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Project Number
RI301-00825/01

MATIMBA ASH DUMP

OPERATING MANUAL

Rev	Description	Date
A	Issued in Final	May 11, 2020

Knight Piésold CONSULTING

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1 INTRODUCTION

The purpose of the operating manual is to provide guidelines to the owner for the general operation and maintenance of the Matimba Ash Dump to ensure the safe usage thereof during its full life span. It gives an overview of the proposed ash deposition process, routine inspections to be carried out and records which should be kept. In the case of unusual circumstances, which may occur, emergency procedures are described in the Emergency Preparedness Plan for this Dam (see Section 7 hereto). This O&M Manual does not cover the operation of the conveyors, offloading facility and its ash stockpile, or loading of any trucks.

The operating manual describes the philosophy of how a dry ash dump is built; continuing with the design philosophy of the various components of the ash dump, and then details the requirements for the operation and maintenance of those components. The operating manual also addresses environmental and rehabilitations requirements; detailing methods of pollution control, plus the monitoring and maintenance procedures.

The document also includes legal and safety aspects of dry ash disposal.

The manual should be kept up to date and be available for use at the Ash Dump.

Should any clarification be required by operators, the designers of the Ash Dump, Knight Piesold, (an Umbani JV member) should be consulted.

It should be stressed that in addition to normal operational controls, regular inspections and regular maintenance are considered essential for the successful operation of the Ash Dump.

2 DOCUMENTATION

The Following Documentation exists for the Ash Dump:

- Matimba Power station – Multidisciplinary Concept Design report – 376-MAT-AABB-D00139-1
- Matimba Ash Dump Extension - Basic Design Report – 301-00825/01
- Matimba Ash Dump Extension - Detailed Design Report – 301-00825/01

2.1 KEEPING OF RECORDS

It is the Ash dump owners' responsibility to compile and keep up to date records of the Ash dump.

These records must thus be maintained by Eskom, and kept in their records office at the Matimba power station site in a location where they can readily be retrieved.

3 DOCUMENT OBJECTIVES

This O&M Manual addresses all Client O&M requirements, as well as all relevant South African regulatory requirements pertaining to the Ash Dump. These include:

- The National Water Act, No. 36 of 1998.
- Government Notice No. 704, Regulations on use of water for mining and related activities aimed at the protection of water resources, in terms of the National Water Act (Act 36 of 1998)
- SANS 1200: Standardized Specifications for Civil Engineering Construction
- Eskom Technical Specification 100820-P23A-Combustion Waste Terrace

4 PARTICULARS OF THE ASH DUMP SITE

4.1 SITE DESCRIPTION

The Matimba Power station is located in the Limpopo Province approximately 18 km from the town of Lephalale as indicated in Figure 4-1. The Ash Dump is located approximately 3 km South of the Matimba Power station terrace and to the south-west of the main road from Lephalale (Ellisras) to the Power Station and Grootegeluk coal mine. (Route P 1675)

The Ash Dump is being constructed on the Zwartwater (507-LQ) farm, which has the following co-ordinates: Longitude: 27°34,6'/ 27°37,5' and latitude 23°41,7' and 23° 44,0'.

The Ash dump as designed will cover an area of approximately 920ha. The Ash Dump was constructed over an area of natural vegetation, after clearing. The Vegetation typically comprises of Bushveld, moderately dense thorn trees, resistant grasses and large well spaced trees which include mopani, maroela, acacia and tamboti.

The general terrain falls in a south easterly direction from a maximum elevation of 896 m in the north-western corner to a minimum elevation of 863m in the extreme south-eastern corner. Drainage is generally in a southerly direction along poorly defined drainage channels towards the Sandloopspruit which runs almost parallel to, and about 0.5km from the southern boundary.

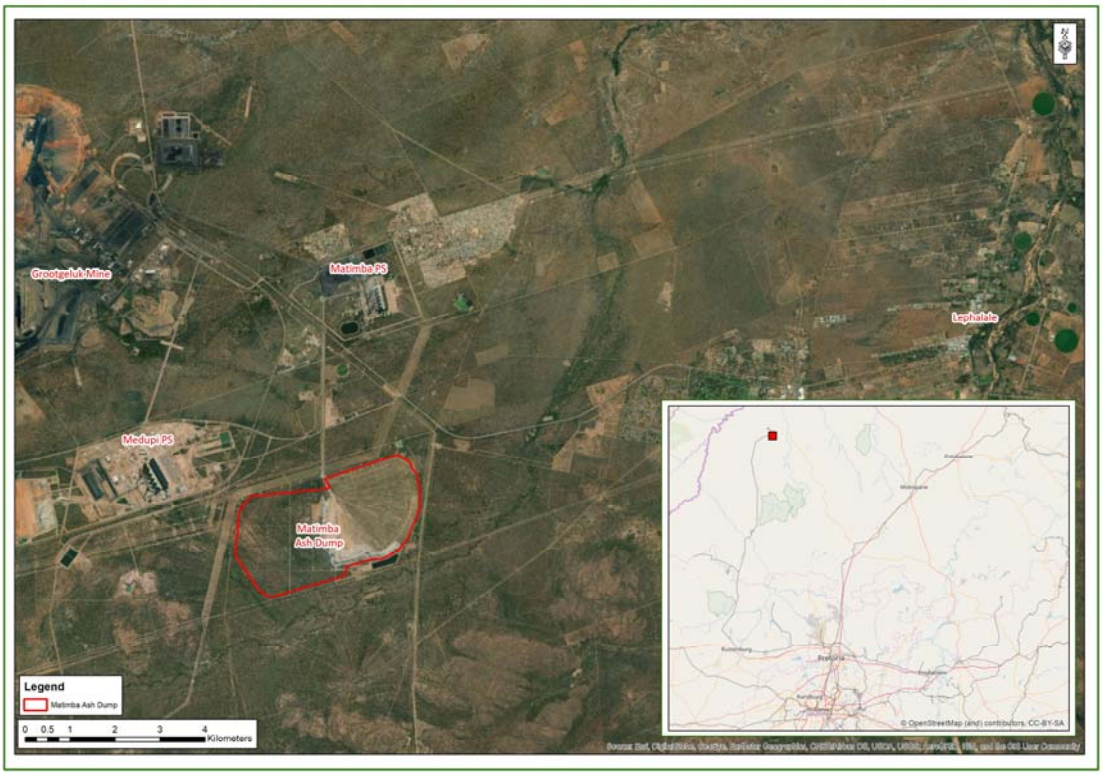


Figure 4-1: Site location (Google Earth image)

4.2 REGIONAL GEOLOGY & GEOHYDROLOGY

Refer to Report - Geotechnical investigation – Knight Piesold – Report Number: OKZ-PvR KHH2522.

The site is generally overlain by

- Transported soils (Colluvium) and sporadically by a thin topsoil cover. It has a pinhole voided soil structure and a loose consistency. The soil grading is mostly slightly silty sand.
- The transported soil is underlain by residual sandstone and conglomerate towards bedrock.
- A well-developed pedogenic horizon (calcrete) has developed within the transported and residual soils. Excavation refusal occurred at the base of most pedogenic horizons present within the investigated area.
- Bedrock occurs as highly weathered very soft to soft rock sandstone and conglomerate. Excavation refusal occurred on the soft rock sandstone/ conglomerate but also on the honeycomb to hardpan calcrete.

Two preliminary geotechnical zones were identified across the investigated area. This includes Zone A and Zone B. Zone A is characterised by shallow bedrock and areas where excavation refusal occurred at depths than less than 1.5 m. Zone B comprises deeper residual and transported soils with highly developed pedogenic soils resulting in variable refusal depths, i.e. between 1.5 m and 2.9 m.

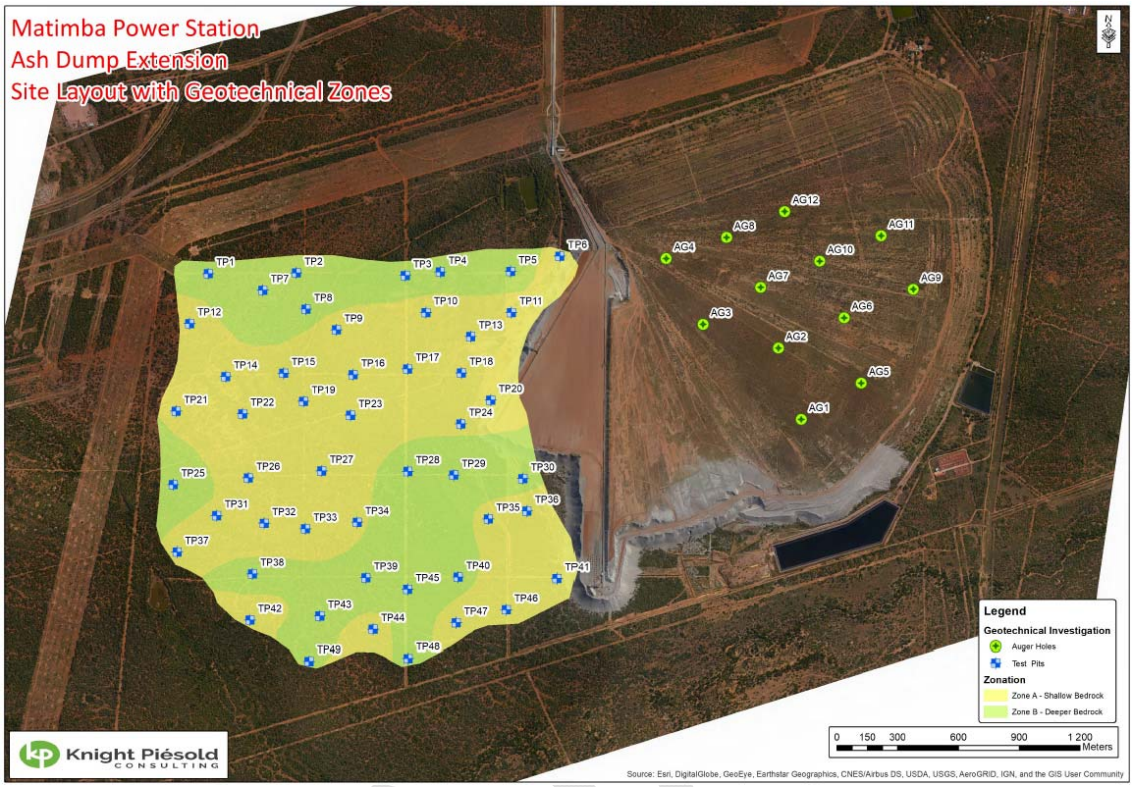


Figure 4-2: Geotechnical Zones

No groundwater seepage was encountered across the investigated area.

4.3 CLIMATE

Lephalele has an annual rainfail of approximately 455 mm. The regional climate is that of hot summers and fairly cool winters, which is typical of the Limpopo region.

The rainfall station providing reliable rainfall data is located at the Lephalale police station.

The average monthly rainfall and evaporation data has been illustrated in Figure 4-3 and Figure 4-4.

The rainy season has been defined as the period from November to March, with the peak rainfall measured in January. The average annual rainfall (Weighted mean annual precipitation) for Matimba is 444 mm.

Winds are mainly light to moderate and blow from the north-east, except for short periods during the thunder storms or weather changes when the wind blows from the north.

The duration of bright sunshine exceeds 80% of the possible in mid-winter and 60% of the possible in summer.

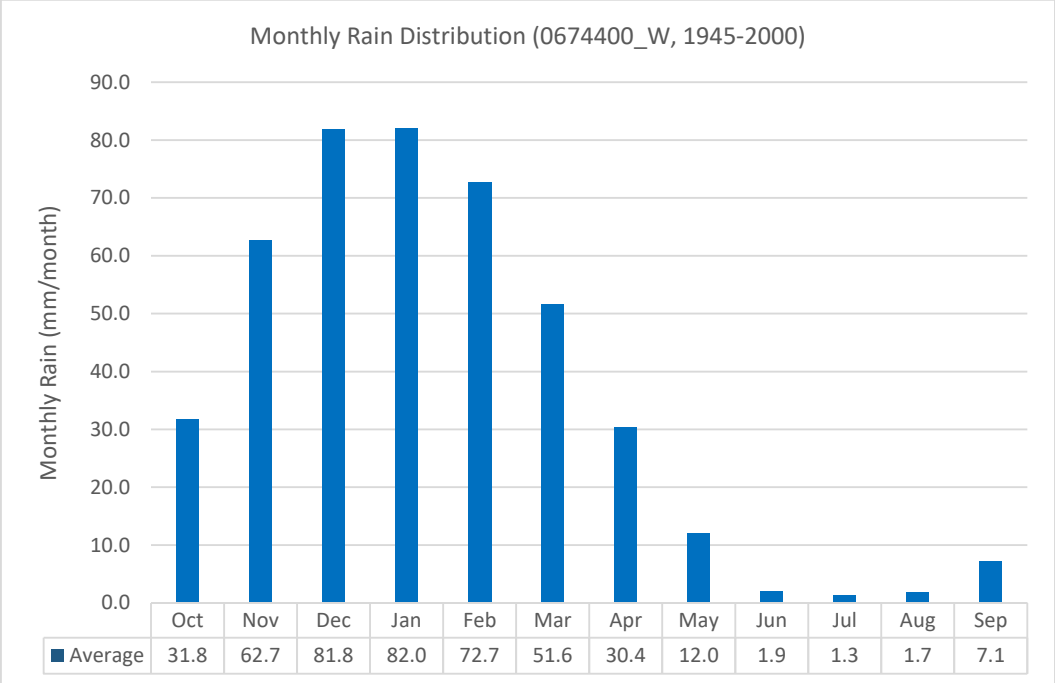


Figure 4-3: Average monthly rainfall distribution

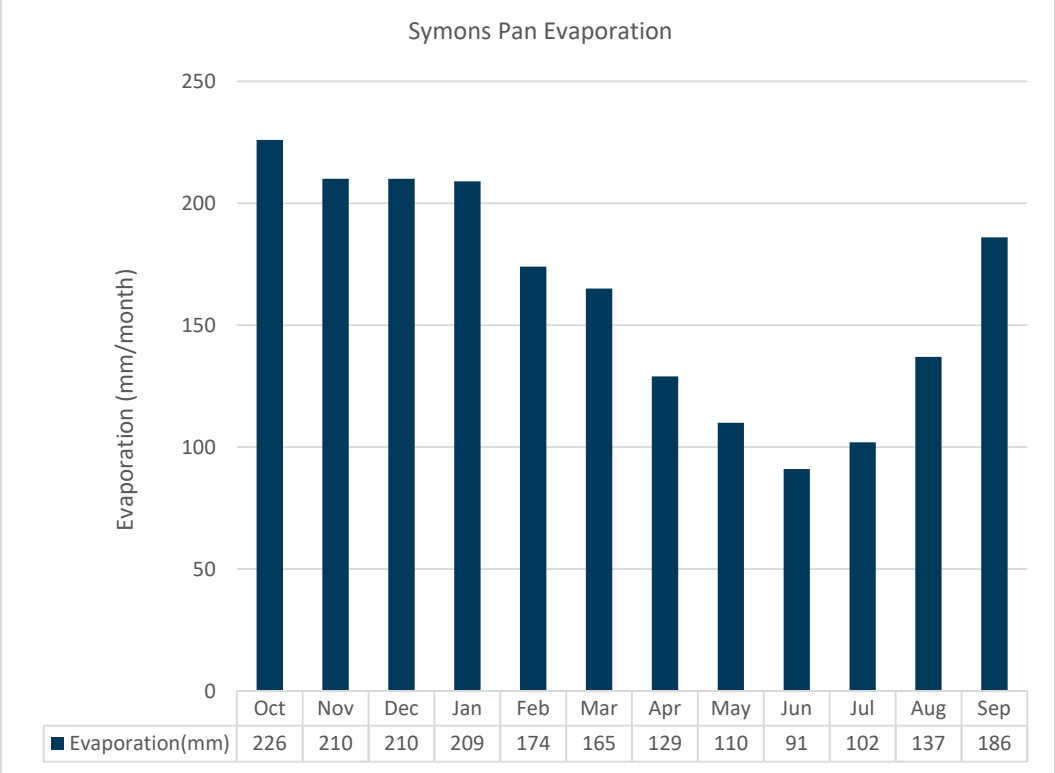


Figure 4-4: Monthly evaporation distribution (Symons Pan)

4.4 ASH DUMP PARTICULARS

The most important particulars of the Dump are given below in Table 4-1.

Table 4-1: Ash Dump Particulars

Detail	
Name of Dam	Matimba Ash Dump
Purpose of Dam	Storage of Ash Discard from Power Station
Date of construction completion	Phase 1 - March 2024
River or watercourse	N/A
Nearest town	Lephalale
District	Limpopo
Maximum ash dump height	90m
Hazard potential category	Low
Ash Hazardous Waste Classification	Non-Hazardous
Deposted Ash Density	800 kg/m³
Station load factor	76%
Ash Content of coal	36% on average
Coal burn rate (CBR) - Design MCR (max continuous rating) - 6 units	5,117,000 tpa
Annual ash make (34% of CBR) (Received to ADF)	6, 396, 250 m³/year
Total volume available (2019-2055)	230,265,000 m³
Expected average yearly volume	6,396,250 m³
Angle of repose	40 ° (Approximately 1:1,2)
Front stack height	40m
Upper stack height	40m on extension (30m on existing facility)
Upper backstack height	10m
Ash Cone height	5m above the stacking platform surface
Maximum cone height (Spreader)	11 m
Maximum cone height (Stacker)	14 m
Minimum distance between shiftable conveyor and spreader or stacker crawlers for access	5 m
Groundwater	N/A
Gross storage capacity	230 265 000 m³
Storage life at design tonnage	
	Phase 1 - 25 585 000 m³
	Phase 2 - 25 585 000 m³
	Phase 3 - 25 585 000 m³
	Phase 4 - 25 585 000 m³
	Phase 5 - 25 585 000 m³

	Phase 6 - 25 585 000 m³
	Phase 7 - 25 585 000 m³
Footprint surface area	
	Phase 1 – 324 150 **m²**
	Phase 2 – 350 590 **m²**
	Phase 3 – 394 970 **m²**
	Phase 4 – 412 560 **m²**
	Phase 5 – 422 680 **m²**
	Phase 6 – 478 910 **m²**
	Phase 7 – 353 170 **m²**
	Phase 8 – 336 980 **m²**
Outside wall slope	1V to 5 H
Footprint Perimeter length of extension	4870m
External perimeter road at ground level	6m wide road around the entire perimeter
Ash Dump liner system	Protection layer, 2.0mm HDPE (Single Textured), GCL, Underdrainage and monitoring system
Leakage detection	Designed as part of the Liner Barrier system
Ground water interception	Nil
Groundwater seepage cut-off	Nil
Instruments	Temperature measurement instruments in the ash dump base layer
Construction Contractor	To be confirmed
HDPE Lining sub-contractor	To be confirmed

The Ash Dump General Arrangement Drawing and Sections through the dump are presented in Figure 4-5, Figure 4-6 and Figure 4-7.

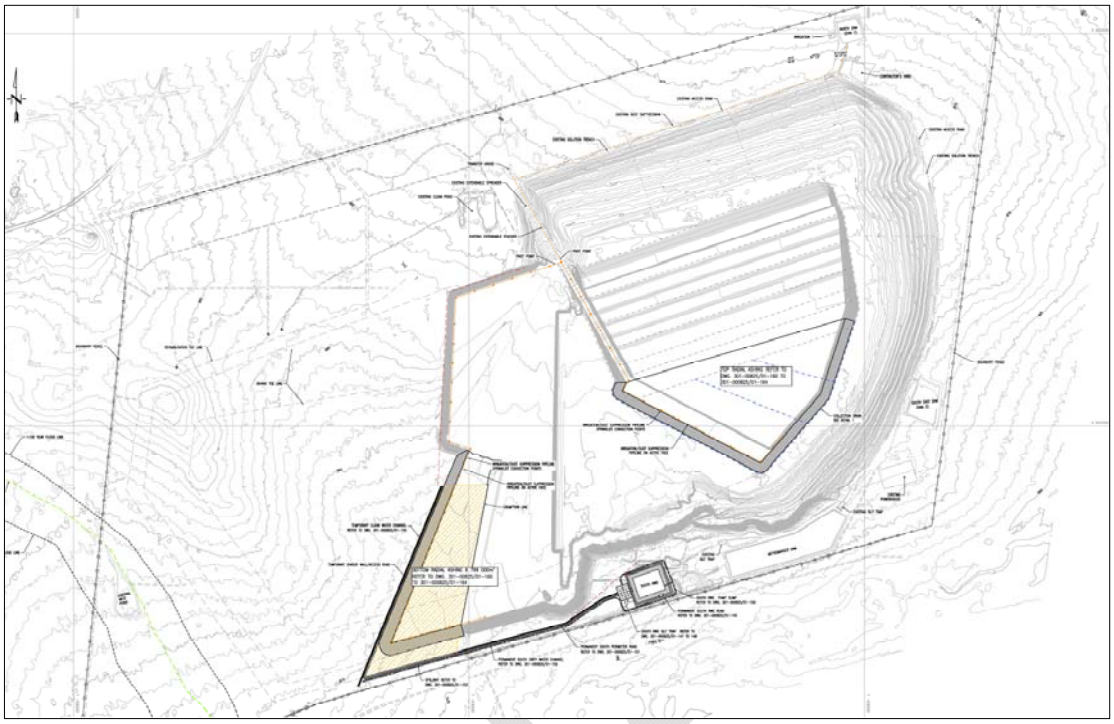


Figure 4-5: Phase 1 – 4 year Ash Dump Design (Drawing 301-00825/01-140)

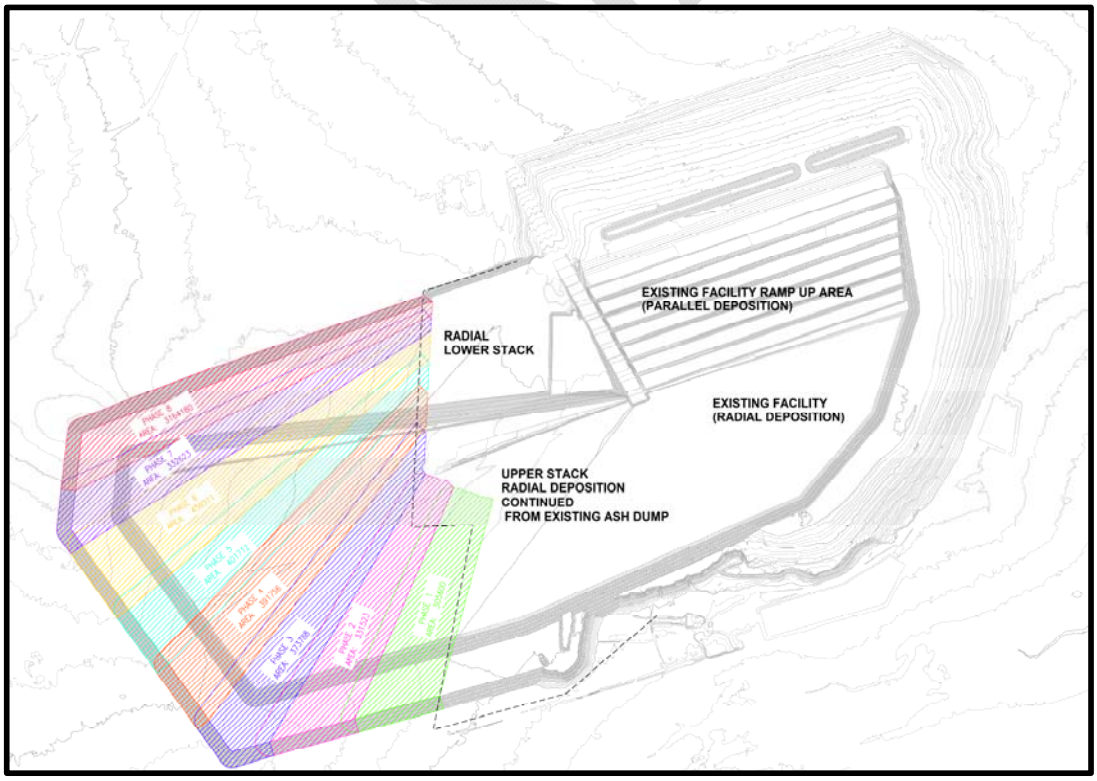
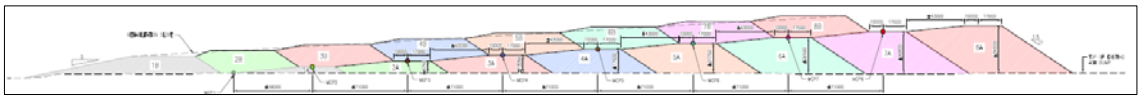
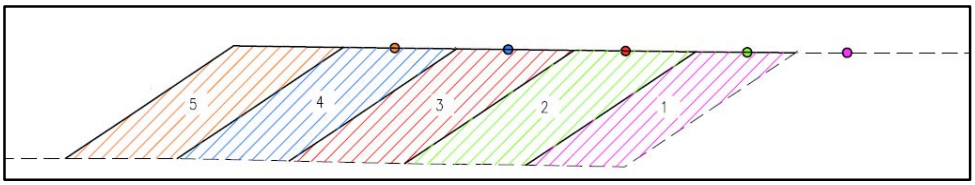


Figure 4-6: 60 year Ash Dump Design



Conveyor positions for ramp up section (Drawing 301-00825/01-117)



Lower Ash Dump Extension

Figure 4-7: Ash Dump Cross Sections

4.5 PHILOSOPHY OF PLACING DRY ASH ON THE DUMP

The ash is brought from the station on a conveyor belt to the Ash Dump facility. The Ash is then transferred by means of a transfer house to two separate conveyor systems that travels across the Ash dump. The two systems are defined as the standby system which operates on the lower stack and the Main system which travels across the top of the existing facility. Next to the standby conveyor belt on the lower stack of ash dump is a machine referred to as the spreader, which travels slowly alongside the conveyor belt removing the ash from the belt and placing the ash on its far side over the edge of the dump. The spreader builds a new face onto the side of the Ash dump as it travels across the dump. When the new face is completed, the conveyor belt and spreader are moved towards the new face and the spreader returns across the dump building a new face on to the one it had just completed. Next to the main conveyor belt on the existing ash dump is a machine referred to as the stacker, which travels slowly alongside the conveyor belt removing the ash from the belt and placing the ash proceeding in a ramp up manner and then in a radial manner.

There are 2 methods in which the conveyor belt and stacker will be moved to continue their construction on the dump. The first is to move the conveyor belt to a position parallel to the first deposition position on the existing facility, so that the stacker builds the ramp up area onto the existing dump in a parallel manner. This is known as Parallel Ash Dump construction.

The second method of construction that will be implemented once the height of 30m is reached on the existing facility ramp up, will be to move only the far end of the conveyor belt keeping the feeder end fixed. In this way the belt creates an arc about the feeder point with the constructed faces being slightly thicker at the far end than at the feeder point. This method of Construction is known as the Radial Ash dump construction method.

Both these methods produce a dump with a straight advancing face, the former also has a straight puter edge, but the second has a curved outer edge. The first method requires continual capital expense to extend the feeder conveyor belt along the one side of the dump in order to feed the conveyor that travels across the top of the dump. In general, if the dump is being built on a restricted site, this will most likely be the best method to adopt. The second method allows capital expenditure to be deferred until a later date as the feeder point does not move as the dump progresses.

4.6 ORIGINAL TERMS OF REFERENCE

The Coal and Ash Section of the Civil and building division of Eskom was requested in 1984 by Matimba Projects Section to produce the relevant designs, drawings and documents necessary to contruct the ash dump at Matimba power station. Preliminary conceptual design drawings, produced in 1985, had to be optimized and detailed to achieve the most economincal and environmentally acceptable method of dry ash disposal.

The optimization was necessary because it was felt that there was insufficient information on the dump development drawings for a contractor to build the dump accurately and economically. The drawings were prepared with as much information on them as was possible so that the tendering contractors can price their tenders with the minimum unknown facts possible.

During 1994 the Civil and Building Division was requested by Matimba Station to produce relevant designs, drawings and documents for the radial development of the Ash Dump up to the year 2005.

In 2017, The ash dump was granted an exemption area in which deposition could occur without the area being lined.

In 2019, basic and detailed designs for the Ash Dump was required to the ash dump facility reaching its initial end of life. The design is required for the ash dump extension to the end of life of the Power station i.e 2055.

4.7 HISTORY OF ASH PLACEMENT

The first ash placed on the dump occurred during September 1987 with the shiftable spreader conveyors in parallel mode. Front the first position, the shiftable conveyors were moved parallel in a southerly direction until 6 movements were completed in approximately November/Deceomber 1994. After the completion of the sixth parallel shift, the shiftable conveyors were fixed in position at their supply end and started a radially operating about the supply point. This radial operation has continued through to the present operation.

4.8 SUMMARY OF THE PRESENT AND FUTURE ASH DUMP CONSTRUCTION PHILOSOPHY

The present construction system of the Ash Dump has followed the methodology laid down in the previous Operating manual that was revised in Jan 2011,and is based on the Radial Ash Dump Construction method for the lower stack. This method will be suitable for operating the Dump for approximately another 2 to 3 years during which time the 2019 detailed design will have to be implemented. The implementation includes a mixture of the parallel and radial disposition on the existing facility.

The first task that would be required is that the ramp up to the existing facility be constructed with the use of the main conveyor. This can be accomplished at the same time with the main conveyor depositing a backstack. After the backstack has been completed with the main conveyor, the standby conveyor will deposit in the northern exemption area. The main conveyor is then to be moved to the top of the existing ash dump position 1. Once the standby conveyor has completed ashing in the northern area of the exemption, the main conveyor will begin to ash allowing the standby conveyor to move to the southern exemption area and begin ashing. The main system and the standby system will run concurrently with the deposition split between the two systems.

The extension of the ash dump has been split into 8 different phases, each with a four year interval. Each of the phases are lined areas.

Once the southern area of the exemption is filled, deposition will be split between the main system and the lined area (Phase 1). Deposition will continue between the main conveyor and the standby system until the 65 year life of the facility has been reached.

(Refer to the Detailed Design Report 301-00825/01, September 2019, for further details with regards to ash deposition and the growth plan method)

5 DESCRIPTION OF THE ASHING (ASH PLACING EQUIPMENT)

The ash is placed onto a conveyor system which transports the ash to a transfer station that distributes the ash to conveyors whereby either a Stacker or Spreader removes the ash from the conveyor and builds a continuous cone of ash along the face of the ash dump.
The following sections discuss the systems and equipment used and their operation.

5.1 THE CONVEYOR SYSTEM

The ash conveyor and stacking systems have been designed as a dual system to allow 100% standby for the removal of ash from the power station to the ash disposal facility.
The ash conveyor system consists of two conveyor systems running parallel to one another. System 1 (The main conveyor – stacker) serves as the back system and System 2 (Standby conveyor – Spreader) acts as the front system. The systems are interchangeable at the transfer houses until Transfer house 6 where the ash will be placed onto a specific system (duty system) – either the main or the standby system.
The ash conveyor system, for the purpose of this document, starts at the back of the boiler with transverse conveyors 11 and 21, which run below the ash bunkers and conditioners. The duty belt deposits ash onto the cross conveyors. One of the two 'cross' conveyors. 12 and 22 transports ash from the power station to Transfer house '5'. Located approximately 1 km north-west of the power station. From here ash is transported on either overland conveyor 13 or 23 to Transfer House '6'. The ash is then transported in a southerly direction along either extendable conveyor 14 or 24 which in turn feeds onto shiftable conveyors 15 or 25.
The shiftable conveyors are positioned on a platform prepared for them on the advancing frontstack. The standby conveyor system proceeds in a radial manner, whereas the main conveyor system is first proceeds in a parallel manner until it builds up a ramp to approximately 30m in height and then proceeds in a radial manner.
On each of the shiftable conveyor systems is a rail mounted tripper car which travels up and down the length of the shiftable conveyor and lifts and transfers the ash onto the stacker or spreaders link boom.

5.2 THE STACKER AND SPREADER MACHINES

The link conveyor "links" the tripper car to the spreader or stacker machines. The link conveyor used at the spreader is fixed to the tripper car and is not able to be slewed or luffed. The ash is deposited directly onto the spreader discharge boom. The spreader machine is a mobile crawler mounted machine with a single fixed boom (Belt wagon).

Figure 5-1: No.1 The Spreader train

The spreader is designed to operate in a number of parallel operations and cannot slew in operation as it is not fixed to the link conveyor. The spreader is thus less flexible in operation than the stacker and is only intended to be used as a standby system. See Figure 3.
The stacker machine also receives ash from a tripper car. Ash is transferred from the shiftable conveyor via the tripper car onto the stacker boom and then onto the stacker discharge boom. In contrast to the spreader's single fixed discharge boom, the stacker consists of separate link and discharge boom conveyors, each of which is capable of slewing independently of each other. The stacker link boom is connected to both the stacker and the tripper car and can move both radially and vertically relative to the tripper car. The stacker's link and discharge booms have been designed to slew through 210° and 270° respectively. See Figure 4. Limit switches have been installed on the mechanical plant to protect the plant from damaging itself by slewing into the machine. This capability plus the extra reach of the stacker make it a much more versatile machine than the spreader. The stacker can deposit more free ash per shift due to its flexibility in slewing and its longer reach. It is therefore used as the main ashing system.

Figure 5-2: No.1 The Stacker train

The stacker and spreader system operation has been designed to operate with a split deposition between the two systems. These systems will operate at 70%-30% for the first phase and then 60%-40% for the remaining phases in order to avoid a clash between the conveyor systems.

5.3 MOBILE EQUIPMENT

Ash from the spreader or stacker should be placed as close as possible to the required dump construction geometry as detailed on the construction drawings. This will result in minimum dozing and maximum free ash. However, there will be occasions when mobile equipment is required to 'doze the ash some distance. e.g. for the construction of side slopes.

Earth moving equipment will be required to move ash to positions outside the reach of the spreader or stacker machines, carry out trimming and profiling of the dump surface, side slopes, and conveyor platforms and to move the head and tail stations during conveyor shifts. A D7, or equivalent bulldozer, fitted with a rail shifting head frame, will be used to shift the shiftable conveyors.

A grader will be used to do final leveling and shaping of the platforms, advancing frontstack slope, side slopes, backstack and rehabilitation top-soil on the final surfaces of the Ash Dump. It will also be used for minor cleaning operations on the spreader and stacker working platforms as well as for grading of roads etc.

Water bowsers will be used for dust suppression of working areas, roads, washing down of the mechanical plant etc. Water bowsers must also be used for dust suppression of advancing slopes which are is difficult to reach with sprinklers or for specific chemical dust suppression applications.

Dump trucks will be used for hauling and placing topsoil and rehabilitation soil on the Ash Dump and for trucking ash from the emergency ashing area to the ash dump complex only when absolutely necessary.

Front end loaders will be used for loading dust suppression soil and rehabilitation soil onto trucks, for general maintenance on and around the Ash Dump and loading stockpiled emergency ash into the inloading hoppers.

6 THE ANCILLARY WORKS AROUND THE DUMP

The following sections form part of the ancillary works around the dump. These items include the roads, drains and storm water controls.

6.1 THE ROAD NETWORK

Permanent gravel roads have been provided for access to the Ash Dump complex; the site office and contractors yards; along the eastern and northern toes of the Ash Dump; up the extendible conveyor ramp and alongside the overland ash conveyor.

Access ways have been constructed up the eastern side of the dump and alongside the shiftable conveyors primarily for the use of the Ash Dump construction personnel, as well as for the use of Eskom's electrical and mechanical maintenance teams, and do not form part of the permanent road network.
Access ways have been designed along the backstack and side slopes of the dump and are used for the rehabilitation and irrigation of the completed areas of the Ash Dump.
Permanent gravel roads are provided for the extension of the Ash Dump complex. Drawing 301-00825-01-105 Rev 2 in Appendix A indicates the layout of the roads and access ways on the Ash Dump Complex.

6.2 DRAINAGE

A Dry Ash Disposal Facility is considered to be a ‘disturbed’ area, from an environmental point of view, even though the completed Ash Dump will be topsoiled and revegetated with indigenous vegetation. The reason for this is that the Dump is covered by a relatively thin layer of topsoil that could be eroded through to the ash. For this reason, no storm water run-off from the Ash Dump may be discharged directly into the natural environment or any stream or river.
Run-off water must be contained and used for dust suppression if the water is ‘dirty’, or irrigation on the Dump if the water is 'clean'.
Permanent concrete lined canals have been provided along the eastern, northern and western toes of the Ash Dump to collect stormwater run-off from the Dump backstack and side slopes. Stormwater is then channelled into stormwater control dams which are situated at the north-eastern and the south eastern corners of the Ash Dump Complex.
Temporary drainage works must be constructed as and when required. Temporary drainage works will include construction of berms and cross berms on backstack and side slopes; stormwater drainage from the working areas and storage area at the eastern end of the Dump; stormwater drainage down the extendible conveyor ramp and the eastern access ramp as well as drainage and emptying of borrow areas in front of the advancing toe of the Dump.

6.3 STORMWATER CONTROL AND EROSION PROTECTION

A stormwater control system, including concrete lined canals and a stormwater dam is included in the initial civil works at the ash dump extension complex. An extension to the stormwater control system was constructed during 1995.

Stormwater control berms were designed to be constructed on the completed backstack and side slopes of the Ash Dump. The berms were designed to break the velocity of the stormwater flowing down the dump slopes. The berms were designed to be a specific distance apart to reduce the possibility and magnitude of erosion of the topsoil and rehabilitated area.

Three take down chutes have been added on the backstack slope of the existing dump during 1994 as a result of the formation of major erosion dongas.

As per the 2019 design, an extension of the stormwater control system has now been designed in order to cater for the additional stormwater runoff from the facility. The design includes the construction of 2 additional dams in the South and North west of the facility to assist with the stormwater control for the extension of the facility.

7 THE ASH DUMP DESIGN PHILOSOPHY

7.1 LIFE AND CAPACITY OF THE ASH DUMP

The Ash Dump will serve as a storage site for approximately 416 million tonnes of ash during the 64 year design life of the Power Station. This will provide the Power Station with sufficient ashing capacity until approximately 2055 AD. The area provided allows for 230 million tonnes of ash, which allows another 36 years of enhanced operation. The actual size of the Ash Dump will depend very much on the load factor of the Power Station and the ash content of the coal burnt during the Station's life-span.

7.2 DAM SAFETY CLASSIFICATION

The Matimba Ash dump has a maximum height limitation of 90m. The ash dump reaches a height of 90 meters on the southern area of the existing facility with an elevation of 869 mamsl. The South West area of the facility reaches the 90m height at an elevation of 870 mamsl.

The dump is located upstream of a watercourse. Any breach or failure of the dump can thus result in extreme environmental damage. The dump therefore has a high hazard classification.

7.3 STAGE CAPACITY CURVES

The expected rate of deposition to the ash dump has been based on the annual ash deposition of 6,396,250 m^3/year. The annual ash deposition occurs as a split deposition between the Stacker and the Spreader and forms the basis of the growth plan.

The capacity curves for the life of facility for each conveyor have been illustrated in Appendix B.

The expected rate of development of the Ash Dump is described in detail in the detailed design report. The designed ash deposition figures, cumulative volume, shift volumes and approximate shift dates have been detailed in the report and should be consulted on a regular basis in order to develop the dump in accordance to the design.

The curves will, when necessary, be revised or updated and re-issued by the Civil and Building Division design team of Eskom. The present co-axial plot has been drawn assuming the spreader and stacker are operating in simultaneously.

For Example. The expected development that coincides with the growth plan as indicated illustrates a split deposition of initially depositing at a 70%-30% between the Stacker and spreader and then this changes for phase 2 to phase 8 to a 60%-40% deposition split accordingly. The ash dump will simultaneously deposit with the Spreader in a radial manner on the lower stack while the Stacker will be used to deposit in a parallel manner on the existing facility building a ramp up to a height of 30m high at which deposition will then switch to a radial deposition.

The co-axial plot must be checked and updated regularly and the remaining life of the Ash Dump predicted to ensure its availability and the remaining life-span of the Dump. The civil designer and technical advisor from Eskom's Civil and Building Division will be responsible for updating the curves.

Table 7-1 below indicates the available storage capacity at each of the sections that are available for deposition.

Table 7-1: Available storage capacities

Defined Ashing Area	Volume (m^3)
Northern Exemption Area	3 782 237
Southern Exemption Area	8 046 774
Lower Radial Front Stack Area	77 952 797
Existing Facility Ramp Up Area	21 200 049
Existing Facility Area	128 043 956
Total	239 025 813

7.4 DETAILED DEVELOPMENT OF THE ASH DUMP

Detailed designs and construction drawings were prepared for the entire life of the facility. These designs indicate the phases ie. phase 0 to phase 8, each phase represents a four year development period until the year 2055. Development of the Ash dump is to be done in phases from phase 0 through to Phase 8. This deposition is described as follows:

PHASE 0

Phase 0 involves deposition in the Northern Exemption Area, Southern Exemption Area and the Existing Facility Ramp Up Area (piggyback). The deposition strategy for this phase has been defined as follows:

- Standby System deposition in the Northern Exemption Area at a 70% deposition rate for an approximate period of five (5) months, combined with the Main System Deposition in the additional back stack and 1:20 ramp area at a 30% deposition rate for an approximate period of five (5) months

- Standby System deposition in the Northern Exemption Area at a 100% deposition rate for an approximate period of 3.7 months. The Main System must be relocated to the Existing Facility Ramp Up Area position 1 and must be commissioned within this period.
- Main System deposition in the Existing Facility Ramp Up Area at a 100% deposition rate for an approximate period of 2.5 months. The Standby System must be relocated to the Southern Exemption Area within this period.
- Main System deposition in the Existing Facility Ramp Up Area and Existing Facility Area at a 70% deposition rate for an approximate period of 47 months, combined with the Standby System deposition in the Southern Exemption Area at a deposition rate of 30% for an approximate period of 47 months until the exemption line is reached.
- At this point Phase 0 will be completed with the Main System located at position 8 (MCP8) and the Standby System located at the exemption line.
- Phase 1 is then initiated

PHASE 1

Phase 1 involves deposition in the Lower Radial Front Stack Area (lined area) and Existing Facility Area. A four-year lined area is required to be constructed for this phase. Construction of this phase must be completed and commissioned before the end of Phase 0 to ensure that continuous ashing can take place on the facility. The deposition strategy for this phase has been defined as follows:

- Main System deposition on the Existing Facility Area at a 70% deposition rate for the duration of Phase 1 (4-years).
- Standby System deposition on the Lower Radial Front Stack Area (lined area) at a 30% deposition rate for the duration of Phase 1 (4-years).
- At the end of Phase 1 the Main System will located at position 23 (MCP23) and the Standby System will be located at position nine (SCP9)

Phase 1 to Phase 8 areas are required to be lined prior to the deposition being able to take place in the area post the exemption area. The ash dump has a single HDPE liner with leakage detection facilities as well as a Geosynthetic Clay Liner (GCL) beneath the HDPE liner. The liner system is over-lain by a 300mm thick drainage layer to limit the ash seepage water head over the liner system and to provide protection to the liner system.
Clean/dirty water separation facilities are provided for clean and dirty stormwater discharge for each phase of the Ash dump.
This is achieved with the construction of dirty water channels around the perimeter of the ash dump that are fed by the temporary drainage channels within the basin of the Ash dump. These channels feed into the new South dam.
Clean stormwater from outside the active ashing areas is diverted by means of temporary gravity channels and a buried penstock setup, for discharge to the environment.

PHASE 2 TO PHASE 8

These phases involve deposition in the Lower Radial Front Stack Area (lined area) and Existing Facility Area. Each phase will require a 4-year lined area to be constructed ahead of time as the Ash Dump advances. The ash deposition splits for Phase 2 to Phase 8 have been calculated and set to ensure

that there is sufficient space between the Main System and the Standby System which ensures that these two (2) systems do not intersect each other. The deposition strategy for these phases have been defined as follows:

- Main System deposition on the Existing Facility Area at a 60% deposition rate for the duration of each Phase (4-years)
- Standby System deposition on the Lower Radial Front Stack Area (lined area) at a 40% deposition rate for the duration of each Phase (4-years)

To keep the design of the Dump dynamic and current, as developments and technologies evolve, it must be regularly reviewed and updated.

7.5 SLOPE STABILITY

The original design of the Ash Dump, done in-house by Eskom, required all advancing frontstack slopes to be 'dozed to a 1:3 slope for stability reasons. (Side-slopes were designed to be 1:5) This was a costly operation and, after gaining some practical experience, it appeared to be unnecessary and a further investigation was required. In 1982 the civil engineering consulting company of Watson, Edwards, vd Spuy & vd Linde were requested to do a geotechnical investigation into the slope stability of the Ash Dump at Matimba Power Station. Steffen, Robertson & Kirsten (Ref 4) undertook the investigation. The results of the investigation allowed the slope angles to be revised. The slope angle of the advancing slope was revised from a 1:3 to a 1:1,2 (natural angle of repose). For the 2019 detailed design it was however put forward that the operational slopes be designed to 1:1.5 and 1:5 for the rehabilitated slopes.

In order to ensure the integrity and safety of the mechanical ash stacking plant and the operators, the mechanical plant must remain a safe distance away from the advancing crest of the dump. This distance is known as the safe edge distance (S.E.D.) and is a function of the height of the operating terrace above natural ground level at the advancing crest of the Dump; the physical properties of the ash and soil below the Ash Dump(founding conditions); and the Dump geometry. In order to maintain a factor of safety of 1.5 for the facility the Stacker should maintain a minimum of 110m from the crest of the lower stack during deposition.

If the dump is built as per the detailed design report, the construction drawings and the methods described in this manual, there should be no need to take unnecessary risks. The safe edge distance does not apply to mobile plants such as bulldozers, as they should be allowed to operate near the edge of the dump in order to carry out their operations.

The Ash Dump construction personnel and Eskom's Ash Dump supervisor must be aware of what the first signs of a slope failure are. These will include tension cracks forming a few metres in from the advancing crest of the Dump; a bulging at the toe of the Dump; and a sudden settlement of the top surface of the Dump. If any of these signs are noticed or seen on the Dump, all mechanical mobile and ash stacking plant must be removed from the area; all relevant parties must be informed; and the Civil and Building Division must be informed of the situation. The Civil and Building Division designers will immediately do a technical evaluation of the area where the reported failure was seen and advise the Ash Dump operators as to the severity of the situation giving recommendation for any remedial action necessary.

One of the main causes of a deep seated slope failure is standing water at the toe of the Dump. The standing water infiltrates the soil decreasing its shear strength and increases the pore water pressure in the soil. This increase in pore water pressure has a negative effect on the internal frictional resistance of the soil. The higher the pore water pressure, the lower the frictional resistance of the soil.

Each phase of the ash dump extension is provided with a temporary trench to lead collected stormwater away from the active ashing face, so that it can then be lifted by means of a trailer mounted diesel pump into the temporary dirty water channel at the edge of the lined area and then to the dirty water storage dam.

7.6 ROADS

Initial civil works provided roads to the Ash Dump complex and around the toe of the Ash Dump to the extendable conveyor. Extending the road around the eastern toe of the Ash Dump was undertaken during 1995. Access ways have been constructed on and around the Ash Dump complex as and where required. Roads will ultimately be provided around each phase and the completed toe of the Ash Dump. These roads will provide access for vehicles to enable ease of plant maintenance, inspections, rehabilitation, delivery of materials, construction and maintenance of the canals and dams, etc.
Any other temporary access ways on or around the Ash Dump or Ash Dump complex as required for the construction of the dump by the Ash Dump construction personnel must be designed and constructed with Eskom's prior approval. If new access ways are to be constructed unnecessary damage to the surrounding bush must be kept to a minimum.

7.7 DESILTING OF STORMWATER

Stormwater running off the ash dump has the potential to erode the surface of the dump, picking up both ash and soil. The drainage system is designed to allow the water to deposit this silt in the stormwater berms on the backstack or side slopes. Silt not contained in the berms should then settle in the concrete lined canals, resulting in the water flowing into the Stormwater Dam carrying very little silt. A silt trap has been provided at each dam in order to limit the amount of silt that enters the water dams. These silt traps should be maintained on a monthly basis in order to limit any build up within the silt trap.

7.8 DIRTY WATER HANDLING

The Ash Dump area has been environmentally defined to be a “dirty area”. The run-off from the ash dump is therefore considered to be dirty water and may not be expelled into the environment. It is for this reason that the facility be designed in a way that all run-off from the facility will flow from the dump, frontstack, backstack and side slopes into concrete channels and then into the storm water dams provided around the ash dump complex. The water, which is discharged into the Stormwater Dams is to be used for dust suppression on the Ash Dump. The water will flow through a silt trap which sole purpose is to collect the silt in the water. Any silt in the water entering the dams, will be allowed to settle in the dam. The dams and silt trap must be surveyed regularly and desilted when necessary.

7.9 CLEAN WATER RUN-OFF

Deposition is to occur on the existing facility of the Ash dump, these areas have already been rehabilitated and the topsoil will be stripped prior to deposition occurring for the relevant conveyor position. As the dump deposition progresses, the ash dump must be rehabilitated. All water that comes into contact with the ash will flow into the stormwater channels and into the stormwater dams.
Stormwater will be considered clean if it has not come into contact with the Ash Dump and is free from any ash pollution. Clean water that flows to the toe of the Dump from the surrounding ‘veld’ will be guided away from the Dump by the use of earth berms. The berms will be constructed about 10 m from the toe of the side slopes or frontstack. Water caught above the western berm should be channelled into the old quarry which is situated to the north-west of the extendible conveyor platform. Any other

clean water flowing around the Ash Dump must be channelled into the 'veld' and away from the Ash Dump.

For each of the lined ashing areas Phase 3 to 8, (years 9 to 33), the clean water from the un-lined catchment portion of the site will collect in the valley depression against the West perimeter of the current lined section. As the valley depression is lower than the ash dump perimeter drains, collected clean water run-off will have to be discharged by gravity via a below-ground decant pipe to achieve discharge to the environment.

7.10 EROSION PROTECTION

Measures shall be taken to prevent the erosion of the ash dump surfaces and slopes at all times. The dump surfaces include the working areas, completed areas and the rehabilitated areas. (including side slopes and backstack slopes) This must be done to prevent erosion of the ash dump and the rehabilitated areas and to minimize the possibility of pollution of the environment. Stormwater control berms have been designed for the backstack and side slopes and must be constructed as soon as possible after that portion of the dump has been completed.
The ash dump must be inspected regularly for erosion of the topsoil, the rehabilitation and the stormwater control berms. Berms and drainage facilities have been provided as part of the overall ash dump design, but if they are not adequate or do not work at all, the problem must be identified and resolved as soon as possible to reduce the cost of ongoing maintenance.

7.11 FUTURE ROADS, CANALS AND STORMWATER DAMS.

As the Dump develops and the natural flow direction changes, new concrete lined canals, earth berms and stormwater dams will have to be built to contain the dirty stormwater run-off.
A clean and dirty water separation system has been implemented for the ash dump extension in order to keep the clean and dirty water separate. The clean water from outside the active ashing area will be collected into a channel from which it will be decanted through a buried pipeline underneath the ash dump, from where it then discharges in a southerly direction towards the South stream. A separation berm is to be constructed next to the clean water channel for each lined phase. This allows the clean stormwater to be guided into the adjacent d stormwater channel at the perimeter of the lined section facility, and hence to the buried decant pipe. This concept has been designed for all of the phases 2 to phase 8. If stormwater berms are going to be ashed over, they must be emptied or drained of any water contained in them long before they are covered.
Future capital work for phases 2 to phase 8 include the construction of, or, extension to roads, canals and dams around the toe of the Ash Dump. These will be constructed as and when required. Road, canal and dam construction is to be phased in with sufficient roads or canals being constructed at one time to provide both access and drainage to or from a particular point or for the duration of ashing operations. New roads, canals and dams, plus extensions to existing roads and canals, must be built to enable the next phase of the Dump construction to continue without affecting the ashing operation or the environment. Planning and construction of these new works, or extensions to existing works, is of paramount importance since they must be in place prior to being required for use.

The extensions of the road and canal, along the south-western toe of the Ash Dump, and the construction of the fourth Stormwater Dam, situated at the south western side of the Ash Dump Complex, should be planned for construction with Phase 1. An additional dam in the North western area

of the facility should also be constructed as part of Phase 1. These extensions to the canal and road and the construction of the Stormwater Dam should be sufficient to last until 2055.

7.12 OPERATING CHARACTERISTICS OF MECHANICAL EQUIPMENT

This section defines the operational characteristics of the mechanical plant which are pertinent to the civil construction of the Ash Dump. For further details on the mechanical plant refer to the mechanical equipment specification

7.12.1 EXTENDABLE CONVEYORS

Table 7-2 Standby Systems extendable conveyor

Description	Dimension
Length of Conveyor	518 m
Belth Width	1350 mm
Belt Speed	3 m/s
Maximum continuous conveying rate	1600 t/hr
Maximum design conveying rate	1920 t/hr

Table 7-3 Main system extendable Conveyor

Description	Dimension
Length of Conveyor	2,050 m
Belth Width	1350 mm
Belt Speed	3 m/s
Maximum continuous conveying rate	1600 t/hr
Maximum design conveying rate	1920 t/hr

7.12.2 SHIFTABLE CONVEYORS

Table 7-4 Standby Systems Shiftable Conveyor

Description	Dimension
Length of Conveyor	2,535 m
Belth Width	1350 mm
Belt Speed	3 m/s
Maximum continuous conveying rate	1600 t/hr
Maximum design conveying rate	1920 t/hr

Table 7-5 Main system Shiftable Conveyor

Description	Dimension
Length of Conveyor	2,400 m
Belth Width	1350 mm
Belt Speed	3 m/s
Maximum continuous conveying rate	1600 t/hr
Maximum design conveying rate	1920 t/hr

7.12.3 STANDBY SYSTEM TRIPPER CAR

Table 7-6 Standby system Tripper Car

Description	Dimension
Length of Tripper Car	34,8 m
Minimum distance from centre line of extendable conveyor to centre line of discharge onto the link boom	45.2 m
Minimum distance from centre of discharge onto the link boom to the centre line of the pulley on the head end station	42.1 m
Tripper link conveyor length	11 m

7.12.4 MAIN SYSTEM TRIPPER CAR

Table 7-7 Main system Tripper Car

Description	Dimension
Length of Tripper Car	47.7 m
Minimum distance from centre line of extendable conveyor to centre line of discharge onto the link boom	74.3 m
Minimum distance from centre of discharge onto the link boom to the centre line of the pulley on the head end station	25,0 m

7.12.5 SPREADER MACHINE

Table 7-8 Spreader Machine

Description	Dimension
Crawler width (Outside edge to outside edge)	7,5 m
Crawler Length	6,3 m
Boom Conveyor reach	1350 mm
Maximum luff angle	14°
Belt Speed	3 m/s
Maximum continuous conveying rate	1600 t/hr

Maximum design conveying rate	1920 t/hr
Maximum stacking height of cone	11 m
Design ground bearing pressure under all conveyor bases	70 kPa

7.12.6 STACKER MACHINE

Table 7-9 Stacker Machine

Description	Dimension
Crawler width (Outside edge to outside edge)	11,5 m
Crawler Length	8,0 m
Link Boom Length	32,5 m
Discharge boom length	35,0 m
Boom conveyor slewing angle	210°
Maximum luff angle	14°
Belt Speed	3 m/s
Maximum continuous conveying rate	1600 t/hr
Maximum design conveying rate	1920 t/hr
Maximum stacking height of cone	15 m
Design ground bearing pressure under all conveyor bases	70 kPa

7.13 EMERGENCY ASHING SYSTEM

In event of either of the machines becoming unavailable due to breaking down, maintenance, etc. Ashing must be done solely with the operational machine. If this is also out of operation a limited volume of ash will be stored in the ash bunkers and the electrostatic precipitators at the Power Station. The maximum storage capacity within the Station is about 12 hours, giving sufficient time for a maintenance team to effect necessary repairs to make the ashing plant operable. However, should the repairs take longer than expected, an emergency ashing facility is available at Transfer House '5'.

The ends of the cross conveyors at Transfer House 5 are connected to a moving head system which, in the case of an emergency, can extend to a position beyond the edge of the Transfer House and deposit ash onto the ground. This ash must be removed as quickly as possible and stockpiled in the adjacent area provided in order to prevent the system from blocking up, and ultimately a load loss.

An emergency ash on-loading hopper has been provided for re-loading the emergency ash back onto the overland ash conveyor.

7.14 DUST SUPPRESSION SYSTEM

The discussed below is of the operating characteristics relating to the mechanical plant which is used in the dry ashing method of ash disposal and has the potential to create severe dust problems in the windy season, detrimentally affecting the efficiency of the operating staff, and equipment, and creating a visual hazard and airborne pollution of the surrounding areas and causing potential safety problems. Readily identifiable negative effects of dust blow are:

- Reduced visibility and hence reduced safety on the Dump and environs. e Unpleasant and unhealthy working conditions.
- Potential long term health problems. (eg. eye and lung problems) This has not been proven to date, but research is being done at present to investigate the possibility of ash dust causing long term health problems.
- Detrimental effects on mobile plant and ash stacking equipment. Ash will block air filters etc, get into control panels and electronic equipment etc, and is very abrasive and wears / erodes moving parts.
- Polluting of vegetation and adjacent areas.
- Detrimental visual impact from the main road and for farmers.

Every effort must be made to control dust-blow from the Ash Dump to try to minimize the possibility of any of the above problems occurring.

Dust suppression of both the top surfaces of the dump and the advancing ash face requires pro-active management. Trying to suppress the dust when the wind is blowing has very little effect, as the treatment blows away with the wind. Dust suppression must be done before the wind blows in order to have a positive effect when the wind does blow.

The following methods, used on their own or combined, have been considered for dust control on the Ash Dump:

- Spraying the Dump with water using a sprinkler system.
- Spraying the Dump with water using mobile plant. (Water bowsers)
- Asacrificial sand layer.
- Additional methods of reducing dust blow include landscaping, planting windbreaks, mobile or mechanical wind breaks etc.

(Refer to report 'Matimba Power Station - Report on Dust Suppression on the Dry Ash Dump and Trials Using AECI Chemicals and Soil Spreading Methods' dated May 1991 by A Kreuiter from Eskom Civil and Building Division.) Ref.5.

7.15 WATER

Water that is applied via a grid sprinkler system, water cannons, mobile sprinkler machines or water bowsers has proven effective in controlling dust on other dry ash dumps in Eskom. It should be applied at a rate so that a surface crust is created that is resistant to wind blowing across it. (The crusts could last from a few days to a few weeks.) To date it has been found that the use of water is the best method of dust suppression in the working areas where it is difficult to use other methods.

Water for the dust suppression will be obtained from the stormwater dams for the entire facility. The dust suppression system has been designed to control the dust levels for the entire facility

7.16 SACRIFICIAL SAND LAYER

A thin (50 mm) layer of sand spread over the frontstack ash surface has proved successful in controlling dust blow problems. The use of sand also reduces the amount of water required for dust suppression. A truck load of sand 'dozed over the crest of the advancing face to some degree reduces the amount of ash blow on the crest caused by the eddying effect of the wind at the crest of the Dump.

7.17 TOP SOILING AND REHABILITATION

Definitions:

- Topsoil: The surface layer of soil. This soil is usually fertile with some form of vegetation growing in it.
- Topsoiling: Topsoiling is the process whereby a layer of soil is placed on top of a previously disturbed surface for the purpose of either dust suppressing the area or to bring that area back to its natural state. (Rehabilitation)

- Rehabilitation: Rehabilitation is the process of revegetating an area to bring it back to its original or natural state.

Topsoiling and rehabilitating of the completed portions of the ash dump is carried out to ensure the following :

i) Assists in limiting or preventing ash dust being blown on the areas where the final ash dump geometry has been completed and the rehabilitation has not been done.
ii) Water running from the dump's rehabilitated surface is 'clean' and uncontaminated by ash. (Except where erosion gullies have been cut into the ash. These gullies must be repaired as soon as possible.)
iii) The site is suitable for other land uses following the dump's completion. The area should therefore be accessible and capable of sustaining future plant growth.
iv) The completed Ash Dump must have as small a negative visual impact on it's environment as possible. Final grading of side slopes and crests should be such that the ground profiles are curved, smooth and flowing rather than sharp changes in line and gradient. Stormwater management should, however, not be compromised in the process.

In accordance with the above, the Ash Dump must be rehabilitated progressively after ever. Shaping of the slopes must be done after every 2 conveyor shifts. Areas where final shaping and levelling of the ash have been completed, (but still require topsoiling,) must be topsoiled immediately and rehabilitated as soon as possible.

Topsoil necessary for use in topsoiling operations must be recovered from positions in front of the advancing ash face before it is covered by ash. Areas and depths of suitable topsoil are shown on the detailed design drawings for each phase. Once stripped the topsoil should be used as soon as possible for top soiling purposes.

If, for some reason, it is necessary to stockpile topsoil, it shall be done in such a way that double handling of the material is minimized and haulage distances are kept to a minimum. Stockpile heaps should not exceed 2,5 m in height and the necessary steps must be taken to prevent their erosion.

Storage of topsoil on the existing facility has been indicated for the initial conveyor positions on the existing facility. Sections and details of this has been provided on drawing 301-00825/01-102 of the detailed design.

7.18 ASH DUMP LINER SYSTEM

The liner system provided for groundwater pollution prevention is as follows, listed from the top downwards:

- 300mm protection layer
- 2mm single textured HDPE layer
- GCL
- Underdrainage and monitoring system
- Prepared natural foundation.

The liner throughout construction and during ashing must be kept clear from any items that could lead to the liner becoming damaged or unusable. After each storm, the protection layer must be assessed in order to maintain the condition of the liner after installation. Any damage to the liner must be noted and the liner repaired to the required standard, in order to comply with the environmental regulations.

7.19 ASH RESOURCES EFFECT ON THE ASH DUMP

"Ash Resources" has an agreement with Eskom to reclaim ash for sale to non-Eskom interests who then manufacture bricks and other products from the ash.

The volume of ash to be reclaimed would be negligible and has therefore been ignored for design purposes.

However, it should be noted that provision for site access will need to be made for the removal of the ash from the Dump. Co-ordination between relevant parties is necessary to avoid any damage to dust suppressed or rehabilitated areas and for the safety of plant and personnel. Special attention must be paid to the areas and methods of reclamation and especially the stability of the Dump in the areas of reclamation.

7.20 ASH DUMP HANDOVER

Ash deposition will occur over areas in which the topsoil would need to be stripped, stockpiled and ashing allowed to continue and then rehabilitated. In order to avoid any conflict over these matters, a procedure must be set up whereby both Eskom and the Ash Dump construction personnel agree to the handing over of a particular area.

It is suggested that a cattle or game fence be erected to separate areas that have been handed over from the operational areas. The areas in question should be surveyed and inspected prior to their acceptance by Eskom and full records kept as handover of new areas progresses. A standard form must be compiled and completed, to record the details of the handover, and a copy filed in the operating manual.

8 DEVELOPMENT AND CONSTRUCTION

8.1 GENERAL

All aspects of the design of the Ash Dump have been based on making maximum use of the Spreader's and Stacker's operational capabilities and therefore keeping the amount of necessary ‘dozing to a minimum. This consists of optimizing various geometrical configurations within the constraints of safe edge distance; access clearance; cone height; boom lengths; dump height; dust suppression; working areas for a 14 hour night time ashing operation; and a 10 hour daytime civil operation etc. The design should therefore result in a cost effective and environmentally acceptable Ash Dump. In the event that unforeseen adverse circumstances arise during the life of the Dump, these will be managed by ongoing consultation between the owners, designers and operators of the Ash Dump.

During the conceptual design an attempt was made to cover all possible eventualities during the life of Matimba Power Station. Existing drawings cover the development of the Ash Dump from conception to final position of the life of the facility.

8.2 DRAWING LIST

A detailed drawing list of all the detailed design drawings, detailing with civil drawings and operational layouts are included in the Appendix of this operating manual. Drawing 301-00825/01-100 indicates the list of drawings for the detailed design of the Ash dump extension.

8.3 DESCRIPTION OF MECHANICAL EQUIPMENT OPERATIONS

This section consists of the operational aspects of the different types of plant encountered on site and what the plant looks like.

8.3.1 DESCRIPTION OF EXTENDIBLE CONVEYORS

Extendible conveyors of the standby system and the main system are situated on the northern side of the ash dump complex. The extendible conveyors join the overland conveyors to the shiftable conveyors. These conveyors are extended or lengthened, as the dump develops in both length and height. To extend the conveyors, the conveyor belts are cut, the head end stations are shifted to the newly constructed shiftable conveyor platform. New extendible conveyor modules are then added to lengthen the system and the belt is then lengthened. The extendible conveyors is ‘extended’ when the main system conveyors are shifted. In the parallel section only the main extendible conveyor is extended. It is important to note that when the extendible conveyors are re-commissioned, the conveyors must be set out to be within tolerance to prevent conveyor trips and damage to the belts, modules or system due to belt misalignment etc, which would affect the integrity of the system. See section 7.11 for extendible conveyor specifications and tolerances.

Both extendible conveyors for the main and standby systems require a stabilized earth platforms to stand on. Both the stabilization of the conveyor platform and the shaping of the extendible conveyor ramp are necessary for erosion protection and drainage of the ramp to ensure the integrity and availability of the extendible conveyors. The shaping of the ramp and the construction of the extensions to the concrete lined canals will form part of the ongoing civil works required as the Dump develops.

8.3.2 DESCRIPTION OF SHIFTABLE CONVEYORS

Shiftable conveyors of the standby system are situated on top of the advancing frontstack platform, the and the main system is situated on the top of the existing facility, from which the spreader and stacker deposit ash to form the frontstack platform and backstack areas. Ash is deposited onto the shiftable conveyor from the extendible conveyor at the tail end of the shiftable conveyor. This pulley structure is therefore called the tail station. The main drive station, at the eastern end of the Dump, is called the head station.

It has been found to be beneficial to construct a gravel surface for the shiftable conveyors to stand on. This will inhibit storm water scouring away the platform under the conveyor bases, thus reducing the possibility of 'trips' due to belt misalignment. The conveyors must be set out according to the specifications in section 7.11.

In order to optimize the cost and efficiency of the ash disposal operation, by keeping the ‘dozing operations to a very minimum, it is necessary to move the shiftable conveyors closer to the advancing frontstack crest of the ash Dump. To do this, the mechanical ash stacking plant is moved/shifted onto the new conveyor platform as soon as the advancing face crest moves too far beyond the reach of the stacker and spreader machines. The conveyors are moved to their next position by carrying out a 'conveyor shift' operation which is detailed in section 7.4.

The design of the Ash Dump and the mechanical plant is based on a split deposition between the main system (stacker) and the standby system (spreader). The dump has been designed in this way in order to make more use of the cost effective stacker, making use of deposition in both areas allows for the facility to maximize on the storage space available with the lower front stack building the “foundation” for the upper stack to ash on. The deposition split varies between the phases and is required to avoid the conveyors from clashing. Clashing of the conveyors would result in the main system (stacker) becoming unusable for a period and the deposition on the standby system (spreader) would then have to be increased. The growth plan provided as per the detailed design indicates the optimal deposition split for each phase to avoid storage and conveyor clashing from occurring.

8.3.3 STANDBY SYSTEM OPERATION – SPREADER MACHINE

The Spreader machine's method of operation is relatively simple. The spreader machine has a single, non slewable boom; is not connected physically to its tripper car and-was designed to operate in a number of operations, the spreader running parallel to the shiftable conveyor. This would result in an optimum operation (with minimum 'dozing).
Four different operations, three of which is a stacker operation, are required for each working area to obtain the maximum volume of non-dozed or "free" ash per shift.

8.3.3.1 FRONTSTACK OPERATION

i) The Spreader will build it's own working plaform along the length of the front stack which will then become the new conveyor platform.

8.3.4 MAIN SYSTEM OPERATION – STACKER MACHINE

The Stacker Machine has a longer reach and is more articulated than the Spreader.
Therefore many methods of operation had to be investigated before the optimum method described hereunder was decided upon. A number of different stacking operations are required at each shiftable conveyor position.
Drawings 301-00825/01-1161 to 301-00825/01-162 indicates the optimum ash deposition operation for phase 1 for the standby system's area.

ii) The first operation for the main system system will be the construction of the dump ramp up area on the existing facility, first working area length of the stacking operation and reduces with the footprint of the existing facility.
iii) This has been designed to limit areas of open ash and therefore limit the amount of possible dust generation.
iv) Upon completion of ash placement at any given conveyor position, the spreader machine is moved back to the tail end of the conveyor. The standby system's shiftable conveyor must then be 'shifted' to its next position. During this time, any maintenance required can be carried out on the standby system.

8.3.4.1 FRONTSTACK OPERATION

i. For both the 30m ramp up section and the stacker radial front stack, the stacker will build it's own working plaform along the length of the front stack which will then become the new conveyor platform.

8.3.4.2 BACKSTACK OPERATION

The Backstack operation starts at the tail end of the shiftable conveyor and works towards the head end which is the Head Station.
Backstacking will occur with the main coveyor from conveyor position MCP1. The main conveyor will lay a frontstack and then a backstack will be placed.

- As soon as the shiftable conveyor has been shifted into position, the stacker backstack road must be constructed. The road must be approximately 15 m wide.
- Ash must be stacked using the chevron method.
- Ash should not be lower than 1 meter from the boom conveyor discharge.
- The distance between chevron lines must not be further than 2m apart.
- The eastern end of the backstack must be constructed and shaped. Drainage berms must be constructed. This will only be done every 2 shifts to ensure standing space for the Stacker during shifts.

- The backstack area between the western and eastern side slopes must be constructed and proper drainage ensured.
- When the stacker reaches the eastern end of the backstack, the backstack side slope must be constructed and shaped. Drainage berms and the new access way must be constructed.
- At this point the stacker must move around the head end of the shiftable conveyor and will start with the frontstack operation.

Backstack operation starting at the head end of shiftable conveyor working to the tail end.

i. Before the Stacker moves aroud the head end, the stacker backstack road must be constructed. The road must be approximately 15 m wide.
ii. After the Stacker has moved around the head end of the conveyor the backstack side slope must be constructed and shaped. Drainage berms and the new access way must be constructed.
iii. Ash must be stacked using the chevron method.
iv. Ash should not be lower than 1 meter from the boom conveyor discharge.
v. Distance between chevron lines must not be futher than 2 meters apart.
vi. The backstack area between the western and eastern side slopes must be constructed and proper drainage ensured.
vii. As each length of working area of the backstack is completed, the backstack must be finally shaped and levelled. A 300 mm layer of topsoil for rehabilitation must be placed on top of the backstack as soon as shaping is complete. If there is a delay with the topsoiling operation the completed area must be dust suppressed immediately after the area has been shaped. Dust suppression can be done using either water, a 50 mm layer of sand or a chemical dust suppressant, depending on the time delay before topsoiling is done. The placing of topsoil allows the horticultural contractor to sow seed etc. required for rehabilitation of the completed areas, section by section and not the entire backstack in a single massive operation. This will also assist with dust suppression on the backstack. As the topsoil can be eroded and washed away by stormwater, the topsoiling operation must be coordinated with the rehabilitation programme and responsibilities for maintenance and repair of erosion gullies etc. must be determined.

8.3.5 MOBILE EQUIPMENT OPERATIONS

The stacker and spreader should be operated in such a way that the ash is placed as close as possible to the final dump profile. However, if required, mobile earth moving plant should be used for the following operations. Optimum types and sizes of plant are to be determined by operating conditions and by the Ash Dump construction personnel.

i. Moving of ash to positions outside the reach of the stacker or spreader when required.
ii. Trimming and final profiling of the Dump surface and side slopes, construction of the conveyor platforms and stormwater control berms, cleaning of concrete lined canals and drains and road maintenance.
iii. Shifting of conveyors and the head and tail stations.
iv. Stripping and placing topsoil and dust suppression soil.

8.3.6 FINAL LEVELS AND SLOPES

To maintain the capacity and geometry of the Ash Dump it is important that the Dump is built to the designed levels shown on the construction drawings. It must be noted that the dump cannot exceed a height of 90m with reference to the NGL.

i. A maximum allowable tolerance on the construction of final surfaces of the frontstack or backstack sloped areas, or side slopes is as follows:

A difference in elevation of + 200 mm with a maximum difference in slope not exceeding + 20 % of the designed slope, over a maximum distance of 10 m, after which the variation must be corrected to the original designed elevation and slope, still remaining within tolerance.

ii. All final Ash Dump side slopes shall have a minimum fall of 1 in 3.5 between berms, unless otherwise stated on the drawings. Erosion protection measures will be constructed on the side slopes which will affect the overall fall.The overall slope of the Ash dump is to be sloped at 1 in 5. For details of the side slopes, see the rehabilitation drawings in Appendix A

iii. The advancing Ash Dump face shall be allowed to fall at the natural angle of repose.

8.3.7 EMERGENCY ASHING AT TRANSFER HOUSE 5

When it is not possible to ash from either the Stacker or Spreader machines, and all ash storage capacity within the station (Precipitators and fly ash bunkers) has been utilized, the emergency ashing facility at transfer house "5" must be used.

8.3.7.1 METHOD OF DEPOSITION

Ash is deposited directly from the end of the cross-conveyor's moving head onto the concrete slab adjacent to the transfer house. The ash must be moved away from the off-loading conveyor to allow more ash to be deposited and provide access for other equipment to remove the ash during emergency ashing or re- loading. Should it be necessary for ash to be stockpiled away from the concrete slab, permission must be obtained from the Environmental Officer.

8.3.7.2 METHOD OF IN-LOADING

The ash must be cleared from the emergency area as quickly as possible to prevent it from hardening, or the possibility of unacceptable amounts of ash being stockpiled. This can be done by using a wheel loader to take ash from the stockpile and load it onto the conveyor through the in-loading hopper. The in-loading hopper is situated next to the transfer house on the western overland ash conveyor. Care must be taken during this operation to ensure that the ash is not loaded in such a way as to cause a blockage of the in-loading hoppers or have the conveyors tripping on instantaneous overload.

8.3.8 CONVEYOR SHIFT PROCEDURES

As per the design growth plan, the standby conveyor will require approximately five to nine shifts per phase.

It is expected that the time duration for the conveyor move will be approximately one week per conveyor, but this will depend upon the amount of maintenance carried out while the system is out of commission. The operation of moving the shiftable conveyors to a new position is known as a shift and can be a time consuming and complex operation. It must be well planned by the Ash Dump operators as extra plant and personnel are required on site during the operation.

Before the shift can take place it must be ensured that:

i. The Dump is sufficiently advanced so the new conveyor position will have the necessary required safe edge distance.

ii. The alternative ashing system is in good working order and has been recently maintained to minimize the need for emergency ashing and has sufficient space for the planned shift period.

iii. The new conveyor platform has been constructed to the correct line and level and within the required tolerances. The construction drawing profiles can be viewed in appendix A. The profiles for phase 1 can be viewed in drawings 301-00825/01-161 to 301-00825/01-164

8.3.9 METHOD OF MOVING THE SHIFTABLE CONVEYORS

This method applies to the shiftable conveyors for both the stacker and spreader. To carry out this operation a bulldozer is fitted with a jib hook and a Demag Rail Shifting Head is necessary.

The following is a rough guideline for a shiftable conveyor 'shift' operation. This section is included to show the interface between the civil works and the mechanical, electrical and C & I work. The mechanical, electrical and C & I work needed in doing the conveyor shift will be done by Eskom personnel. Items marked by an asterisk are to be done by Eskom's Ash Dump supervisor (civil) or the civil contractor.

Prior to the conveyor shift the following must be done:

i. The new positions of the Head Stations must be set out.
ii. All ash on the extendible and shiftable conveyors and on the tripper car and stacker or spreader boom conveyors must be off-loaded.
iii. Prepare the area between existing and new conveyor position by grading the platform surface.

After the decommissioning of the conveyor and water reticulation systems by Eskom's mechanical, electrical and C & I maintenance teams, the following must be done:

iv. Release the belt tension by slackening the tension winch on the head station completely.
v. Cut the conveyor belt near the head station and remove the conveyor belt from the station.
vi. Move the tripper car towards the tail end of the shiftable conveyor to its predetermined position. See Figure 20. The minimum distance between the end of the tripper car and the centre of the drive pulley should make allowance for the following:
vii. *The anchor plates at the Tail Station must be dug open.
viii. *Lift the rail shifting head by attaching the shackle on it to the jib of the bulldozer. Position the head over the rail and lower. As soon as the rail takes the mass, the springs will open the clamp. This is sufficient for the wheel type clamp to be inserted into position. The bar link is now coupled to the rail shifting head which can be lifted. The clamp will close on lifting.
ix. *The modules must be lifted 100 mm vertically and moved a maximum of 500 mm horizontally in the direction of the shift. This operation continues until the conveyor is positioned along the planned set out line of curvature.
x. The tripper car is then moved through the "S" curve to a position at least 20 m past the end of the curve.
xi. Operation (x) is repeated until the shiftable conveyor is in its final position on the new platform.
xii. *Finally, alignment of the shiftable conveyor can be done by pushing lightly, with the bulldozer's blade, against the rails where the conveyor is curved or out of alignment. The conveyor must be aligned to the head and tail stations, which had previously been moved to their correct positions.
xiii. *Attach a sling to the brackets on the shiftable conveyor tail station and drag the tail station into position.
xiv. Once the conveyor and the head and tail stations are in their correct positions, the conveyor belt can be joined and the electrical connections re-connected, etc.
xv. The anchor plates can now be re-connected and the belt can be pre- tensioned.

9 STORMWATER AND EROSION CONTROL

9.1 THE FINAL DUMP SURFACE

9.1.1 BACKSTACK AND SIDE SLOPES

Stormwater runoff from the backstack and side slopes will be controlled by means of berms designed to contain stormwater runoff and to minimize erosion of the slopes. Excess stormwater will be allowed to flow over the berms and will be collected in a concrete lined canal at the toe of the Dump. The major portion of silt will settle in the canals, which must be cleaned / desilted regularly. The water is then channelled into a Stormwater Dam where the remaining silt will settle and the dirty water used for dust suppression. Details of these berms can be found in the hydrology drawings Appendix A.

9.1.2 EXTENDABLE CONVEYOR RAMP

Due to erosion under the extendible conveyor bases caused by stormwater and the consequent conveyor trips due to belt misalignment, the ramp has been shaped to slope away from the conveyors towards the sides and a concrete lined canal has been designed to drain the area between the two extendible conveyors. In an attempt to prevent or limit the possibility of the platforms under the conveyor belts eroding, the platforms under the conveyors are to be cement stabilized where required. The central concrete lined drainage canal starts at the crest of the present shiftable conveyor platform and drains down to the toe of the extendible conveyor platform, where the water flows (at super-critical flow) into a concrete energy dissipator. From there the water flows in a concrete lined canal and into the Ash Dump toe culvert and canal. The conveyor platforms have been stabilized from the transfer house at the end of the overland ash conveyors to the head of the extendable conveyor.
Stormwater caught on the outsides of the extendible conveyors will be drained away from the conveyors and down the outside edges of the conveyor ramp, being contained by either the backstack side slope on the eastern side of the conveyor platform or by a berm on the western crest of the conveyor ramp.All stormwater channels must tie into the existing stormwater canals.

9.1.3 FINAL CONTAINMENT OF STORMWATER RUNOFF

Water in the Ash Dump toe canal will be drained to the Ash Dump stormwater dams situated at the north-east and south-east corners of the Ash Dump complex.
Once the rehabilitation of a total catchment area of the Dump is complete and the stormwater runoff is reasonably clean, the Dams could be classified as Clean Water Dams. In this respect, the Matsimaholo dam will be the first that can be concerted to clean water storage, once rehabilitation of the east section of the dump is complete. The Ash Dump area is classified as a 'disturbed area' and therefore no stormwater from the Ash Dump may be discharged directly into the environment. This water must still be contained and monitored for possible chemical contamination from the ash.

9.2 INTERMEDIATE STORMWATER CONTROL MEASURES

9.2.1 DESILTING OF STORAGE AREAS

Eskom's Ash Dump supervisor shall instruct the civil dump construction personnel to desilt all storage facilities and canals etc. as and when necessary. This will include:

- All concrete lined canals and energy dissipation structures.
- All silt traps.
- Containment berms on and around the Ash Dump.
- Stormwater Dams and related works on the Ash Dump complex.

Care must be taken, when doing maintenance to the above mentioned facilities, to prevent damage to the structures.

9.2.2 RUNOFF FROM ADVANCING ASH FACE

If stormwater runoff from the advancing ash face causes pollution problems in the area in front of the toe of the advancing face, the drainage sections must be checked to see if the drainage in the area is operational and has not been damaged. The drainage for each phase has been designed to eliminate ponding of water from the advancing face of the facility.

9.3 STORMWATER CONTROL IN WORKING AREAS

9.3.1 CONVEYOR PLATFORM

Temporary berms or ·V' drains will be constructed in order to prevent concentrations of stormwater on the advancing surface areas of the Dump and subsequent erosion of the Ash Dump both on the completed dump areas and at the shiftable conveyor platform.

9.3.2 SPREADER / STACKER WORKING AREA

Temporary berms or 'V- drains' shall be constructed in order to prevent concentrations of runoff and subsequent erosion in the spreader and stacker working areas as well as the areas on which the machines will be required to operate in the near future.

10 ONGOING CIVIL WORKS

10.1 ANCHOR PLATES TO CONVEYORS

Anchor plates are required to stabilise / anchor the end points of the shiftable and extendible conveyors. Two types of anchorage mechanisms were used. Initially, a cylindrical block was used. This system was changed to the preferable steel anchor plate, which is still in use.

10.2 DESILTING OF STORMWATER

Stormwater Dams are provided to prevent dirty water from flowing into the natural water courses. Water flowing from the Dump during storms is collected in the Dams and the silt is allowed to settle out. Prior to the water reaching the dams, the water is routed through a silt trap which allows for the silt to settle. The new dams have new silt traps that are to be constructed, that have been designed in a manner that allow a very limited amount of silt to enter the dams.
The water in the dams is used for dust suppression or left to evaporate, leaving any silt behind. In the older dams, the level of the silt gradually rises with each subsequent storm and the capacity of the pond therefore decreases. After each rainy season, the invert level of the dam must be surveyed and when the maximum volume of the dam is reduced by 25 %, the silt must be removed from the pond.
The recovered silt should be removed from the dams/silt traps and deposited in the present working area on the Ash Dump.

When the silt is still wet access may prove difficult and it is suggested that for that reason the ponds be drained during the winter; the ash allowed to dry out and the dams desilted before the following rainy season.
It may not be necessary to clean out the containment areas or small berms in front of the advancing ash face, unless they are full and the ash is spilling into the environment, as they

will be ashed over during the construction operations of the Ash Dump. It may be easier and cheaper to construct new berms instead of cleaning the old berms. This should be considered at the time.

10.3 CLEANING OF THE ASH TRANSFER HOUSES

The cleaning of transfer houses will be done by the Power Station cleaning contractor.

10.4 EXTENSIONS, ADDITIONS AND MODIFICATIONS TO DRAINAGE TRENCHES/BERMS.

Additions and modifications will be required to the existing clean and dirty water drainage systems as the Dump development progresses.

10.4.1 CONCRETE LINED CANAL

The concrete lined canals will need to be extended in phases along the Western (in time becoming the southern) and western toes of the Dump. At present, the concrete lined canals carry stormwater which discharges into the Stormwater Dam on the north-eastern and south-eastern corner of the Ash Dump complex. The canal can be extended in phases as the Dump develops past the south eastern Dam until it crosses the next watershed.

It will not be necessary to extend the dirty water canal on the western side of the Dump, as the Dump will be developed radially. A dirty water canal must be constructed for each of the developing phases.

As rehabilitation of the Dump takes place, an ever- increasing proportion of the water carried in the toe canal will be 'clean'. The 'clean' water will not pose any major pollution threat. It is therefore sensible to allow this 'clean' water to flow into a 'clean' Water Dam. This means that after a certain time, the dirty Water Dam will become a 'clean' Water Dam. Matsimoholo and the south east dams will be the first to undergo the conversion.

Extensions to the canals and the construction of dams will be done in economical contract packages as the Dump progresses. During each contract, sufficient length of canal to allow the water to drain into a dirty Water Dam should be constructed, so that it is capable of providing drainage for at least a further 3 to 5 years of ashing operations.

On the western side of the Dump, a solution trench leading to a decant system must be constructed to prevent clean water flowing in the 'veld', from being mixed with the Ash Dump runoff. The detail of this is as per the detailed design report for each phase.

10.4.2 STORMWATER CONTROL

A dirty water separation berm is required to be constructed at the end of each phase, which will form part of the clean water decant system required between the clean and the dirty water. The decant will separate the clean water from the dirty water and convey the clean water away from the ash dump facility.

10.5 TOPSOIL STRIPPING AND PLACING

This is an ongoing operation and must be carried out in accordance with section 13.6. Topsoil stripping is to be done every 4 years with the construction of the liner.

10.6 EROSION CONTROL

Various measures to combat erosion have been discussed in section 9. These measures must be adhered to and any eroded areas of the Dump must be rectified as soon as possible to prevent pollution problems occurring and for the safety of the horticultural workers on the Dump. The gullies can become overgrown and hidden from view posing a danger to the workers. The existence of erosion gullies should be noted during technical inspections and should be timeously repaired and maintained.

10.7 ACCESS RODS AND RAMPS

Access roads and ramps must be constructed and extended as and when necessary. This work must be planned well in advance since the roads and ramps must be in place and operational by the time they are required.

10.7.1 PERMANENT ROADS AND RAMPS

An access road from the P1675 road to the Ash Dump complex and site offices has been provided. Access roads around the Ash Dump from the site offices have also been provided. One road runs in a westerly direction, along the northern toe of the Ash Dump, to give access to the extendible conveyor platform and working areas on the Dump from the west and to the sub-station and Transfer House 6. The other road runs along the eastern toe of the Dump and will be extended to ultimately give access around the completed Ash Dump.

All extensions to the roads will be done in economical contract packages, as the Dump progresses. These extensions will probably be done at the same time as the extensions to the canal and Dam. The design of the new access roads and drainage will be done by the Civil and Building Division as and when necessary.

10.7.2 TEMPORARY ROADS AND RAMPS ON THE DUMP

Temporary ramps and roads must be constructed to give access onto the working platform of the Dump as it progresses. Access is required for construction machinery, operating and maintenance teams and personnel, topsoiling and rehabilitation operations and Dump supervisors. These roads shall be well maintained and regularly dust suppressed (with water).

Access ramps required to carry out the above are to be positioned as shown on the Dump drawings or as agreed with the Civil Designer responsible for the technical assistance on the Ash Dump complex. All drainage facilities necessary to prevent erosion must be provided when the road is constructed. Monitoring and maintenance of the roads must be ongoing and recorded. See Section 14.1 for maintenance checklists.

10.8 ADVANCING ASH FACE

The advancing ash face will be susceptible to erosion caused by water from leaking pipes, excessive dust suppression operations and by stormwater. This situation must be monitored closely and any gullies which may be forming must be filled with ash as soon as possible to avoid any negative effects on the stability of the advancing ash face.

The Ash Dump should be constructed in such a manner that stormwater runoff will flow away from the face in 'v-drains' or berms and taken off the Dump in a controlled manner. An erosion gully would only be formed where water is allowed to concentrate and then flow over the crest of the Dump. The area surrounding the re-filled gullies must be regraded and built up to the correct levels to prevent a recurrence of the same problem.

10.9 ADVANCING ASH FACE

All facilities must be maintained in the condition in which they were received. Outlined below are areas where ongoing maintenance is required.

10.9.1 IRRIGATION POND

Long grass promotes rodent life which in turn can damage the H.D.P.E. lining. The H.D.P.E. lining can also be damaged by fire. It is therefore important that the grass be kept short and mowed at regular intervals. Grass growing within 1m of the H.D.P.E. lining should be poisoned and removed.

Bare patches are to be re-seeded and erosion gullies repaired and grassed. The irrigation pond overflow/spillway canal must be kept open and free from vegetation that will impair the flow of water.
The safety rope in the irrigation pond is to be checked and replaced as and when necessary.
It is very important that no contaminated water or sludge be deposited in this Dam.

10.9.2 STORMWATER DAMS

These must be desilted as and when necessary in accordance with Section 10.2 of this document.
Any tree or bush growing on the earth embankment, inside or outside the Dam, must be poisoned and removed as soon as possible, as these could be the cause of a piping failure of the Dam.

10.9.3 CONCRETE LINED CANAL

The concrete lined canals along the north, west and east toes of the Dump must be cleaned or desilted as and when necessary. If the concrete panels are damaged during the cleaning operations, these panel must be repaired as soon as possible. Joints between the panels of the concrete canals must be re-sealed as and when necessary.

10.9.4 ENERGY DISSIPATING STRUCTURES

The purpose of these structures is to reduce the velocity of water flowing down the extendible conveyor ramp in order to allow the fast flowing water to change direction and flow into the canal at the bottom of the extendible conveyor ramp. Water will then flow from this point at much slower velocities. This will probably result in the silt settling in the dissipating structure and a joining toe trench. This will therefore, require periodic cleaning to maintain their efficiency.

10.9.5 OFFICE AND WORKSHOPS

The offices and workshops will be made available to the Ash Dump construction personnel and must be maintained in good order and kept clean at all times. All statutory regulations must be adhered to at all times.
The Ash Dump construction personnel must ensure that all the workshop silt, grit and oil traps, french drains and other facilities provided at the site offices and the workshops are kept clean and are well maintained.

11 ENVIRONMENTAL PROCEDURES

11.1 SCOPE

This section contains the procedures that relate to the following aspects: Environmental Responsibilities including:

i. Air Quality Management, specifically the prevention and control of windblown ash and soil dust.
ii. Water Quality Management (Surface and groundwater).
iii. Waste Management.
iv. Land Management.
v. Communication (with neighbouring landowners) (For environmental responsibilities, see chapter 12.)

Ash Rehabilitation includes:

- Topsoil stripping & rehabilitation of the resulting borrow pits.
- Topsoil spreading and soil preparation.

- The application of fertilizers.
- Planting Procedure.
- Irrigation.
- Maintenance.
- (For rehabilitation information, see chapter 13.)

11.2 GOALS

Long term considerations should be borne in mind throughout the operational life of the Ash Dump. The following items can be regarded as long term goals:

- All forms of pollution, including the pollution of natural water resources (rivers, dams, pans, vlei's, and groundwater), soil and air pollution due to ash dust entrainment (blown off surfaces), must be contained and minimized.

- The site must be viable for other land uses after ashing and the completion of rehabilitation. The area must therefore, be accessible and rehabilitated to such an extent that it can sustainable, without intensive maintenance, for future plant growth. The likely future land uses at the Matimba ash areas are grazing or veld conservation.

- The Ash Dump must blend into the environment, and for this reason every effort must be made to limit its potential negative visual impact. Final grading of the top surface and side slopes should be such that grades are preferably irregular rather than regular. Stormwater management must, however, not be compromised in the process.

- In accordance with the above, the Ash Dump must be rehabilitated progressively. Areas prepared for rehabilitation must be rehabilitated immediately. Plant cover must be dense enough to effectively control the dust from being blown from rehabilitated areas. Plant cover must be stable and able to withstand heavy rains without slipping or eroding. All trees, shrubs and grasses used must be indigenous to the area.

11.3 PROGRESS MANUAL

A progress manual must be compiled that lays out a month by month schedule on the rehabilitation measures and other environmental procedures needed to meet the closure specification.
A record of groundwater monitoring results taken from the boreholes, along with a log of the results of dust and wind pollution samples, must be kept.

12 ENVIRONMENTAL RESPONSIBILITY

12.1 WATER QUALITY MANAGEMENT

A ground water monitoring programme has been established and must be continued for the life cycle of the Ash Dump. Monitoring must be done in accordance with the monitoring system as designed by Hodgson, 1987.
Routine monitoring of the groundwater must be conducted in order to monitor any change in the groundwater quality. Any significant changes with regards to the change in the groundwater quality could indicate a breach in the liner system of the facility.

The report “Matimba Power station routine monitoring phase 73” by GHT Consulting services indicates the details with regards to the monitoring/inspection of the entire facility.

Based on the information obtained from the drilling programme and information of ash chemistry from other power stations, the following can be concluded in terms of the potential pollution hazard from dry ash disposal:

- The main elements which can normally leach from the ash are calcium and sulphate. Some trace elements may also be present, but the alkaline environment of the ash water decreases the solubility of the heavy metals in general.
- A portion of the surface runoff from the ash face will infiltrate to depths between 2 to 14m, where weathering of the Waterberg Sediments ceases. Once this water reaches the solid rock, it will move laterally until it reaches a fissure. The water will then flow into the aquifer, which is likely to be at approximately 25 meters below surface in this area. This source of pollution will be small because of the low rainfall and the high evapotranspiration potential of this area. Once the ash disposal has begun, the contribution of pollution by the ash front can be studied by placing monitoring devices ahead of the Dump.

As part of the operations, additional boreholes are to be drilled with each phase extension of the facility.

12.1.1 SURFACE WATER QUALITY

Ash from the Matimba Power Station will be regarded as being of the dry type. This ash typically contains between 10 to 30 % moisture at the point of disposal. The ash is sufficiently dry to be handled by conveyor. As the Ash Dump grows in size, it will be covered with topsoil and then be rehabilitated with indigenous vegetation. From a pollution point of view, the only ash which will be exposed to direct rainfall will be on the advancing face of the Ash Dump. No provision has been made for interception of the surface runoff immediately ahead of the Dump. Water from the face will typically have a pH of around 11, 25 and contain a high percentage of calcium and sulphate. The calcium will precipitate from the water in the presence of carbon dioxide when exposed to air.

A concrete lined toe canal has been constructed to the north, west and east of the Ash Dump to convey stormwater runoff from the rehabilitated portion of the Dump into a Stormwater Dam. This canal will be extended as the Ash Dump grows in size and eventually it will encircle the Dump.

Containment of all polluted (dirty) runoff water is essential to prevent any pollution of natural water bodies such as streams, vlei's etc. Polluted water includes runoff water from unrehabilitated areas, and any other polluted water from sources such as the station Dirty Water Dam which may be used for dust suppression purposes.

Unpolluted storm water runoff from vegetated areas must be controlled to prevent erosion occurring and be allowed to join the natural drainage system of the surrounding area. Clean stormwater flowing down to the toe on the western side of the Dump must be channelled, via a berm/ canal, into the old quarry at the north western corner of the Ash Dump Complex. Clean water in the Ash dump extension area will be decanted through the clean water decant diversion system. The quality of the water allowed to discharge into the natural water course(s) must be monitored regularly.

The Ash Dump is considered to be a 'disturbed area'. Any stormwater flowing from this area must be contained in the Stormwater Dams and must be monitored regularly for any increase in its chemical content. This water is to be used for dust suppression and irrigation of the Ash Dump and may not be released directly into the environment.

The stormwater management procedure to be followed is described in detail in Chapter 9 of this manual.

The cleaning up of natural streams, vlei's, etc. which have been polluted by ash must be carried out immediately to avoid potential claims or costs resulting from this pollution.

12.1.2 GROUND WATER QUALITY

Polluted surface water must be controlled to prevent it from seeping into the ground and reaching the groundwater resources resulting into these water sources becoming polluted. To this end it is essential that the Dump be contoured so that no ponding of water occurs on top of the ash dump.
The possibility of rainfall penetrating through the rehabilitated portion of the Ash Dump will depend largely on the success of the revegetation programme.
A programme must be established and maintained to monitor any changes or trends in the quality of the groundwater in the vicinity of the Ash Dump.
See chapter 16 for a summary of the legal requirements pertaining to water pollution due to the disposal of ash.

12.2 AIR QUALITY MANAGEMENT

The primary concern in this section is the suppression of ash dust preventing the entrainment of this type of dust. However, any other form of air pollution, notably the entrainment of soil dust is also to be managed.
The health effects of fly ash on the human body are still under study in South Africa and there is still controversy as to whether Power Station ash (in general) represents a serious health risk or not. Hopefully, the study will reveal such information as well as values for new exposure limits for fly ash, specifically.
The existing guidelines being followed are those for the exposure limit of fly ash as recommended by the American Conference for Government Industrial
Hygienists which is a time weighted average exposure of 10 1Jg.m·3 (ACGIH 1991).
Air quality should be monitored in the area using dust monitors. Any excessive dust entrainment occurrence must be recorded and measured. In this way the effectiveness of the dust suppression systems can be monitored.

12.2.1 DUST SUPPRESSION PHILOSOPHY

The problem of dust suppression on the Dry Ash Dump at Matimba Power Station was investigated on behalf of Power Station management (Ref 5). Areas of concern were the backstack operating areas before rehabilitation, the advancing face of the backstack as well as the frontstack platform area, and the advancing face that all produced ash dust when the wind blew. Areas to be addressed with the ash dump development include the deposition on the existing facility as well as the Ash dump extension.
In general, ash dust must be continuously controlled to prevent it from becoming airborne. This applies to all the stages of ash handling. Ash dust pollution must not exceed the legal requirements as set out under the Atmospheric Pollution Prevention Act, No 45 of 1965, especially Part IV, Sections 27 to 35. Note that if blown dust causes a nuisance or damage to neighbours of a Power Station, they are entitled to institute a civil case against the Station. See chapter 16 for a summary of the legal requirements pertaining to air pollution due to the disposal of ash.
The method of dust suppression will depend on the availability of water and is integral with the water balance philosophy of the Power Station. Therefore a flexible dust suppression operation needs to be determined taking cognizance of the various alternative methods available. Irrespective of the dust suppression system employed, it must be preventative rather than reactive. In other words, dust suppression must be continuous and not only used when the wind is blowing.
Every effort must be made to ensure that the ash is conditioned to the correct moisture content. This will greatly reduce the problem of dust pollution at the Dump.
The size of the area to be dust suppressed; plant and labour availability; period of dust suppression; access requirements to the area; risk of damage, and water availability all affect the decision in the use of water, dust suppression chemicals or soil spreading methods for a particular situation.

The areas of exposed ash on the Ash Dump can be divided into distinct operating areas, each area having different dust suppression requirements and possible dust suppression methods. These are as follows:

Existing and the extension of the facility:

- Working area (presently ashing).
- Top surface- flat or sloped surfaces (ashing operation complete, surfaces levelled and compacted before shifting or rehabilitation).
- Completed advancing slope faces (natural angle of repose slopes).

Roads:

- Access roads to Dump.
- Access roads on Dump.

It is important to note that the control of dust on a dry ash dump requires a management commitment to protect the health of the personnel working on the Ash Dump from the dust on the Dump and to protect both the environment and Eskom's image in the public eye from dust blowing off the Dump. The techniques for controlling the ash dust are available and work very effectively but, as dust suppression seems to be only a costly overhead and it is sometimes difficult for everyone to see a return on the effort spent, a constant effort from management is therefore required to ensure that a high standard of dust suppression is maintained. Dust suppression is a preventative measure and is most cost effective when done before the winds start to blow and lift the ash. Dust suppression must therefore be done on a regular basis as part of normal operating procedures to achieve optimal results. The following is a summary of the methods of dust suppression suggested for the various operating areas:

i. Existing and Extension of facility

a. Current Ashing Area (Normal Working Conditions):
   - Ensure that the ash is conditioned to the correct moisture content. Spray with water when necessary. (stacker boom sprayer I water cart I sprinkler system I water cannon).

b. Current Ashing Area (during periods of standing due to breakdown or maintenance):
   Spray water (stacker boom sprayer I sprinkler system I water cannon I water cart).

c. Top surface prior to levelling and compaction. or water spray (sprinkler system / water cannon / water cart).

d. Top surface after levelling and compaction.
   50 mm sacrificial sand layer.
   Spray water (sprinkler system I water cannon I water cart).

e. Completed advancing faces (natural angle of repose slopes).
   Spray with water (water cart I ski sprayers I water cannons). Unless otherwise stipulated, the following shall apply.

Water to be applied periodically depending upon the prevailing weather conditions.

Water spray for minimum periods of 4 hours is generally required before the sprayer is moved or a chemical crust can be formed by spraying chemicals, which are mixed in water, with a water cart, a water cannon or by utilizing the sprinkler system.

ii. Roads (General)

- Spray with water regularly depending on the traffic load.

iii. Roads (Ash Dump Access Roads).

- Water regularly depending on the traffic load.

iv. Access roads (On the Ash Dump).

- These roads are to be constructed by the Ash Dump Contractor for his use and is therefore his responsibility.

Eskom maintenance teams will also make use of the road from time to time).

- Water regularly depending on the traffic load.
- Apply a layer of good gravel material on damaged surfaces and fill in potholes as soon as possible.

For more information on dust suppression at Matimba Power Station's Ash Dump refer to the report by A Kreuiter 1991. Ref 5. The detailed design report for the Ash dump also indicates the Dust Suppression to be implemented for the development of the facility.

12.2.2 SOIL DUST POLLUTION

Construction plant access routes, haul roads and/or any other bare soil areas or areas from where dust may be generated, must be sufficiently watered to prevent dust entrainment.

12.3 WASTE MANAGEMENT

12.3.1 MIXING OF TOXIC WASTE

The mixing of toxic waste or any waste other than coal ash with the material being placed on the Dump must not be permitted.

12.3.2 FENCING OF THE ASH DUMP COMPLEX

The Ash Dump Area should be clearly marked to prevent access to unauthorized persons. Appropriate signs indicating the presence of the Ash Dump and its safety risk must be displayed. Warning signs must be maintained to required standards.

12.3.3 LITTER

The Ash Dump must be kept clear of litter or any other waste at all times.

12.4 LAND MANAGEMENT

12.4.1 VELD FIRES AND VELD MANAGEMENT

Steps necessary to control veld fires and a veld fire management plan must be prepared and communicated to personnel working on the Dump.

12.4.2 CONTROL OF UNWANTED PLANT GROWTH

Alien or invasive plants must be controlled. Where removal of these plants is deemed necessary, this must be cleared with a horticultural authority prior to action being taken.
Removal of these plants is only necessary if the alien or invasive plants are spreading to the rehabilitated areas or surrounding land.
Any herbicide used must be approved by an appropriate authority in writing prior to its use: The product(s) must be registered for the specific use(s).

12.4.3 EROSION CONTROL

The protection of all areas subject to erosion is a priority. This can be done by providing temporary or permanent drainage works. Refer also to the general stormwater management procedures. (Chapter 9)
Any erosion damage occurring during the operation of the facility must be repaired and the areas restored to their original condition. Such repair work must be carried out as soon as possible after damage has occurred. All eroded topsoil must be reclaimed from drains or other areas, where possible.

Regular maintenance of all stormwater canals, trenches etc. is necessary to ensure that they will function effectively at all times.
Ongoing monitoring for blockages and erosion is essential and must be done regularly.

12.4.4 DISTURBANCE OF LAND

Construction areas must be limited to the minimum practical area to carry out the ashing operation and rehabilitation of the Dump. These areas must be clearly defined and demarcated. Vehicular movement must be restricted to the cleared areas or recognized roads only.

12.4.5 DESTRUCTION OF WILDLIFE

All reasonable steps need to be taken to prevent injury or death to existing wildlife within or along the site boundaries. This shall include the monitoring of the area for snares, traps etc. on a monthly basis (especially along fence lines).

12.5 ENVIRONMENTAL COMMUNICATION

The environmental procedures outlined in this Operating Manual must be communicated to all personnel involved with the ashing procedure.
It is also imperative that the Station maintains contact with the neighbouring landowners. The Power Station Environmental Committee would be responsible for all aspects of Environmental Communication.

13 ASH DUMP REHABILITATION PROCEDURE

13.1 INTRODUCTION

The current long term aim for the rehabilitation of the Ash Disposal Facility is to establish vegetation on it that will blend with that of the surrounding indigenous veld.

A long term landscape development plan should be drawn up for the farm Zwartwater, and in particular for the Ash Disposal Facility, to ensure continuity in the development thereof.

It is important that ashed areas that become available for top soiling and rehabilitation must be fully top soiled and rehabilitated as soon as possible. This will help to prevent dust generation and/or the erosion of the final Ash Dump surface or of the recently placed topsoil.

The rehabilitation of the Ash Disposal Facility is to include the following:

- site preparation i.e final shaping of the Dump before top soiling
- bush clearance
- stripping of topsoil
- placing and spreading of topsoil
- construction of stormwater control berms
- scarification
- fertilizing
- seeding
- transplanting of existing and new trees and shrubs
- irrigation
- Maintenance

Top soiling of the Ash Dump is to be done by the Ash Dump contractor as part of his contract. A grid of test holes dug by hand should be done to verify the depth of topsoil is a minimum of 300mm.

13.2 MATERIALS

13.2.1 CHEMICALS

All chemicals (agricultural remedies) must be selected, stored, issued and applied in terms of the relevant legislation applicable to agricultural remedies viz. Act 26 of 1947 and Act 15 of 1973.

13.2.2 HERBICIDES

Herbicides shall comply, as relevant, with the requirements of CKS 362, 415, 428, 430, 514, 537, 546, 550, 572 and 578.

13.2.3 INORGANIC FERTILIZERS

The type of fertilizer to be used should be one or more of the following and any other approved fertilizing material that may be specified. All fertilizers must be correctly stored in sealed bags where applicable and protected from the elements.

i. Superphosphate 10,5% P
ii. Potassium phosphate
iii. Limestone Ammonium sulphate 26% N
iv. 4:3:4 (30) + Zn
v. 2:3:2

All inorganic fertilizers must be fully commercial and will be packed in standard containers which carry the name of the manufacturer and product.

13.2.4 ORGANIC FERTILIZERS

i. Compost

Compost must be well matured, friable organic matter and free from weed seed, soil or foreign materials. Spent mushroom compost complying with these requirements is acceptable.

ii. Manure

Manure must be well matured kraal manure free from soil, weed-seed or other foreign material.

iii. Bone Meal

Bone meal must be finely ground with a minimum content of 4 % Nitrogen and 20 % Phosphate

13.2.5 SEED MIXTURES

Only fresh seed must be used, of the type specified. Purity of any seed specified must be not less than 70 %with a minimum germination capacity of 60 %.
Grass seed mixtures must be as specified and must be mixed on site.

13.2.6 GRASS SODS

Grass sods must be harvested, delivered, planted and watered within 36 hours. Sods must be free from undesirable plant material and diseases and must be of the variety of grass specified. Sods must be kept continuously moist.

i. Nursery grown sods

The grass should be grown specifically for sod purposes, mowed regularly and maintained to provide a dense, uniform sod. Sods shall be harvested by giving at least 30 mm thickness of moist soil and must be at least 0.5 m in area.

13.2.7 VELD GRASS MULCH

If specified or required at any stage, the veld grass of surrounding areas can be cut and used as a mulching material. Care must be taken not to permanently damage these areas except for removing the top growth by hand or by suitable mechanical means.
In general, veld grass should be harvested during the dormant season after seed has set.

13.2.8 PURCHASED PLANTS

Plants shall at all times be healthy, balanced in form and well established. Containerized plants must not be rootbound. Plants must grow well and be free from scars or damage, insect pests, diseases or parasites.
Each plant must be handled, packed and transported in the accepted industry manner for that species or variety and all necessary precautions must be taken to ensure that the plants arrive at the site in an acceptable condition for successful growth.
During delivery to the site, plants must be adequately protected from damage by sun, wind or other damaging conditions.

13.2.8.1 CONTAINERIZED PLANTS

Containers must be in good condition and the soil free from weeds.
Containerized plants not planted out immediately shall be stored and maintained in nursery like conditions until they are planted out.

13.2.9 TREE STAKES

Tree stakes must be treated poles (round droppers) complying with SASS 457,
35 mm minimum diameter and 2 400 mm long. These must be used for both single and multiple staking. Creosoted timber must NOT be used.

13.2.10 TREE TIES

Tree ties for fixing trees to stakes should be of plastic, rubber or other similar material which supports the tree in a firm manner. Ties must be designed to minimize abrasion and to allow for sufficient space around the tree trunk to permit growth.

13.3 MECHANICAL PLANT

13.3.1 GENERAL

Machinery which is to operate over grassed areas must be fitted with suitable low pressure tyres to limit the depth of tracking and the amount of compaction of the soil.

13.3.2 SEEDING

Where seeding is done by mechanical means e.g. hydro-seeding, the capabilities of the machine used must be proven prior to its use on the Ash Dump.

13.4 STRIPPING OF TOP SOIL

Topsoil is to be stripped ahead of the advancing face of the Ash Dump for each lined phase of the ash dump extension. Trees that are suitable for transplanting to rehabilitated areas should have been moved prior to the stripping of topsoil. The stripping and spreading of topsoil for rehabilitation purposes should be coordinated to minimize the need for stockpiling of the stripped topsoil. Soil types that are indicated as being unsuitable for topsoil purposes should not be stripped, while suitable soil types should be stripped to its full usable depth or to a maximum depth. A grid of test holes dug by hand should be done in order to verify the depth of topsoil is a minimum of 300mm.
No topsoil is to be removed from areas outside the ashing footprint, especially from areas that are not to be ashed over. Drawing 301-00825/01-102 indicates the depth of the topsoil to be stripped for each phase.

13.5 CONSTRUCTION OF CLEAN WATER DECANT SYSTEM

The main stormwater berm for each phase marks the end of the area for the phase. The stormwater decant system of each phase comprises of the decant system for the clean

water, a clean water berm, which is then separated by the road and the main stormwater berm for the dirty water separation. The detailed design report and drawings indicate the position of the decant as well as the details of the section. The system has been designed to make sure that no contamination of the clean water takes place and the clean water is diverted away from the facility.

13.6 FERTILIZING

The fertilizing programme is based upon the recommendations of Hannse,1984. Soils tests indicated general shortages of calcium and phosphorous.

The recommended fertilizing programme is as follows:

- 1000 kg/ha calcitic lime
- 700 kg/ha Superphosphate
- 250 kg/ha 4:3:4 (30) + Zn

Fertilizer should be applied during dry weather and must be mixed into the soil within 12 hours of application. The lime should be incorporated during soil spreading to ensure thorough mixing with the soil.

The application of fertilizers should be made not more than one week prior to seeding or planting.

It is important to note that the mixing of inorganic fertilizers and seed is not a good practice and should not be allowed.

13.7 SEEDING

Seeding should take place as early as possible during the growing season. Seeding should, however, not commence prior to 15 September and not later than the end of December. Under exceptional circumstances, depending upon the prevailing climatic conditions, the sowing time can be extended to the end of February. Indigenous tree and shrub seeds can and should be incorporated with the veld grass seed mixture. The seeds should be suitably pretreated.

The seed mixture currently used (shown below) can continue, or if the results obtained are unsatisfactory, Eskom Technical Research and Investigations may be approached to propose another seed mixture. The aim is to establish a veld grass type similar to that of the surrounding natural veld grass in the area.

- Anthephora pubescens ("Borseltjie")
- Cenchris ciliaris ("Bioubuffel")
- Chloris gyana (Rhodes)
- Cynodon dactylon ("Kweek")
- Enneapogon cenchroides ("Suurgras")
- Eragrotis teff (Teff)

The seed application rate is approximately 16 kg of seed mixture/ha.

Seed sowing must commence directly after the soil preparation, and before the loosened soil is compacted again. The area to be sown must be uniformly damp, but not water logged, to at least 100 mm prior to seeding.

The seeding method may be hand casting, fluid drilling or any other method that will produce the desired germination rate and acceptable cover.

13.8 PLANTING OF SEEDS AND SHRUBS

13.8.1 CONTAINERIZED PLANTS

Plants are to be indigenous to the area and the number of trees planted per hectare should be on average at least two thirds that of the adjacent undisturbed veld areas. Plants should be planted in a manner so as to resemble natural clumps. The plant material quality should be as specified in clause 13.2.8.

Plants should generally be at least 1.5 m high and smaller plants should be suitably protected against damage from animals or other causes.

Recommended plant species are: Tree Species

- Acacia albida
- Acacia burkel
- Acacia caffra
- Acacia erubescens
- Acacia galpinii
- Acacia karroo
- Acacia nigrescens
- Acacia robusta
- Acacia sieberana "Woodii"
- Acacia tortilis
- Albizia versicolor
- Brachylaena rotundata
- Buddleia saligna
- Cassine transvaalensis
- Celtis africana
- Combretum apiculatum
- Combretum erythrophyllum
- Combretum hereroense
- Combretum molle
- Dias cotinifolia
- Dombeya rotundifolia
- Erythrina lysistetnon
- Euclea crispa
- Halleria lucida
- Kiggelaria africana
- Kirkia wilmsii
- Olea europaea subsp. africana
- Pterocarpus rotundifolius
- Rhus dentata
- Rhus lancea
- Rims leptodictya
- Sclerocarya caffra
- Terminan sericea
- Virgilia oroboides
- Ziziphus mucronate

Shrubs species

- Bauhinia galpinii
- Buddleia auriculata
- Buddleia salvifolia
- Diospyros lycoides

- Diospyros mespiliformis
- Grewia flava
- Mundulea sericea .
- Rhamnus prinoides
- Rhus pyroides
- Rothmania capensis

Excavated holes for planting should be square in plan. The edges of the holes shall be roughened to ensure future root penetration into the ash from the hole. Round holes prevent the roots leaving the hole and are not acceptable.

The dimensions of the holes for planting should be as follows:

- Smaller plants should have holes that are at least twice the size of the particular plants container.

Incorporate compost at the rate of at least 1:1 with the backfill soil and ensure that the backfill is lightly foot compacted. Provide a round depression of a minimum diameter of 300 mm or equal to the width of the hole, whichever is greater, by approximately 75 mm deep around each plant.

Plants brought out of storage for planting should be well watered before removal and be brought out at a rate commensurate with the planting programme. The plants should be protected from drying out and planted on the same day.

Polythene or other non perishable containers must be carefully removed immediately before planting with as little disturbance as possible to the root ball, and any damaged roots carefully pruned.

i. Staking

Trees should be supported and protected by means of a stake, or stake system of the materials as specified in 13.2.10.

Placing of stakes, backfilling, compacting and tree planting must be done in one operation.

ii. Tying

Each tree must be firmly secured to the stake or system of staking at two points, at least, to prevent excessive movement. Tying should be in accordance with the accepted method used in the local climatic conditions.

13.8.2 EX-OPEN GROUND PLANTS

Refer to section 13.4 for details regarding the transplanting of indigenous plants growing within the proposed area for the Ash Facility.

13.9 IRRIGATION

Irrigation of seeded areas should be limited to 6 mm per day for the first six weeks following planting. Care must be taken to ensure that excessive watering does not occur, to prevent erosion. Thereafter no irrigation will be required in order to adapt the established vegetation to survive under natural growing conditions. However, during exceptionally dry spells, the plantings should be kept alive to prevent a total loss of all established vegetation.

Trees and shrubs should be irrigated manually or using an irrigation system within 2 hours of planting, each plant receiving at least 50 litres. Thereafter the

plants should be watered at least weekly during the first growing season or until fully established.

Where Power Station dirty water or other polluted water sources are used for irrigation purposes, the following water quality standards in Table: 13.12 should not be exceeded.

13.10 AFTER PLANTING CARE

Newly seeded/planted areas should be protected against undue traffic and/or other disturbances throughout the establishment period but especially during the first two growing seasons so as to achieve settlement of plants and acceptable grass cover.

13.11 MAINTENANCE

Maintenance should include:

- Continual repair of damage caused by erosion or any other cause. Erosion gullies exceeding 100 mm in width may be repaired by placing Cynodon spp. sods or clumps in the forming gullies to effectively stop them from developing. Place sods/clumps in green vegetable bags together with soil and tread or push it down into the gully. Any other method may also be used provided that it proves to be effective.
- Upkeep of acceptable grass cover with reseeding I sodding as necessary.
- Additional tree/shrub planting as may be required.

Maintenance is, (in addition to the environmental responsibilities,) described elsewhere in the operations manual.

14 MAINTENANCE PROCEDURES

Regular maintenance must be carried out throughout the Ash Dump to maintain full and cost effective use of the Facility.

14.1 CHECKLIST

Various aspects of the Ash Dump Facility must be checked on a regular basis to ascertain whether the Dump is being built to specification and if any remedial works are necessary. Such checking must be marked up on a checklist so that variances can easily be spotted. Appendix C is an example of a checklist. Any additional items may be added to the checklist as they become apparent.

14.2 MAINTENANCE REQUIREMENTS

It is no use carrying out and making records of these checks if immediate remedial action is not taken to rectify the problems. The maintenance cost over the life of the Ash Dump could be very high and therefore any remedial work should be well planned and cost effective. The advantages of a cheap, short life span remedy should always be weighed against the advantages of a more expensive but durable solution.

15 DAMS

15.1 OVERVIEW

All potentially contaminated water on the Matimba Power Station is managed in a closed system. Currently there are 3 dams namely, North dam(dam1), South dam (Dam 2) and

Metsemaholo which was recently constructed. The position of these dams are shown on the General arrangement drawings, Drawing number 301-00825/01-101

There are two new dams that are to be constructed as part of the Ash dump extension. These dams are referred to as the south water dam (SWD) and the North water dam (NWD). The detailed Design Report 301-00825/01 Rev 0 of September 2019 sets out the detail design of the dams to be constructed.

15.2 CONSTRUCTION

The SWD and the NWD construction is to comply with the terms of SANS 1200 DE, Standard Specifications for Small Dams.

To assist in reducing the amount of water at the SWD construction site, the groundwater cut-off drain and stormwater channel should be constructed first. Construction of the SWD will ideally occur during the dry winter months.

It is recommended that after clearing and grubbing the area, the top 300 mm of material should be stripped and carted to stockpile for future rehabilitation purposes. The basin areas can then be excavated, followed by fill placement to the impounding embankments.

The basin area, onto which the liner system is to be installed, should be prepared next by trimming all slopes to those specified, followed by the installation of the groundwater drainage collection system. The sub-grade preparation for liner installation is to be finalised and the various layers of liner installed.

The inlet and outlet pipes for the drainage collection and leakage detection systems should be installed before fill placement, as these will be trenched into natural ground.

Particular care is necessary for placement of the compacted fill around the buried inlet and outlet pipes. Concrete encasement to the pipes is provided in case of seepage from leakage water past the liner system.

The perimeter access road, barriers and fencing will be constructed last.

15.3 EARTHWORKS SPECIFICATIONS

The top 300 mm of in-situ material is to be stripped and carted to stockpile as this material is not suitable for wall building but could be used for rehabilitation purposes later on.

The newly exposed surface is to be ripped to 300 mm deep and re-compacted to minimum 96% Std Proctor density.

Embankment construction will be in maximum 300 mm loose layers compacted to a minimum of 96% Std Proctor density at -1/+2% OMC using a sheep's foot compactor. Trials will be conducted to achieve optimum efficiency.

The sub-grade to be prepared for liner installation will be smooth and free from organic material or any loose angular particles which can damage the liner.

15.4 DAM SAFETY CLASSIFICATION

In terms of Section 117(c)(i) of the National Water Act, 1998, a dam with a storage capacity of more than 50,000 m3 and a vertical wall height exceeding 5.0 m is considered to be a dam with a safety risk. The SWD or the NWD do not fall within the definition of a dam subject to DWA dam safety regulations, as its wall height is less than 5 m. The SWD and the NWD are classified as Category 2 dams.

15.5 STORAGE CAPACITY

Government Notice Regulation 704 specifies that a dirty water system may not spill into a clean water system more than once in 50 years, and that 800 mm freeboard must be provided. The SWD AND NWD is designed to receive stormwater from the Ash dump, for use in the
power station process.
The storage capacity for the water dams are as per Table 15-1: Dam Capacities

Table 15-1: Dam Capacities

Dam	Maximum Capacity (m^3)	Maximum Area (m^2)
Current		
Ash Dam 1	29,500	14,400
Ash Dam 2	86,000	28,600
Metsimaholo Dam	342,000	88,600
Ash Dump Irrigation Dam	2,500	1,225
Extension		
North Return Water Dam	60,000	
South Return Water Dam	80,000	

15.5.1 FUTURE CREST ELEVATIONS FOR DAM 2 PUMP STATION

Table 15-2: Future crest elevations – Dam 2 Pump Station

Description	Elevation (MAMSL)	Static Head (m)
Max Projected Crest Elevation of the Ash Dump (Max ramp section height)	960	88.5
Maximum Elevation of 1st 4 Years	915	43.5
Maximum Elevation of 2nd 4 Years	920	48.5
Maximum Elevation at Base Layer	930	58.5
Maximum Elevation at Closure	980	108.5

15.6 MAINTENANCE OF THE DAMS

15.6.1 MAINTENANCE OF THE DAMS

Each Dam compartment should be emptied at least twice a year for inspection and repairs to the liner system and other components within the dam basins.

The outside face of the dam should be kept clear of trees. Ant nests should be treated with an approved termicide such as Methyl bromide gas, removed and backfilled with compacted soil. Animal holes should also be opened up and backfilled as above.

Erosion of the embankment slopes should be repaired as soon as possible.
Any settlement of the dam crest must be made good by the addition of soil / road surfacing materials as shown on the drawings.

Ruptures or tears in the reservoir liner system must be repaired immediately by specialists experienced in this work. This also applies to the additional textured access strip provided for vehicle access to the basin floors.

15.6.2 SPILLWAYS

The overflow spillway channel must be kept free of any trash which may tend to block it. The spillway channel must be kept clean and free of all vegetation.

The energy dissipater at the bottom of the discharge chute must be kept clear of any sediment that may have accumulated in it. The drain pipes leading from the energy dissipater to the road side drain should also be cleaned out.

Any erosion of the ground downstream of the energy dissipater and alongside spillway channel should be monitored and, where necessary, be repaired as soon as possible. Dumped rockfill or gabions may be required to repair severe erosion.

15.6.3 DRAINAGE PIPES

The outlets to the leakage detector drains and seepage drains must be kept clean and free from clogging.

15.6.4 INLET / OUTLET WORKS

Any control valves should be opened and shut at least four times per year, lubricated and adjusted as necessary and seals or packing replaced, also as necessary. If it be necessary to remove any of the valves or pipework for repairs, it will be necessary to empty the reservoir compartment connected to that component.

The screen over the intake sump should be removed and cleaned regularly and maintained as required. This operation would normally be done each time the reservoir compartment is emptied.

15.6.5 WATER LEVEL MEASUREMENT

Maintenance of the water level instrumentation must be according to the manuals provided for this equipment.

15.6.6 SAFETY BOOMS

It is expected that the HDPE basin liners will be very slippery when wet and, as such, it will be impossible to climb out if one falls in. Therefore safety booms must be kept in good operating conditional at all times. Perished or damaged ropes or floats must be replaced immediately.

15.6.7 ACCESS

Roads to the dam must be maintained to ensure easy access at all times. The gravel wearing course must be re-graded or re-surfaced whenever it is eroded or worn down by weather or traffic. The road at the dam crest must always be maintained at or above the design crest level.

15.6.8 MAINTENANCE DOCUMENTATION

A maintenance register is to be kept by Eskom, and all maintenance actions recorded therein.

The register is to be kept in a records office where it can be found at any time by inspecting and operating personnel.

15.7 INSTRUMENTATION, MEASUREMENTS AND RECORDS

15.7.1 WATER LEVELS

Dam water levels are as recorded by the recorders in concrete recorder towers or by other means must be kept in the records office – either electronically or in log books.

Drainage

Seepage from the finger drain system and seepage cut-off drain must be measured and recorded at 3 monthly intervals and more frequently if unusual circumstances occur. A separate log of these recordings must be kept in the records office.

The leakage detection outlets must be inspected for any discharges concurrently with the seepage measurements. Any discharge from these must be reported immediately.

15.8 OPERATION OF THE DAMS

15.8.1 GENERAL

Dirty water is conveyed to the dams with an average inflow rate of 4249 m^3/m into the NWD and 7535 m^3/m. The water level in the reservoir must never be allowed to rise above FSL.

15.8.2 NORMAL OPERATION

The dams would be allowed to rise and fall simultaneously as water is supplied and / or used through the inlet / outlet pipes.

15.8.3 FREEBOARD

GN 704 stipulates that the minimum freeboard of dams that form part of a dirty water system shall be 0.8m above FSL. Consequently, the SWD spillway was designed for a total freeboard of 1.0 m taking into account the wave run up and the wave setup. The magnitudes of the freeboard components are summarised in Table 15-3.

Table 15-3: SWD freeboard components

Structure	Spillway Length (m)	Wave run – up (m)	Wave set up (m)	RDD (m)	MinimumRequired Freeboard (m)	Total Design Freeboard (m)
North RWD	20	0.4	0.12	0.2	0.80	1.0
South RWD	20	0.4	0.12	0.3	0.82	1.0

15.8.4 OPERATIONAL PROCEDURES

15.8.4.1 OPERATIONAL PROCEDURES – 5 YEAR EXEMPTION PERIOD

The operational procedures and pumping data for the 5-year exemption period scenario is described below. This includes the new Return Water Dams (RWD) that will be located to the north and south of the 5-year exemption period footprint.

Irrigation for Dust Suppression:
The dust suppression for irrigation requirements during the 5-year exemption period will be sourced from the existing Irrigation Dam Pump Station. The surface water runoff generated from the existing footprint will be captured and conveyed to the existing dams, the 5-year exemption period extension footprint will be captured in the new South RWD.

Ash Dump Existing Dam 1 and Existing Ash Dump Irrigation Dam:
The operational procedures and pumping data will remain the same as in the current existing scenario.

Ash Dump Existing Dam 2:
The operational procedures and pumping data will remain the same as in the current existing scenario.

Metsimaholo Dam:
The operational procedures and pumping data will remain the same as in the current existing scenario.

New South Return Water Dam:

- The Return Water Dam was sized as per GN704 i.e. the dam is not allowed to spill except during extreme flood events that are, on average, exceeded no more than once in 50 years. The RWD will receive runoff from the ash dump extension. The dams were modelled taking into account the dust suppression for irrigation demand as described above. The required dam capacity to meet this demand was found to be 80 000 m3 (a 15% allowance for silting has been included in the

capacity). Details regarding the sizing and design are described in Section **Error! Reference source not found.**.

- Pumping from the South Return Water Dam to Metsimaholo Dam is initiated if the dam has greater than 80% storage volume.
- Two KSB 800-065-315-(or equal approved) 126 m3/hr, 20 m head, pumps (one operating, one standby to be kept in the ash dump store), will be required to meet the pumping requirements to Metsimaholo Dam. One pump will be located at the new pump/sump facility adjacent to the South RWD, the other kept in store.

15.8.4.2 OPERATIONAL PROCEDURES – OVERALL

The operational procedures and pumping data for the final Matimba Ash Dump Facility footprint is described below.

Water for Irrigation and Dust Suppression:
The dust suppression and irrigation requirements will be sourced from existing Ash Dump Irrigation Dam. The surface water runoff generated from the footprint will be captured and conveyed to the holding dams. Water for dust suppression and irrigation will then be pumped from the Holding Dams via a pipeline to the existing Ash Dump Irrigation Dam. The constant average daily flow rate for irrigation and dust suppression was calculated to be 5,600 m3/d.

Existing Ash Dump Dam 1 and Ash Dump Irrigation Dam:
The operational procedures and pumping data will remain the same as in the current existing scenario.

Existing Ash Dump Dam 2:
The operational procedures and pumping data will remain the same as in the current existing scenario.

Existing Metsimaholo Dam:
The operational procedures and pumping data will remain the same as in the current existing scenario.

New North Return Water Dam:
The required dam capacity is 60 000 m3 for the New North Return Water Dam as described above.
Pumping from the North Return Water Dam to Ash Dam 1 to is initiated if the dam has greater than 70% storage volume, and Ash Dam 1 has less storage volume than 70%.
Two KSB 80/3 (or equal approved)- 126 m3/hr, 20 m head pumps (one operating one standby), will be required to meet the pumping requirements to Ash Dam 1.

New South Return Water Dam
The required dam capacity is 80,000 m3 for the New South Return Water Dam as described above.
Pumping from the South Return Water Dam to Metsimaholo Dam to is initiated if the dam has greater than 80% storage volume, and Ash Dam 1 has less storage volume than 50%.
Two KSB 80/3 (or equal approved)- 126 m3/hr, 20 m head pumps (one operating, one standby) will be required to meet the pumping requirements to Metsimaholo Dam.

15.8.5 CLEANING AND REPAIRS

When cleaning or maintenance of the dam is required, flow is to be managed in such a manner that the basin is drained and the other dams are still in operation and able to manage the flow if required. Draining will be controlled by valves at the pump station.

Access into the basins by vehicles may only take place on the additional HDPE textured sacrificial wearing strips provided down slope and on the basin floors to the sumps.

Any repairs must only be performed by qualified experienced personnel.

15.9 OPERATING PROCEDURES AFFECTING THE SAFETY OF THE DAM

Should the dam safety or other considerations require that the water level be lowered, this can only be effected by extraction at maximum rate through the inlet / outlet pipe.

The reservoir should be attended continuously during periods of high storm rainfall that may cause the water levels to rise above FSL and even result in undesired spillage.

The spillways must never be blocked by stop logs, sandbags or the like.

15.10 EMERGENCY PLAN

15.10.1 CONDITIONS AFFECTING THE SAFETY OF THE DAM

Emergency situations are classified into three categories depending on the severity of the situation. The required action is dependent on the severity of the situation. The three categories are:

- **Emergency Situation A:** Evacuation – the warning system to evacuate the potential flood area is set into operation.
- **Emergency Situation B:** Emergency preparedness – persons involved are alerted to be prepared to possibly be evacuated.
- **Emergency Situation C:** If the observer is unsure of the degree of gravity – professional advice should be obtained.

15.10.2 EMERGENCY SITUATION A (EVACUATE)

- SWD/NWD wall has failed and water is flowing downstream.
- Water flowing in the spillway channel has caused it to move with resulting flow outside the channel causing serious erosion of the SWD/NWD embankment to the point of a dam break.
- There has been an earthquake and the SWD/NWD wall is damaged.
- The SWD/NWD wall is going to fail or is showing signs of serious damage as listed below:
    - The HDPE liner system has completely failed (torn and damaged over large areas) with uncontrolled turbid water leakage appearing outside the SWD/NWD embankment at the leakage detection and ground water finger drain outlets and / or elsewhere.
    - Large cracks have appeared in the embankment and are still growing. Crack widths which for instance increases by more than 50mm per day at the earth walls, are regarded as very serious.

- Significant movement has taken place. Relative movement of 200mm or more at any part of the SWD/NWD embankment since the previous inspection is for instance regarded as very serious. Sink holes, sliding, or slipping, etc evident.
- Erosion tunnels or boils appear on the outside face of the SWD/NWD embankment or below the embankment toe.and flowing sand or mud is visible in the leakage water.

15.10.3 EMERGENCY SITUATION B (PREPAREDNESS)

- Tears or damage to the top HDPE liner causing significant leakage to be evident at the outlet of the leakage detection pipes – leakage water is clear. (Tears or damage to the whole HDPE liner system causing excessive dirty water leakage to appear from both the leakage detection pipes and ground water finger drain outlets and / or elsewhere are to be considered serious – ie as Emergency Situation A)
- Turbid or dirty seepage water with soil particles and leaking at more than 1l/s from a single point or 10l/s collective seepage.
- Water level of dam is near the non-overspill crest and it is still pouring with rain.
- Blockage of the spillway during a heavy rain event that is not cleared immediately.
- Less serious conditions than those mentioned under situation A

15.10.4 EMERGENCY SITUATION C (UNCERTAIN – GET ADVICE)

- Turbid or dirty seepage water with soil particles and leaking at less than 1l/s.
- Unusual increase in leakage of ground water seepage water without it being the wet season.
- Development of wet patches on the embankment outside slopes or along the inlet / outlet pipe routes.
- Deep erosion of the SWD/NWD embankment outside slopes.
- Damage or deep erosion to the area surrounding the spillway channel.
- Damage to the HDPE liner system – usually causing leakage through the leakage detection pipes.
- Person in charge is unsure of the gravity of the situation.
- Inlet / outlet control valves are defective.

15.10.5 ACTIONS TO BE TAKEN IN AN EMERGENCY

A timely detection of the situation leading to a failure will increase the warning time to potential flooding areas. The person responsible for surveillance shall act immediately when a hazardous situation is observed.

15.10.5.1 ACTION PLAN FOR EMERGENCY SITUATION A (EVACUATE)

- Notify all responsible or affected persons and authorities.

- Threatened persons should be instructed to evacuate immediately. Tick off systematically each person who is warned.
- Open the outlet valves fully and run pumps where applicable to draw down the SWD/NWD.
- An observer shall be placed on the SWD/NWD crest or other strategic place. The observer should have means to communicate with the emergency services.
- Provide lighting to the problem area as quickly as possible.
- Guards with red flags should be placed at road crossings in areas potential to flooding until authorities can take over. Guards to have a means to escape should inundation by flood be imminent.
- Implement a monitoring program to note and measure changes in the situation. Mark cracks with pegs or paint and take readings of crack length, crack width, water levels, leakage rates, or any relative movement on an hourly basis.

15.10.5.2 ACTION PLAN FOR EMERGENCY SITUATION B (PREPAREDNESS)

- Notify all responsible or affected persons and authorities.
- Threatened persons should be warned to be prepared to evacuate if necessary. Tick off systematically each person.
- Further actions are the same as Emergency situation A.

15.10.5.3 ACTION PLAN FOR EMERGENCY SITUATION C (GET ADVICE):

- During Situation C, professional advice should be obtained from the APP, DWA or other professional services provider.
- Furthermore, the situation should be monitored continuously as mentioned in the last point of emergency Situation A.

15.11 WARNING SYSTEM: LIST OF RESPONSIBLE PERSONS

A list of responsible persons/authorities who should issue warnings and take certain actions in the event of an emergency situation is given in authorities below.

Table 15-4 List of responsible persons/authorities.

Name and Contact details	Responsibility
Owner of the dams: Eskom – Matimba Power Station DAM: Chief Engineer Name ---------- Cell phone – Office – Home –	Manager of all activities at the Power Station

E-mail – Office address – Home address –	
Person in control of the SWD/NWD: Name ---------- Cell phone – Office – Home – E-mail – Office address – Home address –	Overall operations and maintenance of SDD/NWD
Head of warning systems: Name ---------- Cell phone – Office – Home – E-mail – Office address – Home address –	Evaluate gravity of emergency situation and issue warnings to evacuate (emergency Situation A) or to be prepared to evacuate (emergency Situation B).

Person responsible for day-to-day operation of the DAMS**:** Name ---------- Cell phone – Office – Home – E-mail – Office address – Home address –	Ensure that the conditions of the Water Use Licence are adhered to, that dam water levels are recorded at the specified intervals, that the Head of warning systems is notified if trigger levels are exceeded.
Head of Provincial Disaster Management Centre: Name ---------- Address Cell phone – Telephone -	Provincial Co-ordination of emergency services. Consult Tables 2 & 3
Co-ordinator of Emergency Services : Name ---------- Address Cell No – Telephone - .	Local Co-ordination of emergency services. Consult Tables 2 & 3
Emergency Services: Name ---------- Address Cell No – Telephone -	
Fire Department – Chief Fire Officer: Name ---------- Address Cell No – Telephone -	
South African Police Station Commander: Name ---------- Address Cell No – Telephone -	

Defence Force – Commando: Name ---------- Address Cell No – Telephone -	

Please add other names deemed appropriate or delete names inappropriate.

15.12 WARNING SYSTEM: LIST OF PERSONS THREATENED BY A DAM BREAK

Because the SWD/NWD is not a dam on a river, but is located on land occupied by the Matimba Power Station, a detailed dam break flood analysis to determine estimated areas of inundation is considered unnecessary, but rather, it must be assumed that all areas with infrastructure below the Dams will be at risk of flooding in the event of a failure of the dam embankment wall.

Table 15-5 is a list of premises that are at risk of flooding should there be a dam break at the **SWD/NWD**. The localities of the listed premises can be found on the Locality Plan in Appendix A.

Table 15-5 List of premises below the SDD that may be affected by a dam break

Please list areas / buildings at risk of flooding

Location	Name of Premises	Distance away from SWD/NWD
1	200m wide perimeter around **SWD/NWD**	0 -200 m
2	Access roads	
3	Stream to the South of the dams	0 -500 m
4		
5		
6		
7		

All persons responsible for evacuation in each department in each of the premises at risk of flooding shall have a daily listing of persons in that section so that they all can be evacuated should Emergency Situation A (Evacuation) arise.

Table 15-6Table 15-6 : List of persons threatened by a dam break. below is a typical list of persons at a premises that is at risk of flooding. This list can be adapted to conform to other evacuation plans in place that Eskom may have such as fire evacuation.

Table 15-6 : List of persons threatened by a dam break.

Date		Time	
Premises			
Department			
Person responsible for emergency evacuation			
Persons on premises			
Name	Time in	Time out	

15.13 PERSONS FROM WHOM PROFESSIONAL ADVICE CAN BE OBTAINED

Table 15-7 below contains the list of persons/authorities whom can be contacted to provide professional advice should an emergency situation develop.

Table 15-7 : List of persons/authorities whom may be contacted to provide professional advice.

Name	Address	Contact numbers
Dam Safety Office Jan Nortje Pr Eng	DWA Dam Safety Office Private Bag X313 Pretoria 0001 170 Sedibeng Building 185 Schoeman Street Pretoria	Tel 0123368010 Cell 0828063794
Technical Consultant	Knight Piésold Consulting	Tel 0118067037

JR (Rob) Williamson, Pr Eng	PO Box 221 Rivonia 2128 4 De la Rey Road, Rivonia	Cell 0832687427
CEO, KPC Vishal Haripersad	Knight Piésold Consulting PO Box 221 Rivonia 2128 4 De la Rey Road, Rivonia	Tel 0118067198 Cell 0835340493

An emergency should be reported to the APP and DSO as soon as possible, during, or after the incident.

16 LEGAL AND SAFETY ASPECTS

An Ash Dump can be a dangerous place and unauthorized persons must not be allowed into the Ash Dump Complex. Preventing public access will reduce much of the legal risk associated with the construction of the Ash Dump.

Safety on the Ash Dump should be constantly addressed and any dangerous working situations must be rectified immediately. Personnel must be kept informed as to safe working practices and all regulations pertaining to the Ash Disposal Site must be adhered to.

Compliance with the above measures will ensure that a good safety record is maintained at the Ash Disposal Facility.

16.1 STATUTORY REQUIREMENTS

The following statutes have relevance to the Ash Disposal Facility and must be adhered to at all times:

- The Mines and Works Act (Act 27 of 1956)
- The Water Act (Act 54 of 1956)
- The Environment Conservation Act (Act 100 of 1982)
- The Conservation of Agricultural Resources Act (Act 43 of 1983)
- The Agricultural Pests Act (Act 36 of 1983)
- The Health Act (Act 63 of 1977)
- The Atmospheric Pollution Prevention Act (Act 45 of 1965)
- The Minerals Act (Act 50 of 1991)
- National Environmental Management act No. 107 of 1998
- National Environmental Management: Waste Act, 2008
- The MOS Act (Act of 1983)

Any amendments or additions to the above must be adhered to from the time they are promulgated.

16.2 ENVIRONMENTAL LEGISLATION

In essence, the law in South Africa can be divided into two broad categories:

- The common law
- Specific legislation

16.2.1 THE COMMON LAW

Principles

The common law of South Africa is derived from Roman Law via Roman Dutch Law. It is not spelt out in a single document but has to be gleaned from numerous sources and it is the task of the lawyer to identify principles and to apply them to the facts in a given situation.

While the principles are to some extent grouped under headings, "Environmental Law" as such, is new and the classification is not to be found in either Roman or Roman Dutch Law.

In general terms, the conceptual or jurisprudentially basis for Environmental Law is to be found largely in the field of neighbour law, which fairly closely-resembles the English Law of Nuisance. This branch of law, is founded on the maxim "secutere tuo et alieneum non /aed,as", i.e. a party should use his property in such a way as not to interfere with the rights of others.

In addition, certain other legal principles, and particularly those relating to liability under the acquilian action, are relevant when the state of affairs complained or results in damage to the complainant or his property or financial interests.

Remedies

The law essentially provides for two remedies:

- Interdict
- Damages

Interdict

A party who is suffering or would suffer harm as a result of the unlawful actions of another may be entitled to an order prohibiting the act complained of i.e. an interdict.

In practice, this may be the most useful form of relief available to a party complaining of damage to the environment, as it entitles him to bring the act complained of to an end or even to forbid it before it begins, rather than having to wait until damage is actually done.

In order to be able to invoke the remedy, the applicant must have locus stand, which is dealt with below.

Damages

It is a general principle of South African law is that if a party suffers physical or financial harm as a result of the wrongful act of another, he will be entitled to compensation from the wrongdoer provided that the act complained of was committed negligently or wilfully.

This principle or ground of action is of particular relevance in the field of waste management, given the potential to contaminate ground water or to diminish the value of land by, for instance, allowing contaminated dust to be blown onto adjacent land.

This remedy is also subject to the locus standi requirement; however; that requirement is generally not as problematic in regard to this form of reluef because if an applicant is able to show the type of loss required in order to qualify for this remedy, then he will in all instances have sufficient interest to establish locus standi.

Locus Standi in Judicio

It is a requirement of South African Law that a party approaching a Court for relief must have locus standi in judicio (legal standing).

This has several components:

Capacity

The party must be competent to institute proceedings, for instance, an individual person, not suffering from any legal disability, will have capacity to institute proceedings, as will a company or close corporation. Usually, this aspect of the locus standi requirement is not problematic and is fairly easily fulfilled.

Interest

A second requirement in order to establish locus standi is that a party must have sufficient or special interest in the outcome of the action. This is a matter of law, which is not capable of easy definition.
In general terms, the applicant or plaintiff must have a special interest in the outcome of the case, exceeding that of an ordinary member of the public. It is not sufficient that he has made it his business to be interested in the action complained of (as for instance in the case of an environmental organization or civil rights group). Instead, what is required is that the act complained of must make some special inroad into his personal rights.

The test has been expressed by saying that his interest must be greater than that of a member of the ordinary public. However, this is not, strictly speaking, correct as it is clear that there would be certain instances in which every member of the public who would be affected by a certain action would have sufficient interest to have locus standi, as for instance in the case of a "public nuisance".
This is a complex issue of law which involves considerations of public policy. Anyone interested in pursuing the debate further would be well advised to read the article by W Bray entitled "Locus Standi in Environmental Law" which was published in the 22nd Volume of the Comparative International Law Journal of South Africa (CILSA) of 1989, and the authorities referred to therein.
Roman and Roman Dutch law acknowledged the existence of the so-called actio popularis or "peoples action" which was available to a member of the public or organization for the enforcement of a public right. It was not necessary for an applicant seeking this form of relief to show a personal interest in the outcome of the dispute over and above that of an ordinary member of the public.
The actio' popularis was, for a long time, thought to be part of South African law, however, the Courts have held that it is not. This decision has been the subject of considerable legal criticism and there is a strong lobby for the reintroduction of this remedy into South African law by way of statutory intervention. The lobby was for a long time led by civil rights movements. However, support has grown
considerably in recent years to the point where it is now becoming overwhelming, and it is safe to say that the day is not far off when this aspect of locus standi will no longer be a requirement in connection with environmental issues.

16.2.2 SPECIFIC LEGISLATION

16.2.2.1 ASH DUST

In order to ensure compliance with the legal requirements the following prescriptions should be adhered to by the accountable person, namely the Power Station Manager:
Applicable Legislation

a. The Atmospheric Pollution Prevention Act, No 45 of 1965 (especially section 27- 35)
b. The Minerals Act, No 50 of 1991 (especially Sections 1, 63(1)(c), (d) and (e) and 68(2).

NOTE:
Although this Act repeals the Mines and Works, the regulations in terms of the latter Act are still in force (see S 68(2) of the Minerals Act). However, the new Act specifies "ash dumps", thereby clarifying the intent of the State. Therefore, the relevant Sections of the Mines and Works Act, as well as regulations in terms thereof must be retained until such time as they are replaced by later ones.

c. The-Mines and Works Act No 27 of 1956"(especially Sections 1 (definitions) and 12 together with the relevant regulations: Regulations R.2227, Reg. Gazette 3094, 31 October 1980 (Chapter 5, Regulation 5.10).

d. Rehabilitation of the ash dump must meet the directives of the Inspector of Mines.

(NOTE: Chapter 5 of the Regulations concerned with environmental aspects of mines and associated works, is at present being revised (see Government Notice No 275, G G No 13075, 22 March 1991). Ash dumps are specifically mentioned as falling within the purview of this legislation.)

General

a. If blown dust causes a nuisance or damage to neighbours of a Power Station, they are entitled to institute a civil case against the Power Station.
b. Information regarding the performance in air pollution control may not be disclosed to anybody outside Eskom, except the CAPCO. It is an offence under Act 45 of 1965 (see Part VI, Section 41(1) to divulge any such information to outsiders.
c. If an accountable employee of Eskom is found guilty of contravening the stipulations of Act 45 of 1965, including the disclosure of information in 'b' above, such person will receive a criminal record and may be subject to the disciplinary code pertaining to Eskom employees.
d. Contravention of the Act provides for a fine of R500-00 or 5 months in prison for a first offence and a fine of R2 000-00 or one year in prison for a second or subsequent conviction of the accountable Eskom employee (See section 46 of the Act).

16.2.2.2 WATER POLLUTION FROM ASH DUMP

The control over water use and water pollution by the relevant authorities is extensive. Environmental practitioners should carefully consider all the implications of the legal constraints contained in the legislation quoted in this advisory note.
This advisory note does not purport to be a legal treatise on water use and pollution, but rather attempts to highlight the most important legal requirements and constraints.

Applicable Legislation

a. The Water Act, No 54 of 1956 (especially Sections 1 to 29, 170 and 171)

1. Control of Private Water

Private water includes natural rainfall, springs (which arise on your property), water from boreholes (which is not derived from a proclaimed "subterranean government water control area" {see Sections 28 and 29 of the Water Act}) and the water which naturally collects on your property, such as a pan, and which cannot be used by persons other than the owner for irrigation. The legal definitions of private water are contained in Sections 1 and 6(2) of the Water Act.

Section-S-of the Water Act is very important as it contains the basic conditions for the use of private water.

- If private water has been used for industrial purposes, a permit must be obtained for the disposal of such water or effluent from the Department of Water Affairs (see Section 21 of the Water Act)
- Any person who controls land on which anything is done, which involves a substance (solid, liquid, vapour or gas) capable of causing the pollution of private water, must take the steps prescribed by regulation under Section 26 of the Water Act to prevent such pollution (see Section 22 of the Water Act).

Note:

- This section of the Water Act gives the Department of Water Affairs very wide powers of control. It is obvious from the above that waste products must not be allowed to pollute water.
- Any person who willfully or negligently pollutes private water, making it less fit for use by other people, for the propagation of fish or other aquatic life or for recreational or other legitimate purposes is guilty of an offence under Section 23 of the Water Act.
- Section 24 of the Water Act gives the Department of Water Affairs very wide powers to control the pollution of private water. The Minister of Water Affairs may even direct that the manufacture, marketing or use of any substance, which causes water pollution, be terminated or restricted (see Section 24(3)).

2. Use of Water for Industrial Purposes

Definition: "Use for industrial purposes" is defined in Section 1 of the Water Act and is very wide in scope. The definition inter alia includes:
"(b) the generation of power"
"(g) any sewerage system or work or any water care work"
"(j) any civil, mechanical or electrical engineering construction work".

- If more than 150 m3 of water is used for industrial purposes per day a permit for such use must be obtained from the Department of Water Affairs (see Section 12(1) of the Water Act). One may call this the "supply permit".
- If any of the conditions of a permit is not adhered to, the Department of Water Affairs may cancel it (Section 12(3)(c)), suspend it or reduce the quantity of water to be used (Section 12(4)(1)).
- Anyone who contravenes the conditions of the supply permit is guilty of an offence in terms of the Water Act.

3. Purification and Disposal of Effluent

- In this part, Sections 21 and 24, the Government Notices in terms of Section 21(1)(a) and Regulations in terms of Section 26 of the Water Act are very important.
- If water has been used for industrial purposes, the user has an obligation to purify or treat such water before disposal (see Section 21(1)(a)).
- The required standards to which waste water or effluent shall be purified or treated are described in Government Notice No 991 in Government Gazette No 9225 of 18 May 1984. These requirements include the "Special Standard", the "Special Standard for Phosphate" and the "General Standard".
- A contravention of Section 21(1) of the Water Act is an offence.
- The Department of Water Affairs has the right to the user of public water (for a definition of "public water" see Section 1 of the Water Act), as to what steps to take to prevent the pollution of such water, whenever anything is done involving a substance (solid, liquid, vapour or gas}, which could pollute water (see Section 22 of the Water Act).
- This Section enables the Department to exercise control over waste disposal on Eskom properties.
- Any person who willfully or negligently pollutes public water, making it unfit for other uses, the propagation of fish or other aquatic life or for recreational or other legitimate purposes, is guilty of an offence under Section 23 of the Water Act.
- In terms of Section 24 of the Water Act, the Department of Water Affairs has very wide powers of access and inspection regarding those matters raised in Sections 21(1) and 22(1)(a) or (b): If anything is found to be inadequate or lacking on the property, the Department If the owner fails to respond satisfactorily to such a directive within a previously specified time, the Department may take the necessary corrective action and recover the costs from the landowner.

4. Dams and Storage

- In times of a water shortage the Minister may, by notification in the Government Gazette, limit the "impounding, storage, abstraction, supply or use" of water in a specified area (see Section 9A of the Water Act).
- If more than 250 000 m3 of public water is impounded or stored or if more than 110 litres per second are abstracted from a public stream, the landowner must obtain a permit from the Department of Water Affairs (see Section 98 of the Water Act).
- All dams with a capacity exceeding 50 000 m3 and wall height exceeding 5 metres are defined as "dams with a safety risk". Such dams must be registered with the Director General of Water Affairs within prescribed periods of time and in a manner prescribed by regulation under Section 9C(6) of the Water Act (see Section 9C of the Act).

b. The Mines and Works Act,No 27 of 1956 (Sections 1 and 12)

1. Mine Water
    - Section 1213 of the Water Act regulates the use of water, which may be removed from a mine. This section must be read in conjunction with the regulations mentioned in 5.1 above as well as Sections 12 (use of water for industrial purposes) and 21 (obligation to purify or treat effluent).
    - Regulations 5.9.1 and 5.9.2 promulgated in terms of Section 12 of the Mines and Works Act, prescribe the handling and disposal of polluted water from mining activities. The revised draft regulations concerning these aspects are given as

17 REFERENCES

3145, *Phase 2 Report for: Geotechnical Assessment and Thermal Investigation at the Matimba Power Station Ash Disposal Facility*, Lephalale, Limpopo Province, Jeffares and Green, June 2015

NEMWA *National Norms and Standards* (GN R 634, 635, 636) (2013), DEA

Government Gazette, 23 Augusts 2013, No.36784, Regulation 636

Matimba power station, Ash Dump Stability check, Jones and Wagener Report No: JW171/03/8939, October 2003

Matimba power station, Ash Dump Basic Design, Knight Piesold Report Number: 301-00825/01, July 2019

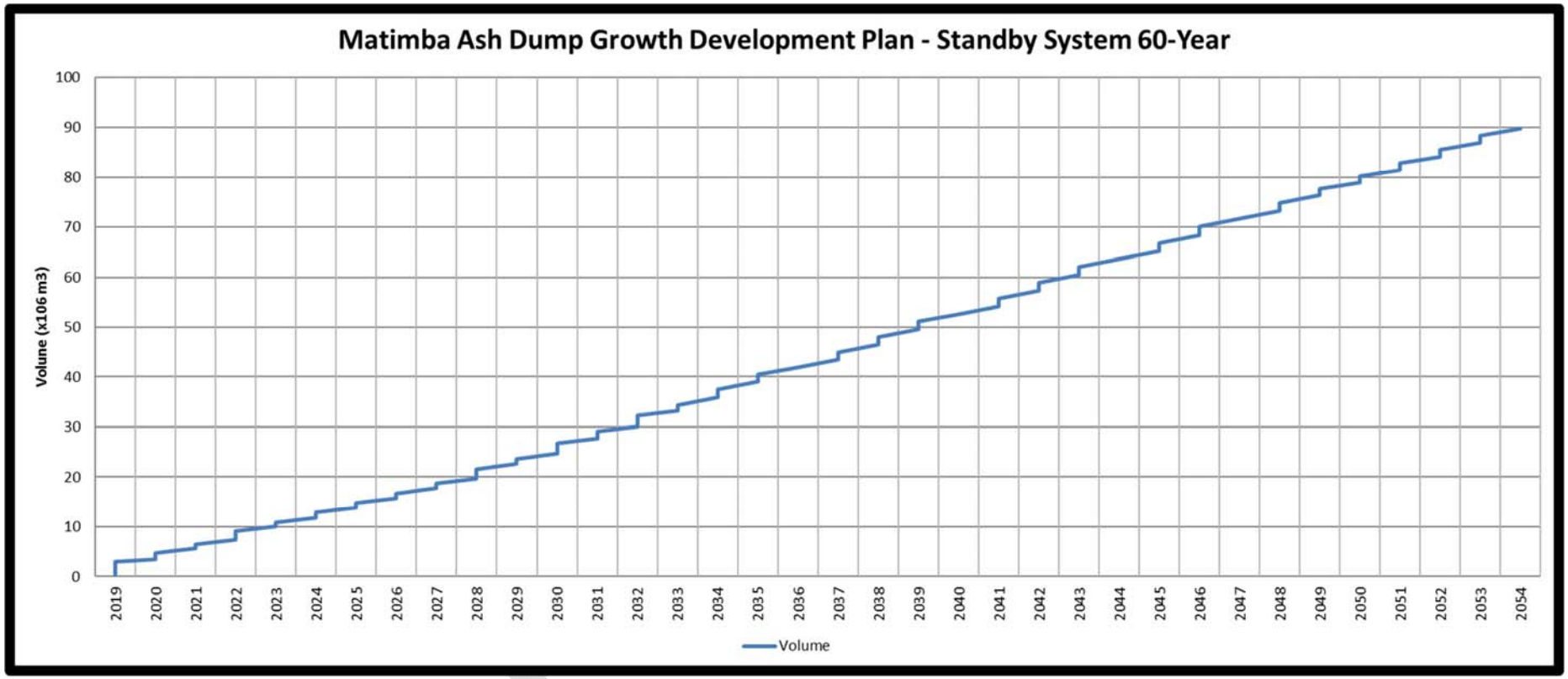
Matimba power station, Ash Dump Basic Design, Knight Piesold Report Number: 301-00825/01, September 2019.

APPENDIX A

DETAILED DESIGN DRAWINGS

APPENDIX B

Capacity Curves


Matimba Ash Dump Growth Development Plan - Standby System 60-Year
Volume (x106 m3)
0
10
20
30
40
50
60
70
80
90
100
2019
2020
2021
2022
2023
2024
2025
2026
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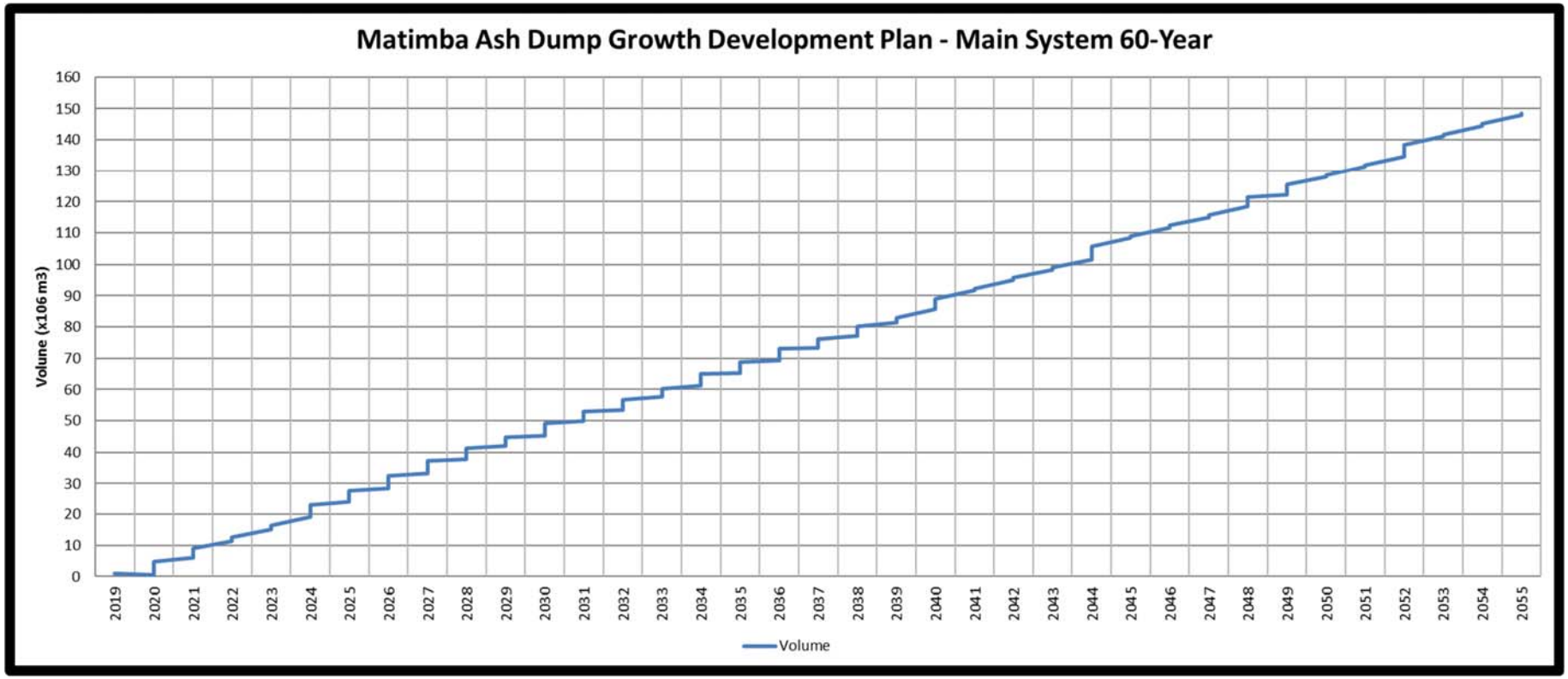
Volume


Matimba Ash Dump Growth Development Plan - Main System 60-Year
Volume (x106 m3)
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APPENDIX C

Routine Inspection Form

GUIDELINES FOR COMPLETION OF THE ROUTINE INSPECTION FORM

A competent person who should be well acquainted with the contents of this full manual, should be appointed to carry out the routine inspections on a quarterly basis. A supply of blank routine inspection forms should always be available at the Dam site. Give description of observations of each component of the Dam by commenting on the different items, e.g. yes, no, slightly, good, poor, none, n/a, what action should be taken and any further applicable comments. Do not leave blank spaces.

Photographs of a particular condition are useful and provide much more information than a description.

Where unfavorable conditions exist, more particulars should be furnished on the reverse side of the form or on separate pages, for example:

- Cracks: state crack width, length and position. Cracks parallel to the dam crest (longitudinal); Cracks perpendicular to the dam crest (transverse)
- Hollows, subsidence and erosion: record extent, depth and position
- Tears or ruptures in liner: record size and position.
- Wet patches: record size and position.

The position should be indicated in chainage/distance with the aid of reference beacons or as the distance from a fixed point such as the spillway wall. The distance inside or outside from the centerline of the wall should also be indicated. The description should be clear enough to determine the degree of change between subsequent inspections. Specific problems should be photographed.

The inspection route should cover the full crest length of the wall, toe of wall,and slopes. Observations should not merely be made from a distance.

Completed inspection forms should be kept for record purposes and be shown (together with the record book) to the Engineer at yearly intervals

A record book should also be kept for recording the items listed below. The list of items and frequencies suggested should be chosen to suit this Ash Dump.

Item	Frequency
Rainfall	Daily
Leakages through top liner into the concrete dirty water drain	weekly
Seepage flow	quarterly
Delivered tonnage	Daily
Irrigation/ dust control water volumes	Daily
Survey of dumped ash/FGD	Yearly
Repair work (details of important repair work, including the date should be recorded in the record book)	Ad hoc

The Emergency Preparedness Plan should be consulted for a description of emergency situations and emergency procedures.

MATIMBA POWER STATION
ASH DUMP
ROUTINE INSPECTION FORM

Date of Inspection: _____
Ash deposit elevation on day of Inspection: _____
Area of Ash deposition on day of inspection: _____
Weather on day of Inspection: _____

For detailed descriptions of problems write on reverse of this sheet or provide additional sheets

2. ASH DUMP OUTSIDE FACES

2.1 Appearance of surface seepage water
Position(s) Estimate of flow Clarity of water

2.2 Appearance of damp patches :
Position(s)
Area of patch

2.3 Appearance of settlement :
Position(s)
Surface area
Maximum depth below normal slope

2.4 Appearance of bulges :
Position(s)
Surface area
Maximum depth below normal slope

2.5 Appearance of cracks :
Position(s)
Direction #
Length
Width
Vertical displacement

2.6 Condition of vegetation :
Grass
Trees / shrubs

2.7 Appearance of erosion

2.8 Holes or depressions
Ant nests, animal burrows, other

2.9 Other

2.10 General condition

3.	**AREA OUTSIDE THE PERIMETER TOE WALL**	
3.1	Appearance of surface seepage water:	
	Position(s)	
	Estimate of flow	
	Clarity of water	
3.2	Appearance of damp patches :	
	Position(s)	
	Location of patches	
3.3	Ash Dump Haul Road	
3.4	Ash Dump Dirty Drain	

Item	Inspection	Comment
4.	**ASH DUMP DEPOSITION CREST**	
4.1	Local depressions :	
	Position(s)	
	Surface area	
	Maximum depth below normal ground	
	Erosion	
	Position(s)	
4.2	Access Ramps	
	Traffic wear	
	4.3 Other	
	4.4 General condition	
5.	**CLEAN WATER DRAINAGE CHANNELS**	
5.1	Ground water drainage outlets –	
	Trash or blockages	
	Discharge –	
6.	**DIRTY WATER DRAIN**	
	Appearance of channel	
6.1	Appearance of precast concrete covers	
6.2	Ash deposits in drain	
6.3	Other	
6.4	General condition	

Item	Inspection	Comment
7.	**TEMPERATURE MEASUREMENT INSTRUMENTATION**	
7.1	Condition of instrument read-outposts	
7.2	Condition of instrument temperature recorder unit	

SIGNATURE OF OBSERVER
(Print name)

SIGNATURE OF OWNER
(Print name)

DATE

DATE