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REPORT ON

**KENDAL POWER STATION:
30 YEAR ASH DISPOSAL FACILITY
PROJECT
CONCEPTUAL ENGINEERING
REPORT**

Report No : 12935-45-Rep-001-Rev5

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EXECUTIVE SUMMARY

Kendal Power Station (PS) was commissioned in the mid 1980s, with a forty (40) year operating life. The initial dry ash dump site was designed to have a capacity for the operating life with an eight year contingency period. The life of the PS has since been upgraded to sixty (60) years, including a five (5) year contingency, and with some other contributing factors, such as the dry density and the load factor, the initial dry ash dump is now under capacity. The PS is therefore expected to be decommissioned at the end of 2053 with a five year added contingency. This means that area to accommodate the additional ash generated during this operational period will need to be established.

The area to the north of the existing Ash Disposal Facility (ADF) has been extended and optimised in order to receive this ash under the Kendal Continuous ADF Project, which was undertaken by Zitholele Consulting (ZC). The Conceptual Engineering designs indicate that ash may be accommodated at the existing Kendal PS ADF site until October 2031 and thereafter an alternative site will need to be licenced to receive ash up to the end of 2058, hence this project, the Kendal Power Station 30 Year Ash Disposal Facility Project.

At the onset of the project, a detailed site screening and identification process was undertaken to identify the most feasible site areas within a maximum radius of 10 km around Kendal PS.

A four phased approach was used to attain the most feasible sites within the study area. This included:

1. Identification of the study area;
2. Defining the developable areas;
3. Undertaking an environmental, social and technical site screening exercise; and
4. Rating and ranking of the identified site areas according to the identified site sensitivities (Overlay analysis).

The outcome of the screening process was the selection of site H.

Eskom EIA Centre of Excellence (CoE) has appointed Zitholele Consulting (Pty) Ltd (Zitholele) to start with the environmental impact assessment (EIA) for the new ADF. Zitholele are also responsible for the conceptual engineering design. These engineering designs will be used to underpin and inform the EIA.

The Conceptual Engineering Report discusses the following:

- The design of the new Ash Disposal Facility (ADF) in compliance with Department of Environmental Affairs (DEA) Norms and Standards as promulgated on 23 August 2013;
- Design of pollution control dams and stormwater management infrastructure in compliance with GN704;
- Diversion of existing services at the site where the new ADF is to be built.

The total air space volume required in Site H was calculated to be 176.2 Mm³. The ADF modelled achieved this volume. The proposed new ADF has a footprint area of 404.7 hectares. The stormwater management system comprises of seven proposed new dams, five (5) Pollution Control Dams (PCD) and two (2) clean water dams.

The conceptual design of the new ADF is discussed further in this report.

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GLOSSARY OF TERMS

ADF	Ash Disposal Facility
ASTM	American Society for Testing and Materials
CDS	Consistent Data Set
CoE	Centre of Excellence
CQA	Construction Quality Assurance
DWS	Department of Water and Sanitation
E-Dump	Emergency Dump
EIA	Environmental Impact Assessment
GN 704	Government Notice 704
NWA	National Water Act
PCD	Pollution Control Dam
PS	Power Station
SANRAL	South African National Roads Agency Limited
VAT	Value-Added Tax
WUL	Water Use Licence
WULA	Water Use Licence Application
ZC	Zitholele Consulting

1 INTRODUCTION

Kendal PS was commissioned in the mid 1980s, with a 40 year operating life. The initial dry ash dump site was designed to have a capacity for the operating life with an eight (8) year contingency period. The life of the PS has since been upgraded to sixty (60) years plus five (5) year contingency and with some other contributing factors, such as the dry density and the load factor, the initial dry ash dump is now under capacity. The PS is therefore expected to be decommissioned at the end of 2053 with a five year added contingency. This means that the area to accommodate the additional ash generated during this operational period will need to be established.

The area to the north of the existing Ash Disposal Facility (ADF) has been extended and optimised in order to receive this ash under the Kendal Continuous ADF Project, which was undertaken by Zitholele Consulting. The Conceptual Engineering Designs indicate that ash may be accommodated at the existing Kendal PS ADF site until October 2031 and thereafter an alternative site will need to be licenced to receive ash up to the end of 2058, hence this project, the Kendal PS 30 Year ADF Project.

2 SITE SCREENING

At the onset of the project, a detailed site screening and identification process was undertaken to identify the most feasible site areas within a maximum radius of 10 km around Kendal PS.

A four phased approach was used to attain the most feasible sites within the study area. This included:

1. Identification of the study area;
2. Defining the developable areas;
3. Undertaking an environmental, social and technical site screening exercise; and
4. Rating and ranking of the identified site areas according to the identified site sensitivities (Overlay analysis).

Based on the combined ratings for the environmental, social and technical elements, and further discussion with the specialist and Eskom technical teams, the following site areas were identified (in order of feasibility) as the most feasible site alternatives to be investigated further during the impact assessment phase: Site C, F, D and B. Refer to Appendix E for the screening report.

Following the Scoping Phase, more detailed specialist investigations were undertaken. Earlier on it was established that Site D had previous undermining, which rendered the site unfeasible from a geotechnical point of view. The site D was then eliminated.

Areas B, C and F were taken forward for detailed (specialist) site assessment. Upon undertaking field studies and further focussed public participation, more detailed mining information was revealed.

Upon the realisation that all these sites were earmarked for mining activities, it was decided to re-introduce Site H as a site alternative. Site H was the next best scoring site alternative in the initial site identification process. Site H is predominantly owned by Eskom. Kusile Mining holds prospecting rights on a large area, which includes Site H. Eskom have been in discussion with Kusile Mining and have obtained written confirmation from them that they would not require this area for mining.

A surface and groundwater interaction study will be undertaken on the pan situated within the pan footprint. This study will commence as soon as a Water Use Licence (WUL) is obtained to start the drilling programme.

Eskom EIA Centre of Excellence (CoE) has appointed Zitholele Consulting (Pty) Ltd (Zitholele) to start with the Environmental Impact Assessment (EIA) for the new ADF. Zitholele are also responsible for the Conceptual Engineering Design. These engineering designs will be used to underpin and inform the EIA.

3 BASIS OF DESIGN

3.1 Assumptions and limitations

The following assumptions were made in developing the conceptual designs presented herewith:

- The requirements for the clean and dirty water systems stipulated in Regulation 704 and Regulation 1560 of the National Water Act, 1998 will be adhered to;
- The Pollution Control Dam (PCD) will be a Stormwater Dam, classified in terms of the National Water Act, 1998;
- The life of the PS was extended up to the year 2058, which includes a five year contingency;
- Construction of the new ADF will start in 2025;
- Ashing on the new lined facility will start in November 2031;
- The Volume of ash per annum stays constant through the whole life of PS;
- All volumes, remaining life and timelines are subject to the dump models that are produced.

3.2 Ash characteristics

3.2.1 Grading and Specific gravity

The fly ash varies from silty sand to silty clay using a triangular soil classification chart (US corps of Engineers). The grading curve exhibits a uniform particle size distribution. According to ASTM D422-63:

- Clay sized particle is larger than 1 micrometre and smaller than 5 micrometre.
- Silt sized particle is larger than 5 micrometre and smaller than 75 micrometre.

- Sand sized particle is larger than 75 micrometre and 425 micrometre.

Thus using the above mentioned envelopes the grading of ash are as follows:

Table 1: Ash grading

Particle size	Weathered fly ash	Median	Fly ash
Clay-sized (%)	5-77	16	14
Silt sized (%)	23-83	60	59
Sand sized (%)	0-64	30	27
D ₅₀ (µm)	3-120	23	27.5
Specific Gravity (G _s)	2-2.2		2.2

Data used from : J.S. Mahlaba et al. Fuel 90 (2011)

3.2.2 Stability

Preliminary slope stability analyses have been briefly considered, based on prior and equivalent studies undertaken for the Continuous Ashing Site, which is intended to serve as the interim extension for the current ADF at Kendal PS.

Owing to the generally non-cohesive nature of soils dominating much of Site H, it is anticipated that the likelihood of slope instability attributed to deep seated failures is very limited. With the exception of the specific deep alluvial areas identified during the study, along the margins of the existing alluvial floodplains, slope stability considerations will largely be attributed to operational issues surrounding the ash quality and strength parameters, with particular emphasis on the introduction of the composite liner which will tend to act as the weakest potential slip surface. Refer to Appendix A for the Geotechnical Report, Slope Stability.

3.2.3 Geology of Site H

Fieldwork carried out over Site H during the second fieldwork programme revealed that most of the area is underlain by pedogenic ferricrete of either nodular or hardpan ferricrete. Various sedimentary units of the Vryheid Formation, Karoo Supergroup, namely sandstone and shale were found to occur at some of the test positions located on Site H. Intrusive rocks of the Rooiberg Suite were encountered in two trial pits on the southern portion of the site.

The natural geology and ground profile of the (undisturbed) site comprises sandstones and mudstones of the Vryheid Formation, overlain by residual soils, which in turn are overlain by transported soils (of colluvial origin). In most areas, soils include some degree of ferruginisation with the presence of nodular ferricrete and hardpan ferricrete. This is evidence of historical groundwater.

Based on the available inferred traces, the approximate surface trace of the Ogies Dyke crosses west-east through the north-western corner of Site H. Refer to Appendix A for the Geotechnical Report

3.2.4 Permeability

The permeability is largely dependent on the density of the ash on the ADF. A value of 11.5 m/year for medium dense ash was assumed. This is the mean of 3 m/y (dense ash) to 20 m/year (loose ash) (Brackley et al, 1987) (6.34×10^{-7} m/sec). This is required for calculating seepage pool to the leachate collection system.

3.3 Annual tonnages

The indicated annual tonnage of ash placed on the ADF is 5500 kt/ annum. This information is from a previous report (Report nr: 11613601-10981-2) in which Golder Associates Africa did the development of an industry waste management plan for Eskom where all the waste type and quantities of all the power stations were considered.

The density of the ash is 850 kg/m^3 and thus the annual airspace required for the continuous ADF is approximately 6.5 Mm^3 / annum. Based on this, the remaining life for the continuous ADF is determined.

Refer to Eskom document number: 240-71273834 for coal quality used and Eskom Consistent Data Set (CDS) . 36-623 for remaining life and coal burn plan utilised for coal consumption values.

3.4 Capacity requirements

The existing ash disposal facility (ADF) was commissioned in the 1980s for a forty (40) year life span and an eight (8) year contingency period. The operating life of the ADF has since then been increased to sixty (60) years and with a number of other design and material changes the existing dump geometry is grossly under capacity.

The total additional capacity required for the ADF is 292.7 Mm^3 from January 2015 until December 2058. With the current boundary and operating machinery limitations, this capacity will not be reached on the current ashing site.

The remaining area between the western and northern streams does not have sufficient capacity to allow a new facility to be established. If the northern stream is diverted the continuous ash dump will only provide 116.5 Mm^3 capacity, therefore 176.2 Mm^3 of ash will need to be deposited on the new 60-year ADF site.

3.5 Dust suppression

The current approach is to use water from the three (3) dam system (Dirty Water Dam, Emergency Dirty Water Dam and Clean Water Dam) that is located on the eastern side of the site and then via irrigation, spray the exposed ash areas to minimise the mobilisation of the ash. Key operational staff members at Kendal PS, are of the opinion that the current system is not fulfilling its intended purpose and that the system will have to be modified so that the ash mobilisation is minimal.

There are a number of techniques and products that can be used such as:

- Using a dust suppression chemical,

- Using a self-propelled spraying system; using pressure to propel itself forward,
- Upgrading the current system with better controls in place,
- 50mm subsoil cover.

The above mentioned options will have to be investigated further in the following phase of the design as there might be a lot of other innovative approaches that can be followed.

3.6 Stormwater Management

The management philosophy for the routing and capturing of stormwater is summarised as follows:

- The separation of the runoff draining south-easterly towards the extended ash dam (i.e. from the area upslope of the ash dump) and runoff generated from within the footprint of the extended ash dump;
- The diversion of %clean+ surface runoff generated from the upslope contributing catchments away from the extended ash dump, thereby isolating the ash dam as %dirty areas+in accordance with the requirements GN 704 in terms of the National Water Act, 1998;
- Containment of all %clean+ surface runoff generated from the rehabilitated areas of the ash dump to clean water holding dams, with a %test and release+philosophy if the water meets the release standards;
- Containment of all %dirty+ surface runoff generated from within the %dirty+ catchment, conveyance and discharge into a dedicated pollution control dam sized in accordance with the requirements GN 704 in terms of the National Water Act, 1998.

The current and proposed stormwater management philosophy is discussed in depth in Section 5 of this report.

4 ADF CONCEPTUAL DESIGN

4.1 Ash disposal

The following forms part of the Conceptual Engineering Design of the ADF:

- Two fixed conveyors will be constructed from the existing Emergency Dump (E-dump) at the PS and will cross under Road 545 to the western side of the road where a new E-dump will be constructed.
- A sump will be placed at the conveyor-road crossing with a pipe leading to the new proposed E-Dump Dirty Water Dam;
- Two fixed conveyors will extend from the new E-Dump towards the ADF on to each extendable and then shift-able conveyors and stackers will be placed in order to dispose ash on the footprint of the new ADF starting from the eastern side of the site and progressing to the western side of the site;
- A starter platform will be built on the eastern side of the site first and will be constructed with bulldozers. The rest of the ash dump will be constructed with the conveyor-stacker system;

- A 1:15 sloped ramp will be constructed on the eastern side of the new ADF and will reach a maximum height of 75 metres which is the maximum height of the ADF;
- The new ADF should be in operation for 27 years;
- The new ADF is tapered on the south western corner due to parcels of land that have mining rights attached to them, situated on the western side of the site, and the need to avoid utilising these parcels of land;
- The proposed new ADF will have a ring access road constructed around its perimeter together with stormwater canals intercepting impacted runoff and directing to a PCD;
- A distance of 362 metres has been achieved between the existing silos, on the north eastern side of the proposed new ADF, and the perimeter of the proposed ADF;
- There will be three access points to the proposed new ADF, with the main access point being at the south eastern corner of the new ADF;
- A proposed Contractor's camp is situated at the south eastern corner of the site;
- A proposed topsoil stockpile area will be situated south of the new ADF.

The figure below, Figure 1, show the ADF layer heights:

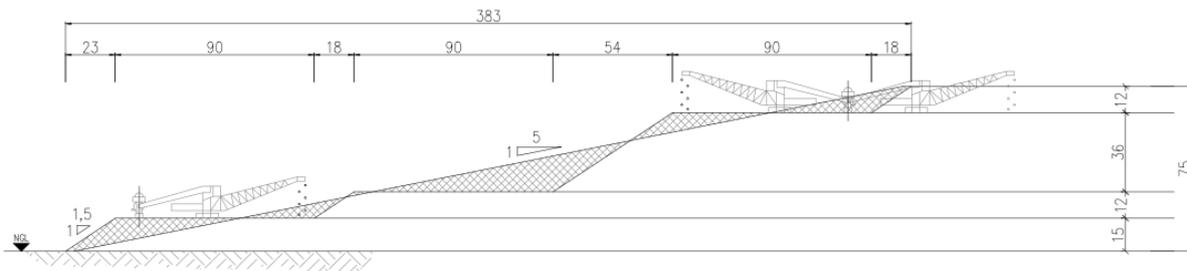


Figure 1: ADF Layer Heights

4.2 Deviation of Transmission and Distribution Power Lines

Several power lines require diversion to accommodate the footprint area of the new ADF on the site:

- 11 kV Distribution Power Line: 1 No. Off;
- 22 kV Distribution Power Line: 1 No. Off;
- 88 kV Distribution Power Line: 2 No. Off;
- 132 kV Distribution Power Line: 2 No. Off;
- 400 kV Transmission Power Line: 2 No. Off.

The Eskom power line servitude and clearance information was obtained from the Eskom document 34-600 DGL Rev 0.

4.3 Road D1390 Diversion

Road D1390 which runs through the proposed new ADF footprint will need to be diverted. The new diverted alignment of the road is on the southern side of the proposed new ADF and intersects with the access road leading to the Kendal PS main entrance.

The new diverted Road D1390 will have a 40 metre road reserve.

4.4 Deviation of the Transnet Pipeline

An existing 18 inch / 450 mm diameter Transnet steel diesel pipeline traverses Site H and runs, directionally, from the south west side of the site to the north east. The existing pipeline runs directly under the proposed footprint area of the new 30 Year ADF.

4.4.1 Options Considered

Three options were considered in order to accommodate the new 30 Year ADF on the preferred footprint taking into consideration the presence of the aforementioned pipeline. They are as follows:

Option 1: The pipeline is discontinued throughout the entire length which it traverses under the proposed footprint. This portion of the pipeline is replaced by diverting it to the west of the proposed ADF complex as shown on Concept Drawing No. 12935/03-09 P00. An alternative to this approach will be to divert the pipeline to the east of the facility, however space is limited and the length of the deviation would be significantly longer.

Option 2: The pipeline remains in place with a protective culvert constructed over it. Adequate allowance will be provided in the culvert for routine maintenance of the pipeline. Ashing operations will continue above the culvert. Drawing No. 12935/03-10 P00 conceptualises this proposal.

Option 3: The pipeline remains in place and the ADF is split into two such that the nearest toe of each facility is outside the servitude of the pipeline. This is shown on Drawing No. 12935/03-11 P00.

Option 4: The pipeline remains in place and the ADF is stopped to the east of the pipeline such that the nearest toe of each facility is outside the servitude of the pipeline. This is shown on Drawing No. 12935/03-12 P00.

A comparative analysis was performed for all four (4) options. The weighted scores were determined for each option and ranked accordingly. **Option 1**, deviation of pipeline, was considered the most feasible option.

The conceptual engineering details for Option 1 are as follows:

- The deviated pipeline will be constructed first;

- The deviated pipeline will run in a northerly direction around the western side of the new proposed ADF;
- Stop valves will be placed on either side of the existing piece of pipeline to facilitate a shorter duration for tapping in;
- The new deviated pipeline will have an unobstructed servitude of 9 metres;
- The new deviated pipeline will have long radius bends to facilitate pigging;
- The soil cover to the pipeline will be a minimum of 2 metres.

A technical memorandum compiled for the deviation of the Transnet pipelines is attached in **Appendix L**.

4.5 Kusile Bulk Water Pipeline

The Kusile Bulk Water Pipeline, which runs from Kendal PS to Kusile PS traverses the southern boundary of the site. This pipeline will not be required to be deviated.

4.6 Liner system

A waste classification was carried out on the ash and it was classified as a Type 3 waste . low hazard waste (Report no: JW030/13/D121-Rev3) which requires disposal on a landfill with a Class C barrier system. A Class C barrier system entails the use of clay or a feasible alternative. Clay is not available on the footprint of the ADF. Tests were done on the in-situ soils to be considered as an alternative to the clay component of the liner. Falling head permeability tests proved that reworking the in-situ material could result in a permeability of 10^{-5} cm/s. It is recommended that the in-situ soils, in conjunction with a 2 mm geo-membrane be used in the barrier system.

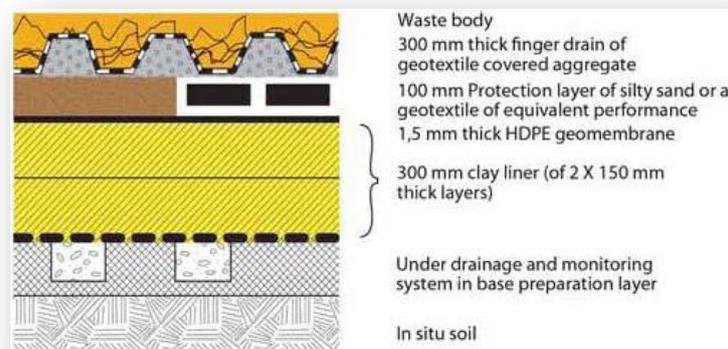


Figure 2: Typical Class C Landfill Barrier System

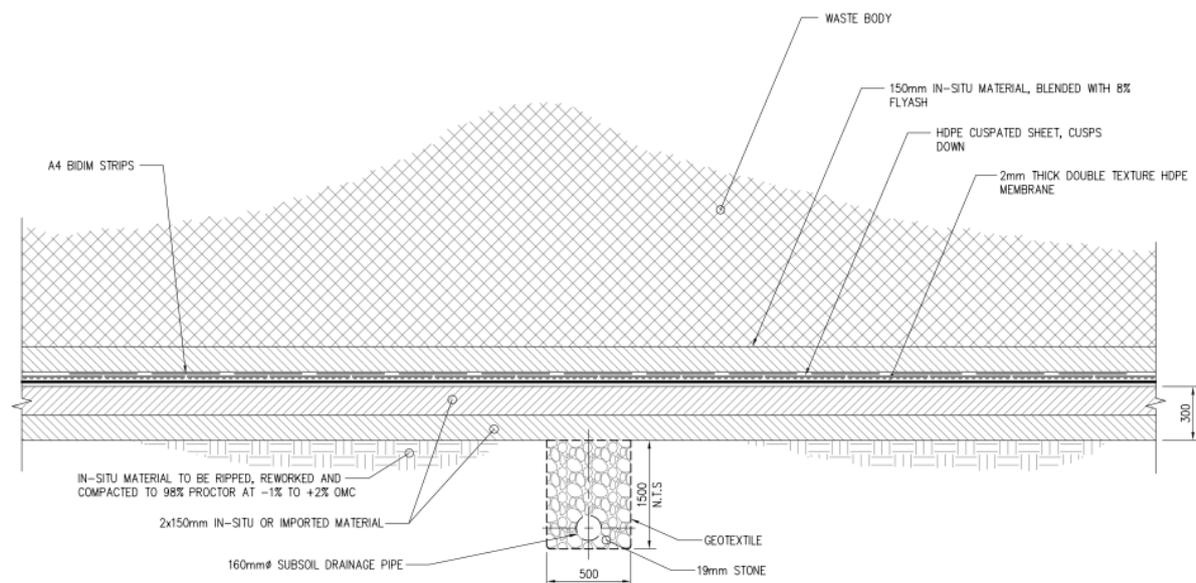


Figure 3: Proposed Class C Barrier System

4.6.1 Liner System Installation

The liner construction will be constructed in stages, as per the ash disposal requirements. At any given point there should be at least one to two years of available footprint of constructed liner. The liner system must be constructed with best practice in relation to manufacturing, transport, storage and installation. The liner system will be installed according to the manufacturer's specifications where applicable.

4.6.2 Sub-soil drainage system

The subsoil drainage system will be installed to prevent hydrostatic pressures on the liner system and to convey clean ground water away from the ash disposal site. The subsoil drain consists of a 110mm or 160mm perforated pipe enclosed in 19mm washed stone. The drains are at a 20m horizontal spacing.

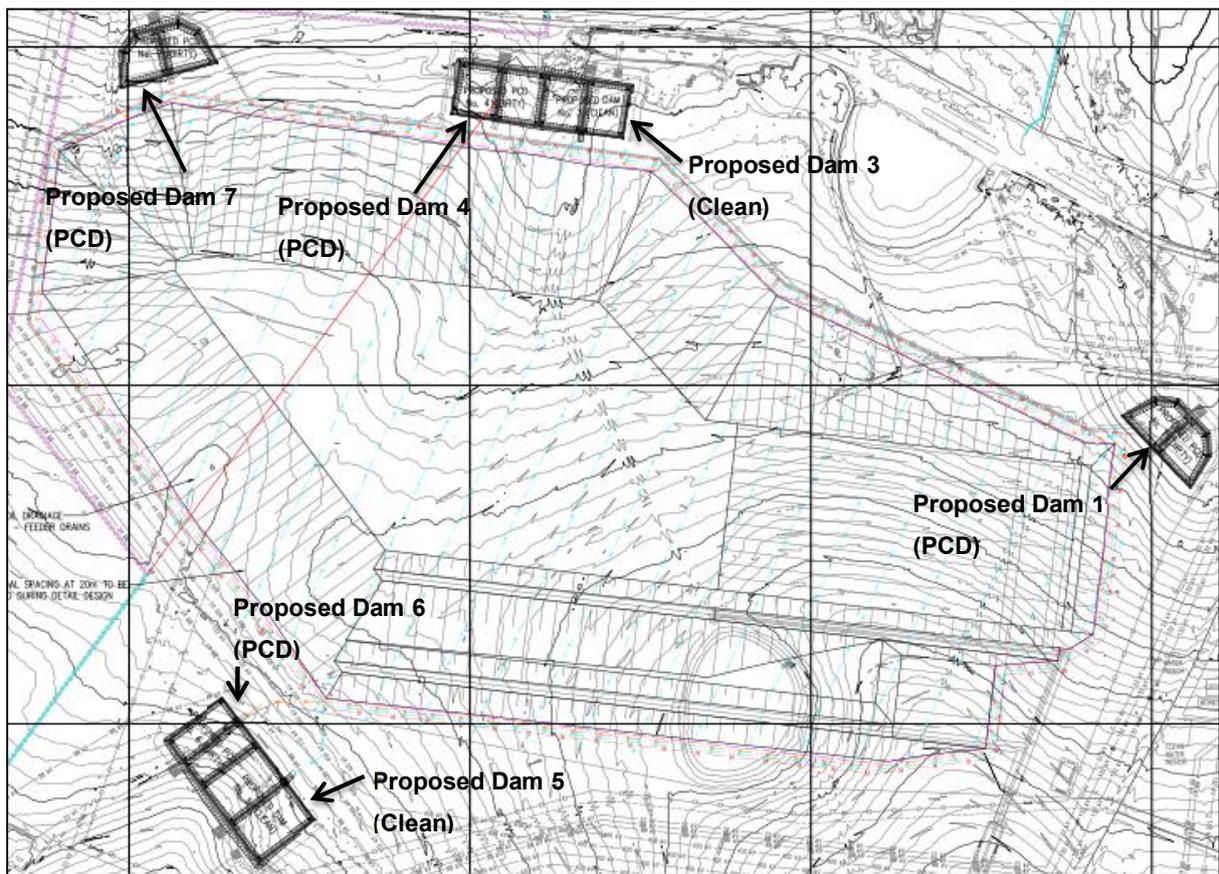


Figure 4: Layout of the sub-soil drainage system

4.7 Capping system

It is proposed that the current system of topsoiling and grassing be continued on the 30 year new ADF site.

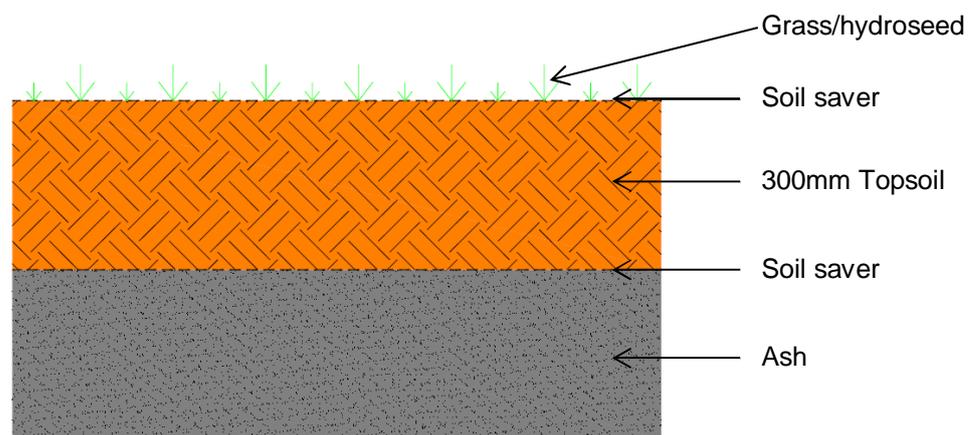


Figure 5: Section through rehabilitated ADF

4.8 E-Dump

A new Emergency Dump, E-dump, will be constructed to the south of the ADF. The facility will operate as an emergency storage of ash. Ash will be transported to the new E-dump on the conveyor system, which will run from the existing E-dump near the PS site to the new E-dump.

The storage capacity of the new E-dump will accommodate an ash volume of maximum continuous rating of the station for 7 days ash production. The total footprint area of the surface bed is 29,024 m² and will accommodate a total volume of 190,000 m³. The area will be bunded within a 1 metre high reinforce concrete wall. The facility will comprise of an impoundment facility and a silt trap. Water from the impoundment facility will be used in that area for washwater and dust suppression.

The surface bed will be cast in 25 m² panels, with expansion joints in between the panels. The expansion joints will comprise of expandable polypropylene filler and will be sealed off at the surface with a two component polyurethane sealant. This will render the joint water tight. The surface beds will be cast with a floor slope of 1 in 200 to facilitate the drainage of stormwater off the beds.

It is proposed to use fibre reinforced concrete due to the ease of construction. The strength and durability of the concrete and its functionality will not be compromised by this choice of material.

5 STORMWATER MANAGEMENT PHILOSOPHY

The PCDs as indicated above will need to be designed in compliance with Government Notice 704. More specifically, Clause 6 (d) of the regulation indicates that:

“Design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years.”

In order to achieve the above, a continuous model was set-up to simulate the duration as mentioned in the regulation in order to determine the performance of the proposed stormwater impoundment infrastructure under normal operating conditions. Following the finalisation of the model, the water balance may be derived for the new ADF once all proposed stormwater infrastructure has been determined.

5.1 Objectives

In order to understand the stormwater management system and the relevance of each of the proposed impoundment and conveyance structures, an integrated water balance needs to be consulted.

This also informs the design of any facility that needs to comply with Government Notice 704. Kendal PS does not have an integrated water balance therefore a conceptual water balance is being proposed for the stormwater management system.

5.2 Existing Stormwater Management System

Currently, the clean water and impacted water are separated within the PS terrace and handled separately. The clean water reports to the Clean Water Dam and the impacted water reports to the Dirty Water Dam via a water Crossover Plant and Silt Trap. Surface runoff within the catchment draining naturally to the above Dirty Water Dams are diverted around it to the Clean Water Dam by means of a berm, located to the north of the dams, and conveyed via a concrete channel located to the south of the dams.

The Farm Dam, located to the west of the existing ADF, does not form part of Kendal Power Station's water balance and is therefore not included in this report.

The current stormwater management is summarised in Figure 6 below and is described in detail thereafter.

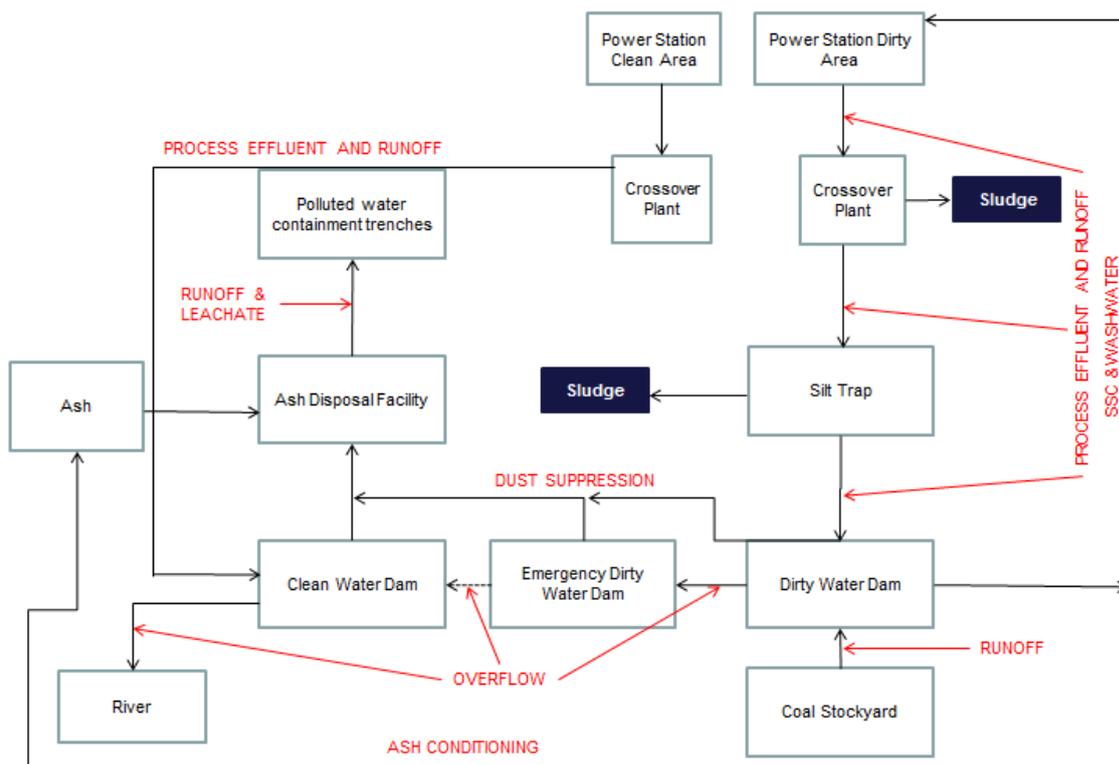


Figure 6: Current Stormwater System

Power Station Terrace

The PS terrace is predominantly considered to be clean with most of the impacted water coming from the process drains. Table 2 below gives a list of the clean and impacted (dirty) catchment areas on the PS terrace.

Table 2: Power Station Terrace - Catchment areas

Catchment	Area (m ²)	Drains To
Dirty Area	274,787	Dirty Water Dam
Station Transformer Yard - Clean	142,469	Clean Water Dam
Generator Roof – Clean	30,929	Clean Water Dam
SW Corner - Clean	176,341	Clean Water Dam
North Clean Area	290,390	Veld discharge (Clean)
Total Power Station Terrace area =	914,916	

5.2.2 Impacted Areas

The impacted area within the PS terrace is located centrally, in the vicinity of the Boiler and Turbine houses. An underground dirty water pipe system, located centrally within the plant, conveys dirty wash water and some runoff to the cross-over plant, where the water is treated, the sludge is removed and then the treated water is conveyed to the dirty water dam.

The Coal Stockyard is also classified as an impacted area. Concrete channels constructed along the boundary of the coal stock yard discharge storm water into an existing settling and attenuation basin which is located at the coal stockyard. At the settling basin the solids settle out of suspension and the liquid are then conveyed via a pipe to the Dirty Water Dam.

Stormwater runoff from the emergency dump is contained locally within a pollution control facility.

5.2.3 Clean Areas

Clean surface water runoff from the PS terrace is collected in an underground clean water pipe system, located centrally within the plant, conveying clean storm water runoff to the cross-over plant then to the Clean Water Dam. Clean storm water runoff that is not collected in the central underground clean water pipe system is collected in concrete channels constructed along the boundary of the plant. On the southern side of the plant the water collected in the channels is discharged and is collected in the Clean Water Dam and on the northern side of the plant the clean water is discharged into the surrounding veld area.

Clean Stormwater runoff from the surrounding veld area on the southern side of the plant is caught by an existing earth berm which directs the storm water runoff to a canal that conveys the water to the clean water dam. This berm is not currently effective as it has been eroded over time and also removed in areas for access.

5.2.4 Cross over plant

No information was available for the design capacity of this facility as well as the process flow. All information contained within the attached Water balance is assumed, based on the

diameter of the clarifiers. The percentage of sludge produced was assumed as approximately 2%.

5.2.5 Silt Traps

Before discharging into the Dirty Water Dam, silt is first settled out at the silt trap which is located in close proximity to the dam. The silt trap is divided into two compartments to facilitate maintenance. Each compartment is concrete lined. An adjustable weir controls the outflow from each compartment to the Dirty Water Dam, which is assumed to be designed to attenuate the outflow to settle out the solids.



Figure 7: Kendal PS Concrete lined Silt Trap with adjustable overflow weir

No information was provided for this facility. Assumptions on functionality were based on its footprint area.

5.2.6 Dirty Water Dam

The Dirty Water Dam is a licenced facility (DWS Licence No: 04/B20E/BCEG/1048) with an annual waste throughput of 1,095 M . The approved size of the facility is not stated in the licence. According to the latest (June 2013) hydrographic survey conducted by Kendal PS, the capacity of this dam was found to be 236,553 m³.

Impacted water is conveyed to the facility at an average rate of 35 /s via a 1500 mm diameter concrete pipeline, as reported by the power station. The current licence for this dirty water dam does not require it to be lined. In-situ weathered granite and felsite underlays the site and acts as a natural barrier.

The Dirty Water Dam has an earth wall with a concrete weir spillway which overflows into the Emergency Dirty Water Dam. A filter drain is located within the dam wall. Upstream and downstream faces of the dam wall, constructed at slopes of 1:2.5 (v:h), are lined with rip-rap for erosion protection against wave action. The base of the dam wall is keyed into the in-situ stiff residual material to prevent against sliding.



Figure 8: Kendal PS Dirty Water Dam with spillway in background

5.2.7 Emergency Dirty Water Dam

The Emergency Dirty Water Dam is a licenced facility to receive a maximum of 55 M of impacted water (duration not specified in the WUL) as an overflow from the Dirty Water Dam when the Dirty Water Dam is full. The approved size of the facility is not stated in the licence. According to the latest (June 2013) hydrographic survey conducted by Kendal PS, the capacity of this dam was found to be 89,335 m³.

Design and construction of the dam wall is as per the Dirty Water Dam. However, the overflow spillway is a trapezoidal channel (approximately 20 metres wide, lined with renomattresses). The spillway discharges to the Clean Water Dam.



Figure 9: Kendal PS Emergency Dirty Water Dam overflow channel

5.2.8 Clean Water Diversion Berm and Channel

An earth berm was designed to divert clean stormwater run-off around the dirty water dams and discharge it to a concrete lined channel which discharges to the Clean Water Dam. However, only remnants of this berm remain due to erosion and removal to open vehicular accesses.

The concrete lined stream diversion trapezoidal channel, approximately 23 metres wide at the top, discharges to the Clean Water Dam. In order to prevent erosion at the discharge point to the Clean Water Dam, a still basin was constructed at the discharged end. This drains to the dam via a reno-mattress lined chute.

5.2.9 Clean Water Dam

The Clean Water Dam is a licenced facility and is contained within the same licence as referenced previously. Design and construction of the Clean Water Dam is the same as the Dirty Water and Emergency Dirty Water Dams. It is licenced to have a storage capacity of 90 M . According to the latest (June 2013) hydrographic survey conducted by Kendal PS, the capacity of this dam was found to be 86,790 m³. A concrete overflow spillway discharges to the natural watercourse.

5.2.10 Coal Stockyard Attenuation Basin

The coal stockyard is located to the south east of the PS terrace and covers an area of approximately 73 hectares. This area comprises of the following infrastructure:

- Coal stockpile,
- Concrete lined channels intercepting stormwater run-off and discharging it to the settling basin,
- Settling and attenuation basin with a combined capacity of 10 M .

The surface runoff is conveyed via concrete lined open drains which are located to the west of the coal stockyard. Two sets of drains, one running in a southern direction and the other northerly, drain to an attenuation dam located centrally to the western boundary of the site.

Upstream of the attenuation basin is a settling basin. The settling basin is concrete lined and facilitates the settlement of solids mobilised from the coal during the storm event. The combined structure is not sized in compliance with the requirements of GN 704 and excess flow reports to the Dirty Water Dam via a 1.2 metre diameter concrete pipe.

Mixing of water in the settling basin and attenuation basin is allowed in the current design. This will need to be modified. Excess flow exits the facility via the settling basin. It is proposed that the excess flow exits the facility via the attenuation basin.

5.2.11 Emergency Dump Stormwater Management

The existing E- Dump is located between the PS and the existing ash dump, on the PS terrace. The facility operates as an emergency storage of ash if the spreaders or stacker at the continuous ash dump is inoperable. The existing area of the E-Dump comprises of a reinforced concrete surface bed with an area of approximately 5,500m². The existing E-Dump includes a silt-trap and stormwater impoundment facility, approximately 1,000m³ in capacity. This impoundment facility has not been designed to comply with GN704 and a separate project is underway to ensure compliance and also to extend the current footprint area and capacity of the E-Dump, which will be required during the operation of the existing ADF.

5.2.12 Pumps and Pipelines

The pumps serving the Dirty Water Dam, Emergency Dam and Clean Water Dam are located downstream of the Clean Water Dam. These pumps deliver water to the ash dump, for dust suppression, and to the PS for wash water and ash conditioning. Ten (10) pumpsets are provided for this, of which four (4) are dedicated to the ash dump and the remainder to wash water at the PS terrace. The combined flow to the ash dump is 60 /s on average and 80 /s on average to the PS terrace.

Two dedicated sets of steel pipelines leave the pump station, a 150mm diameter in a westerly direction to the ash dump and a 350mm diameter in a north-easterly direction to the PS terrace. Currently, the latter pipeline is in the process of being replaced. Both pipelines, painted in conspicuous colours as per the conditions of the WUL, are located above ground and fixed onto concrete plinths.

5.3 Objectives of Proposed Stormwater Management System

The new stormwater system will need to manage the stormwater run-off from the 30 Year ADF, as well as manage the impacts that this has on the existing three (3) dam system. All dams proposed in this system will need to be in compliance with GN704. This will entail the following:

- Confine any unpolluted water to a clean water system, away from any dirty area;
- Design, construct, maintain and operate any clean water system so that it is unlikely to spill into any dirty water system more than once in 50 years;
- Collect the water arising within any dirty area, including seepage;
- Design, construct and maintain all stormwater systems in such a manner as to guarantee the serviceability of such conveyances for flows up to and including those arising as a result of the maximum flood with and average period of recurrence on once in 50 years;
- Design, construct, maintain and operate any dirty water system so that it is unlikely to spill into any clean water system more than once in 50 years.

During the proposed activity, clean water that originally contributed to the runoff within the catchment would temporarily be lost as this water will be diverted to the proposed pollution control dams as impacted water. The proposed activity will be constructed and operated in phases relating to a temporary loss of a maximum ten year period. The ten year period comprises of a five year preparation and operating footprint and five year rehabilitation footprint. The maximum footprint temporarily removed as a contributor to the catchment runoff is 170 hectares.

The proposed activity spans two quaternary catchments, B20 E and B20F. The maximum mean Annual Runoff (MAR) recorded on these two quaternary catchments is 34 mm, which equates to a yearly volume of 57,800 m³ loss in the catchment. This is merely a 0.03% loss within the catchment over a ten year period. The catchment runoff will be reinstated to the natural state once the activity has been completed and the footprint is rehabilitated fully.

5.4 MODELING APPROACH AND ASSUMPTIONS

A fifty (50) year daily time-step model was built using Microsoft Excel for the different scenarios and options as described in the subsequent sections of this report.

5.4.1 Rainfall data

The model takes into consideration daily recorded rainfall closest to the site under investigation. An uninterrupted data set could not be found for Kendal PS, so the one for Cologne in Mpumalanga (Station No. 0478008_W) was used to make-up the required rainfall data. Cologne is located approximately six (6) kilometres south-east of Kendal PS. Data for the period from May 1963 to August 2000 was used from Cologne. Recorded data for Kendal PS was used for the period from September 2000 to May 2013. The combined data set represents fifty (50) years of recorded rainfall. The table below gives the statistics of the data set used.

Table 3: Recorded rainfall statistics

Recurrence Interval (1 in)	1 Day Rainfall Depth (Cologne)	1 Day Rainfall Depth Range (mm)	No. of Occurrences in Data Set
2	54	50 - 65	24
5	74	66 . 85	16
10	90	86 . 100	4
20	106	101 . 124	1
50	131*	125 - 135	1

* A rainfall value of 106mm was changed to 131mm to simulate the 50 year 24 hour rainfall depth

5.4.2 Operating flows

Table 4: Operating flows used in time-step model

Use	Quality	Description	MI/a	m ³ /d
Process Waste	Dirty	Power station to dirty water dam	4350	11918
* Process Waste	Dirty	Power station to dirty water dam	88	241
** Washwater	Dirty	Dirty Water Dam to SSC + Washwater	1720	4712
Ash Conditioning	Dirty	Dirty Water Dam to Ash Conditioning	630	1726

* This area was previously deemed %clean+

** This flow increase from 1,570 MI/a to 1,720 MI/a, due to a change in the power station operations.

*** This information was received from Maxwell Makhanya and Jacobus Van Den Bergh of Kendal Power Station.

5.4.3 Stormwater runoff calculations

The steps for the calculation of stormwater runoff volumes for the areas and dams are given below.

Step 1: Catchment areas are calculated for each area and dam.

Table 5: Catchment areas

Catchment	Hectares
Power Station Clean Area	35
Power Station Dirty Area	27
Coal Stockyard	73
Dirty Water Dam	15
Emergency Dirty Water Dam	5
Clean Water Dam	330
Dam 1	83
Dam 2	5.2
Dam 3	115.5
Dam 4	56
Dam 5	147.6
Dam 6	61
Dam 7	84

Step 2: The Run-off coefficient (C) for each catchment area is calculated. The C-values are calculated as per the SANRAL Drainage Manual. Table 3.7 in the manual provides a description of recommended values of C.

The recommended values are selected according to three characteristics of the catchment under consideration. They are namely:-

- a) Surface slope classification
- b) Permeability classification
- c) Vegetation classification

A C-value for each characteristic is selected and the sum of which is the overall C-value, known as C1, for a particular catchment. C1 is then multiplied by adjustment factors for each return period, i.e. 2, 5, 10, 20, 50, 100 years. The return period for each storm event was determined using the rainfall depth and comparing it against the one day depth as contained in Table 3. Table 3.8 in the aforementioned Manual provides adjustment factors for the value of C1.

Table 6: C values calculated according to catchment characteristics

Catchment	Area (m ²)	Surface Slope Classification	Cs	Permeability Classification	Cp	Vegetation Classification	Cv	C1
Power Station Clean Area	354 414	Flat Areas (3-10%)	0.08	Semi-permeable	0.16	Grasslands	0.21	0.45
Power Station Dirty Area	274 787	Flat Areas (3-10%)	0.08	Impermeable	0.26	No vegetation	0.28	0.62
Coal Stockyard	732 903	Hilly (10-30%)	0.16	Semi-permeable	0.16	No vegetation	0.28	0.6
Dirty Water Dam	150 000	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37
Emergency Dirty Water Dam	50 000	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37
Clean Water Dam	3 300 000	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37
Dam 1A – ADF Catchment	649 687	Hilly (10-30%)	0.16	Permeable	0.08	No Vegetation	0.28	0.52
Dam 1B – Grassland Area	176 770	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37

Dam 2A – E-dump Area	30 000	Flat Areas (3-10%)	0.08	Impermeable	0.26	No Vegetation	0.28	0.62
Dam 2B – Grassland Area	22 000	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37
Dam 3A – ADF Catchment Steep	563 000	Hilly (10- 30%)	0.16	Permeable	0.08	No Vegetation	0.28	0.52
Dam 3B – ADF Catchment Flat	490 000	Vlies & Pans (<3%)	0.03	Permeable	0.08	No Vegetation	0.28	0.39
Dam 3C – Grassland Area	102 000	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37
Dam 4A – ADF Catchment Steep	410 000	Hilly (10- 30%)	0.16	Permeable	0.08	No Vegetation	0.28	0.52
Dam 4B – ADF Catchment Flat	150 000	Vlies & Pans (<3%)	0.03	Permeable	0.08	No Vegetation	0.28	0.39
Dam 5A – ADF Catchment Steep	858 000	Hilly (10- 30%)	0.16	Permeable	0.08	No Vegetation	0.28	0.52
Dam 5B – ADF Catchment Flat	35 000	Vlies & Pans (<3%)	0.03	Permeable	0.08	No Vegetation	0.28	0.39
Dam 5C – Grassland Area	583 000	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37
Dam 6A – ADF Catchment Steep	410 000	Hilly (10- 30%)	0.16	Permeable	0.08	No Vegetation	0.28	0.52
Dam 6B – ADF Catchment	200 000	Vlies & Pans (<3%)	0.03	Permeable	0.08	No Vegetation	0.28	0.39

Dam 7A – ADF Catchment	700 000	Hilly (10-30%)	0.16	Permeable	0.08	No Vegetation	0.28	0.52
Dam 7C – Grassland Area	141 265	Flat Areas (3-10%)	0.08	Permeable	0.08	Grasslands	0.21	0.37

Table 7: C values obtained from adjustment factors for each catchment area

RP	PS Clean Area	PS Dirty Area	CSY	Dirty Water Dam	Emerg Dirty Water Dam	Clean Water Dam	Dam 1A	Dam 1B	Dam 2A	Dam 2B	Dam 3A
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.21	0.23	0.26	0.18	0.18	0.18	0.25	0.25	0.19	0.19	0.25
2	0.23	0.31	0.30	0.19	0.19	0.19	0.32	0.24	0.31	0.19	0.32
5	0.25	0.34	0.33	0.20	0.20	0.20	0.34	0.26	0.34	0.20	0.34
10	0.27	0.37	0.36	0.22	0.22	0.22	0.37	0.28	0.37	0.22	0.37
20	0.30	0.42	0.40	0.25	0.25	0.25	0.40	0.30	0.42	0.25	0.40
50	0.37	0.51	0.50	0.31	0.31	0.31	0.49	0.36	0.51	0.31	0.49
100	0.45	0.62	0.60	0.37	0.37	0.37	0.58	0.43	0.62	0.37	0.58

RP	Dam 3B	Dam 3C	Dam 4A	Dam 4B	Dam 5A	Dam 5B	Dam 5C	Dam 6A	Dam 6B	Dam 7A	Dam 7C
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
2	0.25	0.24	0.32	0.25	0.32	0.25	0.24	0.32	0.25	0.32	0.24
5	0.27	0.26	0.34	0.27	0.34	0.27	0.26	0.34	0.27	0.34	0.26
10	0.29	0.28	0.37	0.29	0.37	0.29	0.28	0.37	0.29	0.37	0.28
20	0.32	0.30	0.40	0.32	0.40	0.32	0.30	0.40	0.32	0.40	0.30
50	0.38	0.36	0.49	0.38	0.49	0.38	0.36	0.49	0.38	0.49	0.36
100	0.45	0.43	0.58	0.45	0.58	0.45	0.43	0.58	0.45	0.58	0.43

Step 3: The adjusted C-values for the PCDs are increased by 7% to take leachate into account.

Step 4: Rainfall, catchment area and C-values are multiplied with each other to obtain a volume of runoff for each area and dam.

5.5 Stages Modelled

Two stages of construction of the dams were modelled. Table 7, below, describes each stage.

Table 8: Stages modelled

STAGES MODELLED		
STAGE 1		
	Dam 1	Pollution Control Dam
	Dam 2	Pollution Control Dam
	Dam 3	Clean Water Dam
	Dam 4	Pollution Control Dam
	Dam 5	Clean Water Dam
	Dam 6	Pollution Control Dam
STAGE 2		
	Dam 1	Pollution Control Dam
	Dam 2	Pollution Control Dam
	Dam 3	Clean Water Dam
	Dam 4	Clean Water Dam
	Dam 5	Clean Water Dam
	Dam 6	Clean Water Dam
	Dam 7	Pollution Control Dam

5.6 Modelling Results

The results of the modelling exercise are summarized in Table 8, below.

Table 9: Modelling Results

Volume m ³		
STAGE 1	Dam 1	130,000
	Dam 2	9,750
	Dam 3	158,000
	Dam 4	135,000
	Dam 5	197,000
	Dam 6	90,000
STAGE 2	Dam 1	130,000
	Dam 2	9,750
	*Dam 3/4	293,000
	*Dam 5/6	287,000
	Dam 7	130,000

*At Stage 2, Dam 3 (PCD) and Dam 5 (PCD) become clean water dams.

5.7 Proposed Infrastructure

The proposed infrastructure is detailed below. Layout drawings of the proposed infrastructure for the option modelled are attached to the appendices.

5.7.1 Pollution Control Dams

The two (2) existing pollution control dams, dirty water dam and emergency dirty water dam, remain in place. Additional Dams 1, 2, 4, 6 and 7 are proposed. The capacities of the dams are given in Table 9, below.

Table 10: Dam Capacities

Dam	Volume m ³
Dam 1	*140,000
Dam 2	9,750
Dam 4	135,000
Dam 6	90,000
Dam 7	130,000

* + 2 days storage for dust suppression water.

The performance (dam levels) of these PCDs for the fifty (50) year simulation period is shown on the respective graphs below.

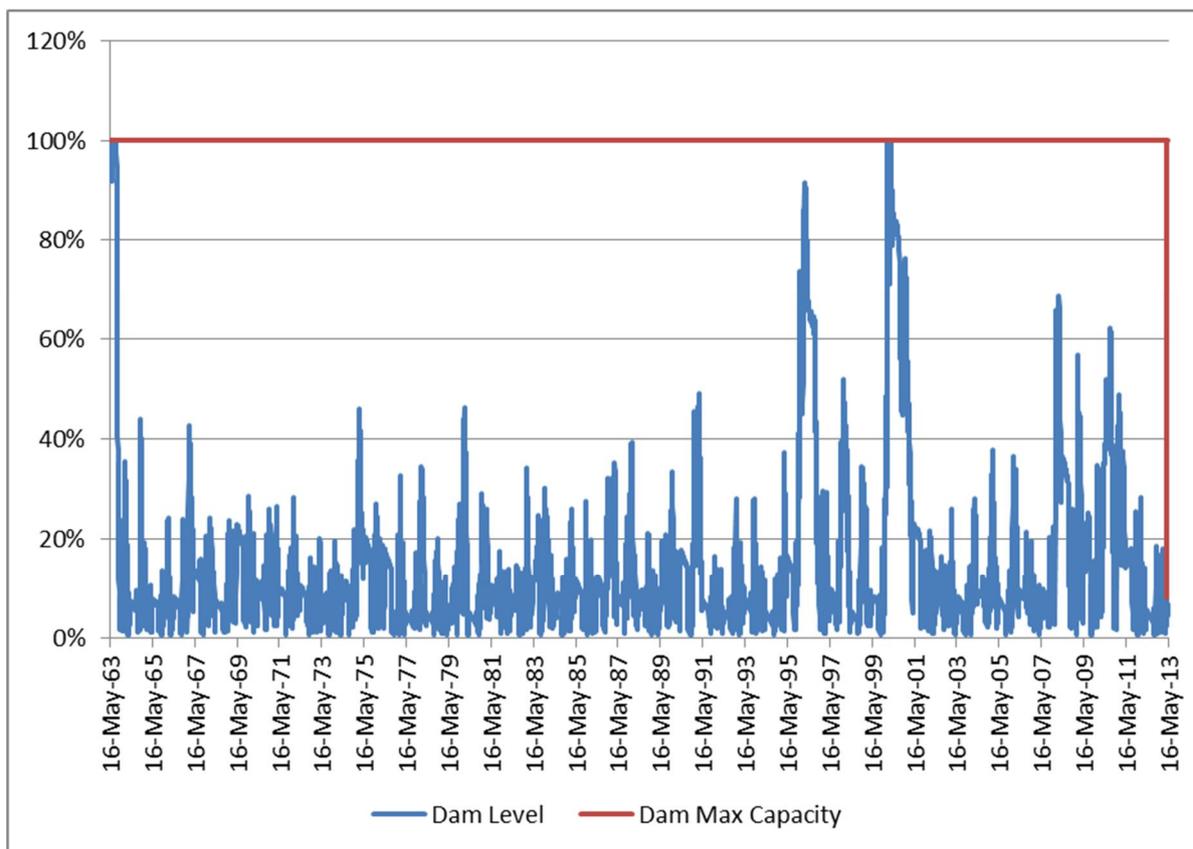


Figure 10: Dirty Water Dam Levels for Simulation Period

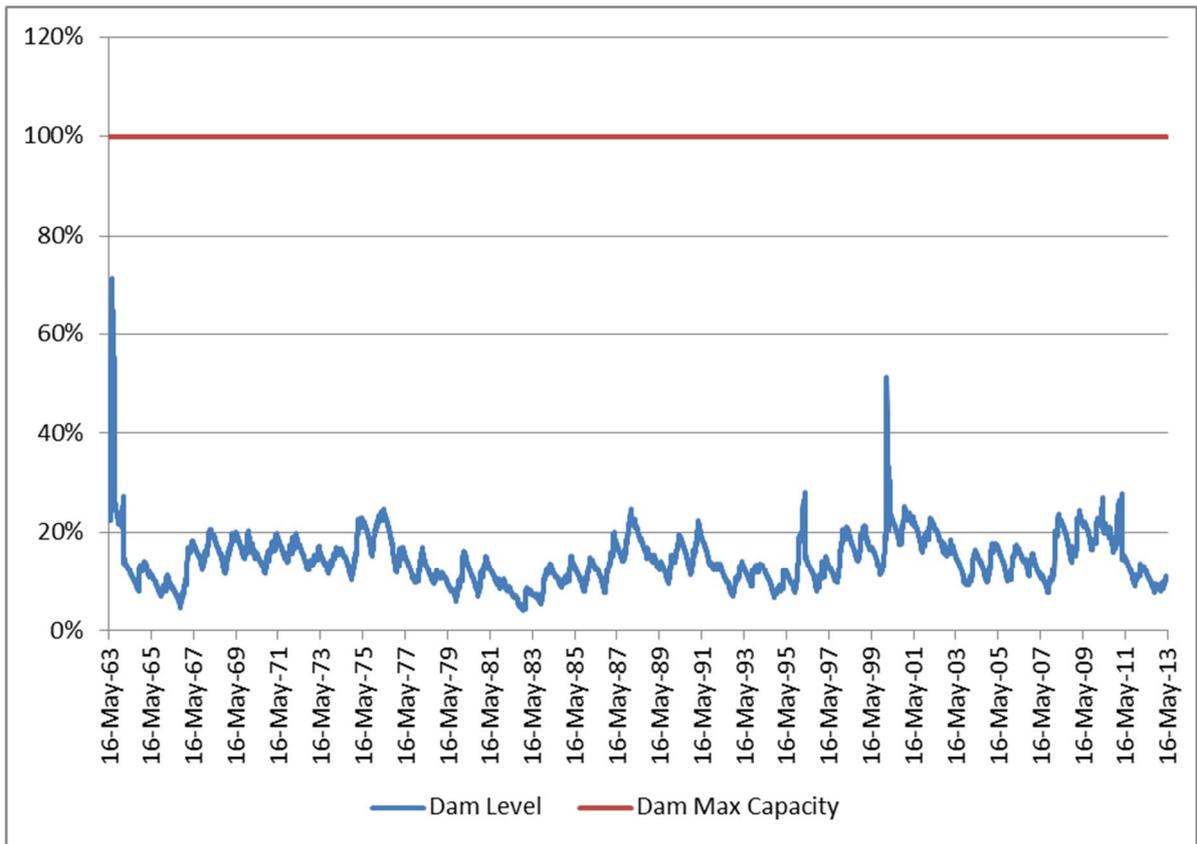


Figure 11: Emergency Dirty Water Dam Levels for Simulation Period

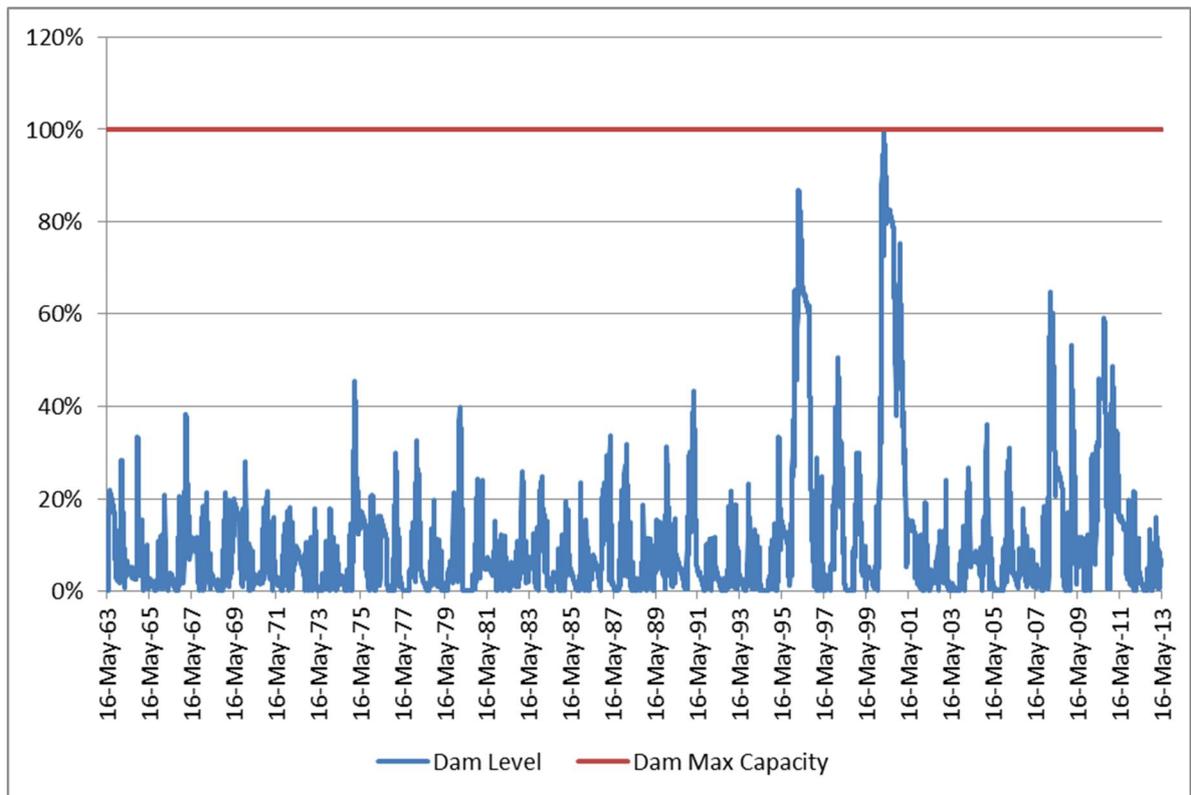


Figure 12: Proposed Dam 1 Levels for Simulation Period

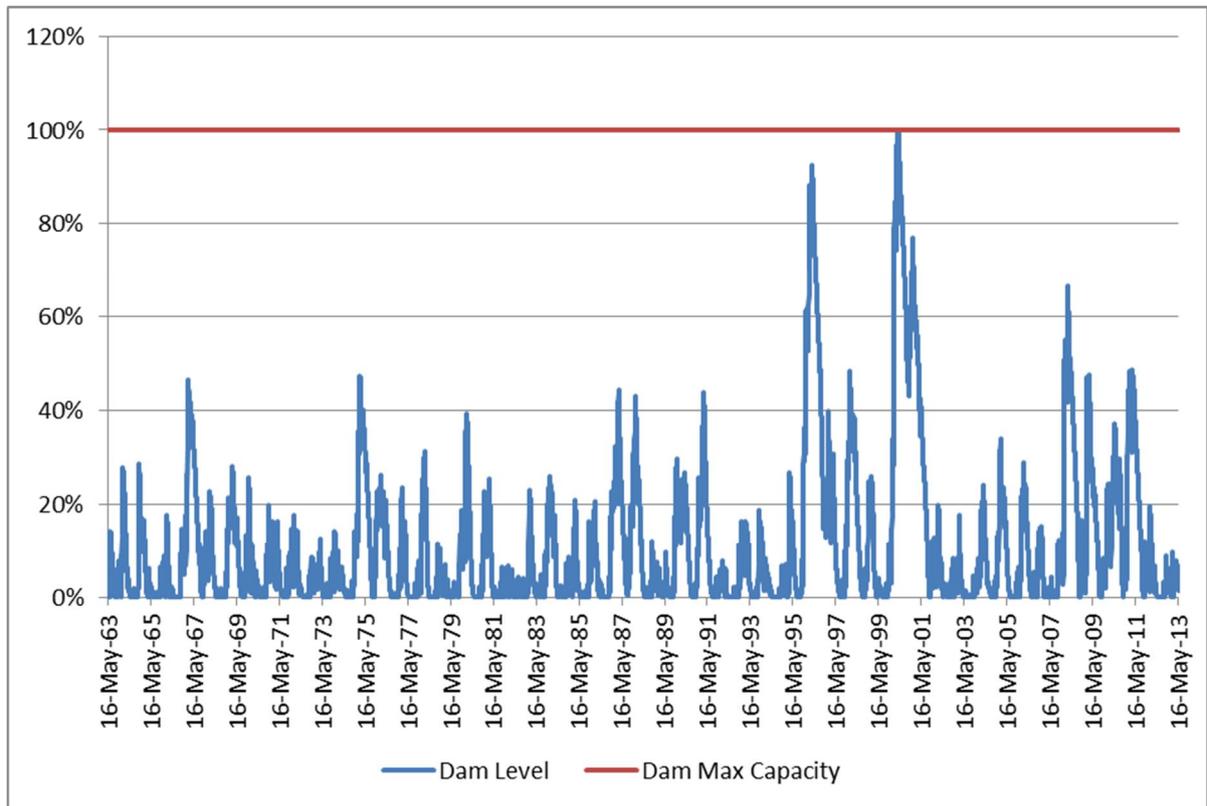


Figure 13: Proposed Dam 2 Levels for Simulation Period

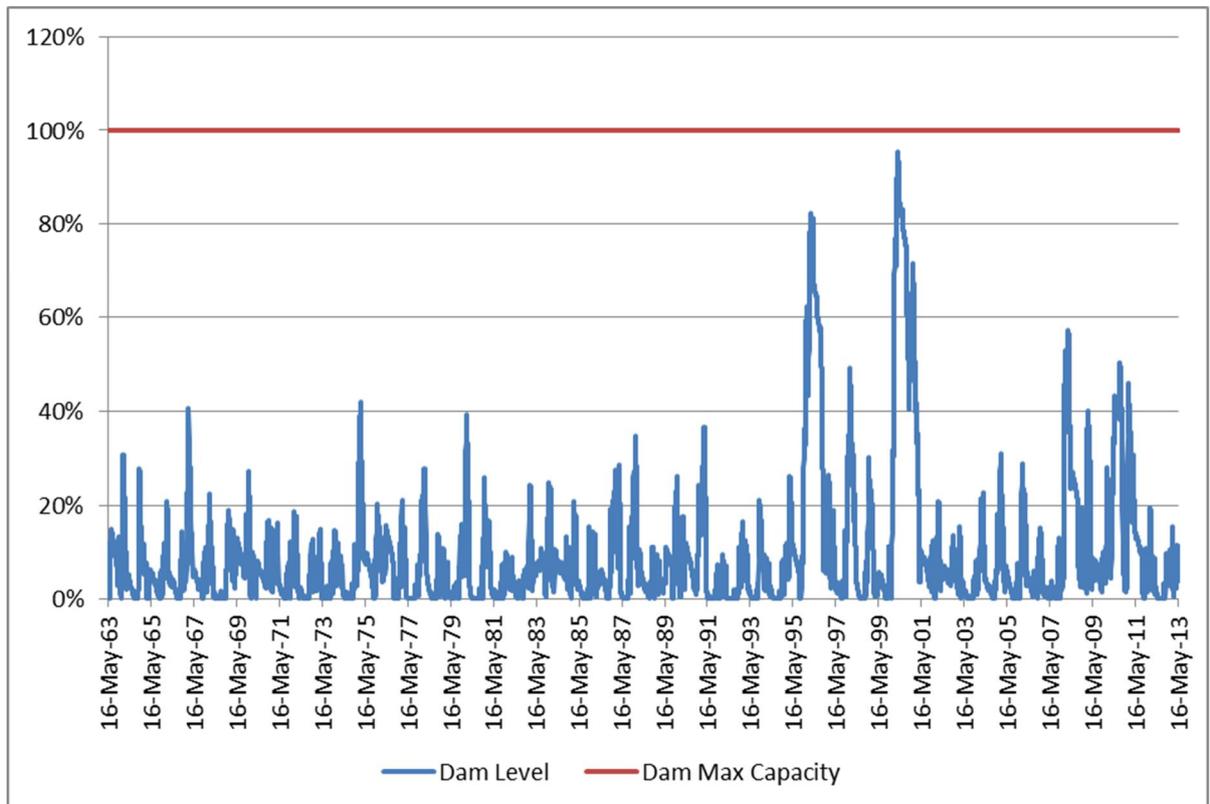


Figure 14: Proposed Dam 4 Levels for Simulation Period

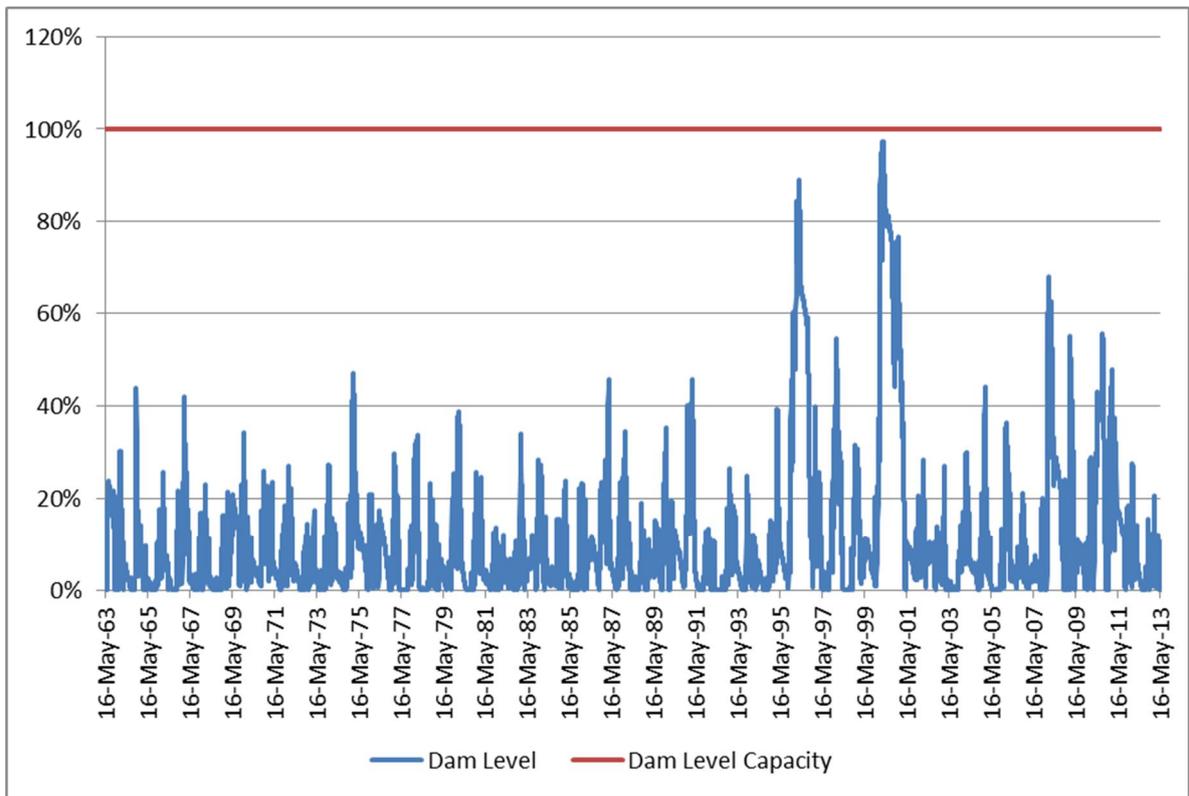


Figure 15: Proposed Dam 6 Levels for Simulation Period

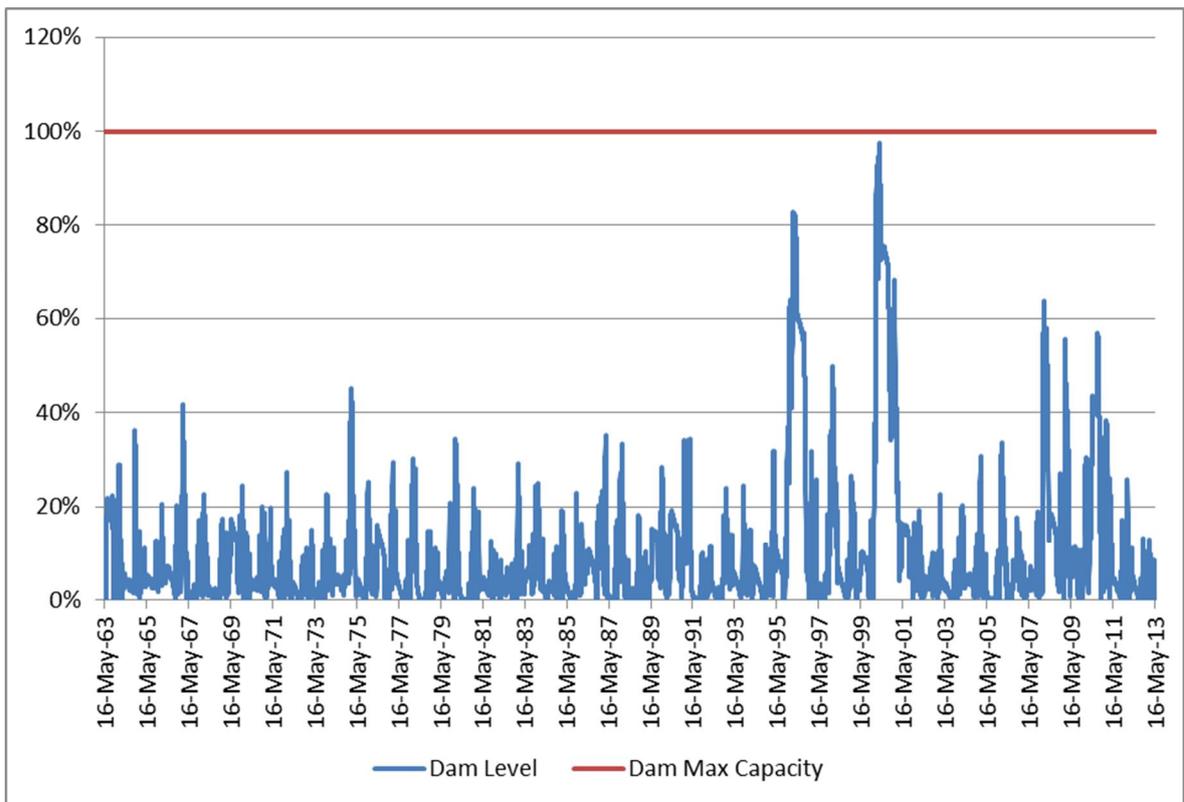


Figure 16: Proposed Dam 7 Levels for Simulation Period

5.7.2 Clean Water Dams

In addition to the existing Clean Water Dam, two (2) more dams are proposed for clean water containment emanating from the rehabilitated areas. These dams will be operated on a controlled release principle which is based on the receiving water quality. It is not the intention to impound clean water if not required, provided that the discharge quality is acceptable. If the water in these clean water dams are deemed impacted, it will be irrigated onto the areas that it emanated from or utilised in the PS water balance if possible.

The following are the proposed Clean Water Dams:

- Dam 3:158 M
- Dam 5:197 M

The performance (dam levels) of these three (including the existing Clean Water Dam) clean water dams for the fifty (50) year simulation period is shown on the respective graphs below.

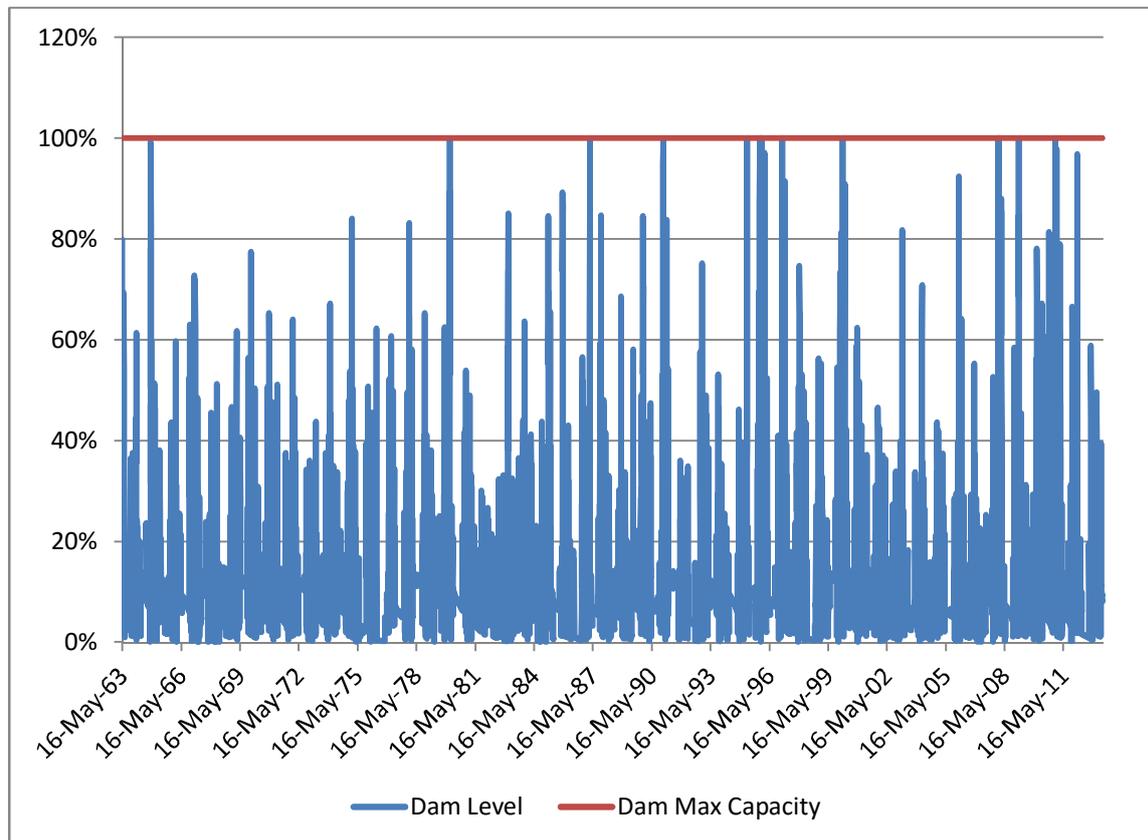


Figure 17: Existing Clean Water Dam Levels for Simulation Period

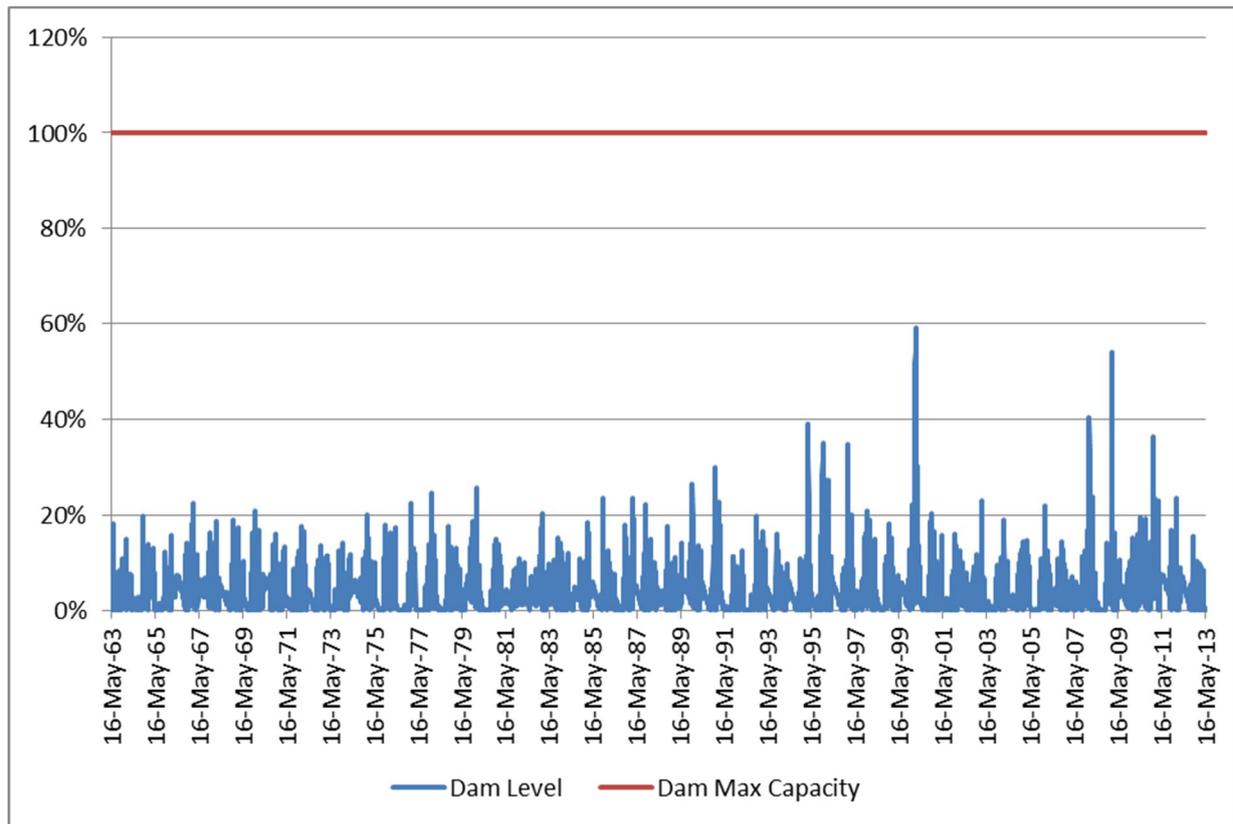


Figure 18: Proposed Dam 3 Levels for Simulation Period

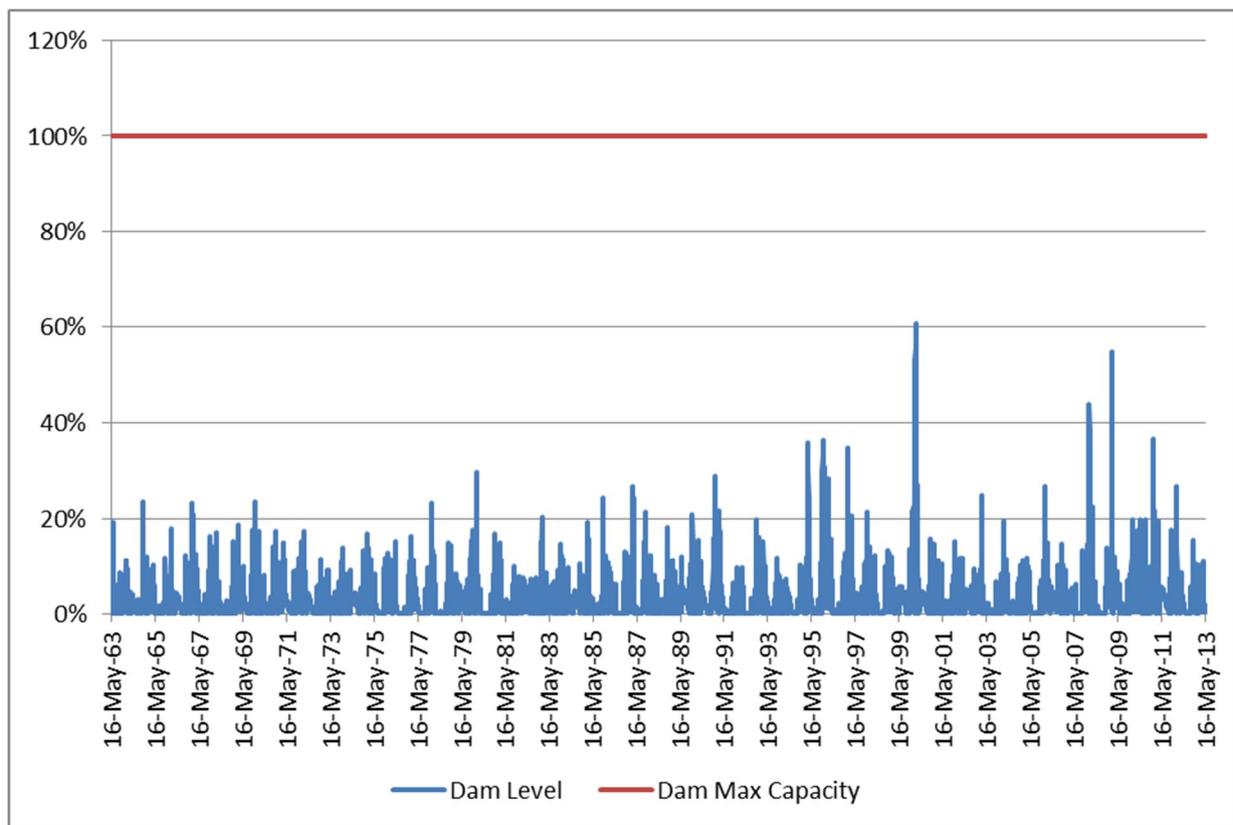


Figure 19: Proposed Dam 5 Levels for Simulation Period

5.7.3 Toe Paddocks

In order to prevent siltation within the channels and reduce the required velocities, it is proposed that paddocks be constructed at the toe of the advancing face to intercept run-off from the new ADF and allow this to overflow to the discharge channels.

The temporary structures will facilitate siltation. It is envisaged that the paddocks will be constructed from earth and with the lining over the paddock wall. The walls will have spillways to allow cascading of water from one paddock into the next. The paddocks will be covered over when dozing the side slope down to the final 1:5 slope for rehabilitation of that section of the facility.

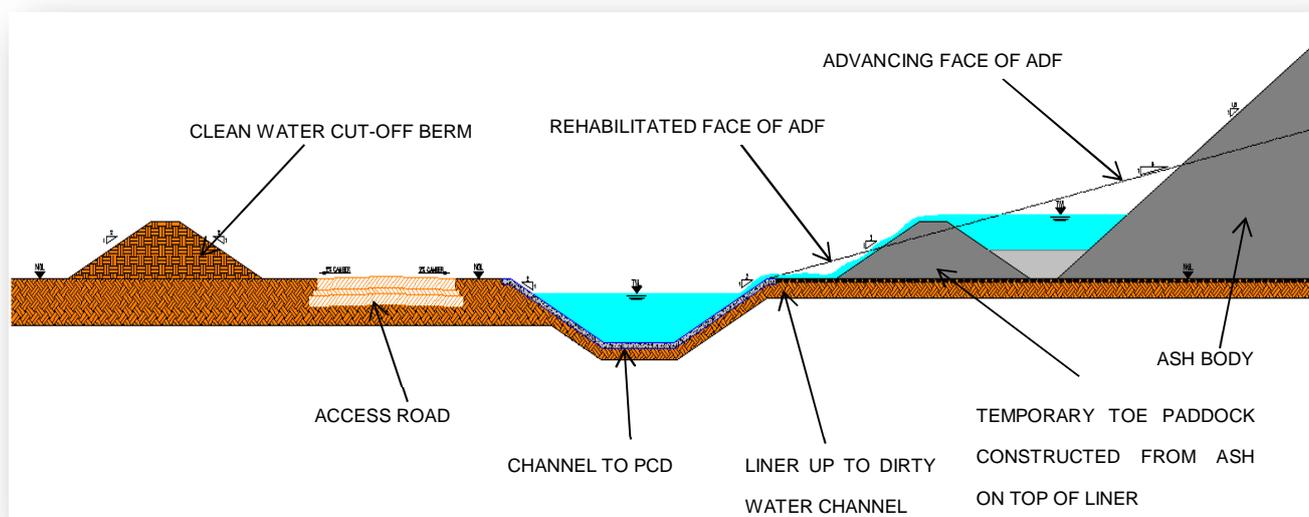


Figure 20: Positioning of Temporary Toe Paddocks

5.7.4 Storage Reservoirs

Apart from capturing runoff from its respective areas, water for dust suppression will also be stored in Dam 1. It is proposed that an additional two days of storage be allowed for, in the capacity of this dam.

5.7.5 Conveyance infrastructure (pumps, pipelines and channels)

The proposed operational philosophy around stormwater management will involve the construction of new infrastructure. Apart from the dams, as mentioned in the previous sections of this report, conveyance infrastructure will be required for the following reasons:

- Conveyance of spills from one facility to the next;
- Conveyance of dust suppression water from the relevant dams to the dedicated storage reservoirs;
- Conveyance of rehabilitated irrigation water from the relevant dams to the dedicated storage reservoirs;
- Dust suppression from storage reservoir to open ash area of the new ADF;

- Irrigation from storage reservoir to the rehabilitated area of the new ADF;
- Irrigation of the PS terrace grassed areas from the existing Clean Water Dam.

5.8 Dust Suppression Abstraction Philosophy

Impacted (dirty) Stormwater will be contained in six (6) pollution control dams, namely:

1. Dirty Water Dam (existing)
2. Emergency Dirty Water Dam (existing)
3. Dam 1 (proposed)
4. Dam 4 (proposed)
5. Dam 6 (proposed)
6. Dam 7 (proposed)

The operating philosophies of these dams are interlinked with respect to the abstraction of water for dust suppression, and will need to be managed effectively to ensure peak performance. The relationship between these dams is as follows:

- The Emergency Dirty Water Dam will need to always have 55 M available storage capacity therefore it should be given priority for dust suppression to maintain this volume.
- If the Emergency Dirty Water Dam has the available storage available, then water for dust suppression will have to be abstracted from the existing Dirty Water Dam, Dam 1, Dam 4, Dam 6 or Dam 7. Water will be abstracted from the dam with the highest volume by percentage of its storage capacity.
- Dam 1 will be used as a storage reservoir for dust suppression. Water from the five (5) other PCDs are pumped to Dam 1 for dust suppression. Dam 1 will be sized to accommodate a two (2) day storage capacity for dust suppression.
- The dust suppression depth ranges used in the water balance model are as follows:
 - Winter Months: 5.7 mm . 7 mm
 - Summer Months: 11.3 mm . 14 mm

5.9 Hydraulic Analysis

5.9.1 Sizing of “Clean” stormwater diversion drains and berms

Clean surface water runoff generated from rehabilitated areas of the new ADF will ultimately report into clean water drains running along the northern and southern toe lines of the new ADF.

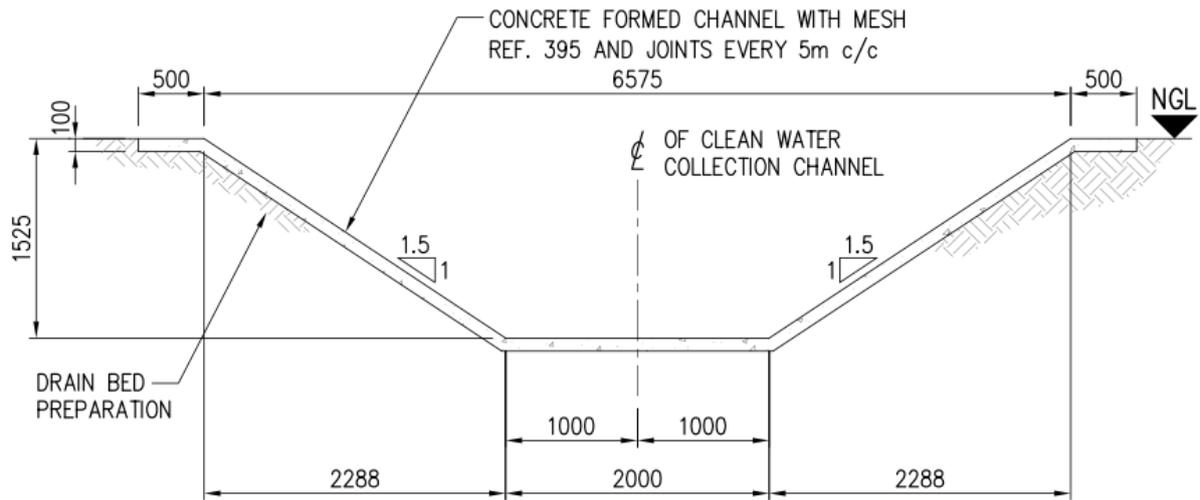


Figure 21: Clean Water Drain

5.9.2 Sizing of “Dirty” stormwater conveyance drains

Dirty surface water runoff generated from the open ash area of the new ADF will ultimately report into dirty water drains running along the perimeter of the new ADF.

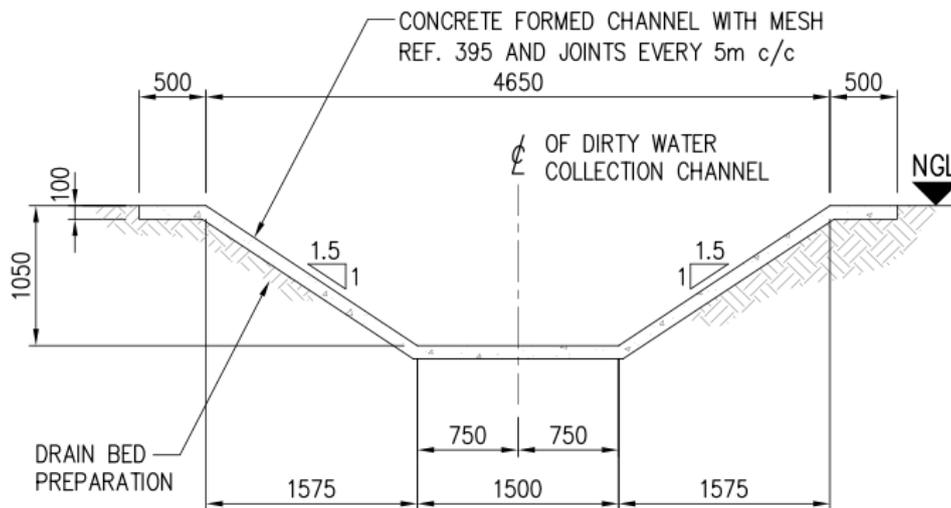


Figure 22: Dirty Water Drain

5.10 Water Balance

The Water Balance is shown in Appendix D. Normal operating levels for the dams, both existing and proposed, are shown on the graphs in Section **Error! Reference source not found.**

5.11 Operational Requirements

In sizing the proposed infrastructure, several assumptions were made for the operational philosophy surrounding the new ADF and its infrastructure. These assumptions need to be realised during operation in order to ensure the optimum performance of the new infrastructure.

5.11.1 Monitoring of Quality in Clean Water Dams

The Clean Water Dams, Dams 3 and 5 have been sized so that they do not spill more than once in fifty years, after also taking into consideration the irrigation onto the rehabilitated areas. The above mentioned dams will need to be monitored for water quality on a continuous basis. If the water is deemed clean (with respect to the discharge quality of the receiving environment), then it may be released. However, if the quality does not meet the discharge quality, then this water must be irrigated onto the rehabilitated areas or utilised in the PS water balance.

5.11.2 Maintaining Open Ash Areas for Dust Suppression

The option takes into account three open ash area sizes, of 93, 82 and 67 hectares to be maintained during operations and to balance the dirty water system using dust suppression without the need for a Water Treatment Plant. The respective dams have been sized accordingly. If significantly smaller areas are maintained, the dams recommended in this report will be too small to ensure that we do not spill more than once in fifty years from the pollution control dams.

5.11.3 Maintaining Silt Traps

The storage capacity of the proposed dams does not assume a continuous influx of silt into it as it is equipped with a silt trap. If these silt traps are not maintained as per their design requirements, the performance of the dams will be compromised. The silt traps will be finalised during Detailed Design and the operations thereof need to be communicated to the PS operators.

5.12 Way Forward for Stormwater Management

It is recommended that a Water Use Licence Application (WULA) be made for the water uses, as described in this report.

6 PHASED APPROACH TO ASH DISPOSAL FACILITY

A starter platform for the extendible and shiftable conveyors will be built first on the eastern side of the site. A 1:15 average sloped ramp (made of ash) will then be constructed using parallel shifts (1:10 slope between shifts plus level shiftable conveyor platforms) and will reach a maximum height of 75 metres which is the maximum height of the new ADF. The

rest of the new ADF will be constructed with the conveyor-stacker system using parallel shifts and ending with radial shifts.

7 OPERATION AND MAINTENANCE PLAN

There is currently an Operational Manual in place for the existing Kendal ADF which provides insight into all current activities on site. This Operational Manual will be revised during Detailed Design of the New 30 Year ADF.

7.1 Code requirements in terms of SABS 0286

The following needs to be in accordance with SABS 0286

- Management
- Operational phase appointment
- Facility audit
- Hazard classification
- Operating manual
- Operation of the ash dump
- Operation of silt trap/s and pollution control dam
- Monitoring and maintenance requirements
- Rehabilitation and environmental considerations

8 CAPITAL COST ESTIMATE

ZC conducted a high level capital cost estimate. The total capital cost for the new ADF is estimated to be R 2, 172, 440, 336.74 (Excluding VAT) and excluding the costs for the deviation of the Eskom Transmission and Distribution power lines. See **Appendix H** for a high level cost breakdown. (The breakdown also does not include costs for land acquisition and relocation of communities).

9 CONSTRUCTION AND OPERATION PHASES

ZC has compiled a table and drawing that documents the phasing of the project from the estimated start of construction (2025) to the planned end of operations (2055). Refer to **Appendix J** for the Construction and Operation Phases table and drawing.

10 WETLAND AVOIDANCE

Due to several restrictions on the Site H footprint, the new ADF as well as appurtenant infrastructure has been proposed to be constructed on wetlands and a pan. This could not be avoided in meeting the design objectives i.e. accommodating ash within the boundaries of the site. A technical memorandum has been drafted, which documents the implications on the project if the above-mentioned wetlands and pan are to be avoided. See **Appendix K** for this technical memorandum.

11 REFERENCES

- 11.1 Ramdayal, N., & Owens-Collins, S. (2016). *13615779-304421-1 REV3 Preliminary Geotechnical Investigation of Preferred Sites B, C, F and H for Proposed Eskom 30 year Kendal Ash Disposal Facility Rev 3*. Midrand, Gauteng: Golder Associates.
- 11.2 The South African National Roads Agency Limited. (2007). *Drainage Manual 5th Edition*. Pretoria, Gauteng: SANRAL.
- 11.3 van Zyl, M. (2013). *JW030/13/D121 - Rev2 Kusile and Kendal Power Stations Ash Disposal Facilities Waste Classification Report*. Sandton, Gauteng: Jones & Wagener.

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APPENDIX A
Geotechnical Report

APPENDIX B
Waste Classification Report

APPENDIX C
Conceptual Engineering Drawings

APPENDIX D
Water Balance Diagram

APPENDIX E
Screening Report

APPENDIX F

Technical Memo: Selection of Barrier System

APPENDIX G
Construction Quality Assurance (CQA) Plan

APPENDIX H
High Level Capital Cost Breakdown

APPENDIX J
Construction & Operation Phases

APPENDIX K

Technical Memo for Design Considerations to avoid Wetlands

APPENDIX L

Technical Memo for Transnet Pipeline