Eskom	Scope of Work	Hendrina Power Station

Title: **Seven-Year Dam De-Silting & Lining scope of work.**

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Area of Applicability:	**Hendrina Power Station**
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Compiled by	**Functional Responsibility**	**Authorised by**
Date:	Date:	Date:

Content

1. Introduction

Hendrina Power Station is located in the Mpumalanga Province, approximately 30 km from Hendrina Township and 30 km from Middelburg.

The Seven Year Dam is an unlined earth embankment that collects runoff from the eastern side of the power station and coal stockyard.

A subsurface drainage system located east of the chimneys and precipitator plant conveys stormwater and station effluent via a 1050 mm concrete pipe into an underground culvert discharging into the dam.

Additional stormwater from the stockpile area is routed through channels into a concrete settling sump, with overflow also directed into the same 1050 mm pipe.

A concrete pre-settling channel along the security fence further conveys runoff from the southeastern section of the station to the dam inlet culvert.

The dam has a maximum storage capacity of approximately 18,000 m³ and a maximum wall height of 3.6 m.

It comprises a sandy-clayey core embankment and includes a concrete-lined spillway section measuring about 2 m in length and 300 mm in height to accommodate overflow during high rainfall events, with a maximum spillway capacity of 18,588 m³.

The Seven Year Dam is currently non-compliant with the station's Water Use Licence (No. 24046033) and applicable regulatory requirements (DWS, GN 704, and ZLED) and therefore requires lining to meet compliance standards.

2. Supporting Clauses

2.1 Scope

The document covers the scope of work and minimum requirements for Seven-year dam De-Silting & Lining Project.

2.1.1 Purpose

The purpose of this document is to provide the scope of work for seven-year dam De-Silting & Lining Project.

2.1.2 Applicability

The document is applicable to Hendrina Power Station.

2.2 Normative/Informative References

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

2.2.1 Normative

[1] National Environmental Management Act 107 of 1998

[2] The National Water Act (Act 36 of 1998)

[3] The Minerals Act (Act 50 of 1991)

[4] The Occupational Health and Safety Act (Act 85 of 1993)

[5] Zero Liquid Effluent Discharge (ZLED)

[6] NEMA No.107 of 1998, section 24

[7] Government Notice (GN) 704

[8] SANS 1200: Standardized Specifications for Civil Engineering Construction

2.2.2 Informative

[9] Final Design Report by Shaweni Consulting Engineers.

Abbreviations

Abbreviation	Explanation
DWS	Department of Water and Sanitation
ECSA	Engineering council of south Africa
GN	Government Notice
HDPE	High-density polyethylene
MP	Maturation Pond
NEMA	National environmental Management Act
OHS ACT	Occupational Health and Safety act
SANS	South African National Standards

Abbreviation	Explanation
WWR	Waste Water Recovery
ZLED	Zero Liquid Effluent Discharge

Roles and Responsibilities

Role	Responsibility
Civil Engineering	Compiles the scope of work to line the dam
Projects Department	Facilitates the process of sourcing a contractor to execute the scope of work
Environmental Department	Advice on any legal requirements.

2.5 Process for Monitoring

N/A.

2.6 Related/Supporting Documents

Seven-year dam De-Silting & Lining Design by Shaweni Consulting.

3. Scope of Work for Seven-Year dam De-Silting & Lining Project.

3.1 Scope of Work

The Seven Year Dam is an unlined earth dam, which collects run-off water from the eastern side of the power station and from the coal stockpile.

The Seven Year dam has a maximum storage capacity of 18 588 m^3 and a maximum dam wall height of 3.6 m, with a concrete lined spillway section measuring approximately 2 m long by 300 mm high.

Runoff from the ash spillages is conveyed from the ash booster pump house to the Seven Year Dam by an earth channel, which connects to a concrete pre-settling channel. Run-off from the coal stockpile is conveyed to the Seven Year Dam via concrete settling weir which connects to a concrete pipeline.

Figure 1: Seven-year dam Aerial View

3.1.1 Construct Temporary Diversion System

Due to lack of dam isolation, liner construction of the seven-year dam will be conducted in 2 phases.

3.1.2 Seven-year dam Diversion System Phase 1

Inactive dam compartment connected to existing concrete culvert is lined, while water is diverted to gravitate to the active dam compartment.

i. Reduce water level of Seven Year Dam to its lowest operational level i.e. 15-30%
ii. Construct temporary diversion system Phase 1 by installing GeoRevet bags to divide the dam into two compartments (Dam division is established by filling GeoRevet bags with clay material, lining and stacking the bags to create a retaining. wall. Seven-year dam fill material to be sourced offsite due to site material found unsuitable for function. Two Geosynthetic clay liner will be used to drape the bags in between to prevent water seepage. This to enable the functioning of the dam division while effluent is discharged and stored in active dam

compartment. Excavator to be used to carry and position the GeoRevet bags in the dam. Inflow water to be channelled to active dam compartment while inactive dam compartment is under liner construction.

iii. Pump water to the active dam compartment which is not connected to the inlet sump.

iv. Construct temporary brick sump (with 200mm concrete slab), and High-Density Polyethylene (HDPE) pipe to connect to existing concrete culvert. HDPE pipe to be installed at the same invert level as existing concrete culvert. This to supporting lining of inactive dam compartment while water is diverted to gravitate, via the temporary HDPE pipe, to the active dam compartment.

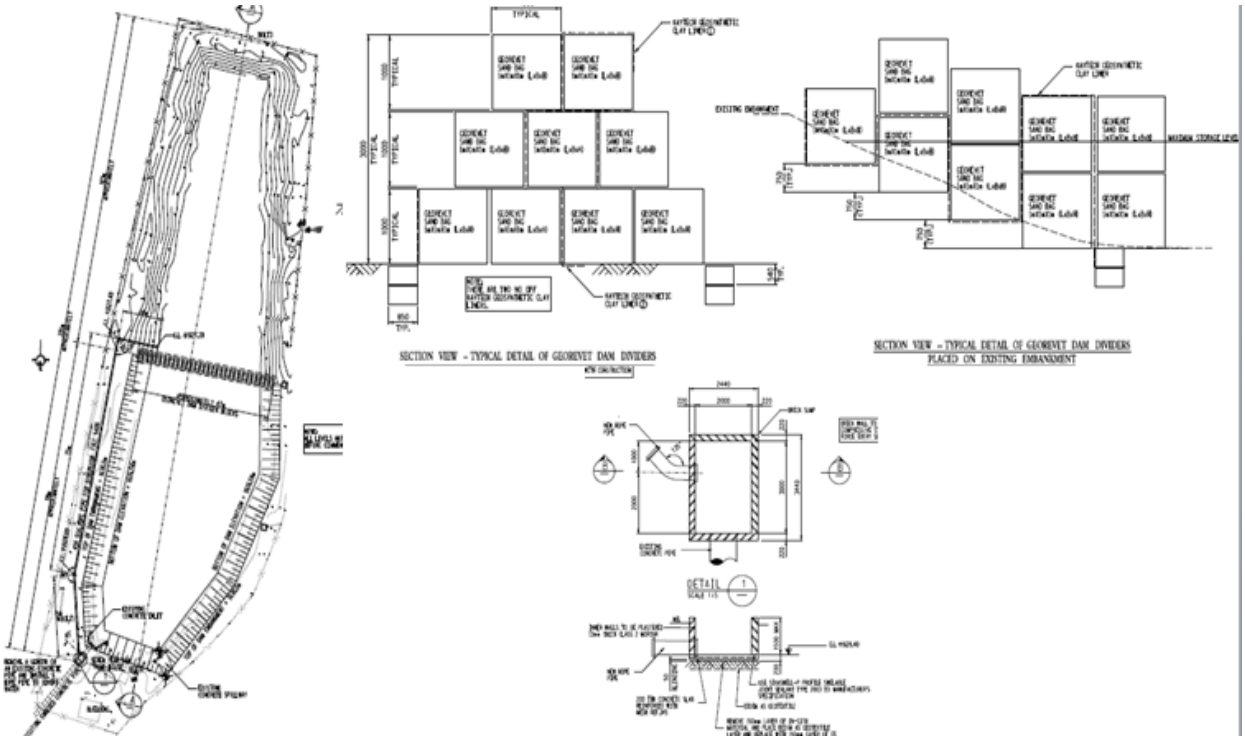

Figure 2: Seven-year dam Diversion System Phase 1, Detail Design (MSHAWENIØØ1)

3.1.3 Seven-year dam Diversion System Phase 2

i. Section of the dam not connected to the inlet concrete culvert to be lined.

ii. Reduce water level of Seven Year Dam to its lowest operational level 15-30%

iii. Construct temporary diversion system Phase 2 by installing GeoRevet bags to divide the dam into two compartments (Dam division is established by filling GeoRevet bags with clay material, lining and stacking the bags to create a retaining wall. Seven-year dam fill material to be sourced offsite due to site material found unsuitable for function. Two Geosynthetic clay

liner will be used to drape the bags in between to prevent water seepage. This to enable the functioning of the dam division while effluent is discharged and stored in active compartment. Excavator to be used to carry and position the GeoRevet bags in the dam. This to enable the functioning of the dam division while effluent is discharged and stored in active dam compartment.

iv. Pump water to the active dam compartment not connected to the sump.

v. Construct temporary brick sump with 200mm concrete slab and HDPE pipe to be connected to existing concrete culvert. HDPE pipe will be installed at the same invert level of existing concrete culvert. This to equip compartment of dam within the inlet section is lined while water is diverted to gravitate, via the HDPE pipe, to the operating dam compartment. Pumping system not to be utilized as its directly linked to the dam section under liner construction. Temporary diesel pumps to be in operation.

vi. Existing electrical pumping system/temporary diesel pumps can be utilized to prevent inflow of effluent onto the inactive dam compartment during liner construction works.

vii. De-Silt inactive dam compartment using mechanical dredging.

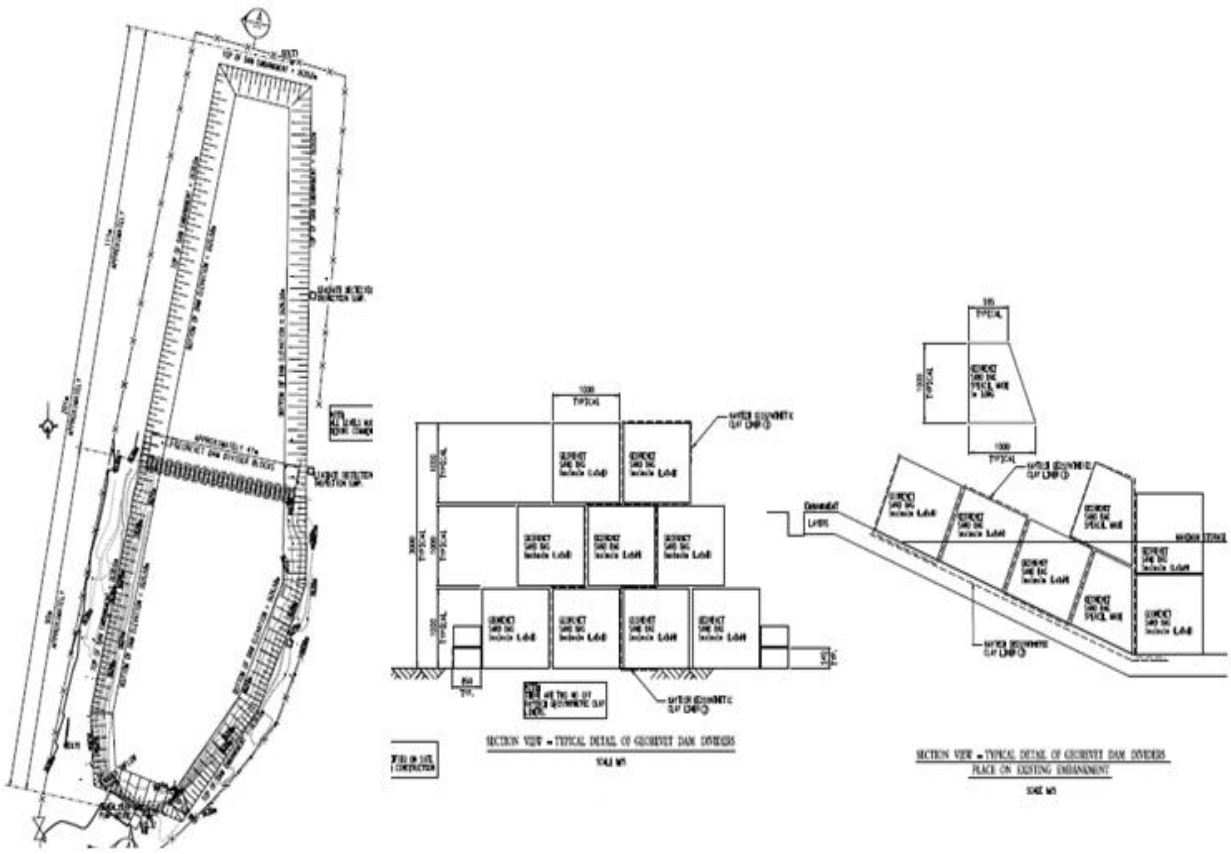

Figure 3: Seven-year dam Diversion System Phase 2, Detail Design (MSHAWENIØØ1)

3.1.4 Construct Earthworks

i. Earthworks construction is a Bottom-Up Approach whereby excavation is conducted to free the required space before liner construction. During backfill, material to be compacted in lifts from bottom to top of the wall with inclusion of the geotextiles (Environmental Investigation findings MSHAWENØØ1).
ii. Remove 50mm topsoil. Seven Year Dam materials to be disposed appropriately.
iii. Excavate basin area and construct embankment with top width ranging from 1500mm-3000mm to prevent seepage, excessive settlement, and erosion over time. Furthermore, this to permit access for maintenance vehicle.
iv. Rip exposed bedding (clay) surface to 300mm deep and re-compact to minimum 95% Mod-AASHTO.
v. Construct embankment clay fil material in 300mm layers, compacted to minimum 95% Mod-AASHTO
vi. Geotechnical Engineer to inspect/assess excavated surface to verify foundation conditions. Silt or clay soils are ideal for pond foundations and construction, as they do not allow the wastewater to quickly seep through to the groundwater. Building ponds over coarse sands, gravels and fractured rock or other materials, that will allow effluent to seep out of the pond or allow groundwater to percolate, should be avoided.
vii. Install Pozidrain 4S2500/NW8 leachate collection system before constructing and compacting secondary and third 150mm clay fill material, each compacted at 95% Mod-AASHTO. Drainage and leakage detection system to be trenched into natural ground.
viii. Install leak drain S5U STD leachate detection system.

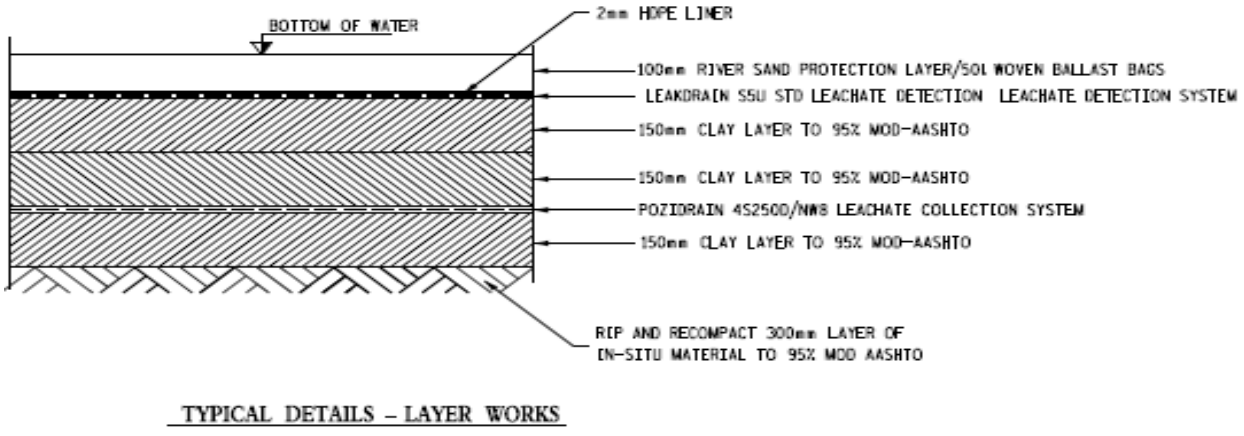

Figure 4: Section details of Earthworks for Maturation Pond & Seven Year Dam Lining, Detail Design (MSHAWENIØØ1)

3.1.5 Construct Leak detection system

In extension to the earthworks construction, Drainage and leakage detection system is to be trenched into natural ground.

i. Construct Pozidrain 4S250D/NW8 (HDPE cuspated core laminated to a geotextile filter) blanket over the whole area of dam basin (and embankment) to collect and transmit water onto the leak drain S5u std pipes. Furthermore, Pozidrain forms a void and physical barrier protects liner from being mechanically damaged by capillary rise of water.
ii. Construct 2x layers of Bidim A5 wrapped around stones, to support pipe bedding.
iii. Construct 110mm (M100) HDPE perforated drainpipe
iv. Construct 19mm stones backfilling material directly enclosing drainage pipe.
v. Construct leakdrain S5u std across (flexible HDPE pipe) to drain any leak effluent through the liner and gravitate to be collected by perforated HDPE 110m (M100) pipe positioned at the side of the dam. Leak detection system to be installed after construction 2x150mm clay fill material, each compacted to minimum 95% Mod-AASHTO.
vi. Construct reinforced concrete sump (25.15/31271 and 25.15/312720) to accommodate final collection point of water channelled by drainage and leak detection system.

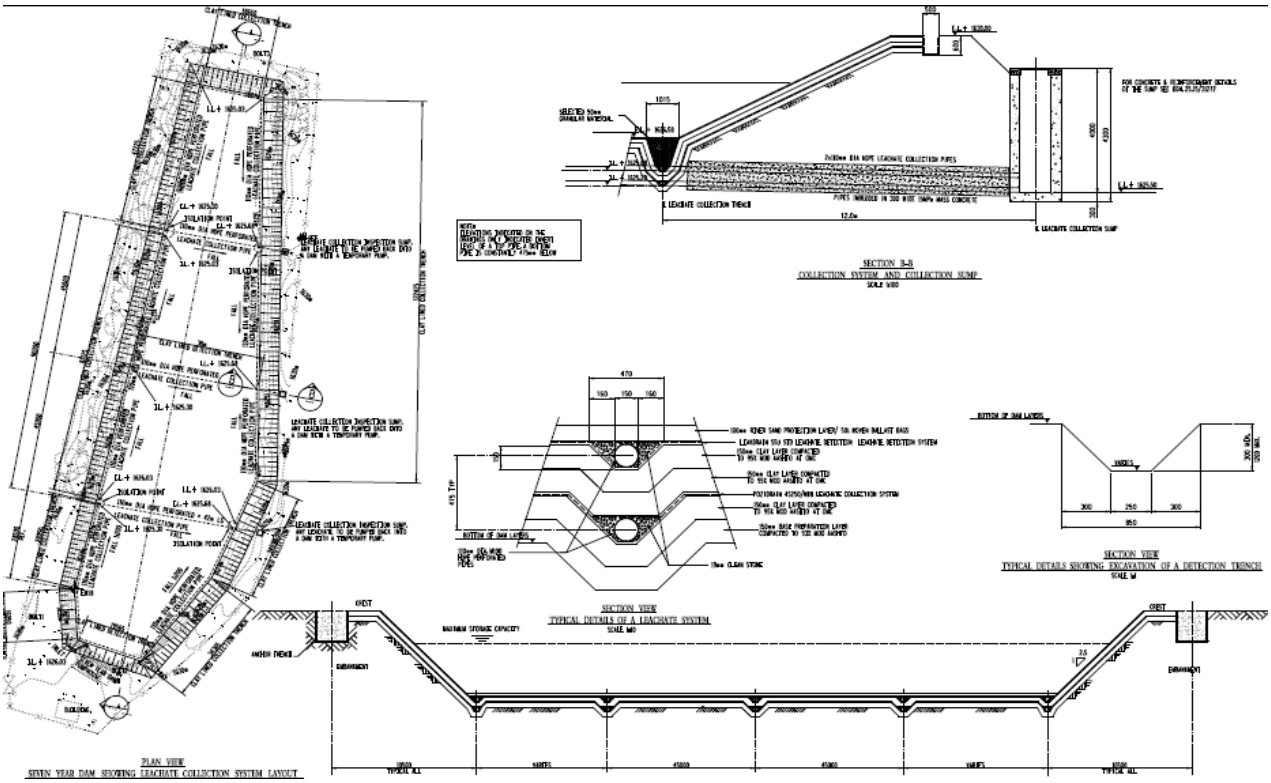

Figure 5: Seven-year dam Leak Detection System, Detail Design (MSHAWENIØØ1)

3.1.6 Construct 2mm HDPE liner

The purpose of lining a dam is to ensure that the contamination plume of the waste effluent is contained in the dam and prevented to seep onto underground water resources. Environmental investigation was conducted; whereby water & sludge samples were collected at both dam for lab analysis. This was conducted to establish the-hazard/waste classification of the effluent routed to the dams. Findings indicated that as per the salts & organics in the sludge, the recommended liner system to prevent release of contamination plume from Maturation Pond & Seven Year Dam is the Waste Type 1 Liner system, based on a Class A landfill assumption (Government Gazette 36784, 2013).

i. Assemble liner on site using wedge and fusion welds, as per SANS standard and drawing 25.15/312565 and 25.15/31267.Issue welding certification.
ii. Construct liner connections to concrete surface using stainless steel angle iron 50x50x5mm Grade 304
iii. Clamp HDPE liner to the angle iron, between 2x4mm thick rubber gaskets
iv. Conduct NDT (air pressure, electric spark and vacuum box testing).
v. Install river sand or woven ballast bags (50l) to protect HDPE liner
vi. Submit As-Built layout and detail drawings of earthworks, drainage system, and HDPE liner membrane
vii. Submit maintenance strategy of earthworks, drainage system, and HDPE liner membrane

Sludge Waste	Maturation Pond	Seven Year Dam
Metals	Waste Type 4. Class D design landfill disposal. Barium and Manganese -Type 3.	
Inorganic Anions	Waste Type 4.	
Organics	Waste Type 0, with Styrene being Type 1, Methyl t-butyl ether being Type 2 and 1,1,1,2 Tetrachloro ethane being Type 2..	Type 0, with Styrene, Formaldehyde and 1,2 Dichloro ethylene being Type 1, Methyl t butyl ether being Type 2 and 1,1,1,2 Tetrachloro ethane being Type 2

Table 1: Sludge Results (National Environmental Management: Waste Act, and National Norms and Standards for Assessment of Waste for Landfill Disposal , Government Gazette 36784, 2013).

Liner system Type 1 waste , Class A ←

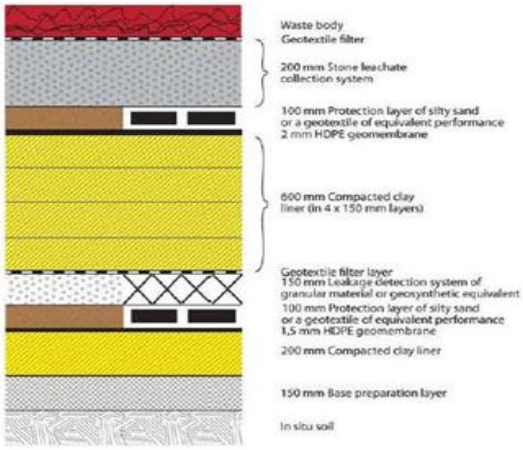

Figure 6: Seven-year dam Liner Selection, Detail Design (MSHAWENIØØ1)

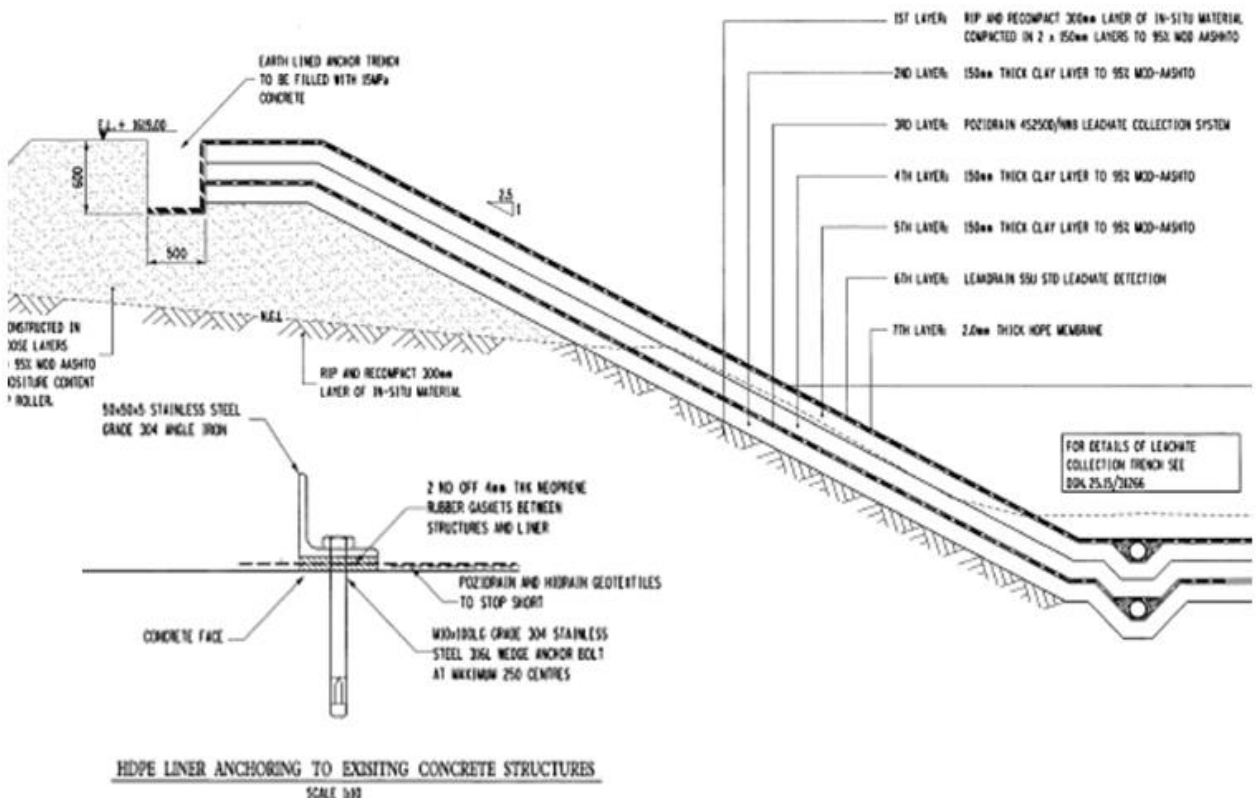

Figure 7: Cross-sectional detail of the seven-year dam Liner System, Detail Design (MSHAWENIØØ1)

3.1.7 Site Rehabilitation

i. Remove Geo-revet bags from the dams. Water to occupy dams as per normal operations.
ii. Disconnect HDPE pipe at Maturation Pond
iii. Dismantle sump and disconnect temporary HDPE pipe at the seven-year dam.
iv. Rehabilitate site areas by removing and disposing construction rubble.

4. HDPE Liner Details & Specification

The liner which will be installed is a 2 mm HDPE liner which has more than 15 years' service life. The liner will be joined together using wedge welds and for repairs and on difficult areas fusion weld will be used. Full welding specifications to be provided by the supplier.

The welds will be done as per SANS specifications.

Non-destructive tests such as air pressure testing, electric spark testing and vacuum box testing will be done on site. Certificate for the welding tests to be provided on site.

Liner connection to concrete surfaces will be done making use of an angle iron 50mm x 50mm x 5m Grade 304. The HDPE geo-membrane liner will be clamped to the angle iron, between two 4 mm thick rubber gaskets.

The industry is characterized by different connection specifications for angle iron such as the use of galvanized mild steel or stainless steel or making use of a button connection.

The appointed liner expect is to provide full specification in this regard. The HDPE will be protected by river sand or weight down by woven ballast bags (50 litre).

Leakdrain S5u std will be placed under the HDPE liner. The liner will be secured in a trench (500mm x 600mm) 1000 mm from the edge of the embankment.

5. Leachate Collection System Details & Specification

Geomembrane liners should not be considered to be fully impervious as they are susceptible to damage during installation and over the service lifetime.

These defects are typically punctures on the liner which reduce the effectiveness of geomembrane as a hydraulic barrier, especially under high hydraulic heads. A hydraulic and analytical study ((Weber, C.T and Zozornberg, J.G (2007).leakage through geosynthetic dam lining system) was conducted previously for geomembrane liners to evaluate flow through defects for different hydraulic heads in dams.

The flow components include the flow through the defect itself, flow across the interface between the geomembrane and the soil and the flow through the soil layer.

From this experiment, the flow estimate through a defect of about $2mm^2$ is about 2.6 x 10-$10m^3/s$ with a velocity of about 1x10-8 m/s. Based on this study we estimate that a pipe diameter of 160mm (M150) for Maturation Pond will be sufficient to cater for possible leaks from liner defects.

Pozidrain and leakdrain will be placed under HDPE and clay layer to drain the leakages to the pipe networks.

Pozidrain is a thin, high strength preformed drainage (or gas vent) geo-composite consisting of a HDPE cuspated core laminated to a geotextile filter.

The geotextile is laminated either onto the dimpled side or in many cases both sides of the drainage core.

Pozidrain when laid forms a blanket (horizontal, sloping or vertical) to collect and transmit water or gas from the surrounding ground into adjacent ditches or pipes.

Pozidrain also protects geomembrane liners from physical damage by the backfill. Pozidrain must be finally covered. In certain applications Pozidrain forms a void and physical barrier that stops the capillary rise of water.

Leakdrain consists of an extruded, flexible cuspated HDPE core of various thicknesses and profile heights, with excellent resistance to compression and is especially designed for use in landfill sites. Leakdrain forms the basis of an efficient detection system.

Leakdrain will not only identify the presence of a leak but also has sufficient capacity to collect the discharge and guide it safely to a collection point until repairs can be made.

Leakdrain S5u std geotextile will be placed under the HDPE liner to drain any waste that leach through the liner.

The waste will drain to the side of the dam and get collected using a finger drain system consisting of perforated HDPE pipes 110mm and 150mm in diameter placed in 19mm washed stones. Pozidrain 4S250D/NW8 will be placed under the clay layer, water collected from the leaks will be directed to the side of the dam and collected using finger drain system.

The water from the Pozidrain 4S250D/NW8 and leakdrain S5u std will gravitate to the collector pipe which will gravitate to the concrete reinforced sump.

The sump can be accessed through the manhole cover which will be on the ground level. The sump will be monitored on a quarterly basis through the manhole cover and pumped as and when required through the manhole cover.

The cover is considered as a medium duty as it weighs about 75kg. The effluent that accumulates in the sumps will be pumped back to the dams.

6. SHEQR requirements

The Contractor complies with the Occupational Health and Safety Act no 85 of 1993 and its regulations, Eskom SHE Policy, Standards, Procedures, Guidelines, Specifications and Regulations as per **Table 1**.

7. Records to be kept.

All correspondence to be given to Eskom's project manager.

8. Notes / Forms / Appendices / Annexures

None

9. Acceptance

This document has been seen and accepted by:

Name	Designation

10. Revisions

Date	Rev.	Compiler	Remarks
			Draft

11. Development Team

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

12. Acknowledgements

- N/A