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1. INTRODUCTION

Duvha Power station has two ash water returning dams namely the Low-Level Dam (LLD) and the High-Level Dam (HLD). The dams are used as a storage facility for ash water and contaminated water collected from the station. The LLD is the first receiving facility after water and ash has been separated at the ash dam via penstock and silt trap. The ash water from the LLD is then pumped to the HLD via the Ash Water Return (AWR) pumps. The ash water is then pumped from HLD via the sluice booster pumps to the ash plant for ashing cycle to take place.

The HLD consists of four compartments, compartments 1 and 3 have a capacity of 12 000m^3 each with a 1m suction pipe line for the process pumps which are located on the western side of the HLD. Compartment 2 and 4 have a capacity of 89 000m^3 each with a 1 m suction line for the booster pumps which are located on the eastern side of the HLD (see plant overview in Appendix A).

During the ash deposition and decanting process at the ash dam, some of the ash particles pass through and settle in the silt trap, LLD and some carried over through pumping to the HLD. The HLD compartments are all currently silted and need cleaning. The HLD compartment 3 dam wall was damaged during the cleaning process in 2019 and needs repairing.

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

The purpose of this document is to outline the scope of work required for cleaning HLD compartments 1, 2, 3 and 4 to restore the storage capacity of the HLD and repairing of compartment 3 dam wall to ensure structural stability.

2.2 APPLICABILITY

This document applies to Duvha Power Station only.

2.3 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.3.1 Normative

1. ISO 9001 Quality Management Systems.
2. Construction Regulations, 2014
3. 32-727 - Eskom Safety, Health, Environment and Quality (SHEQ) Policy
4. Occupational Health and Safety Act No. 85 of 1993,
5. QM58 - Suppliers contract quality requirements specification
6. SANS 1200 - Standardized specification for civil engineering construction

These documents are indispensable for the application of this document, i.e., documents to be used together with this document.

2.3.2 Informative

7. 474-58 (Rev1): Document and Records Management

2.4 DEFINITIONS

2.4.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

HLD 1: High level dam compartment 1

HLD 2: High level dam compartment 2

HLD 3: High level dam compartment 3

HLD 4: High level dam compartment 4

2.5 ABBREVIATIONS

Abbreviation	Description
APP	Approved Professional Person
AW	Ash Water
AWR	Ash Water Return
HLD	High Level Dam
LLD	Low Level Dam
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
QM	Quality Management
SE	System Engineer
SHEQ	Safety, Health, Environment and Quality
SRD	Stakeholder Requirements Definition

2.6 ROLES AND RESPONSIBILITIES

Appointed Contractor/Supplier – Execute the scope of work as per the employer's specification. To ensure quality assurance is done as per QM 58 and SHEQ Policy is adhered to.

Project manager – To ensure that the supplier executes all the work specified in the scope of work on the set timelines.

System Engineer (SE) – The SE will review all works which is being executed and ensure that quality assurance is adhered to.

2.7 REQUIRED CRITERIA FOR CONTRACTOR

- The contractor must be CIDB compliant.
- The contractor must provide a record of having carried out similar woks (cleaning of dams)
- The contractor must have necessary technical personnel to execute the work.
- The contractor must demonstrate the technical competency to execute the scope by providing a detailed method statement and project plan.

2.8 RELATED/SUPPORTING DOCUMENTS

This is the list of drawings issued by the Employer at or before the Contract Date and which apply to this contract.

Description	Document Number	Revision
High Level Reservoir Layout	057/8782	13

3. SCOPE OF WORKS

3.1 DESCRIPTION OF THE WORKS

The scope of work entails cleaning of all HLD compartments (1, 2, 3 and 4) by means of dredging, and cleaning, and repairing compartment 3 damaged embankments (dam wall).

3.1.1 Pre and post survey

The supplier shall conduct a pre survey to determine the amount of sludge in all the High-level dam compartments before any work commences. A post survey after cleaning shall also be conducted to determine the amount of sludge removed from each compartment. The pre surveys must be done using a bathymetry survey method and the post survey shall be done by physically taking spot height level on the cleaned compartment. The survey report shall be submitted to the system engineer and shall be verified by the Approved Professional Person (APP) appointed by the employer. The survey data must also be submitted together with the report on model maker file and auto cad file, this will also be verified by the APP.

3.1.2 Isolation

3.1.2.1 System description

The HLD has 4 compartments to store ash water which is pumped from the LLD. The water gets discharged into the HLD compartments 1 & 3 via the two 800 NB steel pipes. The two 800NB pipes have isolation valves stuck in an open position. Two flanges have been welded on each discharge point. Water gravitates from HLD 1 to HLD 2 due to difference in height between the two compartments and gravitates from HLD 3 to HLD 4 due to the differences in height between the two compartments. There are suction pipelines from HLD 1 and 3 (process water pipeline) which are interlinked. Similarly, there are suction lines from HLD 2 and 4 (Booster pumps). The suction pipelines for all 4 compartments have a diameters of 1000mm. Water pushes back from the HLD 3 to 1 or vice versa via the process water pipeline. There is an existing balance line from line 1 which supplies directly to compartments 2 and 4. Refer to figure 1 for your reference. The options to be implemented for isolation are listed as follows:

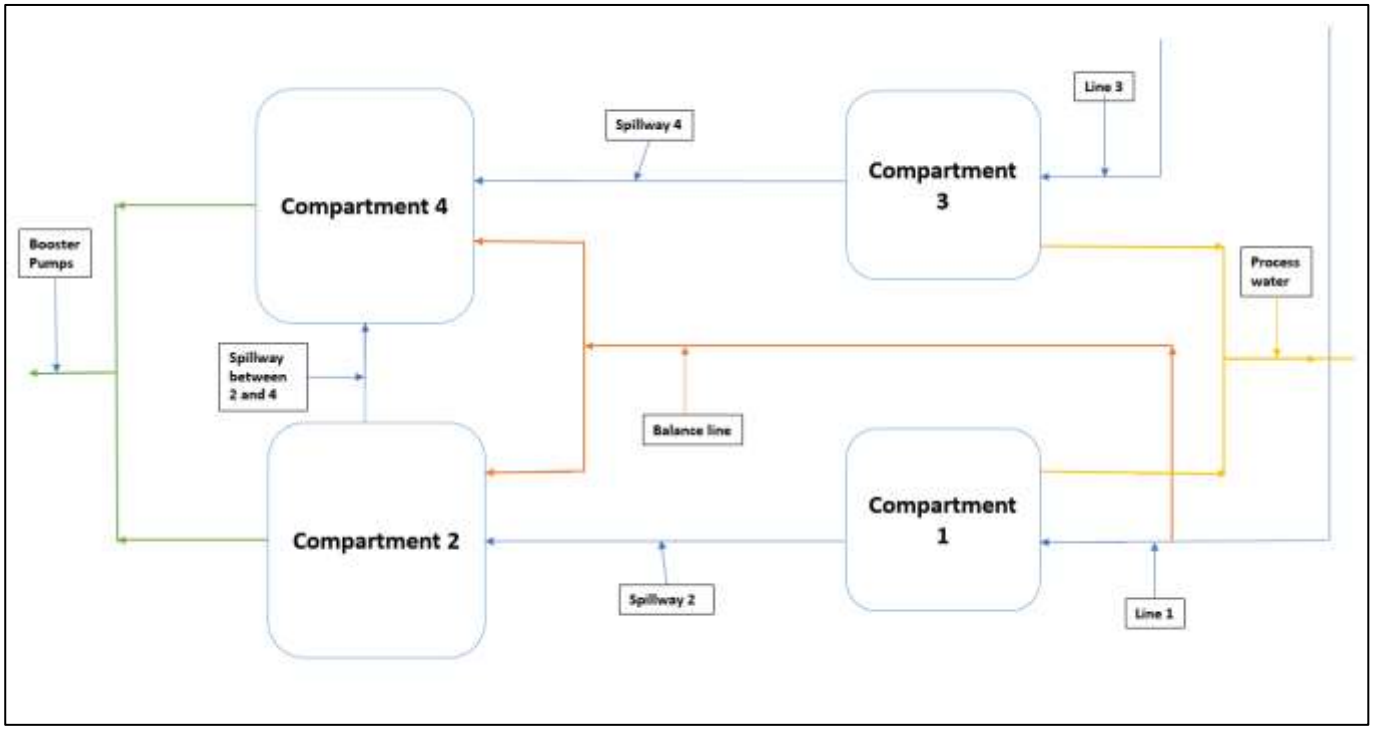

Figure 1: High level dam configuration

3.1.2.2 Option 1: Isolate compartments 1 and 3 simultaneously.

- Fabricate and install 800NB steel blank plate which are 12mm thick on the discharge points of the 800NB pipes (line 1 and line 3) which have isolation valves to isolate the lines by manually blanking the pipes.
- Install a balance line from line 3 to supply directly to compartments 2 and 4. This shall assist with supply to compartments 2 and 4.

3.1.2.3 Option 2: Isolate one compartment at a time.

3.1.2.3.1 Isolate compartment 1

- Fabricate and install 800NB steel blank plate on the discharge point of the 800NB pipe which has an isolation valve to isolate line 1 which discharges at Compartment 1 by manually blanking the pipe. This will prevent water from being discharged during cleaning.
- Install inflatable balloons at compartment 1 process water line to prevent backflow of process water and obtain full isolation of the compartment.

3.1.2.3.2 Isolate compartment 3

- Fabricate and install 800NB steel blank plate on the discharge point of the 800NB pipe which has an isolation valve to isolate line 3 which discharges at Compartment 3 by manually blanking the pipe. This will prevent water from being discharged during cleaning.
- Install inflatable balloons at compartment 3 process water line to prevent backflow of process water and obtain full isolation of the compartment.

3.1.2.3.3 Isolating Compartments 2 and 4

- Install sandbags on the spillway 2 to prevent water from flowing into compartment 2.
- Install sandbags on spillway 4 to prevent water from flowing into compartment 4.
- Install inflatable balloon on the balance line if it's not isolated.
- Only one compartment of the two can be isolated at a time.

It is the contractor's responsibility to ensure a successful isolation, should the contractor have a suggestion of a different method of isolation, they shall submit to the Employer's engineer for review and acceptance before execution.

3.1.2.4 Responsibilities of the Contractor:

- The Contractor shall have an authorised person who is permitted to take permit to work as per the Eskom plant safety regulations Procedure.
- Fabricate the blank plate which will fit on the inlet pipes (800NB pipe) and align to the existing flange currently installed. The plate thickness shall at least be 12mm.
- Install and uninstall a blank flange on the 800NB discharge pipe to isolate HLD 1 & 3.
- Install a balance line from line 3 to supply directly to compartments 2 and 4.
- Dive and explore all suction lines for the feasibility to install the balloon or blank. The supplier shall use commercial divers for this activity. The supplier shall submit certificates of competence of divers to the engineer for approval before the work commences. No work shall commence before this is reviewed and accepted.
- Supply and install inflatable plugs (balloon) to prevent backflow of water for all the 4 compartments for the duration of the works. The pipe diameter is 1000mm for all compartments.
- Drain water from HLD 1, 2, 3 and 4 (this will be based on the compartment required as per the programme since they cannot all be drained at the same time) by means of pumping to any of the compartment available as advised by the system engineer. Note: HLD 1 has a capacity of 12 000m^3 , HLD 3 has capacity of 12 000m³, HLD 2 has capacity of 89 000m³ and compartment 4 has 89 000m^3.
- Effluent water from the water treatment plant discharges at the HLD 2 and 4. Therefore, supply and installation of a plastic pipe of 100mm diameter and length of 200m will be required. The pipe shall be supplied with all necessary claps to redirect the discharge point of effluent water into dam 2 or dam 4 (pipe should be able to handle effluent with PH <1)
- HLD 3 has no point of access where vehicle or any machinery can drive closer for repairs. The contractor shall supply and install plastic geomembrane, sandbag together with soil to blank off the spillway (width of 6m, length of 10m and depth of 2m) on HLD 4 to allow access. The guardrails of 10m long shall be supplied and fixed on both sides of the spillway to prevent vehicle form falling into the dam or downstream of the spill way. Supply and apply a wearing course of 300mm on top of the sandbags to bring the area to smooth road surface.
- Supply and install sandbags together with plastic geomembrane to blank of spill way between HLD 4 and 2 and HLD 1 and 3 to prevent water from flowing from one compartment to another.
- Ensure that isolation is successfully implemented to be able to execute the works.
- Provide an alternative isolation method statement for review to the Employer's engineer for review and acceptance.

3.1.3 Building of permanent access ramps for each high-level dam

The HLD compartments were constructed without access ramps to access the ponds during maintenance activities. The Contractor shall construct permanent ramps against the inner slopes of the compartments to allow access for future maintenance and repairs of dam compartments. The ramps should have an incline slope of at least 1(V):6(H) to allow for truck access (See drawing no. 047/D/001R for details).

The ramps are components of the upstream dam embankments, and it is important that the Contractor or its duly appointed sub-contractor is well versed with the construction of dam infrastructure or similar. The following selected material with properties should be imported and used for the ramp construction. The specification of the materials is:

PI	:	14 - 18%
Clay Content	:	10 - 30%
Liquid Limit	:	30-60
Max Dry Density	:	1590-1830Kg/m³
Grading	:	More than 60% through 0.425 sieve
Note	:	Use Unified Soil Classification System

The Contractor shall ensure that all material specifications are met and that a record system to provide traceability of the source and use of the specified materials are always readily available. All material sources need to be authorised prior to use and shall be inspected by Eskom at its discretion. Compaction shall apply as follows:

- Material must be placed in layers, not exceeding 300mm and must be compacted to the required density i.e., 98% Standard Proctor at optimum moisture content (OMC).
- For any work to be undertaken in any of the compartments, the compartment needs to be drained, dried out and the inter leading connections to the other compartments sealed off. See desilting of the compartment basins below for more detail.
- Before and during the construction of the ramps, specific agreed hold points shall be in the project schedule for the Approved Professional Person (APP) to inspect the works, provide advice on further construction and approve the works already undertaken. No work will be allowed to be completed unless due authorisation is provided.

3.1.4 De-silting of HLAWRD.

Desilting of HLD will be done using excavation method. The contractor shall have all necessary machinery to excavate, load, transport and dump the sludge at the designated stockpile or discard site on the ash dam which is approximately 6.5km away from the HLD. A proposed route shown in figure 1 below shall be used to transport sludge to the ash dump. The estimated amount of silt to be removed is approximately 150 000m³. Specific records need to be kept of all disposals and this need to be countersigned by the relevant Eskom personnel.

It is the responsibility of the contractor to provide all necessary equipment & machinery to be used for this work based on the above-mentioned approximated volume of silts and dam sizes. It is recommended that suitable size haul trucks be used for the transportation of the silt to the discard site. The tyre pressure of this haul trucks should be kept as low as is practically and safely possible, to prevent embankment crest and slope damage, ideally below 300kPa. The trucks shall be sealed after taking the silt to avoid spilling on the access road causing environmental contraventions. The specific Eskom and Duvha Power Station Road use regulations must be always adhered to.

The following scope of work should apply:

a) Draining: The water within the specific compartment needs to be drained / pumped into a relevant compartment as advised by the Employer's engineer for the compartment basin to dry out prior to any work commencement. The interlinking spillway(s) to the specific compartment should be closed off as described on section 3.1.2.

b) Access ramp: The construction of the access ramp to the compartment will be executed to ensure appropriate access to the equipment to be used as described on section 3.1.3.

c) Silt removal: After access is possible to the compartment basin floor, an excavator can start with excavating the silt to be removed. Front-end loader and trucks can then be used to load and remove the silt to the approved designated discard area. This should continue until the required excavation level has been reached.

d) Special care should be taken during the excavation process not to damage the existing constructed embankment slopes and not to damage the current rip rap. Should any damage occur, this needs to be reported to the project manager, the contractor shall be liable for damages incurred during cleaning. The scope of work below should apply with the consent of Auxiliary Engineering and the APP:

- All loose material within the damaged embankment section must be excavated in a V-shape from basin level up to crest level until in-situ densities are at least 95% Proctor.
- The slopes of the V-formation must not be vertical to facilitate proper compaction and benching and to provide a stable face.
- The excavated material must be stockpiled and wetted to optimum moist content (OMC) before compacting back into the embankment.
- The damaged area after V-shaping must be box-cut to provide a base from where the backfill layer works can start. Layer works shall start at dam basin level.
- Box-cut surfaces shall be grubbed and wetted before layer backfilling commences.
- Material must be placed in layers, not exceeding 300mm and must be compacted to the required density i.e., 98% Standard Proctor at optimum moisture content (OMC).
- The backfilled layers / steps shall be overfilled and cut back (shaped) to match the adjacent slope gradients as initially constructed.
- Compaction tests need to be conducted after every two layers to ensure that the density requirements are met. This is very important, and an arrangement must be made with a reputable civil engineering laboratory to manage the testing. Proof must be sent to the Engineer for approval.
- Contractor must prove to Engineer that compaction specifications are met by submitting appropriate test results for record (i.e., DCP and / or Troxler testing). A representative sample of the backfill material shall be tested for MOD / maximum dry density.
- Due to usually restricted space of work area, it is recommended that a small size self-propelled Bomag compactor be used for the compaction of the layer works.
- Material Specifications:

  PI: 14 - 18%

  Clay Content: 10 - 30%

  Liquid Limit: 30-60

  Max Dry Density: 1590-1830Kg/m³

  Grading: More than 60% through 0.425 sieve

Note: Use Unified Soil Classification System

e) Spillway: The cleaning of the concrete spillways is a part of the scope of work. All silt needs to be cleaned off the concrete using a suitable high pressure cleaning system. Where there are cracks in the concrete spillways, these need to be identified, cleaned, and sealed. The contractor shall provide an appropriate methodology based on the identified issue.

f) When the desilting and cleaning of a compartment has been completed, a basin survey shall be conducted to establish the exact amount of silt excavated and removed. This record will be used for future reference. The works will not be considered complete unless the survey is conducted and approved by the Employer's System Engineer.

g) The Contractor's responsibilities in terms of reclamation / desilting of the silt are:

- Managing the reclamation process in a controlled and safe manner to ensure that sufficient capacity is available for continuous recycle of return ash water.
- Liaise and co-operate with the relevant Eskom Project Manager and representatives regarding the reclamation operations; bringing to their attention any problems or suggestions to improve operations. Also, to note any aspects that could impact on the successful reclamation of the silt.
- Any damage to the existing dam embankments should be reported without hesitation to the project manager and the auxiliary engineering department. The supplier will be responsible and liable for any repair of the damage which shall be done as per section 3.1.4 d.
- Practice good housekeeping by keeping the area where work is being conducted clean during and on finalisation of the work.
- Contractor will also be required to quantify the amount of silt removed per day by means of counting no. of trucks and send report daily. The quantity will be verified by the survey conducted after removal of silt.

Figure 2: Proposed route to be used for the disposal of silt

3.1.5 Compartment 3 dam wall repair

The Contractor must perform the following activities when repairing the embankment wall in compartment 3 (see figure 2 for plant layout):

- All loose material within the damaged embankment section (area as indicated in figure 2 schematic) must be excavated in a V-shape from basin level up to crest level until in- situ densities are at least 95% Proctor.
- The slopes of the V-formation must not be vertical to facilitate proper compaction and benching and to provide a stable face.
- The excavated material must be stockpiled and wetted to optimum moisture content (OMC) before compacting back into the embankment.
- The damaged area, after V-shaping must be box-cut to provide a base from where the backfill layer works can start. Layer works to start at dam basin level.
- Box-cut surfaces shall be grubbed and wetted before layer backfilling commences.
- Material must be placed in layers, not exceeding 300mm and must be compacted to the required density i.e., 98% Standard Proctor at optimum moisture content (OMC).
- The backfilled layers / steps shall be overfilled and cut back (shaped) to match the adjacent slope gradients as initially constructed.
- Compaction tests need to be conducted after every two layers in order to make sure the density requirements are met. This is very important, and an arrangement must be made with a reputable civil engineering laboratory to manage the testing. Proof must be sent to the system engineer for approval.
- Contractor must prove to the system engineer that compaction specifications are met by submitting appropriate test results for record (i.e., DCP and / or Troxler testing). A representative sample of the backfill material shall be tested for MOD / maximum dry density.
- Due to restricted space and work area, it is recommended that a small size self- propelled Bomag compactor be used for the compaction of the layer works.

The core material specifications are as follows:

PI: 14 - 18%

Clay Content: 10 - 30%

Liquid Limit: 30-60

Max Dry Density: 1590-1830Kg/m^3

Grading: More than 60% through 0.425 sieve Note: Use Unified Soil Classification System

Note: Use Unified Soil Classification System

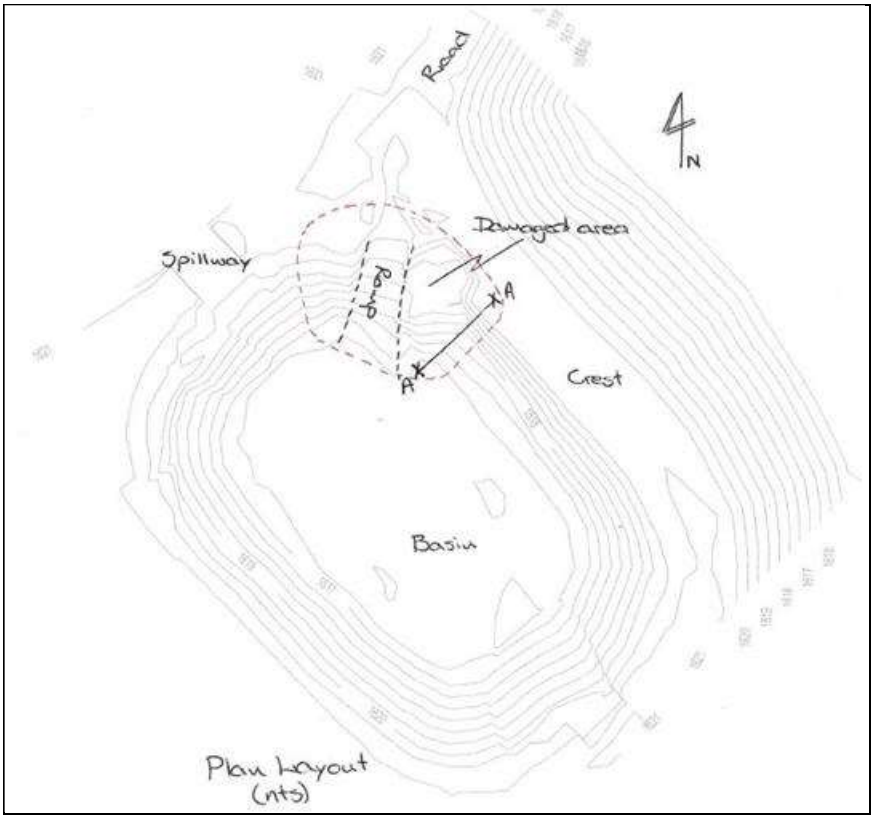

Figure 3: Compartment 3 embankment layout plan

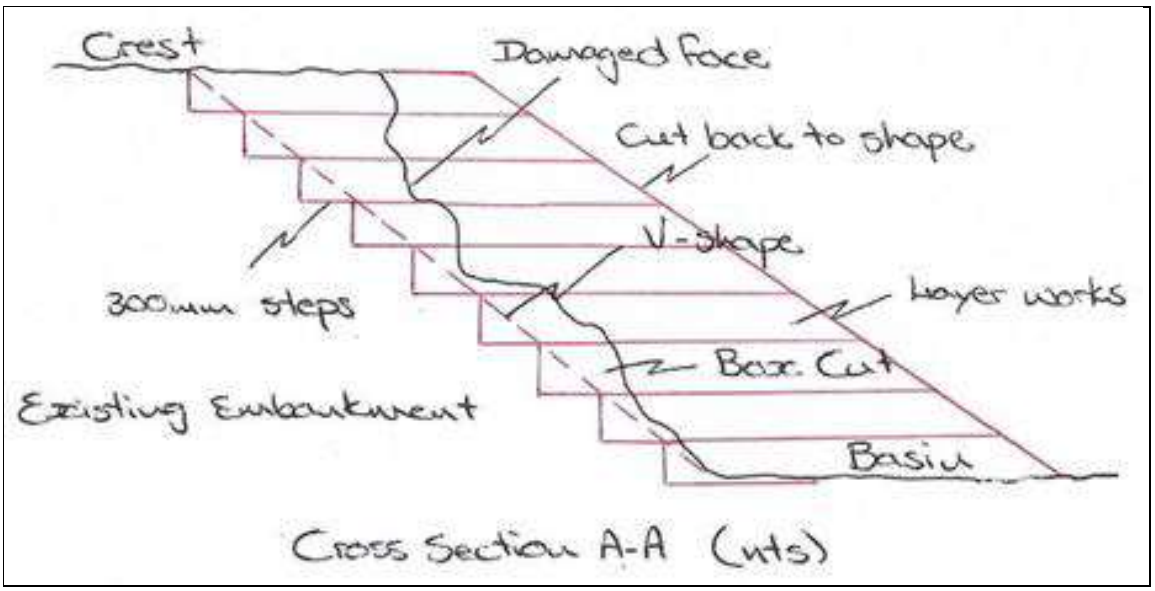

Figure 4: Section A-A of damaged area and proposed solution

3.1.6 Spillway repair work

The spillways surface areas between the compartments are corroded for an estimated area of 50m². The concrete aggregates are exposed, and the area needs to be repaired. The following is required:

- Scrabble and remove the damaged surface area of the concrete trenches.

- Surface preparation (wire brush and clean the surface of the concrete to receive the new concrete topping)
- Apply 'wet to dry' epoxy to concrete surface to receive new concrete topping. (Specification of the epoxy to be approved by the engineer together with the QCP)
- Supply and pour 30MPa fast curing concrete grouting. The grouting specification shall be reviewed and accepted by an engineer before commencing with the works.

3.1.7 Level indicator

The HLD currently does not have a manual level indicator to monitor the dam level. The supplier will be required to fabricate and install a manual level indicator in compartment 2 and 4 as per figure 4 and 5 below.

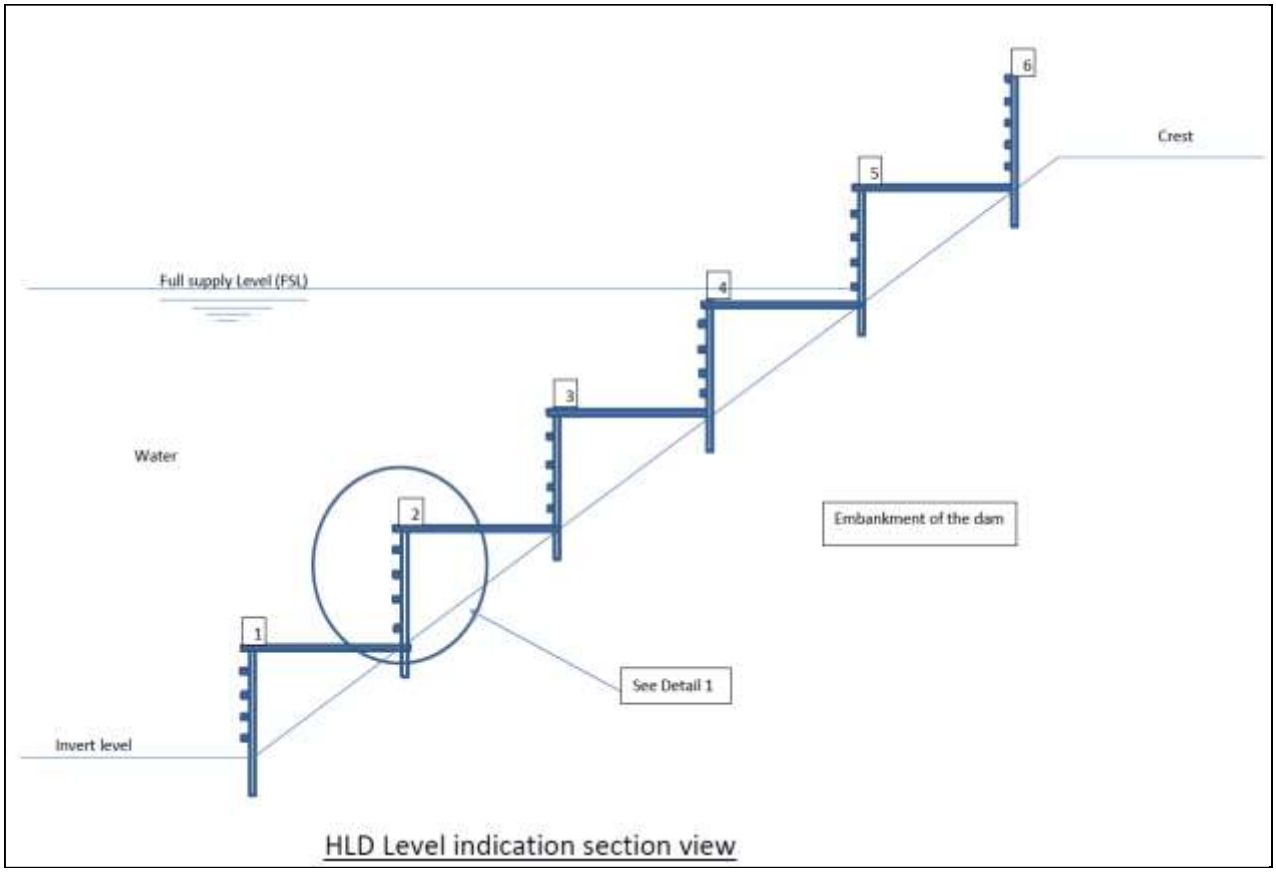

Figure 5: HLD Level Indicator section view

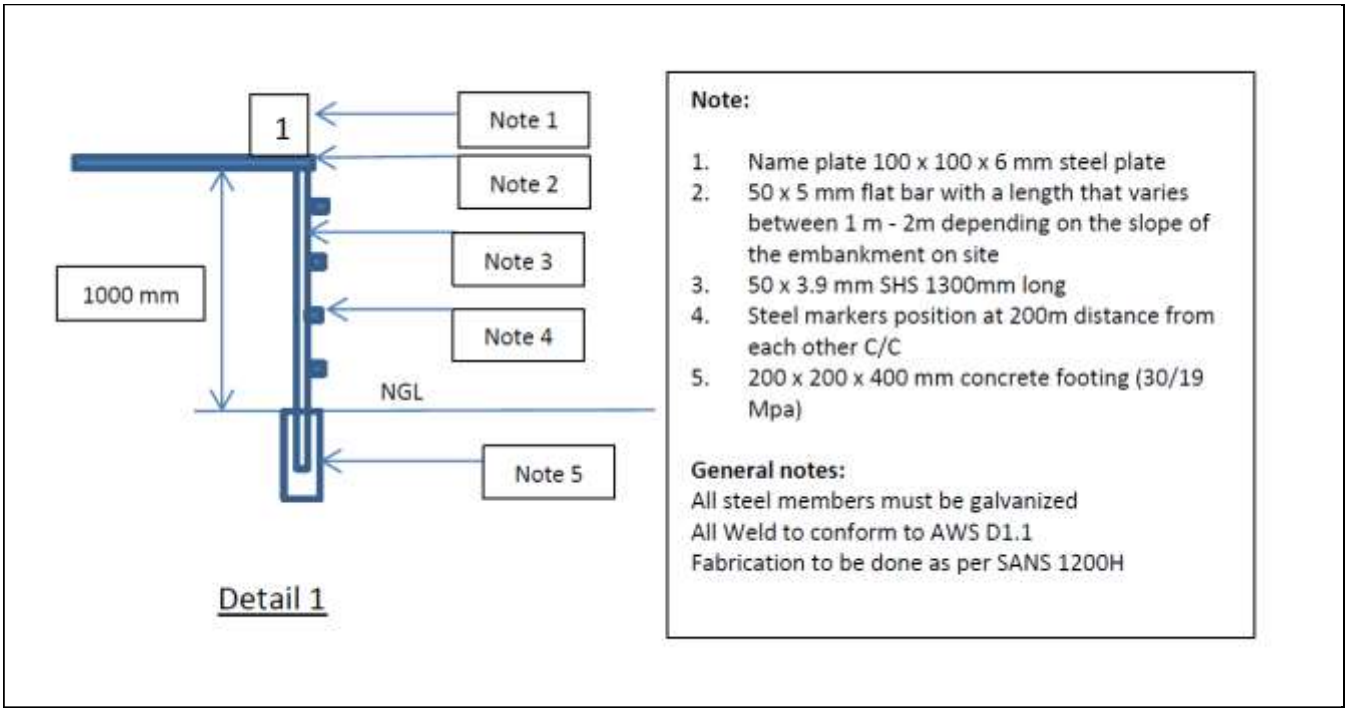

Figure 6: Level indicator detail 1

3.2 EMPLOYER'S DESIGN REQUIREMENTS

3.2.1 Functional Requirements

Blank plate

The blank specification is as follows:

- The pipe size is 800NB.
- The plate should be 12mm think.
- The steel material should be S355JR U.N.O
- The plate should align with existing welded flange.

Pump

The pump specification should be as follows:

- Supply Diesel pump – 200 L/s at BEP (best efficient point)
- Supply Suction line and discharge line with length of 8m and 50m respectively
- The pump must be secured in a trolley and be able to be transported around all compartments.
- Working medium – ash water with a PH 12 alkaline
- Pump particle passage – must be greater than 75mm.
- System head – 15m

Earthworks

The core material specifications are as follows:

PI	:	14 - 18%
Clay Content	:	10 - 30%
Liquid Limit	:	30-60
Max Dry Density	:	1590-1830Kg/m³
Grading	:	More than 60% through 0.425 sieve

Note: Use Unified Soil Classification System

Concrete works

The grouting must have the following:

- Compressive Strength of at least 30MPa
- Flexural Strength of at least 6.0 N/mm2
- Tensile Strength at least 2.6 N/mm2
- Easy mixing and placing
- Rapid strength development
- Fatigue tested.
- Good flow properties
- Free from chlorides and metallic particles
- Expansive properties
- Very high mechanical strengths.
- Not corrosive or toxic

3.3 CONTRACTOR'S DESIGN

The supplier will be required to provide the following:

- The methodology on how silt removal will be done which must reflect all machinery that will be utilised for the project.
- High level programme for the project

4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Thami Khumalo	System engineer- Ash plant

5. REVISIONS

Date	Rev.	Compiler	Remarks
December 2023	0.1	MA Khohliso	Draft document for review
January 2023	1.0	MA Khohliso	Final document for signatures

6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

N/A

7. ACKNOWLEDGEMENTS

Takalani Mudonde

APPENDIX A: PLANT OVERVIEW