedures and inspection of the facility.

7.10.5 The License Holder shall maintain records of the occurrence and duration of any start-up, maintenance, shutdown, or malfunction in the operation of each unit; any malfunction of the air pollution control equipment; or any periods during which a CEMS is inoperative.

7.10.6 Notification of a start-up, shutdown, or a malfunction shall be made by the License Holder in accordance with Condition 7.8

8. DISPOSAL OF WASTE AND EFFLUENT ARISING FROM ABATEMENT EQUIPMENT CONTROL TECHNOLOGY

The disposal of any waste and effluent arising from pollution mitigation measures proposed must comply with the relevant legislation and requirements of the relevant authorities.

Point or Area Source Code	Waste / Effluent Type	Hazardous Components Present	Method of Disposal
Stacks 1 and 2	Ash	Heavy metal trace elements and silica	Ash dump
Stacks 1 and 2	Fabric filter bags	Heavy metal trace elements and silica	Ash dump / waste disposal site
Once FGD is installed:			
Stacks 1 and 2	Gypsum	Heavy metal trace elements and silica	Co-disposal on ash dump OR distribution to market
Stacks 1 and 2	FGD waste water	Heavy metal trace elements and silica	Waste water treatment plant

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9. PENALTIES FOR NON-COMPLIANCE WITH LICENSE AND STATUTORY CONDITIONS OR REQUIREMENTS

Failure to comply with any of the License and relevant statutory conditions and/or requirements is an offence, and the License Holder, if convicted, will be subjected to those penalties as set out in section 52 of the AQA.

10. ATMOSPHERIC EMISSION LICENSE ENDORSEMENT

SIGNATURE: [signature]

NAME: T.M Mphahlele

DESIGNATION: Senior Manager

DATE: 01/04/2015

Appendix 5.1 Metrological data

1. Monitoring Location

Station name	South latitude	East longitude	Height above sea level	Source
Medupi Monitoring Station	23° 44'	27° 32'	902 m	http://www.saaqis.org.za/ViewSite.aspx?SiteID=281
Ellisras Airport Station	23° 44'	27° 41'	851 m	http://rp5.co.za/Weather_archive_in_Ellisras

Source : Original data was obtained from Website in the table.

Source: JICA Survey Team

Figure App 5.1-1 Climate and Metrological Data Monitoring Station Map.

2. Wind velocity (WVL) and Wind direction (WDR)

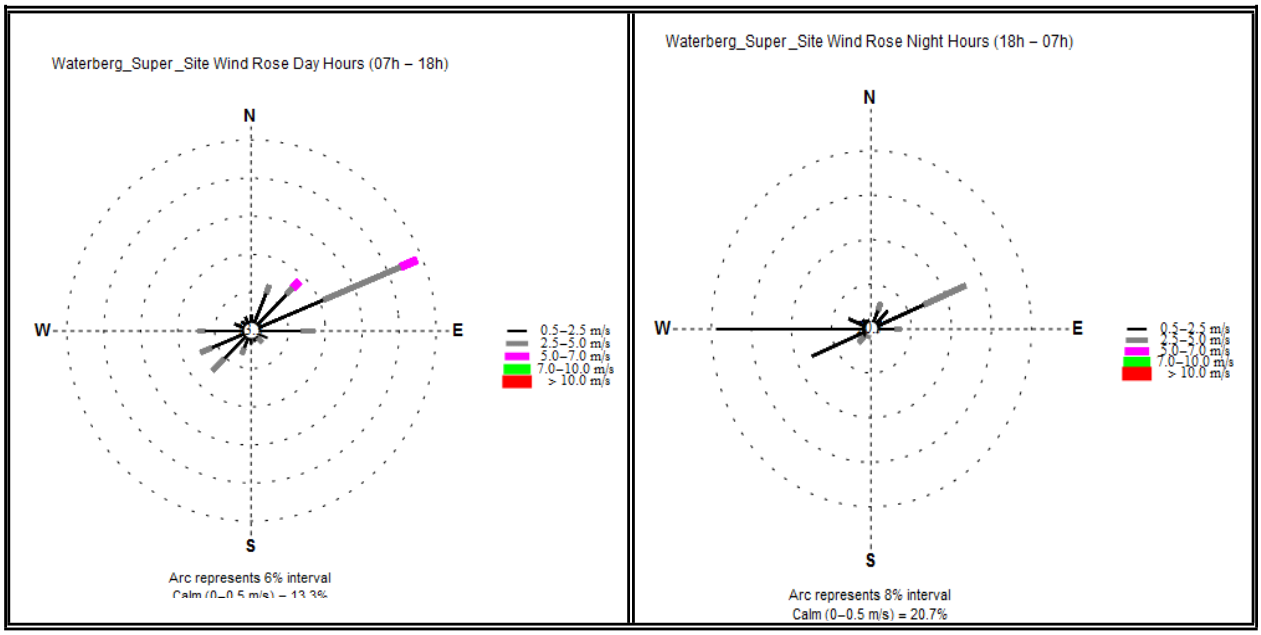
Table App. 5.1-2 Earth's Surface Wind Velocity at Medupi Monitoring Station (2016-2017)

Year	2016	2016	2016	2016	2016	2016	2017	2017	2017	2017	2017	2017	12 months	
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Average	Max
Highest Hourly Mean	5.8	5.1	5.8	8	6.3	5.1	4.9	6.5	4.7	4.3	4.1	3.7	5.4	8
Highest Daily Mean	4.1	3.5	4	5	3.6	3.8	4	4	2.4	2.1	2.5	1.8	3.4	5
Highest10min Mean	6.9	6	6.8	8.6	7.9	6.8	6.4	8.3	5.4	5.8	5.2	4.5	6.6	8.6

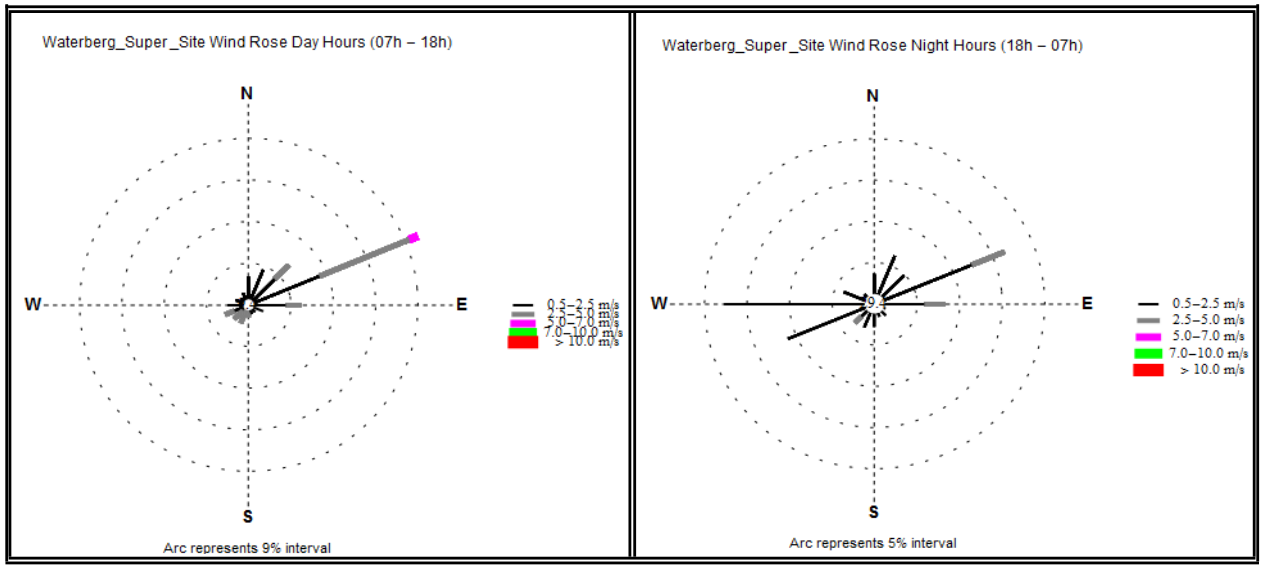
Source Medupi Air Quality Monthly Report, July 2016-June 2017, Eskom

Following figures show the daytime and night-time wind roses for July 2016-July 2017 at Medupi monitoring site. The center of the wind rose depicts the position of the air quality monitoring station. The positions of the spokes in the polar diagram represent directions from which the wind was blowing. The length of the segment indicates the percentage of the time the wind blew from that direction and the speed in the various categories are denoted by colours and width.

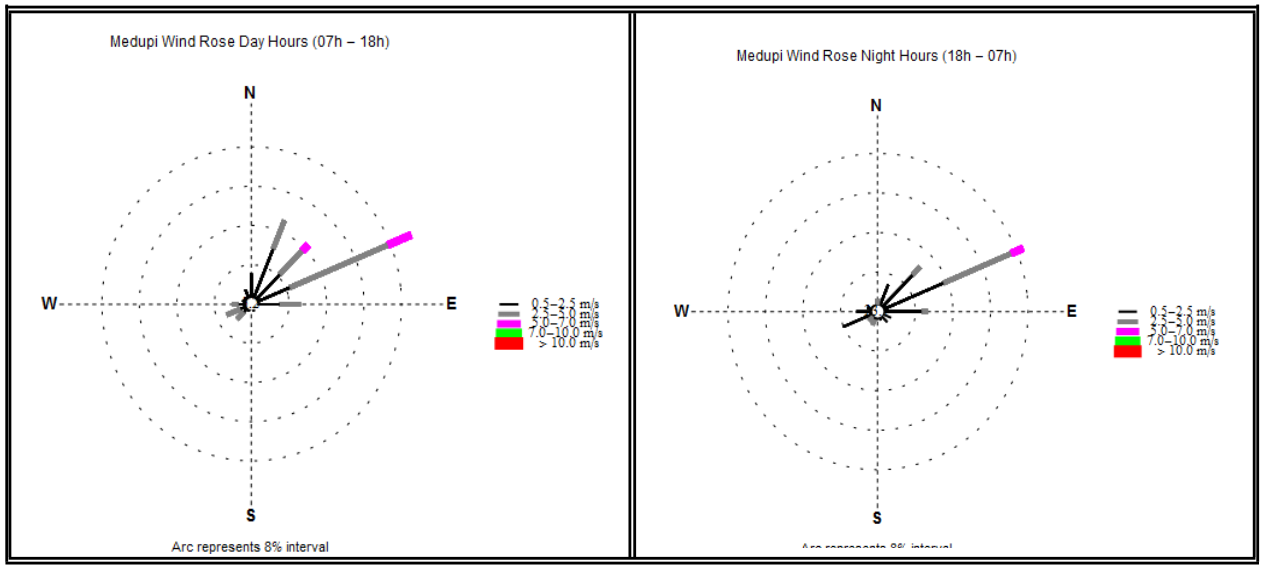
July 2016



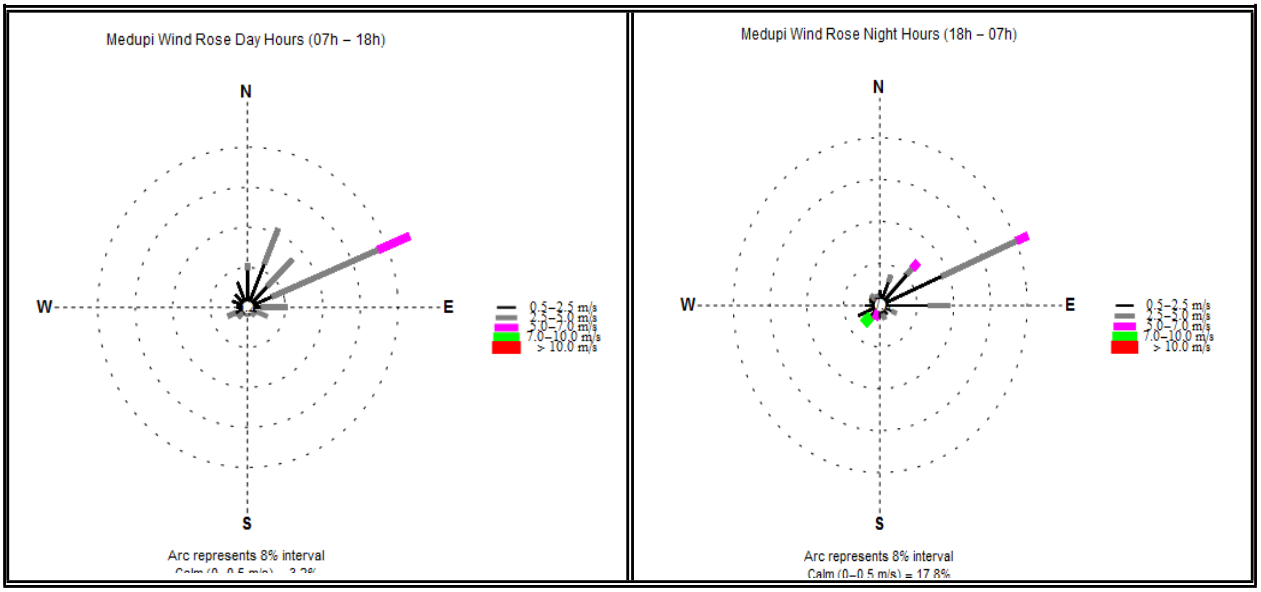
August 2016



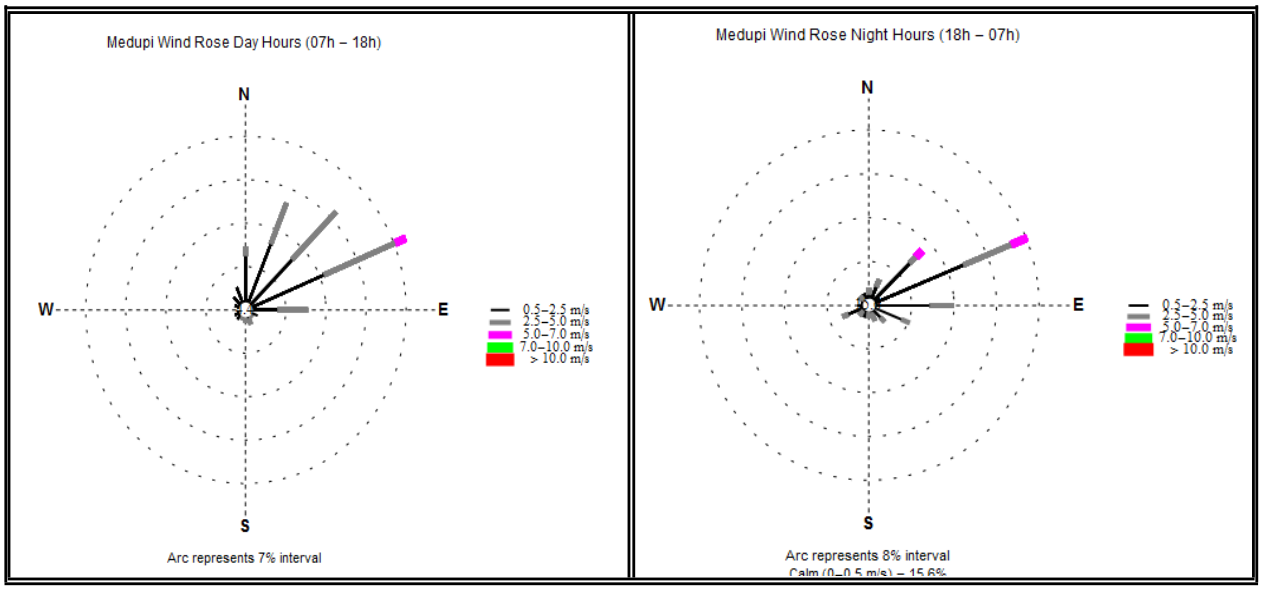
September 2016



October 2016



November 2016



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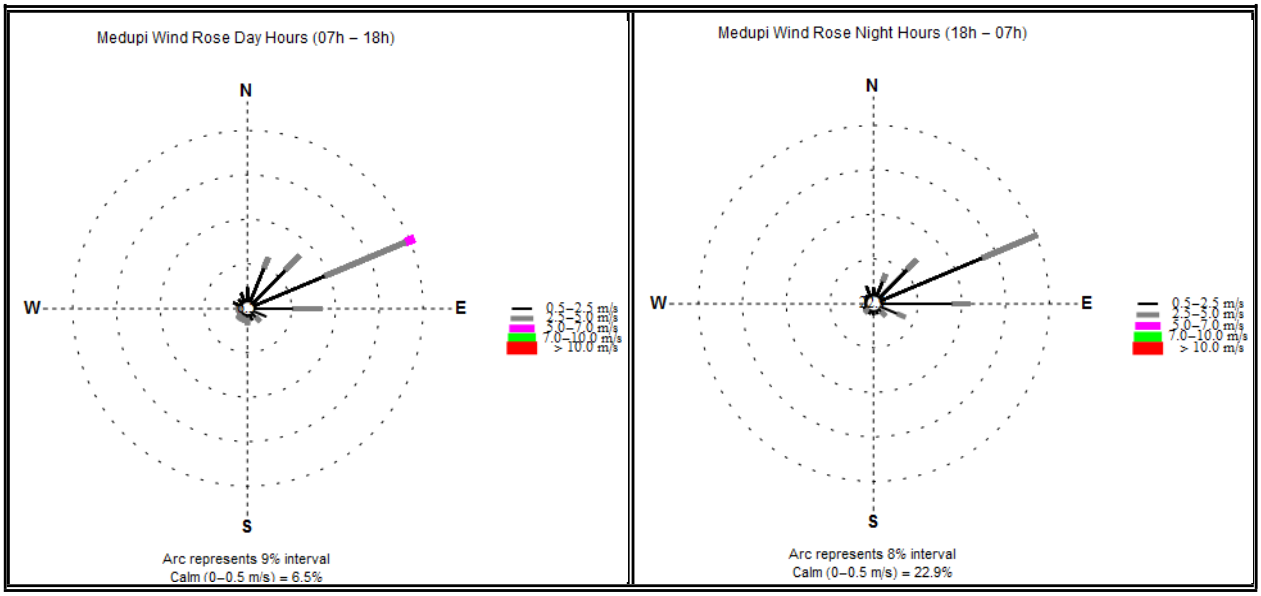

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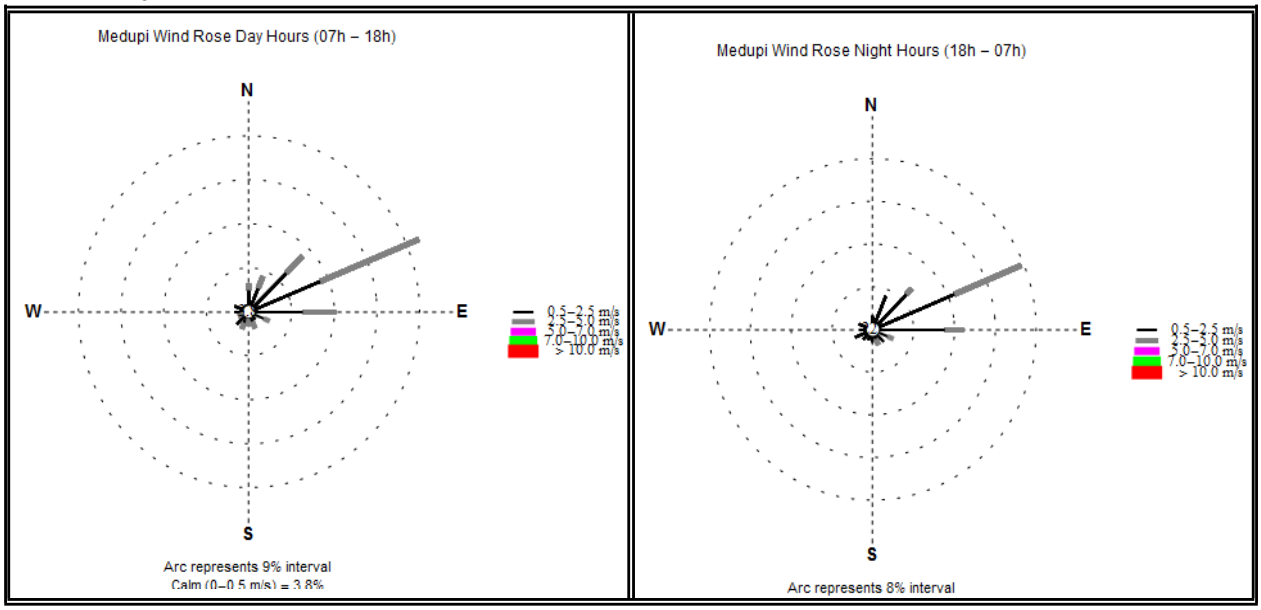
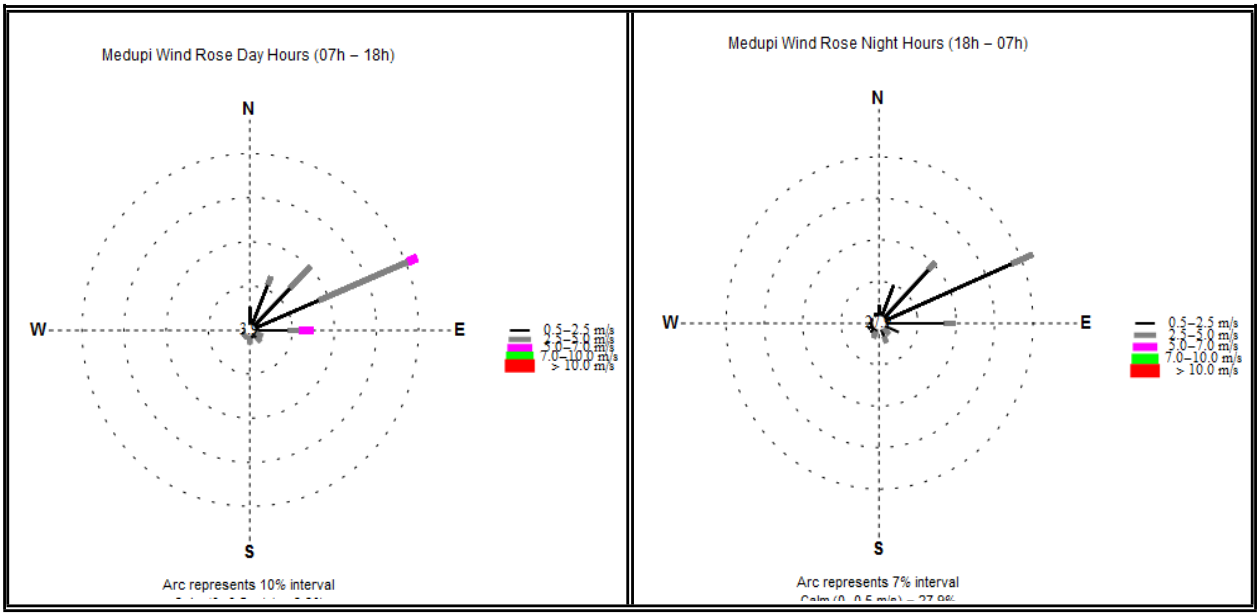
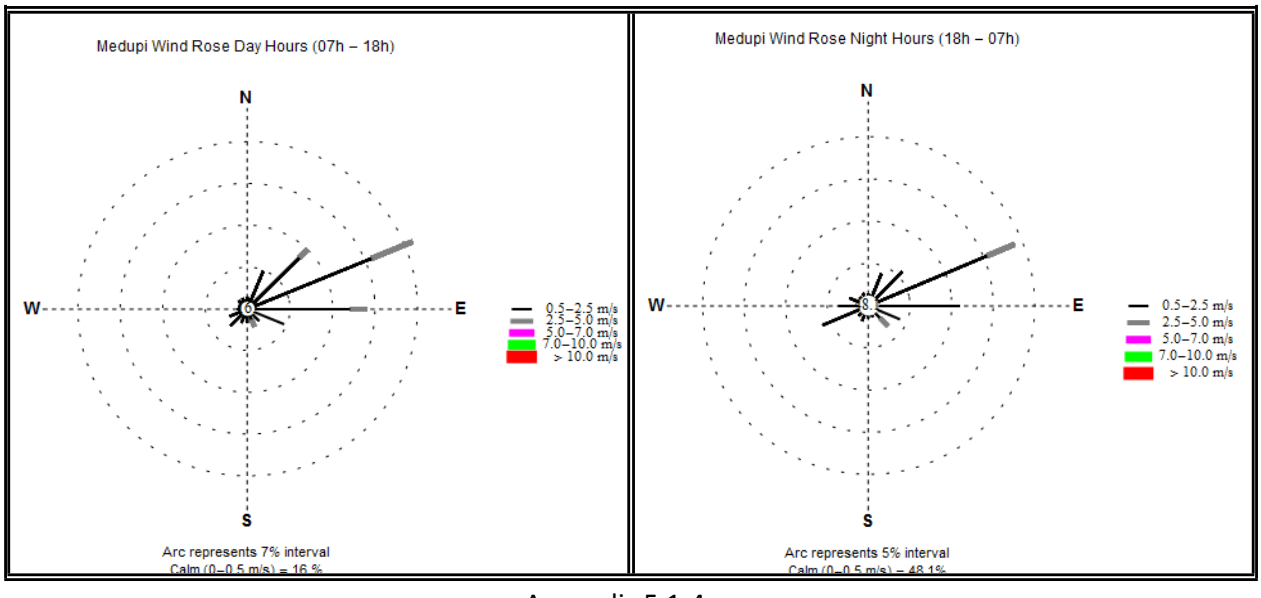


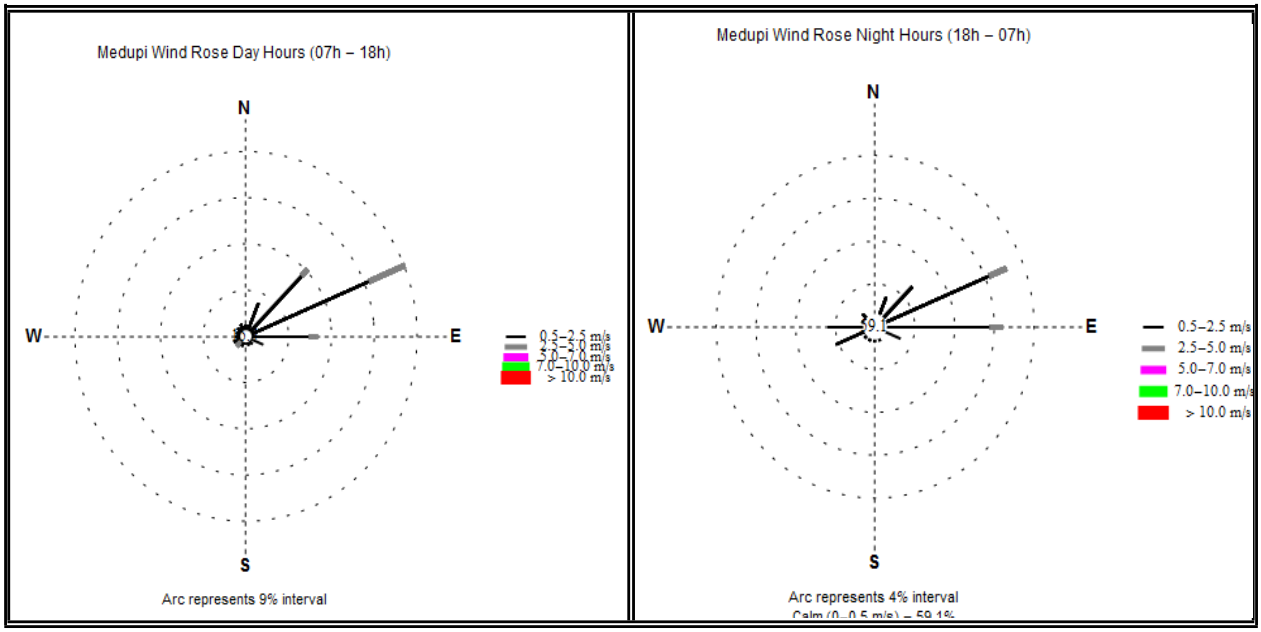
February 2017



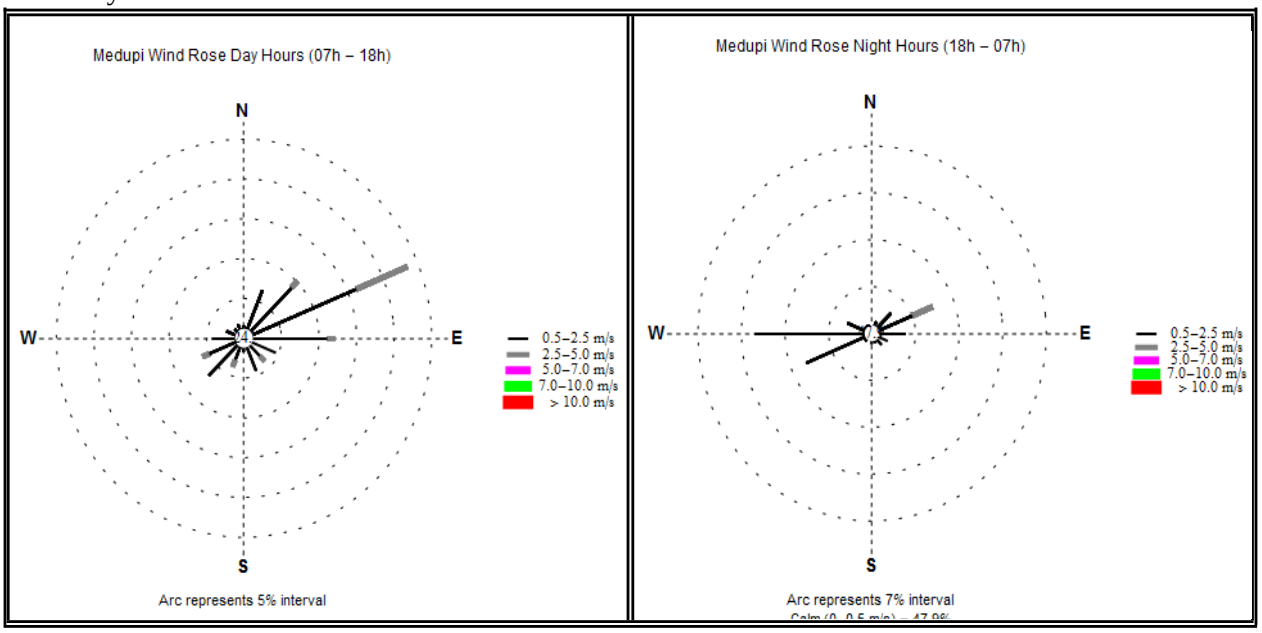
March 2017



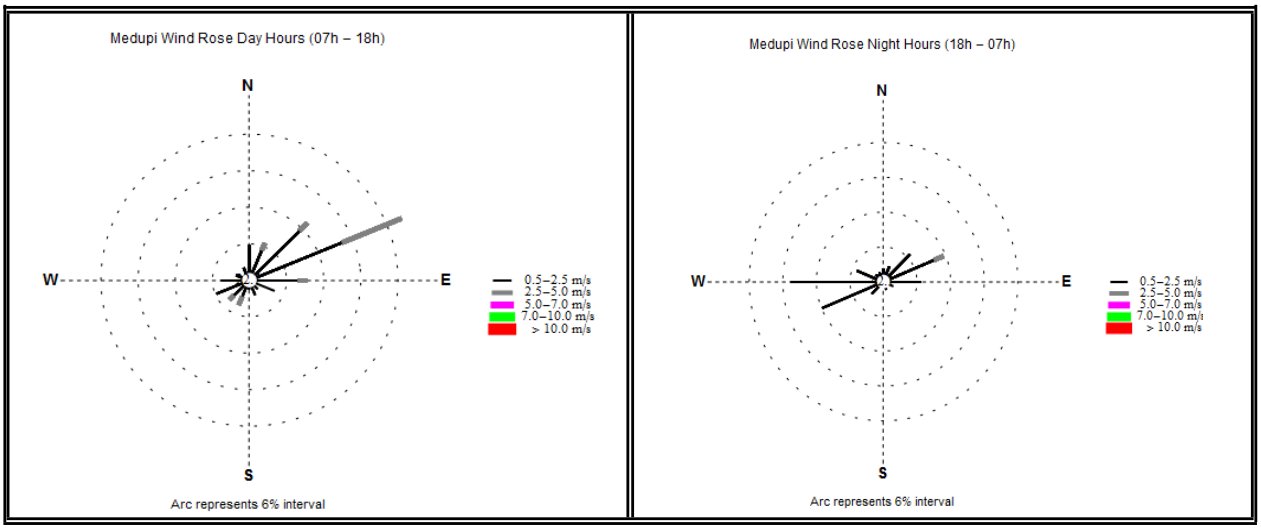
April 2017



May 2017



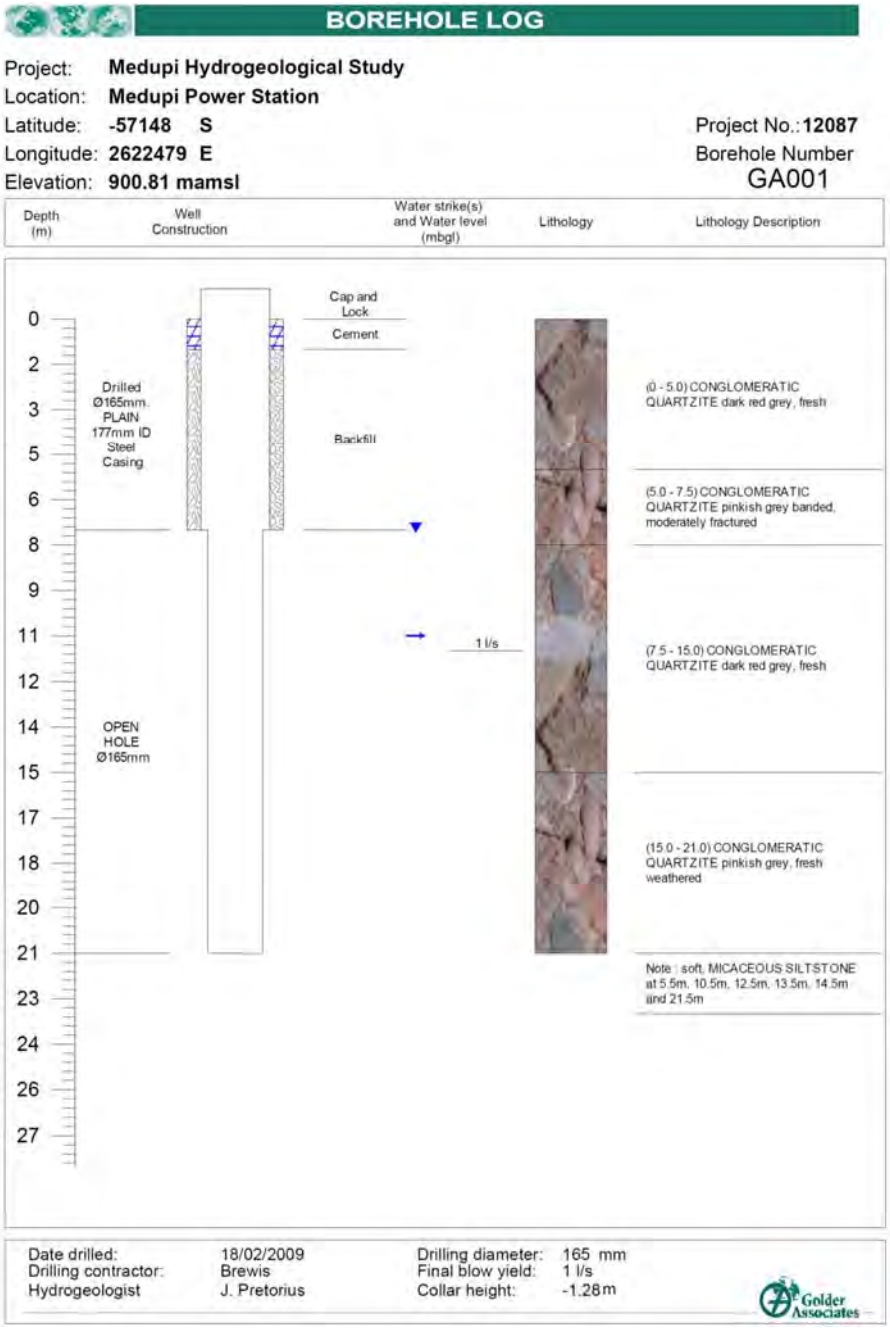
June 2017



Appendix 5.2 Geological data

The borehole logs on the site (close to planned area of FGD) are shown below.

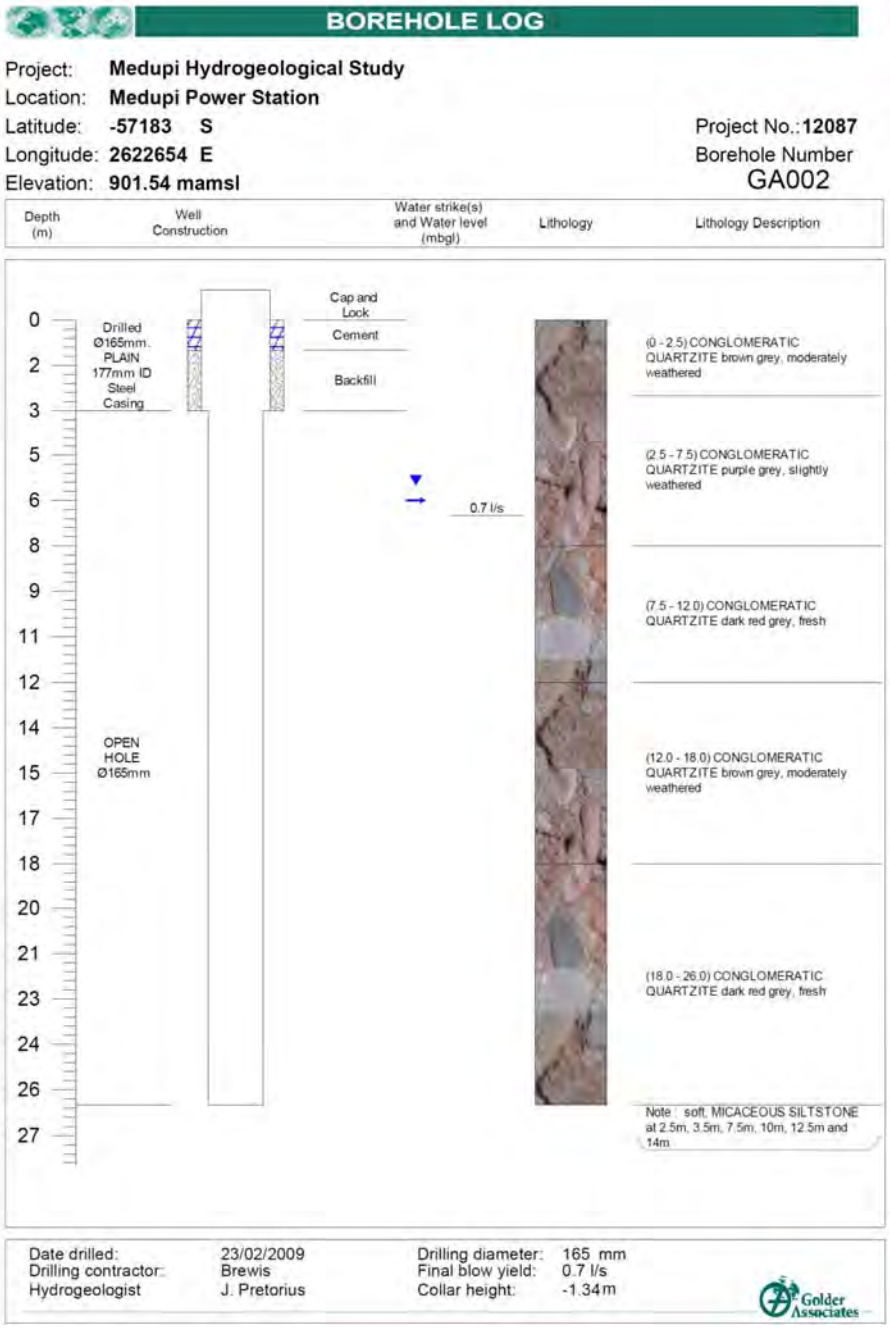
GA001 (Close to Unit 1)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-1 Borehole log “GA001”

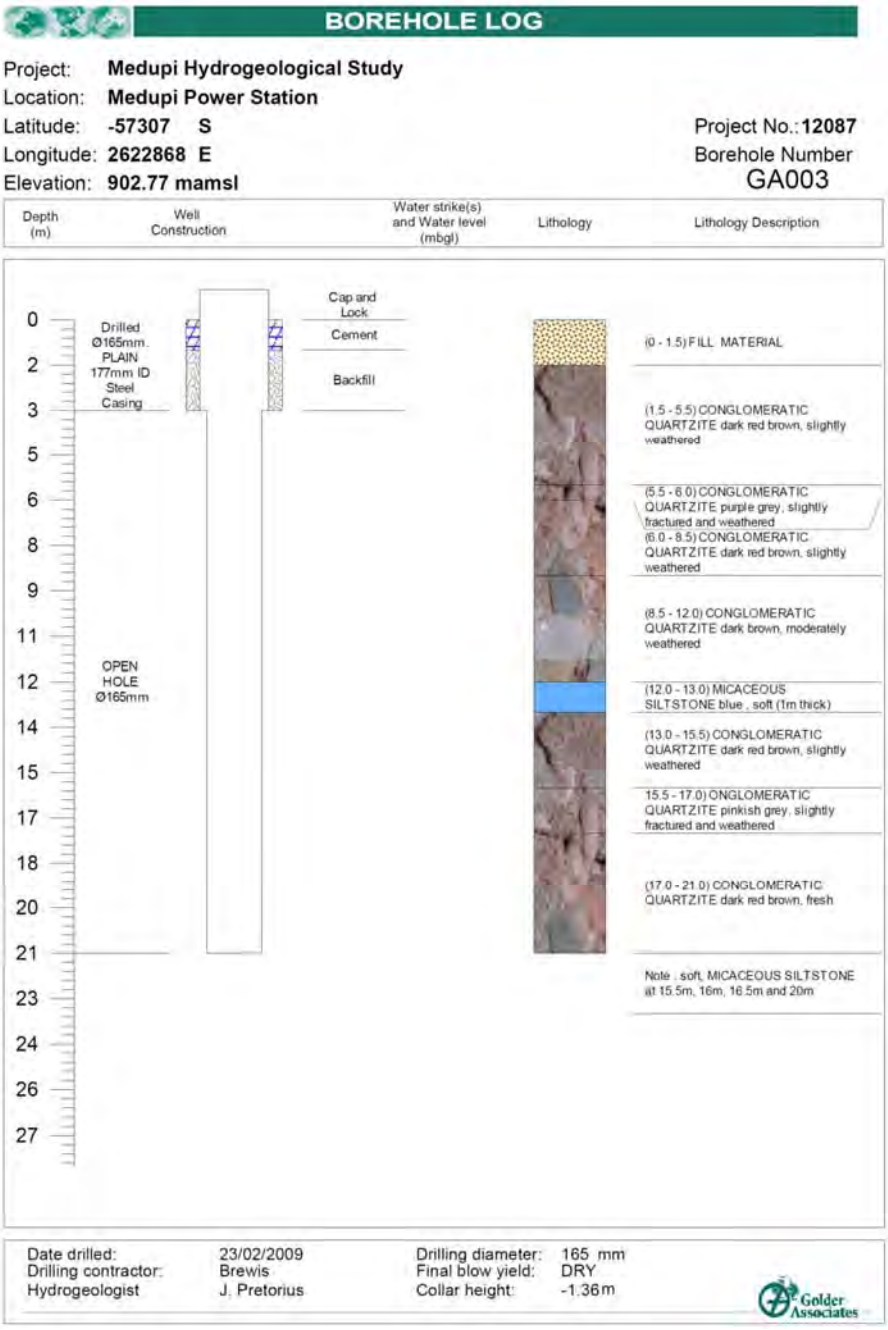
GA002 (Close to Unit 2)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-2 Borehole log “GA002”

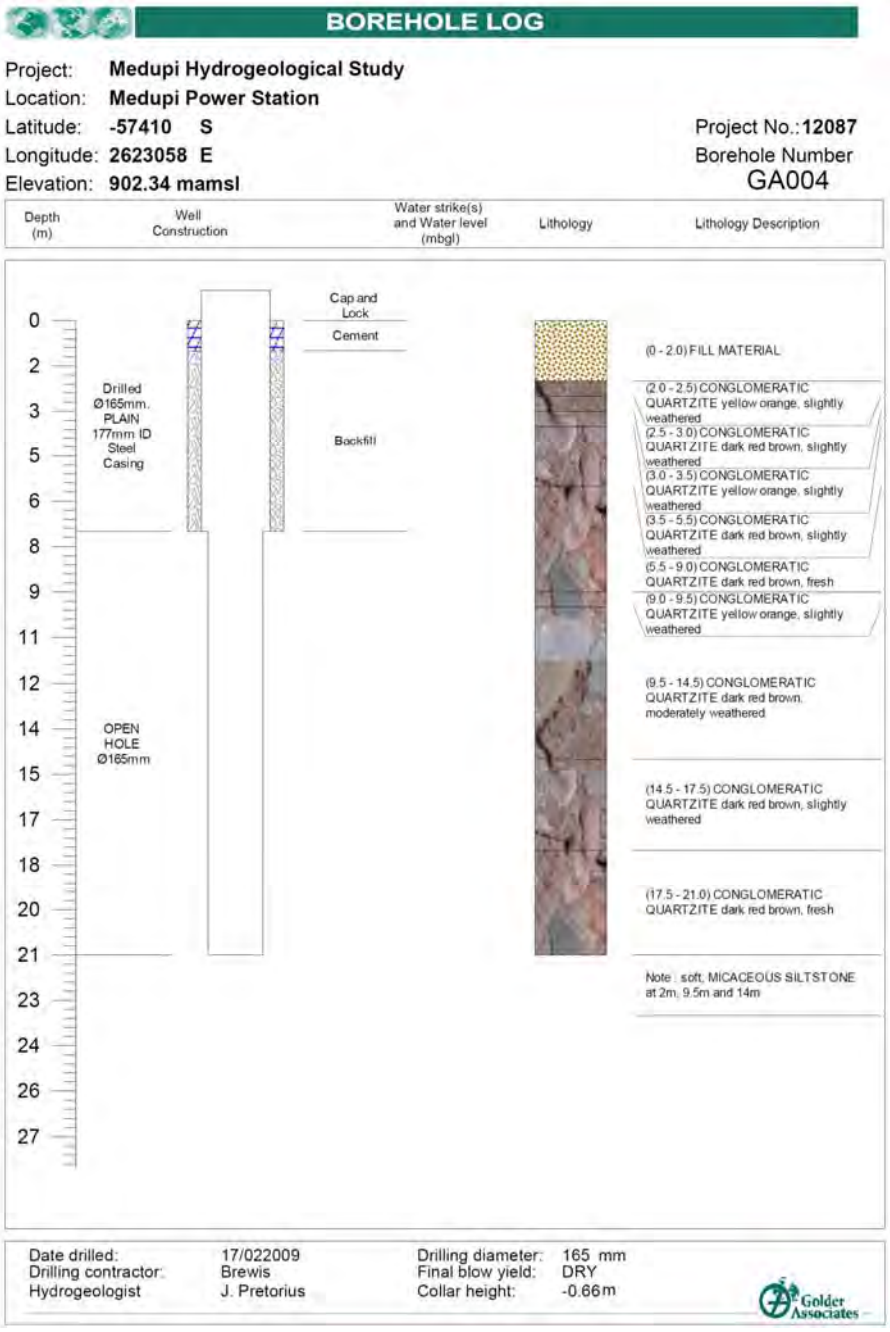
GA003 (Close to Unit 4)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-3 Borehole log “GA003”

GA004 (Close to Unit 6)



Source MEDUPI POWER STATION SHALLOW GROUNDWATER STUDY/ June 2009

Figure App. 5.2-4 Borehole log “GA004”

Appendix 7.1
Risk Management Framework (Medupi Retrofit)

Risk Management Framework

Project Name: Preparatory Survey on Flue Gas Desulfurization System at Medupi Power Station in Republic of South Africa
Country: Republic of South Africa
Sector: Energy

Potential project risks	Assessment
1. Stakeholder Risk	Probability: M
(Description of risk) Delay of the suspension of the operation due to delay of water resource development. Water intake: If the gas heat exchanger is installed to FGD, the water consumption at Medupi power station in total can be saved from 13.4 mil. m³/year to 11.0 mil. m³/year. Existing water right from phase one (1) of Mokolo-Crocodile Water Augmentation Project (MCWAP) is 9.4 mil. m³/year. So water supply from phase two (2) of Mokolo-Crocodile Water Augmentation Project (MCWAP) is needed in order to operate all of FGD.	Impact: M Analysis of probability and impact: MCWAP phase 2 is under design and seeking fund. If some issues, i.e. delay of purchasing fund, land acquisition and approval of EIA, commencement of water supply will be delayed. Mitigation measures: Adoption of water saving equipment (Gas Cooler). (less water needed methodology) Action during the implementation: Monitoring progress of TCWAP phase 2 closely. Contingency plan (if applicable): NO necessity
2. Executing Agency Risk	
2.1. Capacity Risk	Probability: L
(Description of risk) Delay of the project implementation due to incapability of the project executing agency If the executing agency is not capable enough for appropriate process of daily works, timely decision makings, or coordination with relevant authorities, the project implementation may be seriously delayed. Such an incapability may also lead to dispute with the project management consultant (PMC) or the contractor on contractual or payment issues.	Impact: M Analysis of probability and impact: Eskom has experience to control and coordinate approximately 30 packages on boiler, turbine, generator and balance of power construction work on original Medupi PS construction. Mitigation measures: A dedicated unit for the Project, PIU, has been proposed in the Study and Eskom should commit the establishment. Action during the implementation: PMC will assist the Eskom and PIU for timely and proper processes and decision makings. The Steering Committee will monitor the Project's progress and give instructions Eskom for improvement when necessary. Contingency plan (if applicable): NO necessity
2.2. Fraud & Corruption Risk	Probability: L
(Description of risk) Corruptions in the procurement procedures of the PIU or the contractor in huge amount project generally.	Impact: H Analysis of probability and impact: If happens and being exposed, however, the Project may not be proceeded. Mitigation measures:

If happens, corruption at any process of the project, such as procurement procedures of the PIU or the contractor, would prevent implementation of the project.	All procurement processes will be conducted strictly complying with both Eskom's guidelines and JICA's guidelines.
	Action during the implementation:
	JICA will monitor the procurement procedures of the PIU and the contractor through the concurrence processes. In the procurement of the contractors, PMC will assist and monitor the bidding procedures in compliance with both the Eskom's guidelines and the JICA's guidelines.
	Contingency plan (if applicable):
	NO necessity
3. Project Risk	
3.1. Dispute Risk (between Contractor and workers)	Probability: H
(Description of risk) Delay and over budget of the project due to strike of labor. In South Africa, labor union has great power and selects frequently to do strike with long duration. It may be serious cause of both over budget and delay of construction work.	Impact: H
	Analysis of probability and impact:
	There is high possibility of strike judging from original Medupi PS construction.
	Mitigation measures:
	Preparation of appropriate budget accounted into inflation ratio.
	Action during the implementation:
	Establishment of methodology to dissolve official strike. No tolerance for un-official strike. (Some un-official strikes occurred at original Medupi PS construction case)
	Contingency plan (if applicable):
	NO necessity
3.2. Dispute Risk (inter Contractors)	Probability: L
(Description of risk) No achievement of intended performance due to any reasons, e.g. construction defects.Unlike the EPC (Engineering, Procurement and Construction) scheme, each contractor of EPS (Engineering, Procurement and Supply) and construction burdens limited own responsibility.	Impact: M
	Analysis of probability and impact:
	There are some practice of separate EPS and construction contract in United States, so experienced manufacturer can make appropriate construction manual.
	Mitigation measures:
	Scope of responsibilities both EPS and construction contractor should be defined in each contract.
	Action during the implementation:
	EPS contractor should provide construction manual with construction contractor prior to commencement of erection of FGD.
	Contingency plan (if applicable):
	NO necessity
3.3. Program & Donor Risk	Probability: L
(Description of risk) Bad debt due to delay of permission for power tariff revision based on investment to FGD, i.e. environmental measure. FGD does not produce financing benefit,	Impact: H
	Analysis of probability and impact:
	NERSA (National Energy Regulatory of South Africa) does not understand necessity of power tariff revision accounted into expenditure for FGD.
	Mitigation measures:

but huge amount of capital cost and the operational cost will be spent. In the case permission for power tariff revision will delay, Eskom receives negative financial impact.	Establishment of estimation methodology for cost of pollution abatement.
	Action during the implementation:
	Submission of application for power tariff revision.
	Contingency plan (if applicable):
	NO necessity
3.4. Delivery Quality Risk	Probability: M
(Description of risk) Unfitting with original flue gas system due to lack of experience and/or capacity of engineering company. Incapability of engineering (design) works may occur lack of pressure and erosion.	Impact: H
	Analysis of probability and impact:
	Original (under construction) Medupi PS has high quality. Equipment for FGD also shall be designed and supplied by well-experienced manufacturer. So, it is sure that Medupi PS after FGD construction will keep high reliability.
	Mitigation measures:
	Preparation of appropriate Prequalification condition should be needed.
	Action during the implementation:
	PIU should adopt direct contract or bidding by short list.
	Contingency plan (if applicable):
	NO necessity
4. Other Risk	Probability: L
(Description of risk) Lower project's beneficial effects due to frequent failure in amount and viability of the electric supply derived from insufficient O&M skill. Incapability of O&M works may prevent the Project from generating the expected beneficial effects.	Impact: L
	Analysis of probability and impact:
	Possibility of O&M failure is not high because recent power plant is usually controlled by automatic control system in order to prevent human failure.
	Mitigation measures:
	To provide Off Job training service prior to commissioning period should be included in contract through manufacturer of FGD (EPS contractor).
	Action during the implementation:
	PIU will prepare budget including Off Job training and power plant manager will assign their staff as trainee to learn necessary knowledge.
	Contingency plan (if applicable):
	NO necessity
5. Overall Risk Rating	Probability: L
(Overall comments)	Impact: M

1/ Descriptions in the risk management matrix can be brief and concise. In order to record the description of each risk as well as the evidence for the team's assessment, a separate sheet should be prepared to describe the details.

Appendix 7.2
Comparison between JICA safety guidance and RSA regulation

	JICA Safety guidance			RSA regulation			Remark
Item	Section		Description	Section		Description	
General Rules							
Purpose							
Purpose	1.1.1	-	The Guidances contain the basic policies for safety management, and technical guidance on specific methods for safe execution of works in order to prevent occupational accidents and public accidents on ODA construction projects for public and other facilities.			NA	
			By fully understanding these Guidances and complying with the regulation therein, Project Stakeholders will be in a position to respect the basic human rights of all parties involved in ODA construction projects. This will help prevent the occurrence of occupational and public accidents by creating a culture of safety, and help realize social development in the recipient country. This is the purpose of these Guidances.			NA	
Composition of the Guidances	1.1.2	-	The Guidances are composed of the following six chapters: Chapter 1 General Rules Chapter 2 Basic Policies for Safety Management Chapter 3 Contents of the “Safety Plan” Chapter 4 Contents of the “Method Statements on Safety” Chapter 5 Technical Guidance for Safe Execution (by the Type of Work) Chapter 6 Technical Guidance for Safe Execution (by the Type of Accident)			NA	
Out-of-scope items	1.1.3	-	Since the Guidances specifically contain the recommended practice for safety management for ODA construction works, these Guidances are not intended to cover the occupational health and sanitation or environmental or social considerations related to works other than general construction works.			NA	
Scope of Application							
Relevant projects	1.2.1	-	The Guidances apply to works for public and other facilities to be constructed with Technical Cooperation, ODA loan (project type) and General Grant Aid which JICA implements (hereinafter "ODA Projects").			NA	

			Although the Guidances do not apply to plant works based on EPC (Engineering, Procurement, and Construction) Contracts which cover a whole range of design, procurement of materials, and construction, this does not preclude the application of the whole or part of the clauses or sub-clauses of these Guidances to policies for safety management of those projects.			NA	
Relevant parties	1.2.2		These Guidances apply to all Project Stakeholders involved in ODA Projects, including the Employer, Engineer, Contractor, subcontractors, and workers.			NA	
Applicable provisions	1.2.3		All provisions contained in these Guidances are the basic requirements to be complied with by the Project Stakeholders to ensure safety of ODA Projects.			NA	
Plans for Safety Management							
			In the Guidances, two plans for the safety management for construction work sites shall be prepared and implemented by the Contractor, namely the "Safety Plan" and "Method Statements on Safety." The Contractor/Tenderer shall prepare the Safety Plan in the pre-construction stage. The Contractor shall however prepare Method Statements on Safety in the construction stage.				
Safety Plan	1.3.1.1		The Contractor/Tenderer shall prepare the Safety Plan at the pre-construction stage and submit it to the Employer/Engineer.			JST seems that Contractor Health and Safety Plan(HSE plan) prepared by contractor based on provision specified in Eskom Contract Regulation has almost same contents.	
	1.3.1.2		The Safety Plan is positioned as the basic plan for safety management in ODA construction works at site and establishes basic policies on the general safety management and operation for the entire works at site.				
	1.3.1.3		Chapter 3 "Contents of the Safety Plan" specifies the items to be incorporated into the Safety Plan.				
	1.3.1.4		The Tenderer shall submit his Safety Plan to the Employer/Engineer at the time specified in the Tender Documents. The Contractor shall submit the Safety Plan to the Employer/Engineer at the time specified in the contract documents. If no submission deadline is specified in the contract documents, the Contractor shall submit the Safety Plan to the Employer/Engineer no later than seven (7) days prior to the commencement of the relevant works.				
	1.3.1.5		The Employer/Engineer shall review the Safety Plan prepared and submitted by the Contractor/Tenderer taking				

			into account the need to maintain safety during construction works at site.				
Method Statements on Safety	1.3.2.1		The Contractor shall prepare a Method Statements on Safety at the construction stage and submit the statements to the Employer/Engineer.				
	1.3.2.2	0	The Method Statements on Safety shall define a detailed plan to implement and manage safety in ODA Projects and shall include specifics for the safe execution of works and safety measures for each type of work in accordance with the execution plans specifying the method or sequence for implementation.				
	1.3.2.3	-	In Chapter 4 "Contents of the Method Statements on Safety" specifies the items to be incorporated in the Method Statements on Safety.				
	1.3.2.4	-	The Contractor shall submit the Method Statements on Safety to the Employer/Engineer prior to commencement of the relevant works according to the execution plans or their equivalent document. If the submission date of the Method Statements on Safety is specified in the contract documents or other applicable documents, then this deadline shall be followed.				
	1.3.2.5	-	The Employer/Engineer shall review the Method Statements on Safety prepared and submitted by the Contractor from the viewpoint of maintaining safety during construction works at site.				
Roles and Responsibilities of Project Stakeholders							
Precedence	1.4.1	-	The roles and responsibilities of Project Stakeholders specified in the contract documents shall take precedence over these Guidances.				
Employer	1.4.2	(1)	The Employer shall endeavor to strictly comply with the relevant laws and regulations of the recipient country and use the Guidances to ensure the safety of the Project Stakeholders during construction works at site and protect nearby local residents, and any other third parties, from every potential accidental risk foreseen to arise from the construction works at site.			Article 5 (a) prepare a baseline risk assessment for an intended construction work project; (b) prepare a suitable, sufficiently documented and coherent site specific health and safety specification for the intended construction work based on the baseline risk assessment contemplated in paragraph (a); (c) provide the designer with the health and safety specification contemplated in paragraph (b); (d) ensure that the designer takes the prepared health and safety specification into consideration during the design stage; (e) ensure that the designer carries out all responsibilities contemplated in regulation 6; (f) include the health and safety specification in the	Construction Regulations-2014
		(2)	The Employer shall, in collaboration with the Engineer, review the Safety Plan and the Method Statements on Safety prepared by the Contractor and provide notice, suggestion or guidance for improvement to the Contractor if there are any risks to safety.				
		(3)	The Employer shall, in collaboration with the Engineer, make sure the work is carried out in accordance with the Safety Plan and the Method Statements on Safety				

			prepared by the Contractor and provide notice, suggestion or guidance for improvement.			tender documents; (g) ensure that potential principal contractors submitting tenders have made adequate provision for the cost of health and safety measures; (h) omitted (i) omitted (j) omitted (k) omitted (l) discuss and negotiate with the principal contractor the contents of the principal contractor's health and safety plan contemplated in regulation 7(1), and must thereafter finally approve that plan for implementation; (m) ensure that a copy of the principal contractor's health and safety plan is available on request to an employee, inspector or contractor; (n) take reasonable steps to ensure that each contractor's health and safety plan contemplated in regulation 7(1)(a) is implemented and maintained; (o) ensure that periodic health and safety audits and document verification are conducted at intervals mutually agreed upon between the principal contractor and any contractor, but at least once every 30 days; (p) ensure that a copy of the health and safety audit report contemplated in paragraph (o) is provided to the principal contractor within seven days after the audit; (q) stop any contractor from executing a construction activity which poses a threat to the health and safety of persons which is not in accordance with the client's health and safety specifications and the principal contractor's health and safety plan for the site; (r) where changes are brought about to the design or construction work, make sufficient health and safety information and appropriate resources available to the principal contractor to execute the work safely; and (s) ensure that the health and safety file contemplated in regulation 7(1)(b) is kept and maintained by the principal contractor.	
		(4)	The Employer shall endeavor to create an environment where all Project Stakeholders positively participate in activities to promote safety on construction sites.				
		(5)	When two or more Contractors carry out work at the same construction site, the Employer shall establish an environment for mutual cooperation and coordination on safety management.				
		(6)	The Employer shall notify the Contractor of natural conditions, social conditions or any other factors that may affect the management of safety for constructions works at site.				
Engineer	1.4.3	(1)	The Engineer shall have a full understanding of the roles and responsibilities of the Employer on the management of safety for construction works at site and, together with the Employer, appropriately implement activities to manage safety, including these obligations specified in the contract documents.				

		(2)	The Engineer shall, in collaboration with the Employer, review the Safety Plan and the Method Statements on Safety prepared by the Contractor and provide notice, suggestion or guidance for improvement to the Contractor if there are any risks to safety.				
		(3)	The Engineer shall, in collaboration with the Employer, make sure the work is carried out as per the Safety Plan and the Method Statements on Safety prepared by the Contractor and provide notice, suggestion or guidance for improvement.				
Contractor	1.4.4	(1)	The Contractor shall be responsible for operation and management of safety on construction sites.			Section (1) of Article 7 (a) provide and demonstrate to the client a suitable, sufficiently documented and coherent site specific health and safety plan, based on the client's documented health and safety specifications contemplated in regulation 5(1)(b), which plan must be applied from the date of commencement of and for the duration of the construction work and which must be reviewed and updated by the principal contractor as work progresses; (b) open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, which must be made available on request to an inspector, the client, the client's agent or a contractor; and (c) on appointing any other contractor, in order to ensure compliance with the provisions of the Act- (i) provide contractors who are tendering to perform construction work for the principal contractor, with the relevant sections of the health and safety specifications contemplated in regulation 5(1)(b) pertaining to the construction work which has to be performed; (ii) ensure that potential contractors submitting tenders have made sufficient provision for health and safety measures during the construction process; (iii) ensure that no contractor is appointed to perform construction work unless the principal contractor is reasonably satisfied that the contractor that he or she intends to appoint, has the necessary competencies and resources to perform the construction work safely; (iv) ensure prior to work commencing on the site that every contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for	Construction Regulations-2014
		(2)	The Contractor shall appropriately prepare the Safety Plan at the appropriate time in the pre-construction stage in accordance with the relevant laws and regulations of the recipient country and these Guidances. In the construction stage, the Contractor shall appropriately prepare the Method Statements on Safety, which shall specify the details of safe methods to implement safety measures prior to the start of each item of work and submit the document to the Employer and Consultant for review.				
		(3)	The Contractor shall make appropriate revision or correction whenever any insufficiency or suggestion for improvement relating to safety is raised following the review of the Safety Plan and the Method Statements on Safety.				
		(4)	The Contractor shall undertake work according to the Safety Plan and the Method Statements on Safety they prepared. Whenever the Safety Plan or the Method Statements on Safety need to be amended in consideration of the latest site conditions, social and environmental conditions and/or any other relevant				

		particulars. The Contractor shall without delay update and maintain the documents for review at will by the Employer and Engineer.			Occupational Injuries and Diseases Act, 1993; (v) appoint each contractor in writing for the part of the project on the construction site; (vi) take reasonable steps to ensure that each contractor's health and safety plan contemplated in subregulation (2)(a) is implemented and maintained on the construction site; (vii) ensure that the periodic site audits and document verification are conducted at intervals mutually agreed	
	(5)	The Contractor shall take into account the safety of nearly local residents and any other parties, as well as all Project Stakeholders of the construction project.				

		(6)	The Contractor shall carry out construction works for the safety of nearly local residents and any other third parties, as well as Project Stakeholders of the project.			upon between the principal contractor and any contractor, but at least once every 30 days; (viii) stop any contractor from executing construction work which is not in accordance with the client's health and safety specifications and the principal contractor's health and safety plan for the site or which poses a threat to the health and safety of persons; (ix) where changes are brought about to the design and construction, make available sufficient health and safety information and appropriate resources to the contractor to execute the work safely; and (x) discuss and negotiate with the contractor the contents of the health and safety plan contemplated in subregulation (2)(a), and must thereafter finally approve that plan for implementation; (d) ensure that a copy of his or her health and safety plan contemplated in paragraph (a), as well as the contractor's health and safety plan contemplated in subregulation (2)(a), is available on request to an employee, an inspector, a contractor, the client or the client's agent; (e) hand over a consolidated health and safety file to the client upon completion of the construction work and must, in addition to the documentation referred to in subregulation (2)(b), include a record of all drawings, designs, materials used and other similar information concerning the completed structure; (f) in addition to the documentation required in the health and safety file in terms of paragraph (c)(v) and subregulation (2)(b), include and make available a comprehensive and updated list of all the contractors on site accountable to the principal contractor, the agreements between the parties and the type of work being done; and (g) ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner in the form of Annexure 3.	
Subcontractor	1.4.5	(1)	Each subcontractor shall carry out construction works in compliance with the relevant laws and regulations of the recipient country applicable to the construction work and these Guidances.			Section (2) of Article 7 (2) A contractor must prior to performing any construction work- (a) provide and demonstrate to the principal contractor	Construction Regulations-2014

		(2)	Each subcontractor shall establish and maintain safe and sanitary site conditions according to the instructions of the Contractor.			a suitable and sufficiently documented health and safety plan, based on the relevant sections of the client's health and safety specification contemplated in regulation 5(1)(b) and provided by the principal contractor in terms of subregulation (1)(a), which plan must be applied from the date of commencement of and for the duration of the construction work and which must be reviewed and updated by the contractor as work progresses; (b) open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, and which must be made available on request to an inspector, the client, the client's agent or the principal contractor; (c) before appointing another contractor to perform construction work be reasonably satisfied that the contractor that he or she intends to appoint has the necessary competencies and resources to perform the construction work safely; (d) co-operate with the principal contractor as far as is necessary to enable each of them to comply with the provisions of the Act; and (e) as far as is reasonably practicable, promptly provide the principal contractor with any information which might affect the health and safety of any person at work carrying out construction work on the site, any person who might be affected by the work of such a person at work, or which might justify a review of the health and safety plan.	
		(3)	Each subcontractor shall cooperate with other subcontractors engaged on the construction site in accordance with the instructions of the Contractor.				
		(4)	Each subcontractor shall receive from the Contractor an explanation on the Safety Plan and the Method Statements on Safety prepared by the Contractor. Each subcontractor shall pass on the explanation received from the Contractor to their employees and have them fully comply with those explanation to ensure safety.				
Workers		(1)	Each worker shall carry out construction work in compliance with the relevant laws and regulations of the recipient country applicable to construction work and these Guidances.			No discription regaring duties of workers in Safety Regulation,2014	
		(2)	Each worker shall follow the instructions given by the Contractor and their managers.				
		(3)	Each worker shall cooperate with the Contractor and their managers to maintain safety at the construction site.				
		(4)	Each worker shall pay attention to their own safety as well as to the safety of their co-workers, all Project Stakeholders, as well as the nearly local residents and any other third parties affected by the work.				

		(5)	Each worker shall comply with the Safety Plan and the Method Statements on Safety prepared by the Contractor and the rules applicable to the entire construction works at site.				
		(6)	When undertaking work, each worker shall use protective equipment for safety and sanitation, either designated or provided, in an appropriate manner and at the appropriate time and location.				
Basic Policies for Safety Management							
Basic Principles of Safety Management							
Basic principle 1: Safety is a top priority	2.1.1		All Project Stakeholders shall put top priority on safety and use their best endeavours to eliminate the occurrence of accidents.			NA	
Basic principle 2: Elimination of causes	2.1.2		The Contractor shall identify every possible danger in each process of construction work, and examine, analyze and eliminate the causes of such danger and take appropriate action to ensure the safe execution of the work.			NA	
Basic principle 3: Thorough precautions	2.1.3		The Contractor shall give consideration to in advance the inherent risk of accidents at each stage of construction work, review appropriate measures to cope with such risks, and commence work once these preventive measures have been implemented.			NA	
Basic principle 4: Thorough compliance with relevant laws and regulations	2.1.4		2.2 Compliance with Relevant Laws and Regulations shall be complied with.			NA	
Basic principle 5: Thorough prevention of public accidents	2.1.5		All Project Stakeholders shall implement safety management measures taking the interests of third parties duly into consideration in order to prevent public accidents.			NA	
Basic principle 6: Thorough implementation of PDCA cycle for safety management	2.1.6		2.3 PDCA for Safety Management shall be complied with.			NA	
Basic principle 7: Thorough sharing of information	2.1.7		All Project Stakeholders shall share all safety-related information they possess in a manner and at times as appropriate in the circumstances.			NA	

Basic principle 8: Thorough participation of all Project Stakeholders	2.1.8		All Project Stakeholders shall actively participate in activities related to safety management at construction sites.			NA	
Compliance with Relevant Laws and Regulations							
Compliance with laws and regulations of recipient countries	2.2.1		In addition to following the Guidances the Contractors shall conduct ODA Projects in compliance with all related laws and regulations of the recipient country.			The scheme of The Construction Health and Safety Technical Committee is stimulated in Article 31 of Construction Regulations-2014. The Committee has power to advise the chief inspector on construction related codes, standards and training requirements: Provided that any accredited or approved training must be in accordance with South African Qualifications Authority standards;	Construction Regulations-2014
Survey of relevant laws and regulations	2.2.2		The Contractors shall survey all relevant laws and regulations applicable to construction work in the recipient country prior to the commencement of the ODA Project. The Employer/Engineer shall provide information on the relevant laws and regulations to the Contractor and provide maximum assistance to the Contractor on the procedures that they should take as per the relevant laws and regulations				
Confirmation of the relevant laws and regulations	2.2.3		The Contractor shall prepare the Safety Plan and its Method Statements on Safety in compliance with the relevant laws and regulations.				
			The Employer/Consultant shall review the relevant laws and regulations noted therein and instruct the Contractor to consider any additional laws or regulations not considered by the Contractor.				
Confirmation of the compliance levels	2.2.4		The Employer/Consultant shall check the Contractor's compliance with the relevant laws and regulations on a regular basis. If the Contractor fails to comply with the relevant laws and regulations, the Employer/Consultant shall instruct the Contractor to so comply.				
PDCA for Safety Management							
Basic principle of PDCA for safety management	2.3.1		The basic principle of PDCA for safety management shall be the cycle of "Plan, Do, Check, Act" with "Plan" being the process of establishing the Safety Plan and its Method Statements on Safety, "Do" being the specific implementation of the plan thus established, "Check" being the observation and confirmation of the safety management process, and "Act" being the implementation of improvements to the implemented plans based on the past performance to ensure the continuous development of field site safety standards. The cycle of these processes				

			shall be defined as PDCA for safety management. The Contractor shall have chief responsibility for the implementation of safety management.				
Formulation of the "Plan"	2.3.2		As part of the "Plan" the Contractor/Tenderer shall formulate the Safety Plan as the basic safety management.				
			The Contractor shall then formulate a Method Statements on Safety as the more detailed safety management plan for implementation.				
Broad Publication at the "Planning" stage	2.3.3		The Contractor shall document the items necessary to ensure safety at construction sites, disclose the same to all Project Stakeholders and ensure that those items are fully understood at the "Planning" stage.				
"Do"	2.3.4		The Contractor shall implement safety management on construction sites according to the Safety Plan and its Method Statements on Safety as formulated at the "Planning" stage.				
Observation and confirmation ("Check")	2.3.5		The Employer/Engineer shall review the Contractor's implementation of the "Doing" stage in accordance with the Safety Plan and the Method Statements on Safety and give guidance where it is in any way insufficient or incorrect.				
			The Contractor shall check their own implementation of the "Doing" stage and implement improvements where insufficient in any way.				
			The managing office's safety managers shall make regular observations and undertake checks.				
Disclosure of results at the "Check" stage	2.3.6		The Contractor shall document and disclose the results of the "Check" stage to the Project Stakeholders.				
"Act"	2.3.7		The Contractor shall examine specific methods of implementing safety measures or related management systems and take corrective action based on their results at the "Checking" stage. In addition, the Contractor shall review their Safety Plan and the Method Statements on Safety and submit revised versions to the Employer/Engineer.				
			The Employer/Engineer shall review the submitted documents.				
Broad publication of the results of the "Acting" stage	2.3.8		In case the Safety Plan or the Method Statements on Safety is revised, the Contractor shall document the revision and disclose such revision to the Project Stakeholders. In particular, the Contractor shall explain the types of work to which such change is to be				

			implemented and ensure that, prior to the commencement of the relevant work, the change is understood by workers who engage in such work.				
Investigation of causes of occupational accidents	2.3.9		If an occupational accident takes place, the Employer, Engineer and Contractor shall suspend construction work to the extent necessary during the necessary period and investigate the cause. The Contractor shall remove the cause in accordance with the basic principles of safety management, clarify measures to prevent the risk of accidents occurring and resume work with the approval of the Employer.				
			The Contractor shall re-examine the Safety Plan and the Method Statements on Safety based on the results of the examination and revise them as required. The Employer/Engineer shall review those documents if revised.				
Continuous improvement	2.3.10		The Contractor shall ensure that the PDCA safety management process is implemented and continuously improved in order to maintain safety at construction sites.				
Contents of the “Safety Plan”							
Composition of the Safety Plan							
Items for inclusion in the Safety Plan	3.1.1		(1) Basic Policies for Safety Management (2) Internal Organizational Structure for Safety Management (3) Promotion of the PDCA Cycle (4) Monitoring (5) Safety Education and Training (6) Voluntary Safety Management Activities (7) Sharing Information (8) Response to Emergencies and Unforeseen Circumstances				
Compliance with items for inclusion	3.1.2		Since items that constitute the Safety Plan as described in Clause 3.1.1 apply generally to all ODA Projects, the Contractor shall incorporate all those items into their Safety Plan.				
			Items other than those specified in Clause 3.1.1 "Items for inclusion in the Safety Plan" which arise with respect to the scope of work or the conditions for construction, shall also be specified in the Safety Plan.				
Basic Policies for Safety Management							
			The Contractor shall determine the basic policies for safety management applicable during construction (hereinafter the "Basic Policies") based on the scope of work, the environment				

			where the works are performed, relevant laws and regulations of the recipient country, contract documents and other applicable or documents or data incorporated into the contract. It is also recommended to describe the basic policies of the managing office.				
Internal Organizational Structure for Safety Management							
		(1)	Establish an internal organizational structure for safety management.				
		(2)	Appoint appropriate personnel, including a supervisor responsible for safety management and safety officers, within the internal organizational structure and clarify their respective roles, responsibilities and authority.				
		(3)	In accordance with any requirements under the contract documents, consider establishing an organization appropriate to manage safety, such as a safety committee, which may be composed of appropriate Project Stakeholders including the Employer, Consultant, and subcontractors				
Promotion of the PDCA Cycle							
			The Contractor shall set out the basic principles for promotion of the PDCA Cycle at construction sites in accordance with Clause 2.3 "PDCA for Safety Management".				
Monitoring							
		(1)	The Contractor shall undertake tests at all areas on site to determine the extent of implementation of and compliance with safety management principles in accordance with the Safety Plan. In addition, the Contractor shall undertake tests to determine the extent of implementation of strategies for the safe execution of each type of work in accordance with the Method Statements on Safety.				
		(2)	The Contractor shall report to the Employer/Engineer in accordance with the contract documents in the event of injury attributable to an occupational accident or construction work. On receipt of such report, the Employer/Engineer shall notify the competent governmental organization and JICA of the accident or injury in accordance with the relevant laws and regulations of the recipient country and the contract documents. The Employer, Engineer and Contractor shall keep records of all such reports and maintain them until the completion of the work.				

		(3)	The Contractor shall collect and analyze information on dangerous incidents that do not result in occupational accidents but may lead to such accidents ("near-misses") and utilize that information to prevent future occupational accidents.				
			The Employer/Engineer shall monitor the Contractor's implementation of safety management principles and give appropriate guidance to the Contractor where they find any safety-related problems.				
Safety Education and Training							
		(1)	Compliance with laws and regulations of the recipient country on education and training on safety				
		(2)	Education to all Project Stakeholders (and to all new entrants to the site) on: 1) An overview of the construction site 2) General rules on the construction site including the Safety Plan 3) Protective gear 4) Items necessary to ensure safety when carrying out work in addition to 1) through 3) above				
		(3)	Education on the Method Statements on Safety for the assigned work				
		(4)	Education when changes are made to work				
		(5)	Education and training for special workers 1) Workers engaged in work that is regulated by the laws and regulations of the recipient country 2) Operators or drivers of construction machinery or equipment 3) Workers engaged in work in excavated areas, shafts, underground passages or tunnels 4) Workers handling explosives and engaged in blasting work 5) Workers engaged in work that uses compressed air 6) Workers engaged in reinforcing bar work, concreting work, or formwork 7) Workers engaged in other kinds of work belonging to special categories				
		(6)	Education and training for emergency response personnel				
		(7)	Education for third parties (other than Project Stakeholders) when they enter the work area				

		(8)	Training for emergencies and unforeseen circumstances				
		(9)	Activities to promote safety awareness				
		(10)	Language used for education and training				
		(11)	Confirmation and recording education and training				
Voluntary Safety Management Activities							
		(1)	Morning meetings on safety				
		(2)	Foreseeing hazardous activities				
		(3)	Tool box meetings				
		(4)	Safety rota systems				
		(5)	Regular, monthly and periodic inspections				
		(6)	Sorting, decluttering and cleaning				
		(7)	Safety conventions				
		(8)	Safety patrol				
		(9)	Near-miss reporting system				
		(10)	Other activities				
Sharing Information							
		(1)	Description of education for new entrants				
		(2)	Other information necessary to maintain safety				
Response to Emergencies and Unforeseen Circumstances							
Response to emergencies	3.9.1	(1)	The priority of saving human lives				
		(2)	The establishment of an emergency communication network				
		(3)	Procedures for responding to emergencies				
		(4)	Responding to first-aid treatment				
		(5)	Reporting on accidents and injuries				
Responding to unforeseen circumstances	3.9.2	(1)	Emergency evacuation procedures				
		(2)	The establishment of an emergency communication network system				

		(3)	Procedures for responding to unforeseen circumstances				
		(4)	Collection of weather information				
Contents of the “Method Statements on Safety”							
Contents of the “Method Statements on Safety”							
Responding to unforeseen circumstances	4.1.1	(1)	The Contractor shall include the specifications and quantity of any construction plant and machinery to be used for the works.			JST seems that Contractor Health and Safety (HSE) Plan prepared by contractor based on provision specified in Eskom Contract Regulation has almost same contents. Employer Policies and Procedures Safety, Health and Environmental Requirements Schedule Part 9 Section 4	
		(2)	The Contractor shall include any equipment and tools to be used for the works.				
		(3)	The Contractor shall include the specifications and quantities of any major materials to be used for the works.				
		(4)	The Contractor shall include the required qualifications and licenses required for each type of work.				
		(5)	The Contractor shall include the order of command for the works specifying the relevant supervisors for each type of works. At times, the process for monitoring the implementation of works may be unclear, especially in cases involving subcontractors. As such, in order to avoid any confusion, the Method Statements on Safety should specify the relevant supervisors for each type of work (including subcontract works).				
		(6)	The Contractor shall categorize each item of work and set them out according to the works schedule				
		(7)	The Contractor shall specify the procedure for the execution of major work operations for each type of work.				
		(8)	The Contractor shall include all foreseeable risks for each work item.				
		(9)	The Contractor shall review and include precautionary measures to prevent occurrence of foreseeable risks, including information on the type of protective gear required for the works.				
Method Statements on Safety - Template	4.1.2		A template for a Method Statements on Safety is shown below for guidance. A form different to that below is acceptable as long as it fully satisfies the requirements as set out in Clause 4.1.1 "Items for inclusion in a Method Statements on Safety".				
Applicable Standards for the "Technical Guidance for Safe Execution of Works"							

Technical Guidance for Safe Execution of Works	4.2.1.1		The Technical Guidance applies to the type of work set out in Clause 1.2.1 "Relevant projects".				
	4.2.1.2		The Technical Guidance provides the minimum safety standards for the management of works and accidents that are commonly applied in ODA Projects, according to the type of works in question. The Technical Guidance is generally applied when the Contractor plans and executes the safety management principles and the Consultant tests and confirms the same. It is recommended that prior to determining an agreed plan and procedure for the execution of the works, safe work methods and procedures and strategies for safety be fully reviewed in light of foreseeable risks of accident (if any) and with reference to the Technical Guidance, and that the results of that review be compiled in writing in a Method Statements on Safety in order to eliminate or reduce the risk of accidents occurring.				
			Such recommended application of the Technical Guidance, however, does not preclude any party from adopting in their construction contract any other standards which are more comprehensive and stringent than those stipulated in the Technical Guidance. This is particularly the case with respect to individual contracts which require special attention to safety measures such as those concerning the construction of very long bridges, underground work, submarine work, or work near existing traffic or construction projects.				
Applicable Standards for the Method Statements on Safety	4.2.2		When any risk specified in Clause 4.1.1(8) "Foreseeable risks" is foreseen, that risk shall be identified with reference to the checklist shown in Clause 4.2.3. The counter measures for those foreseeable risks must comply with the provisions of the corresponding items shown in Chapter 6 "Technical Guidance for Safe Execution (by the Type of Accident)".				

Checklist for foreseeable risks	4.2.3		1) Does the work involve a risk that workers will fall from high places? If the answer is yes, comply with the provisions of Clause 6.1 "Measures for Prevention of Fall Accidents". 2) Does the work involve a risk that flying or falling objects will hit workers? If the answer is yes, comply with the provisions of Clause 6.2 "Measures for Prevention of Accidents involving Flying or Falling Objects". 3) Does the work involve a risk that workers will be crushed by the collapse or fall of sediment or structures? If the answer is yes, comply with the provisions of Clause 6.3 "Measures for Prevention of Accidents involving Collapse of Structures". 4) Does the work involve a risk that workers will be caught or entangled by machines or structures? If the answer is yes, comply with the provisions of Clause 6.4 "Measures for Prevention of Accidents involving Construction Machinery". 5) Does the work involve a risk of explosion? If the answer is yes, comply with the provisions of Clause 6.5 "Measures for Prevention of Explosion Accidents". 6) Does the work involve a risk of fire? If the answer is yes, comply with the provisions of Clause 6.6 "Measures for Fire Prevention". 7) Does the work involve a risk that the general public or any other third party will suffer adverse effects? If the answer is yes, comply with the provisions of Clause 6.7.1 "General rules for prevention of third-party accidents". 8) Does the work involve a risk that underground facilities, aerial lines, or surrounding facilities will be damaged? If the answer is yes, comply with the provisions of Clauses 6.7.2 "General rules on preventing accidents relating to underground utilities or facilities" and 6.7.3 "General rules on preventing accidents relating to aerial utilities including aerial lines". 9) Does the work involve the risk of traffic accidents? If the answer is yes, comply with the provisions of Clause 6.8 "Measures for Prevention of Traffic Accidents".				
Applicable Standards for	4.2.4		5.1 Excavation Work				
			5.2 Pile Foundation Work				

the Technical Guidance for Safe Execution (by the Type of Work)			5.3 Formwork and Form Shoring System Work				
			5.4 Reinforcing Bar Work				
			5.5 Concrete Work				
			5.6 Work over water				
			5.7 Demolition Work				
			5.8 Work where there is danger of oxygen deficiency				
			5.9 Slinging Work				
Applicable Standards for protective gear	4.2.5		Any use of protective gear in the aforementioned types of work shall comply with the provisions specified in Clause 6.9 Protective Gear.				
Technical Guidance for Safe Execution (by the Type of Work)							
Excavation Work							
Understanding of conditions for construction	5.1.1.1	(1)	Properties and characteristics of the ground to excavate, groundwater, artesian water, water inflow, and the presence of high-temperature gas or toxic gas	13: Excavation	-	13.CR 13: Excavation 13. (1) A contractor must- (a) ensure that all excavation work is carried out under the supervision of a competent person who has been appointed in writing for that purpose; and (b) evaluate, as far as is reasonably practicable, the stability of the ground before excavation work begins. (2) A contractor who performs excavation work- (a) must take reasonable and sufficient steps in order to prevent, as far as is reasonably practicable, any person from being buried or trapped by a fall or dislodgement of material in an excavation; (b) may not require or permit any person to work in an excavation which has not been adequately shored or braced: Provided that shoring and bracing may not be necessary where- (i) the sides of the excavation are sloped to at least the maximum angle of repose measured relative to the horizontal plane; or (ii) such an excavation is in stable material: Provided that-	Construction Regulations-2014
		(2)	The depth and area for excavation				
		(3)	Working space available for excavation work, underground buried utilities or facilities, and aerial utilities such as aerial line.				
		(4)	Natural properties such as topography, meteorology or oceanographic phenomena				
Cofferdam walls and timbering	5.1.1.2	(1)	The Contractor shall consider the following requirements when determining the type of cofferdam wall and timbering: 1) The Contractor shall undertake a comprehensive review based on the relevant conditions for construction once he has a full understanding of various characteristics including water cut-off performance, constructability, and rigidity of the timbering. 2) The Contractor shall check the level of safety against stress, strain, deformation and displacement as well as determine risk of piping, boiling and heaving based on the particular ground properties.				

		(2)	The structure shall be sufficiently strong to prevent ground failure regardless of the local conditions where such structure is constructed, including ground properties, geology, cracking, ground water content, seepage water, and the status of buried utilities or facilities which may compromise safety during excavation work.			(aa) permission has been given in writing by the appointed competent person contemplated in subregulation (1) upon evaluation by him or her of the site conditions; and (bb) where any uncertainty pertaining to the stability of the soil still exists, the decision from a professional engineer or a professional technologist competent in excavations is decisive and such a decision must be noted in writing and signed by both the competent person contemplated in subregulation (1) and the professional engineer or technologist, as the case may be; (c) must take steps to ensure that the shoring or bracing contemplated in paragraph (b) is designed and constructed in a manner that renders it strong enough to support the sides of the excavation in question; (d) must ensure that no load, material, plant or equipment is placed or moved near the edge of any excavation where it may cause its collapse and consequently endangers the safety of any person, unless precautions such as the provision of sufficient and suitable shoring or bracing are taken to prevent the sides from collapsing; (e) must ensure that where the stability of an adjoining building, structure or road is likely to be affected by the making of an excavation, steps are taken to ensure the stability of such building, structure or road and the safety of persons; (f) must cause convenient and safe means of access to be provided to every excavation in which persons are required to work, and such access may not be further than six meters from the point where any worker within the excavation is working; (g) must ascertain, as far as is reasonably practicable, the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and must before the commencement of excavation work that may affect	
		(3)	Materials to be used for such a structure shall be sufficient to withstand applied stress, strain, deformation and displacement, and be of good quality, free of cracking, deformation, and corrosion.				
Excavation slope for open cutting	5.1.1.3		When the slope is cut using open cutting techniques, the Contractor shall determine the excavation gradient that would prevent ground failure, required for the particular excavation conditions and other relevant factors.				
Procedure for execution of the works	5.1.1.4		The Contractor shall determine in advance the excavation procedure and responsible supervisors for the particular conditions for the construction and other relevant factors.				
Drainage plan	5.1.1.5		The Contractor shall plan for appropriate drainage of water during excavation based on the conditions of the ground to excavate, including groundwater, artesian water, ground water content, and presence of seepage water, as well as the presence of inflow of surface water to the excavation area.				
Ventilation plan	5.1.1.6		The Contractor shall consider the appropriate ventilation required during excavation, based on the properties of the ground to excavate, dust that may be generated during work, the presence of toxic gas and other relevant factors.				
Construction machinery and equipment plan	5.1.1.7		When excavation machines are used, the Contractor shall select machines appropriate for the conditions for construction, the scale of work, the period of work, and other relevant factors. In addition, the Contractor shall determine in advance the traveling routes for excavation machines, loading machines, and transporting machines, the earth and material loading sites and how to access the sites.				
Protective gear	5.1.1.8		Workers shall wear protective gear such as safety helmets or protective boots during work. When working at a place where there is a risk of falling from heights, they shall use safety belts.				

Prevention of ground collapse	5.1.2.1	(1)	The Contractor shall have excavation work undertaken strictly in accordance with the instructions of the responsible supervisor and in accordance with the excavation procedure and methods.			any such service, take the steps that are necessary to render the circumstances safe for all persons involved; (h) must ensure that every excavation, including all bracing and shoring, is inspected- (i) daily, prior to the commencement of each shift; (ii) after every blasting operation; (iii) after an unexpected fall of ground; (vi) after damage to supports; and (v) after rain, by the competent person contemplated in subregulation (1), in order to ensure the safety of the excavation and of persons, and those results must be recorded in a register kept on site and made available on request to an inspector, the client, the client's agent, any other contractor or any employee; (j) must cause every excavation which is accessible to the public or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered, to be- (i) adequately protected by a barrier or fence of at least one metre in height and as close to the excavation as is practicable; and (ii) provided with warning illuminates or any other clearly visible boundary indicators at night or when visibility is poor, or have resort to any other suitable and sufficient precautionary measure where subparagraphs (i) and (ii) are not practicable; (j) must ensure that all precautionary measures stipulated for confined spaces as determined in the General Safety Regulations, 2003, are complied with by any person entering any excavation; (k) must, where the excavation work involves the use of explosives, appoint a competent person in the use of explosives for excavation, and must ensure that a method statement is developed by that person in accordance with the applicable explosives legislation; and (/) must cause warning signs to be positioned next to an excavation within which or where persons are	
		(2)	The Contractor shall not place or store excavated earth and sand near excavated slopes. In case the earth and sand has to be temporarily stored near an excavated slope, the Contractor shall take appropriate measures to prevent collapse of the excavated slope or falling of the earth and sand into the excavated area.				
		(3)	When the surface of the ground falls as a result of rain, wind or water flowing from the ground surface to the excavation site, the Contractor shall implement protective measures such as covering the slope surface with protective sheets or nets.				
		(4)	The responsible supervisor shall immediately evacuate workers to a safe place when there is a risk of ground collapse or landslide.				
		(5)	The Contractor shall cancel excavation work when there is a risk that workers will be exposed to danger during those excavation works as a result of bad weather such as strong wind or rainstorms.				
		(6)	When bad weather due to sudden change or a natural disaster occurs, the responsible supervisor shall immediately suspend the work and evacuate workers to a safe place.				
Prevention of falls	5.1.2.2	(1)	Where works are undertaken at a place more than two metres above ground level, the Contractor shall construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers use protective gear to prevent themselves from falling, such as safety belts or fall arrestors. Where safety belts are used, the Contractor shall ensure that equipment is affixed to which the belts may be attached.				
		(2)	The Contractor shall install stoppers or similar equipment at appropriate locations to prevent construction vehicles or machines from falling into an excavation area.				

Prevention of accidents caused by flying or falling objects	5.1.2.3	(1)	Workers shall wear safety helmets to avoid hazards by earth and sand and other flying or falling objects during excavation work.			working or carrying out inspections or tests. Employer Policies and Procedures Safety, Health and Environmental Requirements Schedule Part 9 Section 4	
		(2)	The Contractor shall provide methods to prevent objects falling, such as baseboards, on excavated slopes to prevent objects from falling into the excavation site.				
		(3)	The Contractor shall ensure that no materials, equipment, excavated earth and sand or other materials are placed near excavated slopes.				
		(4)	When materials, machines, etc. are transferred from ground surface into an excavation site, the Contractor shall provide all feasible means to protect workers in the excavation site such as ropes and suspension bags.				
		(5)	When heavy objects are transported to an excavation site with hoisting equipment, the Contractor shall use appropriate hoisting attachments to prevent workers from entering or staying under the cargo. The Contractor shall station flagmen or signalmen to ensure safe operation by operators.				
Prevention of accidents caused by construction machinery	5.1.2.4	(1)	Excavation machines shall be operated by qualified personnel or their equivalent.				
		(2)	Flagmen shall be stationed in the following locations when excavation machines are being operated: 1) At locations where a work is undertaken in the vicinity of a road, building or any other facility 2) At locations where visibility is poor 3) On the edge of a cliff 4) At locations where there is a risk of earth and sand falling or collapsing 5) At locations where work is undertaken with excavation machines in the vicinity of other workers 6) At locations where work is undertaken on a road 7) When an excavation machine moves backwards				
		(3)	Standardized signs or signals shall be established to facilitate accurate and smooth communication among operators, flagmen, signalmen and workers.				
		(4)	When operating excavation machines or other equipment, the places where such machines are operated shall be off-limits.				

		(5)	No operators shall leave the operator's cabin while keeping the machines in an unstable condition or with the engines running.				
		(6)	No operators shall park excavation machines on a slope or on weak/fragile ground.				
		(7)	Excavation machines shall strictly be used within the range for safe use and only for its intended use.				
		(8)	When work with an excavation machine is undertaken at a place where there is a risk of a rock fall, appropriate protective measures such as head guards shall be provided in the operator's cabin.				
		(9)	When workers use rock drills, attention shall be drawn to the following: 1) Stabilizing the foothold and keeping the work place in order. 2) Using sufficiently long air hoses for rock drills. 3) When work is undertaken on a slope, making sure that no drills will fall or slide downward. Workers shall also wear protective gear such as safety belts whenever necessary.				
		(10)	The guidance specified in Clause 6.4 "Measures for Prevention of Accidents Involving Construction Machinery" is complied with.				
Prevention of public accidents and traffic accidents	5.1.2.5	(1)	When work is undertaken on a public road, the Contractor shall adopt appropriate measures to prevent the entry of unauthorized personnel including third parties into the work area, such as barricading the work site and stationing the watch-personnel and traffic-control personnel.				
		(2)	When work is undertaken on a public road, workers shall wear reflector vests.				
		(3)	Where buried utilities or facilities are located under the ground of a work site or where excavation is undertaken in the ground near a structure, then if damage to those utilities, facilities or structures by overturning or collapsing is likely, the Contractor shall take appropriate measures prior to the commencement of work, so as to prevent the risk, such as the relocation or reinforcement of the utilities, facilities or structures.				
		(4)	When earth and sand is backfilled over buried utilities or facilities, the Contractor shall undertake backfilling undertake according to the predetermined specifications, without applying unsymmetrical pressure or damaging the buried utilities or facilities.				

Working environment	5.1.2.6	(1)	Where there is seepage water at or an inflow of surface water to a work site, the Contractor shall properly treat such water prior to the commencement of any work.				
		(2)	The Contractor shall provide lighting strong enough to ensure safe excavation at the excavation site, taking into account the depth of excavation and the working environment.				
		(3)	When powder dust is generated from work, workers shall wear protective gear such as respirators when undertaking the work.				
		(4)	When loud noise is generated from the works, workers shall wear protective gear such as earplugs when undertaking the work. Since verbal communication is difficult in such circumstances, the Contractor shall determine an alternative means of communication in advance.				
		(5)	The Contractor shall install ventilation equipment as required to properly maintain the air quality at an excavation site. Particularly when a mechanical apparatus that houses an internal combustion engine is installed at an excavation site, installation of ventilation equipment is necessary to prevent accidents by exhaust gas poisoning.				
Inspection of excavation sites	5.1.2.7	(1)	The Contractor shall inspect the ground and the area surrounding at an excavation site as follows: 1) Inspection timing a) Before the start of work and at the beginning of each work shift b) After the occurrence of heavy rain or an earthqua 2) Items to be checked a) The ground to be excavated b) The condition of seepage water at an excavation site				
		(2)	In case the ground inspection indicates a risk of ground failure, the responsible supervisor shall immediately suspend excavation work and take appropriate anti-failure measures. The Contractor shall clarify the appropriate method of excavation or means to prevent ground failure taking into account the particular ground conditions, and resume the work only after confirming there is no likelihood of ground failure.				

		(3)	The Contractor shall ensure that mechanical equipment such as excavation machines or rock drills undergo predetermined inspection before the commencement of work and at any predetermined time, so to ensure that equipment is free of all defects. The Contractor shall immediately remove or repair here any equipment that is found to be defective, prior to the start of work.				
When installing cofferdam and timbering, the Contractor shall:	5.1.3.1	(1)	Install cofferdam and timbering in accordance with the predetermined sequences.				
		(2)	Commence excavation only after it is clear that the necessary structurals of the cofferdam and timbering have been precisely safely installed in their correct positions.				
		(3)	Firmly fix the cofferdam wall and timbering to prevent dislocation caused by vibrations and/or other external forces such as excavation works. In addition, the Contractor shall align the structurals of all timbering in a linear fashion and normal to the cofferdam wall.				
		(4)	Not place heavy materials on the structurals of the timbering.				
		(5)	Not use the timbering structurals for suspension used in the protection of buried utilities or facilities unless otherwise specified. The Contractor shall install another structurals columns suspended for purpose of protection separatively from the timbering.				
		(6)	Regularly inspect the cofferdam walls and timbering for deformation of the structurals, slackening of the fastening portions, or changes in groundwater or the surrounding ground level of the cofferdam wall and timbering during the construction. The Contractor shall undertake such inspections even during a periods when no work is being undertaken.				
		(7)	Ensure that when any anomaly is observed in the cofferdam wall and timbering, the responsible supervisor shall immediately evacuate workers to a safe place and take all necessary action to cope with the observed abnormal phenomenon. The responsible supervisor shall notify the appropriate manager in charge of the work suspension and also take appropriate action while the work is suspended.				
		(8)	Comply with the guidance specified in Clause 5.9 "Slinging Work".				
		(9)	Comply with the guidance specified in Clause 6.4.2 "Measures for mobile crane work".				

Inspection of cofferdam and timbering	5.1.3.2		The Contractor shall inspect cofferdam walls and trench timbering as follows: 1) Inspection timing a) Before the start of work and at the beginning of each work shift b) After the occurrence of a heavy rain or an earthquake 2) Items to be checked a) Creak, warp, and damage of structurals b) Degree of compression of timbering c) Slackening of the connections and joints of structurals d) Clearance in the back of the cofferdam wall				
Pile Foundation Work							
Understanding of the execution conditions	5.2.1.1	(1)	Properties and characteristics of the ground, artesian water, and the presence of high-temperature gas and toxic gas			No discription regaring pile foundation work in Safety Regulation,2014	
		(2)	Depth to the bearing stratum, working space available for pile foundation work, and utilities such as underground cables and aerial lines				
		(3)	Natural properties such as topography, meteorology or maritime phenomena				
Procedure for execution of the works	5.2.1.2		The Contractor shall determine in advance the procedure and the responsible supervisor for the pile foundation work based on the particular the conditions for construction and other relevant factors.				
Construction machines	5.2.1.3	(1)	The Contractor shall always level the place where construction machines are positional or operated, check for their respective bearing capacities, and provide appropriate measures, so as to prevent the machines overturning.				
		(2)	The Contractor shall not undertake work simultaneously at place right above or below the construction machines, and shall ensure that no person is present underneath hoisted cargo, such as structurals.				
		(3)	When handling, inspecting or servicing construction machines, the Contractor shall stop engines to prevent accidents, such as injuries to workers involving moving parts of machines.				
		(4)	When two or more pile drivers are used for one limited working site, the Contractor shall maintain sufficient clearance between the pile drivers.				
Protective gear	5.2.1.4		Workers shall wear safety helmets, protective boots and other protective gear when undertaking work. Workers shall use safety belts where there is a risk of falling.				

At the time of placing a pile driver	5.2.2.1	(1)	Take measures to prevent entry of unauthorized workers into the work range.				
		(2)	Take measures to prevent collapses of pile drivers.				
		(3)	For positioning of pile drivers on soft ground, check the strength of the ground and take necessary measures to prevent slides and over turning, including ground improvement or the use of iron plates.				
		(4)	When supports and trestles of pile drivers may cause sliding, provide appropriate reinforcement using, for example, stakes or wedges.				
		(5)	Always maintain good drainage at places where pile drivers are used.				
		(6)	Undertake slinging work in a safe and secure manner within the rated loads.				
		(7)	Not use hoisting wire ropes and hanging hooks that are deformed, cracked or damaged.				
		(8)	Use marks and other means for hoisting wire ropes, so as to prevent excessive winding.				
		(9)	Not use the following wire ropes for pile drivers 1) Hoisting wire ropes that do not satisfy the standards prescribed in the relevant laws and regulations of the recipient country. 2) Ropes with joints 3) Ropes with noticeable form breaks or corrosions				
		(10)	When a pile driver is assembled, use the pile driver only after checking the following conditions and making sure no issues pertain thereto: 1) The existence of slacks or injuries to the joints of machine parts 2) The installation conditions of hoisting wire ropes, sheaves and pulley blocks 3) The functions of brakes and ratchets of hoisting devices 4) The installation conditions for winches				
At the time of pile driving work	5.2.2.2	(1)	Ensure that workers use earplugs as appropriate for the work. Since verbal communication is difficult in such circumstances, the Contractor shall determine an alternative means of communication in advance.				
		(2)	Maintain a wide ground contact area with the pile driver, and use planking, square timbers and other means as needed.				

		(3)	When climbing leaders, install main ropes and use fall arrestors and safety belts.				
		(4)	Take measures to prevent entry of unauthorized workers into the work range.				
		(5)	Always inspect the structurals of the pile driver and hoisting equipment, and immediately repair or replace defective items prior to use.				
All-casing method	5.2.3.1	(1)	Take measures to prevent entry of unauthorized workers into the work area.				
		(2)	When moving machinery with tractions or jacks, ensure that work shall be undertaken strictly in accordance with the instructions of the responsible supervisor.				
		(3)	Always maintain jacks and pulleys and use the prescribed wire ropes.				
		(4)	Ensure that no person approaches the boring gantry during operation of the hammer grabs, and maintain a "no access" policy for this purpose.				
		(5)	Ensure that workers are allowed to enter a casing only after ventilation equipment is installed inside, toxic gas is measured and safety is confirmed in advance.				
		(6)	For putting tremies or reinforced frames, operators, slinging workers and signalmen are assigned, and the work is undertaken in accordance with established signals.				
		(7)	When work ceases, take measures such as installing protection nets, so as to prevent workers from falling into the casing.				
Reverse circulation drilling method	5.2.3.2	(1)	Assembling, dismantling and moving of gantries shall be undertaken strictly in accordance with the instructions of the responsible supervisor.				
		(2)	For putting tremies or reinforced frames, operators, slinging workers and signalmen are assigned, and the work is undertaken in accordance with established signals.				
		(3)	While ramming down or drawing casings, only those workers necessary to undertake the work shall be allowed to approach the gantry, and there is no access to the relevant work area for that purpose.				
Formwork and Form Shoring System Work							
Procedure for execution of the works	5.3.1.1		The Contractor shall determine the procedures for assembling and dismantling of forms and form shoring system, and appoint the responsible supervisors.			No discription regaring formwork and form shoring system work in Safety Regulation,2014	

Structure and materials of forms and form shoring system	5.3.1.2	(1)	The Contractor shall construct forms and form shoring system to a firm structure matching the shape and dimensions of the concrete structure, concrete placement method and other relevant conditions. The Contractor shall determine the specifications of the structure and materials based on the particular strength analysis.				
		(2)	The Contractor shall consider loading in the vertical and horizontal direction, and lateral pressure of the concrete in the structural review of the form shoring system. The Contractor shall also determine the structural specifications in consideration of special loads not previously expected.				
		(3)	The Contractor shall ensure that the materials used for forms and form shoring system have sufficient strength and are free of damage, deformation or corrosion.				
Protective gear	5.3.1.3		Workers shall wear protective gear such as safety helmets, protective boots and gloves when undertaking work. Workers shall use safety belts where there is a risk of falling.				
At the time of fabrication of forms	5.3.2.1	(1)	Always arrange materials and tools in an orderly manner at form fabrication workshops.				
		(2)	Always inspect machinery and tools used to fabricate forms, and ensure the safety device functions properly prior to use.				
		(3)	Take measures to ensure that no unauthorized workers have access to the form fabrication workshop.				
		(4)	Ensure that two workers carry lengthy or heavy goods.				
		(5)	Take measures to prevent cargo collapse or scattering when storing form materials or fabricated forms.				
		(6)	Ensure that fabricated forms are free of protrusions such as nails.				
At the time of assembly of forms	5.3.2.2	(1)	When there is a risk of workers being injured by reinforcing bars, etc. after tripping or falling, the Contractor shall take security measures such as covering of reinforcing bars with protective sheets before performing the assembly work.				
		(2)	Form assembly places shall always be kept in order.				
		(3)	Measures of no-entry of unauthorized workers shall be taken.				

		(4)	Where work is undertaken at a place more than two meters above ground level, the Contractor shall construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers shall use protective gear to prevent falls, such as safety belts or fall arrestors when conducting the work. Where safety belts are used, the Contractor shall affix appropriate equipment to connect the belts.				
		(5)	Once reinforcement fabricated, the Contractor shall not use rebars as access platforms or working floors.				
		(6)	The Contractor shall ensure that heavy or big forms are handled by not a single worker but by two or more workers.				
		(7)	The Contractor shall firmly affix assembled forms so as to prevent their collapse by wind or vibration.				
At the time of dismantle of forms	5.3.2.3	(1)	Ensure that form dismantle places are always kept in order.				
		(2)	Prevent other workers from entering any authorised access areas.				
		(3)	Stock dismantled form materials, nails or other fixings, and structurals by type, and at a place that does not disturb dismantling work.				
		(4)	Where work is undertaken at a place more than two meters above ground level, construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers shall use protective gear to prevent falls, such as safety belts or fall arrestors, when conducting work. Where safety belts are used, the Contractor shall ensure that appropriate equipment is affixed to which the belts may be connected.				
		(5)	Ensure that no work is undertaken simultaneously at places right above or below any dismantling work being undertaken, so as to avoid accidents caused by flying or falling objects. No forms or any other objects shall be thrown from higher to lower levels or directly dropped.				
At the time of form shoring system assembly and dismantle		(1)	When assembling form shoring system, prepare assembling diagrams in advance, and assemble the shoring system according to the drawings.				
		(2)	Assemble form shoring system according to the assembling diagrams. No assembling diagrams shall be modified without prior permission.				

		(3)	Ensure that the responsible supervisor shall directly supervise assembling and dismantling of form shoring system.				
		(4)	Take measures to prevent settlement of strut posts of the form shoring system.				
		(5)	Take measures to fasten the posts of the struts, so as to provide reinforcing lateral battens, as well as to prevent the sliding of the strut posts.				
		(6)	Take measures to ensure that there is no unauthorized access to the area where the assembly or dismantle of form shoring system is being undertaken.				
		(7)	Use lifting nets or hanging bags, etc. to lift up or down materials, equipment or tools.				
		(8)	Where work is undertaken at a place more than two meters higher or lower than the ground level, construct scaffolding prior to the commencement of work. Where it is impossible to construct scaffolding, workers shall use protective gear for prevention of falls such as safety belts or fall arrestors when conducting the work. Where safety belts are used, the Contractor shall ensure that appropriate equipment is affixed, to which the belts may be connected.				
		(9)	Not use the outsides of the assembled reinforcing bars or forms as access platforms or working floors.				
		(10)	Suspend work in case of danger caused by bad weather such as strong wind or rainstorms.				
		(11)	Not dismantle form shoring system before the prescribed strength of concrete is ascertained.				
At the time concrete is laid	5.3.3.2	(1)	Determine the sequence of concrete placing and the placing height in advance to prevent unsymmetrical pressures on the form shoring system, and place the concrete uniformly.				
		(2)	Inspect the shoring system and undertake repairs if any anomaly is found prior to concrete placing.				
		(3)	During concrete placing, inspect the conditions of shoring system to make sure the shoring system is always in a safe state. When any anomaly is observed in the form and form shoring system, immediately suspend the placing work, and take appropriate measures to cope with the circumstances.				
Reinforcing Bar Work							

Procedure for execution of the works	5.4.1.1		The Contractor shall determine the execution procedure and the responsible supervisor for fabrication of rebars in advance based on the particular conditions for construction and other relevant factors.			No discription regaring reinforcing bar work in Safety Regulation,2014	
Protective gear	5.4.1.2		Workers shall wear safety helmets, protective boots and gloves when undertaking work. Workers shall use safety belts where there is a risk of falling.				
At the time of rebar bending	5.4.2.1	(1)	Always arrange materials and tools in an orderly manner at rebar bending workshops.				
		(2)	Inspect machines and tools used to fabricate rebars prior to commencement of the work, use appropriate tools, and not use defective ones.				
At the time of rebar transport	5.4.2.2	(1)	Use two or more workers to transport long size rebars, and shall not allow transportation in an unusual or unreasonable manner.				
		(2)	Bundle and carry rebars, when they are not already bundled.				
		(3)	Ensure that attention is drawn to the front and back of transporting workers so as to avoid contact with others. Special attention shall be necessary for bent long size bars.				
At the time of rebar fabrication	5.4.2.3	(1)	Construct scaffolding prior to the commencement of work when undertaking work at a place more than two meters above ground level. Where it is impossible to construct scaffolding, workers shall use protective gear, such as safety belts or fall arrestors, so as to prevent falls when undertaking work. Where safety belts are used, the Contractor shall ensure that appropriate equipment is affixed to which the belts may be connected.				
		(2)	Secure safety paths at areas where reinforcing bar work is undertaken by, for example, providing steel plates on which to walk. When footboards are used, they shall be securely fixed on both ends to prevent overturning.				
		(3)	Ensure that workers are careful not to have their hands, arms or feet caught by rebars during fabrication work.				
		(4)	Take measures to protect against rebars projecting at places where work is being undertaken on a higher level and there is a risk of workers' falling.				
		(5)	Provide appropriate supports to rebars for walls, columns or similar vertical structural, so as to prevent their fall or collapse.				
Concrete Work							

Procedure for execution of the work	5.5.1.1		The Contractor shall determine the execution procedure and the supervisor responsible for concrete work in advance based on the conditions for construction and other relevant factors.			No discription regaring reinforcing bar work in Safety Regulation,2014	
Protective gear	5.5.1.2		Workers shall wear safety helmets, protective boots and gloves when undertaking work. Workers shall use safety belts where there is a risk of falling.				
At the time of assembly and use of concrete plant	5.5.2.1	(1)	Specify the supervisor responsible for assembly and operation of the concrete plant, and ensure that the plant is operated strictly in accordance with the instructions of the supervisor and in accordance with the assembling diagram. The plant shall be used only after the Contractor has undertaken tests prior to operation.				
		(2)	Station flagmen at gateways of concrete plant facilities as needed.				
		(3)	Establish safety paths in concrete plant facilities to separate traffic roads of walkers and vehicles.				
		(4)	Ensure that lighting for concrete plant facilities is sufficient for the work environment.				
		(5)	Install ventilation equipment in measuring rooms or at other places where work generates dust and soot. Workers shall also use protective equipment such as dust masks when working in such places.				
		(6)	Turn off machinery prior to undertaking maintenance to or repairing the concrete plant.				
At the time of concrete transport	5.5.2.2	(1)	Establish in advance the routes, that concrete mixers shall take from the concrete plant to the area where the concrete is to be laid.				
		(2)	When concrete mixers run on public roads, check the traffic conditions of relevant neighbouring routes, and take measures to prevent traffic accidents and other necessary measures.				
		(3)	When concrete mixers run through other work areas, contact and coordinate the relevant supervisors in those areas, to ensure that safety measures are fully implemented, routes are appropriately indicated and safety passage are maintained.				
		(4)	Determine in advance the travelling speeds applicable at the construction sites and ensure that operators do not exceed speed limits. Speed limit signs shall be put up at easily visible places and flagmen shall be stationed as necessary.				

		(5)	Implement measures to prevent runaway vehicles when operators leave the driver's cabin to discharge concrete from concrete mixers, such as using brakes or stoppers.				
		(6)	Ensure that concrete mixer operators wear safety helmets when discharging concrete.				
		(7)	When transferring concrete to the area where it is to be laid with a lifting machine, ensure that the access under the transfer range of the conc.-bucket is strictly restricted and take measures to prevent the leak of concrete from the bucket.				
At the time concrete is laid	5.5.2.3	(1)	Determine in advance the method and procedure, the range and speeds, etc. for laying the concrete, and ensure that the concrete is laid strictly in accordance with the instructions of the responsible supervisor.				
		(2)	Ensure that workers laying concrete wear protective gear such as protective gloves and boots to prevent the concrete being in direct contact with the skin.				
		(3)	Lay concrete in accordance with the predetermined procedures, and avoid laying concrete in a concentrated portion.				
		(4)	When shoots are used to lay concrete, place the shoots appropriately, so as to prevent overflow of concrete in consideration of the property of concrete, the method for laying the concrete, the shape and gradient of shoot and the connecting method.				
		(5)	Where there is a risk of workers falling from high places, take measures to prevent falls, such as the installation of scaffolding, provision of handrails and the mandatory use of safety belts when laying concrete.				
		(6)	Always check forms and form shoring system when laying concrete, so that work can be undertaken in a safe and secure manner.				
		(7)	Clearly specify the waiting areas and travelling routes for concrete mixers and their stationary positions where concrete is being laid, so as to prevent concrete mixers being involved in accidents or collisions.				
		(8)	Station flagmen at the stationary positions for concrete mixers and at locations where concrete is being laid.				
		(9)	When concrete is released for laying from stationary concrete mixers, install vehicle stoppers to firmly prevent the wheels of the vehicles from moving.				
	5.5.2.4	(1)	Inspect concrete pump placers as appropriate prior to use.				

At the time the concrete pump placer is in use		(2)	Ensure that communication with operators of concrete pump placers and workers holding hose tips is maintained by: 1) Installing necessary communication equipment such as radios or bells. 2) Establishing and following standardized signals.				
		(3)	Undertake concrete pumping operations, including start-up, shutdown, and adjustment of discharge, during pumping of concrete, in accordance with the signals sent from the hose end.				
		(4)	Securely connect transport pipes to hoses and between transport pipes using couplings and other tools.				
		(5)	Take measures to prevent falling off or swaying of transport pipes, including fixing the pipes to a firm structure.				
		(6)	When positioning concrete pump placers, check the ground condition of the positioning area and take appropriate measures as necessary to prevent vehicles from overturning.				
		(7)	Station flagmen to guide concrete mixers in order to prevent contact between the concrete pump placer and concrete mixer. To avoid collisions with concrete pump placers, the Contractor shall provide vehicle stopper at places where concrete is discharged from the concrete mixer.				
		(8)	Ensure that flagmen for concrete mixers are not positioned between concrete mixers and pump placers to prevent them being caught between them.				
		(9)	When the boom of a concrete pump placer is extended close to an aerial line, take measures to prevent contact between the boom and the aerial line.				
Work over Water							

Understanding of execution conditions	5.6.1.1		The Contractor shall understand the following conditions for construction in advance: 1) Water depth, topography, and geology 2) Local characteristics mainly concerning maritime phenomena and meteorology 3) Traffic conditions in the work area, including traffic routes on the water or fairways 4) The presence of underwater obstacles such as sunken ships 5) The presence of buried utilities such as communication cables, power cables, gas pipes or water pipes 6) Aerial lines and other similar utilities around the work area			Medupi FGD retrofit project does not include work over water.	
Procedure for execution of the works	5.6.1.2		The Contractor shall specify in advance the procedure for executing the work and the supervisor responsible for the work over the water taking into account the particular conditions for construction and other relevant factors.				
Protective gear	5.6.1.3		Workers shall use life jackets when undertaking work. They shall use safety belts when working in areas where they may fall and be injured by flying or falling objects or collide with permanent or temporary structures.				
When working over water	5.6.2	(1)	Implement the following measures when undertaking work over water: 1) Measures to prevent workers from falling into water 2) Development of systems to rescue workers if they fall into water				
		(2)	Ensure that workers do not undertake work over water alone.				
		(3)	Implement measures to ensure safety against floods, rainstorms, or sea waves during work over water.				
		(4)	Collect information on water levels or tide levels in conjunction with the work.				
		(5)	Prescribe and communicate emergency response measures to all relevant workers in advance.				
		(6)	Put in place protective gear for ready use, including life preservers and ropes.				
		(7)	Draw particular attention to lighting during night work and station watch-personnel as appropriate.				
		(8)	Prohibit the overboarding and the overloading of any vessel.				
		(9)	Install and regularly maintain lifesaving appliances at the appropriate positions in the boat.				

		(10)	Take safety measures when undertaking work on a river with dams located upstream against water release from the dam reservoir.				
		(11)	Suspend work during stormy weather such as heavy rainfall or strong winds.				
Demolition Work							
Understanding of the conditions for construction	5.7.1.1		(1) Understanding of the structure conditions 1) Structural strength, scale, shape, structural sections, interior and exterior finishes, and the building services of the structure 2) Previous uses of the structure (presence of chemical substances, flammable materials and other hazardous materials) 3) Status of damage, wear, corrosion, and deterioration of the structure and its structural (2) Understanding of the surrounding environmental conditions This includes topography, geology, structures in the neighbouring area (particularly hospitals and other facilities susceptible to vibration, noise or dust), public transportation such as railroads or roads, underground materials and utilities, aerial utilities and other restricting conditions.	14: Demolition work		14.CR 14: Demolition work 14. (1) A contractor must appoint a competent person in writing to supervise and control all demolition work on site. (2) A contractor must ensure that before any demolition work is carried out, and in order to ascertain the method of demolition to be used, a detailed structural engineering survey of the structure to be demolished is carried out by a competent person and that a method statement on the procedure to be followed in demolishing the structure is developed by that person. (3) During a demolition, the competent person contemplated in subregulation (1) must check the structural integrity of the structure at intervals determined in the method statement contemplated in subregulation (2), in order to avoid any premature collapses. (4) A contractor who performs demolition work must- (a) with regard to a structure being demolished, take steps to ensure that- (i) no floor, roof or other part of the structure is overloaded with debris or material in a manner which would render it unsafe; (ii) all reasonably practicable precautions are taken to avoid the danger of the structure collapsing when any part of the framing of a framed or partly framed building is removed, or when reinforced concrete is cut; and (iii) precautions are taken in the form of adequate shoring or other means that may be necessary to prevent the accidental collapse of any part of the structure or adjoining structure; (b) ensure that no person works under overhanging	Construction Regulations-2014
Procedure for execution of the works	5.7.1.2		The Contractor shall specify in advance the procedures for execution of the works and the supervisors responsible for dismantling work, taking into account the conditions for construction and other relevant factors.				
Protective gear	5.7.1.3		Workers shall wear safety helmets and protective gear to protect their legs, feet and hands when undertaking work. Workers shall wear goggles when there is a need to protect their faces against flying objects or when undertaking the particular type of work. Workers shall wear dust masks when undertaking work that generates dust. Workers shall use safety belts when working in areas where they may fall.				
At the time of demolition work	5.7.2	(1)	Ensure that demolition works are undertaken strictly in accordance with the instructions of the responsible supervisor.				

		(2)	Take measures to restrict unauthorised access of workers to the demolition area where they are not related to the work.			material or a structure which has not been adequately supported, shored or braced; (c) ensure that any support, shoring or bracing contemplated in paragraph (b), is designed and constructed so that it is strong enough to support the overhanging material; (d) where the stability of an adjoining building, structure or road is likely to be affected by demolition work on a structure, take steps to ensure the stability of such structure or road and the safety of persons; (e) ascertain as far as is reasonably practicable the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and must before the commencement of demolition work that may affect any such service, take the steps that are necessary to render circumstances safe for all persons involved; (f) cause every stairwell used and every floor where work is being performed in a building being demolished, to be adequately illuminated by either natural or artificial means; (g) cause convenient and safe means of access to be provided to every part of the demolition site in which persons are required to work; and (h) erect a catch platform or net above an entrance or passageway or above a place where persons work or pass under, or fence off the danger area if work is being performed above such entrance, passageway, or place so as to ensure that all persons are kept safe where there is a danger or possibility of persons being struck by falling objects. (5) A contractor must ensure that no material is dropped to any point, which falls outside the exterior walls of the structure, unless the area is effectively protected. (6) No person may dispose of waste and debris from a high place by a chute unless the chute-	
		(3)	Surround areas of a structure where third parties are exposed to danger associated with demolition by the fence or the equivalent and clearly indicate the area as a dangerous work area.				
		(4)	Construct scaffolds or makeshift passages to ensure the safety of workers during dismantling. The Contractor shall take measures to prevent falls where there is a risk of falling, and instruct workers to use safety belts and other protective gear.				
		(5)	Not undertake work simultaneously at any places right above or below the level where demolition work is to be undertaken.				
		(6)	Ensure that no structure being demolished is left in a state where it may collapse due to strong wind or other factors.				
		(7)	Sprinkle water and take any other necessary action as necessary to prevent the generation of dust when a structure is to be demolished.				
		(8)	Take measures to prevent unauthorised access to areas where construction machinery is to be operated.				

		(9)	Suspend work during stormy weather such as heavy rainfall or strong winds.			(a) is adequately constructed and rigidly fastened; (b) if inclined at an angle of more than 45 degrees to the horizontal, is enclosed on its four sides; (c) if of the open type, is inclined at an angle of less than 45 degrees to the horizontal; (d) where necessary, is fitted with a gate at the bottom end to control the flow of material; and (e) discharges into a container or an enclosed area surrounded by barriers. (7) A contractor must ensure that every chute used to dispose of rubble is designed in such a manner that rubble does not free-fall and that the chute is strong enough to withstand the force of the debris travelling along the chute. (8) A contractor must ensure that no equipment is used on floors or working surfaces, unless such floors or surfaces are of sufficient strength to support the imposed loads. (9) Where a risk assessment indicates the presence of asbestos, a contractor must ensure that all asbestos related work is conducted in accordance with the Asbestos Regulations, 2001, promulgated by Government Notice No. R. 155 of 10 February 2002. (10) Where a risk assessment indicates the presence of lead, a contractor must ensure that all lead related work is conducted in accordance with the Lead Regulations, 2001, promulgated by Government Notice No. R.236 of 28 February 2002. (11) Where the demolition work involves the use of explosives, a method statement must be developed in accordance with the applicable explosives legislation, by an appointed person who is competent in the use of explosives for demolition work and all persons involved in the demolition works must adhere to demolition procedures issued by the appointed person. (12) A contractor must ensure that all waste and debris are as soon as reasonably practicable removed and disposed of from the site in accordance with the applicable legislation.	
Work where there is danger of oxygen deficiency							

Key points for the preparation stage	5.8.1.1		1) Wells, open caissons, shafts, tunnels, pneumatic caissons and other similar places that have not been used for a long period of time 2) The insides of those places listed in 1) above, that are in contact with or either lead to the following layers: a) Sand gravel layers that have impermeable layers located right above, which have little or no water content or running water b) Strata containing ferrous salts or first manganese salts c) Strata containing methane, ethane or butane d) Strata gushing out or likely to gush out with carbonated water e) Sludge layers 3) Cisterns, conduits, manholes and pits 4) The insides of cisterns, conduits, manholes and pits where rainwater, river water, or seepage water stagnates or previously stagnated at some point in time. 5) The insides of tanks, holds, cisterns, pipes, conduits, manholes, ditches, pits in which human waste, sapropel, sludge, pulp liquid, or other corroded or easily decomposable substances are contained or were once contained. 6) An excavation work site, a pile foundation work site or surroundings, where construction by a pneumatic method is or once was carried out . 7) Places where work is undertaken with internal combustion	Work in confined spaces	-	Work in confined spaces 5. (1) An employer or a user of machinery shall take steps to ensure that a confined space is entered by an employee or other person only after the air therein has been tested and evaluated by a person who is competent to pronounce on the safety thereof, and who has certified in writing that the confined space is safe and will remain safe while any person is in the confined space, taking into account the nature and duration of the work to be performed therein. (2) Where the provisions of subregulation (1) cannot be complied with the employer or user of machinery, as the case may be, shall take steps to ensure that any confined space in which there exists or is likely to exist a hazardous gas, vapour, dust or fumes, or which has or is likely to have, an oxygen content of less than 20 per cent by volume, is entered by an employee or other person only when-- (a) subject to the provisions of subregulation (3), the confined space is purged and ventilated to provide a safe atmosphere therein and measures necessary to maintain a safe atmosphere therein have been taken; and (b) the confined space has been isolated from all pipes, ducts and other communicating openings by means of effective blanking other than the shutting or locking of a valve or a cock, or, if this is not practicable, only when all valves and cocks which are a potential source of danger have been locked and securely fastened by means of chains and padlocks. (3) Where the provisions of subregulation (2)(a) cannot be complied with, the employer or user of machinery shall take steps to ensure that the confined space in question is entered only when the employee or person entering is using breathing apparatus of a type approved by the chief inspector and, further, that-- (a) the provisions of subregulation (2) (b) are complied with; (b) any employee or person entering the confined space is using a safety harness or other similar equipment, to which a rope is securely attached which reaches beyond the access to the confined space, and	1031 - OHS - General Safety Regulations, 1986
Procedure for execution of the works	5.8.1.2		The Contractor shall specify in advance the procedure for execution of the works and the supervisors responsible for work to be undertaken where there is a danger of oxygen deficiency, taking into account the relevant conditions for construction and other relevant factors.				
Measurement of the working environment	5.8.1.3		The Contractor shall specify in advance the timing and method for measuring oxygen concentration, and the procedure when the management concentrations in various working environments is to be applied.				
Advance training to workers	5.8.1.4		1) The influence of oxygen deficiency on the human body and the related symptoms 2) Usage of protective gear including a respirator 3) Evacuation in the event of accident and methods of emergency treatment				

Protective gear	5.8.1.5		Workers shall wear safety helmets and protective gear to protect their feet when undertaking work. Where toxic gas exists, they shall wear gas masks or respirators. They shall use safety belts when working at places where they may fall.			the free end of which is attended to by a person referred to in paragraph (c); (c) at least one other person trained in resuscitation is and remains in attendance immediately outside the entrance of the confined space in order to assist or remove any or persons from the confined space, if necessary; and (d) effective apparatus for breathing and resuscitation of a type approved by the chief inspector is available immediately out side the confined space. (4) An employer or user of machinery shall take steps to ensure that all persons vacate a confined space on completion of any work therein. (5) Where the hazardous gas, vapour, dust or fumes contemplated in subregulation (2) are of an explosive or flammable nature, an employer or user of machinery shall further take steps to ensure that such a confined space is entered only if -- (a) the concentration of the gas, vapour, dust or fumes does not exceed 25 per cent of the lower explosive limit of the gas, vapour, dust or fumes concerned where the work to be performed is of such a nature that it does not create a source of ignition; or (b) such concentration does not exceed 10 per cent of the lower explosive limit of the gas, vapour, dust or fumes where other work is performed. (6) The provisions of this regulation shall mutatis mutandis also apply, in so far as they can be so applied, to any work which is performed in any place or space on the outside of and bordering on or in the immediate vicinity of, any confined space, and in which place or space, owing to its proximity to the confined space, any hazardous article, oxygen-deficient atmosphere or dangerous concentration of gas, vapour, dust or fumes may occur or be present.	
Key points for working in places where there is a risk of oxygen deficiency	5.8.2	(1)	Install and maintain measurement equipment necessary to measure gas concentration in the working environment, when working in places where there is a risk of oxygen deficiency.				
		(2)	Undertake measurements of the working environment when undertaking work in places where there is a risk of oxygen deficiency, prior to the start of each and every work shift. If the measurement result exceeds the management standard, the Contractor shall immediately take necessary measures and ensure that no work is undertaken until the measurement reading shows a value below the standard value.				
		(3)	Comply with the following requirements when measuring the working environment: 1) When entering the measuring area, protective gear such as respirators shall be worn so as not to directly breathe in the air in the measuring area. 2) Measurements shall not be made by a single worker only; they shall be made always with the appropriate watch-personnel stationed.				
		(4)	Always maintain ventilation when work is undertaken at a place where there is a risk of oxygen deficiency.				
		(5)	Provide protective gear including respirators, evacuation tools including ladders and ropes, and other appliances necessary for rescue, when work is undertaken at a place where there is a risk of oxygen deficiency.				
		(6)	Take measures to prevent unauthorised access in areas where there is a risk of oxygen deficiency, and post relevant signs.				
		(7)	Ensure that the supervisor responsible immediately suspends the work whenever there is the potential for oxygen deficiency and evacuates workers to a safe place.				
		(8)	Ensure that rescue crew use protecting gear (such as respirators) when rescuing victims of oxygen deficiency and take measures to prevent secondary accidents.				
		(9)	Ensure that work is always undertaken with constant ventilation, when working in a closed space where an internal combustion engine of a construction machine is being operated.				

Slinging Work							
Key points for slinging work	5.9.1	(1)	Ensure that slinging work is undertaken by personnel who have a license certified in accordance with the relevant laws and regulations of the recipient country or who have the equivalent knowledge, capability and experience.			No discription regaring slinging work in Safety Regulation,2014	
		(2)	Use slinging equipment appropriate for the shape and weight of the cargo to be hoisted.				
		(3)	Always check slinging equipment before use and specify checkpoints, inspection methods, and the responsible inspectors in advance. Any inappropriate or defective slinging equipment shall be discarded immediately.				
		(4)	Store slinging equipment in an orderly manner at a place free of rainfall, soot and dust.				
		(5)	Hoist pipes and other slippery cargo only after measures to prevent falls are taken.				
		(6)	Not hoist long and short materials together.				
		(7)	Use hoisting boxes and other appropriate methods when hoisting small materials.				
		(8)	Prevent unauthorised access to work areas where workers are undertaking slinging work.				
		(9)	Ensure that no workers are present under hoisted cargo.				
		(10)	Comply with the guidance specified in Clause 6.4.2.3.” Measures for operation of mobile cranes”				
Technical Guidance for Safe Execution (by the Type of Accident)							
Measures for Prevention of Fall Accidents							

General rules	6.1.1	-	When undertaking work at a place more than two meters above ground level, the Contractor shall construct scaffolding prior to the execution of the works and ensure that workers wear safety helmets when conducting the works. Where it is impossible to construct scaffolding, workers shall use protective gear such as safety belts, fall arrestors and other anti-fall gear. The Contractor shall affix handrails, main ropes and other equipment as appropriate where the use of anti-fall protective gear is contemplated.	Personal safety equipment and facilities	-	Personal safety equipment and facilities 2. (1) Subject to the provisions of paragraphs (f), (g), (h) and (i) of regulation 5 of the General Administrative Regulations published under Government Notice R. 2206 of 5 October 1984, every employer and every user of machinery shall make an evaluation of the risk attached to any condition or situation which may arise from the activities of such employer or user, as the case may be, and to which persons at a workplace or in the course of their employment or in connection with the use of machinery are exposed, and he shall take such steps as may under the circumstances be necessary to make such condition or situation safe. (Replaced by GAR, 1994 by Government Notice R. 17403 of 6 September, 1996.) (2) Where it is not practicable to safeguard the condition or situation contemplated in subregulation (1), the employer or user of machinery, as the case may be, shall take steps to reduce the risk as much as is practicable, and shall provide free of charge and maintain in a good and clean condition such safety equipment and facilities as may be necessary to ensure	1031 - OHS - General Safety Regulations, 1986

						that any person exposed to any such condition or situation at a workplace or in the course of his employment or on premises where machinery is used is rendered safe. (3) Taking into account the nature of the hazard that is to be countered, and without derogating from the general duties imposed on employers and users of machinery by subregulations (1) and (2), the safety equipment and facilities contemplated in subregulation (2) shall include, as may be necessary -- (a) suitable goggles, spectacles, face shields, welding shields, visors, hard hats, protective helmets, caps, gloves, gauntlets, aprons, jackets, capes, sleeves, leggings, spats, gaiters, protective footwear, protective overalls, or any similar safety equipment or facility of a type that will effectively prevent bodily injury; (b) waterproof clothing, high-visibility clothing, chemical-resistant clothing, low temperature clothing, chain mail garments, waders, fire retardant or flame-proof clothing, ice-jackets, or any similar safety equipment of a type that will effectively protect the wearer thereof against harm; (c) belts, harnesses, nets, fall arresters, life lines, safety hooks, or any similar equipment of a type that will effectively protect persons against falls; (d) mats, barriers, locking-out devices, safety signs, or any similar facility that will effectively prevent slipping, unsafe entry or unsafe conditions; (e) protective ointments, ear-muffs, ear-plugs, respirators, breathing apparatus, masks; air lines, hoods, helmets, or any similar safety equipment or facility of a type that will effectively protect against harm; (f) suitable insulating material underfoot where persons work on a floor made of metal stone, concrete or other similar material; and (g) generally, such safety equipment or facilities as may be necessary to render the persons concerned safe. (4) An employer or a user of machinery, as the case may be, shall take steps to ensure that no safety equipment or facility provided as required by this or any other regulation is removed from a workplace or from premises where machinery is used, except for purposes of cleaning, repair, maintenance, modification, mending or replacement, and no person	

						shall remove any such safety equipment or facility from a workplace or premises where machinery is used, except for the aforesaid purposes. (5) An employer shall instruct his employees in the proper use, maintenance and limitations of the safety equipment and facilities provided. (6) An employer shall not require or permit any employee to work unless such an employee uses the required safety equipment or facility provided in terms of this or any other regulation. (7) The provisions of this regulation shall not be construed as derogating from the provisions of any specific regulation prescribing specific safety equipment or facilities.	
Scaffolding Structure and materials of scaffolding	6.1.2.1	(1)	Analyze the structural strength required for scaffolding based on the loads to be applied in the working areas and the expected service loads, and determine the appropriate structure for scaffolding.	16:Scaffolding	-	(1) A contractor must appoint a competent person in writing who must ensure that all scaffolding work operations are carried out under his or her supervision and that all scaffold erectors, team leaders and inspectors are competent to carry out their work. (2) A contractor using access scaffolding must ensure that such scaffolding, when in use, complies with the safety standards incorporated for this purpose into these Regulations under section 44 of the Act.	Construction Regulations
		(2)	Design the scaffolding structure to sustain expected loads for the relevant works after adequate review of the risk of any overturning or collapse of the structure.	Demolition and excavation 13D.Scaffold framework	-	Scaffold framework 13D.(1) An employer shall ensure that - (a) Scaffold standards are properly propped against displacement and are secured vertically on firm foundations: Provided that putlog scaffolds shall incline slightly towards the structure; (b) (i) steel scaffold standards with 'heavy', 'medium', 'light', or 'very light', platform loadings which shall not exceed 320, 240, 160 and 80 kg/m2 respectively, are spaced not more than 1.8 m, 2 m, 2.5 m and 3 m apart, respectively; and	1031 - OHS - General Safety Regulations, 1986
		(3)	Use materials for scaffolding that can be reasonably procured within the country in which the project is located. More specifically, the Contractor shall select reliable, durable and appropriate materials that are free of defects in terms of strength, damage or corrosion.				
		(4)	Construct scaffolding on a firm and flat foundation to prevent sliding or collapse and use additional supports as				

			appropriate where any part(s) of the foundation is on soft ground.			(ii) wooden scaffold standards are spaced not more than 3 m apart; (c) ladders are spaced vertically not more than 2.1 m apart; (d) putlogs or transoms -- (i) which do not support a platform, are spaced at the same distances as the distances prescribed in paragraph (b) in respect of scaffold standards. (ii) which support a platform, are spaced not more than 1.25 m apart if the platform is constructed of solid timber boards; and (e) every part of a wooden scaffold frame has a diameter of at least 75 mm or a section of similar strength. (2) No employer shall use a scaffold, or permit it to be used unless it - (a) is securely and effectively braced to ensure stability in all directions; (b) is secured at suitable vertical and horizontal distances to the structure to which work is being done, unless it is designed to be completely free-standing; (c) is so constructed that it has a throughout factor of safety of at least two; and (d) is inspected at least once a week and every time after bad weather by a person who has adequate experience in the erection and maintenance of scaffolds, and all findings are recorded in a register or report book. (3) No employer shall require or permit that - (a) a scaffold with a supporting wooden framework exceeds a height of 10 m; and (b) a scaffold is erected, altered or dismantled by or under the supervision of a person other than a person who has had the necessary training and experience of such work and who has been appointed by the employer in writing for this purpose. Scaffold platforms 13E.(1) An employer shall ensure that - (a) every plank of a solid wooden scaffold platform is at least 275 mm wide and 38 mm thick; (b) every plank which forms part of a scaffold platform is supported at distances not exceeding 1.25 m, and its ends are projected not less than 70 mm and	
		(5)	Provide supporting measures such as braces to prevent the collapse of the scaffolding structure.				
Scaffolding Measures for assembly and dismantle of scaffolding	6.1.2.2	(1)	Prevent unauthorised access to the area where scaffolding is assembled or dismantled.				
		(2)	Specify the details of the responsible supervisor(s), the location of the work area, the scope, and procedure for the works, and the required protective gear.				
		(3)	Ensure that workers use appropriate protective gear such as safety belts when assembling or dismantling scaffolding if there is any risk of falling.				
		(4)	Install handrails along the entire length of the working floor to prevent accidents. Handrails shall be installed also at places other than working floors, where there is risk of falling. The height or structure of the handrails shall be adequately reviewed to prevent any accidents.				
		(5)	Install baseboards, mesh sheets, protection nets and other appropriate measures for handrails as required, so as to prevent the fall of objects from the working floor.				
		(6)	Provide appropriate means for workers to move between higher and lower level working areas.				
		(7)	Apply floorboards to the floor of the working platform at appropriate intervals to prevent workers tripping over any openings between the floorboards. Floorboards shall be firmly fastened.				
		(8)	Where there are openings on the working area, install adequate handrails or fencing around the opening with sufficient signs and notifications at or near the opening. On non-working days, those openings shall be closed or covered up to prevent any falls.				
		(9)	Cancel work when workers are likely to be exposed to danger while undertaking work during bad weather such as strong wind or rainstorms. The procedure and requirement for cancellation of the works shall be predetermined based on the working conditions.				
Scaffolding Measures on	6.1.2.3	(1)	Specify and notify all workers of the maximum live load for scaffolding, and install signs showing such information at locations easily visible to workers.				

the use of scaffolding		(2)	Not place materials exceeding the predetermined upper limit of live loads in the working area.			not more than 200 mm beyond the last prop; (c) every plank of a scaffold platform is firmly secured to prevent its displacement; and (d) every platform is so constructed as to prevent materials and tools from falling through. (2) An employer shall ensure that every scaffold platform- (a) with 'heavy' 'medium', 'light' or 'very light' platform loadings as referred to in regulation 13D (1) (b) (i) is not less than 1 125 mm and not more than 1 380 mm, not less than 1 125 mm and not more than 1 150 mm, not less than 900 mm and not more than 1 150 mm, and not less than 675 mm and not more than 1 150 mm, respectively, wide: Provided that where a platform is used only as a gangway, a platform width of 450 mm shall be sufficient; (b) which is more than 2 m above the ground is on all sides, except the side facing the structure, provided with- (i) substantial guard rails of at least 900 mm and not exceeding 1 000 mm in height; and (ii) toe-boards which are at least 150 mm high from the level of the scaffold platform and so affixed that no open space exists between the toe-boards and the scaffold platform: Provided that if the toe-boards are constructed of timber, they shall be at least 25 mm thick; (c) is not more than 75 mm from the structure: Provided that where workmen must sit to work, this distance may be in creased to not more than 300 mm; and (d) is kept free of waste, projecting nails or any other obstructions, and is kept in a non-slip state. (3) No employer shall require or permit that a working platform which is higher than 600 mm be supported on a scaffold platform, and shall provide an additional guard rail of at least 900 mm and not exceeding 1000 mm in height above every such working platform. (4) An employer shall ensure that convenient and safe access is provided to every scaffold platform, and where the access is a ladder, the ladder shall project at least 900 mm beyond the top of the platform. Suspended scaffolds	
		(3)	Draw sufficient attention to where materials are placed in working areas, so as to ensure uniform placement and prevent destabilization of the scaffolding.				
		(4)	Not use the working platform to store materials other than those for immediate use. No materials or equipment shall be placed at access to the scaffolding.				
		(5)	Not remove or modify handrails installed at the working area or other parts of the scaffolding without prior approval. When handrails must be removed, the Contractor shall undertake the removal works after ensuring that there is no unauthorised access to the scaffolding and taking all preventive measures to avoid the occurrence of any accidents.				
		(6)	Inspect scaffolding daily before the commencement of work to ensure there are no problems with the scaffolding structure and the safety handrails. Any defective scaffolding shall be removed and/or repaired immediately.				
		(7)	In the case of inappropriate weather conditions such as strong wind or heavy rains, or natural disasters such as earthquakes, temporarily suspend works and inspect the scaffolding prior to the resumption of the works.				
		(8)	Take measures, so as to ensure that there is no unauthorized access into working areas where scaffolding is in place.				

							13F. (1) An employer shall ensure that the outriggers of each suspended scaffold - (a) are constructed of steel or any other material of similar strength and have a factor of safety of at least four with respect to the load it is to carry; (b) have an overhang of not more than 1.8 m beyond the edge of the structure and are of such length that the counteracting length can be anchored securely: (c) are, otherwise than by means of weights at the inner-ends, properly propped, suitably spaced and firmly anchored: Provided that an inspector may grant permission that outriggers may be anchored by means of weights; and (d) are provided with stop or other effective devices at the outer-ends to prevent the displacement of ropes. (2) An employer shall ensure that the working platform of every suspended scaffold is suspended by: (a) pulley-blocks, sheaves, winches or hoists of the correct size for the ropes being used; (b) at least two independent steel wire ropes in the case of a working platform which is not wider than 912 mm, and at least four independent steel wire ropes in the case of a working platform which is 912 mm and wider; and (c) steel wire ropes of which the factor of safety is at least ten with respect to the maximum load which each rope is to carry. (3) An employer shall ensure that - (a) the hand or power-driven machinery used for the lifting or lowering of the working platform of a suspended scaffold is so constructed and maintained that an uncontrolled movement of the working platform cannot occur; (b) the machinery referred to in paragraph (a) is so situated that it is easily accessible for inspection; (c) the rope connections to the outriggers are vertically above the connections to the working platform; and (d) in the case of a working platform suspended by two ropes only, the connections of the ropes to the working platform are of such height above the level of the working platform as to ensure the stability of the working platform. (4) An employer shall ensure that the working platform of every suspended scaffold -	

						(a) is at least 456 mm and not exceeding 1.8 m in width; (b) is suspended as near as possible to the structure to which work is being done and, except when light work is being done, is secured at every working position to prevent horizontal movement between the working platform and the structure; (c) is on all sides, except the side facing the structure, provided with substantial guard rails of at least 900 mm and not exceeding 1000 mm in height above the level of the working platform: Provided that in the case of a working platform suspended by two ropes only, the guard rails shall be on all sides; and (d) is on an sides provided with toe-boards which are at least 150 mm high from the level of the working platform and so affixed that no open space exists between the toe-boards and the working platform: Provided that if the toe-boards are constructed of timber, they shall be at least 25 mm thick. Trestle scaffolds 13G.(1) No employer shall use a trestle scaffold, or permit it to be used, unless - (a) it is soundly constructed of solid material, and (b) all reasonable precautionary measures have been taken to prevent the unexpected spreading of its supporting legs when it is in use. (2) No employer shall use a trestle scaffold or permit it to be used, if it - (a) is higher than 3 m; or (b) consists of more than two tiers.	
Measures for Prevention of Accidents Involving Flying or Falling Objects							
General rules	6.2.1	-	When undertaking work involving a risk of flying or falling objects, the Contractor shall take the following measures into account for the particular work conditions. The workers shall also wear safety helmets.	10:Fall Protection		10.CR 10: Fall protection 10. (1) A contractor must- (a) designate a competent person to be responsible for the preparation of a fall protection plan; (b) ensure that the fall protection plan contemplated in paragraph (a) is implemented, amended where and when necessary and maintained as required; and (c) take steps to ensure continued adherence to the fall protection plan. (2) A fall protection plan contemplated in subregulation (1), must include-	Construction Regulations-2014
		(1)	Measures for the installation of safety nets				
		(2)	Measures for work areas with height differences or openings				
		(3)	Measures for work conducted at different heights				
		(4)	Measures for work with rotating machines				

Measures for the installation of safety nets	6.2.2	(1)	Install safety nets to prevent workers from being injured by objects falling from higher places.			(a) a risk assessment of all work carried out from a fall risk position and the procedures and methods used to address all the risks identified per location; (b) the processes for the evaluation of the employees' medical fitness necessary to work at a fall risk position and the records thereof; (c) a programme for the training of employees working from a fall risk position and the records thereof; (d) the procedure addressing the inspection, testing and maintenance of all fall protection equipment; and (e) a rescue plan detailing the necessary procedure, personnel and suitable equipment required to affect a rescue of a person in the event of a fall incident to ensure that the rescue procedure is implemented immediately following the incident. (3) A contractor must ensure that a construction manager appointed under regulation 8(1) is in possession of the most recently updated version of the fall protection plan. (4) A contractor must ensure that- (a) all unprotected openings in floors, edges, slabs, hatchways and stairways are adequately guarded, fenced or barricaded or that similar means are used to safeguard any person from falling through such openings; (b) no person is required to work in a fall risk position, unless such work is performed safely as contemplated in subregulation (2); (c) fall prevention and fall arrest equipment are- (i) approved as suitable and of sufficient strength for the purpose for which they are being used, having regard to the work being carried out and the load, including any person, they are intended to bear; and (ii) securely attached to a structure or plant, and the structure or plant and the means of attachment thereto are suitable and of sufficient strength and stability for the purpose of safely supporting the equipment and any person who could fall; and (d) fall arrest equipment is used only where it is not reasonably practicable to use fall prevention equipment. (5) Where roof work is being performed on a construction site, the contractor must ensure that, in addition to the requirements set out in subregulations	
		(2)	Declare an area protected by a safety net to be off-limits, when the safety net is removed due to particular work requirements. After removal, the said area shall be immediately restored to its original condition.				
		(3)	Use safety mesh nets that fit the intended purpose and use.				
Protection against flying or falling objects at work areas with heights or openings	6.2.3	(1)	Use only appropriate lifting equipment such as rope or cranes when objects are to be transferred from a higher to a lower working area.				
		(2)	Keep clear all work areas where objects may easily fall such as on scaffolding in excavated or access areas. No materials or equipment shall be placed at or near such locations. In case materials or equipment have to be temporarily placed at these locations, appropriate measures shall be taken, such as fastening with ropes or packing in boxes or bags, so as to prevent scattering or fall of those objects or to prevent workers from tumbling or falling by tripping over them.				
		(3)	Take preventive measures involving the use of baseboards at the edges of working floors, openings, or the top of slopes, so as to prevent the fall of materials or equipment.				

						(2) and (4), it is indicated in the fall protection plan that- (a) the roof work has been properly planned; (b) the roof erectors are competent to carry out the work; (c) no employee is permitted to work on roofs during inclement weather conditions or if any conditions are hazardous to the health and safety of the employee; (d) all covers to openings and fragile material are of sufficient strength to withstand any imposed loads; (e) suitable and sufficient platforms, coverings or other similar means of support have been provided to be used in such a way that the weight of any person passing across or working on or from fragile material is supported; and (t) suitable and sufficient guard-rails, barriers and toe-boards or other similar means of protection prevent, as far as is reasonably practicable, the fall of any person, material or equipment.	
Measures for work conducted at different heights	6.2.4	(1)	Coordinate works that are to be executed at varying heights, so as to avoid work being undertaken simultaneously right above or below at different heights.			There are some discriptions regaring fall protection in Safety Regulation, 2014. However, no discription complying with requirement of JICA safety guideline.	
		(2)	Where work must be undertaken simultaneously at different heights, determine in advance the relevant supervisor for such works, the relevant work area, working time, and method and procedure of the works. Workers at different heights shall maintain constant communication with each other while undertaking the work.				
		(3)	Where work must be undertaken simultaneously at different heights, put up sufficient signage around that area and ensure in advance that workers communicate and coordinate the works to be executed at different heights . Sufficient signalmen and watch-personnel shall be stationed near those working areas, so as to ensure that the works are conducted in a safe and secure manner.				
Measures for rotating machines	6.2.5	-	Machines that produce any flying material or cut waste shall be covered or protected by protective fences. In case it is difficult to use a cover or fencing due to the nature of work, workers shall use protective gear when conducting work. Any area subject to risk of falling or flying objects shall be declared off-limits for unauthorized workers.				
Measures for Prevention of Accidents Involving Collapse of Structures							

General rules	6.3.1	-	Depending on the work conditions, the Contractor shall consider the following measures when undertaking work where there is a risk of accidents involving the collapse of structures. In addition to the measures set out below, workers shall wear safety helmets when conducting the work.			There are some discriptions regaring scaffolding and excavation in Safety Regulation, 2014. However no discription regarding collapse.	
		(1)	Measures to prevent the collapse of the natural ground				
		(2)	Measures to prevent the collapse of cargo				
		(3)	Measures to prevent the collapse of temporary structures (timbering, forms, form shoring system, scaffolding, etc.)				
		(4)	Measures to prevent the collapse of structures				
Measures to prevent the collapse of natural ground	6.3.2	-	The Contractor shall comply with the following guidances :				
		(1)	The guidance specified in Clause 5.1.1.2.”Cofferdam walls and timbering”				
		(2)	The guidance specified in Clause 5.1.1.3. “Excavation slope for open cutting”				
		(3)	The guidance specified in Clause 5.1.2.1. “Prevention of ground collapse”				
Measures to prevent collapse of cargos	6.3.3	(1)	When loading materials on cargo handling machines, the Contractor shall undertake the loading work, so as to avoid uneven loading. In addition, thematerials shall be fastened or covered with ropes or sheets to prevent any collapse or fall.				
		(2)	When unloading cargos, the Contractor shall not pull out materials in the middle of the piling.				
		(3)	The Contractor shall appoint a supervisor for the loading and unloading work, which shall be undertaken under his instructions and control.				
Measures to prevent the collapse of temporary structures (timbering, forms, form shoring system,	6.3.4	(1)	When assembling forms and form shoring system, prepare the assembling diagrams in advance, and assemble in accordance with the plans and drawings. The Contractor shall assign the responsible supervisor for this work and the work shall be undertaken strictly in accordance with his instructions and control.				
		(2)	Inspect in advance the materials for use in temporary structures and, in particular, those that would be used repeatedly, and shall not use those that are damaged, deformed or corroded.				

scaffolding, etc.)		(3)	Shall prevent unauthorised personnel from accessing work areas when assembling or dismantling temporary structures, and postpone such work in the case of bad weather conditions such as strong wind or rainstorms.				
		(4)	Follow the guidance specified in Clause 5.1.1.2. "Cofferdam walls and timbering"				
		(5)	Follow the guidance specified in Clause 5.1.3. "Key points for cofferdam and timbering"				
		(6)	Follow the guidance specified in Clause 5.3.3. "Key points for the form shoring system work"				
		(7)	Follow the guidance specified in Clause 6.1.2. "Scaffolding"				
Measures to prevent collapse of structures	6.3.5	(1)	The Contractor shall follow the guidance specified in Clause 5.7. "Demolition Work"				
Measures for Prevention of Accidents Involving Construction Machinery							
General rules	6.4.1	-	The Contractor shall consider the following particulars when undertaking work using construction machinery.	23: Construction vehicles and mobile plant	-	23.CR 23: Construction vehicles and mobile plant 23. (1) A contractor must ensure that all construction vehicles and mobile plant- (a) are of an acceptable design and construction; (b) are maintained in a good working order; (c) are used in accordance with their design and the intention for which they were designed, having due regard to safety and health; (d) are operated by a person who- (i) has received appropriate training, is certified competent and in possession of proof of competency and is authorised in writing to operate those construction vehicles and mobile plant; (ii) has a medical certificate of fitness to operate those construction vehicles and mobile plant, issued by an occupational health practitioner in the form of Annexure 3.; (e) have safe and suitable means of access and egress; (f) are properly organized and controlled in any work situation by providing adequate signalling or other control arrangements to guard against the dangers relating to the movement of vehicles and plant, in order to ensure their continued safe operation;	Construction Regulations-2014
		(1)	The Operator				
		(2)	Inspection and maintenance of the machines				
		(3)	Safety devices on the machines				
		(4)	Stationing of flagmen				
		(5)	Measures to prevent unauthorized access				
		(6)	Measures for the suspension and completion of work				
		(7)	Provision of training on safety issues				
Operator	6.4.1.1	(1)	The Contractor shall appoint and permit only trained, qualified and certified operators of construction machinery to operate the machines. The names of the regular operators shall be inscribed on their respective machines and only those appointed operators shall operate the machines.				

		(2)	The Contractor shall take steps to ensure the good physical and health condition of the operators. The operators shall be trained to have sufficient rest and shall not be subject to excessive work.			(g) are prevented from falling into excavations, water or any other area lower than the working surface by installing adequate edge protection, which may include guardrails and crash barriers; (h) are fitted with structures designed to protect the operator from falling material or from being crushed should the vehicle or mobile plant overturn; (i) are equipped with an acoustic warning device which can be activated by the operator; (j) are equipped with an automatic acoustic reversing alarm; and (k) are inspected by the authorised operator or driver on a daily basis using a relevant checklist prior to use and that the findings of such inspection are recorded in a register kept in the construction vehicle or mobile plant. (2) A contractor must ensure that- (a) no person rides or is required or permitted to ride on a construction vehicle or mobile plant otherwise than in a safe place provided thereon for that purpose; (b) every construction site is organized in such a way that, as far as is reasonably practicable, pedestrians and vehicles can move safely and without risks to health; (c) the traffic routes are suitable for the persons, construction vehicles or mobile plant using them, are sufficient in number, in suitable positions and of sufficient size; (d) every traffic route is, where necessary, indicated by suitable signs; (e) all construction vehicles and mobile plant left unattended at night, adjacent to a public road in normal use or adjacent to construction areas where work is in progress, have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, in order to identify the location of the vehicles or plant; (f) all construction vehicles or mobile plant when not in use, have buckets, booms or similar appendages, fully lowered or blocked, controls in a neutral position, motors stopped, wheels chocked, brakes set and	
		(3)	The Contractor shall not permit any operator to operate construction machinery if he is seen to be under the influence of any of the following conditions: 1) Intoxicated from consumption of alcohol 2) Suffering from the effects of excessive consumption of alcohol 3) Extremely exhausted 4) Suffering from any other condition that makes him unfit for any works for the operation of construction equipment or machinery.				
Inspection and maintenance	6.4.1.2	-	The Contractor's personnel with requisite knowledge and skill shall undertake inspection and maintenance of construction machinery in accordance with the relevant laws and regulations of the recipient country, prior to the start of work and at the predetermined times. The Contractor shall undertake such inspection and maintenance taking into account the following requirements.				
		(1)	In principle, undertake inspection and maintenance only after ensuring the machine has ceased to operate and the power is turned off.				
		(2)	Take appropriate measures to prevent falling or overturning machines.				
		(3)	Take appropriate measures to prevent any unauthorised access to the work area where inspection or maintenance is undertaken.				
		(4)	Undertake inspection and maintenance on a flat and secure surface when the machine is not in operation. If for some unavoidable reason it has to be undertaken on a slope, stoppers shall be applied for the undercarriage of the machine to prevent slippage or movement.				
		(5)	Shut down the engine of the construction machinery, engage the brake and lock all rotating parts.				

		(6)	Lower all attachments onto the ground. If for some unavoidable reason inspection or maintenance has to be undertaken under a raised blade or bucket, the Contractor shall take appropriate measures to prevent the attachment from dropping, for example, by using supports such as struts or blocks.			ignition secured; (g) whenever visibility conditions warrant additional lighting, all mobile plant are equipped with at least two headlights and two taillights when in operation; (h) tools, material and equipment are secured and separated by means of a physical barrier in order to prevent movement when transported in the same compartment with employees; (i) vehicles used to transport employees have seats firmly secured and adequate for the number of employees to be carried; and (j) all construction vehicles or mobile plant traveling, working or operating on public roads comply with the requirements of the National Road Traffic Act, 1996.	
		(7)	Take appropriate measures when a machine is being repaired, including the complete shutdown of the machine's functions and preventing any operation or movement of the machine during repair.				
Safety devices	6.4.1.3	(1)	The Contractor shall check the safety devices fitted to construction machinery confirm the operation of the device, and shall not operate any construction machinery if the safety device has been removed or modified.				
		(2)	For construction machines capable of moving backwards, the Contractor shall use only such machines fitted with safety devices that give a warning when the machine moves backwards.				
Stationing of flagmen	6.4.1.4	(1)	Station flagmen when work is undertaken at the road shoulder, on the edge of a slope, and at other locations where there is a risk of vehicles overturning.				
		(2)	Station flagmen where workers and construction machinery are required, for unavoidable reasons, to work in the same vicinity.				
		(3)	Establish standardized signs and controlling procedures where flagmen are stationed.				
Prevention of unauthorized access	6.4.1.5	(1)	The Contractor shall declare danger zones to be off-limits to unauthorised personnel in order to prevent the occurrence of accidents, such as injury caused by collision with construction machinery. Where it is impossible to restrict access for unavoidable reasons, the Contractor shall station flagmen or other appropriate personnel.				
Measures for suspension and completion of work	6.4.1.6	-	When suspending or completing work using construction machinery, theContractor shall:				
		(1)	Station construction machinery on flat and secure ground and lower buckets onto ground level.				
		(2)	Apply stoppers around the undercarriage of construction machinery to immobilize them when they must be positioned on a slope.				
		(3)	Turn off the engine, engage the brakes and remove the key from the vehicle.				

Provision of education on safety	6.4.1.7	(1)	The Contractor shall provide operators and workers engaging in work using construction machines with necessary training, including training on the deployment of construction machines, the work area, the scope of work, the method of work, and the work procedures to be undertaken prior to the commencement of work.				
		(2)	Whenever any major changes are made to the deployment of construction machinery, the work area, the scope of work, the method of work, and the work procedures, the Contractor shall provide further training to the relevant operators and workers.				
Measures for mobile crane work							
Guiding and signaling for mobile cranes	6.4.2.1	(1)	The Contractor shall appoint only one signalman, who shall use the predetermined signals and provide signals in a clear manner.	22: Cranes		22. A contractor must, in addition to compliance with the Driven Machinery Regulations, 1988 ensure that where tower cranes are used- (a) they are designed and erected under the supervision of a competent person; (b) a relevant risk assessment and method statement are developed and applied; (c) the effects of wind forces on the crane are taken into consideration and that a wind speed device is fitted that provides the operator with an audible warning when the wind speed exceeds the design engineer's specification; (d) the bases for the tower cranes and tracks for rail-mounted tower cranes are firm, level and secured; (e) the tower crane operators are competent to carry out the work safely; and the tower crane operators have a medical certificate of fitness to work in such an environment, issued by an occupational health practitioner in the form of Annexure 3.	Construction Regulations-2014
		(2)	The signalman shall give signals from a position outside the work range that holds a good view of the hoisted cargo and is reasonably visible by the crane operator.				
		(3)	In case the signalman has no choice but to give signals at a position not visible to the operator, he shall use radio or other means to allow the operator to receive the signals.				
Measures for the arrangement and installation of mobile cranes	6.4.2.2	(1)	Ensure that there are no obstacles in the work range of the mobile crane.				
		(2)	Establish a procedure that considers any obstacles in the work area and alerts all relevant workers and operators as to their existence in advance.				
		(3)	Check the ground conditions on which to position or transport the mobile crane.				
		(4)	Apply steel plates or conduct ground improvement works when the load-bearing capacity of the ground is insufficient, so as to prevent the crane from overturning.				
		(5)	Set the body of the mobile crane horizontally and extend the outriggers to their fullest depending on the load.				
		(6)	Conduct pre-operation inspection of the mobile crane to check safety devices or warning equipment. Safety devices or warning equipment shall not be turned off during work.				
		(7)	Check the condition of the outriggers or the condition of the ground on which the crane is positioned during operation. Any anomaly, if found, shall immediately be corrected or removed.				

Measures for operation of mobile cranes	6.4.2.3	(1)	Immediately suspend work if anomaly is found during the work, investigate the causes, and take all necessary measures prior to resuming work.				
		(2)	Confirm that the entire weight, including the cargo to hoist, hooks, slinging equipment and other hoisting attachments, is less than the rated hoisting load.				
		(3)	Provide indications or other means that allow operators and slinging workers to always be aware of the rated load of the mobile crane.				
		(4)	Use anti-release appliances when hoisting cargo, so as to prevent slinging equipment from releasing from the hooks.				
		(5)	When slinging cargo, temporarily stop the cargo when it is afloat only slightly from ground level, and check the machine for stability, the centre of gravity of the cargo and the condition of sling.				
		(6)	When hoisting cargo, position the hook right above the cargo to hoist.				
		(7)	When turning cargo, confirm that there are no workers or obstacles inside the turning range, and the operators shall slowly turn the cargo.				
		(8)	Slowly and silently lower cargo.				
		(9)	Not use mobile cranes to transport or hoist workers unless, because of the nature of the work or the need to complete the work, it is necessary to undertake such crane operation, in which case the Contractor shall take the following measures: 1) Provide means to prevent overturning or falling off of the hoisting basket. 2) Have workers use protective equipment such as safety belts. 3) Use the power-driven lowering when the hoisting basket is lowered down.				
		(10)	Ensure that no operators leave the operator's cabin with the cargo hoisted up.				
		(11)	Ensure that no workers are present under the hoisted cargo.				
		(12)	Take appropriate measures to restrict unauthorised access during the mobile crane work, so as to prevent workers from entering areas where cargo may fall.				
Measures for Prevention of Explosion Accidents							

General rules	6.5.1	(1)	When handling explosives in construction work, the Contractor shall: 1) Comply with all relevant requirements prescribed in the relevant laws and regulations of the recipient country. 2) Ensure that all necessary arrangements are made by qualified personnel prescribed by the relevant laws and regulations of the recipient country, and that workers are not exposed to any danger related to use of explosives.			Vide Regulation - 109 - OHS - Explosives Regulation	Regulation - 109 - OHS - Explosives Regulation
		(2)	Ensure that work contents, work methods and procedures, and other detailed work plans are prepared by the qualified personnel and made known to all relevant workers.				
		(3)	Appoint the responsible supervisors among the qualified personnel to supervise the work.				
		(4)	Ensure that workers to be assigned to blasting work are clearly identifiable from other workers by the use of signs or labels on their safety helmets.				
		(5)	Provide workers to be assigned to blasting work with sufficient training on the dangers of blasting work and the important particulars about safety and security.				
		(6)	Conduct blasting work on the ground in the daytime in principle. If blasting work has to be conducted after nightfall for unavoidable reasons, the Contractor shall provide sufficient lighting.				
		(7)	Secure the safety of workers engaged in other works by taking into consideration the following requirements: 1) Blasting times shall be determined with the consent of the relevant supervisors in other works. 2) An advance warning shall be given to the supervisors in other works, and blasting work shall be conducted after making sure those supervisors thoroughly understand when the blasting work is to be conducted.				
		(8)	Declare an area a "danger zone" where it is considered to be dangerous for workers as a result of blasting work, and declare an area a "safety zone" where workers can stand by there in safety during blasting work.				
		(9)	Take measures to ensure that worker's access to the danger zone is restricted by: 1) Setting up a watch-station. 2) Installing a warning signboard. 3) Installing a blasting warning sign at an easily visible location around the danger zone.				

Measures for storage of explosives	6.5.2		The Contractor shall:				
		(1)	Prepare a balance sheet of explosives recording the amount of explosivesreceived, used, and remaining for each implementation of blasting work.				
		(2)	Strictly manage explosives balance sheets.				
		(3)	Take adequate care in relation to loss and theft of explosives.				
		(4)	Store explosives in a place: 1) Where access is restricted for unauthorized personnel, there is sufficient ventilation, clean and dry atmosphere is always maintained, and there is no direct exposure to sunlight. 2) Where there is no fire or risk of falling stones. 3) With a lockable facility to prevent entry from outside. 4) Resistant to fire.				
		(5)	Not store flammable materials such as dried grass, tree leaves or shrubs around the explosives storage.				
		(6)	Not open the storage door during thunderstorms or when a thunderstorm is expected.				
Measures for transport of explosives	6.5.3		The Contractor shall:				
		(1)	Put detonation devices and explosives in separate containers and transported individually.				
		(2)	Not put explosives of different kinds in the same container.				
		(3)	Identify the containers in which the explosives are stored up, as such by attaching explosives signs on their exteriors.				
		(4)	Ensure that vehicles transporting explosives satisfy the following requirements: 1) They run smoothly and are in good condition. 2) They have a structure that does not cause the explosives to fall from their cargo rack. 3) They are equipped with fire extinguishers.				
		(5)	Ensure that explosives are not transported by being tucked in workers' pockets or by being carried by workers.				
	6.5.4		The Contractor shall:				

Measures for handling of explosives		(1)	Establish the work procedures for safe and efficient charging of explosives and make these procedures known to all relevant workers.				
		(2)	Ensure that explosives and detonators are handled carefully and are not beaten, thrown, or dropped.				
		(3)	Cancel any blasting work when lightning is likely.				
		(4)	Ignite explosives when conducting blasting, only after it has first evacuated workers in the danger zones, stationed watch-personnel to prevent access to the danger zones, and notified relevant parties of the blasting operation.				
		(5)	Drill boreholes after ensuring there are no slick holes or remaining powder from the previous blasting.				
		(6)	Handle and treat any misfired dynamites found after blasting, using appropriate methods.				
		(7)	Return powder planned to be used but not actually used, to the same explosives storage after completion of work.				
Measures for Fire Prevention							
General rules	6.6.1		The Contractor shall:	29: Fire precautions on construction sites		29. A contractor must, in addition to compliance with the Environmental Regulations for Workplaces, 1987, ensure that- (a) all appropriate measures are taken to avoid the risk of fire; (b) sufficient and suitable storage is provided for flammable liquids, solids and gases; (c) smoking is prohibited and notices in this regard are prominently displayed in all places containing readily combustible or flammable materials; (d) in confined spaces and other places in which flammable gases, vapours or dust can cause danger (i) only suitably protected electrical installations and equipment, including portable lights, are used; (ii) there are no flames or similar means of ignition; (iii) there are conspicuous notices prohibiting smoking; (iv) oily rags, waste and other substances liable to ignite are without delay removed to a safe place; and (v) adequate ventilation is provided; (e) combustible materials do not accumulate on the construction site; (f) welding, flame cutting and other hot work are done only after appropriate precautions have been taken to	Construction Regulations-2014
		(1)	Appoint a fire control manager, and establish an emergency communication network and fire prevention management system.				
		(2)	Install fire-extinguishing facilities appropriate for the type of work conducted at all locations where a fire is handled, and clearly indicate the whereabouts of those facilities.				
		(3)	Replace fire extinguishers with new ones before expired.				
		(4)	Establish signals to warn of the outbreak of fire.				
		(5)	Review and undertake evacuation drills and fire-fighting drills.				
		(6)	Ensure that qualified personnel take precautionary measures when welding or cutting using fire.				
		(7)	Store waste contaminated with oil or solvent in metal containers, or dispose of it in the appropriate manner.				
		(8)	Ensure that no flammable materials are at or around a fire-handling site.				
		(9)	Immediately give a fire-warning signal following the outbreak of a fire.				

		(10)	Install warning signals throughout the entire construction site.			reduce the risk of fire; (g) suitable and sufficient fire-extinguishing equipment is placed at strategic locations or as may be recommended by the Fire Chief or local authority concerned, and that such equipment is maintained in a good working order; (h) the fire equipment contemplated in paragraph (g) is inspected by a competent person, who has been appointed in writing for that purpose, in the manner indicated by the manufacturer thereof; (i) a sufficient number of workers are trained in the use of fire- extinguishing equipment; (j) where appropriate, suitable visual signs are provided to clearly indicate the escape routes in the case of a fire; (k) the means of escape is kept clear at all times; (/) there is an effective evacuation plan providing for all- (i) persons to be evacuated speedily without panic; (ii) persons to be accounted for; and (iii) plant and processes to be shut down; and (m) a siren is installed and sounded in the event of a fire	
Measures for Prevention of Public Accidents							
General rules for prevention of third-party accidents	6.7.1		When undertaking work with a risk of third-party accidents, the Contractor shall review following measures taking into account the particular work conditions: 1) Installation of temporary enclosures and gates and related measures 2) Measures relating to the area around gates to construction sites 3) Installation of temporary pedestrian passages 4) Communication with local residents in the vicinity of the construction sites 5) Decluttering and cleanliness 6) Measures relating to work on public roads 7) Prevention of flying or falling object accidents to third parties 8) Prevention of dust generation 9) Provision of sufficient lighting 10) Prevention of noise and vibration 11) Site patrol			Medupi FGD retrofit project does not have risk of public accident.	

Installation of temporary enclosures and gates	6.7.1.1		The Contractor shall construct temporary hoarding and gates on he perimeter of the construction site, so as to prevent access by third parties and the occurrence of public accidents.				
Measures relating to temporary enclosures and gates	6.7.1.2	(1)	The Contractor shall construct temporary enclosures on the perimeter of the construction site to prevent third parties accessing the site at any given time. The Contractor shall review the structural measures designed to prevent children accessing the work area, taking into account the following requirements: 1) Temporary enclosures shall be of a height that is difficult for children to climb over. 2) The mesh-size used for the temporary enclosure shall be sufficiently small to prevent children from putting their limbs or heads through. 3) Temporary enclosures shall have no open underside, so that children cannot slip through.				
		(2)	Temporary enclosures shall be made of materials that would withstand strong wind or external forces and be durable enough to persist during the planned installation period.				
		(3)	When installing temporary enclosures, the work shall be undertaken taking third parties into consideration.				
		(4)	Temporary enclosures shall be regularly inspected and maintained to ensure they prevent intrusions.				
		(5)	Gates shall be constructed on the temporary enclosures. The locations of the gates shall not disturb traffic of general vehicles and pedestrians.				
		(6)	Gates shall be lockable. When the gates are open, the Contractor shall take appropriate measures including the stationing of watch-personnel or flagmen for work vehicles.				
		(7)	Gates of temporary enclosures shall be indicated as such, and warning signs prohibiting entry of unauthorized personnel into the site shall be put up.				
		(8)	No third parties or general vehicles shall be allowed to enter the construction area without prior permission, regardless of whether or not work is being conducted.				
Measures relating to the area around gates to	6.7.1.3	(1)	The Contractor shall provide entry and exit areas for work vehicles at the construction site and install appropriate guidance signboards or other similar measures to inform third parties including pedestrians of the entry and exit of work vehicles.				

construction sites		(2)	The Contractor shall ensure that the traffic of third parties is a top priority at the gates, and extend efforts to prevent public accidents associated with entry and exit of work vehicles. Traffic-control personnel or flagmen shall be stationed as needed taking into account the frequency of work vehicles accessing the gate and the general volume of traffic.				
Measures relating to temporary pedestrian passages	6.7.1.4		When allowing third parties to use passages temporarily constructed for work, the Contractor shall create temporary pedestrian passage in accordance with the following requirements: 1) Fences or panels shall be set up on the border between the temporary passage and the construction area. 2) Temporary passages shall be wide and high enough for pedestrians to pass. 3) The floor of the temporary passage shall be designed, so as to prevent stumbling, slipping and other injuries. 4) Temporary passages shall be identified by the use of signs, and guidance signboards or other similar measures shall be provided to prevent accidental entry into the construction site. 5) Appropriate lighting shall be installed and activated on nightfall. 6) When work is undertaken above or near a temporary passage, measures shall be taken to prevent accidents caused by flying or falling objects.				
Communication with local residents around the construction sites	6.7.1.5	(1)	The Contractor shall, jointly with the Employer and Engineer in accordance with the contract documents, notify the local residents of the outline of the construction work, and promote communication and cooperation with them on the work.				
		(2)	The Employer and Engineer shall enable communication to be convenient with local residents.				
Decluttering and cleanliness	6.7.1.6		The Contractor shall always keep the inside and surrounding of the construction site decluttered and clean, so as to avoid causing nuisance to local residents.				
Measures relating to work on public roads	6.7.1.7		When undertaking work on public roads, the Contractor shall take measures to allow the safe passage of general vehicles and third parties, and prohibit the entry of third parties into the work area.				

Measures for prevention of accidents to third parties caused by flying or falling objects	6.7.1.8		The Contractor shall take measures to prevent objects flying or falling when undertaking work near the border of the construction site or in high places and there is a risk that third parties will be injured by those objects				
Measures for prevention of dust generation	6.7.1.9		When dust is generated by implementing the construction work and can cause damage to the surrounding area, the Contractor shall take measures to prevent spreading of dust to the surrounding area taking the following requirements into consideration. When allowing third parties to use temporarily constructed passages, temporary pedestrian paths shall be set up by: 1) Stopping or reducing the amount of work that generates dust. 2) Reducing the amount of dust generation. 3) Sprinkling water and using any other appropriate methods as necessary to reduce the spread of dust generated by the work. 4) Preventing dust from being scattered close to its source.				
Provision of sufficient lighting	6.7.1.10		The Contractor shall provide another appropriate lighting where the construction work requires removal or relocation of existing public lighting facilities, causing any trouble to traffic of third parties.				
Prevention of noise and vibration	6.7.1.11		The Contractor shall take measures to mitigate noise and vibration, which is generated when undertaking construction work and can cause damage to the surrounding area, by: 1) Stopping or reducing the amount of work that generates noise or vibration. 2) Taking measures to mitigate the source of the noise or vibration.				
Site patrol	6.7.1.12		The Contractor shall patrol both the construction site and its vicinity to check and find any conditions that may affect third parties.				

General rules on preventing accidents relating to underground utilities or facilities	6.7.2	(1)	When the presence of underground utilities or facilities is foreseen at a construction site, the Contractor shall conduct a survey on such buried utilities or facilities based on the design documents and preliminary survey information, taking into account safe work methods and procedures for the protection of buried utilities or facilities.				
		(2)	When the presence of underground materials or facilities is foreseen at a work site, the Contractor shall consult with the relevant organisations in charge of such buried utilities or facilities, and after obtaining all appropriate permissions, shall undertake the necessary work in accordance with the relevant laws and regulations of the recipient country.				
		(3)	The Contractor shall check the kind and type, location (plan and depth), relevant standard, structure, and other details of the underground utilities or facilities in advance, so as to accurately understand the area of impact associated with excavation of those buried utilities or facilities.				
		(4)	The Contractor shall notify and ensure the relevant workers understand the information on the underground utilities or facilities, the method and procedure of excavation, the method of protection, emergency response and other necessary data relating to those utilities or facilities.				
General rules on preventing accidents relating to aerial utilities including aerial lines	6.7.3	(1)	The Contractor shall survey aerial lines or other aerial utilities existing in the construction area and identify the type, location (position, height, etc.) and the relevant organisations of any such aerial utilities in advance.				
		(2)	The Contractor shall consult with the relevant organisations owning the identified aerial utilities, and after obtaining all appropriate permissions undertake the required work in accordance with the relevant laws and regulations of the recipient country.				
		(3)	Where construction work is likely to be in contact with or to cut aerial lines or other utilities during the work, the Contractor shall take protective measures by: 1) Protecting aerial utilities such as aerial lines 2) Installing height control facilities at the gate to the construction site 3) Installing signage indicating the location of aerial utilities 4) Restricting access of construction machinery and				

			imposing restrictions on the turning movement range of the machines				
		(4)	Maintaining sufficient space when conducting work in the vicinity of aerial utilities.				
		(5)	Providing information to the relevant workers on aerial utilities, including the type and location, the work method and procedure, restricted access areas, and restricted turning movement ranges.				
Measures for Prevention of Traffic Accidents							
General rules on construction sites	6.8.1		When there is a risk of traffic accidents within the construction site, the Contractor shall adopt the following measures taking into account the work conditions: 1) Installing safety paths and related measures 2) Installing travelling routes for work vehicles and related measures				
Installation of safety paths	6.8.1.1		The Contractor shall install and maintain safety pedestrian paths to ensure the safe passage of workers within the construction site.				
Measures relating to safety paths	6.8.1.2		The Contractor shall:				
		(1)	Clearly separate safety paths from vehicle routes avoiding complicated crossings between them.				
		(2)	Ensure safety paths are wide enough to allow safe passage of workers taking into account the number of workers working in each site.				
		(3)	Take measures that prioritize pedestrians where safety paths cross vehicle routes.				
		(4)	Ensure safety paths have level floors, so as to prevent stumbling, slipping or other injuries.				
		(5)	Identify safety paths by signage.				

		(6)	Ensure no obstacles such as materials or equipment are placed on safety paths.				
Installation of safety paths	6.8.1.3		The Contractor shall specify and maintain travelling routes for safe passage of vehicles and construction machines within the construction site.				
Measures relating to the travel routes of work vehicles	6.8.1.4		The Contractor shall:				
		(1)	Clearly separate work vehicle travel routes from safety paths.				
		(2)	Ensure that work vehicle travel routes are wide enough to allow the passage of work vehicles in terms of the number, size and type of vehicles and machinery, and taking into account the scale of the relevant construction work.				
		(3)	Determine the alignment, profile and cross-sections for the travelling routes in consideration of the durability of the road surface, drainage systems and other factors in order to ensure safe passage of vehicles.				
		(4)	Avoid work vehicle travel routes with alignments that represent steep slopes or sharp curves.				
		(5)	Minimise the number of intersections between vehicle travel routes or crossings with safety pedestrian paths.				
		(6)	Ensure that no obstacles are placed on vehicle travel routes that would cause disruption.				
		(7)	Identify work vehicle travel routes using signs.				
		(8)	Determine and clearly indicate the applicable speed limits for the travel routes, and any weight limits that are imposed.				
		(9)	Station flagmen as needed at borders between work vehicle travel routes and public roads in order to prevent collisions with pedestrians or public vehicles.				
		(10)	Indicate height restrictions where aerial lines or other aerial utilities exist above the work vehicle travel routes, and prohibit the use of those routes by vehicles exceeding the restriction.				
General rules on public roads	6.8.2		When there is a risk of traffic accidents on public roads in connection with the construction work, the Contractor adopt the following measures as appropriate for the particular work conditions: 1) Measures relating to commuting with cars 2) Measures relating to work on public roads				

Measures relating to commuting with cars	6.8.2.1		The Contractor shall:				
		(1)	Determine commuting routes in advance and ensure that workers commute to work using the predetermined routes. If traffic conditions require a detour away from the predetermined commuting routes, the Contractor shall ensure workers drive in a safe manner, so as to prevent road accidents.				
		(2)	Ensure that drivers have a good understanding of the traffic conditions of the commuting routes.				
		(3)	Ensure that drivers shall consider the road conditions and shall not drive in haste.				
		(4)	Check the health conditions of drivers prior to driving, and shall prohibit from driving those who are likely to be unable to drive in a safe manner, because of, for example, fatigue, sickness or influence of alcohol.				
		(5)	Install and use appropriate lighting when driving is necessary after night has fallen.				
		(6)	Periodically inspect and maintain vehicles used for commuting, so as to prevent traffic accidents due to breakdown or defects.				
Measures relating to work on public roads	6.8.2.2		The Contractor shall:				
		(1)	Obtain the relevant permission when it is necessary to conduct work on public roads, through the relevant procedures in accordance with the provisions of the relevant laws and regulations of the recipient country prior to the commencement of work.				
		(2)	Clearly indicate work areas on public roads and take measures to prevent unauthorised access by third parties to the area. Relevant watch-personnel shall be stationed as needed.				
		(3)	Maintain the travelling areas for pedestrians and public vehicles so as to prevent road traffic issues, and station flagmen at appropriate spots to guide public vehicles.				
		(4)	Maintain safe pedestrian passages for the smooth passage of children and the elderly.				

		(5)	Take measures to allow drivers of public vehicles to be able to identify the work area from a distance and drive in a safe and secure manner by: 1) Installing road signs at work areas. 2) Installing notice boards to give advance notice of work on public roads. 3) Providing lighting that increases the visibility of road signs and notice boards, when working after nightfall. 4) Firmly affix road signs and notice boards, so as to ensure they do not overturn owing to strong wind or rainfalls.				
		(6)	Provide appropriate lighting when undertaking work after nightfall, and take care to prevent the dazzling light of the installed lighting fixture from disturbing drivers of public vehicles.				
		(7)	Install a detour information board to inform public vehicles and pedestrians of the need for diversions of public vehicles, and deploy flagmen as appropriate.				
		(8)	Notify local residents of the plan to work on public roads, so as to obtain their understanding and cooperation.				
Protective Gear							
General rules	6.9.1		The Contractor shall:				
		(1)	Ensure that workers use personal protective gear appropriate for the type of work and working environment where they may be exposed to danger during construction work.				
		(2)	Use personal protective gear that is properly certified by the relevant laws and regulations of the recipient country.				
		(3)	Provide workers with training on how to use and manage protective gear, and instruct them to use it appropriately.				
		(4)	Ensure that workers use appropriate protective gear depending on the work, and undertake work in a safe and secure manner.				
Safety helmet	6.9.2	(1)	The Contractor shall ensure that safety helmets are used to reduce the impact to the head in the event of a fall, and protect the head from flying or falling objects.				
		(2)	The Contractor shall inform workers of the type and location of work that requires safety helmets to be worn, and provide them with education on how to use the				

			helmets. They shall also be instructed to use them whenever necessary.				
		(3)	The safety helmet shall be designed or conditioned to fit the head of a wearer, and the chinstrap shall always be tightened when the wearer conducts work with a risk of falling.				
		(4)	The Contractor shall ensure that damaged safety helmets are never used.				
Safety belts	6.9.3		The Contractor shall ensure that:				
		(1)	Safety belts are used to prevent falls when work is undertaken at a high level, on the edge of a working floor, and near an opening where workers may fall.				
		(2)	Safety belts are used that are appropriate to the location or contents of work.				
		(3)	Workers are notified of the type and location of work that requires use of safety belts, and trained to correctly use them. They shall also be instructed to use them whenever necessary.				
		(4)	Damaged safety belts (even if damaged from a single event) are not used.				
		(5)	Safety belt hooks that have a latch are used.				
		(6)	Safety belt hooks are attached at a position higher than the waist.				
		(7)	A safety belt attaching system is installed whenever using a safety belt. The attaching system is strong enough to support a fall, and shall be checked for any anomalies before use.				
Protective gear for the eyes and face	6.9.4	(1)	The Contractor shall ensure that protective gear is used to protect the eyes and face against sparks or minute powder dust generated from grinders, splashes of chemicals from solvents, or sparks or light beams from welding or cutting work.				
		(2)	When using protective gear for the face such as goggles, the right type of goggles shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring face protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				

Protective gear for ears	6.9.5	(1)	The Contractor shall ensure that protective gear is used to protect the ears where strong noise is generated.				
		(2)	When ear protective gear such as ear plugs or earmuffs are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring ear protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Protective gear for hands	6.9.6	(1)	The Contractor shall ensure that protective gear is used to protect hands against substances that may damage the skin, and during welding or cutting work.				
		(2)	When protective gear such as gloves is used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring hand protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Protective gear for feet	6.9.7	(1)	The Contractor shall ensure that protective gear is used to protect feet against injuries from falling objects, being caught between objects, electric shocks and skin-damaging substances.				
		(2)	When protective gear for feet such as safety boots or high boots are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring feet protective gear, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Lifebuoy	6.9.8	(1)	The Contractor shall ensure that lifebuoys are used to prevent drowning accidents, when workers undertake work where they may fall into water.				
		(2)	When lifebuoys are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring lifebuoys, trained to correctly use them and given detailed instructions to use them whenever necessary.				
Respirators	6.9.9	(1)	The Contractor shall ensure that respirators are used to maintain breathing when workers undertake work where there may be explosions, fire, oxygen deficiency, or the				

			handling of toxic gas, and also when such accidents have occurred.				
		(2)	When respirators are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring respirators, trained to correctly use them, and given detailed instructions to use them whenever necessary.				
		(4)	Respirators shall be periodically inspected and always be maintained in good condition.				
Dust and gas masks	6.9.10	(1)	The Contractor shall ensure that dust and gas masks are used to protect workers against harmful conditions, when undertaking work that generates powder dust, gas or steam, or has other health hazards.				
		(2)	When dust and gas masks are used, the right type of gear shall be used taking into account the type of work.				
		(3)	Workers shall be notified of the type and location of work requiring dust and gas masks, trained to correctly use them and given detailed instructions to use them whenever necessary.				
		(4)	When dust and gas masks are used, the working parts of those masks shall be checked prior to use.				
		(5)	Dust masks shall not be used in a place, where there is a low oxygen concentration, or when filled with toxic gas.				
		(6)	When dust masks are used, spare dust masks or filters shall readily be made available.				
		(7)	When workers find it difficult to breathe with dust masks on, they shall immediately change the filters prior to re-use.				
		(8)	Gas masks shall not be used at a place with low oxygen concentration.				
		(9)	When gas masks are used, spare gas masks and canisters shall readily be made available.				
		(10)	The expected expiry of a gas mask shall be determined prior to use.				
		(11)	Whenever workers sense any abnormal odour during use of gas masks, they shall immediately check the status of the filter and change canisters in a safe place as required.				

Appendix 8.1
Inflow Discharge into Mokolo, Klipvoor, Vaalkop, and Roodekopjes Dams

Table App. 8.1-1 Inflow Record into Reservoirs (1/4)

Mokolo Dam Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.00	1.73	9.85	19.65	39.53	22.43	7.53	5.35	3.80	3.27	3.00	2.42	9.88
1981 /82	1.33	1.40	1.13	2.58	0.96	1.41	0.75	0.47	0.35	0.53	0.35	0.23	0.96
1982 /83	0.00	0.00	0.00	0.00	0.00	0.61	0.26	0.36	0.32	0.07	0.19	0.00	0.15
1983 /84	0.00	0.03	0.57	1.92	0.15	0.00	0.08	0.01	0.00	0.00	0.06	0.06	0.24
1984 /85	0.07	0.10	2.07	2.91	6.08	6.43	1.63	0.51	0.15	0.11	0.00	0.08	1.68
1985 /86	0.03	0.11	0.02	0.05	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.02
1986 /87	0.00	0.00	6.69	5.64	1.41	0.53	0.45	0.12	0.00	0.00	0.00	0.00	1.24
1987 /88	0.00	0.17	10.99	3.21	3.70	0.00	5.33	3.02	1.11	1.04	0.41	0.22	2.43
1988 /89	0.12	0.54	0.42	1.02	5.55	7.42	3.17	2.40	1.55	0.80	0.44	0.09	1.96
1989 /90	0.05	0.05	1.93	1.09	4.53	2.64	3.10	2.33	0.84	0.61	0.33	0.13	1.47
1990 /91	0.01	0.16	0.05	0.30	8.29	21.02	10.25	3.20	1.82	1.04	0.44	0.05	3.89
1991 /92	0.05	0.00	0.00	0.01	0.23	0.10	0.00	0.00	0.00	0.00	0.02	0.14	0.05
1992 /93	0.15	0.00	0.14	0.07	0.00	0.00	0.04	0.00	0.00	0.04	0.06	0.09	0.05
1993 /94	0.06	0.02	2.50	8.51	30.72	5.77	3.05	1.03	0.52	0.46	0.21	0.00	4.40
1994 /95	0.00	0.04	0.00	0.00	0.00	0.41	0.95	0.64	0.23	0.10	0.09	0.12	0.22
1995 /96	0.06	0.23	19.85	31.48	0.00	37.01	11.41	7.23	4.96	3.97	2.81	1.13	10.01
1996 /97	0.53	2.28	5.90	8.31	7.76	24.93	8.92	6.10	4.85	0.00	0.00	0.00	5.80
1997 /98	0.00	1.26	0.00	6.11	1.62	1.06	0.41	0.07	0.17	0.39	0.30	0.13	0.96
1998 /99	-	-	-	-	7.04	2.27	1.23	0.71	2.15	0.00	0.56	0.00	1.75
1999 /00	0.03	0.12	0.89	34.16	73.75	32.84	39.16	16.05	11.67	7.41	4.92	2.42	18.62
2000 /01	1.74	1.23	2.32	0.84	1.31	16.69	5.67	4.23	2.42	1.79	1.18	0.38	3.32
2001 /02	0.28	19.91	34.61	7.11	3.70	1.91	1.44	0.91	1.94	0.94	0.58	0.30	6.14
2002 /03	0.07	0.24	0.00	0.76	0.29	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.13
2003 /04	0.05	0.21	0.07	0.55	3.25	43.72	27.03	7.56	4.09	2.84	1.58	0.47	7.62
2004 /05	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
2005 /06	0.00	0.03	0.00	3.73	25.04	51.25	12.02	5.50	3.69	2.45	1.54	0.56	8.82
2006 /07	0.40	0.30	0.34	0.47	0.11	0.02	0.26	0.00	0.01	0.00	0.32	0.00	0.19
2007 /08	0.20	4.34	25.00	52.88	17.67	9.09	6.71	3.74	2.06	1.43	0.87	0.10	10.34
2008 /09	0.73	4.66	8.72	32.30	40.16	24.22	8.02	6.81	4.86	3.30	2.05	1.27	11.42
2009 /10	2.50	1.52	3.84	8.99	11.25	3.72	37.29	29.13	11.00	6.44	5.17	3.31	10.35
2010 /11	1.34	2.08	7.50	45.81	15.91	8.03	11.06	5.35	4.11	3.16	1.91	0.36	8.89
2011 /12	0.59	0.00	9.22	31.80	13.53	4.14	0.00	1.71	1.53	1.26	0.65	0.85	5.44
2012 /13	0.75	1.04	8.51	10.62	11.82	2.86	2.76	1.50	0.80	0.74	0.05	0.00	3.45
2013 /14	0.00	0.00	0.34	6.62	4.96	136.45	26.07	10.17	5.74	4.08	2.51	1.45	16.53
2014 /15	0.60	2.86	10.42	9.99	11.98	2.68	3.74	1.62	0.67	0.97	0.30	1.02	3.90
2015 /16	0.00	0.03	0.34	0.01	0.08	4.07	1.34	0.59	0.45	0.23	0.14	1.00	0.69
2016 /17	0.00	0.18	2.41	5.69	11.28	0.00	0.00	0.00	0.00	-	-	-	2.17
Average	0.33	1.30	4.91	9.59	9.83	12.86	6.52	3.47	2.10	1.37	0.92	0.51	4.48

Source: DWS

Table App. 8.1-2 Inflow Record into Reservoirs (2/4)

Klipvoor Dam Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.67	3.07	10.59	3.97	7.04	5.21	1.46	1.62	1.52	1.51	1.31	1.32	3.27
1981 /82	1.22	1.16	2.36	4.84	2.47	2.13	0.92	1.02	1.00	1.36	1.14	0.74	1.70
1982 /83	1.18	1.29	0.99	4.36	1.17	1.25	1.33	0.86	1.12	1.05	0.98	0.48	1.34
1983 /84	0.50	3.86	3.46	1.97	0.00	1.53	1.08	0.45	0.71	1.08	0.62	0.25	1.29
1984 /85	2.01	0.68	1.44	2.62	0.71	2.39	0.44	0.70	0.65	0.66	0.42	0.29	1.08
1985 /86	0.08	1.86	2.03	1.42	0.65	0.22	0.46	0.42	0.57	0.57	0.45	0.24	0.75
1986 /87	8.83	4.19	14.03	4.78	0.78	2.54	1.23	0.60	0.68	0.73	0.75	1.12	3.35
1987 /88	1.25	2.40	4.64	1.70	0.61	3.19	1.71	0.97	0.89	0.99	0.93	1.03	1.69
1988 /89	1.31	0.89	1.13	1.92	15.46	5.66	1.35	1.76	2.33	1.29	1.23	0.92	2.94
1989 /90	0.80	2.96	6.16	1.72	1.96	3.83	1.55	2.79	1.31	1.42	1.32	1.04	2.24
1990 /91	1.58	0.55	1.41	3.04	7.15	14.87	3.17	1.14	1.38	1.17	1.15	0.91	3.13
1991 /92	0.48	0.82	1.88	0.83	0.74	0.35	0.29	0.46	0.72	0.73	0.69	0.42	0.70
1992 /93	0.22	1.13	1.81	1.60	3.68	2.16	1.13	0.61	0.87	0.83	0.78	0.34	1.26
1993 /94	2.74	1.88	2.74	3.40	9.71	1.71	1.64	1.10	0.76	0.99	1.02	0.38	2.34
1994 /95	0.36	1.34	2.03	1.98	2.06	2.12	3.86	5.29	1.37	1.26	0.94	0.41	1.92
1995 /96	0.62	3.44	8.59	13.21	85.01	22.12	5.16	3.47	2.67	2.43	2.10	1.03	12.49
1996 /97	0.91	3.30	6.91	4.57	1.19	19.41	10.85	5.03	8.36	3.71	2.79	3.33	5.86
1997 /98	2.01	3.68	4.44	6.22	3.11	2.59	1.79	1.15	1.38	1.55	1.36	1.14	2.53
1998 /99	2.59	5.40	8.35	7.06	2.02	1.53	2.27	2.52	2.10	1.84	1.37	1.00	3.17
1999 /00	0.84	0.89	3.94	18.08	57.83	20.57	19.76	6.25	0.00	3.59	2.98	2.28	11.42
2000 /01	4.99	6.96	8.93	1.95	3.56	4.26	2.03	3.39	1.99	2.02	1.70	1.43	3.60
2001 /02	1.32	0.00	0.00	2.40	2.56	1.35	0.00	1.22	1.87	1.38	1.32	1.39	1.23
2002 /03	1.04	1.35	2.02	4.24	3.26	2.49	1.24	0.88	1.31	1.16	1.12	0.78	1.74
2003 /04	0.96	1.40	1.28	2.70	5.93	0.00	5.84	2.84	1.88	2.02	1.64	1.04	2.29
2004 /05	0.66	1.28	3.90	8.89	2.93	3.05	4.30	1.58	1.31	1.26	1.23	0.61	2.58
2005 /06	0.29	1.07	1.51	14.96	21.19	28.55	4.12	2.42	2.15	2.08	2.24	1.40	6.83
2006 /07	0.90	2.74	1.54	2.54	1.23	0.50	0.64	0.85	1.64	1.45	1.19	0.72	1.33
2007 /08	5.45	2.40	7.66	53.11	8.89	17.50	6.61	4.48	3.33	2.53	1.95	0.92	9.57
2008 /09	0.86	4.83	2.79	7.15	15.10	14.68	3.41	3.14	3.53	2.98	2.78	1.47	5.23
2009 /10	3.40	5.81	8.81	9.23	6.48	3.15	21.08	13.77	4.91	3.65	2.60	1.26	7.01
2010 /11	0.87	2.03	11.55	31.22	11.04	8.87	12.94	6.24	4.36	3.41	3.00	1.85	8.11
2011 /12	2.05	3.08	5.18	5.06	4.04	1.73	2.34	1.68	1.74	1.91	1.68	2.69	2.77
2012 /13	5.14	6.21	8.22	3.86	3.36	2.21	4.46	2.85	2.24	2.56	2.15	1.21	3.71
2013 /14	1.92	3.06	9.66	4.10	7.85	35.13	7.01	3.59	3.18	2.93	2.57	0.00	6.75
2014 /15	1.31	3.30	8.80	8.41	3.88	2.95	3.28	2.11	2.55	2.33	1.90	2.49	3.61
2015 /16	0.78	1.79	1.20	5.30	2.00	10.80	2.51	3.46	2.85	2.28	1.97	1.10	3.00
2016 /17	1.79	3.95	2.78	10.47	16.02	8.16	4.93	3.60	0.00	0.00	0.00	-	4.70
Average	1.73	2.60	4.72	7.16	8.72	7.05	4.01	2.60	1.92	1.75	1.50	1.08	3.74

Source: DWS

Table App. 8.1-3 Inflow Record into Reservoirs (3/4)

Vaalkop Dam Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.00	4.65	8.56	18.99	12.15	12.39	2.57	0.48	0.18	0.00	0.32	0.09	5.03
1981 /82	0.00	1.17	2.89	3.71	3.17	0.84	0.10	0.00	0.05	0.13	0.15	0.13	1.03
1982 /83	0.42	0.26	0.22	0.20	0.13	0.03	0.00	0.00	0.00	0.01	0.02	0.02	0.11
1983 /84	0.02	0.10	1.05	0.42	0.03	0.03	0.00	0.14	0.00	0.58	0.00	1.06	0.29
1984 /85	1.19	0.65	0.82	4.50	0.76	0.54	0.00	0.01	0.02	0.02	0.03	0.04	0.72
1985 /86	0.30	0.26	0.00	0.01	0.48	0.10	0.20	0.00	0.00	0.00	0.00	0.00	0.11
1986 /87	0.03	0.17	1.79	2.21	0.13	1.19	0.02	0.00	0.01	0.00	0.01	6.22	0.98
1987 /88	0.09	0.10	1.87	0.31	1.09	2.04	0.00	0.00	0.00	0.15	0.23	0.08	0.50
1988 /89	0.05	0.02	0.10	0.37	2.73	0.11	0.00	0.01	0.00	0.00	0.00	0.00	0.28
1989 /90	0.13	0.63	0.97	0.36	1.15	0.03	0.17	0.00	0.00	0.00	0.00	0.35	0.32
1990 /91	0.33	0.00	0.29	1.84	9.51	3.94	0.00	0.00	0.00	0.04	0.00	0.00	1.33
1991 /92	0.33	0.00	0.02	0.00	0.05	0.18	0.08	0.02	0.00	0.00	0.00	0.00	0.06
1992 /93	0.00	0.10	1.44	0.35	0.00	0.21	0.04	0.05	0.00	0.05	0.01	0.00	0.19
1993 /94	0.07	0.00	0.04	0.05	3.99	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.35
1994 /95	0.00	0.00	0.04	0.00	0.27	9.62	2.52	0.70	0.00	0.00	0.00	0.09	1.10
1995 /96	0.12	1.25	17.10	3.05	35.43	3.63	0.31	0.10	0.04	0.00	0.00	0.00	5.09
1996 /97	0.00	0.00	0.41	3.93	0.00	46.13	0.00	26.92	6.34	2.50	1.17	2.35	7.48
1997 /98	0.07	0.06	0.07	1.67	0.22	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.20
1998 /99	0.02	0.00	5.46	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
1999 /00	0.00	0.00	0.44	4.23	0.00	25.83	12.52	3.49	2.04	1.15	0.31	0.00	4.17
2000 /01	0.42	0.00	6.44	0.00	0.00	0.00	0.00	1.48	0.00	0.00	0.00	0.06	0.70
2001 /02	0.80	0.00	12.93	1.92	5.92	0.00	0.03	0.12	0.42	0.00	0.00	0.00	1.84
2002 /03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.66	0.16
2003 /04	0.55	0.58	0.00	3.21	6.71	9.82	0.96	0.00	0.43	0.48	0.40	0.35	1.96
2004 /05	0.27	0.27	0.93	1.04	1.37	0.00	0.00	0.13	0.18	0.44	0.63	0.00	0.44
2005 /06	0.00	0.00	0.96	5.49	10.95	0.00	0.00	0.00	0.00	0.00	0.94	0.00	1.53
2006 /07	0.14	0.71	0.41	0.06	0.97	0.00	0.05	0.17	1.62	0.00	0.32	0.12	0.38
2007 /08	2.12	2.02	4.64	8.66	3.55	6.37	1.12	0.00	0.74	0.46	0.44	0.20	2.53
2008 /09	0.09	1.06	0.25	3.65	0.00	0.00	0.00	0.59	0.74	0.49	0.00	0.00	0.57
2009 /10	0.41	0.07	0.85	7.63	1.75	0.22	3.59	13.53	1.76	0.00	1.33	0.94	2.67
2010 /11	0.62	0.87	12.68	28.66	6.94	9.08	9.24	4.65	6.35	3.37	2.89	2.24	7.30
2011 /12	1.31	0.65	2.21	2.08	0.00	0.84	0.62	0.01	0.13	0.00	0.00	0.37	0.69
2012 /13	0.00	0.00	0.46	1.59	0.34	0.00	0.68	0.08	0.00	0.13	0.00	0.00	0.27
2013 /14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014 /15	0.00	0.00	0.00	0.74	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.22	0.08
2015 /16	0.00	0.00	0.00	0.00	0.00	4.89	0.00	0.00	0.00	0.00	0.00	0.00	0.41
2016 /17	0.00	0.00	0.00	18.02	67.38	5.64	0.00	0.00	0.00	0.00	0.00	-	8.28
Average	0.27	0.42	2.33	3.52	4.79	3.89	0.94	1.42	0.57	0.27	0.28	0.43	1.60

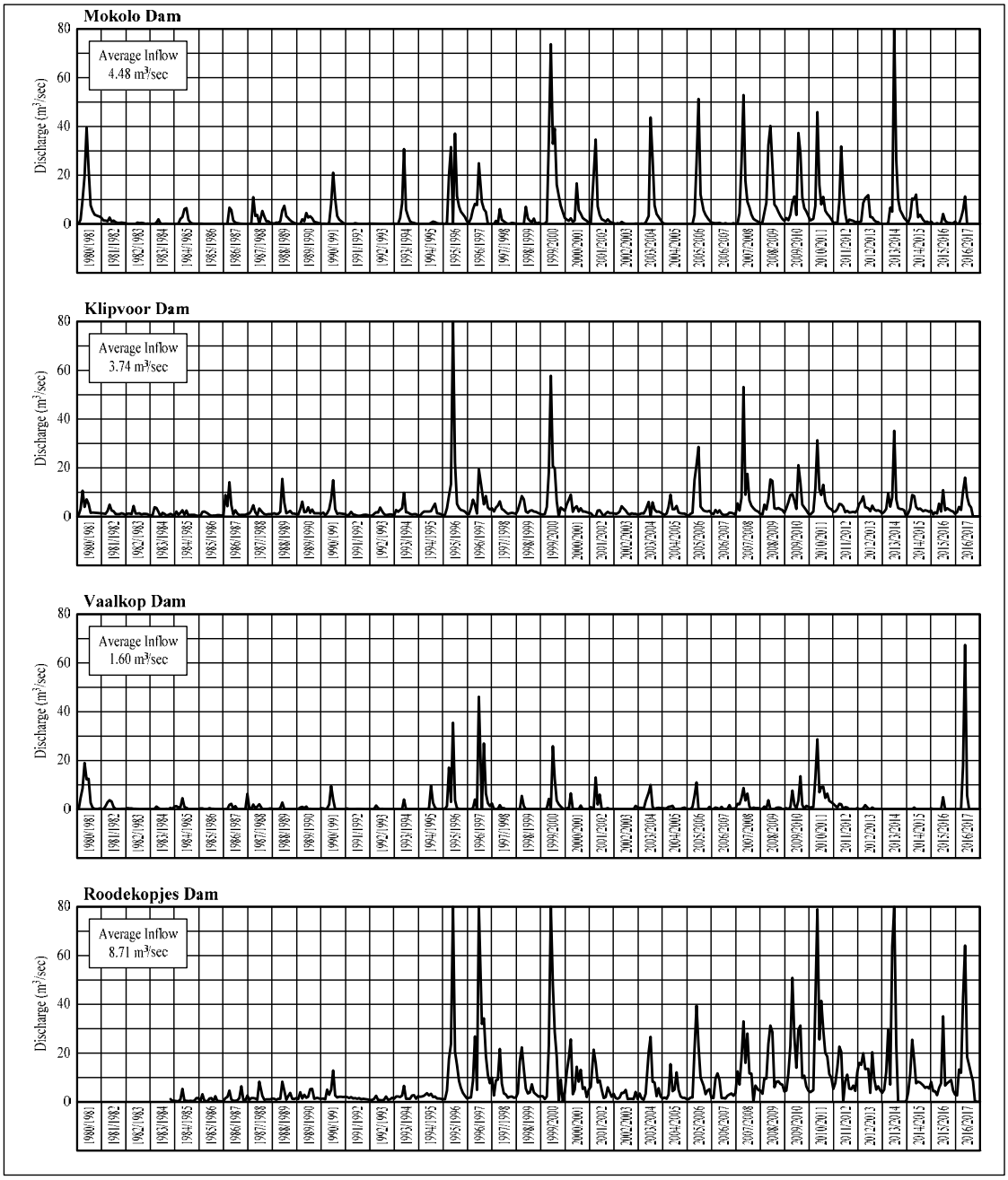
Source: DWS

Table App. 8.1-4 Inflow Record into Reservoirs (4/4)

Roodekopjes Dam Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	1.15	0.23	0.44	0.60
1984 /85	0.25	0.19	1.01	5.24	0.38	0.48	0.25	0.40	0.32	0.35	1.52	1.53	0.99
1985 /86	0.33	3.14	0.42	0.19	1.30	1.50	0.18	2.30	0.30	0.22	0.15	0.20	0.85
1986 /87	1.54	1.91	4.63	1.01	0.35	0.47	0.53	1.47	6.38	0.63	0.59	2.58	1.84
1987 /88	0.85	1.46	1.46	1.32	0.85	8.28	2.44	0.86	0.93	1.01	0.99	1.42	1.82
1988 /89	1.29	0.82	1.24	1.29	8.23	4.65	0.86	2.33	3.69	1.25	1.14	1.52	2.36
1989 /90	1.15	3.97	1.37	2.82	1.63	2.09	5.11	5.34	1.29	1.62	1.37	1.20	2.42
1990 /91	1.36	0.95	4.99	2.81	4.93	12.79	2.53	1.83	2.00	2.01	1.94	2.00	3.35
1991 /92	1.88	1.53	1.94	1.30	1.51	1.24	1.45	1.00	1.22	1.10	0.93	0.88	1.33
1992 /93	0.62	1.26	2.46	0.71	0.74	0.61	0.83	2.11	0.85	1.02	1.59	1.22	1.17
1993 /94	2.12	2.13	1.88	2.52	6.47	1.20	1.20	1.25	2.63	2.75	1.20	2.36	2.31
1994 /95	1.99	2.22	2.47	3.58	2.59	3.22	1.88	2.21	1.35	1.37	1.17	0.97	2.08
1995 /96	1.01	4.60	17.56	23.68	124.18	20.62	15.00	8.57	5.68	3.63	2.43	1.32	19.02
1996 /97	1.61	1.81	8.73	26.81	4.90	100.55	31.92	34.28	18.75	10.96	7.59	9.82	21.48
1997 /98	2.63	8.77	9.07	21.65	7.48	3.37	2.97	1.57	1.98	2.23	1.65	1.75	5.43
1998 /99	3.55	16.51	22.28	13.36	5.40	3.39	3.82	7.18	3.78	3.15	2.07	2.35	7.24
1999 /00	2.31	1.09	2.15	23.18	183.25	48.12	28.75	18.40	0.00	9.09	0.00	3.93	26.69
2000 /01	12.37	17.96	25.53	3.13	5.06	14.31	8.29	13.10	5.25	5.91	1.93	4.95	9.82
2001 /02	6.06	21.45	15.96	7.80	8.78	4.82	1.56	1.84	5.90	3.99	2.05	3.26	6.96
2002 /03	1.50	1.24	1.77	3.71	3.62	4.90	1.06	1.20	1.24	1.07	4.02	1.08	2.20
2003 /04	3.33	1.34	0.75	3.26	20.50	26.72	8.27	7.82	2.27	5.59	2.18	1.33	6.95
2004 /05	1.72	1.28	2.79	15.36	4.27	5.01	11.99	4.82	2.12	1.65	1.58	1.04	4.47
2005 /06	0.94	1.81	1.81	21.58	39.55	22.89	9.97	6.60	3.15	4.61	5.09	1.57	9.96
2006 /07	1.53	9.68	11.69	8.97	1.51	1.48	1.38	2.47	2.98	3.40	2.40	3.64	4.26
2007 /08	12.50	6.98	17.87	33.00	15.99	27.96	11.71	11.49	0.00	6.65	4.81	4.58	12.80
2008 /09	3.31	9.58	9.49	23.86	31.23	28.58	5.91	8.25	8.40	7.26	7.05	4.17	12.26
2009 /10	4.56	11.43	22.93	50.92	26.72	13.90	29.64	31.20	9.76	10.75	6.41	4.67	18.57
2010 /11	3.93	4.71	41.17	78.95	25.59	41.41	29.51	20.00	18.54	11.38	9.84	5.25	24.19
2011 /12	7.73	14.06	22.60	20.63	0.00	8.56	11.16	5.42	5.14	6.67	4.48	12.24	9.89
2012 /13	16.00	15.11	19.89	13.43	13.59	3.61	20.26	9.35	4.95	6.37	4.77	3.71	10.92
2013 /14	4.97	12.21	29.73	7.07	63.83	108.56	23.27	0.00	0.00	0.00	0.00	0.00	20.80
2014 /15	3.81	11.36	25.38	17.09	7.59	8.28	7.87	6.76	5.73	6.16	5.40	8.11	9.46
2015 /16	4.32	4.31	2.67	5.66	7.57	35.03	6.65	7.59	8.23	8.95	4.58	2.96	8.21
2016 /17	2.57	13.31	11.86	42.89	64.06	18.35	14.96	11.37	8.46	0.00	0.00	-	17.08
Average	3.50	6.37	10.53	14.81	21.02	17.79	9.19	7.28	4.34	3.94	2.74	2.97	8.71

Source: DWS



Source: DWS

Figure App. 8.1-1 Inflow Record into Reservoirs

Appendix 8.2
Reservoir Water Level at Mokolo, Klipvoor, Vaalcap, and Roodekopjes Dams

Table APP. 8.2-1 Reservoir Water Level at 4 Dams (1/4)

Mokolo Dam Unit : El.m

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	908.27	907.72	907.84	910.42	912.42	912.36	912.23	912.18	912.09	912.09	912.07	912.08	910.98
1981 /82	912.03	911.93	911.86	911.78	911.90	911.86	911.89	911.83	911.66	911.49	911.34	910.64	911.68
1982 /83	910.35	909.44	909.02	908.72	908.41	907.27	906.22	905.91	905.54	905.21	904.85	904.55	907.12
1983 /84	902.04	901.57	901.21	901.04	900.64	900.12	899.57	899.13	898.51	898.05	897.60	897.00	899.71
1984 /85	896.45	895.87	895.25	895.92	897.16	899.84	902.58	902.72	902.39	901.51	900.58	898.67	899.08
1985 /86	897.94	897.22	896.31	895.52	894.58	893.76	892.95	892.77	892.48	892.14	891.84	891.54	894.09
1986 /87	891.17	890.90	890.63	895.53	896.97	897.39	896.97	896.09	895.80	895.46	895.18	894.90	894.75
1987 /88	894.69	892.15	891.87	899.05	899.39	900.82	907.30	908.99	909.90	909.40	909.36	909.25	902.68
1988 /89	908.89	908.14	907.91	907.52	907.19	908.78	911.18	911.96	912.03	912.03	911.97	911.28	909.91
1989 /90	910.82	910.30	909.64	909.84	909.64	910.52	910.89	911.41	911.97	911.97	911.72	911.31	910.84
1990 /91	910.70	910.13	909.36	908.72	908.36	910.62	912.39	912.11	912.05	912.03	912.00	911.67	910.84
1991 /92	911.10	910.36	909.49	908.93	908.49	907.72	907.47	907.20	906.91	906.68	905.25	904.59	907.85
1992 /93	903.93	903.44	903.20	902.41	902.11	901.92	901.67	901.40	901.11	900.84	900.57	898.89	901.79
1993 /94	898.15	896.85	896.60	897.86	902.07	912.21	912.13	912.07	912.01	911.92	911.59	911.36	906.23
1994 /95	910.80	909.08	908.10	907.77	907.31	906.62	906.58	906.76	906.19	906.07	905.42	905.18	907.16
1995 /96	904.51	903.73	902.92	910.55	912.57	912.62	912.29	912.18	912.15	912.11	912.10	912.05	909.98
1996 /97	911.81	911.54	911.69	912.07	912.15	912.12	912.34	912.14	912.24	912.09	912.07	912.02	912.02
1997 /98	912.00	911.87	911.79	911.15	912.13	912.03	911.63	911.09	910.73	910.16	910.05	909.45	911.17
1998 /99	908.79	-	908.09	-	912.22	912.10	912.09	912.00	911.70	911.84	911.45	911.12	911.14
1999 /00	910.38	909.68	909.07	909.16	912.38	912.53	912.46	912.41	912.25	912.24	912.14	912.09	911.40
2000 /01	912.04	912.00	911.82	912.04	911.53	911.29	912.16	912.09	912.06	911.89	912.02	911.99	911.91
2001 /02	911.40	910.80	912.67	912.30	912.08	912.03	911.99	911.93	911.70	911.81	911.69	911.37	911.81
2002 /03	910.93	910.31	909.68	909.21	909.03	908.71	908.40	908.12	907.81	906.91	906.23	905.98	908.44
2003 /04	905.16	903.99	903.73	903.37	903.36	904.48	911.98	912.22	912.09	912.08	912.05	912.01	908.04
2004 /05	911.52	910.96	910.32	910.69	910.85	910.44	910.13	910.02	909.93	909.73	908.91	908.44	910.16
2005 /06	907.62	906.83	906.59	905.84	907.12	912.76	912.39	912.17	912.11	912.10	912.03	911.98	909.96
2006 /07	911.32	910.68	910.30	909.74	909.50	908.91	908.61	908.44	908.18	907.97	906.51	905.81	908.83
2007 /08	905.19	904.98	906.49	912.21	912.45	912.19	912.10	912.02	912.05	911.97	912.02	911.86	910.46
2008 /09	911.39	910.79	911.34	912.15	912.79	912.16	911.87	911.74	912.07	912.08	912.06	912.02	911.87
2009 /10	912.04	912.05	912.04	912.08	912.27	912.15	912.07	912.55	912.29	912.20	912.15	912.10	912.17
2010 /11	912.03	911.50	911.40	911.64	912.29	912.15	912.06	912.58	912.04	912.03	912.05	912.05	911.99
2011 /12	911.66	911.44	911.30	912.47	912.38	912.11	912.10	912.04	912.01	911.84	911.70	911.38	911.87
2012 /13	911.16	911.02	910.71	911.85	912.20	912.08	912.01	912.05	912.00	911.73	911.63	911.19	911.64
2013 /14	910.75	909.73	909.06	908.86	911.05	912.12	912.27	912.14	912.17	912.14	912.11	912.06	911.21
2014 /15	911.78	911.40	911.62	912.18	912.14	912.08	912.04	912.10	912.01	911.84	911.68	911.19	911.84
2015 /16	910.87	910.12	909.30	908.67	908.03	907.71	908.71	908.80	908.30	908.16	907.09	906.84	908.55
2016 /17	905.77	905.28	904.81	905.21	907.26	910.64	912.05	912.03	912.02	-	-	-	908.34
Average	907.77	907.11	906.89	907.62	908.23	908.84	909.35	909.33	909.20	908.94	908.64	908.27	908.35

Source: DWS

Table APP. 8.2-2 Reservoir Water Level at 4 Dams (2/4)

Klipvoor Dam Unit : El.m

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	986.99	985.63	986.71	989.11	989.22	989.19	989.12	989.14	989.12	989.13	988.85	988.23	988.37
1981 /82	987.42	986.18	985.80	986.62	988.46	988.51	988.44	988.55	988.66	988.40	987.82	986.67	987.63
1982 /83	984.28	983.12	983.35	982.36	983.97	980.99	980.15	981.45	982.12	983.00	983.72	984.16	982.72
1983 /84	981.06	980.25	983.65	985.30	983.23	978.99	981.07	982.03	982.33	982.86	983.73	983.94	982.37
1984 /85	979.57	981.98	981.14	981.16	981.90	980.27	982.50	982.67	983.22	983.51	983.95	982.54	982.03
1985 /86	978.82	978.24	979.01	981.71	982.81	979.05	979.29	979.77	980.16	980.84	981.45	981.82	980.25
1986 /87	981.90	987.65	987.85	989.37	988.98	988.04	987.56	987.61	987.69	987.82	987.99	987.01	987.46
1987 /88	985.88	984.46	984.67	986.49	985.90	984.42	986.01	986.82	987.16	987.28	987.39	987.19	986.14
1988 /89	986.45	985.99	985.43	985.11	984.41	989.34	989.15	989.12	989.10	989.11	988.99	988.60	987.57
1989 /90	987.71	986.93	987.82	989.13	988.53	988.52	989.11	989.15	989.11	989.05	989.11	988.87	988.59
1990 /91	988.01	987.50	986.56	986.00	986.53	988.92	989.23	989.11	989.10	989.10	989.09	988.92	988.17
1991 /92	988.13	987.17	986.84	987.21	986.14	984.39	983.61	983.48	983.59	983.86	984.14	983.98	985.21
1992 /93	982.80	981.91	982.67	983.90	983.00	984.05	984.02	984.34	984.52	984.88	985.17	984.72	983.83
1993 /94	981.36	982.55	982.87	983.67	984.51	988.69	988.41	988.53	988.67	988.22	987.79	987.12	986.03
1994 /95	985.14	982.96	983.25	983.28	983.16	981.24	981.41	984.66	987.47	987.61	987.30	986.58	984.50
1995 /96	984.43	982.81	985.08	988.81	989.43	989.44	989.16	989.14	989.14	989.13	989.14	989.00	987.89
1996 /97	988.28	987.52	988.25	989.08	989.11	988.20	989.20	989.15	989.30	989.15	989.15	989.13	988.79
1997 /98	989.12	988.68	989.08	988.94	989.06	988.80	988.46	988.62	988.80	988.86	988.87	988.59	988.83
1998 /99	987.79	987.84	989.17	989.22	989.03	988.27	987.73	988.22	989.01	989.12	989.11	988.93	988.62
1999 /00	988.00	987.10	986.93	988.26	989.21	989.26	989.30	989.17	989.15	989.15	989.14	989.11	988.65
2000 /01	989.07	989.26	989.16	989.11	988.69	988.62	989.12	989.07	989.10	989.10	989.10	988.89	989.02
2001 /02	988.25	987.81	989.21	989.12	988.86	988.66	988.47	988.62	988.88	989.08	989.09	988.90	988.75
2002 /03	988.39	987.59	987.21	987.09	987.57	987.60	987.20	987.47	987.65	987.07	986.83	985.81	987.29
2003 /04	984.17	982.78	983.77	982.22	984.23	986.03	989.17	989.13	989.10	989.11	989.10	988.79	986.46
2004 /05	987.79	986.29	986.19	987.04	989.18	988.67	988.64	989.11	989.09	989.05	988.75	987.91	988.14
2005 /06	985.85	983.84	983.72	983.67	989.27	989.39	989.14	989.11	989.10	989.09	989.09	988.87	987.51
2006 /07	988.05	987.03	987.78	987.34	987.74	987.17	986.06	986.09	986.33	986.31	986.60	985.91	986.87
2007 /08	984.55	987.25	987.44	988.97	989.40	989.05	989.19	989.08	989.10	989.07	989.10	988.86	988.42
2008 /09	987.96	987.23	988.90	989.03	989.14	989.23	989.16	989.08	989.11	989.11	989.13	989.04	988.84
2009 /10	988.60	988.87	989.11	989.13	989.20	989.03	989.00	989.32	989.12	989.12	989.11	988.96	989.05
2010 /11	988.13	987.12	987.49	989.15	989.33	989.11	989.28	989.19	989.10	989.12	989.09	989.06	988.76
2011 /12	988.60	988.23	988.75	989.16	989.12	989.09	988.78	989.10	989.10	989.11	989.10	988.96	988.93
2012 /13	988.74	989.15	989.23	989.17	989.07	988.96	988.87	989.14	989.12	989.12	989.11	988.83	989.04
2013 /14	987.81	987.13	987.38	989.17	989.04	989.17	989.18	989.09	989.10	989.10	989.10	989.04	988.69
2014 /15	988.28	987.41	987.83	989.20	989.13	989.01	989.12	989.11	989.09	989.11	989.06	988.80	988.76
2015 /16	988.48	987.34	986.95	985.62	986.90	985.97	989.09	989.10	989.14	989.14	989.12	988.91	987.98
2016 /17	988.00	987.58	987.78	987.57	989.26	989.40	989.12	989.11	989.10	989.12	989.11	-	988.65
Average	986.32	985.90	986.32	986.93	987.34	987.10	987.34	987.59	987.78	987.84	987.88	987.52	987.15

Source: DWS

Table APP. 8.2-3 Reservoir Water Level at 4 Dams (3/4)

Vaalkop Dam Unit : El.m

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	979.17	978.56	979.73	980.64	980.85	980.78	980.76	980.72	980.61	980.46	980.23	979.91	980.20
1981 /82	979.55	979.22	978.93	978.77	978.82	978.64	978.43	978.24	977.98	977.66	977.44	977.17	978.40
1982 /83	976.84	976.74	976.59	976.27	975.93	975.51	975.16	974.91	974.68	974.50	974.32	974.11	975.46
1983 /84	973.83	973.53	973.35	973.93	973.21	972.80	972.53	972.21	972.02	971.66	972.05	971.69	972.73
1984 /85	972.37	973.13	973.32	973.44	976.03	976.02	976.02	975.72	975.48	975.26	975.03	974.71	974.71
1985 /86	974.37	974.14	973.86	973.50	973.08	972.96	972.42	972.27	972.04	972.49	972.96	972.98	973.09
1986 /87	972.57	972.21	972.71	973.85	975.10	974.78	975.18	974.87	974.54	974.22	974.01	973.58	973.97
1987 /88	976.84	976.52	976.32	976.97	976.86	977.10	977.73	977.56	977.31	977.04	976.84	976.17	976.94
1988 /89	975.89	975.60	975.26	975.03	974.87	976.90	976.63	976.40	976.16	976.00	975.74	976.76	975.94
1989 /90	977.54	977.04	976.89	977.05	976.95	977.18	976.94	976.81	977.50	977.89	978.74	978.49	977.42
1990 /91	977.95	977.32	976.83	976.58	977.15	979.85	980.73	980.48	980.24	980.02	979.77	979.75	978.89
1991 /92	979.71	979.44	979.10	978.82	978.42	977.96	977.48	977.09	976.70	976.35	975.97	975.55	977.72
1992 /93	974.94	974.23	974.05	974.69	974.43	973.94	973.37	972.76	972.79	972.80	972.05	972.28	973.53
1993 /94	972.37	971.90	972.32	972.52	972.92	975.23	974.58	974.02	973.49	973.78	974.16	973.46	973.40
1994 /95	973.61	973.17	973.53	973.80	974.03	973.29	978.35	978.96	978.95	978.61	978.28	977.90	976.04
1995 /96	977.41	976.90	976.95	980.75	980.76	980.86	980.69	980.60	980.76	980.65	980.53	980.38	979.77
1996 /97	979.95	979.45	978.99	979.38	980.74	980.52	981.02	980.77	980.87	980.77	980.77	980.76	980.33
1997 /98	980.69	980.34	980.33	980.24	980.74	980.37	980.04	979.65	979.22	978.84	978.40	977.86	979.73
1998 /99	977.26	976.74	977.84	980.31	980.76	980.49	980.04	979.82	979.75	979.63	979.31	979.02	979.25
1999 /00	978.54	977.97	977.43	977.51	979.46	980.86	980.90	980.80	980.82	980.79	980.79	980.64	979.71
2000 /01	980.38	980.51	980.82	980.75	980.30	979.80	979.37	979.95	980.78	980.67	980.50	980.26	980.34
2001 /02	980.12	980.08	980.94	980.82	980.73	980.75	980.43	979.86	979.32	978.97	978.63	978.05	979.89
2002 /03	977.53	976.73	975.60	974.87	975.80	976.73	976.42	975.63	976.21	975.32	974.04	974.99	975.82
2003 /04	973.93	974.02	974.02	974.16	976.10	978.07	980.76	980.70	980.75	980.47	980.36	980.24	977.80
2004 /05	979.66	979.00	978.22	977.79	977.82	978.30	977.89	978.07	978.30	977.92	977.22	976.52	978.06
2005 /06	975.94	975.63	975.34	975.34	977.99	980.92	980.78	980.75	980.68	980.23	979.76	979.86	978.60
2006 /07	979.66	979.18	978.83	978.54	978.77	978.88	977.91	977.10	976.69	977.36	977.46	977.35	978.14
2007 /08	976.78	977.58	978.14	979.45	980.78	980.62	980.78	980.77	980.70	980.77	980.73	980.73	979.82
2008 /09	980.60	980.07	979.90	979.59	980.79	980.62	980.76	980.54	980.75	980.75	980.34	980.25	980.41
2009 /10	980.12	979.89	979.68	979.86	980.82	980.45	980.48	980.79	980.78	980.78	980.77	980.77	980.43
2010 /11	980.62	979.86	979.19	980.75	980.83	980.77	980.81	980.83	980.72	980.75	980.68	980.15	980.50
2011 /12	979.42	978.61	977.86	978.19	978.44	977.80	977.37	977.21	976.91	976.68	976.41	976.50	977.62
2012 /13	976.73	976.85	977.10	977.64	978.40	978.50	977.98	978.18	978.31	978.11	977.72	977.91	977.79
2013 /14	977.78	977.85	977.67	977.99	977.81	980.83	980.83	980.77	980.50	980.15	979.97	979.81	979.33
2014 /15	979.48	979.00	978.80	978.86	978.61	978.18	977.78	977.57	977.33	977.13	977.22	977.31	978.10
2015 /16	977.53	977.34	977.38	977.34	977.29	977.14	978.67	978.53	978.42	978.31	978.35	978.10	977.87
2016 /17	977.83	977.42	977.22	977.75	981.18	980.89	980.53	980.17	980.10	979.91	979.62	-	979.33
Average	977.45	977.13	977.05	977.40	977.93	978.25	978.34	978.16	978.08	977.94	977.76	977.55	977.75

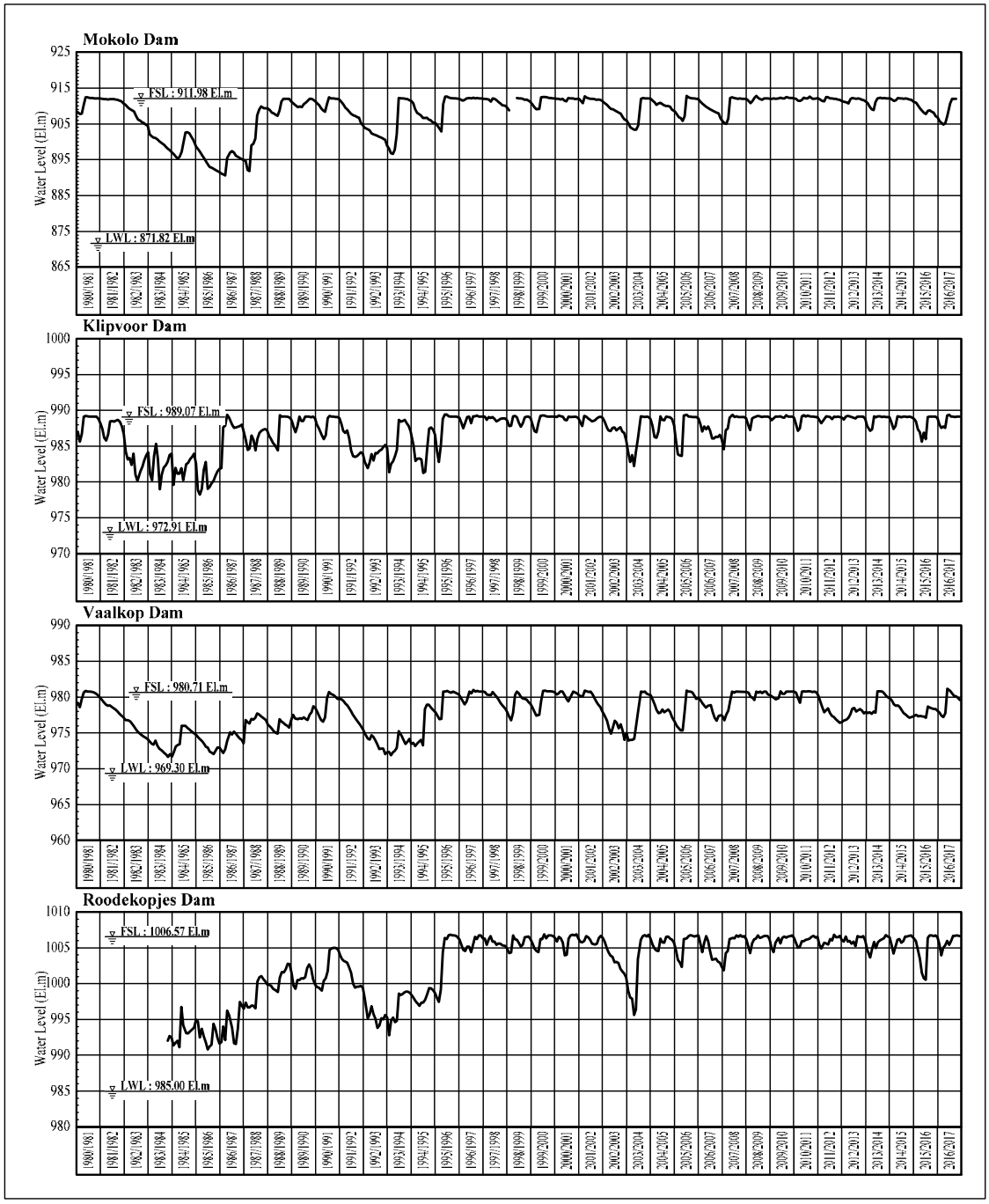
Source: DWS

Table APP. 8.2-4 Reservoir Water Level at 4 Dams (4/4)

Roodekopjes Dam Unit : El.m

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	992.00	992.70	992.45	992.38
1984 /85	991.39	991.75	992.01	991.09	996.74	994.19	993.08	993.02	993.36	993.58	993.85	994.96	993.25
1985 /86	994.70	992.50	993.69	992.64	991.84	990.83	991.19	991.45	994.41	993.63	992.45	991.64	992.58
1986 /87	991.81	994.01	992.12	996.22	995.57	993.79	991.67	991.55	993.74	997.44	996.96	996.49	994.28
1987 /88	997.34	996.69	996.67	996.95	996.90	996.57	1000.32	1000.93	1001.04	1000.66	1000.34	999.88	998.69
1988 /89	999.84	999.68	999.30	999.15	998.82	1000.85	1001.63	1001.57	1002.02	1002.79	1002.75	1001.50	1000.82
1989 /90	999.73	999.26	1000.49	1000.51	1000.75	1000.72	1000.93	1002.17	1002.68	1002.14	1000.60	999.88	1000.82
1990 /91	999.51	999.46	999.05	1000.40	1000.77	1001.77	1004.69	1004.90	1004.96	1005.00	1004.80	1004.26	1002.46
1991 /92	1003.62	1003.26	1003.10	1002.92	1002.29	1001.52	999.98	999.46	999.57	999.61	999.68	999.43	1001.20
1992 /93	997.90	995.15	995.67	996.83	995.74	995.09	993.82	994.18	995.18	995.03	995.65	995.25	995.46
1993 /94	992.79	994.83	995.26	994.63	994.84	998.61	998.43	998.58	998.82	998.88	998.84	998.61	996.93
1994 /95	998.02	997.57	997.23	996.89	997.34	997.34	997.75	998.54	999.40	999.35	999.10	998.67	998.10
1995 /96	998.03	997.46	999.17	1004.35	1006.39	1006.25	1006.78	1006.86	1006.73	1006.75	1006.62	1006.18	1004.30
1996 /97	1005.41	1004.72	1004.56	1005.15	1005.15	1004.39	1005.47	1006.56	1006.23	1006.76	1006.72	1006.33	1005.62
1997 /98	1006.28	1005.40	1006.20	1006.62	1005.86	1005.86	1005.41	1005.61	1005.55	1005.36	1005.25	1004.85	1005.69
1998 /99	1004.26	1004.38	1006.74	1006.19	1006.14	1005.69	1005.17	1005.48	1006.49	1006.55	1006.60	1006.20	1005.82
1999 /00	1005.61	1004.91	1004.56	1004.40	1006.22	1006.22	1006.90	1006.34	1006.74	1006.75	1006.62	1006.41	1005.97
2000 /01	1005.89	1006.53	1006.32	1005.70	1003.95	1004.05	1006.28	1006.74	1006.83	1006.75	1006.87	1006.26	1006.01
2001 /02	1005.81	1005.77	1005.99	1006.63	1006.49	1006.14	1005.56	1005.46	1005.59	1006.38	1006.69	1006.37	1006.07
2002 /03	1005.80	1004.95	1004.37	1003.89	1003.73	1003.00	1003.02	1002.87	1002.07	1001.71	1001.41	1000.87	1003.14
2003 /04	999.04	998.05	997.89	995.62	996.38	1003.44	1006.12	1006.62	1006.78	1006.59	1006.82	1006.30	1002.47
2004 /05	1005.48	1004.91	1004.58	1004.58	1006.30	1005.77	1005.74	1006.55	1006.57	1006.28	1006.13	1005.69	1005.72
2005 /06	1004.70	1003.34	1002.93	1002.30	1006.23	1006.35	1006.64	1006.79	1006.66	1006.57	1006.69	1006.74	1005.49
2006 /07	1005.58	1004.38	1005.73	1006.65	1005.92	1004.49	1003.32	1003.38	1003.47	1003.08	1002.96	1002.35	1004.28
2007 /08	1001.87	1004.24	1004.58	1006.25	1006.39	1006.35	1006.73	1006.54	1006.81	1006.53	1006.62	1006.21	1005.76
2008 /09	1005.27	1004.27	1005.63	1006.16	1006.26	1006.72	1006.40	1006.49	1006.66	1006.67	1006.64	1006.19	1006.11
2009 /10	1005.01	1004.40	1005.72	1006.36	1005.61	1006.37	1006.57	1006.44	1006.57	1006.63	1006.73	1006.37	1006.06
2010 /11	1005.73	1005.04	1005.16	1005.94	1005.91	1006.11	1006.19	1006.28	1006.54	1006.68	1006.41	1006.55	1006.04
2011 /12	1005.40	1004.91	1005.73	1005.62	1005.45	1006.22	1006.04	1006.83	1006.50	1006.47	1006.68	1006.06	1005.99
2012 /13	1005.90	1006.60	1005.87	1005.96	1005.56	1005.87	1005.20	1006.66	1006.53	1006.47	1006.61	1006.01	1006.10
2013 /14	1004.75	1003.62	1004.84	1005.82	1004.96	1005.76	1006.04	1006.20	1006.34	1006.77	1006.57	1006.48	1005.68
2014 /15	1005.43	1004.20	1005.16	1006.13	1006.22	1005.73	1005.92	1006.58	1006.60	1006.69	1006.71	1006.28	1005.97
2015 /16	1005.92	1004.69	1003.47	1001.49	1000.76	1000.53	1006.37	1006.72	1006.72	1006.66	1006.75	1006.46	1004.71
2016 /17	1005.45	1003.97	1004.99	1005.37	1005.99	1005.41	1005.97	1006.67	1006.67	1006.76	1006.61	-	1005.81
Average	1002.10	1001.66	1001.96	1002.28	1002.53	1002.67	1003.07	1003.36	1003.66	1003.41	1003.34	1002.85	1002.74

Source: DWS



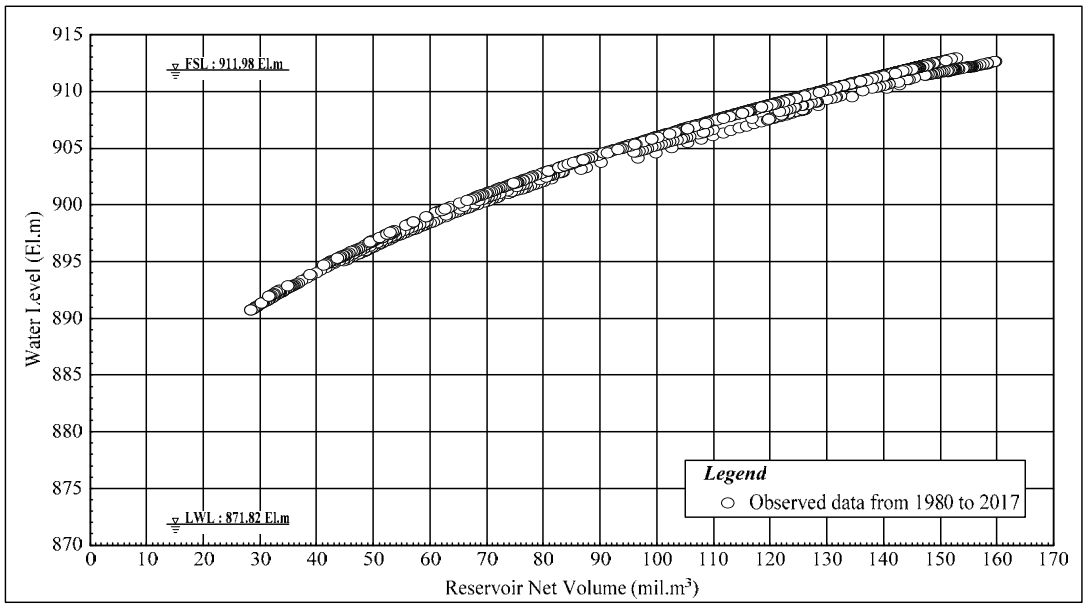
Source: DWS

Figure App. 8.2-1 Reservoir Water Level Record at 4 Dams

Appendix 8.3
Reservoir Height – Volume (H-V) Curves

1) Mokolo Dam

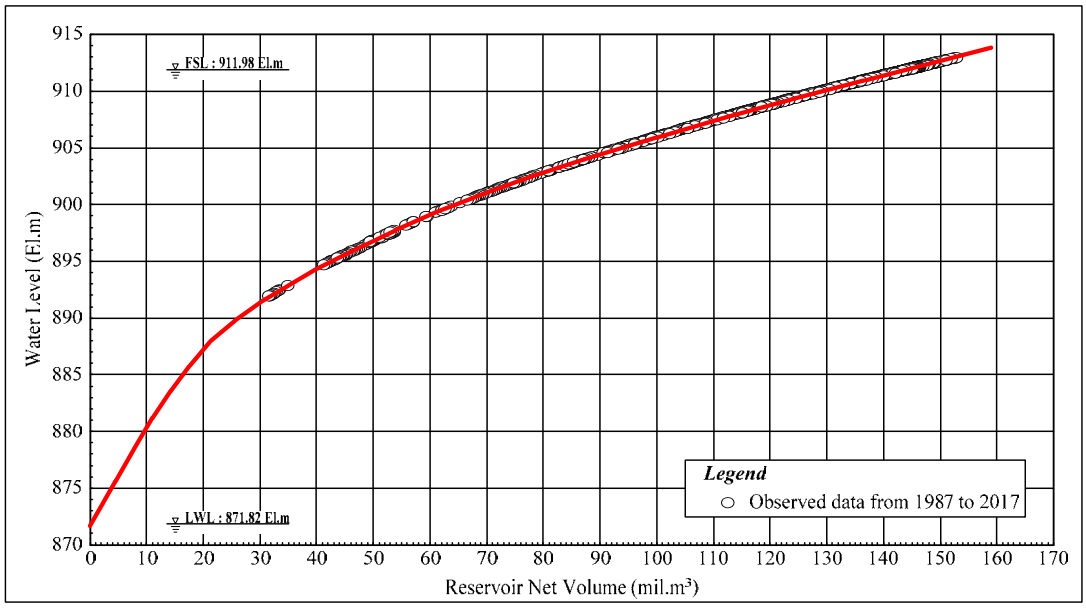
Observation reservoir water level and reservoir volume data of Mokolo dam was observed from April 1980 to September 2017 at weekly interval. Figure App. 8.3-1 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-1 Relationship between Water Level vs Net Volume of Mokolo Reservoir (Data Period: 1980 to 2017)

Reservoir storage volume was decreases year by year due to sediment inflow into reservoir. Figure App. 8.3-1 shows 2 trends in reservoir water level and reservoir storage volume. Figure App. 8.3-2 shows plot of the data after 1987, when the tendency of reservoir water level and reservoir storage volume becomes one.



Source: JST

Figure App. 8.3-2 H-V Curve of Mokolo Reservoir

Relationship between reservoir water level and reservoir volume is compatible, H-V curve of Mokolo

reservoir adopts Figure App. 8.3-2 and Table App. 8.3-1.

Table App. 8.3-1 H-V Curve of Mokolo Reservoir

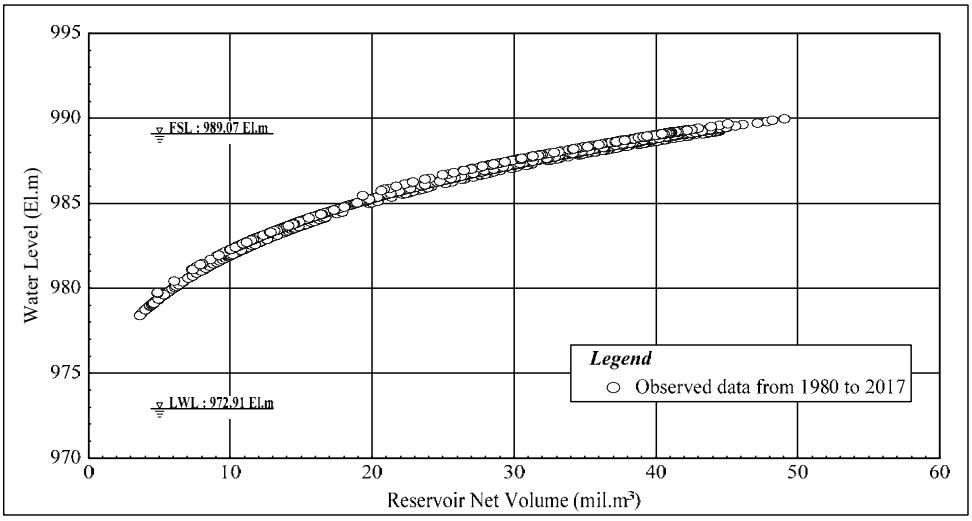
Water Level (El.m)	Net Reservoir Volume (mil.m^3)	Note
871.82	0.0	Low Water Level
875.00	4.0	
880.00	9.5	
885.00	16.5	
890.00	26.0	
895.00	42.5	
900.00	65.0	
905.00	94.0	
910.00	129.5	
911.98	145.8	Full Supply Level

Source: JST

Note: Net Reservoir Volume; reservoir volume between FSL and LWL.

2) Klipvoor Dam

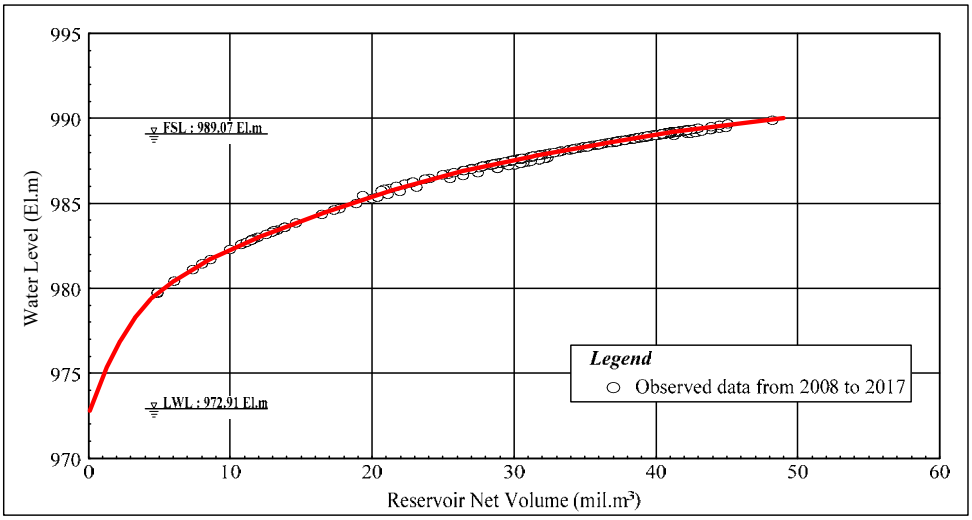
Observation reservoir water level and reservoir volume data of Klipvoor dam was observed from January 1980 to September 2017 at weekly interval. Figure App. 8.3-3 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-3 Relationship between Water Level vs Net Volume of Klipvoor Reservoir (Data Period: 1980 to 2017)

The relationship between reservoir water level and reservoir volume is different in the past and recent years due to sedimentation as well as Mokolo dam. Figure App. 8.3-4 shows plot of the data after 2008, when the tendency of reservoir water level and reservoir storage volume becomes one.



Source: JST

Figure App. 8.3-4 H-V Curve of Klipvoor Reservoir

Relationship between reservoir water level and reservoir volume is compatible, H-V curve of Klipvoor reservoir adopts Figure App. 8.3-4 and Table App. 8.3-2.

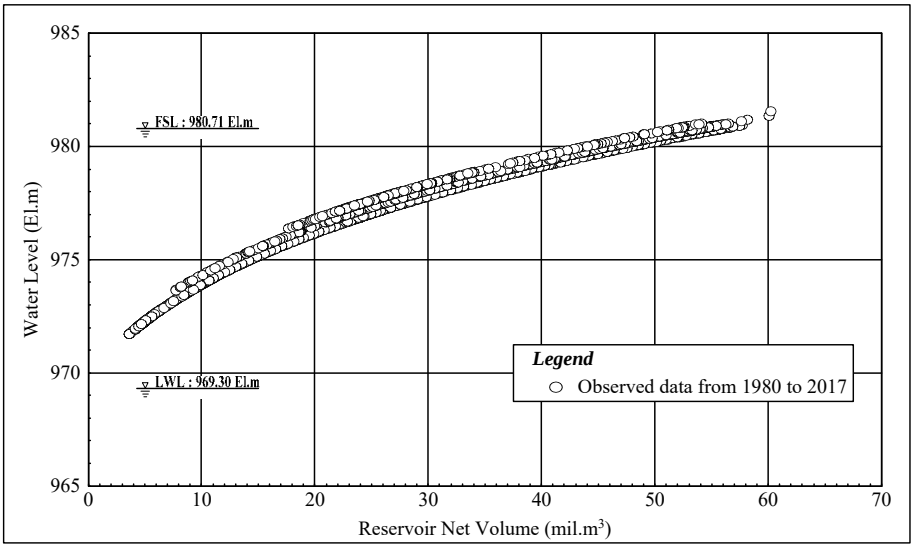
Table App. 8.3-2 H-V Curve of Klipvoor Reservoir

Water Level (El.m)	Net Reservoir Volume (mil.m^3)	Note
972.91	0.0	Low Water Level
975.00	1.1	
977.50	2.7	
980.00	5.3	
982.50	10.7	
985.00	18.4	
987.50	29.8	
989.07	40.7	Full Supply Level

Source: JST

3) Vaalkop Dam

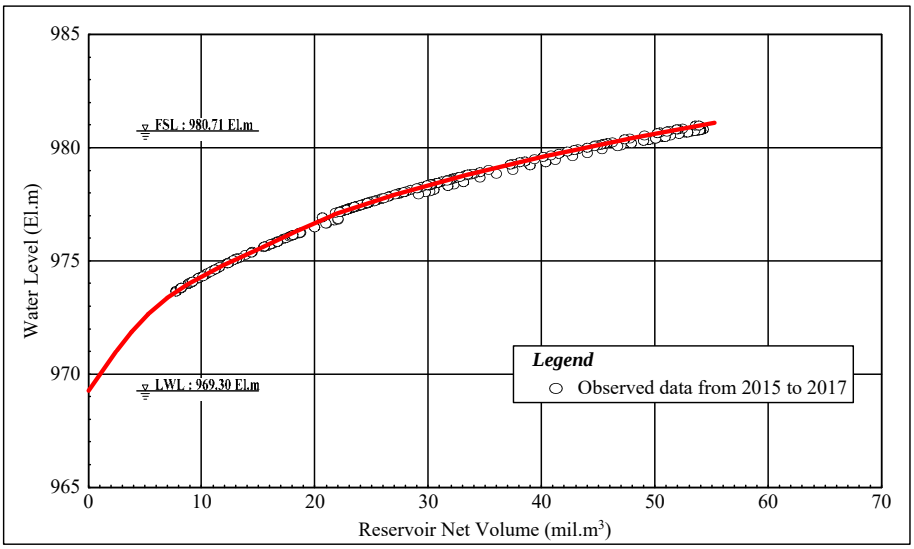
Observation reservoir water level and reservoir volume data of Vaalkop dam was observed from January 1980 to September 2017 at weekly interval. Figure App. 8.3-5 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-5 Relationship between Water Level vs Net Volume of Vaalkop Reservoir (Data Period: 1980 to 2017)

The relationship between reservoir water level and reservoir volume is different in the past and recent years due to sedimentation as well as Mokolo and Klipvoor dams. Figure App. 8.3-6 shows plot of the data after 2015, when the tendency of reservoir water level and reservoir storage volume becomes one.



Source: JST

Figure App. 8.3-6 H-V Curve of Vaalkop Reservoir

Relationship between reservoir water level and reservoir volume is compatible, H-V curve of Vaalkop reservoir adopts Figure App. 8.3-6 and Table App. 8.3-3.

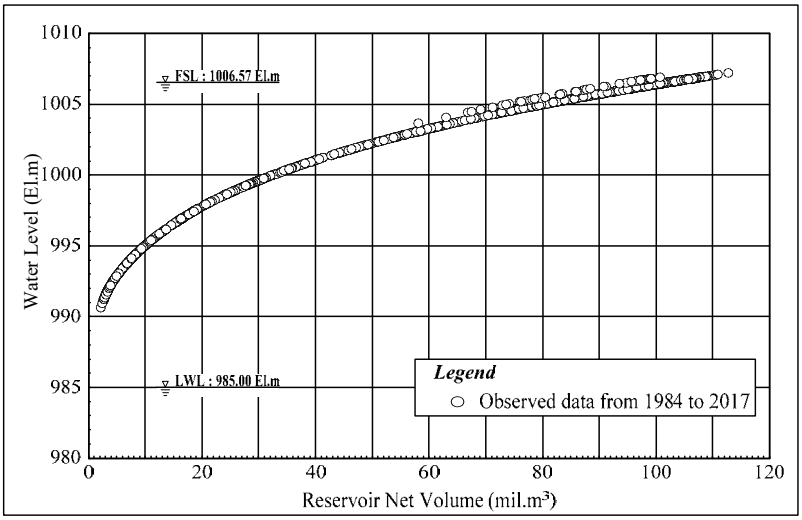
Table App. 8.3-3 H-V Curve of Vaalkop Reservoir

Water Level (El.m)	Net Reservoir Volume (mil.m^3)	Note
969.30	0.0	Low Water Level
970.00	1.0	
972.50	5.0	
975.00	12.7	
977.50	24.2	
980.00	44.0	
980.71	51.3	Full Supply Level

Source: JST

4) Roodekopjes Dam

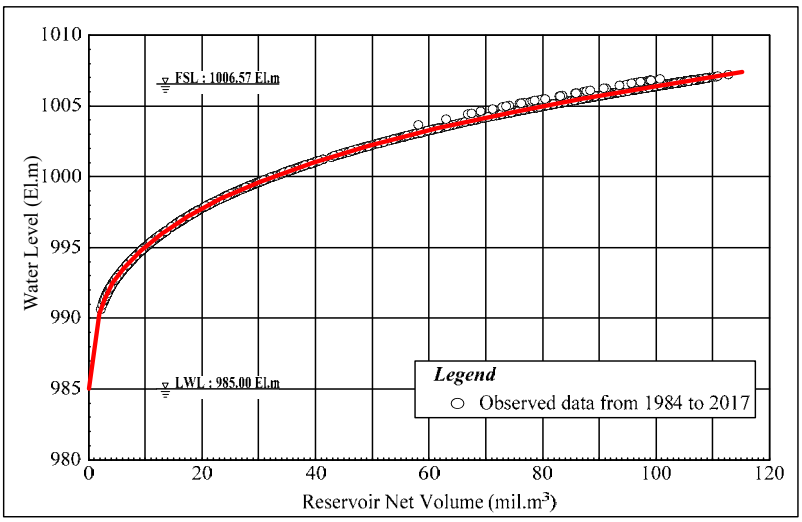
Observation reservoir water level and reservoir volume data of Roodekopjes dam was observed from June 1984 to September 2017 at weekly interval. Figure App. 8.3-7 shows all data of observed reservoir water level and reservoir volume.



Source: DWS

Figure App. 8.3-7 Relationship between Water Level vs Net Volume of Roodekopjes Reservoir (Data Period: 1984 to 2017)

The observation data of Roodekopjes dam is different from other dams, and the relationship between reservoir water level and reservoir volume is compatible. Therefore, H-V curve of Roodekopjes reservoir adopts Figure App. 8.3-8 and Table App. 8.3-4 without rejecting data.



Source: JST

Figure App. 8.3-8 H-V Curve of Roodekopjes Reservoir

Table App. 8.3-4 H-V Curve of Roodekopjes Reservoir

Water Level (El.m)	Net Reservoir Volume (mil.m^3)	Note
985.00	0.0	Low Water Level
987.50	1.0	
990.00	2.0	
992.50	4.2	
995.00	10.0	
997.50	19.0	
1000.00	33.0	
1002.50	52.2	
1005.00	80.2	
1006.57	96.4	Full Supply Level

Source: JST

Appendix 8.4
Discharge of Remain Basin

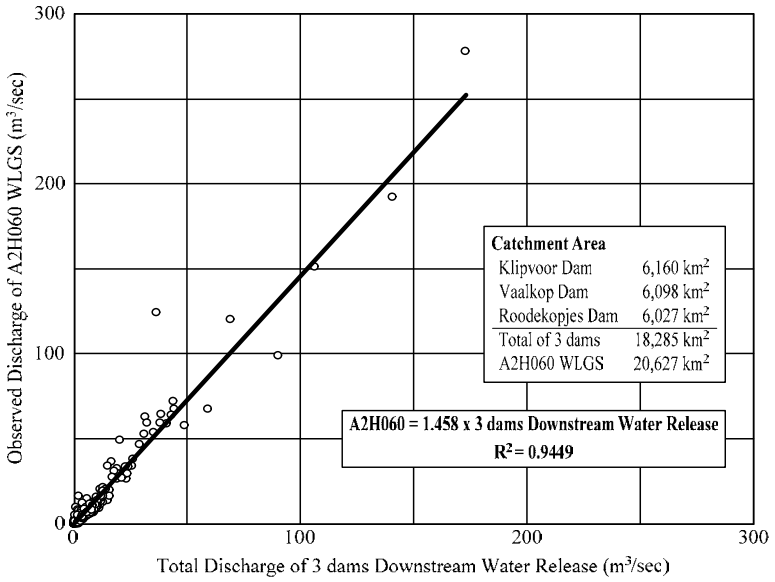
The discharge of remain basin is calculated from the relation between the downstream water release record of Klipvoor, Vaalkop, Roodekopjes dams and discharge of downstream water level gauging station (WLGS), and catchment area ratio. A2H060 WLGS managed by DWS is located downstream of 3 dams, which is close to intake site of MCWAP Phase 2 in Thabazimbi. The catchment area of above key points as shown in Table App. 8.4-1.

Table App. 8.4-1 Catchment Area of Key Points for Discharge of Remain Basin

No.	Location	Catchment Area (km^2)
1	Klipvoor Dam	6,160
2	Vaalkop Dam	6,098
3	Roodekopjes Dam	6,027
	Total of 3 dams	18,285
4	A2H060 WLGS	20,627
5	Thabazimbi (proposed MCWAP Phase 2 intake site)	23,762

Source: JST

The total of downstream water release records of 3 dams and the discharge record of A2H060 WLGS are correlated as shown in Figure App. 8.4-1 (R^2=0.9449).



Source: JST

Figure App. 8.4-1 Correlation of 3 dams Downstream Water Release and Discharge of A2H060 WLGS

The missing discharge data of A2H060 is interpolated by the correlation formula with downstream water release records of 3 dams as follows.

Discharge of A2H060 (m^3/sec) = 1.458 x Downstream Water Release Record of 3 Dams (m^3/sec)

Table App. 8.4-2 shows the estimated monthly mean discharge of A2H060 WLGS after interpolation of missing data.

Table App. 8.4-2 Estimated Monthly Mean Discharge at A2H060 WLGS

Unit : m^3/sec

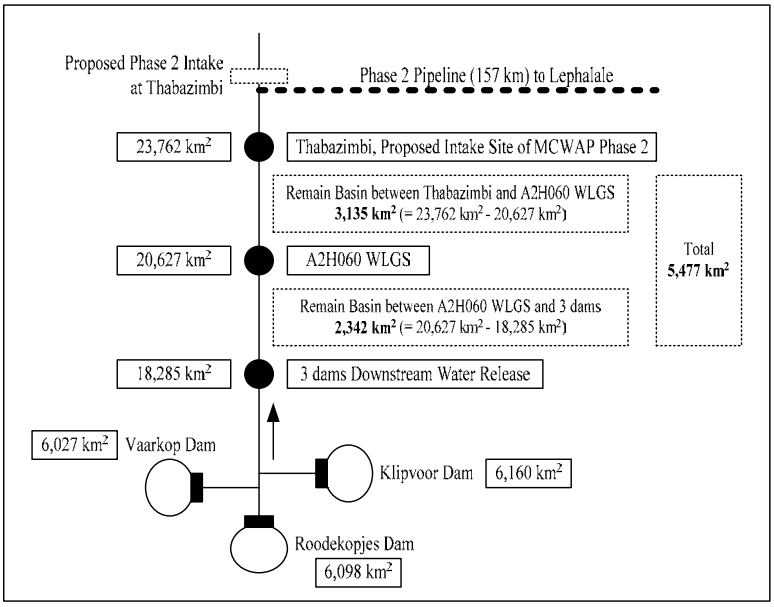
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean
1984 /85	1.32	1.02	2.00	2.09	2.88	1.30	0.00	0.00	0.00	0.00	1.00	3.41	1.25
1985 /86	0.29	1.79	0.49	0.01	3.87	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.56
1986 /87	0.34	4.49	9.55	7.69	4.25	4.19	0.71	0.46	0.07	0.02	2.66	3.39	3.15
1987 /88	3.26	3.07	3.83	3.36	3.27	1.98	0.30	0.05	1.25	1.28	2.01	2.69	2.19
1988 /89	2.62	1.84	2.29	3.30	4.88	7.34	1.46	1.78	2.77	1.78	2.21	4.68	3.08
1989 /90	3.23	2.20	3.84	4.09	2.63	2.87	1.77	3.28	1.59	2.62	2.99	3.41	2.88
1990 /91	3.70	3.02	3.70	3.65	3.34	15.79	4.93	1.54	1.97	3.03	3.04	4.19	4.32
1991 /92	4.44	2.54	3.03	3.96	4.76	4.29	1.48	0.30	0.13	0.33	0.40	3.65	2.44
1992 /93	3.17	2.21	1.62	2.83	3.27	2.60	0.84	0.13	0.05	0.01	0.74	4.01	1.79
1993 /94	2.24	1.83	1.84	3.58	4.89	2.31	0.86	0.52	1.74	2.18	2.32	3.78	2.34
1994 /95	3.57	1.28	2.42	2.69	3.89	3.32	0.84	1.34	1.24	2.40	2.64	3.91	2.46
1995 /96	2.95	1.55	8.89	36.14	233.42	49.22	19.29	11.22	7.31	5.61	5.26	6.01	32.24
1996 /97	5.71	4.11	7.14	33.91	9.45	192.27	58.43	90.90	31.11	19.00	14.72	17.22	40.33
1997 /98	11.21	5.32	9.15	36.11	11.60	7.67	3.01	1.41	2.64	2.86	3.76	5.15	8.32
1998 /99	4.74	6.21	33.89	20.21	9.72	7.22	2.67	1.32	2.98	3.12	3.65	6.24	8.50
1999 /00	5.82	3.00	3.61	17.72	24.22	119.85	67.32	26.94	18.53	13.23	9.13	6.43	26.32
2000 /01	12.72	25.01	51.32	11.89	6.62	5.63	4.67	14.79	7.60	6.68	7.21	10.30	13.70
2001 /02	10.24	44.17	36.67	14.44	23.62	29.22	4.98	3.40	4.00	4.70	7.43	9.75	16.05
2002 /03	9.89	4.30	4.05	5.16	5.96	3.93	0.45	0.01	0.64	0.54	3.54	5.25	3.64
2003 /04	4.20	0.23	2.60	0.54	1.01	33.65	14.48	7.89	4.24	4.05	4.38	6.04	6.94
2004 /05	5.75	2.47	4.17	8.33	8.28	7.73	8.75	4.87	6.53	3.18	4.96	6.84	5.99
2005 /06	5.54	5.30	3.19	12.08	64.37	67.70	16.83	8.82	5.11	5.40	5.28	6.59	17.18
2006 /07	6.99	3.54	5.94	9.06	6.19	5.64	1.15	0.35	2.68	1.39	2.87	4.85	4.22
2007 /08	3.30	4.72	12.25	124.19	32.26	62.78	20.92	13.43	11.71	6.95	6.66	7.44	25.55
2008 /09	7.31	4.69	6.53	30.60	52.68	53.54	9.63	6.99	9.77	9.71	9.66	8.90	17.50
2009 /10	8.12	8.35	29.29	67.21	33.32	13.86	59.00	63.95	15.52	12.67	8.47	7.48	27.27
2010 /11	8.28	5.66	71.87	150.81	46.30	57.58	59.34	33.30	28.67	19.45	13.50	13.27	42.34
2011 /12	12.20	11.08	26.35	28.35	16.20	9.50	6.77	7.07	4.49	5.18	6.04	13.07	12.19
2012 /13	14.78	26.34	30.82	19.82	10.31	7.07	15.20	11.79	5.64	6.83	6.29	8.80	13.64
2013 /14	12.50	5.78	28.96	12.05	98.78	277.53	37.78	19.07	13.63	16.03	10.11	9.79	45.17
2014 /15	9.09	7.26	26.79	27.12	15.48	6.66	4.71	5.46	4.45	4.23	5.38	9.11	10.48
2015 /16	8.32	12.27	6.41	11.53	6.53	15.85	3.88	11.15	10.25	7.71	6.51	7.84	9.02
Mean	6.18	6.77	13.89	22.33	23.69	33.76	13.51	11.05	6.51	5.38	5.15	6.67	12.91

Source: JST

The remain basin of 2,342 km^2 (= 20,627 km^2 - 18,285 km^2) from the downstream of 3 dams to A2H060 WLGS subtracts the downstream water release of 3 dams from the discharge record of A2H060 WLGS. If the estimated discharge of remain basin is a negative value, it is set to 0.0 m^3/sec.

The discharge of remain basin (3,135 km^2 = 23,762 km^2 - 20,627 km^2) from A2H060 WLGS to Thabazimbi is calculated with the estimated catchment area ratio of remain basin by 1.34 (= 3,135 km^2 / 2, 342 km^2).

Figure App. 8.4-2 shows a schematic diagram of remain basin between 3 dams and Thabazimbi in Crocodile river.



Source: JST

Figure App. 8.4-2 Schematic Diagram of Remain Basin between 3 dams and Thabazimbi

The estimated discharge of remain basin from 3 dams to Thabazimbi is shown in Table App. 8.4-3. The area of the remain basin between 3 dams and Thabazimbi is 5,477 km^2 (= 2,342 km^2 + 3,135 km^2).

Table App. 8.4-3 Estimated Discharge of Remain Basin between 3 dams and Thabazimbi

Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1984 /85	2.37	1.74	0.56	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.72	3.26	1.04
1985 /86	0.00	0.00	0.00	0.00	4.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1986 /87	0.07	4.14	19.76	13.44	4.02	4.99	0.00	0.34	0.00	0.00	2.60	4.25	4.47
1987 /88	2.96	2.94	6.18	4.19	4.06	2.27	0.00	0.00	0.00	0.00	0.00	1.97	2.05
1988 /89	1.63	0.19	1.32	2.74	8.60	11.82	0.82	2.16	3.67	0.85	0.00	3.44	3.10
1989 /90	0.88	1.53	4.76	4.09	1.66	2.39	1.07	5.68	0.14	0.00	0.00	0.41	1.88
1990 /91	2.23	2.15	3.71	3.33	3.08	32.09	8.31	0.06	0.09	0.00	0.00	0.33	4.62
1991 /92	1.96	0.40	0.55	0.40	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
1992 /93	0.00	3.30	0.92	0.99	3.26	0.37	0.00	0.00	0.00	0.00	0.00	2.13	0.91
1993 /94	3.04	1.80	0.00	3.91	9.63	1.02	0.00	0.00	0.00	0.61	0.53	2.67	1.94
1994 /95	2.12	0.00	0.34	1.61	1.20	2.75	0.38	1.51	0.00	0.16	0.42	2.25	1.06
1995 /96	0.75	0.00	6.54	45.32	171.57	67.28	12.13	8.34	4.78	3.62	1.72	0.60	26.89
1996 /97	0.53	1.51	8.40	19.03	2.90	120.12	40.16	66.81	22.87	13.96	10.82	12.65	26.65
1997 /98	8.24	3.91	6.73	26.54	8.52	3.08	2.34	0.00	0.00	0.00	0.00	0.32	4.97
1998 /99	2.63	4.56	24.91	19.99	4.70	2.09	0.00	1.21	2.16	1.85	0.00	2.22	5.53
1999 /00	0.63	0.58	0.89	13.03	16.46	118.04	53.64	20.77	13.60	8.52	4.74	0.00	20.91
2000 /01	9.35	18.38	37.73	0.96	4.48	6.42	6.28	10.87	5.58	4.91	5.30	7.57	9.82
2001 /02	7.53	32.47	26.96	10.61	17.37	18.21	3.66	2.50	2.94	3.45	5.46	7.17	11.53
2002 /03	7.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
2003 /04	0.00	0.00	0.00	0.00	0.00	43.82	19.79	5.84	0.00	0.00	0.00	0.00	5.79
2004 /05	0.05	0.00	0.01	2.60	3.28	5.69	5.25	3.58	4.80	0.00	0.00	1.02	2.19
2005 /06	0.00	3.90	0.00	18.91	60.32	108.24	17.64	5.84	0.00	1.58	1.33	0.00	18.15
2006 /07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007 /08	0.00	0.00	7.92	204.92	30.14	72.44	18.44	6.88	1.93	1.77	0.00	0.00	28.70
2008 /09	0.00	0.02	0.00	17.73	50.61	42.27	9.10	2.86	3.74	2.17	0.11	0.00	10.72
2009 /10	1.23	8.55	22.44	18.63	21.59	4.60	61.78	48.13	12.32	18.57	0.44	0.00	18.19
2010 /11	0.00	0.00	64.75	104.17	40.39	19.64	49.50	24.73	12.49	8.33	0.95	0.00	27.08
2011 /12	0.00	0.00	6.81	15.01	0.60	0.00	0.00	0.41	0.00	0.00	0.00	2.30	2.09
2012 /13	6.28	17.16	29.76	13.23	0.00	0.00	6.98	5.89	0.33	1.19	0.00	0.00	6.73
2013 /14	9.19	0.28	12.19	3.97	19.81	244.33	27.28	13.76	7.40	6.61	1.67	0.00	28.87
2014 /15	0.00	0.23	12.77	23.06	11.38	0.00	2.33	0.00	0.00	0.00	0.00	0.15	4.16
2015 /16	0.00	9.02	0.00	10.10	0.00	8.69	0.26	3.20	3.89	0.00	0.81	0.00	3.00
Average	2.22	3.71	9.59	18.95	15.75	29.46	10.85	7.54	3.21	2.44	1.18	1.71	8.88

Source: JST

Appendix 8.5
Actual Water Use of Mokolo, Klipvoor, Vaalcap, and Roodekopjes Dams

(1) Mokolo Dam

Water of Mokolo dam is classified into 1) water use for industry and town and 2) downstream river release. Industry and town also includes Medupi TPP, which is supplied through pipeline of MCWAP Phase 1. Table App.8.5-1 shows water supply records from Mokolo dam to industry and town, and Table App.8.5-2 shows downstream river release discharge records from Mokolo dam.

Table App.8.5-1 Record of Water Use for Industry and Town from Mokolo Dam through MCWAP Phase 1 Pipeline

Unit : m3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	0.19	0.20	0.23	0.21	0.08	0.16	0.16	0.14	0.15	0.17
1981 /82	0.14	0.15	0.13	0.17	0.25	0.19	0.15	0.16	0.15	0.21	0.18	0.18	0.17
1982 /83	0.15	-	0.15	0.14	0.17	0.20	0.16	0.15	0.15	0.16	0.19	0.22	0.17
1983 /84	0.18	0.19	0.18	0.22	0.23	0.18	0.18	0.21	0.17	0.15	0.17	0.19	0.19
1984 /85	0.24	0.25	0.22	0.25	0.25	0.26	0.26	0.23	0.23	0.23	0.26	0.32	0.25
1985 /86	0.35	0.31	0.35	0.33	0.31	0.30	0.26	0.22	0.29	0.25	0.24	0.31	0.29
1986 /87	0.28	0.23	0.22	0.33	0.32	0.29	0.29	0.39	0.29	0.22	0.23	0.18	0.27
1987 /88	0.40	0.36	0.26	0.33	0.33	0.18	0.32	0.17	0.31	0.30	0.27	0.25	0.29
1988 /89	0.32	0.39	0.28	0.29	0.28	0.29	0.33	0.31	0.27	0.40	0.31	0.48	0.33
1989 /90	0.44	0.38	0.31	0.39	0.36	0.39	0.35	0.34	0.36	0.34	0.36	0.38	0.37
1990 /91	0.38	0.51	0.38	0.33	0.31	0.35	0.43	0.39	0.40	0.44	0.42	0.39	0.39
1991 /92	0.43	0.31	0.30	0.34	0.69	0.46	0.31	0.34	0.29	0.33	0.33	0.38	0.38
1992 /93	0.37	0.32	0.38	0.35	0.29	0.34	0.37	0.32	0.30	0.40	0.28	0.33	0.34
1993 /94	0.36	0.25	0.31	0.36	0.35	0.37	0.30	0.32	0.30	0.36	0.38	0.38	0.34
1994 /95	0.42	0.39	0.36	0.36	0.38	0.38	0.37	0.35	0.33	0.38	0.37	0.39	0.37
1995 /96	0.43	0.45	0.31	0.40	-	0.36	0.41	0.44	0.40	0.34	0.29	0.39	0.38
1996 /97	0.41	0.39	0.29	0.35	0.50	0.30	0.24	0.37	0.40	0.38	0.37	0.37	0.36
1997 /98	0.42	0.43	0.45	0.43	0.46	0.47	0.40	0.48	0.44	0.42	0.49	0.42	0.44
1998 /99	0.39	0.44	0.29	0.41	0.47	0.44	0.42	0.39	0.38	0.43	0.40	0.44	0.41
1999 /00	0.46	0.43	0.46	0.34	0.36	0.37	0.31	0.33	0.36	0.37	0.44	0.33	0.38
2000 /01	0.36	0.37	0.35	0.41	0.41	0.32	0.32	0.34	0.36	0.35	0.35	0.37	0.36
2001 /02	0.39	0.30	0.40	0.37	0.38	0.34	0.31	0.35	0.23	0.26	0.27	0.31	0.33
2002 /03	0.36	0.48	0.37	0.34	0.37	0.26	0.26	0.23	0.25	0.28	0.34	0.35	0.32
2003 /04	0.39	0.35	0.45	0.30	0.28	0.35	0.26	0.26	0.25	0.23	0.26	0.32	0.31
2004 /05	0.35	0.34	0.28	0.31	0.28	0.32	0.32	0.29	0.33	0.28	0.26	0.24	0.30
2005 /06	0.23	0.23	0.28	0.35	0.24	0.25	0.22	0.25	0.29	0.35	0.35	0.30	0.28
2006 /07	0.28	0.31	0.32	0.34	0.27	0.26	0.36	0.26	0.33	0.40	0.32	0.32	0.31
2007 /08	0.34	0.25	0.26	0.32	0.40	0.37	0.42	0.40	0.39	0.38	0.34	0.38	0.35
2008 /09	0.45	0.48	0.57	0.48	0.34	0.36	0.39	0.34	0.29	0.31	0.36	0.38	0.40
2009 /10	0.41	0.42	0.51	0.64	0.67	0.78	0.64	0.65	0.71	0.67	0.70	0.73	0.63
2010 /11	0.71	0.70	0.69	0.71	0.70	0.85	0.67	0.60	0.66	0.62	0.05	0.07	0.59
2011 /12	0.06	0.67	0.64	0.66	0.70	0.68	-	0.60	0.70	0.57	0.37	0.41	0.55
2012 /13	0.48	0.47	0.37	0.40	0.41	0.37	0.45	0.46	0.44	0.49	0.10	0.09	0.38
2013 /14	0.05	0.05	0.05	0.09	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.45	0.08
2014 /15	0.53	0.52	0.48	0.53	0.56	0.44	0.49	0.54	0.18	0.41	0.53	0.54	0.48
2015 /16	0.58	0.56	0.52	0.52	0.50	1.13	0.54	0.55	0.50	0.54	0.47	0.52	0.58
2016 /17	0.52	0.49	0.50	0.49	0.46	0.50	0.50	0.61	0.54	-	-	-	0.51
Average	0.36	0.38	0.35	0.37	0.38	0.38	0.34	0.35	0.34	0.35	0.31	0.34	0.35

Source: DWS

Pipeline discharge is supplied about 0.35 m^3/sec without monthly fluctuation. Medupi TPP is currently running 3 units (Unit No. 4, 5, 6), and the amount of water used is 0.09 m^3/sec (= 0.03 m^3/sec x 3 units). 0.26 m^3/sec obtained by subtracting 0.03 m^3/sec from 0.35 m^3/sec is the amount of currently water used by industry and town other than Medupi TPP.

Table App.8.5-2 Record of Downstream Water Release from Mokolo Dam

Unit : m3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.87	1.43	1.96	13.29	39.39	22.27	7.23	5.28	3.43	2.92	2.60	2.03	8.56
1981 /82	1.02	1.22	0.80	1.75	0.71	0.66	0.52	0.55	0.53	0.53	1.99	0.51	0.90
1982 /83	2.33	0.93	-	-	2.21	2.84	0.71	0.50	0.54	0.49	0.52	-	1.23
1983 /84	0.47	0.46	0.56	2.25	0.69	0.75	0.51	0.75	0.60	0.58	0.73	0.58	0.74
1984 /85	0.67	0.69	0.67	0.63	0.41	0.39	0.76	0.84	1.76	1.66	-	0.88	0.85
1985 /86	0.71	1.03	0.88	0.89	0.80	0.61	0.01	0.00	0.00	0.00	0.00	0.00	0.41
1986 /87	0.00	-	0.00	2.98	0.17	0.75	1.42	0.01	0.01	0.02	0.02	0.02	0.49
1987 /88	2.74	0.03	0.02	1.98	0.28	-	0.05	0.03	2.09	0.59	0.15	0.66	0.78
1988 /89	1.73	0.40	1.01	1.45	0.57	0.13	0.24	1.65	1.15	0.31	1.98	0.57	0.93
1989 /90	0.71	1.43	0.81	0.90	1.24	0.98	0.90	0.03	0.22	0.82	0.89	1.20	0.84
1990 /91	0.84	1.42	1.15	0.90	0.65	15.29	10.34	2.75	1.27	0.47	0.71	1.15	3.08
1991 /92	1.35	1.85	1.00	0.67	1.42	0.02	0.02	0.02	0.02	2.93	1.00	0.99	0.94
1992 /93	0.51	0.02	1.36	0.01	-	0.08	0.04	0.04	0.03	0.03	2.72	0.84	0.52
1993 /94	1.66	0.03	0.07	0.04	0.84	5.28	2.57	0.57	0.27	0.87	0.22	0.79	1.10
1994 /95	3.82	2.06	-	0.66	-	0.03	0.02	1.62	0.03	1.14	0.02	1.01	1.04
1995 /96	1.16	1.40	0.04	25.21	139.01	37.25	10.97	6.78	4.41	3.42	2.35	1.02	19.42
1996 /97	0.49	1.33	4.00	7.64	7.03	23.95	8.98	5.22	4.68	-	-	-	7.04
1997 /98	-	0.80	1.44	2.32	0.89	1.51	1.22	0.27	1.15	0.01	1.21	1.25	1.10
1998 /99	-	-	-	-	6.40	1.52	0.64	1.09	1.07	0.49	0.75	0.89	1.61
1999 /00	1.10	1.41	0.05	24.31	73.03	32.55	39.08	15.99	11.27	7.12	4.30	1.80	17.67
2000 /01	0.98	1.00	1.03	1.31	1.67	13.29	5.28	3.71	2.43	0.76	0.58	1.39	2.79
2001 /02	1.37	13.86	35.08	6.92	2.98	1.15	1.08	1.10	1.12	0.78	0.95	0.96	5.61
2002 /03	1.42	1.07	-	0.59	0.50	0.03	0.03	0.02	2.02	1.12	0.02	1.39	0.75
2003 /04	2.06	0.03	0.03	0.03	0.08	23.07	25.99	7.41	3.62	2.40	1.09	1.14	5.58
2004 /05	1.01	1.29	0.90	0.10	1.18	0.71	0.83	0.05	0.06	0.05	0.91	1.51	0.72
2005 /06	0.07	0.07	0.06	0.05	7.04	52.51	12.14	5.15	3.15	2.02	0.99	1.83	7.09
2006 /07	1.45	0.97	1.32	0.24	1.05	0.03	0.02	0.01	0.00	3.06	1.44	0.95	0.88
2007 /08	0.21	0.13	8.25	52.16	17.47	8.86	6.23	2.94	1.65	0.64	0.64	0.71	8.32
2008 /09	1.56	2.21	5.45	30.03	41.73	24.55	7.68	5.18	4.37	2.83	1.49	0.49	10.63
2009 /10	1.82	0.97	3.02	7.67	10.56	2.92	37.48	29.17	10.39	5.65	4.29	2.30	9.69
2010 /11	1.77	1.31	5.81	43.34	15.46	7.03	8.48	6.14	3.23	2.22	1.57	1.05	8.12
2011 /12	0.90	0.91	13.74	31.45	13.16	3.16	3.64	0.87	1.08	0.85	0.91	0.69	5.95
2012 /13	0.39	1.44	4.45	9.09	11.35	2.35	2.10	0.91	0.95	0.30	0.95	0.65	2.91
2013 /14	2.16	0.98	0.77	0.13	0.79	136.57	26.14	9.74	5.40	3.82	2.21	1.35	15.84
2014 /15	0.63	1.40	8.30	9.16	11.30	1.98	2.57	0.96	0.71	0.79	0.94	1.08	3.32
2015 /16	0.94	1.53	1.06	0.84	0.06	0.06	0.06	1.13	0.13	2.30	0.03	2.87	0.92
2016 /17	0.31	0.65	0.80	0.31	0.31	-	-	-	-	-	-	-	0.47
Average	1.18	1.36	3.21	8.04	11.78	12.15	6.28	3.29	2.08	1.54	1.21	1.07	4.43

Source: DWS

Downstream water release from Mokolo dam has abound in discharge during the rainy season from December to May.

(2) Klipvoor Dam

The main purpose of Klipvoor dam is water supply for irrigation. The intake of irrigation water is located downstream of Klipvoor dam. Record of downstream water release from Klipvoor dam is shown in Table App.8.5-3.

Table App.8.5-3 Record of Downstream Water Release from Klipvoor Dam

Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	2.89	1.10	4.71	3.98	7.19	5.51	1.10	1.41	1.30	2.07	2.74	3.03	3.09
1981 /82	3.50	1.69	0.74	0.50	1.84	2.08	0.44	0.41	1.47	2.61	3.38	4.56	1.94
1982 /83	2.52	0.88	1.91	2.28	4.37	1.77	0.22	0.17	0.11	0.13	0.30	3.68	1.53
1983 /84	1.02	0.51	1.05	4.58	3.65	0.10	0.11	0.06	0.07	0.01	0.22	4.24	1.30
1984 /85	0.16	1.33	1.33	1.87	2.09	0.43	0.10	0.00	0.20	0.01	1.93	3.09	1.05
1985 /86	0.30	1.35	0.09	0.16	3.85	0.04	0.12	0.10	0.01	0.01	0.03	0.03	0.51
1986 /87	0.04	3.57	9.92	5.58	3.60	3.29	0.72	0.12	0.12	0.10	2.74	3.18	2.75
1987 /88	3.22	2.03	1.47	2.57	2.96	0.52	0.02	0.03	0.47	0.54	1.11	2.32	1.44
1988 /89	1.99	1.56	1.55	2.69	4.13	5.74	1.17	1.50	2.13	1.37	1.94	2.71	2.37
1989 /90	2.18	0.80	2.58	2.92	1.79	2.08	1.19	2.62	1.20	0.99	1.63	2.88	1.90
1990 /91	2.38	2.12	2.18	2.00	0.74	13.99	3.08	0.83	1.18	0.91	1.29	2.65	2.78
1991 /92	2.43	1.25	0.91	2.60	3.45	1.15	0.26	0.18	0.26	0.24	0.75	1.62	1.26
1992 /93	0.92	0.32	0.25	2.45	2.15	2.07	0.52	0.20	0.17	0.23	1.27	3.98	1.21
1993 /94	1.62	1.47	1.67	2.23	0.40	1.97	0.90	0.37	1.68	1.82	2.24	3.82	1.68
1994 /95	3.02	0.85	1.85	1.93	3.87	1.90	0.04	0.01	0.83	1.77	2.15	3.83	1.84
1995 /96	2.40	0.33	0.73	11.53	85.09	22.59	4.87	3.27	2.48	2.18	2.19	2.55	11.68
1996 /97	2.41	1.31	4.36	4.28	3.48	17.01	10.72	4.53	8.57	3.47	2.51	3.09	5.48
1997 /98	2.79	2.22	4.43	5.79	3.53	3.13	0.94	0.30	0.96	1.28	1.77	2.88	2.50
1998 /99	2.20	1.84	8.07	7.19	3.80	2.53	0.70	0.24	1.53	1.61	1.53	3.07	2.86
1999 /00	2.48	0.99	0.85	15.31	57.78	20.63	19.87	6.07	-	3.39	2.70	1.99	12.01
2000 /01	4.28	7.03	8.74	2.65	3.66	2.49	1.94	3.09	1.75	1.78	1.92	2.74	3.51
2001 /02	2.25	-	-	2.70	2.87	1.37	-	0.20	1.04	1.10	1.59	2.34	1.72
2002 /03	2.62	1.79	2.14	2.87	2.78	2.97	0.22	0.15	2.45	1.47	2.79	3.10	2.11
2003 /04	2.42	0.13	2.75	0.37	2.73	-	5.70	2.68	1.64	1.80	2.19	3.16	2.33
2004 /05	3.48	1.22	2.08	3.30	4.13	2.79	2.80	1.38	1.16	1.85	3.05	4.64	2.66
2005 /06	3.00	1.09	1.42	4.22	21.22	29.15	3.93	2.15	1.93	1.81	2.55	3.16	6.30
2006 /07	2.79	0.80	2.18	1.09	2.05	2.28	0.36	0.16	1.53	0.65	2.23	2.76	1.57
2007 /08	0.59	1.81	3.60	51.97	9.65	17.58	6.62	4.18	3.22	2.24	2.33	2.95	8.90
2008 /09	2.21	0.33	2.21	6.75	14.61	14.65	3.38	2.79	3.33	2.73	2.71	2.40	4.84
2009 /10	2.41	4.76	8.55	8.84	6.66	2.86	19.95	14.15	4.70	3.41	2.70	3.15	6.85
2010 /11	2.86	0.95	7.44	30.50	11.19	8.27	12.94	6.21	4.09	3.30	2.80	2.74	7.77
2011 /12	2.73	1.37	3.91	4.91	3.79	2.13	1.11	1.37	1.47	1.67	1.77	2.90	2.43
2012 /13	3.97	5.52	8.09	3.89	3.21	2.10	3.53	2.53	2.01	2.33	2.58	3.47	3.60
2013 /14	3.16	2.16	5.00	4.11	7.28	34.85	6.98	3.22	2.92	2.72	2.43	-	6.80
2014 /15	3.01	2.04	5.06	8.20	3.72	2.34	2.89	1.87	2.18	2.16	2.28	3.10	3.24
2015 /16	3.11	2.36	3.34	2.79	3.65	3.49	2.08	3.02	2.67	2.10	2.27	3.14	2.83
2016 /17	2.49	3.33	3.16	6.08	15.72	8.54	4.81	3.39	2.67	-	-	-	5.58
Average	2.37	1.78	3.34	6.15	8.61	6.84	3.51	2.03	1.82	1.61	2.02	3.00	3.59

Source: DWS

(3) Vaalkop Dam

Water of Vaalkop dam is classified into 1) water use for industry and town and 2) downstream river release. Table App.8.5-4 shows water supply records from Vaalkop dam to industry and town, and Table App.8.5-5 shows downstream river release discharge records from Vaalkop dam.

Table App.8.5-4 Water Use Record for Industry and Town from Vaalkop Dam

Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	0.29	0.29	0.24	0.29	0.30	0.27	0.34	0.32	0.30	0.31	0.31	0.33	0.30
1981 /82	0.33	0.31	0.29	0.30	0.31	0.27	0.25	0.29	0.25	0.23	0.28	0.30	0.28
1982 /83	0.27	0.27	0.29	0.29	0.29	0.22	0.19	0.19	0.18	0.17	0.17	0.19	0.23
1983 /84	0.19	0.23	0.17	0.21	0.27	0.21	0.21	0.22	0.23	0.20	0.24	0.25	0.22
1984 /85	0.26	0.27	0.24	0.26	0.26	0.12	0.12	0.29	0.29	0.28	0.30	0.30	0.25
1985 /86	0.34	0.32	0.29	0.30	0.32	0.31	0.29	0.30	0.25	0.28	0.29	0.32	0.30
1986 /87	0.31	0.30	0.27	0.29	0.34	0.31	0.31	0.32	0.31	0.29	0.29	0.31	0.30
1987 /88	0.35	0.33	0.31	0.33	0.35	0.32	0.29	0.30	0.30	0.31	0.34	0.35	0.32
1988 /89	0.35	0.38	0.35	0.34	0.31	0.29	0.33	0.31	0.31	0.32	0.37	0.41	0.34
1989 /90	0.46	0.31	0.31	0.39	0.34	0.36	0.34	0.32	0.33	0.30	0.41	0.45	0.36
1990 /91	0.47	0.41	0.41	0.29	0.41	0.42	0.45	0.45	0.43	0.44	0.42	0.46	0.42
1991 /92	0.46	0.47	0.47	0.49	0.60	0.57	0.55	0.56	0.49	0.17	0.17	0.34	0.45
1992 /93	0.36	0.26	0.33	0.31	0.27	0.63	0.61	0.67	0.63	0.62	0.67	0.71	0.51
1993 /94	0.59	0.65	0.66	0.60	0.57	0.55	0.67	0.63	0.64	0.54	0.54	0.55	0.60
1994 /95	0.61	0.48	0.59	0.46	0.84	0.64	0.50	0.51	0.62	0.57	0.55	0.77	0.60
1995 /96	0.82	0.83	0.68	0.46	0.41	0.36	0.31	0.55	0.61	0.56	0.56	0.53	0.56
1996 /97	0.58	0.50	0.56	0.57	0.61	0.59	0.59	0.57	0.56	0.55	0.54	0.58	0.57
1997 /98	0.57	0.58	0.59	0.55	0.60	0.55	0.57	0.57	0.55	0.53	0.59	0.58	0.57
1998 /99	0.61	0.58	0.57	0.55	0.59	0.74	-	-	-	-	-	-	0.61
1999 /00	-	-	-	-	-	-	-	-	-	-	-	-	-
2000 /01	-	-	-	-	-	-	-	-	-	-	-	-	-
2001 /02	1.31	1.13	1.11	1.38	1.44	1.54	1.56	1.49	1.32	1.42	1.43	1.50	1.39
2002 /03	1.71	1.72	1.51	1.74	1.67	1.74	1.88	1.85	1.70	1.63	1.71	1.80	1.72
2003 /04	1.76	1.62	1.76	1.70	1.73	1.64	1.60	1.46	1.54	1.44	1.55	1.76	1.63
2004 /05	1.78	1.96	1.69	1.78	1.81	1.69	1.64	1.74	1.74	1.74	1.78	1.86	1.77
2005 /06	2.02	1.91	1.83	1.77	1.76	1.73	1.71	1.71	1.60	1.58	1.54	1.75	1.74
2006 /07	1.94	1.85	1.84	1.95	1.82	1.89	1.66	1.75	1.68	1.67	1.74	1.81	1.80
2007 /08	1.64	1.83	1.84	1.79	1.99	1.79	1.83	1.73	1.60	1.74	1.82	1.94	1.80
2008 /09	2.08	1.86	1.81	1.72	1.83	1.79	1.70	1.83	1.77	1.82	1.70	1.82	1.81
2009 /10	1.90	1.95	2.04	1.93	2.01	2.04	2.04	1.93	1.86	1.94	1.97	1.90	1.96
2010 /11	1.99	2.01	1.94	1.86	2.01	2.07	2.04	1.94	1.95	1.86	1.89	2.04	1.97
2011 /12	1.99	1.98	1.92	2.01	2.16	2.10	2.00	1.90	1.90	1.85	1.81	1.85	1.96
2012 /13	1.92	1.99	2.04	2.12	2.14	2.12	2.06	2.10	2.13	2.09	2.07	2.04	2.07
2013 /14	1.96	1.94	1.87	1.94	1.99	1.92	1.98	1.97	1.95	2.04	2.06	2.08	1.98
2014 /15	2.12	2.06	2.08	2.11	2.15	2.18	2.17	1.99	2.18	1.98	2.14	2.23	2.12
2015 /16	2.20	2.23	2.15	2.19	2.30	2.26	2.15	2.01	1.99	1.97	2.00	2.13	2.13
2016 /17	1.89	1.85	1.94	1.59	1.95	2.23	2.37	-	-	-	-	-	1.98
Average	1.10	1.08	1.06	1.05	1.11	1.10	1.10	1.05	1.04	1.01	1.04	1.10	1.07

Source: DWS

The average water supply of industry and town is 1.07 m^3/sec. In recent years since 2010, the average water supply has risen to 2.20 m^3/sec.

Table App.8.5-5 Record of Downstream Water Release from Vaalkop Dam

Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	0.89	4.80	18.09	12.41	12.04	2.37	0.54	0.50	-	1.18	0.90	5.37
1981 /82	0.45	1.79	3.11	3.36	3.41	1.27	0.49	0.47	0.68	0.49	0.56	0.57	1.39
1982 /83	0.47	0.39	0.53	0.62	0.62	0.44	0.20	0.19	0.18	0.17	0.17	0.19	0.35
1983 /84	0.19	0.23	0.24	1.06	0.32	0.21	0.21	0.22	0.23	0.20	0.24	0.25	0.30
1984 /85	0.26	0.27	1.23	0.26	0.50	0.27	0.13	0.29	0.29	0.28	0.35	0.36	0.37
1985 /86	0.46	0.39	0.34	0.38	0.47	0.52	0.30	0.30	0.25	0.28	0.29	0.32	0.36
1986 /87	0.31	0.41	0.34	0.29	0.40	0.36	0.31	0.32	0.37	0.35	0.45	0.37	0.36
1987 /88	0.43	0.38	0.31	0.33	0.35	0.32	0.29	0.30	0.42	0.39	1.42	0.51	0.45
1988 /89	0.45	0.40	0.39	0.42	0.39	0.36	0.33	0.31	0.33	0.35	0.56	0.60	0.41
1989 /90	1.30	0.86	0.53	0.50	0.39	0.44	0.34	0.32	0.45	0.42	0.63	1.50	0.64
1990 /91	1.57	0.63	0.56	0.54	0.60	0.66	0.48	0.45	0.54	0.62	0.65	0.72	0.67
1991 /92	0.78	0.70	0.62	0.77	0.88	0.91	0.60	0.59	0.57	0.26	0.26	0.55	0.63
1992 /93	0.49	0.26	0.39	0.50	0.39	0.76	0.61	0.70	0.64	0.72	0.78	0.92	0.60
1993 /94	0.63	0.65	0.80	0.70	0.57	0.66	0.67	0.67	0.77	0.61	0.69	0.79	0.68
1994 /95	0.82	0.57	0.72	0.58	1.10	0.88	0.50	0.53	0.76	0.66	0.68	1.03	0.74
1995 /96	0.94	0.93	5.33	3.60	35.12	3.74	0.32	1.26	1.17	0.84	0.82	0.96	4.59
1996 /97	1.07	0.99	1.04	1.29	1.45	45.10	16.12	26.61	6.74	2.54	1.77	2.56	8.94
1997 /98	0.96	0.96	0.97	1.57	1.21	1.16	0.84	0.81	0.80	1.00	1.06	1.03	1.03
1998 /99	1.05	0.83	0.82	1.20	1.14	1.05	-	0.11	0.10	0.19	0.26	0.28	0.64
1999 /00	0.29	0.30	0.30	0.32	-	26.65	12.70	5.34	4.55	3.24	0.65	0.39	4.97
2000 /01	0.36	0.90	7.80	0.63	0.49	0.44	0.10	0.90	1.11	0.31	0.24	1.28	1.21
2001 /02	1.52	13.12	15.31	3.27	5.82	-	1.84	1.65	1.52	1.59	1.78	1.88	4.48
2002 /03	2.01	1.98	1.73	1.96	1.89	1.96	2.01	1.89	-	-	1.95	2.03	1.94
2003 /04	1.90	1.67	2.00	1.83	1.73	2.71	1.75	2.13	1.69	1.59	1.71	1.94	1.89
2004 /05	1.94	2.16	1.83	1.93	2.11	1.83	1.67	1.75	1.92	2.02	1.99	2.11	1.94
2005 /06	2.24	2.00	1.91	1.86	1.86	-	-	1.78	-	-	1.71	1.94	1.91
2006 /07	2.16	2.04	2.01	2.14	2.00	2.14	1.80	1.76	1.68	1.67	1.74	1.81	1.91
2007 /08	1.65	1.83	1.84	6.08	5.05	7.16	2.99	2.49	1.76	2.04	2.19	2.18	3.10
2008 /09	2.49	2.24	2.15	2.11	5.11	6.50	2.41	2.06	2.69	2.06	2.40	2.53	2.89
2009 /10	2.24	2.15	2.13	5.48	2.90	2.21	4.14	14.63	2.83	-	2.29	2.28	3.93
2010 /11	2.66	2.80	7.87	29.41	7.36	9.42	10.85	4.93	5.98	4.67	4.56	4.35	7.91
2011 /12	3.44	2.82	2.44	2.54	2.76	2.67	2.27	2.14	2.09	2.12	2.03	2.06	2.45
2012 /13	2.15	2.23	2.25	2.31	2.35	2.33	2.27	2.30	2.31	2.22	2.20	2.20	2.26
2013 /14	2.11	2.12	2.05	2.14	31.42	66.16	4.35	2.17	2.15	2.39	2.35	2.44	10.15
2014 /15	2.49	2.42	2.41	2.41	2.46	2.46	2.43	2.24	2.39	2.16	2.29	2.39	2.38
2015 /16	2.36	2.36	2.30	2.36	2.46	2.40	2.30	2.18	2.17	2.13	2.15	2.28	2.29
2016 /17	2.05	-	2.06	9.36	70.00	6.88	2.58	-	-	-	-	-	15.49
Average	1.35	1.60	2.26	3.09	5.82	6.15	2.39	2.43	1.55	1.27	1.31	1.40	2.55

Source: DWS

(4) Roodekopjes Dam

Water of Roodekopjes dam is classified into 1) water use for irrigation and 2) downstream river release. Table App.8.5-6 shows water supply records from Roodekopjes dam to irrigation, and Table App.8.5-7 shows downstream river release discharge records from Roodekopjes dam.

Table App.8.5-6 Water Use Record for Irrigation from Roodekopjes Dam

Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	-	0.02	0.86	0.44
1984 /85	0.02	0.02	0.84	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.09
1985 /86	0.02	0.46	0.06	0.07	0.02	0.06	0.04	0.20	0.95	1.00	0.52	0.04	0.29
1986 /87	0.02	0.90	0.02	0.04	0.04	0.04	0.01	0.01	0.03	0.23	0.03	0.03	0.12
1987 /88	0.03	0.03	0.03	0.03	0.03	0.02	0.01	0.02	0.02	0.03	0.03	0.03	0.03
1988 /89	0.03	0.03	0.03	0.03	2.05	0.03	0.04	0.03	0.03	0.03	3.08	3.46	0.74
1989 /90	0.38	0.03	0.03	0.03	0.03	0.03	0.03	2.72	1.84	3.61	0.29	0.04	0.76
1990 /91	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	1.02	1.02	0.20
1991 /92	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03
1992 /93	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.83	0.71	0.06	1.13	1.17	0.34
1993 /94	0.05	1.13	1.00	1.05	0.08	0.06	0.06	0.23	1.27	1.33	0.06	1.41	0.64
1994 /95	0.68	1.52	1.28	1.40	0.05	1.26	0.06	0.07	0.06	0.07	0.07	0.07	0.55
1995 /96	0.06	0.07	0.07	0.07	0.09	0.08	0.09	2.33	1.03	0.74	0.73	0.10	0.46
1996 /97	0.10	0.10	2.78	2.69	1.31	0.08	0.09	0.11	0.48	0.34	1.01	0.38	0.79
1997 /98	0.11	1.25	1.04	2.26	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.46
1998 /99	0.11	0.38	3.19	2.50	0.94	0.11	0.11	0.39	0.84	0.21	0.29	0.06	0.76
1999 /00	0.07	0.05	0.04	2.02	3.27	1.18	0.03	2.66	-	2.83	-	0.04	1.22
2000 /01	0.48	2.83	1.31	0.06	0.07	0.07	2.93	3.02	1.37	0.50	0.34	1.20	1.18
2001 /02	0.74	3.44	2.30	1.45	0.61	0.05	0.05	0.07	0.07	0.17	0.06	0.84	0.82
2002 /03	0.37	0.07	0.07	0.06	2.33	1.78	0.79	3.48	0.18	0.03	2.28	0.04	0.96
2003 /04	1.62	1.20	2.09	1.90	0.05	1.84	0.80	3.08	0.41	1.09	1.26	0.04	1.28
2004 /05	0.03	0.05	0.05	1.14	2.30	1.11	2.37	2.63	0.83	0.03	0.03	1.17	0.98
2005 /06	2.05	1.59	1.30	2.30	1.84	1.76	2.63	2.35	0.05	0.22	1.38	1.67	1.59
2006 /07	0.84	0.64	1.03	2.96	1.56	0.04	0.04	1.40	2.32	2.31	1.96	0.63	1.31
2007 /08	1.51	1.55	1.70	1.99	1.22	1.26	2.20	1.66	-	1.58	2.08	1.99	1.70
2008 /09	0.84	0.39	1.33	2.60	1.82	1.48	1.40	3.08	2.57	0.30	1.81	2.21	1.65
2009 /10	1.55	1.85	2.22	1.45	0.09	2.55	2.14	1.51	1.57	2.07	1.99	1.50	1.71
2010 /11	0.00	0.00	0.84	1.65	1.55	0.82	1.69	0.23	0.00	1.30	0.00	0.00	0.67
2011 /12	0.00	0.42	1.67	1.67	0.63	1.30	1.59	2.06	1.76	1.67	2.48	2.50	1.48
2012 /13	1.75	2.01	3.42	3.21	2.92	1.13	2.06	2.65	1.73	1.19	3.25	2.77	2.34
2013 /14	3.07	2.48	2.42	2.25	0.76	0.00	0.00	0.00	0.00	1.11	1.59	1.53	1.27
2014 /15	1.54	1.62	1.29	1.19	1.44	1.58	2.18	2.23	2.22	3.07	2.92	3.14	2.04
2015 /16	2.64	3.06	3.03	2.73	2.63	1.38	2.38	2.29	2.02	2.43	1.67	2.11	2.36
2016 /17	1.64	1.72	1.82	2.19	1.15	0.01	0.62	2.17	2.00	-	-	-	1.48
Average	0.68	0.94	1.16	1.31	0.94	0.65	0.81	1.32	0.86	0.93	1.05	0.98	0.97

Source: DWS

Table App.8.5-7 Record of Downstream Water Release from Roodekopjes Dam

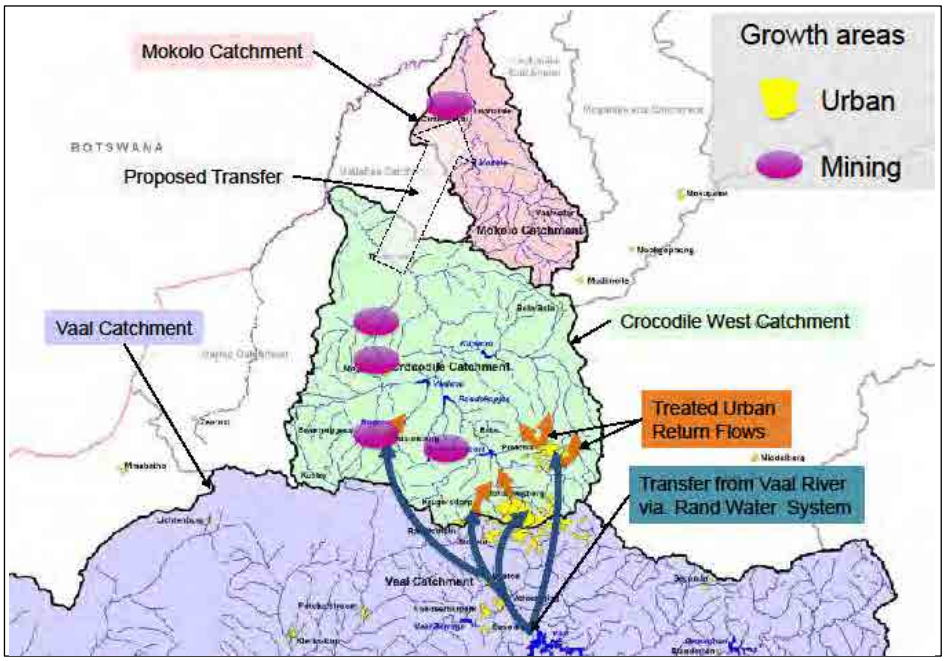
Unit : m^3/sec

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Ave
1980 /81	-	-	-	-	-	-	-	-	-	-	-	-	-
1981 /82	-	-	-	-	-	-	-	-	-	-	-	-	-
1982 /83	-	-	-	-	-	-	-	-	-	-	-	-	-
1983 /84	-	-	-	-	-	-	-	-	-	0.01	0.30	0.04	0.12
1984 /85	0.05	0.01	0.53	0.19	3.55	1.32	0.19	0.07	0.06	0.04	0.35	1.66	0.67
1985 /86	2.02	1.62	1.10	0.49	1.65	1.24	0.01	0.00	0.00	0.00	0.00	0.02	0.68
1986 /87	0.00	2.32	0.76	1.65	2.13	1.69	0.50	0.00	1.64	0.99	1.10	1.21	1.17
1987 /88	1.56	1.43	0.88	1.23	1.18	0.68	0.54	0.25	1.80	1.63	1.84	1.33	1.20
1988 /89	1.47	1.36	1.34	1.71	0.81	1.93	0.78	0.54	0.87	1.06	1.90	2.61	1.37
1989 /90	1.56	0.69	1.28	1.85	1.53	1.41	0.97	0.53	1.08	2.48	2.67	1.74	1.48
1990 /91	1.17	1.47	1.56	1.69	1.42	1.41	0.90	1.06	1.39	2.56	2.96	3.32	1.74
1991 /92	2.81	1.67	2.17	3.02	3.73	5.01	2.35	0.42	0.85	0.67	1.20	3.73	2.30
1992 /93	4.17	0.54	0.83	1.91	1.49	1.68	0.35	0.16	0.20	0.14	0.80	2.18	1.20
1993 /94	0.31	0.41	1.41	1.21	0.20	1.21	0.57	0.30	1.06	1.31	1.40	1.84	0.94
1994 /95	1.85	0.99	1.55	1.42	2.28	1.26	0.17	0.16	1.19	1.68	1.78	1.92	1.35
1995 /96	1.69	1.09	0.77	13.17	124.97	16.73	13.79	6.40	4.10	3.22	3.70	4.80	16.20
1996 /97	4.41	2.48	2.51	24.49	6.75	95.84	25.15	35.74	14.60	10.49	8.32	9.25	20.00
1997 /98	6.73	2.69	5.31	23.20	6.74	5.19	1.16	1.16	2.42	2.18	3.04	3.98	5.32
1998 /99	2.56	3.43	22.43	10.47	6.57	5.28	1.55	0.69	1.96	2.13	3.39	5.01	5.46
1999 /00	5.27	2.46	2.93	11.84	181.10	42.76	31.70	12.72	8.17	6.35	6.45	6.33	26.51
2000 /01	8.36	16.25	27.41	10.85	4.21	2.44	1.89	9.25	4.10	4.27	4.70	5.78	8.29
2001 /02	5.50	17.17	9.85	6.63	10.38	7.23	1.57	0.68	1.22	1.64	3.32	4.81	5.83
2002 /03	4.77	3.21	3.29	4.21	4.20	2.46	0.32	0.19	2.03	1.70	2.97	5.39	2.89
2003 /04	3.45	0.27	1.72	0.27	0.85	12.21	4.27	3.27	2.68	2.70	3.33	5.12	3.34
2004 /05	3.79	2.06	2.33	5.30	4.77	3.48	4.83	1.59	2.56	2.05	3.47	4.29	3.38
2005 /06	3.94	1.64	2.37	2.14	36.73	19.48	6.05	4.55	3.29	3.26	3.00	5.94	7.70
2006 /07	5.97	1.82	5.25	9.28	6.87	5.53	0.63	0.25	2.11	1.24	2.29	4.27	3.79
2007 /08	1.86	3.54	7.02	30.54	14.33	24.66	10.05	8.00	9.13	4.16	4.49	7.03	10.40
2008 /09	6.65	2.44	4.70	20.91	25.95	28.97	3.33	3.71	5.48	6.72	7.21	7.72	10.32
2009 /10	5.35	2.55	17.56	53.77	21.20	9.69	28.46	28.74	7.43	7.71	5.99	6.09	16.21
2010 /11	6.39	3.49	36.32	76.88	21.68	39.77	27.33	17.80	17.35	11.22	8.53	10.92	23.14
2011 /12	9.53	8.78	21.00	19.40	13.18	7.62	4.63	4.76	3.13	3.37	4.98	10.03	9.20
2012 /13	9.95	16.78	15.85	11.86	8.16	5.56	9.95	6.98	3.19	4.10	4.37	6.93	8.64
2013 /14	6.47	3.54	21.70	8.21	58.90	106.95	21.78	11.03	8.31	10.81	7.06	8.01	22.73
2014 /15	7.45	4.74	18.92	14.85	8.16	5.16	1.29	3.85	2.55	2.58	4.47	6.65	6.72
2015 /16	7.06	6.05	5.93	4.85	5.33	9.74	1.47	7.60	6.42	5.62	4.01	5.63	5.81
2016 /17	7.17	6.40	7.91	38.15	66.43	15.18	10.29	8.89	5.58	-	-	-	18.44
Average	4.28	3.80	7.77	12.65	19.92	14.87	6.63	5.49	3.88	3.34	3.50	4.71	7.57

Source: DWS

Appendix 8.6
Return Flow of Waste Water Treatment Works

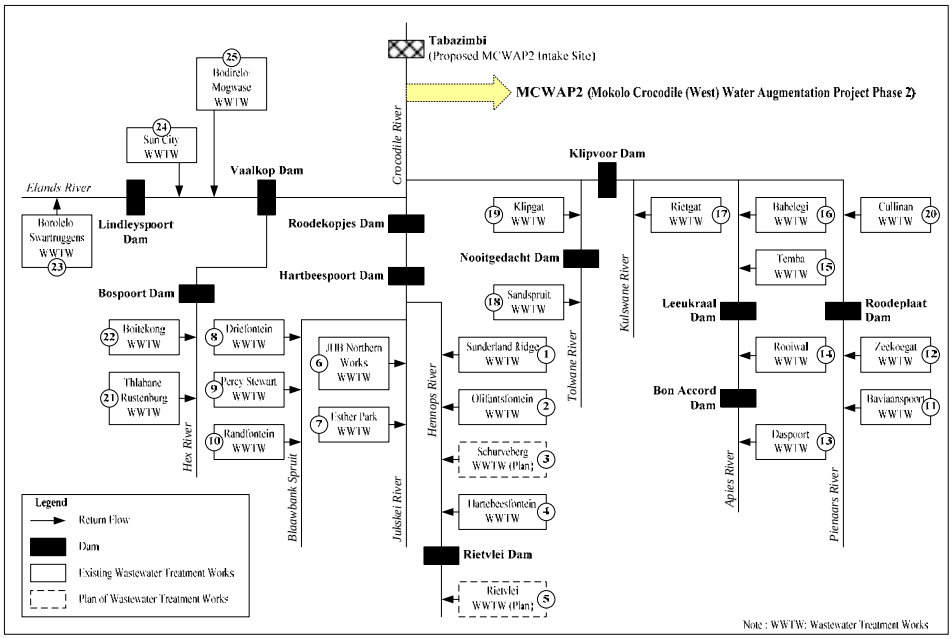
The Crocodile River catchment is supplied water for domestic water in Johannesburg and Pretoria, and mining water by the Land Water System from the Vaal River catchment. The Land Water System is Project of water transfer from Vaal River catchment to Crocodile River catchment. The supplied water is used for domestic water, mining water, etc., and treatment water through waste water treatment works (WWTW) is return to Crocodile River catchment. Figure App. 8.6-1 shows the Land Water System provided by DWS.



Source: DWS

Figure App. 8.6-1 Land Water System

There are 23 existing waste water treatment plants supplied from Land Water System in the Crocodile River catchment. Other 2 WWTWs are also planned. Figure App. 8.6-2 shows a schematic diagram of the existing and planned WWTWs in the Crocodile River catchment.



Source: JST

Figure App. 8.6-2 Schematic Diagram of Existing and Planned Waste Water Treatment Works

In Johannesburg and Pretoria, water demand will increase from future population growth forecasts. Expansion of existing WWTWs and construction of new WWTWs are planned, and increases return flow to the Crocodile River catchment. Table App. 8.6-1 shows the WWTW capacities in 2016 and 2030, collected from the report of " Crocodile (West) River Reconciliation Strategy 2015, DWS". The WWTW where the plan for 2030 is unknown shall apply the capacity of 2016.

Table App. 8.6-1 Capacity of Waste Water Treatment Works in 2016 and 2030

No.	Name of WWTW	Capacity (mil.litter/day)		Capacity (mil.m^3/year)	
		2016	2030	2016	2030
1	Sunderland Ridge	95.00	209.00	34.68	76.29
2	Olifantsfontein	105.00	157.00	38.33	57.31
3	Schurveberg (Plan)	0.00	55.00	0.00	20.08
4	Hartebeesfontein	45.00	45.00	16.43	16.43
5	Rietvlei	0.00	193.00	0.00	70.45
6	JHB Northern Works	450.0	450.0	164.25	164.25
7	Esther Park	0.40	0.40	0.15	0.15
8	Driefontein	35.00	50.00	12.78	18.25
9	Percy Stewart	17.00	17.00	6.21	6.21
10	Randfontein	19.50	19.50	7.12	7.12
11	Baviaanspoort	66.00	305.00	24.09	111.33
12	Zeekoegat	70.00	161.00	25.55	58.77
13	Daspoort	58.00	58.00	21.17	21.17
14	Rooiwal	205.00	492.00	74.83	179.58
15	Temba	33.00	120.00	12.05	43.80
16	Babelegi	4.70	4.70	1.72	1.72
17	Rietgat	28.00	119.00	10.22	43.44
18	Sandspruit	20.00	60.00	7.30	21.90
19	Klipgat	55.00	91.00	20.08	33.22
20	Cullinan	2.00	0.00	0.73	0.00
21	Thlabane/Rustenburg	42.00	42.00	15.33	15.33
22	Boitekong	8.00	8.00	2.92	2.92
23	Borolelo/Swartruggens	2.50	2.50	0.91	0.91
24	Sun City	5.14	5.14	1.88	1.88
25	Bodirelo/Mogwase	4.00	4.00	1.46	1.46
Total		1,370.24	2,668.24	500.14	970.57

Source: Crocodile (West) River Reconciliation Strategy 2015, DWS

Among the 25 WWTWs in the above table, the return flow are recorded until 2005 of 18 WWTWs. The monthly mean return flow is shown in Table App. 8.6-2.

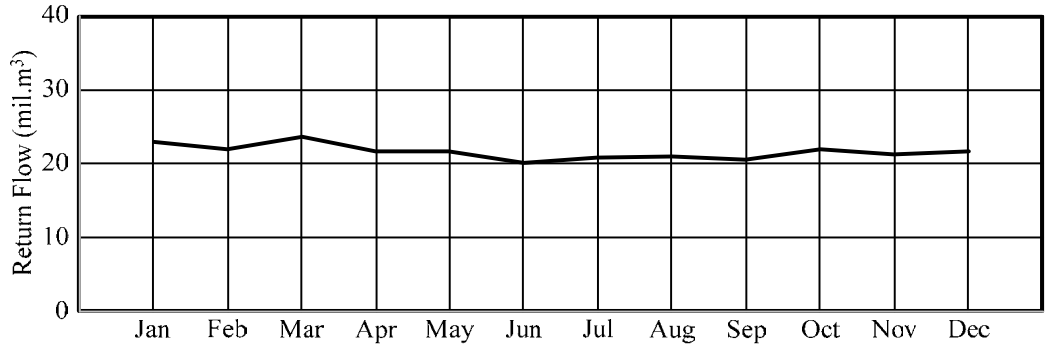
Table App. 8.6-2 Monthly Mean Return Flow Record

Unit : mil.m^3

No.	Name of WWTW	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	1. Sunderland Ridge	1.28	1.27	1.35	1.19	1.21	1.16	1.15	1.13	1.08	1.18	1.18	1.14	14.34
2	2. Olifantsfontein	2.05	1.91	2.01	1.85	1.93	1.65	1.64	1.66	1.93	2.19	1.66	1.82	22.31
3	4. Hartebeesfontein	1.14	1.11	1.23	1.20	1.02	0.99	1.14	1.13	1.09	1.00	1.04	1.07	13.16
4	6. JHB Northern	7.60	7.01	7.72	7.45	7.58	7.28	7.50	7.50	7.20	7.55	7.46	7.37	89.22
5	7. Esther Park	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.12
6	8. Driefontein	0.47	0.46	0.49	0.46	0.48	0.46	0.48	0.47	0.46	0.48	0.47	0.47	5.64
7	9. Percy Stewart	0.44	0.47	0.48	0.45	0.45	0.47	0.48	0.48	0.47	0.50	0.50	0.47	5.66
8	11. Baviaanspoort	1.24	1.14	1.18	1.07	0.96	0.90	0.94	0.89	0.90	1.02	1.03	1.19	12.48
9	12. Zeekoegat	1.19	1.06	1.16	1.04	1.05	0.98	1.04	1.05	1.01	1.09	1.07	1.12	12.86
10	13. Daspoort	1.36	1.26	1.36	1.30	1.35	1.25	1.27	1.29	1.25	1.33	1.30	1.34	15.66
11	14. Rooiwal	4.28	4.46	4.75	3.85	3.91	3.46	3.58	3.73	3.52	3.95	3.84	3.86	47.20
12	15. Temba	0.21	0.21	0.22	0.23	0.18	0.17	0.17	0.17	0.17	0.17	0.19	0.20	2.29
13	16. Babelegi	0.06	0.07	0.07	0.07	0.08	0.07	0.06	0.07	0.07	0.06	0.06	0.06	0.79
14	17. Rietgat	0.34	0.29	0.38	0.30	0.28	0.24	0.23	0.24	0.24	0.23	0.23	0.27	3.28
15	18. Sandspruit	0.12	0.11	0.13	0.12	0.11	0.10	0.10	0.10	0.09	0.09	0.10	0.12	1.31
16	19. Klipgat	0.91	0.88	1.01	0.96	0.86	0.81	0.81	0.83	0.87	0.90	0.88	1.03	10.73
17	21. Thlabane/Rustenburg	0.14	0.13	0.03	0.05	0.08	0.05	0.08	0.10	0.06	0.07	0.08	0.05	0.93
18	22. Boitekong	0.11	0.10	0.09	0.10	0.10	0.09	0.10	0.10	0.11	0.10	0.11	0.12	1.22
Total		22.96	21.93	23.68	21.70	21.65	20.15	20.80	20.95	20.53	21.93	21.21	21.71	259.19

Source: The assessment of water availability in the Crocodile (West) River catchment by means of water resource related models in support of the planned future licensing process 2008, Department of Water Affairs and Forestry

Figure App. 8.6-3 shows the variation of the monthly mean return flow. The monthly fluctuation of return flow is almost constant throughout the year.



Source: JST

Figure App. 8.6-3 Monthly Fluctuation of Return Flow

Also, the average return flow is about 50% (= total return flow [259.19 mil.m^3] / WWTW capacity in 2016 [500.14 mil.m^3]) of WWTW capacity. Assumed future return flow forecasts are as follows:

Waste water treatment works with return flow record

Future Return Flow (mil.m^3/year) = (Return Flow Record / Present WWTW Capacity) x Future WWTW Capacity

Waste water treatment works without return flow record

Future Return Flow (mil.m^3/year) = 50% x Future WWTW Capacity

The return flow in 2023 when MCWAP 2 is completed is estimated by linear interpolation between return flow of 2016 and 2030. The assumed return flow in 2023 is shown in Table App. 8.6-3.

Table App. 8.6-3 Assumed Return Flow in 2023

No.	Name of WWTW	WWTW Capacity (mil.m^3/year)			Return Flow Ratio	Return Flow (mil.m^3/year)		
		2016	2023	2030		2016	2023	2030
1	Sunderland Ridge	34.68	55.48	76.29	0.41	14.34	22.94	31.55
2	Olifantsfontein	38.33	47.82	57.31	0.58	22.31	27.83	33.36
3	Schurveberg	0.00	10.04	20.08	0.50	0.00	5.02	10.04
4	Hartebeesfontein	16.43	16.43	16.43	0.80	13.16	13.16	13.16
5	ERWAT Rietvlei	0.00	35.22	70.45	0.50	0.00	17.61	35.22
6	JHB Northern Works	164.25	173.38	182.50	0.54	89.22	94.18	99.13
7	Esther Park	0.15	0.15	0.15	0.82	0.12	0.12	0.12
8	Driefontein	12.78	15.51	18.25	0.44	5.64	6.85	8.06
9	Percy Stewart	6.21	6.21	6.21	0.91	5.66	5.66	5.66
10	Randfontein	7.12	7.12	7.12	0.50	3.56	3.56	3.56
11	Baviaanspoort	24.09	67.71	111.33	0.52	12.48	35.08	57.67
12	Zeekoegat	25.55	42.16	58.77	0.50	12.86	21.22	29.58
13	Daspoort	21.17	21.17	21.17	0.74	15.66	15.66	15.66
14	Rooiwal	74.83	127.20	179.58	0.63	47.20	80.24	113.28
15	Temba	12.05	27.92	43.80	0.19	2.29	5.31	8.33
16	Babelegi	1.72	1.72	1.72	0.46	0.79	0.79	0.79
17	Rietgat	10.22	26.83	43.44	0.32	3.28	8.61	13.94
18	Sandspruit	7.30	14.60	21.90	0.18	1.31	2.62	3.93
19	Klipgat	20.08	26.65	33.22	0.53	10.73	14.24	17.75
20	Cullinan	0.73	0.37	0.00	0.00	0.00	0.00	0.00
21	Thlabane/Rustenburg	15.33	15.33	15.33	0.50	7.67	7.67	7.67
22	Boitekong	2.92	2.92	2.92	0.50	1.46	1.46	1.46
23	Borolelo/Swartruggens	0.91	0.91	0.91	0.50	0.46	0.46	0.46
24	Sun City	1.88	1.88	1.88	0.50	0.94	0.94	0.94
25	Bodirelo/Mogwase	1.46	1.46	1.46	0.50	0.73	0.73	0.73
Total		500.14	746.15	992.16		271.86	391.95	512.04

Source: JST

The assumed value of return flow in 2023 is 391.95 mil.m^3/year. Return flow in 2023 is increases by 120.09 mil.m^3/year compared to return flow in 2016 (= 391.95 mil.m^3/year - 271.86 mil.m^3/year).

Return flow of WWTW No.1 to No.10 flows into Hartbeespoort Dam located upstream of Roodekopjes Dam, WWTW No.11 to No.17 and No.20 flows into Klipvoor Dam, and WWTW No.21 to No.25 flows into Vaalkop Dam. Return flow of WWTW No.18 and No.19 flows directly to the Crocodile River located downstream of Klipvoor Dam. Return flow in 2016 has already flowed into each dam in the Crocodile River catchment, and it will be return flow with increased differential return flow in 2023 and 2016. Table App. 8.6-4 shows the distribution of return flow to each dams and the Crocodile River.

Table App. 8.6-4 Distribution of Return Flow to Each Dams and Crocodile River

No.	Place of Return Flow	2016 Return Flow		2023 Return Flow		2023-2016 Return Flow	
		mil.m^3/year	m^3/sec	mil.m^3/year	m^3/sec	mil.m^3/year	m^3/sec
1	Roodekopjes Dam	154.01	4.88	196.93	6.24	42.92	1.36
2	Klipvoor Dam	94.56	3.00	166.90	5.29	72.34	2.29
3	Vaalkop Dam	11.25	0.36	11.25	0.36	0.00	0.00
4	Crocodile River	12.04	0.38	16.86	0.53	4.82	0.15
Total		271.86	8.62	391.95	12.43	120.09	3.81

Source: JST

The increase of return flow from 2016 to 2023 is 120.09 mil.m^3/year (=3.81 m^3/sec).

1) Return Flow into Existing Dams

The future return flow is predicted as described in above, but the return flow from the existing WWTW is already reflected of the dam inflow in the Crocodile River basin. Although it possesses WWTW construction status and return flow records as of 2016, there is no information up to the construction year of WWTW. As for the current inflow record of dams, there are mixed periods of with return flow and without return flow

from WWTW.

Therefore, in order to ensure consistency of the dam inflow data, the transition of return flow is examined for each dam. The verification of the transition of return flow is carried out by the runoff coefficient (coefficient of rainfall and dam inflow).

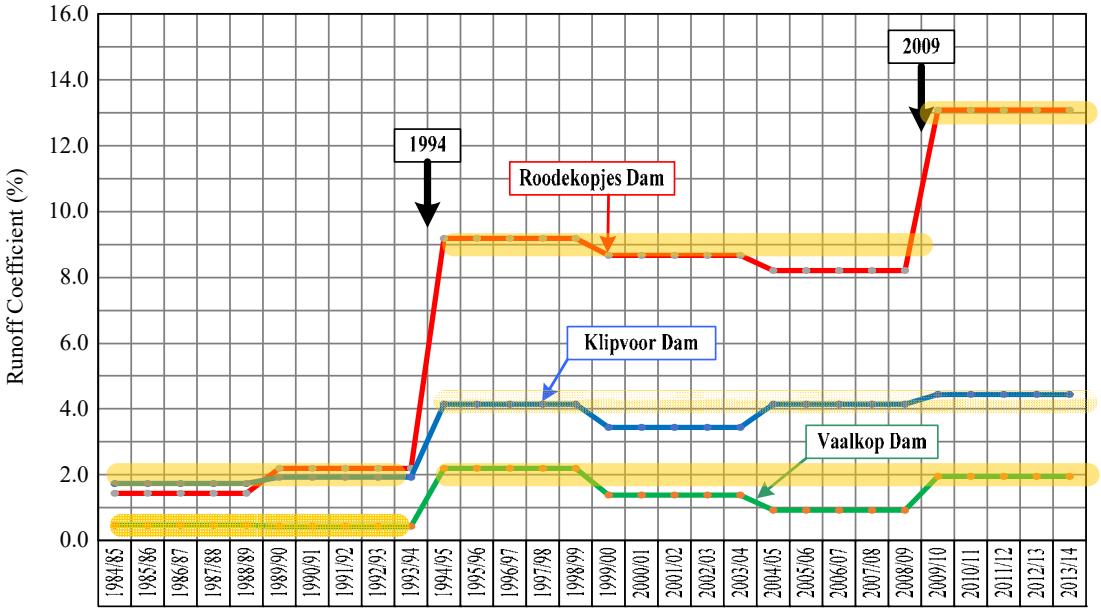
Table App. 8.6-5 shows the runoff coefficient of 3 dams in the Crocodile River basin. Since there is fluctuation in the runoff coefficient of each year, the 5-year average runoff coefficient is calculated.

Table App. 8.6-5 Runoff Coefficient of 3 Dams in the Crocodile River Basin

Year	Dam Inflow (m3/sec)			Rainfall (mm) at Mokolo.D	Dam Inflow (mm)			Runoff Coefficient (%)			Runoff Coefficient (%), 5-year Average		
	Klipvool	Vaalcop	Roodekopjes		Klipvool	Vaalcop	Roodekopjes	Klipvool	Vaalcop	Roodekopjes	Klipvool	Vaalcop	Roodekopjes
1984/85	1.08	0.72	0.99	667	5.6	3.7	5.2	0.83	0.55	0.78	1.74	0.46	1.44
1985/86	0.75	0.11	0.85	410	3.8	0.6	4.5	0.93	0.14	1.09	1.74	0.46	1.44
1986/87	3.35	0.98	1.84	549	17.2	5.1	9.6	3.13	0.93	1.76	1.74	0.46	1.44
1987/88	1.69	0.50	1.82	540	8.7	2.6	9.5	1.60	0.48	1.77	1.74	0.46	1.44
1988/89	2.94	0.28	2.36	676	15.0	1.5	12.3	2.22	0.22	1.83	1.74	0.46	1.44
1989/90	2.24	0.32	2.42	485	11.5	1.6	12.6	2.36	0.34	2.61	1.94	0.44	2.18
1990/91	3.13	1.33	3.35	546	16.0	6.9	17.5	2.93	1.26	3.20	1.94	0.44	2.18
1991/92	0.70	0.06	1.33	442	3.6	0.3	7.0	0.81	0.07	1.58	1.94	0.44	2.18
1992/93	1.26	0.19	1.17	445	6.5	1.0	6.1	1.45	0.22	1.37	1.94	0.44	2.18
1993/94	2.34	0.35	2.31	559	12.0	1.8	12.1	2.14	0.32	2.16	1.94	0.44	2.18
1994/95	1.92	1.10	2.08	597	9.8	5.7	10.9	1.65	0.96	1.83	4.14	2.21	9.18
1995/96	12.49	5.09	19.02	779	63.9	26.3	99.5	8.21	3.38	12.78	4.14	2.21	9.18
1996/97	5.86	7.48	21.48	650	30.0	38.7	112.4	4.62	5.95	17.30	4.14	2.21	9.18
1997/98	2.53	0.20	5.43	364	13.0	1.1	28.4	3.56	0.29	7.80	4.14	2.21	9.18
1998/99	3.17	0.56	7.24	612	16.2	2.9	37.9	2.65	0.48	6.19	4.14	2.21	9.18
1999/00	12.45	4.17	26.69	874	63.8	21.6	139.6	7.29	2.47	15.97	3.45	1.38	8.66
2000/01	3.60	0.70	9.82	419	18.4	3.6	51.4	4.40	0.86	12.27	3.45	1.38	8.66
2001/02	1.64	1.84	6.96	546	8.4	9.5	36.4	1.54	1.75	6.67	3.45	1.38	8.66
2002/03	1.74	0.16	2.20	452	8.9	0.8	11.5	1.97	0.19	2.55	3.45	1.38	8.66
2003/04	2.50	1.96	6.95	622	12.8	10.1	36.4	2.06	1.63	5.84	3.45	1.38	8.66
2004/05	2.58	0.44	4.47	-	13.2	2.3	23.4	-	-	-	4.15	0.93	8.20
2005/06	6.83	1.53	9.96	-	35.0	7.9	52.1	-	-	-	4.15	0.93	8.20
2006/07	1.33	0.38	4.26	346	6.8	2.0	22.3	1.96	0.57	6.44	4.15	0.93	8.20
2007/08	9.57	2.53	12.80	718	49.0	13.1	67.0	6.82	1.82	9.32	4.15	0.93	8.20
2008/09	5.23	0.57	12.26	726	26.8	3.0	64.1	3.68	0.41	8.83	4.15	0.93	8.20
2009/10	7.01	2.67	18.57	1441	35.9	13.8	97.2	2.49	0.96	6.74	4.44	1.94	13.09
2010/11	8.11	7.30	24.19	572	41.5	37.8	126.6	7.26	6.60	22.14	4.44	1.94	13.09
2011/12	2.77	0.69	9.89	-	14.2	3.5	51.7	-	-	-	4.44	1.94	13.09
2012/13	3.71	0.27	10.92	662	19.0	1.4	57.1	2.87	0.21	8.64	4.44	1.94	13.09
2013/14	7.36	0.00	20.80	733	37.7	0.0	108.9	5.15	0.00	14.86	4.44	1.94	13.09
2014/15	3.61	0.08	9.46	533	18.5	0.4	49.5	3.47	0.08	9.29			
2015/16	3.00	0.41	8.21	-	15.4	2.1	43.0	-	-	-			
2016/17	4.70	8.28	17.08	-	24.1	42.8	89.3	-	-	-			

Dam Inflow (m3/sec) : Annual mean dam inflow (m3/sec) record from DWS
Rainfall (mm) : Rainfall at Mokolo dam (mm) record from DWS
Runoff Coefficient (%) : = Dam Inflow (mm) / Rainfall (mm)
Source: JST

Figure App. 8.6-4 shows the 5-year average runoff coefficient.



Source: JST

Figure App. 8.6-4　5-year Average Runoff Coefficient of 3 Dams in the Crocodile River Basin

Runoff coefficient is nearly constant, and it does not change year by year. The change in the runoff coefficient in Figure App. 8.6-4 is judged to be due to return flow. Roodekopjes dam has changed runoff coefficient in 1994 and 2009, Klipvoor and Vaalkop dams have a change runoff coefficient in 1994.

Return Flow of Roodekopjes Dam

The return flow of Roodekopjes dam in 2016 is 4.88 m3/sec (see Table App. 8.6-4). The runoff coefficient from 2010 to 2014 is 13% (see Figure App. 8.6-4). Estimate the return flow of Roodekopjes Dam before 2009, uses return flow of 4.88 m3/sec and runoff coefficient of 13%. The 5-year average runoff coefficient in Figure App. 8.6-4 is 2% from 1984 to 1994, and 9% from 1995 to 2009. Estimated return flow before 2009 at this coefficient is as shown in Table App. 8.6-6.

Table App. 8.6-6　Estimated Return Flow before 2009 in the Crocodile River Basin

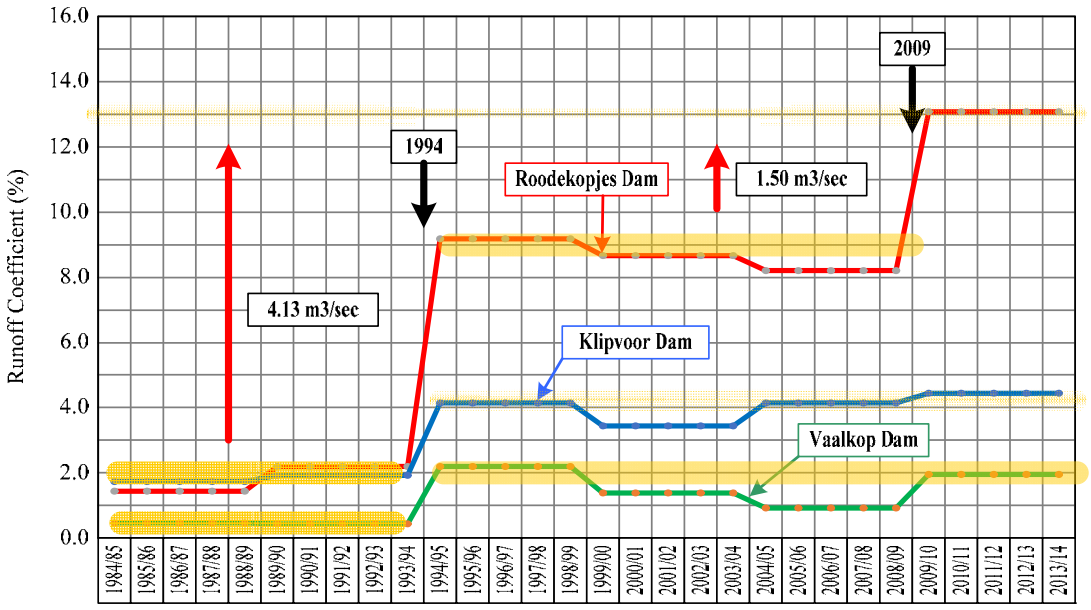
Period	Return Flow (m^3/sec)	Runoff Coefficient (%)	Compare with 2016 (%)
1984-1994	0.75	2	15 (=2%/13%)
1995-2009	3.38	9	69 (=9%/13%)
2010-2016	4.88	13	100 (=13%/13%)

Source:　JST

Add the difference return flow to the inflow of Roodekopjes dam under the condition that the current WWTW is constructed in past return flow. The added difference return flow is shown below.

1984 - 1994 :　+ 4.13 m^3/sec (= 4.88–0.75)
1995 - 2009 :　+ 1.50 m^3/sec (= 4.88–3.38)
2010 - 2016 :　+ 0.00 m^3/sec (= 4.88–4.88)

Figure App. 8.6-5 shows difference return flow mentioned above.



Source:　JST

Figure App. 8.6-5　Difference Return Flow in the Crocodile River Basin

Return Flow of Klipvool Dam, Vaalkop Dam and Downstream of Crocodile River

Return flow of Klipvoor, Vaalkop dams and downstream of the Crocodile River was considered as well as Roodekopjes dam. Return flow was added from 1984 to 1994 (There is no change of runoff coefficient in 2009 for this 2 dams). Downstream dams of Crocodile River has no data, therefore, return flow of downstream

of Crocodile River is similar to Klipvoor and Vaalkop dams.

Klipvoor Dam : 1984 - 1994 ; + 1.50 m^3/sec (= 3.00–1.50)
Vaalkop Dam : 1984 - 1994 ; + 0.27 m^3/sec (= 0.36–0.09)
Crocodile River : 1984 - 1994 ; + 0.28 m^3/sec (= 0.38–0.10)

Past Return Flow Consider to Water Balance Calculation

Table App. 8.6-7 summarizes the difference return flow of Roodekopjes Dam, Klipvoor Dam, Vaalkop Dam and downstream dams of Crocodile River. This difference return flow is added to the inflow of 3 dams and downstream dams of Crocodile River for water balance calculation.

Table App. 8.6-7 Difference Return Flow in the Crocodile River Basin

Location	Return Flow (m^3/sec)		
	1984-1994	1995-2009	2010-2016
Roodekopjes Dam	4.13	1.50	-
Klipvoor Dam	1.50	-	-
Vaalkop Dam	0.27	-	-
Crocodile River	0.28	-	-
Total	5.98	1.50	0.00

Source: JST

Appendix 9.1 South African Codes and Eskom Specific Codes

(1) South African codes

South African codes regarding engineering, procurement and supply of FGD is shown in Table App9.1-1

Table App9.1-1 South African codes regarding engineering, procurement and supply of FGD

Number	Revision	Title
SANS 10100		The structural use of concrete
SANS 10108		The Classification of Hazardous Locations and the Selection of Apparatus for Use in such Locations
SANS 60079-10		Electrical apparatus for explosive gas atmospheres Part 10: Classification of hazardous areas
SANS 101003-2004		Noise Level
SANS 10142-1		The Wiring of Premises, Part 1: Low-voltage installations
SANS 10160		Basis of structural design and actions for buildings and industrial structures
SANS 10162		The structural use of steel
SANS 10164		The structural use of masonry
SANS 10164-2		The structural us of masonry, Part 2: structural design and requirements for reinforced and prestressed masonry
SANS 1200 HC		Corrosion protection of structural steelwork
SANS 1411-1		Materials of Insulated Electric Cables and Flexible Cords, Part 1:Conductors
SANS 1411-7		Materials of Insulated Electric Cables and Flexible Cords, Part 7: Polyethylene (PE)
SANS 1574		Electric cables – Flexible Cords and Cables
SANS 1632-1		Batteries, Part 1 – General information – Definitions, abbreviations and symbols
SANS 1632-2		Batteries, Part 2 – Vented-type stationary lead-acid cells and batteries
SANS 1632-3		Batteries, Part 3 – Vented-type prismatic nickel-cadmium cells and batteries
SANS 1632-4		Batteries, Part 4 - Valve regulated type stationary lead-acid cells and batteries
SANS 1652		Battery Chargers - Industrial Type
SANS 10109		Concrete floors
SANS 10400		The application of the National Building Regulations
SANS 1200		set Standardized specification for civil engineering construction
SANS 60034-1		Rotating Electrical machines Part 1 – Rating and performance
SANS 60079-14		Explosive atmospheres Part 14: Electrical installations design, selection and erection
SANS 60794-1-1		Optical fiber cables Part 1-1: Generic specification – General
SANS 60794-1-2		Optical fiber cables Part 1-2: Generic specification – Basic optical cable test procedures
SANS 61312		Protection against lightning electromagnetic impulse
SANS 61312-1		Protection against lightning electromagnetic impulse Part 1: General Principles
SANS 61312-2		Protection against lightning electromagnetic impulse Part 2: Shielding of structures, bonding inside structures and earthing
SANS 61312-3		Protection against lightning electromagnetic impulse Part 3: Requirements of surge protective devices (SPDs)
SANS 61312-4		Protection against lightning electromagnetic impulse Part 4: Protection of equipment in existing structure
SANS 1085:2004		Wall outlet boxes for the enclosure of electrical accessories
SANS 1433-1-2:2008		Electrical terminals and connectors
SANS 10198-1-5:2004		The selection, handling and installation of electric power cables of rating not exceeding 33 Kv
SANS 60034-1-34:2010		Rotating electrical machines
SANS 60044-1-8:2003		Instrument transformers
SANS 60050-441:1984		International electrotechnical vocabulary Chapter 441: Switchgear, controlgear and fuses
SANS 60072-1-3:1991		Dimensions and output series for rotating electrical machines
SANS 60076-1-21:2011		Power transformers

SANS 60086-1-5:2011		Primary batteries
SANS 60099-1-8		Surge arresters
SANS 60204-1-32:2009		Safety of machinery
SANS 60227-1-5:2006		Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
SANS 60269-1-6:2010		Low-voltage fuses
SANS 60282-1-2:2010		High-voltage fuses
SANS 60287-1-3:2010		Electric cables – Calculation of the current rating
SANS 60309-1-4:2012		Plugs, socket-outlets and couplers for industrial purposes
SANS 60439-1-5:2004		Low-voltage switchgear and controlgear assemblies
SANS 60502-4:2006		Power cables with extruded insulation and their accessories for rated voltages from 1 Kv (Um = 1,2 Kv) up to 30 Kv (Um = 36 Kv) Part 4
SANS 60614-2-3-14:1990		Specification for conduits for electrical installations
SANS 60909-0-4: 2010		Short-circuit currents in three-phase a.c. systems
SANS 60947-1-8:2012		Low-voltage switchgear and controlgear
SANS 61800-1-8		Adjustable speed electrical power drive systems
SANS 61869-1-5:2013		Instrument transformers
SANS 61936-1		Power installations exceeding 1 Kv a.c
SANS 62262:2004		Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
SANS 60529:2001 / IEC 60529:2001		Degrees of protection provided by enclosures (IP Code)
SANS 10329:2004		The design and construction of sectional steel tanks for storage of liquids at or above ground level
SANS 10252-1		Water supply and drainage for buildings Part 1: Water supply installations for buildings
SANS 966-1		Components of pressure pipe systems Part 1 : Unplasticized poly(vinyl chloride) (PVC-U) pressure pipe systems

- Eskom specific codes

  Eskom specific codes regarding engineering, procurement and supply of FGD is shown in Table App9.1-2

Table App9.1-2 Eskom Specific codes regarding engineering, procurement and supply of FGD

Number	Revision	Title
0.00/1310		Standard Power & Control Cable Code
36-721		Generation MV And LV Protection Philosophy For Eskom Power Stations
240-56176852		Essential Power Supplies For Power Stations Standard
240-56247004	1	Thermal Insulation Standard
0.54/393		Earthing Standard
ANSI/ISA-77 20-1993		Fossil Fuel Power Plant Simulators
EED_GTD_C&I_007		EED/GTD Technical Guideline: Modes of Operation - Local & Remote
240-56355808		Guideline for Ergonomic Design of Power Station Control Suites
GGS 0462		Quality Requirements For Engineering And Construction Works In Generation
240-56227443	5	Requirements for Power and Control Cables for Power Stations
240-56357518		Power Station electric Motors Procurement Standard
240-56356530		Environmental Conditions For Process Control Electronic Equipment Used at Power Stations
240-56227516	4	Specification for LV Switchgear and Control Gear Assemblies and Associated Equipment for Voltages up to and including 1000 V AC and 1500 V DC
240-53114214	1	Station cabling and racking standard
240-56356396	1	Earthing and lighting standard
GGSS 0690	0	Medium Pressure Pipelines
GGSS 0839		Eskom specification for self contained battery and charger
240-53114256		Eskom specification for battery stands
GGS 1427		Instrument Piping
N.PSZ 45-698		Engineering Drawing Office and Engineering Documentation Standard
NRS 042		Guide For the Protection of Electronic Equipment against Damaging Transients

NWP 3058, VOL 6		Battery Test Procedure For Acceptance and Type Testing of Lead Acid Vented Stationery Cells and Valve Regulated Sealed Lead Acid Cells
NWS 1582	1	Labels on Control Relay Panels and other Indoor and Outdoor Equipment
240-49230111		Hazard and Operability (HAZOP) Study Guideline
240-49230046	0	Failure Mode Effects (And Criticality) Analysis (FMECA) Guideline
240-56242363		Emission Monitoring and Reporting Standard
240-56242850		Continuous Emission Monitoring System Selection Standard
IEEE 1050 -2004		IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations
IEEE Green Book 142 -2007		IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
ISO 898-1		Mechanical Properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs
ISO 898-5		Mechanical Properties of fasteners made of carbon steel and alloy steel - Part 5: Set screws & similar under tensile stressesthreaded fasteners not
ISO 9000: 2005		Quality Management System – Fundamentals and Vocabulary
ISO 9001: 2008		Quality Management Systems – Requirements
ISO 10006:2003		Quality Management System – Guideline for Quality Management in Projects
ISO 10005: 2005		Quality Management Systems - Guidelines for Quality Plans Standard
NERSA GRID CODE		NERSA - South African Grid Code
NRS 013:2007		Medium-voltage cables
32-9		Definition of Eskom Documents
32-85		Eskom Information Security Policy
32-188		Procurement and Supply Chain Management Procedure
32-391		Integrated Risk Management Framework and Standard
32-894		Server Rooms and Data Centres Standard
36-193		The Management of Plant Simulations
240-56355910		The Management of Plant Software
36-776		Environmental conditions of Process Control Equipment used in Power Stations
240-56355541		Control System Computer Equipment Habitat Requirements
39-59		Project/Process Quality plan
39-60		Contract Quality Requirements Standard
240-53114190		Internal Audit Standard
240-53114186		Document and Record Management Procedure
249-53114194		Control of Non-conforming Product
39-65		Quality Management System Policy
39-66		Quality Management System Manual
240-53114192		Corrective and Preventive Action Standard
39-71		Quality Control Plan Standard
240-55896482	5	Design of Vertical Flat Base and Horizontal Steel Storage Tanks Guidelines
QM-1		Supplier Audit Standard
240-53113685		Design Review Procedure
240-53114002		Engineering Change Procedure
240-53114026		Project Engineering Change Management Procedure
32-1155		Eskom Standard Project Life Cycle Model Policy
240-55864784		Guideline for the preparation of a specification for an Expert Chemistry System (ECS)
240-5584789		Analytical Chemistry Laboratory Method Validation Guideline
240-55864833		Chemistry Manual for Auxiliary and Ancillary Cooling Water Systems
240-55864830		Design Guideline for Bulk Liquid Chemical Offloading/ Unloading Systems
240-55864855		Design Guideline for Semi Bulk Liquid Chemical Handling
240-55864827		Specification for Flexible Hose Suitable for Use with Aggressive Fluids (Ammonia, Sodium Hydroxide and Sulphuric Acid)
ISO 8573.1		Guide to Compressed air systems ASME VIII Pressure Vessels
GGS 0529		Compressed Air Testing
TBD GGR 0992		Plant Safety Regulations
240-52843902		Engineering Terms and Abbreviation Standard
240-56356376		Procedure for On-site Commissioning of Low Pressure Systems
GGSS 0317		Specification for storage Tanks
ESKSCAAC6		Pipeline Identification Specification
240-56227902		Dry Type Transformers Used In Power Stations Specification
240-56176953		Acdc Board Installation And Commissioning Manual
240-56177006		Acdc Board Maintenance Manual
240-56177100		Acdc Systems User Guideline

240-56177186		Design Guide For Power Station Battery Rooms Guideline
240-56177396		Battery Capacity Test Manual
240-56178099		Battery Charger Installation And Commissioning Manual
240-56176078		Battery Commissioning Manual
240-56176082		Battery Installation Manual
240-56176097		Cable Schedule Template
240-55714363		Coal Fired Power Stations Lighting And Small Power Installation Standard
TBD 369		Dc And Ups Settings Document
240-56356396		Earthing And Lightning Protection Standard
240-56355574		Earthing Standards
240-56227648		Maintenance Of L M H Range Nickel Cadmiu Batteries Work Instruction
240-56227711		Maintenance Of Vantage Nickel Cadmium Cells Standard
TBD 406		Mv Load Motor Parameters
240-56227773		Switchgear Schedule Template
240-56227778		Fault Current Calculations Rating Switch Gear Standard
240-56356445		Earthing And Lightning Protection Of Equipment Moving On Rails Coal Stackers Reclaimers And Ash Stackers Guideline
240-56227780		Installation Of Cables And Cable Racks At Power Stations Specification
240-56227929		Power Station Standby Diesel Generators Specification Standard
240-56239133		High Pressure Pipework Supports Standard
240-56356455		Rectifier Specification
240-56227788		Safe Disposal Of Redundant Batteries Work Instruction
240-53114248		Battery Chargers Specification
240-53114294		Flat Plate Lead Acid Cells Specification
240-56227809		Specification For Lv Power And Control Cable Rated Voltage 600 1000V Specification
240-53113666		Specification For Medium Power Transformers Used In Power Stations Schedule A B
240-56227823		Medium Voltage Impregnated Paper And Xlpe Insulated Cables Specification
240-56356460		Perimeter Security Lighting At Eskom Installations Standard
240-56356465		Switchboard List Template
240-56227830		The Safe Handling Of Batteries And Electrolyte Work Instruction
240-56228095		Transportation Of Electrolyte And Battery Cells Standard
TBD 439		Ups And Dc Schedule
240-56227573D		Ac Metal Enclosed Metal Clad Swithgear And Control Gear For Voltages Above 1Kv Up To And Including 52Kv Specification
240-56227881		Arc Flash Protective Clothing And Personal Protective Equipment Against The Thermal Hazard Of Electrical Arc Specification
240-56227883		Battery Test And Type Testing Of Lead Acid Vented Stationary Cells And Valve Regulated Sealed Lead Acid Cells Work Instruction
240-56356472		Clean Conditions For Power Transformer Outage Standard
240-56356486		Conveyor Belt Interface To Ac Metal Enclosed Switchgear And Control gear For 1Kv to 52 Kv Specification
240-56356491		Dc Earth Fault Detection Manual
240-56356510		Definitions Of Terms Applicable To Dc Emergency Supplies Standard
240-56356523		Section 1 Mv And Lv Distribution System Earthing Standard
240-56535950		Electrical Plant Information Files Standard
240-56356530		Environmental Conditions For Process Control Electronic Equipment And Components Used At Power Stations Manual
240-56227426		Management Of Power Station Mv And Lv Protection And Settings Standard
240-56227430		Eskom’s Undervoltage Philosophy For Large Fossil Fuel Power Stations Guideline
240-56356411		Fire Barrier Seals For Electrical Cable Installations At Power Plants Standard
240-56227515		Eskom Under Voltage Philosophy For Large Fossil Fuel Power Stations Guideline
240-56227520		Large Power Generator Transformers In Power Stations Specification
240-56227923		Quality Requirements For Stationary Vented Nickel Cadmium And Lead Acid Batteries For Power Stations Standard
240-57859177		Control Of Clean Conditions When Working On Generators And Large Motors Standard
240-56536488		Control Of Works Performed On Large Power Transformers Standard
TBD 486		Insulation Testing Of Mv Metal Clad Switchgear
240-56357314		Interlocking On Ac Metal Enclosed Switchgear And Control gear For Voltages 1Kv To 52 Kv Specification
240-56357332		Licensing Generating Facilities Work Instruction
240-56357346		List Of Approved Relays For Use On Power Stations Standard
240-56357366		Long Term Plant Health Indicators Manual

240-56535959		Management Of Emergency Ac And Dc Supplies At Power Stations Standard
240-56535964		Management Of Power Station Mv And Lv Protection Standard
240-56356630		Management Of Generation Protection Standard
240-56536505		Management Of Hazardous Locations Standard
240-56535978		Management Of Large Generators During Outages And Works Standard
240-56357421		Measurements And Metering Standard
240-56357424		Mv And Lv Switchgear Protection Standard
TBD 504		Medium Voltage Switchboard Maintenance
TBD 505		Management Of Safety Risks Of Mv Switchboard
240-56357438		Mv Motor Heater Interface To Ac Metal Enclosed Switchgear And Control gear For Voltages 1Kv To 52Kv Specification
240-60238757		On Site Dry Out Of Power Transformers Within Generation
240-56357462		Guideline On Shaft Voltage And Current Monitoring Manual
240-56357489		Plant Related Abbreviations For Inter System Use Standard
240-56535985		Power Station Medium Voltage Switchgear Management Standard
240-56357579		Precommissioning Of Large Power Transformers Standard
240-56357641		Electricity Impurity Tests For Lead Acid Batteries At Power Stations Work Instruction
240-56357725		Water Impurity Tests For Lead Acid Batteries And Nickel Cadmium Batteries Standard
240-56356630D		Management Of Generator Protection Standard
240-56356668		Maintenance Of Power Station Earthing And Earth Mats Guideline
240-56356675		Partial Discharge Testing Guideline
240-56356687		Transformer Long Term Plant Health Indicator Guideline
240-56356696		Monitoring Generator By Gas Analysis Guideline
240-56357019		Replacement Of Above Ground Copper Earthing Networks With Aluminum Guideline
240-56357281		Lay Up Mothballing Of Generation Electrical And Process Control Equipment In Power Stations Manual
240-56227292		Specification For Corrosion Protection Of Plant And Equipment With Coatings Specification
240-56227389		Specification For Loose Starters For Power Stations For Voltages Up To 1000V Ac And 1200V Dc Specification
240-56227394		Portable Earthing Equipment Specification
240-56227409		Refurbishment Of Battery Chargers At Power Stations Specification
240-56227419		Actions And Precautions To Be Followed When Receiving A Buccholtz Alarm Standard
240-56227424		Commissioning And Recommissioning Of Power Transformers Standard
240-56358929		Electronic Protection And Fault Monitoring Equipment For Power Systems Standard
240-56358993		Maintenance Of Power Transformers Standard
240-56359013		Maintenance Of Substation Isolators Standard
240-56359053		Transformer Hand Condition Monitoring Standard
240-56359083		Requirements For Measurement And Metering Systems For All Eskom Power Stations In Generation Standard
240-56359118		Low Voltage Variable Speed Drive Control Equipment Standard
240-56359660		Specification For Medium Voltage Motor Switching Devices Standard
240-56360031		Static Uninterruptible Power Supplies Specification
240-56360034		Stationary Vented Lead Acid Batteries Standard
240-56360086		Stationary Vented Nickel Cadmium Batteries Standard
240-56360387		Storage Of Power Station Electric Motors Standard
240-56361164		Sweep Frequency Response Analysis Testing Guideline
240-56361242		Non Phase Segregated Gas Insulated Ac Metal Enclosed Switchgear And Control gear for 1Kv To 52Kv Specification
240-56361296		Circuit Breakers To Independent Supplies In Ac Metal Enclosed Switchgear And Control gear For 1Kv And Up Specification
240-56361382		Transformer Hand Condition Monitoring Guideline
240-56361422		Transformer Insulation Moisture Measurement Guideline
240-56361435		Transport Of Power Station Electric Motors Standard
240-56361454		Undervoltage Protection Standard
240-56357751		Protection Of Electronic Equipment Against Damage By The Discharge Of Static Electricity Work Instruction
240-56357765		Radio Station Earthing And Bonding Standard
240-56357787		Diesel Alternator Sets For Fixed Installations Specification
240-56358788		Refurbishment Of Generator Stators For Steam Or Gas Turbines Standard
240-56178825		Requirements For Transportation And Movement Of Large Electrical Equipment Standard
TBD 591		Responsibilities For The Management Of Transformer

TBD 592		Rotary Current Asynchroous Motors Technical Requirements
240-56179027		Safety Measures Personal Protective Equipment for Thermal Hazard Of Electrical Arc For Metal Clad Switchgear Up To 11Kv Standard
240-56358900		Sampling And Testing Of Mineral Insulating Oil For Power Transformers Within Generation Division Standard
240-57859036		Lv Motor Deviation Schedule Template
240-57859043		Lv Motor Document Submittal Schedule Vdss Template
240-57859046		Lv Motor Technical Schedule Template
240-57617998		Typical General Arrangement Template
240-57617975		Procurement Of Power Station Low Voltage Electric Motors Specification Standard
240-64430501		Low Voltage Speed Drive Control Equipment Standard
BS 8007		Code of practice for design of concrete structures for retaining aqueous liquids
ESK PB AAQ 3	2	Interior specifications for Eskom
32-402		Energized perimeter fence
200-6166		Backfill specification
200-26680		Architectural technical specification
200-37830		Medupi User Requirement Specification
200-42385		Master Document List
84CIVL007		Conceptual architectural design specifications for Structures and other Buildings
84CIVL036		Stormwater design criteria
84CIVL037		Sewer network
84CIVL053		Concrete specification
240-56364537		Design of steel structures standard
240-56364542		Standard for reinforced concrete foundations and structures
240-56364545		Structural design and engineering standard
240-53458817		Design bulk material handling plant
1S0 5048:1989		Continuous mechanical handling equipment. Belt conveyors with carrying idlers -Calculation of operating power and tensile forces.
240-55864434		Storage and Handling of Conveyor Belting in Eskom Guideline
240-55864498		Operation and Selection of Fluid and Mechanical Couplings Specification
240-55864499		Specification for Belt Conveying Systems (Rev 1) Standard
240-55864504		Belt Conveyor Structural Steelwork and Welding Specification
240-55864505		Erection of belt Conveyor Mechanicals Specification
240-55864509		Ceramic Lagging for Pulleys Specification
240-55864544		Quality Requirements for the Purchasing of Conveyor Belting Guideline
240-55864546		Ceramic Lagging for Pulleys Guideline
240-55864551		Ash Stacker and Tripper Equipment Standard
240-55864562		Steelcord Reinforced Conveyor Belting Specification
240-55864564		Conveyor Belt Rolls Standard
240-55864521		Transfer Houses Cladding Guideline Manual
240-55864479		Belt Conveyor Chute Design Manual
240-55864503		Belt Conveyor Mechanical Components Standard
240-55864574		On-site Hot Repairs on Steel Cord Reinforced Conveyer Belt Standard
240-55864585		Textile Ply Belt Splicing Quality Control Standard
240-55864586		Steel Cord Belt Splicing Quality Control Standard
240-55864587		Conveyor Belt Manufacturing Repairs Standard
240-55864550		Mass Meters for Coal Measurement in Power Stations Design Specification
240-55864553		Magnetic Separators and Metal Detectors Specification
240-55864558		General Purpose Textile Reinforced Conveyor Belting Standard
240-56737448		Fire Detection and Life Safety Design Standard
240-56737654		Inspection Testing and Maintenance of Fire Detection Systems Standard
240-54937450		Fire Protection and Life Safety Design Standard
240-54937454		Inspection Testing and Maintenance of Fire Protection Systems Standard
240-54937439		Fire Protection - Detection Assessment Standard
ESKAMAAA1		Corporate Identity Document
N.PSZ 45-45		Kraftwerk Kennzeichen System (KKS) Key Part – Fossil Power Station
N.SSZ 45-629		KKS Plant Labeling Specification
200-4190		The Application of KKS Plant Coding
200-5343		Medupi Power Station Project – Standard Abbreviations
200-41103		Medupi Diesel Generator Operating, Control and Protection Philosophy
200-35586		Medupi MV switchgear Interlocking philosophy
200-50085		Medupi PS Project - Chop-over Philosophy
200-19408		Medupi Power Station, Auxiliary power system description
200-72508		Low voltage switchgear protection and control philosophy for Medupi Power Station,

240-53573084		Design Structures and Buildings
240-53573086		Design Roads and Railways
240-53573079		Perform Geotechnical Engineering
240-53573085		Design Dams,Waterways and Hydro

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Environment House · 473 Steve Biko Road, Arcadia · PRETORIA

DEA Reference: 14/12/16/3/3/2/1060
Enquiries: Ms Bongeka Ngcoliso
Telephone: 012-399-9376 **E-mail:** BNgcoliso@environment.gov.za

Ms Diedre Herbst
Eskom Holdings SOC Limited
PO Box 1091
JOHANNESBURG
2157
Tel: (011) 800 3501
Cell: (083) 660 1147
E-mail: HerbstDL@eskom.co.za.

PER E-MAIL / MAIL

Dear Ms Herbst

APPLICATION FOR ENVIRONMENTAL AUTHORISATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998), AS AMENDED (NEMA); GOVERNMENT NOTICES. R982, R983 AND R984, AS AMENDED: PROPOSED RETROFITTING OF A FLUE GAS DESULPHURISATION (FGD) SYSTEM AT THE MEDUPI POWER STATION WITHIN LEPHALALE LOCAL MUNICIPALITY, LIMPOPO PROVINCE

With reference to the above application, please be advised that the Department has decided to grant an environmental authorisation to you. The Environmental Authorisation (EA) and reasons for the decision are attached herewith.

In terms of Regulation 4(2) of the National Environmental Management Act: the Environmental Impact Assessment Regulations, 2014, as amended (the EIA Regulations), you are instructed to notify all registered interested and affected parties, in writing within 14 (fourteen) days of the date of this EA, of the Department's decision as well as the provisions regarding the submission of appeals that are contained in the Regulations.

In terms of the Promotion of Administrative Justice Act, 2000 (Act No 3 of 2000), you are entitled to the right to fair, lawful and reasonable administrative action; and to written reasons for administrative action that affects you negatively. Further your attention is drawn to the provisions of the Protection of Personal Information Act, 2013 (Act no. 4 of 2013) which stipulates that the Department should conduct itself in a responsible manner when collecting, processing, storing and sharing an individual or another entity's personal information by holding the Department accountable should the Department abuses or compromises your personal information in any way.

Your attention is drawn to Chapter 2 of National Environmental Management Act, 1998 (Act No. 107 of 1998) National Appeal Regulations published under Government Notice R993 in Government Gazette No. 38303 dated 08 December 2014 (National Appeal Regulations, 2014), which prescribe the appeal procedure to be followed. Kindly include a copy of this document (National Appeal Regulations, 2014) with the letter of notification to interested and affected parties in this matter.

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Should any person wish to lodge an appeal against this decision, he/she must submit the appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered interested and affected party, and any organ of state with interest in the matter within 20 days from the date that the notification of the decision was sent to the registered interested and affected parties by the applicant; or the date that the notification of the decision was sent to the applicant by the Department, whichever is applicable.

Appeals must be submitted in writing in the prescribed form to:

Director: Appeals and Legal Review of this Department at the below mentioned addresses.

By email: appealsdirectorate@environment.gov.za;

By hand: Environment House
473 Steve Biko Street
Arcadia
Pretoria
0083; or

By post: Private Bag X447
Pretoria
0001

Please note that in terms of Section 43(7) of the NEMA, the lodging of an appeal will suspend the environmental authorisation or any provision or condition attached thereto. In the instance where an appeal is lodged, you may not commence with any activity authorised in the EA until such time that the appeal is finalised.

To obtain the prescribed appeal form and for guidance on the submission of appeals, please visit the Department's website at https://www.environment.gov.za/documents/forms#legal_authorisations or request a copy of the documents at appealsdirectorate@environment.gov.za.

Yours faithfully

Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Date: 06/09/2018

CC:	Dr Mathys Vosloo	Zitholele Consulting Pty Ltd	Tel: 011 270 2079	Email: mathysv@zitholele.co.za
	Mr Tsholedi Joel Ngoasheng	Limpopo Economic Development, Environment and Tourism	Tel: 015 290 7134	Email: NgoashengTJ@ledet.gov.za.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Environmental Authorisation

In terms of regulation 25 of the Environmental Impact Assessment Regulations, 2014

Medupi Power Station Flue Gas Desulphurisation (FGD) Retrofit Project

Waterberg District Municipality

Authorisation register number:	*14/12/16/3/3/2/1060*
Last amended:	*First issue*
Holder of authorisation:	*ESKOM HOLDINGS SOC LIMITED*
Location of activity:	*LIMPOPO PROVINCE: Within Ward 3 of Lephalale Local Municipality*

This environmental authorisation does not negate the holder of the authorisation's responsibility to comply with any other statutory requirements that may be applicable to the undertaking of the activity.

Decision

The Department is satisfied, on the basis of information available to it and subject to compliance with the conditions of this environmental authorisation, that the applicant should be authorised to undertake the activities specified below.

Non-compliance with a condition of this environmental authorisation may result in criminal prosecution or other actions provided for in the National Environmental Management Act, 1998 and the EIA regulations.

Details regarding the basis on which the Department reached this decision are set out in Annexure 1.

Activities authorised

By virtue of the powers conferred on it by the National Environmental Management Act, 1998 (Act No.107 of 1998) and the Environmental Impact Assessment Regulations, 2014 the Department hereby authorises –

ESKOM HOLDINGS SOC LIMITED

(hereafter referred to as the **holder of the authorisation**)

with the following contact details –
Ms Diedre Herbst
Eskom Holdings SOC Limited
PO Box 1091
JOHANNESBURG
2157
Tel: (011) 800 3501
Cell: (083) 660 1147
E-mail: HerbstDL@eskom.co.za.

to undertake the following activities (hereafter referred to as "the activity") indicated in Listing Notice 1 and Listing Notice 2 of 2014 EIA Regulations as amended:

Listed activities	**Activity/Project description**
GN R. 327 Activity 9: *The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water - (i) with an internal diameter of 0,36 metres or more.*	Construction of clean and dirty water infrastructure associated with the rail yard and FGD infrastructure will be greater than 360mm and 1km in length.
GN R.327 Activity 12 *The development of (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; or c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse.*	Construction of the proposed rail yard or rail siding take-of point from the existing Thabazimbi – Lephalale mainline will occur within 32 m of the wetlands identified bordering the existing railway line, while construction of the rail yard infrastructure, gypsum and limestone handling facilities and proposed pollution control dam will occur within 32 m of an existing pan located on the western border of the rail yard development area.
GN R.327, Activity 19 *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells,*	Infilling or excavation of more than 10m^3 within a watercourse will occur during construction of the

Listed activities	**Activity/Project description**
shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	rail yard and associated infrastructure.
GN R.327, Activity 25 The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.	The proposed (Waste Water Treatment Plant) WWTP, which will be operated as a Zero Liquid Effluent Discharge (ZLED) plant to treat wastewater originating from the FGD infrastructure, will have a daily throughput capacity of more than 2 000 m3 but less than 15 000 m3.
GN R.325, Activity 4 The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.	The construction of facilities or infrastructure for the handling, storage, and transportation (conveyance) of gypsum,(Waste Water Treatment Plant) WWTP salts and sludge (~1420m3), diesel and chemical substances that will be stored and used in the rail yard workshops within the FGD footprint and rail yard will cumulatively be more than 500m3
GN R.325, Activity 6 *The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in*	A new Water Use Licence will be required to support the project (as part of the

Listed activities	Activity/Project description
terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent.	station); an amendment or variation of the station's Atmospheric Emission Licence will be required; and the Waste Management Licence for the Ash Disposal Facility will be required. All these permits are affected by the proposed FGD development.
GN R.325, Activity 7 The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods – (iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day.	The operation and transportation (conveyance) of gypsum, Waste Water Treatment Plant (WWTP) salts and sludge, diesel and chemical substances that will be stored and used in the rail yard workshops within the FGD footprint and rail yard will be more than 50 tons per day.
GN R.325, Activity 12 *The development of railway lines, stations or shunting yards.*	The construction of a railway tie-in line and yard for purposes of transport of products to the Power Station and waste products from the Power Station.

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Listed activities	Activity/Project description
GN R.325, Activity 15 *The clearance of an area of 20 hectares or more of indigenous vegetation.*	The total development footprint of the railway yard and associated infrastructure will be greater than 20ha, therefore the clearance of more than 20ha indigenous vegetation will be required.

as described in the Final Environmental Impact Report (FEIAr) dated 24 May 2018 at:

Farm Names:

- Portion 0 of Farm Naauw Ontkomen 509 LQ;
- Portion 0 of Farm Eenzaamheid 687 LQ and
- Portion 0 of Farm Kromdraai 690 LQ

21 Digit SG code:

T	0	L	Q	0	0	0	0	0	0	0	0	0	5	0	9	0	0	0	0	0
T	0	L	Q	0	0	0	0	0	0	0	0	0	6	8	7	0	0	0	0	0
T	0	L	Q	0	0	0	0	0	0	0	0	0	6	9	0	0	0	0	0	0

Development footprint point	Latitude (DMS)	Longitude (DMS)
Corner Point A	23°42'34.88"S	27°32'40.66"E
Corner Point B	23°42'35.73"S	27°33'11.34"E
Corner Point C	23°42'25.30"S	27°33'31.10"E
Corner Point D	23°42'15.17"S	27°33'24.72"E
Corner Point E	23°42'06.49"S	27°33'41.51"E
Corner Point F	23°42'35.56"S	27°33'59.42"E
Corner Point G	23°43'16.10"S	27°31'38.02"E
Corner Point H	23°43'14.84"S	27°31'39.86"E
Corner Point I	23°42'58.62"S	27°32'36.00"E
Shape Centre Point J (Centroid)	23°42'42.03"S	27°33'15.92"E

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the location indicated in the locality plan, attached as Annexure 2 of this authorisation.

- for the retrofitting of a Flue Gas Desulphurisation (FGD) system at the Medupi Power Station within Lephalale Local Municipality in the Limpopo Province.

The infrastructure associated with this facility includes:

- The construction and operation of a railway yard or rail siding to receive Limestone and transport gypsum via rail,
- The installation of diesel storage facilities within the FGD and railway yard footprint,
- The construction and operation of the wet FGD system as well as associated infrastructure required for operation of the FGD system,
- The handling, treatment and conveyance of gypsum and effluent,
- The construction and operation of a Waste Water Treatment Plant (WWTP), and the management, handling, transport and storage of salts and sludge generated through the waste water treatment process at a temporary waste storage facility; and a complete water management system.
- The transportation of salts and sludge via trucks from the temporary waste storage facility to a final Waste Disposal Facility to be contracted by Eskom for the first 5 years of operation of the FGD system.

Conditions of this Environmental Authorisation

Scope of authorisation

1. The retrofitting of a Flue Gas Desulphurisation (FGD) system at the Medupi Power Station is approved as per the geographic coordinates cited at the table reflected in page 6 above.
2. Authorisation of the activity is subject to the conditions contained in this environmental authorisation, which form part of the environmental authorisation and are binding on the holder of the authorisation.
3. The holder of the authorisation is responsible for ensuring compliance with the conditions contained in this environmental authorisation. This includes any person acting on the holder's behalf, including but not limited to, an agent, servant, contractor, sub-contractor, employee, consultant or person rendering a service to the holder of the authorisation.

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4. The activities authorised may only be carried out at the property as described above.
5. Any changes to, or deviations from, the project description set out in this environmental authorisation must be approved, in writing, by the Department before such changes or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations and it may be necessary for the holder of the authorisation to apply for further environmental authorisation in terms of the regulations.
6. The holder of an environmental authorisation must apply for an amendment of the environmental authorisation with the competent authority for any alienation, transfer or change of ownership rights in the property on which the activity is to take place.
7. This activity must commence within a period of **five (05) years** from the date of issue of this environmental authorisation. If commencement of the activity does not occur within that period, the authorisation lapses and a new application for environmental authorisation must be made in order for the activity to be undertaken.
8. Commencement with one activity listed in terms of this environmental authorisation constitutes commencement of all authorised activities.

Notification of authorisation and right to appeal

9. The holder of the authorisation must notify every registered interested and affected party, in writing and within 14 (fourteen) calendar days of the date of this environmental authorisation, of the decision to authorise the activity.
10. The notification referred to must –

10.1. specify the date on which the authorisation was issued;

10.2. inform the interested and affected party of the appeal procedure provided for in the National Appeal Regulations, 2014;

10.3. advise the interested and affected party that a copy of the authorisation will be furnished on request; and

10.4. give the reasons of the competent authority for the decision.

Commencement of the activity

11. The authorised activity shall not commence until the period for the submission of appeals has lapsed as per the National Appeal Regulations, 2014 and no appeal has been lodged against the decision.

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In terms of section 43(7), an appeal under section 43 of the National Environmental Management Act, 1998 will suspend the environmental authorisation or any provision or condition attached thereto. In the instance where an appeal is lodged you may not commence with the activity until such time that the appeal has been finalised.

Management of the activity

12. The Environmental Management Programme (EMPr) submitted as part of the Application for EA is hereby approved. This EMPr must be implemented and strictly adhered to.

Frequency and process of updating the EMPr

13. The EMPr must be updated where the findings of the environmental audit reports, contemplated in Condition 23 below, indicate insufficient mitigation of environmental impacts associated with the undertaking of the activity, or insufficient levels of compliance with the environmental authorisation or EMPr.
14. The updated EMPr must contain recommendations to rectify the shortcomings identified in the environmental audit report.
15. The updated EMPr must be submitted to the Department for approval together with the environmental audit report, as per Regulation 34 of GN R. 982. The updated EMPr must have been subjected to a public participation process, which process has been agreed to by the Department, prior to submission of the updated EMPr to the Department for approval.
16. In assessing whether to grant approval of an EMPr which has been updated as a result of an audit, the Department will consider the processes prescribed in Regulation 35 of GN R.982. Prior to approving an amended EMPr, the Department may request such amendments to the EMPr as it deems appropriate to ensure that the EMPr sufficiently provides for avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity.
17. The holder of the authorisation may apply for an amendment of an EMPr, if such amendment is required before an audit is required. The holder must notify the Department of its intention to amend the EMPr at least 60 days prior to submitting such amendments to the EMPr to the Department for approval. In assessing whether to grant such approval or not, the Department will consider the processes and requirements prescribed in Regulation 37 of GN R. 982.

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Monitoring

18. The holder of the authorisation must appoint an experienced independent Environmental Control Officer (ECO) for the construction phase of the development that will have the responsibility to ensure that the mitigation/rehabilitation measures and recommendations referred to in this environmental authorisation are implemented and to ensure compliance with the provisions of the approved EMPr.

18.1. The ECO must be appointed before commencement of any authorised activities.

18.2. Once appointed, the name and contact details of the ECO must be submitted to the *Director: Compliance Monitoring* of the Department at Directorcompliance@environment.gov.za.

18.3. The ECO must keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO.

18.4. The ECO must remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site is ready for operation.

Recording and reporting to the Department

19. All documentation e.g. audit/monitoring/compliance reports and notifications, required to be submitted to the Department in terms of this environmental authorisation, must be submitted to the *Director: Compliance Monitoring* of the Department at Directorcompliance@environment.gov.za.

20. The holder of the environmental authorisation must, for the period during which the environmental authorisation and EMPr remain valid, ensure that project compliance with the conditions of the environmental authorisation and the EMPr are audited, and that the audit reports are submitted to the *Director: Compliance Monitoring* of the Department at Directorcompliance@environment.gov.za.

21. The frequency of auditing and of submission of the environmental audit reports must be as per the frequency indicated in the EMPr, taking into account the processes for such auditing as prescribed in Regulation 34 of GN R. 982.

22. The holder of the authorisation must, in addition, submit an environmental audit reports to the Department within 30 days of completion of the construction phase (i.e. within 30 days of site handover) and a final environmental audit report within 30 days of completion of rehabilitation activities.

23. The environmental audit reports must be compiled in accordance with appendix 7 of the EIA Regulations, 2014 and must indicate the date of the audit, the name of the auditor and the outcome

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of the audit in terms of compliance with the environmental authorisation conditions as well as the requirements of the approved EMPr.

24. Records relating to monitoring and auditing must be kept on site and made available for inspection to any relevant and competent authority in respect of this development.

Notification to authorities

25. A written notification of commencement must be given to the Department no later than fourteen (14) days prior to the commencement of the activity. Commencement for the purposes of this condition includes site preparation. The notice must include a date on which it is anticipated that the activity will commence, as well as a reference number.

Operation of the activity

26. A written notification of operation must be given to the Department no later than fourteen (14) days prior to the commencement of the activity operational phase.

Site closure and decommissioning

27. Should the activity ever cease or become redundant, the holder of the authorisation must undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

Specific conditions

28. The EA holder must ensure that the storage areas have firm, waterproof base and drainage system. It must be designed and managed such that there is no escape of contaminants to the environment. All runoff must be prevented from entering local watercourses including wetlands.
29. The holder of environmental authorisation must prevent spillages. Where the spillages occur, the holder of authorisation must ensure the effective and safe cleaning of such spillages.
30. The Waste Management Licence (WML) for the existing ash disposal facility must be amended to allow the co-disposal of ash and gypsum. The amendment of the WML must be obtained prior to any co-disposal to the current ash disposal facility.

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31. The holder of environmental authorisation must prevent the occurrence of nuisance conditions or health hazards.
32. No effluent must be discharged into any storm water drain or furrow, whether by commission or by omission.

General

33. A copy of this environmental authorisation, the audit and compliance monitoring reports, and the approved EMPr, must be made available for inspection and copying-

33.1. at the site of the authorised activity;

33.2. to anyone on request; and

33.3. where the holder of the environmental authorisation has a website, on such publicly accessible website.

34. National government, provincial government, local authorities or committees appointed in terms of the conditions of this authorisation or any other public authority shall not be held responsible for any damages or losses suffered by the holder of the authorisation or his/her successor in title in any instance where construction or operation subsequent to construction be temporarily or permanently stopped for reasons of non-compliance by the holder of the authorisation with the conditions of authorisation as set out in this document or any other subsequent document emanating from these conditions of authorisation.

Date of environmental authorisation: 06/09/2018

Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs

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Annexure 1: Reasons for Decision

1. Information considered in making the decision

In reaching its decision, the Department took, *inter alia*, the following into consideration -

a) The information contained in the EIAr dated 24 May 2018;
b) The comments received from the Limpopo Department of Economic Development, Environment and Tourism (LDEDET) and interested and affected parties as included in the EIAr dated 24 May 2018;
c) Mitigation measures as proposed in the EIAr dated 24 May 2018 and the EMPr;
d) The information contained in the specialist studies contained within Appendix D of the EIAr; and
e) The objectives and requirements of relevant legislation, policies and guidelines, including section 2 of the National Environmental Management Act, 1998 (Act No.107 of 1998).

2. Key factors considered in making the decision

All information presented to the Department was taken into account in the Department's consideration of the application. A summary of the issues which, in the Department's view, were of the most significance is set out below.

a) The findings of all the specialist studies conducted and their recommended mitigation measures.
b) The need for the proposed retrofitting of Flue Gas Desulphurisation (FGD) technology to remove sulphur dioxide from the exhaust flue gases of the Medupi Power Station operations, Eskom Holdings SOC Limited, established a SO_2 emissions target of 400mg/Nm3 at 6% O_2 for power stations commissioned between 2002 and 2017. This target complies with the minimum emissions standards stipulated by the National Environmental Management: Air Quality Act (Act 39 of 2004), which requires a concentration of 500mg/Nm3 at 10% O_2. The Air Quality Strategy further recommended that the Medupi Power Station be fitted with a flue gas desulphurisation technology in order to comply with the emissions standards set. Therefore in response to the Eskom Air Quality Strategy and funder requirements, the Medupi Power Station units have been designed, and

constructed, with provisions incorporated into the space and equipment design to accommodate the installation of the wet limestone FGD system.

c) The EIAr dated 24 May 2018 identified all legislation and guidelines that have been considered in the preparation of the EIAr dated 24 May 2018.

d) The methodology used in assessing the potential impacts identified in the EIAr dated 24 May 2018 and the specialist studies have been adequately indicated.

e) A sufficient public participation process was undertaken and the applicant has satisfied the minimum requirements as prescribed in the EIA Regulations, 2014 for public involvement.

3. Findings

After consideration of the information and factors listed above, the Department made the following findings -

a) The identification and assessment of impacts are detailed in the EIAr dated 24 May 2018 and sufficient assessment of the key identified issues and impacts have been completed.

b) The procedure followed for impact assessment is adequate for the decision-making process.

c) The proposed mitigation of impacts identified and assessed adequately curtails the identified impacts.

d) The information contained in the EIAr dated 24 May 2018 is accurate and credible.

e) EMPr measures for the pre-construction, construction and rehabilitation phases of the development were proposed and included in the BAR and will be implemented to manage the identified environmental impacts during the construction phase.

In view of the above, the Department is satisfied that, subject to compliance with the conditions contained in the environmental authorisation, the authorised activities will not conflict with the general objectives of integrated environmental management laid down in Chapter 5 of the National Environmental Management Act, 1998 and that any potentially detrimental environmental impacts resulting from the authorised activities can be mitigated to acceptable levels. The environmental authorisation is accordingly granted.

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Annexure 2: Locality Plan

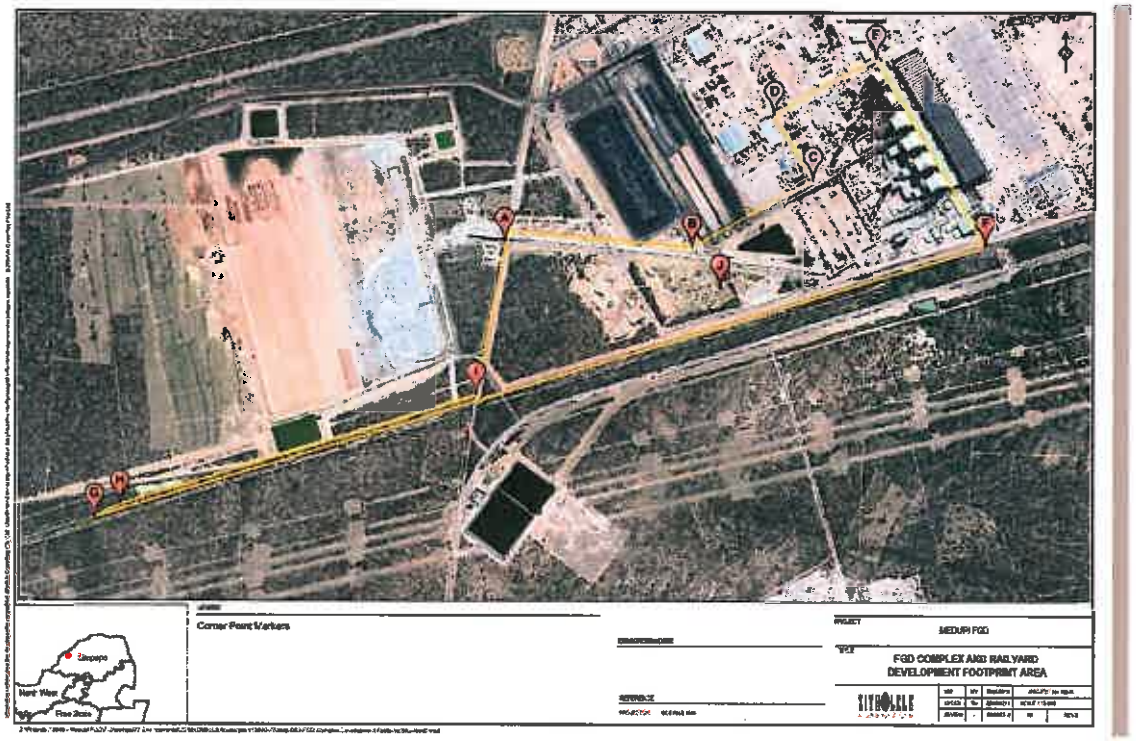

Figure 1: FGD complex and railyard development footprint area

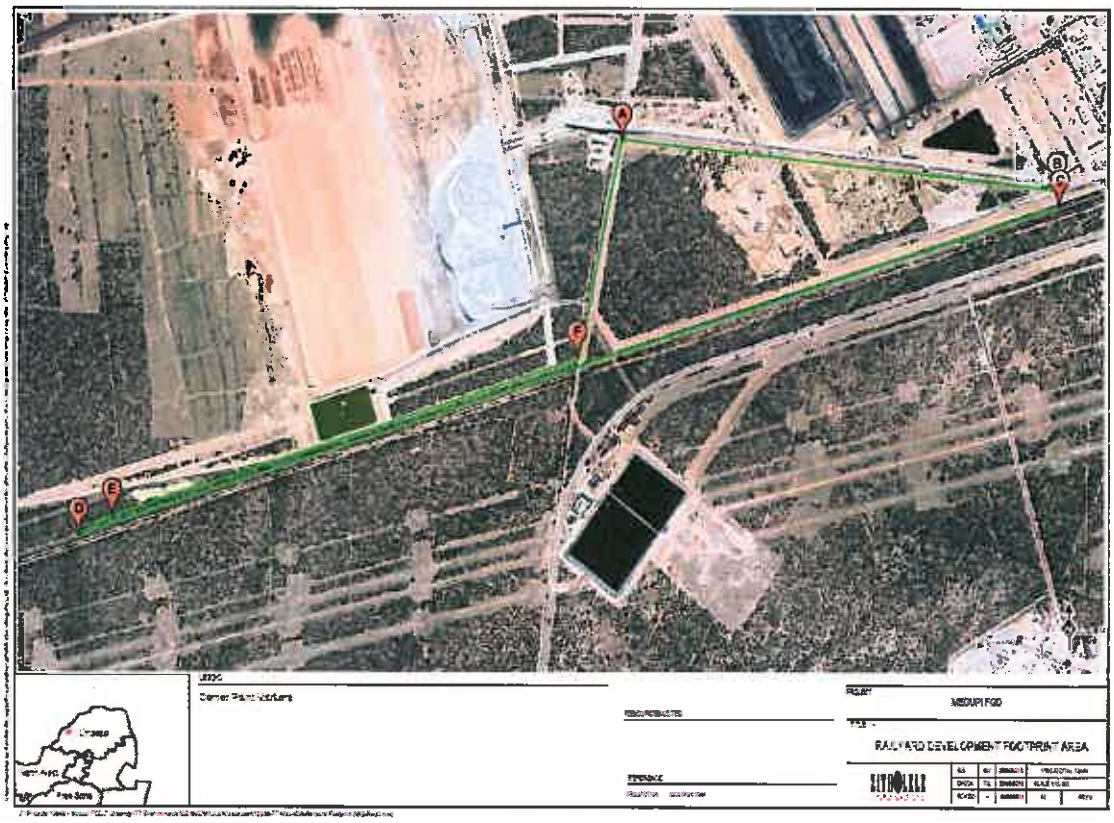

Figure 2 :Railyard development footprint area

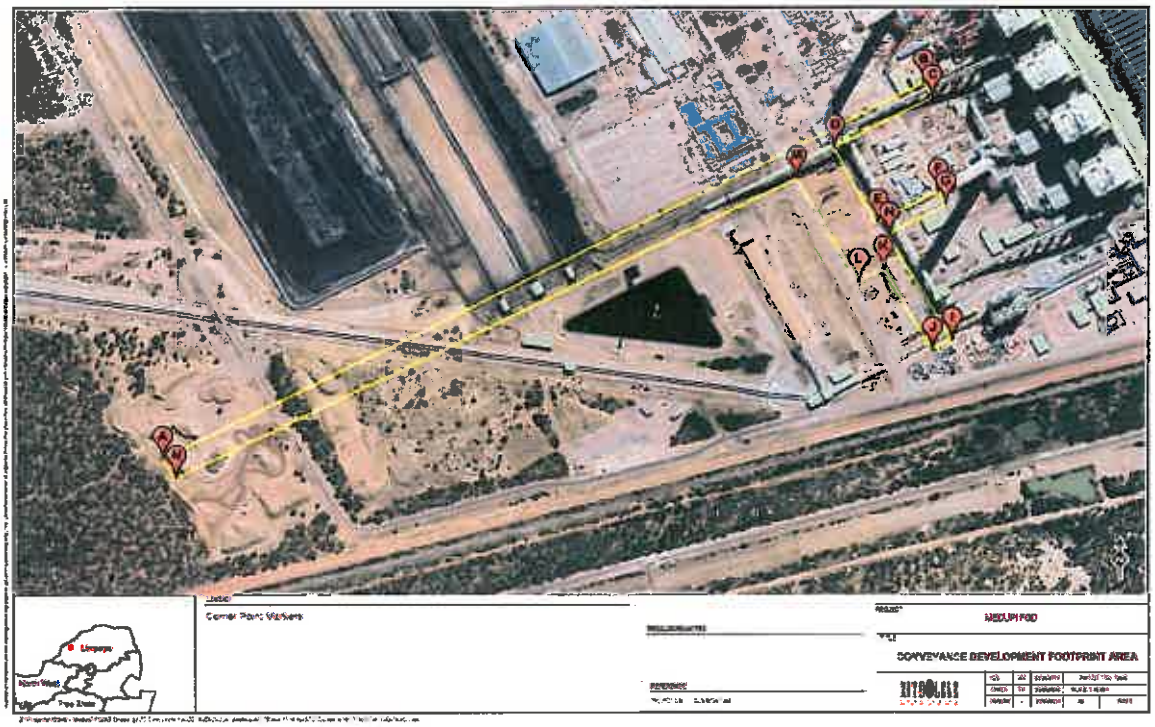

Figure 3: Conveyance development footprint area

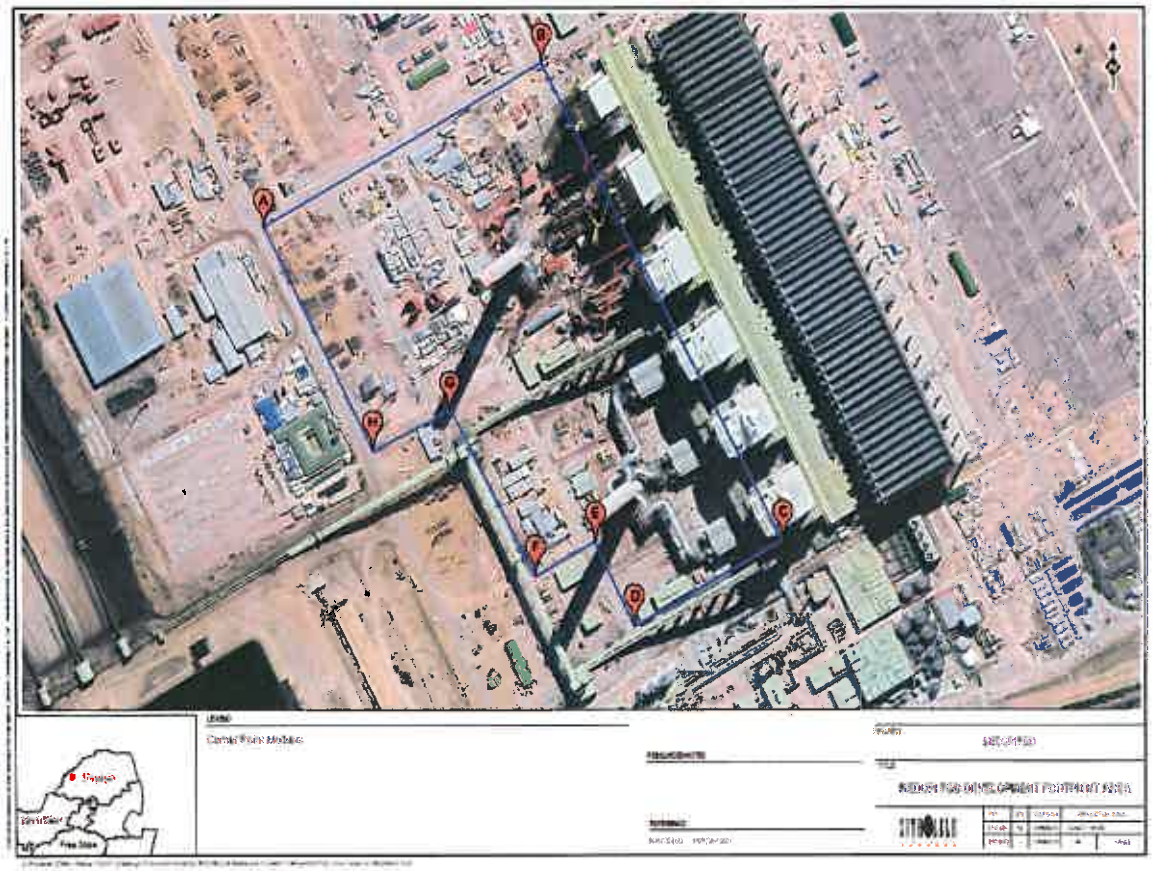

Figure 4: Medupi FGD development footprint area

environmental affairs
Department:
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Reference: 14/12/16/3/3/2/1060/AM1
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E-mail: HerbstDL@eskom.co.za

PER E-MAIL / MAIL

Dear Ms Herbst

AMENDMENT OF THE ENVIRONMENTAL AUTHORISATION ISSUED ON 06 SEPTEMBER 2018 FOR THE PROPOSED RETROFITTING OF A FLUE GAS DESULPHURISATION (FGD) SYSTEM AT MEDUPI POWER STATION WITHIN LEPHALALE LOCAL MUNICIPALITY, LIMPOPO PROVINCE.

The Environmental Authorisation (EA) (Reference number 14/12/16/3/3/2/1060) for the above project issued by the Department on 06 September 2018, and your amendment application received by the Department on 13 September 2018, refer.

Based on a review of the reason for requesting an amendment to the above EA, this Department, in terms of Chapter 5 of the Environmental Impact Assessment Regulations, 2014 as amended Regulation 27 (4) has decided to amend the EA dated 06 September 2018 as follows:

1. The listed notice authorised on page 3-7 of the EA is amended to add the following:

Listed activities	**Activity/Project description**
GN R.327, Activity 24 *The development of a road-* *(ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres*	The road infrastructure is associated with the railway yard, limestone stockpile and gypsum storage facility will be more than 8 m wide and 1km in length when considering the road surface area and shoulder of the road.
GN R.327, Activity 34 *The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an*	Medupi Power Station's existing provisional AEL will require an amendment due to the storage and handling of

Listed activities	Activity/Project description
amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution.	limestone on site and the additional storage of fuel at the railway siding workshops and FGD development footprint. The additional storage of fuel is considered an expansion of the existing fuel storage capacity within the Medupi Power Station footprint.
GN R.324, Activity 4 *The development of a road wider than 4 metres with a reserve less than 13,5 metres,* ***(e) Limpopo*** *(i) Outside urban areas,* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;*	The south western extent of the railway yard development area, which provides for the runoff railway line from the main railway line, is located within a critical biodiversity area as identified in Waterberg District Bioregional Plan, which was developed from the Limpopo Conservation Plan (C-Plan) version 2. Some of the service roads within this area will be wider than 4 metres with a reserve less than 13.5 metres.
GN R.324, Activity 12 *The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* ***(e) Limpopo*** *ii. Within critical biodiversity areas identified in bioregional plans*	The south western extent of the railway yard development area, which provides for the runoff railway line from the main railway line, is located within a critical biodiversity area as identified in Waterberg District Bioregional Plan, which was developed from the Limpopo Conservation Plan (C-Plan) version 2. The clearance of vegetation to allow construction of the runoff railway line and associated infrastructure, including a service road, will be more than 300m^2, while the vegetation is largely intact natural vegetation.
GN R.324, Activity 14 *The development of-* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—*	The south western extent of the railway yard development area, which provides for the runoff railway line from the main railway line, is located within

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Listed activities	Activity/Project description
(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; ***(e) Limpopo,*** *(i) Outside urban areas:* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;*	a critical biodiversity area as identified in Waterberg District Bioregional Plan, which was developed from the Limpopo Conservation Plan (C-Plan) version 2. The runoff railway line and associated infrastructure, including service road, will cover an area greater than 10m^2 and will be located within 32m of a wetland area as identified by the wetland specialist

2. To clarify wording on EAIR receipt date from:

The wording currently reads as follows ***"the Final Environmental Impact Assessment Report (FEIAr) dated 24 May 2018"*** on Page 6 under the table of listed activities, Page 13 under section 1 (a) to (c), Page 14 under section 2 (c) and (d), and Page 14 under section 3 (a) and (d).

Is hereby amended to:

The Final Environmental Impact Assessment Report (FEIAr) dated 23 May 2018"on Page 6 under the table of listed activities, Page 13 under section 1 (a) to (c), Page 14 under section 2 (c) and (d), and Page 14 under section 3 (a) and (d).

This proposed amendment letter must be read in conjunction with the EA dated 06 September 2018.

In terms of Regulation 4(2) of the Environmental Impact Assessment Regulations, 2014 (the Regulations), you are instructed to notify all registered interested and affected parties, in writing and within 14 (fourteen) days of the date of the EA, of the Department's decision in respect of your application as well as the fact that an appeal may be lodged against the decision in terms of the National Appeals Regulations, and the provisions regarding the submission of appeals as contained in the Regulations.

Should any person wish to lodge an appeal against this decision, he/she must submit the appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered interested and affected party, and any organ of state with interest in the matter within 20 days from the date that the notification of the decision was sent to the registered interested and affected parties by the applicant; or the date that the notification of the decision was sent to the applicant by the Department, whichever is applicable.

Appeals must be submitted in writing in the prescribed form to:

Director: Appeals and Legal Review of this Department at the below mentioned addresses.

By email: appealsdirectorate@environment.gov.za;

By hand: Environment House
473 Steve Biko,
Arcadia,
Pretoria,
0083; or

MJ

By post: Private Bag X447,
Pretoria,
0001

Please note that in terms of Section 43(7) of the National Environmental Management Act, 1998, the lodging of an appeal will suspend the environmental authorisation or any provision or condition attached thereto. In the instance where an appeal is lodged, you may not commence with the activity until such time that the appeal is finalised.

To obtain the prescribed appeal form and for guidance on the submission of appeals, please visit the Department's website at https://www.environment.gov.za/documents/forms#legal_authorisations or request a copy of the documents at appealsdirectorate@environment.gov.za.

Yours faithfully

Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Date: 11/10/2018

CC:	Dr Mathys Vosloo	Zitholele Consulting Pty Ltd	Tel: 011 270 2079	Email: mathysv@zitholele.co.za
	Mr Tsholedi Joel Ngoasheng	Limpopo Economic Development, Environment and Tourism	Tel: 015 290 7134	Email: NgoashengTJ@ledet.gov.za.

Appendix 11.2 Environmental Authorization for Medupi PS

Ref: 12/12/20/695
Tel: (012) 310 3031 Fax: (012) 320 7539 e-mail: mntene@deat.gov.za
Enquiries: Ms Masili Ntene

Ms D Herbst
Eskom Holdings Limited: Generation Division
PO Box 1091
JOHANNESBURG
2000

Fax: (011) 800 3501

Dear Ms Herbst

GRANTING OF CONDITIONAL AUTHORISATION FOR PROJECT REFERENCE 12/12/20/695: CONSTRUCTION OF THE PROPOSED ESKOM HOLDINGS LIMITED: GENERATION DIVISION 4800MW COAL FIRED POWER STATION AND ASSOCIATED INFRASTRUCTURE NEAR LEPHALALE

Please find attached the record of decision in respect of your application for authorisation in terms of Regulations R1182 and R1183 (as amended) promulgated under sections 21, 22, 26 and 28 of the Environment Conservation Act (Act 73 of 1989).

Yours sincerely

Ms Pam Yako
Director-General
Department of Environmental Affairs and Tourism

Date: 21/09/06

CC: Ms Ashlea Strong Bohlweki Environmental Fax: (011) 466 3841

RECORD OF DECISION FOR PROJECT REFERENCE 12/12/20/695: CONSTRUCTION OF THE PROPOSED ESKOM GENERATION 4800MW COAL FIRED POWER STATION, NEAR LEPHALALE

By virtue of the power delegated by the Minister in terms of section 33(1) Environment Conservation Act, (Act 73 of 1989) ("the Act"), I hereby, in terms of section 22(3) of the Act, authorise Eskom Generation to undertake the activities specified/ detailed below subject to the indicated conditions.

1. DESCRIPTION, EXTENT AND LOCATION OF THE ACTIVITY:

As illustrated in the site layout Plan in Appendix A of the Final Environmental Impact Report dated 22 May 2006 the proposed development entails the following:

- The construction of a 4800MW coal fired power station near Lephalale, on approximately 700ha of the farm Naauwontkomen 509 LQ
- The installation of ancillary infrastructure including the ashing facility on 500-1000ha of the farm Eenzaamheid 687 LQ
- The construction of a conveyor belt for coal supply on the eastern alignment
- The re-routing of the Steenbokpan Road to the northern alternative
- The construction of the overland ash conveyor belt

2. KEY FACTORS INFORMING THE DECISION:

2.1 In reaching its decision in respect of the application, the Department of Environmental Affairs and Tourism ("the Department") has taken, *inter alia,* the following into consideration:

a) The information contained in the:
- Final Scoping Report dated
- Final Environmental Impact Assessment Report dated 22 May 2006.
- Specialist Reports contained in the Final Environmental Impact Assessment Report.
- Addendum to the Final Environmental Impact Assessment Report dated June 2006.
- Comments on the Environmental Impact Assessment Report dated 18 July 2006 from the Department of Water Affairs and Forestry (DWAF).
- Minutes of the meeting held on 10 May 1982 in the office of the Chief Officer (Air Pollution Control) between Eskom and the Department of Health to discuss the Pollution Control conditions related to Eskom's power stations and related matters.

b) Compliance with applicable international and national legislation and departmental policies:
- The Act
- The principles set out in Section 2 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA)
- Process 29 set out in the Scheduled processes under the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965).
- The principles of sound management of toxic chemical set out in Chapter 19 of Agenda 21
- Minimum requirements for landfills by the Department of Water Affairs and Forestry (second edition, 1998)
- Stockholm Convention

c) The findings of the site inspection undertaken by Mr Vincent Matabane and Mr Ndhivhuwo Netshilaphala on 6th April 2005

d) The objections from MW De Jager Kinder Trust/Landelani Game Lodge & MW De Jager Safaris set out in the letter dated 2nd August 2006 from Ivan Pauw & Partners to Bohlweki Environmental Consultants in Midrand.

2.2 In reviewing this information, the Department made the following findings:

The existing Matimba Power Station is a dry cooled, coal fired pulverised fuel power station comprising six 665 MW units, representing a total nominal capacity of 3990 MW and a total net maximum generation capacity of 3690 MW

- The proposed power station is a dry cooled, coal fired pulverised fuel power station will have a generation capacity of 4800 MW
- Existing sources of atmospheric emission which occur in the vicinity of the proposed development sites include:
  - Existing Matimba Power Station and its associated ash dump
  - Grootgeluk coal mining operations
  - Brickworks operating at Hanglip
  - Household fuel combustion
  - Potential veld fires
  - Sewage works (Farm Nelsonkop)
  - Wind blown dust from areas and agricultural activities
  - Vehicle exhaust releases and road dust entertainment along paved and unpaved roads in the area
- The proposed power station is approximately 3 Km away from the existing Matimba Power Station and the Marapong Village
- The existing Matimba Power Station does not have SO_2 and NO_2 abatement measures in place
- The burning of coal in the proposed power station will potentially release significant amounts of air pollutants such as Sulphur Dioxide (SO_2), Nitrogen oxides (NO_x), Carbon Monoxide (CO), and trace amounts of mercury.
  Ambient SO_2 levels resulting from the new power station are predicted to cause health effects in the Marapong residential area
  The proposed power station will potentially release significant amounts of greenhouse gases, namely, Carbon Dioxide (CO_2) and Nitrous Oxide (N_2O).
  Ambient SO_2 standards are already being exceeded in the area where the new power station is proposed.
- Ambient air quality standards in the Marapong residential area are already being exceeded
- The proposed development will result in a loss of approximately 1 500 hectares of vegetation due to the required pre construction site clearing.
  Approximately 1000 ha of the above are intended for facility for disposal / storage of ash. A conventional ash dam has been proposed and assessed but mention is made of investigations into alternatives to this disposal option, including backfilling at the Grootegeluk open cast coal mine. The investigation of alternatives in this regard has not sufficiently progressed to allow for an informed decision with regard to ash disposal / storage at this stage. It is however acknowledged that an ashing facility will be required.
  The proposed development is part of Eskom's new capacity installation programme and is intended to meet the future base load electricity demands of South Africa which is under severe pressure.

- The purpose of the proposed power station is to increase the Eskom Generation base load capacity to facilitate the forecast increase in demand by 2010 and to further supply this additional capacity in such a way that it improves security of supply to the national grid system and South Africa in its entirety.

Based on the information considered, the Department's conclusions are that:
(a.) the proposed activities may lead to substantial detrimental impact on the environment;
(b.) the need for the project have been adequately demonstrated;
(c.) the activities will result in some socio-economic benefits, not only to the Lephalale area, but to the country as a whole;
(d.) the implementation of the mitigation measures and conditions set out in this Record of Decision, are considered adequate to minimise detrimental impacts to acceptable levels;
(e.) subject to successful implementation of conditions and mitigation measures, the proposed development is likely to be acceptable; and
(f.) the principles of section 2 of NEMA can largely be upheld.

It is further the Department's conclusion that further information on alternatives for the disposal of ash produced by the facility is required before an informed decision can be made on this aspect of the application.

The Department has accordingly decided to grant Eskom Holdings Limited: Generation Division authorisation in terms of Regulations R 1182 and R 1183 (as amended), promulgated under section 21, 22 and 26 of the Environment Conservation Act (Act 73 of 1989) for the activities specified below, subject to the conditions and provisions listed below.

3. CONDITIONS

3.1 Description of the activity

The authorisation applies in respect of the following activities as listed in Schedule 1, regulation R. 1182 and described in the final environmental impact report dated 22 May 2006 and the addendum report to the final environmental impact report dated June 2006:

Item 1: The construction, erection or upgrading of-
- (a) facilities for commercial electricity generation with an output of at least 10 megawatts and infrastructure for bulk supply;
- (c) with regard to any substance which is dangerous or hazardous and is controlled by national legislation-
  - (i) infrastructure, excluding road and rails, 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;
- (n) sewerage treatment plants and associated infrastructure;

Item 2: The change of land use from-
- (c): agricultural or zoned undetermined use or an equivalent zoning to any other land use.

Item 9: Scheduled processes listed in the Second Schedule to the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965). (Process 29 (a) – Power Generation Processes in which fuel is burned for the generation of electricity for distribution to the public or for purposes of public transport).

The following activity applied for is not included in this authorisation and will be addressed in an amended or supplementary record of decision:

- Item 8: The disposal of waste as defined in section 20 of the Act, excluding domestic waste, but including the establishment, expansion, upgrading or closure of facilities for all waste, ashes and building rubble

The decision contemplated above will be based on the review of the investigation and assessment of alternative ash disposal options to be submitted to the Department for consideration.

SPECIFIC CONDITIONS

Air quality management

3.2.1.1 Eskom must initiate a programme for the continuous monitoring of ambient concentrations of pollutants in the Marapong residential area as well as surrounding areas around the proposed power station and existing Matimba power station. This programme must be included in the construction EMP and the operational EMP to be submitted to the authorities for acceptance prior to construction, commissioning and operation of the power station. The programme must, among others, detail the installation of air quality monitoring equipment at an appropriate location within the Marapong residential area. The site for the air quality monitoring equipment should be such that the monitored ambient air represents a fair reflection of the ambient air the majority of Marapong residents are likely to breathe. The air quality monitoring equipment must be such as to provide continuous measurement of the following substances or mixtures of substances: Sulphur Dioxide (SO_2); Nitrogen Dioxide (NO_2); Carbon Monoxide (CO); Particulate Matter (PM10 and PM 2.5); Ozone (O_3); and Mercury (Hg).

The installation should also include gas-sampling systems as appropriate for the parameters being monitored, meteorological equipment and data management systems that will allow the effective and reliable transfer of data. The programme must also detail the compilation of a commissioning report produced by an independent party indicating that the installations are in place, calibrated and operating to internationally acceptable standards of operation. The programme must also detail reporting procedures including, among others, the submission of quarterly reports to the department detailing the monitoring results obtained from the installation detailed above and any other monitoring results from Eskom monitoring stations in the area. The monitoring reports must provide, but are not limited to the provision of, both a numeric and graphical representation of measured concentrations of the measured pollutants with a comparison against any applicable ambient air quality standards published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004). This information should include detailed information for the 3 month period to which the report relates as well as a summary of historical trends from the commencement of monitoring activities.

3.2.1.2 Eskom shall install, commission and operate any required SO_2 abatement measures that may be necessary to ensure compliance with any applicable emission or ambient air quality standards published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).

3.2.1.3 Notwithstanding the measures referred to in 3.2.8.2, should the monitoring referred to in 3.2.8.1 indicate non-compliance with ambient SO_2 standards, Eskom shall install, commission and operate any required SO_2 abatement measures in respect of the existing Matimba Power Station as may be necessary to ensure compliance with any applicable emission or ambient air quality standards published in terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).

3.2.1.4 Eskom must initiate a programme of support for initiatives aimed at improving air quality in the Marapong residential area. This programme must be included in the construction EMP and carried through to the operational EMP.

3.2.1.5 The power station must be operated in compliance with any related Registration Certificate issued in terms of the Atmospheric Pollution Prevention Act, Act 45 of 1965, or any related Atmospheric Emission License issued in terms of the National Environment Management: Air Quality Act, Act 39 of 2004

3.2.2 Environmental Monitoring Committee (EMC)

3.2.2.1 This development is authorised on condition that the developer establishes an EMC with clear terms of reference as described in 3.2.2.6.

3.2.2.2 Amongst others the EMC shall consist of the following members:

(a) A chairperson as described in 3.2.2.3,
(b) The ecologist that participated in the EIA process, or any other suitably qualified and experienced ecologist approved for this purpose by the department,
(c) Two representatives of the public, one community member from Marapong and one from Lephalale.
(d) Environmental Control Officer (ECO) (once appointed in terms of 3.2.4 below), and
(e) A senior site manager from the main contractor.

3.2.2.3 The EMC must appoint an independent chairperson who has appropriate people and project management skills.

3.2.2.4 The EMC must meet on a bi-monthly basis from the inception of the project.

3.2.2.5 The EMC must report to the Director-General of the Department of Environmental Affairs and Tourism on a bi–monthly basis and the report must include matters as described in 3.2.2.6 below.

3.2.2.6 The purpose of the EMC is to execute the following:

(a) To monitor and audit project compliance to the conditions of this record of decision, environmental legislation and specific mitigation requirements as stipulated in the environmental impact report and the Environmental Management Plans.
(b) To make recommendations to the Director-General on issues related to the monitoring and auditing of the project.

(c) The EMC shall decide on the frequency of meetings should a need arise to review the prescribed frequency. This change should be communicated to the department for acceptance.

3.2.2.7 All costs associated with the EMC shall be borne by the applicant. The terms of reference for the EMC must, in addition to the scope of work as detailed in 3.2.2.6, clearly set out roles and responsibilities related to logistical arrangements, administration and financial arrangments associated with the EMC.

3.2.2.8 Upon completion of construction, the role, responsibilities and constitution of the EMC shall be re-considered and re-established with new terms of reference for the operational phase of the development.

3.2.3 Environmental Management Plan (EMP)

3.2.3.1 Eskom must submit a site specific construction EMP to the relevant authorities for acceptance before commencement of any of the activities related to this authorisation. The EMP must include but not be limited to the following aspects:

- Rehabilitation of all areas disturbed during the construction phase of the project excluding those areas where permanent structures are erected.
- Siting and management of construction camps, sanitation, ablution and housing facilities as well as material storage areas used by the contractor. All work areas must be supplied with proper sanitation facilities.
  Management and rehabilitation of access roads to individual construction areas that will not become permanent roads upon completion of construction. Any new road constructed for any purpose not authorised as part of this authorisation, must comply with the relevant SANS codes and permission for construction must be obtained from DEAT as required by Schedule 1, item 1 (d) of R. 1182.
- Waste avoidance, minimisation and disposal of waste at an appropriate facility.
- Protection of any heritage sites likely to be impacted by the development should such sites be found during any phase of the project to follow.
  Provisions for harvesting of any medicinal plants that may occur on site prior to site clearance.
- Protection of indigenous vegetation where such is not affected by the physical footprint of the power station plant or ancillary infrastructure and associated construction works.
- Provision for plant search and rescue of protected and endangered species which should be done before commencement of any construction related activity.
- Management of traffic during the construction phase of the development where the site access roads and other transportation networks intersect.
- Measurement, monitoring and management of noise and dust pollution levels during the construction phase.
- A fire control management plan for implementation on site.
- Implementation of site specific erosion and sediment and dust control measures during the construction phase of the project.
- Insofar as it relates to the activities hereby approved, all recommendations and mitigation measures as proposed in the final environmental impact report dated 22 May 2006 and the

addendum report to the final environmental impact report dated June 2006 forms part of this record of decision and must be implemented as part of the EMP.
All relevant requirements emanating from 3.2.1 above.

3.2.3.2 Once accepted by DEAT, the revised construction EMP will be seen as a dynamic document. However, any changes to the EMP, must be submitted to DEAT for acceptance before such changes could be effected. Such a submission for consideration by DEAT must be accompanied by recommendations of the EMC.

3.2.3.3 Compliance with the accepted construction EMP must form part of all tender documentation for all contractors working on the project and must be endorsed contractually.

3.2.3.4 Eskom must submit an EMP for the operational phase of the development to DEAT and other relevant provincial and local authorities for acceptance prior to the completion of construction phase and the inception of the operational phase of the development. The revised operational EMP will be seen as a dynamic document. However, any substantial changes to the operational EMP, which is environmentally defendable, must be submitted to DEAT for acceptance before such changes could be effected.

3.2.4 Environmental Control Officer (ECO)

3.2.4.1 The EMC in conjunction with the developer must appoint a suitably qualified Environmental Control Officer (ECO) who would on behalf of the EMC, on a daily basis monitor the project compliance with conditions of the record of decision, environmental legislation and recommendations of the EMP. The cost of the ECO shall be borne by the applicant.

3.2.4.2 The ECO must be appointed one month before the start of construction and the authorities must be notified of such an appointment for communication purposes.

3.2.4.3 The ECO shall ensure that periodic environmental performance audits are undertaken on the project implementation.

3.2.4.4 The ECO shall submit an environmental compliance report on a two-monthly basis, in writing, to the Director-General of the Department of Environmental Affairs and Tourism (DEAT), copied to the Limpopo Department of Economic Development, Environment and Tourism.

3.2.4.5 The ECO shall maintain the following on site:

- A daily site diary
- A non-conformance register
- A public complaint register
- A register of audits

3.2.4.6 The ECO shall remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site is handed over to Eskom by the contractor for operation.

3.2.4.7 The ECO shall report to and be accountable to the EMC.

Monitoring and auditing

3.2.5.1 Records relating to monitoring and auditing must be made available for inspection to any relevant authority in respect of this development.

3.2.5.2 This department reserves the right to monitor and audit the development throughout its full life cycle to ensure that it complies with the conditions stipulated in the record of decision as well as mitigation measures in the final environmental impact report dated 22 May 2006, the addendum report to the final environmental impact report and the construction and operational EMPs.

Transportation and handling of hazardous materials.

3.2.6.1 During the construction of the power station, an effective monitoring system must be put in place to ensure safety and to detect any leakage or spillage of coolants from all oil containing equipment during transportation, their handling and installation.

3.2.6.2 The transportation and handling of hazardous substances must comply with all the provisions of the Hazardous Substances Act, (Act No.15 of 1973), associated regulations as well as SABS 0228 and SABS 0229 codes.

Rehabilitation after construction

3.2.7.1 No exotic plant species may be used for rehabilitation purposes. Only indigenous plants may be utilised.

3.2.7.2 Measures aimed at controlling invasive plant species and weeds must be implemented and must form part of the relevant EMP.

3.2.7.3 No disturbance of the land at any stream or rivers edge is allowed unless such disturbance complies with legislation and conforms to strict design parameters.

Compliance with other legislation

3.2.8. Archaeological remains, artificial features and structures older than 60 years are protected by the National Heritage Resources Act, 1999 (Act No. 25 of 1999). Should any archaeological artefacts be exposed during excavation for the purpose of laying foundations, construction in the vicinity of the finding must be stopped. An archaeologist must be called to the site for inspection. Under no circumstances shall any artefacts be destroyed or removed from the site. The South African Heritage Resource Agency must be contacted to this effect. Their recommendations should be included in the construction EMP and be adhered to.

3.2.8.2 All provisions of the Occupational Health and Safety Act, 85 of 1993, and any other applicable legislation must be adhered to by the holder of this authorisation.

3.2.8 3 All provisions of the National Water Act, Act 36 of 1998, must be adhered to by the holder of this authorisation.

3.2.8 4 All provisions of the National Environment Management: Air Quality Act, Act 39 of 2004, must be adhered to by the holder of this authorisation.

3.2.8 5 All provisions of the Atmospheric Pollution Prevention Act, Act 45 of 1965, must be adhered to by the holder of this authorisation.

3.2.8.6 All provisions of the National Environment Management: Biodiversity Act, Act 10 of 2004, must be adhered to by the holder of this authorisation.

3.2.8.7 Should fill material be required for any purpose, the use of borrow pits must comply with the provisions of the Minerals and Petroleum Resources Development Act, 28 of 2002 administered by the Department of Minerals and Energy.

3.2.8.9 A permit shall be obtained from the provincial department of nature conservation for the removal of indigenous protected and endangered plant and animal species.

Water quality management

3.2.9.1 Eskom shall continuously monitor the ground water quality and implement measures to ensure that pollution of the resource does not occur. The monitoring programme for water quality and measures to control and prevent pollution of the resource shall be included in the operational EMP.

3.3 GENERAL CONDITIONS

This authorisation is granted only in terms of section 22 of the Environment Conservation Act,1989 (Act No.73 of 1989) and does not exempt the holder thereof from compliance with any other legislation.

This authorisation refers only to the activities as specified and described in the final environmental impact report dated 22 May 2006 and the addendum report to the final environmental impact report dated June 2006. Any other activity listed under section 21 of the Environment Conservation Act, 1989 (No. 73 of 1989) which is not specified above, is not covered by this authorisation, and must therefore comply with the requirements of the Environment Conservation Act, Government Notice R 1182 and R.1183 (as amended).

This authorisation is subject to the approval of the relevant local authorities in terms of any legislation administered by those authorities.

The applicant must, within 7 (seven) calendar days of receipt of this record of decision inform all interested and affected parties and at least include the following:

(i) That an authorisation has been issued to the applicant to proceed with the construction and operation of the activity. If requested, provide copies of this ROD.

(ii) That any appeals against the issuing of the authorisation must be lodged with the Minister of Environmental Affairs and Tourism within 30 (thirty) days from the date on which this ROD has been issued to the applicant at the address stipulated in this ROD.

(iii) That an appeal questionnaire may be used in the lodging of an appeal. It is obtainable from the Department's offices at tel. (012) 310 3590 or e-mail: cveeden@deaL.gov.za.

(iv) The date on which the ROD was issued to the applicant in terms of regulation 10(1) and the date by which appeals must reach the Minister.

Failure to inform interested and affected parties within the stipulated time period may result in the Minister considering requests from such parties for permission to submit a late appeal favourably.

One week's written notice must be given to this Department before commencement of construction activities. Such notice shall make clear reference to the site location details and reference number given above.

One week's written notice must be given to this Department before commencement of operation activities. Such notice shall make clear reference to the site location details and reference number given above.

The applicant shall be responsible for ensuring compliance with the conditions contained in this ROD by any person acting on his behalf, including but not limited to, an agent, servant, or employee or any person rendering a service to the applicant in respect of the activity, including but not limited to, contractors and consultants.

The applicant must notify the Department in writing, within 24 (twenty four) hours if any condition of this authorisation cannot, or is not, adhered to. The notification must be supplemented with reasons for non-compliance.

A copy of the authorisation and ROD shall be available on site during construction and all staff, contractors and sub-contractors shall be familiar with or be made aware of the contents of this authorisation and ROD.

3.3.10 Compliance/non-compliance records must be kept and shall be made available on request from the authorities within five days of receipt of the request.

3.3.11 Any changes to, or deviations from, the project description set out in this letter must be approved, in writing, by the Department before such changes or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations.

3.3.12 This Department may review the conditions contained in this letter from time to time and may, by notice in writing to the applicant, amend, add or remove a condition.

3.3.13 In the event that the predicted impacts exceed the significance as predicted by the independent consultant in the final environmental impact report and appendices dated 22 May 2006 and the addendum report to the final environmental impact report dated June 2006, the authorisation may be withdrawn after proper procedures have been followed.

3.3.14 In the event of any dispute concerning the significance of a particular impact, the opinion of the Department of Environmental Affairs and Tourism (DEAT) in respect of its significance will prevail.

3.3.15 The applicant must notify the Department, in writing, at least 10 (ten) days prior to the change of ownership, project developer or the alienation of any similar rights for the activity described in this letter. The applicant must furnish a copy of this document to the new owner, developer or person to whom the rights accrue and inform the new owner, developer or person to whom the rights accrue that the conditions contained herein are binding on them.

3.3.16 Where any of the applicant's contact details change, including the name of the responsible person, the physical or postal address and/or telephonic details, the applicant must notify the Department as soon as the new details become known to the applicant.

3.3.17 National government, provincial government, local authorities or committees appointed in terms of the conditions of this application or any other public authority or authorisation shall not be held responsible for any damages or losses suffered by the applicant or his successor in title in any instance where construction or operation subsequent to construction be temporarily or permanently stopped for reasons of non-compliance by the applicant with the conditions of approval as set out in this document or any other subsequent document emanating from these conditions of approval.

3.3.18 If any condition imposed in terms of this authorisation is not complied with, the authorisation may be withdrawn after 30 days written notice to the applicant in terms of section 22(4) of the Environment Conservation Act, 1989 (Act No. 73 of 1989).

3.3.19 Failure to comply with any of these conditions shall also be regarded as an offence and may be dealt with in terms of sections 29, 30 and 31 of the Environment Conservation Act, 1989 (Act No. 73 of 1989), as well as any other appropriate legal mechanisms.

3.3.20 The applicant shall be responsible for all costs necessary to comply with the above conditions unless otherwise specified.

Any complaint from the public during construction must be attended to as soon as possible to the satisfaction of the parties concerned. A complaints register must be kept up to date and shall be produced upon request.

3.3.22 Departmental officials shall be given access to the properties earmarked for construction activities for the purpose of assessing and/or monitoring compliance with the conditions contained in this document at all reasonable times.

All outdoor advertising associated with this activity, whether on or off the property concerned, must comply with the South African Manual for Outdoor Advertising Control (SAMOAC) available from this Department.

3.4 DURATION OF AUTHORISATION

If the activity authorised by this letter does not commence within 4 (four) years from the date of signature of this letter, the authorisation will lapse and the applicant will need to reapply for exemption or authorisation in terms of the above legislation or any amendments thereto or any subsequent new legislation.

4. CONSEQUENCES OF NON-COMPLIANCE

The applicant must comply with the conditions set out in this letter. Failure to comply with any of the above conditions may result in, *inter alia*, the Department withdrawing the authorisation, issuing directives to address the non-compliance – including an order to cease the activity – as well as instituting criminal and/or civil proceedings to enforce compliance.

5. APPEALS

Appeals in respect of this decision must be lodged with the Minister of Environmental Affairs and Tourism within 30 (thirty) days of the date of this decision. Appeals can be submitted utilising one of the following methods:

By facsimile:	(012) 322 0082
By post:	Private Bag X447, Pretoria 0001
By hand:	2nd Floor, Fedsure Forum Building, North Tower, cor. Van der Walt and Pretorius Streets, Pretoria.

Appeals must comply with the provisions of Regulation 11 of Government Notice No. R. 1183 which reads as follows:
"An appeal to the Minister or provincial authority under section 35(3) of the Act must be done in writing within 30 days from the date on which the ROD was issued to the applicant in terms of regulation 10(1);
An appeal must set out all the facts as well as the grounds of appeal, and must be accompanied by all relevant documents or copies of them which are certified as true by a commissioner of oaths."

An appeal questionnaire may be used in the lodging of an appeal. It is obtainable from the Department's offices at tel. (012) 310 3590 or e-mail: cveeden@deat.gov.za.

Should the applicant wish to appeal any aspect of this decision, the applicant must notify and furnish copies of the appeal which will be submitted to the Minister, to all registered interested and affected parties. Proof of such notification must be submitted to the Minister with the appeal. Failure to comply with this provision may result in the Minister refusing to consider the appeal.

6. APPLICANT:

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2000

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7. CONSULTANT:

Bohlweki Environmental (Pty) Ltd
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1686

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8. SITE VISIT

A site visit was undertaken by Mr Vincent Matabane and Mr Ndhivhuwo Netshilaphala from the department, Eskom personnel and the consultant on 6th April 2005.

Ms Pam Yako
Director – General
Department of Environmental Affairs and Tourism

Date: 21/09/06

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1	1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a)Y	(a) Final EIA report on Medupi FGD project was submitted to DEA on 23 of May 2018.
2			(b) Have EIA reports been approved by authorities of the host country's government?	(b)Y	(b) DEA has granted Environmental Autthorisation (EA) for the Medupi FGD project on September 2018 (Amendment of EA on October 2018).
3			(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N/Y	(c) EA includes general conditions and specific conditions. Conditions require the project proponent to ensure to pay attention to water and soil contamination, to prevent spillage, and to comply with the all relevant regulations. Conditions are not additional requirement of study.
4			(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d)N	(d) The project is required to obtain the following Licenses and Environmental Authorizations: -Air Emissions License (AEL) in terms of the National Environmental Management: Air Quality Act, 2004 (39 of 2004) (NEMAQA); -Water Use Licensee (WUL) in terms of Section 21 of the National Water Act, 1998 (Act No 36 of 1998) (NWA) and; -Waste Management License (WML) as per the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA). The application for AEL will be revised according to the expiration date (2020) of the AEL of the Medupi PS and reapplied. The application for WUL was submitted in June 2018. The application for WML was submitted in March 2018.
5		(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a)Y	(a) Brief description of the project and the potential impacts were explained to the local stakeholders through stakeholder consultation meetings at the scoping stage on November 2014. Two key stakeholder workshops and three public meetings were held in March 2018 at the Draft EIA stage.
6			(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b)Y	(b) Final EIA report was prepared based on the appropriate question-and-answers of the key stakeholder workshops and Public meetings consultations. All contents are summarized as “Correspondence with I&APs" and “Comment and Response Note” as Appendixes of the final EIA report.
7		(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a) Alternative assessment was conducted including no-project. The alternative analysis was conducted for technology to be applied for desulfuration, namely Wet FGD and FGD-CFB both technology and environment/social aspects. As a result, it was concluded that the installation of Wet FGD (WFGD) facilities is considered as the feasible technology after the evaluation. The optional locations for installation was not considered since the FGD is supposed to be installed to the

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
					existing Medupi PS and the available layout is limited.
8	2 Pollution Control	(1) Air Quality	(a) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by the power plant operations comply with the country's emission standards? Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? Are any mitigating measures taken?	(a)Y	(a) PM, SO_2,NO_2, and CO of emission gas from existing Medupi PS are continuously monitored in compliance with the existing AEL of the Medupi PS. The Medupi PS annual emissions report from April 2016 to March 2017 report that NO_2 is under the emission standards, but SO_2 and PM are not satisfied with the emission standards. High particulates emissions were noticed in September and October 2016, due to leaking bag from the Pulse Jet Fabric Filter Plant, which is the technology in place to reduce dust / particulates emissions. Action plan to address the issue (i.e. bag replacement) was developed and implemented. Emission exceedance for SO2 were reported in September and October2016, due to the presence of high Sulphur content in the coal. Coal blending at Medupi PS was completed in March 2017. Impacts on ambient air quality by operation of Medupi PS with/without FGD were assessed by calculation of the air concentrations with following three scenarios; i) 2014 Baseline: under operation of Matimba Power Station ii) 2020 Baseline: under operation of Matimbe Power Station and Medupi Power Station without FGD iii) Proposed Project operations under operation of Matimbe Power Station and Medupi Power Station with FGD As for SO2, there are areas that have not satisfied with the environmental standard under the scenario i) that only existing Matimba PS operates. In scenario ii), the environmental standard unachieved area is expanded to the residential area. However, the area of non-compliance of SO_2 concentrations reduces significantly for scenario iii) and reduces the significance to the lower impact as no exceedances of the NAAQS are simulated at the closest sensitive receptors in the study area. No exceedances of the NAAQS for NO_2 and PM were simulated at sensitive receptors due to proposed project operations. The ambient air quality will be improved through reduction of SO_2 due to the operation of FGD system and reduction of PM due to have sprinkled water and covered topsoil.

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
9			(b) In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?	(b)Y	(b) Gypsum generated from FGD is processed the existing Ash Disposal Facility (ADF). It was confirmed that dust does not exceed the standard to confirm with periodical monitoring results of the existing operating conditions of Medupi PS. To prevent dust generation, to be vegetated cleared areas, or to keep moist topsoil will be taken as the mitigation measurements.
10		(2) Water Quality	(a) Do effluents including thermal effluents from the power plant comply with the country's effluent standards? Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause any significant temperature rise in the receiving waters?	(a)N/A	(a) There is no thermal effluent from the FGD facilities.
11			(b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country's effluent standards?	(b)Y	(b) There are no environmental issues on leachates from the existing coal piles and coal ash disposal sites in accordance with monitoring report prepared by Medupi PS.
12			(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	(c)Y	(c) The wastewater from FGD will be treated and the clean water will be re-used in the plant. There is no factor to polluted surface water due to discharge from FGD. Polluted water from Medupi PS is separated from surface water and discharged into the pollution control dam in Medupi PS site. Surface water and groundwater will be periodically monitored and confirm that the standard is not exceeded.
13		(3) Wastes	(a) Are wastes, (such as waste oils, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's regulations?	(a)Y	(a)Wastes are treated and managed in accordance with Waste Management License. Record and report the sorting situation and the amount of waste by type. The FGD Plant and the FGD Waste Water Treatment Plant operation will generate three waste streams, namely FGD Gypsum, FGD WWTP Sludge, and FGD WWTP Crystallizer Solids. These three waste streams required the assessment in terms of the "National Norms and Standards for the Assessment of Waste for Landfill Disposal" (National Norms and Standards) of DEA (DEA, 2013a).
14	2 Pollution Control	(4) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	(a)Y	(a) Currently the noise standards are generally satisfied at the residence near the power station. The noise generated by the project operation including main steam boilers, steam turbine-generator units, vehicles/trucks for transporting limestone, and will not exceed the selected noise guidelines at Noise Sensitive Receptors (NSR) surrounding the Medupi PS with an increase above the baseline of less than 3 dBA at all of the

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
					identified NSR. As for Vibration, there is no receptor in the surrounding area, so there is no effect of vibration. FGD is planned in the site of the existing Medupi PS facility, there are no neighboring dwellings.
15		(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a)N	(a) There is no possibility of utilization of groundwater during construction phase and operation phase.
16		(6) Odor	(a) Are there any odor sources? Are adequate odor control measures taken?	(a)N	(a) There are no order sources.
17	3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country' s laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) The project site is in Medupi PS site. Medupi PS is already developed and is not protected area.
18		(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a)N	(a) The project site is planned in the Medupi PS. There are no primeval forests, tropical rain forests, ecologically valuable habitats.
19			(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b)N	(b) The project site is planned in the Medupi PS. There are no protected habitats of endangered species designated by the country's laws or international treaties and conventions.
20			(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c)Y	(c) When an animal is observed in the place, it is processing as relocation to the outside.
21			(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(d)N	(d) Water will supply from MCWAP 1 and 2 by DWS. There is no possibility of water use from groundwater and surface water directly near project site.
22			(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	(e)N	(e) There is no thermal effluent from the FGD facilities. The wastewater from FGD will be treated and the clean water will be re-used in the plant.
23	4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a)N/A	(a) There is no resettlement and land acquisition caused by project implementation. The grievance redress mechanism conforms to the current environmental communication procedure of the Medupi PS and is appropriately responded.
24			(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) N/A	
25			(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic	(c) N/A	

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
			studies on resettlement?		
25			(d) Are the compensations going to be paid prior to the resettlement?	(d) N/A	
27			(e)Are the compensation policies prepared in document?	(e) N/A	
28			(f)Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) N/A	
29			(g) Are agreements with the affected people obtained prior to resettlement?	(g) N/A	
30			(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) N/A	
31			(i) Are any plans developed to monitor the impacts of resettlement?	(i) N/A	
32			(j) Is the grievance redress mechanism established?	(j) N/A	
33	4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a)Y	(a) Employment opportunity might be created due to the project implementation.
34			(b) Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project implementation? If the existing infrastructure is insufficient, are any plans developed to construct new infrastructure or improve the existing infrastructure?	(b)N	(b) The project site is planned in the Medupi PS. There is no plan developed to construct new infrastructures.
35			(c) Is there a possibility that large vehicles traffic for transportation of materials, such as raw materials and products will have impacts on traffic in the surrounding areas, impede the movement of inhabitants, and any cause risks to pedestrians?	(c)Y	(c) The traffic volume will be increased to transport limestones to Medupi PS and transport salts and sludge to hazardous waste facilities. The project proponent will arrange the traffic control staff at intersection, if necessary.
35			(d) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(d)Y	(d) There are integrated response strategies, which are education and awareness, prevention; check of employees' HIV status, treatment, care, and support for diseases and development of more HIV/Aids related campaigns by the developer educating its contractors.
36			(e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?	(e)N/A	(e) Water will supply from MCWAP 1 and 2 by DWS. There is no possibility of water use from groundwater and surface water directly near project site. There is no thermal effluent from the FGD facilities. The wastewater from FGD will be treated and the clean water will be re-used in the plant.
37		(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country' s laws?	(a)N	(a)There is no the local archeological, historical, cultural, and religious heritage in the project site. There is an old tomb in the site of the power station, but there is no modification by the FGD and related facilities. A buffer area of 10 m surrounded by a fence is provided.

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
38		(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) Potential visual impacts associated with construction of the FGD infrastructure within the MPS or construction of the rail yard were deemed negligible due to the existing visual character of the Medupi Power Station infrastructure surrounding the proposed infrastructure.
39		(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a)N/A	(a) There is no ethnic minority and indigenous people in the project site.
40			(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(b) N/A	(b)ditto
41		(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a)Y	(a) The project proponent complies with labor laws and ordinances associated with the working conditions of South Africa. In addition to this, the project proponent established the independent requirement and program as follows.
42			(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b)Y	(b) All Personal Protective Equipment (PPE) required to be used by contractors is supplied by the project proponent. In addition, there is a full-time emergency team on site with necessary medical facilities and paramedics operated 24/7 supplied by the project proponent.
43			(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c)Y	(c)Since the project proponent has already established and applied the comprehensive Safety Health Environment programs and implementation system in the Medupi PS project, the existing framework and implementation are reviewed as follows and considered to be applied to this project.
44			(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(d)Y	(d) Regular joint meetings are held to ensure threats are identified and mitigation measures put in place prior to any violence erupting. The Medupi PS Project does have many mechanisms including the Environmental Monitoring Committee (EMC) and Project Information Offices in town as well as surrounding communities where residents are able to raise grievances with procedures in place to address any complaints.
45	5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a)Y	(a) There are no receptors around the project site, impacts during construction is limited. In addition, mitigation measures are planned for pollution (groundwater quality, waste, ecosystem, soil erosion, etc.) during construction.

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
46			(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts?	(b)Y	(b) Impact on the wetland would be expected to be minor since the FGD infrastructure is situated within the footprint of the existing Medupi PS.
47			(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	(c)Y	(c) It is predicted that the influence on traffic due to the increase in traffic volume and trucks and the possibility of infectious diseases increase due to increase in workers during construction. Appropriate mitigation measures for road traffic and prevention of infectious diseases are planned by the project proponent.
48		(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	(a)Y	(a) There are no new coal piles in FGD project. In addition, worker in power station educated with Medupi Emergency Preparedness Plan and accident prevention measures are planned.
49		(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a)Y	(a) The items for which any mitigation measures will be taken are supposed to be monitored. The project proponent will monitor groundwater quality, solid waste, ecosystem, soil erosion, existing social infrastructure and services, infectious diseases such as HIV/AIDS, working conditions, and accidents.
50			(b) What are the items, methods and frequencies of the monitoring program?	(b)Y	(b) Based on the existing framework for Medupi PS, conduct regularly based on the standards of South Africa and report each month.
51			(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c)Y	(c) The monitoring implementation system has already been established in existing framework for Medupi PS, and feasibility is secured.
52			(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d)Y	(d) Monitoring report shall be prepared and submitted to the relevant authorities in line with license and permission.
53	6 Note	(1) Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a)N/A	(a)-
54			(b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	(b)N/A	(b)-
55		(2) Note on Using Environmental	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the	(a)N	(a) The quantity of greenhouse gas emission during the operation of FGD will not increase. Because the electricity for

Appendix 11.3 Environmental Checklist of JICA Guidelines for Environmental and Social Considerations

Check Item No.	Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		Checklist	project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).		FGD operation will be from Medupi PS and total amount of electricity generation by PS will not change.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are requested to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Appendix 11.4 Environmental Monitoring Form

Environment Monitoring Form (Construction Stage and Operation Stage)

1. Compliance Report

Check Item	Preparation/Submission Date	Status/ Summary / Issues / Note
Compliance Audit Report		
Safety Health and Environmental Specification		
Emergency Preparedness Plan		
Work Instruction		

2. Ambient Air Quality- monthly base data form-

2-1 Summary of Monthly Data

Pollutant	Unit	Highest hourly Mean	No. of Hourly National Limit Exceedance	Highest Daily mean	No. of Daily National Limit Exceedance	No. of 8 hrs moving Average Limit	Highest 10 min mean	No. of Daily National Limit Exceedance	National Ambient Air Quality Standard[*1]		
									Period	limit	Number of annual exceedance
PM2.5	μg/m^3								24hr	40	4
									1year	20	0
PM10	μg/m^3								24hr	75	4
									1year	40	0
NO_2	ppb								1year	21	0
									1hr	106	88
SO_2	ppb								1hr	134	88
									10min	191	526
									24hr	48	4
CO	ppm								1hr	26	88
									8hr	8.7	11
O_3	ppb								8hr	61	11.

* Government Notice No.1210 (2009) of National Environmental Management: Air Quality Act (NEMAQA) (Act 39 of 2004)

2-2 Exceedances of National Ambient Air Quality Standards

hourly exceedances						
Pollutant	Limit* (ppb)	Year	Month	Day	Time	Concentration (ppb)
SO_2	134					
10 minutess exceedances						
Pollutant	Limit	Year	Month	Day	Time	Concentration
SO_2	191					

* Government Notice No.1210 (2009) of National Environmental Management: Air Quality Act (NEMAQA) (Act 39 of 2004)

2-3 Number of Exceedances of the National Ambient Air Quality Standards (Annual Check)

Parameter Measured	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Number of Exceedances	Allowed Number of Exceedances*
PM2.5 (Daily)														4
PM10 (Daily)														4
NO_2 (Hourly)														0
SO_2 (10 minutes)														526
SO_2 (hourly)														88
SO_2 (Dayly)														4
O3 (8hours)														11

* Government Notice No.1210 (2009) of National Environmental Management: Air Quality Act (NEMAQA) (Act 39 of 2004)

2-4 Dust-fall

Month / Site ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
01													
02													
Average													
Acceptable Dust Fall Rate*: 1200 $mg/m^2/day$, 30 days Average													

* National Dust Control Regulation (GNR 827 November 2013)

3. Emission Gas （During Operation）- monthly base data form-

Unit X	Days	PM (mg/Nm^3)	SO_2 (mg/Nm^3)	NO_2 (mg/Nm^3)	CO (mg/Nm3)	CO_2 (mg/Nm3)	Temp (°C)	Press (kPa)	Velocity (m/s)	O2 (%)
	Day 1									
	Day 2									
	Day 3									
	Day 4									
	Day 5									
	Day 6									
	Day 7									
	Day 8									
	Day 9									
	Day 10									
	Day 11									
	Day 12									
	Day 13									
	Day 14									
	Day 15									
	Day 16									
	Day 17									
	Day 18									
	Day 19									
	Day 20									
	Day 21									
	Day 22									
	Day 23									
	Day 24									
	Day 25									
	Day 26									
	Day 27									
	Day 28									
	Day 29									
	Day 30									
Daily Limit	National Standard for New Plant* (for Existing plant)	50 (100)	500 (3,500)	750 (1100)	-	-	-	-	-	-

Source *: Government Notice No.248 (2010) of National Environmental Management: Air Quality Act (Act 39 of 2004), Atmospheric Emissions License by Limpopo Province Government, March 2015, under normal conditions of 10% 0_2, 273 Kelvin and 101.3kPa.

4. Water quality (Ground water) and Ground Water Level

Table1

Monitoring Location	Groundwater level (m)	Physical Determinants		Chemical Determinants								
		pH	EC (mS/m)	Cd (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	p-Alk (mg/l)	m-Alk (mg/l)	Cl (mg/l)	SO_4 (mg/l)	NO3 as N(mg/l)
01												
02												
SANS241: 2011 Max. Allowable Limit (*1)	-	9.7	<170	-	-	200	-	-	-	300	500	11
Class 0 Max. Allowable Limit (*2)	-	9.5	<70	-	<70	<100	<25	-	-	<100	<200	<6
Class 1 Max. Allowable Limit (*2)	-	10	150	-	100	200	50	-	-	200	400	10
Class 2 Max. Allowable Limit (*2)	-	10.5	370	-	200	400	100	-	-	600	600	20
Class 3 Max. Allowable Limit (*2)	-	11	520	-	400	1000	500	-	-	1200	1000	40
Class 4 Max. Allowable Limit (*2)	-	>11	>520	-	>400	>1000	>500	-	-	>1200	>1000	>40
South African Water Quality Guidelines (SAWQG), Volume 5 – Agricultural Use – Livestock Watering Target Range	-	-	154	0.01	500	2000	-	-	-	1500	100	1000
Minimum												
Maximum												
Average												

*1：South Africa National Standard (SANS) 241 (2011)

*2：Department of Water Affairs and Forestry : DWAF Guidelines 1998 Water category：Class0: Ideal water quality, Class1: Good water quality, Class2: Marginal water quality, water suitable for short-term use only, Class3: Poor water quality, and Class 4: Unacceptable water quality

Table2

Monitoring Location	Chemical Determinants									Others (if any)	Water Quality Class
	F (mg/l)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)	Cr (III) (mg/l)	Cr (VI) (mg/l)	Cu (mg/l)	Co (mg/l)	COD (mg/l)		
01											
02											
SANS241: 2011 Max. Allowable Limit*	1.5	0.3	0.3	0.5	-	-	-	-	-		
Class 0 Max. Allowable Limit	<0.7	-	<0.01	<0.1	-	-	-	-	-		
Class 1 Max. Allowable Limit	0.7-1.0	-	0.01-0.2	0.1-0.4	-	-	-	-	-		
Class 2 Max. Allowable Limit	1.0-1.5	-	0.2-2.0	1.0-4.0	-	-	-	-	-		
Class 3 Max. Allowable Limit	1.5-3.5	-	2.0-10.0	4.0-10.0	-	-	-	-	-		
Class 4 Max. Allowable Limit	>3.5	-	>10.0	>10.0	-	-	-	-	-		
South African Water Quality **Guidelines (SAWQG), Volume 5 – Agricultural Use – Livestock Watering Target Range	2	5	10	10	-	2	0.5	2	-		
Minimum											
Maximum											
Average											

*1：South Africa National Standard (SANS) 241 (2011)

*2：Department of Water Affairs and Forestry : DWAF Guidelines 1998 Water category：Class0: Ideal water quality, Class1: Good water quality, Class2: Marginal water quality, water suitable for short-term use only, Class3: Poor water quality, and Class 4: Unacceptable water quality

5. Waste

Description of Waste Management

Report of condition of waste management (with pictures attached)

Amount of Waste

Month	Amount of Waste during Construction					Amount of Waste during Operation				
	Oil contained materials	Oil contained liquid waste	Empty chemical containers	Sanitary Waste	Other Hazardous (if any)	Ash	FGD Gypsum	FGD WWTP Sludge	FGD WWTP Crystallizer Solids	Others (if any)
	Tons	litters	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Total										

Note: Kinds of generated hazardous waste are not limited above.

6. Ecosystem (Flora and Fauna)

Items / Area/Location	Date	Name of Species	Rare species, Common species or Foreign species	Description of Finding and Action

7. Soil Erosion (During Construction)

Check Point: To check the construction design and site condition through the site inspection

Items / Area/Location	Date	Severity	Source Category	Description of Finding and Action (if any problems are found)

8. Existing Social Infrastructure and Services (Road Traffic)

Check Point: To check the traffic problem in and around the power station

Items / Area/Location	Date	Severity	Source Category	Description of Finding and Action (if any problems are found)

9. Infectious diseases such as HIV/AIDS

Check Point: To Record of HIV/Aids workplaces programme

Name of Programme or topic	Date	Target/Area	Atendance	Summary / Achievement / Note
Education and awareness campaign				
Check the health check sheet				
Treatment, care, and support				
Monthly medical health services				
Others (if any)				

10. Working Condition

Check Point: To record the Safety Health and Environmental Program and training

Name of Programme or topic	Date	Target/Area	Attendance	Description
Safety Health and Environmental induction				
Trainings on OHSAS 18002				
First aid program				
Evacuation warden				
Occupational Health and Safety Act 85 of 1993 OHS Act				
Working at heights				
Fundamentals of firefighting				
Construction regulations				
Eskom Lifesaving Rules				
Behavior Safety awareness				

Check Point: To check the working condition through the site inspection

Items / Area/Location	Date	Severity	Source Category	Description of Finding and Action (if any problems are found)
Construction Site				
Workers Camp				

11. Accidents

Check Point: To record accidents

Items / Area/Location	Date	Severity	Source Category	Description of Finding and Action

12. Complaints from Residents

Check Point: To record complaints (if any)

Items / Area/Location	Date	Severity	Source Category	Description of Finding and Action