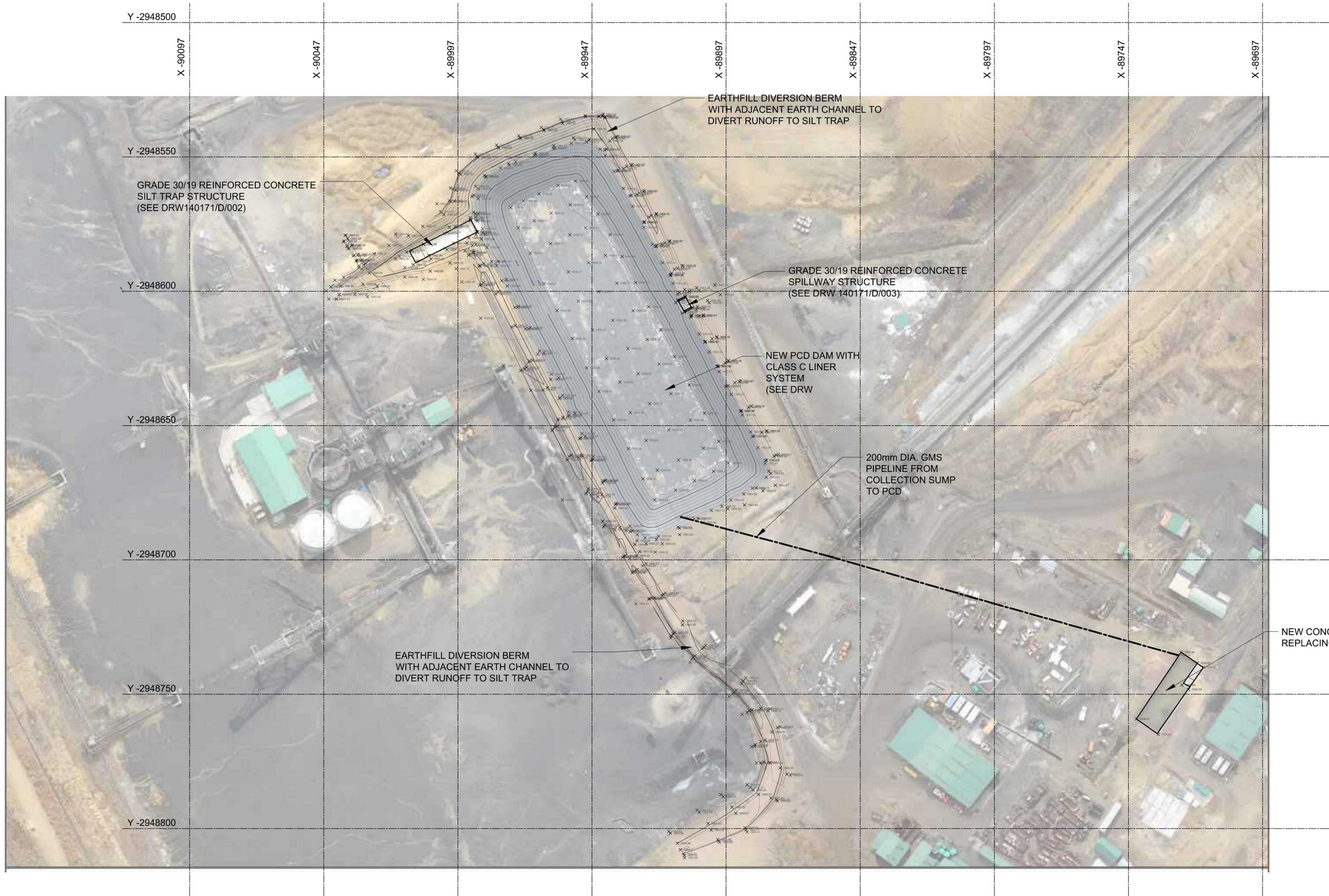


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Woodmead Business Park,  
145 Western Service Road,  
Woodmead,  
2191

Postnet Suite 722,  
Private Bag X29,  
Gallo Manor,  
2650

Tel: +27 11 656 3938  
Fax: +27 11 656 3962  
E-Mail: info@eceng.co.za

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**MOOIPLAATS COLLIERY**

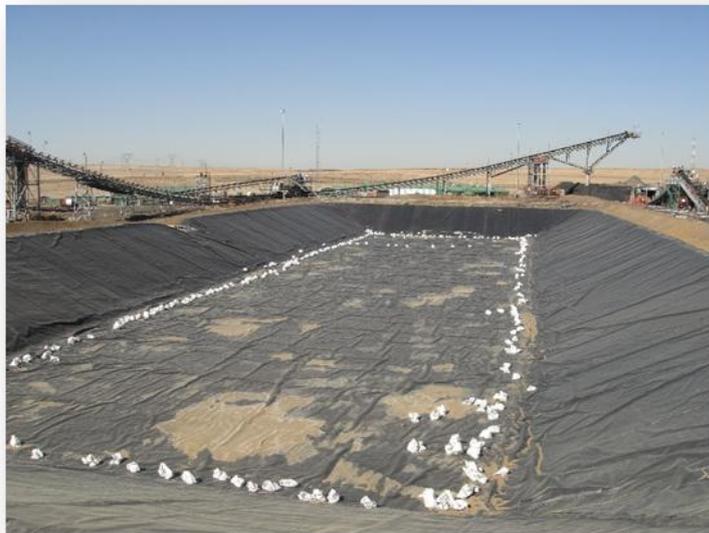
Plan Description

**SITE LAYOUT  
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|          | Name       | Signature |
|----------|------------|-----------|
| Designed | R WOOLFSON |           |
| Drawn    | R WOOLFSON |           |
| Checked  | PJ GOUWS   |           |
| Approved | PJ GOUWS   |           |
| Pr. No.  |            |           |

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**MP1401 – MOOPLAATS COLLIERY**



**CONSTRUCTION COMPLETION REPORT**

PROJECT NO: 140171

**OCTOBER 2015**

**COAL OF AFRICA LIMITED**

South Block, Summercon Office Park  
Cnr Rockery Lane and Sunset Avenue,  
**Lonehill, 2191**  
Email: nico.pretorius@coalofafrica.com



**Gauteng Office**  
**Woodmead, Johannesburg**

Tel: +27 11 656 3938

Fax: +27 11 656 3962

Office 02, Ground Floor, Maple Place South, Woodmead Business Park,  
145 Western Service Road, Woodmead, 2191

Postnet Suite 722, Private Bag X29, Gallo Manor, 2052

[www.eceng.co.za](http://www.eceng.co.za)

**DOCUMENT CONTROL SHEET**

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| <b>Compiled By:</b> | <br>.....<br>R Woolfson (BScEng) | 19/10/2015<br>.....<br>Date |
| <b>Reviewed By:</b> | <br>.....<br>PJ Gouws (PrEng)    | 19/10/2015<br>.....<br>Date |

| Revision | Description        | Date Issued | Revision By: |
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**LIST OF ABBREVIATIONS**

|          |                                       |
|----------|---------------------------------------|
| DSO      | Dam Safety Office                     |
| DWS      | Department of Water and Sanitation    |
| EPA      | Environmental Protection Agency       |
| FSL      | Full Supply Level                     |
| HDPE     | High-Density Polyethylene             |
| MAP      | Mean Annual Precipitation             |
| MLD      | Million litres per day                |
| NGL      | Natural Ground Level                  |
| NOC      | Non-Overspill Crest                   |
| OMC      | Optimum Moisture Content              |
| PCD      | Pollution Control Dam                 |
| Pr. Eng. | Professional Engineer                 |
| RC       | Reinforced Concrete                   |
| RL       | Reduced Level                         |
| RLMA     | Regional L-Moments Algorithm          |
| SANCOLD  | South African Committee on Large Dams |
| SAWS     | South African Weather Service         |
| SWMM     | Storm Water Management Model          |
| WULA     | Water Use License Application         |

## 1. INTRODUCTION

### 1.1 Background

The Mooiplaats Colliery near Ermelo, Mpumalanga required a solution to manage storm water runoff because it is below acceptable water quality standards (Fourie, 2011). This runoff should form part of a closed dirty water system which was not the case before the start of this project.

Work had previously been carried out to construct a pollution control dam (PCD) according to recommendations made in Water & Salt Balance Study: Water Balance Analysis Report (Coetzee, 2010) by Nurizon Consulting Engineers in order to address this problem. Construction was stopped for undisclosed reasons, and the colliery was placed on care and maintenance until the PCD could be completed.

Element Consulting Engineers (Pty) Ltd was asked to re-evaluate the capacity which was recommended in the above mentioned report by Nurizon, through execution of an updated water balance model, in accordance with the Best Practice Guidelines A4: Pollution control dams by the Department of Water and Sanitation. The results of this were presented in the form of a preliminary/concept design report in August 2014 and the design was accepted and approved by Kelvin Legge (DWS).

### 1.2 Contract Information

|                                 |                            |
|---------------------------------|----------------------------|
| Construction Commencement Date: | <b>15 January 2015</b>     |
| Practical Completion Date:      | <b>29 June 2015</b>        |
| Contract Value (Incl. VAT):     | <b>R4 168 788.32</b>       |
| Contractor:                     | <b>LVR Plant (Pty) Ltd</b> |
| Client:                         | <b>Langcarel (Pty) Ltd</b> |

## 2. SITE LOCATION AND DESCRIPTION

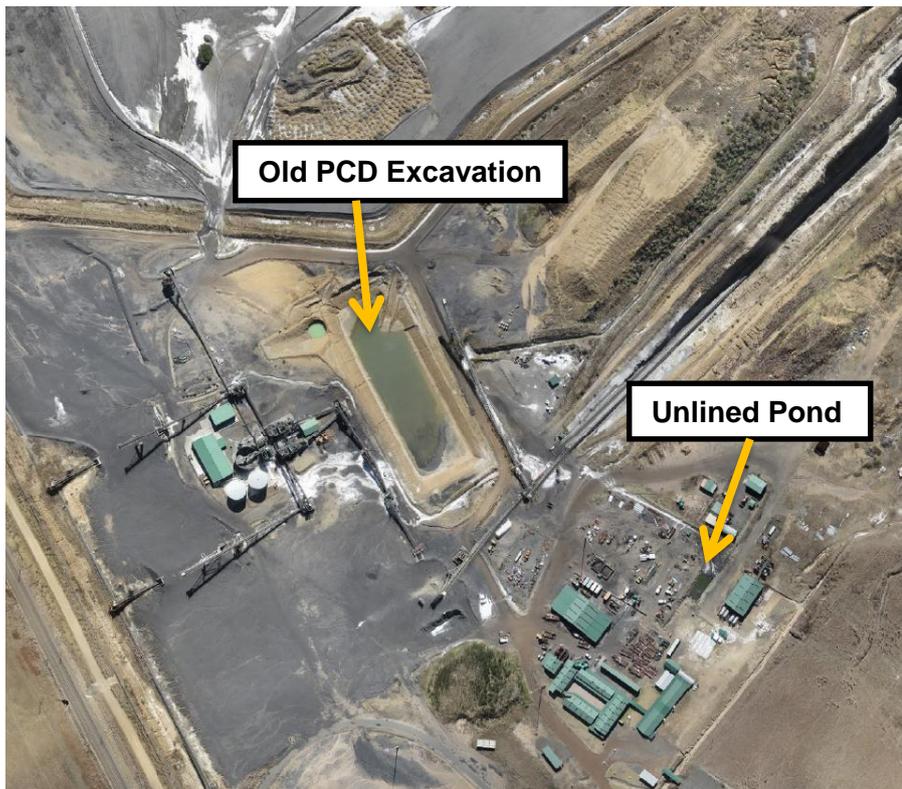
The site is a colliery, located near the town of Ermelo in Mpumalanga, which is situated on the Mooiplaats Farm). Approximate co-ordinates of the colliery are 26°39'00"S, 30°06'00"E.

The site is approximately 5km from the Eskom Camden Power Station and can be accessed via the N2 road between Ermelo and Piet Retief.

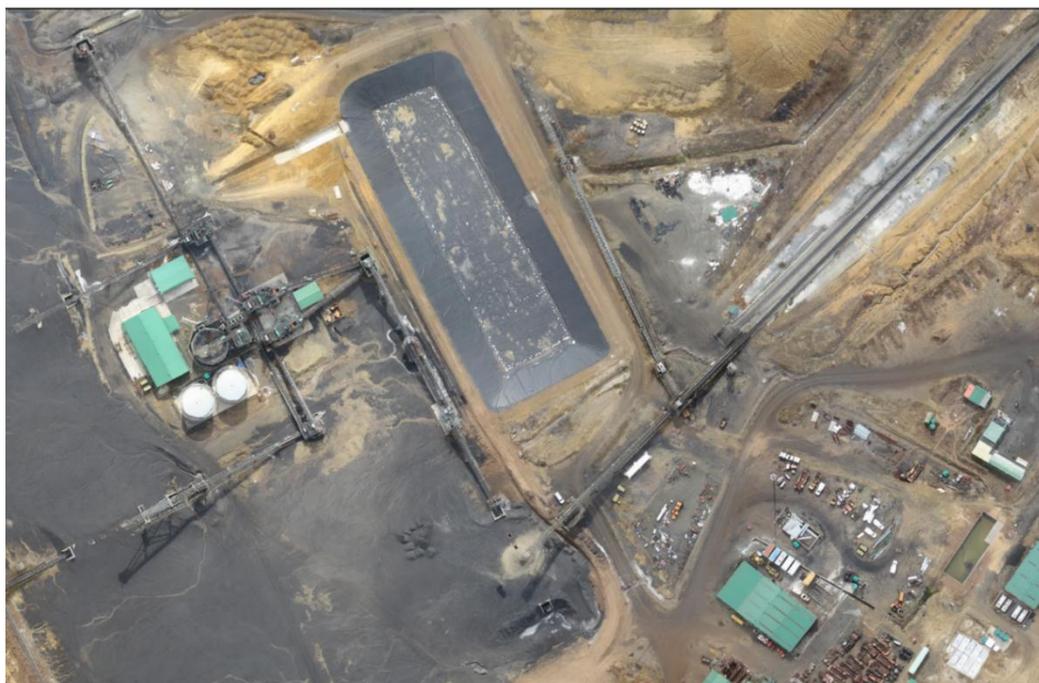
The existing PCD excavation lies between the co-disposal facility and the office area. The unlined pond is situated in the office area.



**Figure 2.1: Site Location**



**Figure 2.2: Aerial view prior to construction**



**Figure 2.3: Aerial view after completion of the works**

### 3. SCOPE OF WORK

The scope of work was as follows:

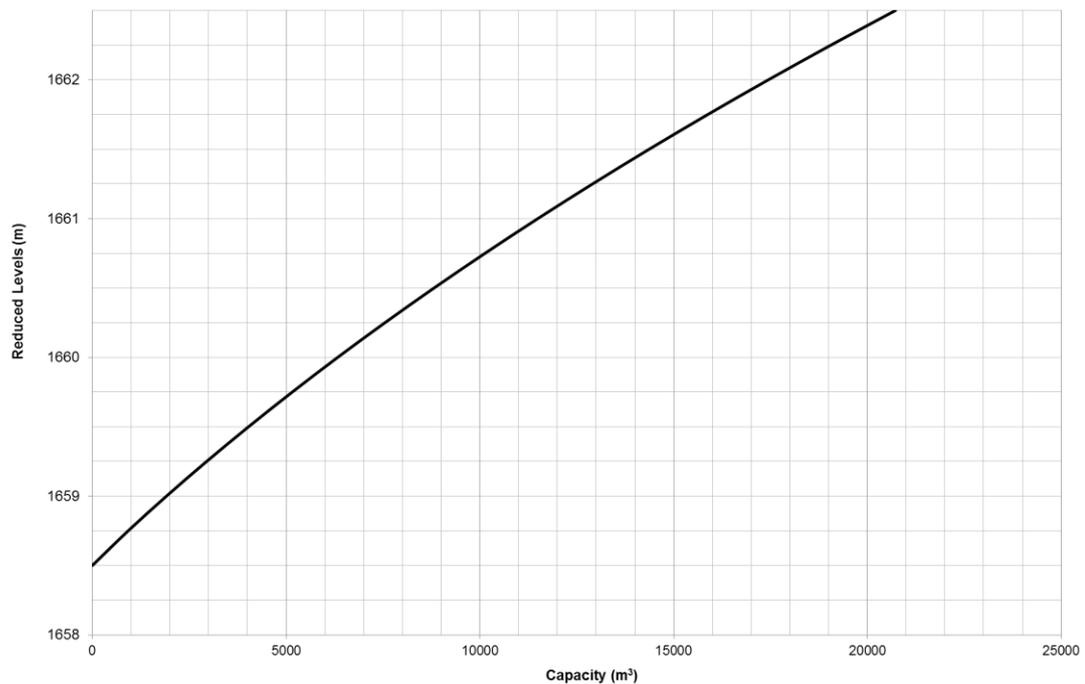
- Construction of a pollution control dam with the following liner specifications:
  - 300mm clay layer compacted to 98% standard proctor density at 2% wet of OMC (optimum moisture content)
  - 1.5mm thick HDPE (High-density polyethylene) geomembrane above the clay layer
- Construction of a reinforced concrete spillway structure
- Construction of a reinforced concrete sediment/silt trap structure
- Construction of earth fill diversion berms compacted to 98% standard proctor density at 2% wet of OMC. Side channels were to be formed alongside these berms to divert runoff towards the silt trap structure.
- A runoff channel was to be constructed upstream of the spillway to divert flow towards the drainage opportunity to the east.
- Construction of a reinforced concrete collection sump near the administration offices to capture runoff from the area downstream of the PCD. The water will then be pumped back to the PCD via a new 170m long, buried pipeline
- Install and test a pump supplied by the client for the above mentioned pipe line

### 4. BASIC CHARACTERISTICS OF THE WORKS

#### 4.1 Pollution Control Dam

The existing excavation was re-sized such that the constructed, lined, PCD would have a capacity of approximately **22059 m<sup>3</sup>** at full supply level. The actual capacity at full supply level after construction was **20721m<sup>3</sup>** (see Figure 4.1).

The PCD liner system consists of a 1.5mm thick HDPE (High-density polyethylene) geomembrane directly above a 300mm clay layer compacted to 98% standard proctor density at 2% wet of OMC (optimum moisture content) which was compacted in layers of no greater than 150mm. (See Appendices for test results).



**Figure 4.1: As-built stage/capacity curve of PCD**

## 4.2 Silt Trap

The design also includes a concrete silt trap structure which allows for sediment in the surface runoff to settle before the water enters the PCD. This minimizes the quantity of silt entering the PCD, thus increasing its life span, as well as reducing the need for maintenance within the PCD which can prove difficult due to the susceptibility of HDPE lining to damage.

The silt trap also includes an access ramp which would allow for a front end loader to enter the structure for removal of sediment if necessary. This ramp was constructed with a slope of 1 in 5 which is deemed to be sufficiently flat for its purpose.

The structure was constructed using Grade 30/19 concrete.

The silt trap has a 200mm thick reinforced concrete surface bed with Ref. 617 high-tensile weld mesh at 50mm cover to the bottom of the surface bed. Similarly, the walls

of the structure are 200mm thick and have the same mesh at 50mm cover to the outside of the structure.

Construction joints were placed along the shorter dimension of the structure at 5m spacing (see attached drawings). These joints were then saw-cut and filled with a waterproofing elastic joint sealant (Sikaflex-11FC).

Construction joints between the base of the walls and the floor slab were treated with Sikadur-32N wet to dry epoxy bonding agent to facilitate the bond between the surfaces.

An overflow ledge 560mm below the top level of the walls was constructed to allow flow of water into the PCD without overtopping of the silt trap.

This overflow was designed to have an effective freeboard of 500mm and a width of 5m which is adequate to pass the 1 in 50-year flood peak. This overflow is approximately 1.5m above the base of the silt trap which will allow for silt particles to settle within the structure before water enters the PCD.

The level of this overflow is at **1663.44m**.

### 4.3 Spillway Structure

The *Best Practice Guidelines A4: Pollution control dams* from DWS, states that spillway sizing for pollution control dams should be carried out based on the guidelines set out in *Guidelines to Safety in Relation to Floods*. These guidelines indicate the applicable design discharge recurrence intervals to be used to determine required spillway discharge capacities; however, they are based on upstream wall heights which is not applicable in this case as the PCD is below ground level. Furthermore, according to the DSO, a dam having a wall height of less than 5m and a storage capacity of less than 50 000m<sup>3</sup>, as is the case in this situation, does not need to be registered with DWS as a dam having a safety risk (see attached confirmation letter in appendices).

Despite this, it was decided to design the spillway for the 1 in 100-year flood peak of **2.64m<sup>3</sup>/s**.

The spillway was constructed from grade 30/19 concrete. Only 500mm freeboard is required to pass the 1:100 year flood peak, although the available freeboard is higher as a result of raising the NOC levels for aesthetic reasons. The discharge capacity of the spillway was evaluated using the equation below:

$$Q = CLH^{3/2}$$

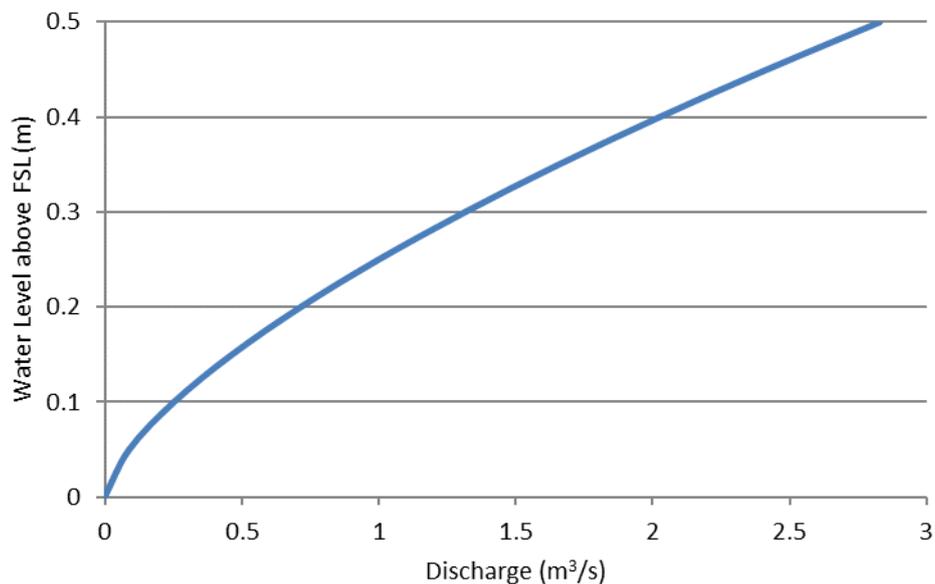
With

$$C = 1.6$$

$$L = 5\text{m}$$

$$H = 0.5\text{m}$$

Using these values, the spillway discharge capacity is **2.83m<sup>3</sup>/s** which is greater than the 1 in 100-year flood peak. It should be noted that the discharge coefficient used is that of a broad-crested weir which was deemed to be a conservative estimate of the spillway capacity. **Figure 2** shows the relationship between discharge and water level above FSL for this spillway.



**Figure 2: Spillway Discharge Curve**

#### 4.4 Spillway Runoff Channel

Discharge from the spillway due to the 1 in 100 year flood is not expected to produce runoff with significant velocities. Despite this, some erosion damage could take place. It was therefore decided during construction to make use of layer of rockfill material to line the spillway channel. This layer extends over the full width (5m) of the spillway.

#### 4.5 Collection Pond

Sizing of the new concrete lined collection pond was done through computation of the 1 in 50 year flood runoff volume for the sub-catchment that drains into it. It was decided to line this pond with concrete for access purposes and an access ramp was also included in the design. Water collecting in this pond is to be pumped into the PCD when the water level is **1.80m** above the bottom of the pond.

The capacity of the pond was designed for the 1 in 50 year runoff volume, which would be a worst-case scenario (i.e. No pumping taking place). It should also be noted that during a significant storm event, there may have been a build-up of sediment and water in the pond prior to the start of the storm which would reduce the available capacity before spillage occurs.

In addition to this, water quality of the runoff that collects in this pond is non-compliant with the SANS 241:2006 standards as determined by testing done on samples from the area (Fourie, 2011). Concentrations of Na, SO<sub>4</sub> and F are significantly higher than is derisible according to these standards. As such, it can be concluded that the prevention of spillage from this pond is as important as prevention of spillage from the PCD.

The structure was constructed using Grade 30/19 concrete. As is the case with the silt trap, the surface bed of this pond was reinforced with Ref. 617 high-tensile weld mesh at 50mm cover to the bottom of the bed. The walls are 200mm thick and reinforced with Ref. 617 high-tensile weld mesh at 50mm cover to the outside of the structure. Construction joints between the base of the walls and the floor slab were treated with Sikadur-32N wet to dry epoxy bonding agent to facilitate the bond between the surfaces.

#### 4.6 Diversion Berm with Collection Channel

Two diversion berms were constructed with adjacent channels in order to convey runoff towards the silt trap. This will reduce the quantity of sediment entering directly into the PCD, thus increasing its life-span and reducing the need for sediment removal from the PCD.

The berm slopes are protected from erosion by grass cover which is was in the process of being established at the time of writing.

The diversion berm on the North/North-Eastern side of the dam does not have a side channel along its entire length due to topographical restrictions. Channel A (Western Side of PCD) was designed to have a slope of approximately **1 in 400** while Channel B (Eastern/Northern Side of PCD) was designed to have a slope of **1 in 50**. Both of these channels terminate at a level of **1664.00m** once they reach the silt trap structure.

### 5. DESIGN CHANGES DURING CONSTRUCTION

- The position of the spillway was changed to make use of a more effective drainage opportunity. The spillway channel could then drain into a collection sump with a channel leading out of the mine.
- The spillway channel was originally planned to be constructed using a soilcrete layer, however it was decided that to save costs, rockfill material available on site should be used.
- The chute from the concrete silt trap leading into the PCD was originally planned to run along the slope. For ease of construction it was decided to rather construct a horizontal overflow ledge.
- The NOC of the dam was raised by approximately 780mm from the original planned level of 1664.00m. The lowest point on the dam crest is 1664.78m on the Southern side. The crest levels on the northern side of the dam were slightly higher at the start of construction and a decision was taken to raise the crest to the same level all around the dam for aesthetic reasons. As such, more freeboard is available than was required based on the design.

- The above change required that the silt trap overall levels were raised by 500mm (which reduced excavation costs) and that the diversion berm crest levels were raised by approximately 1m.

## 6. EXTENSION OF TIME

An extension of 28 days was granted by the Engineer. The Contractor submitted a claim dated 26 May 2015 citing the following reasons to claim for an extension of time:

1. Rainfall (as per Contract document) – 6 Days
2. 3 heavy rainfall events, each causing a delay of 3 days – 9 Days. There was a significant quantity of clay material on site that created working challenges during periods of heavy rainfall.
3. Additional work:
  - The quantity of silt in the Genset dam was underestimated and excavation took longer than expected.
  - Additional fill was required at the silt trap location.
  - Levelling of PCD crest
4. Working hours were only made known after commencement of the works.

Practical completion was granted on 24 June 2015 and therefore 15 days' worth of penalties were imposed. This amounted to **R 78,360.75** (Excl. VAT).

## 7. QUALITY CONTROL DURING CONSTRUCTION

The following tests were carried out during construction to ensure quality control:

- Concrete cube testing for the silt trap structure, spillway structure and collection pond.
- Compaction tests within the basin of the PCD
- Compaction tests on the diversion berms
- General foundation indicator tests were taken on the clay material obtained on site for the PCD clay layer.

**8. OUTSTANDING ITEMS**

- The certificate of completion was granted on condition that the Contractor completes grass establishment on the diversion berms and side channels after winter.
- This was completed by 14 October 2015.

**9. CERTIFICATE OF COMPLETION**

See Appendices.

**APPENDIX A:  
PHOTO REPORT**

**APPENDIX B:  
AS-BUILT DRAWINGS**

**APPENDIX C:  
TEST RESULTS**

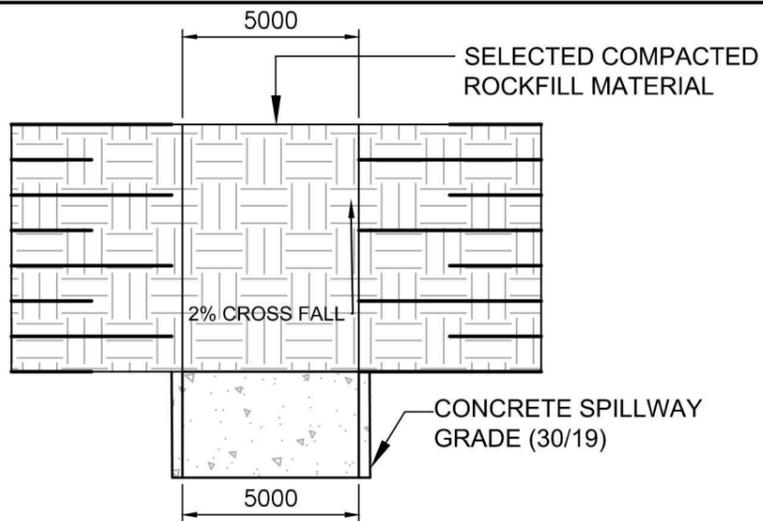
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CERTIFICATE OF COMPLETION**

**APPENDIX E:  
DWS DAM SAFETY OFFICE LETTER**

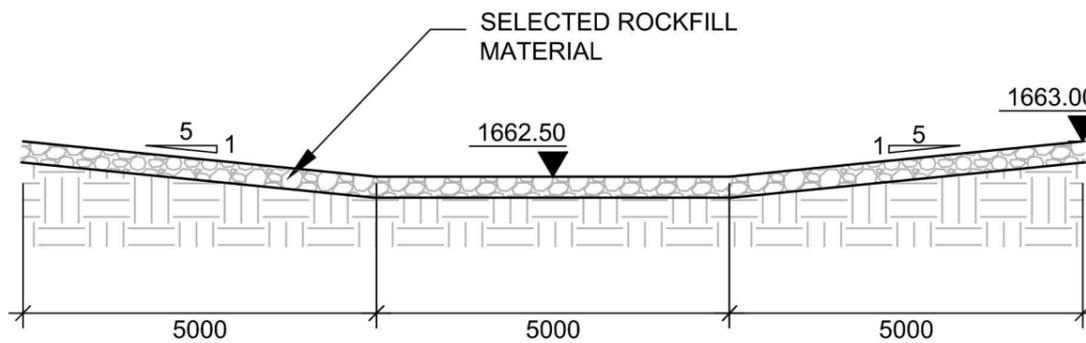
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VARIATION ORDER FORMS**

**APPENDIX G:  
EXTENSION OF TIME LETTER**

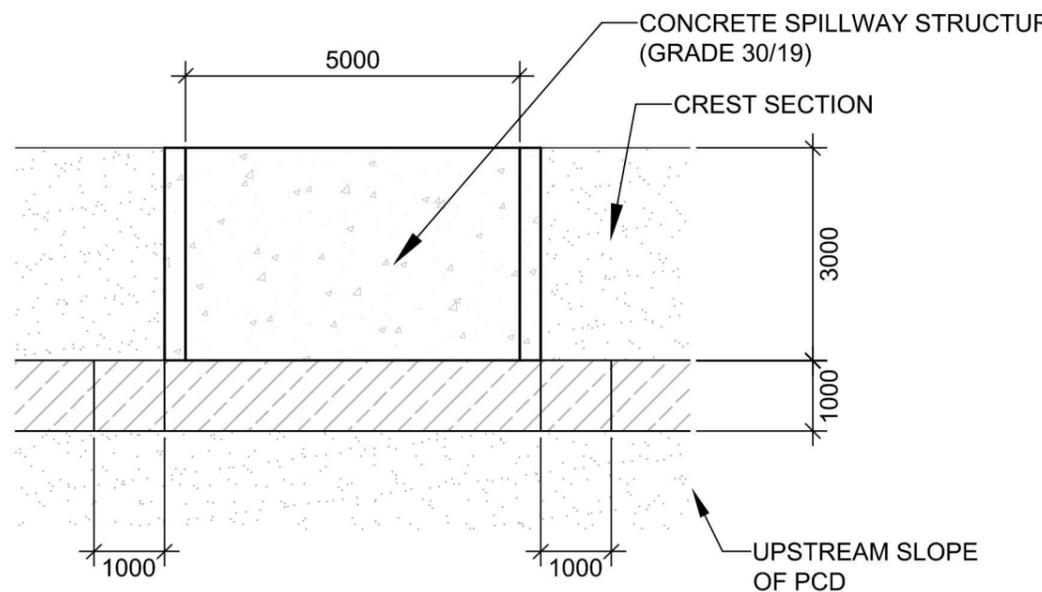




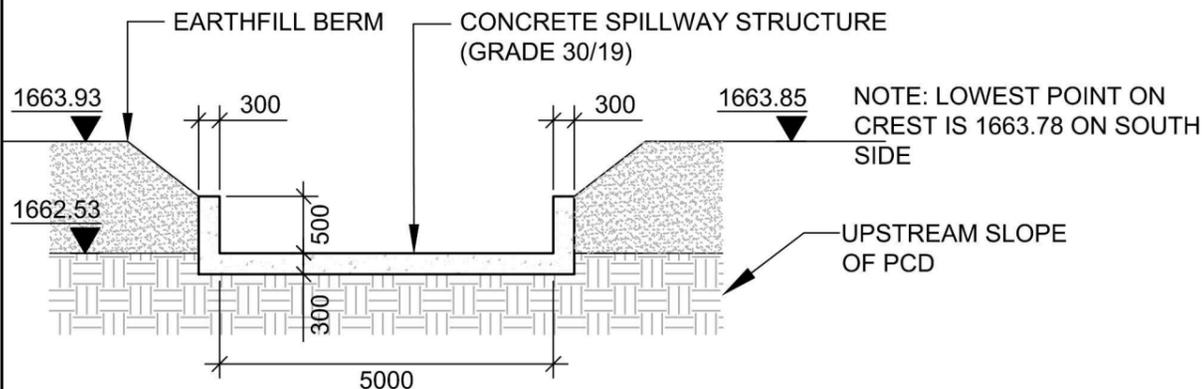
**PLAN VIEW OF SPILLWAY RUNOFF CHANNEL**  
SCALE 1:200



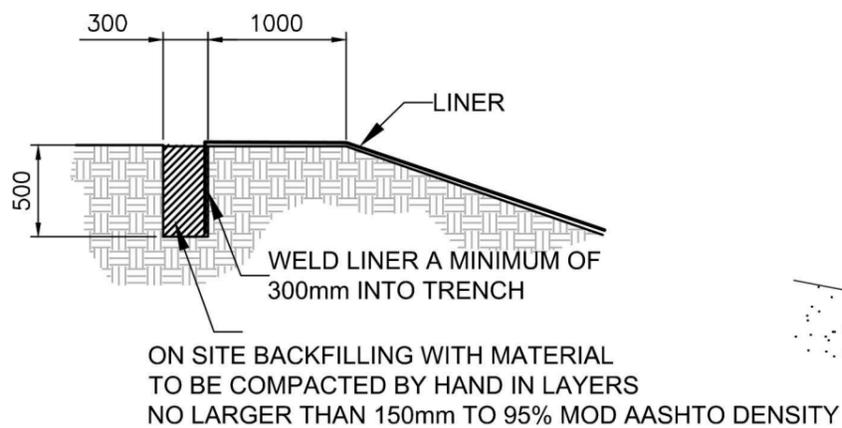
**FRONT VIEW OF SPILLWAY RUNOFF CHANNEL**  
SCALE 1:100



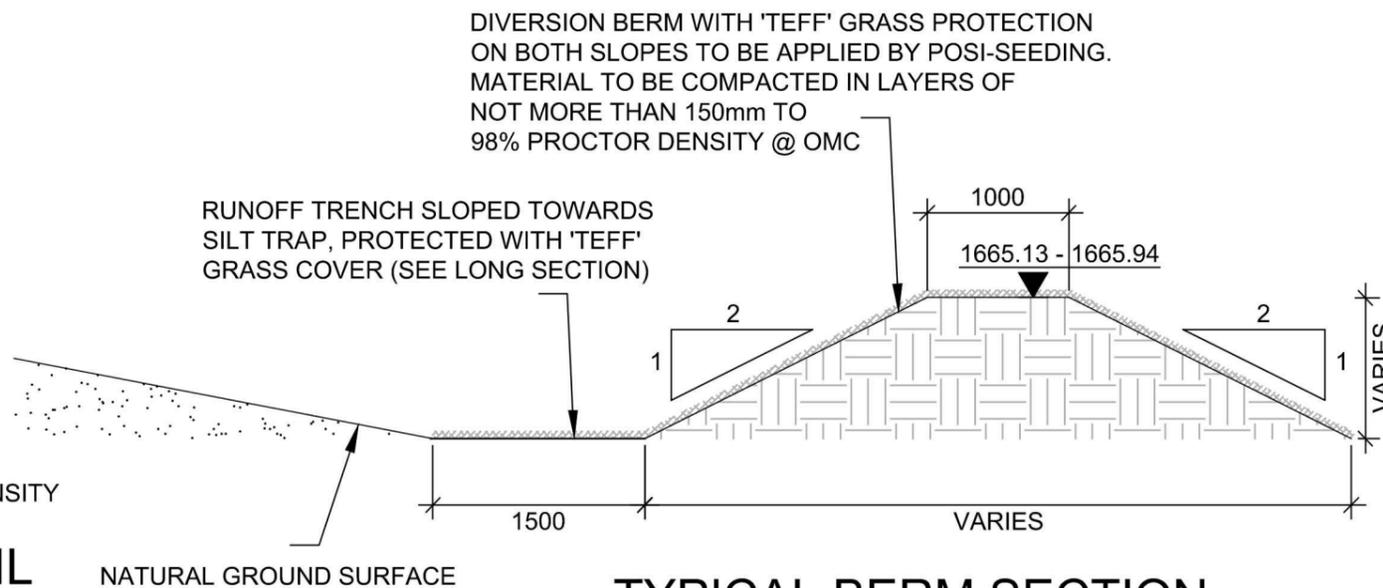
**SPILLWAY PLAN VIEW**  
SCALE 1:100



**SPILLWAY FRONT VIEW**  
SCALE 1:100



**TYPICAL ANCHOR TRENCH DETAIL**  
SCALE 1:200



**TYPICAL BERM SECTION**  
SCALE 1:50

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Scale 0 5 10 15 20mm  
ORIGINAL SIZE A3

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Project

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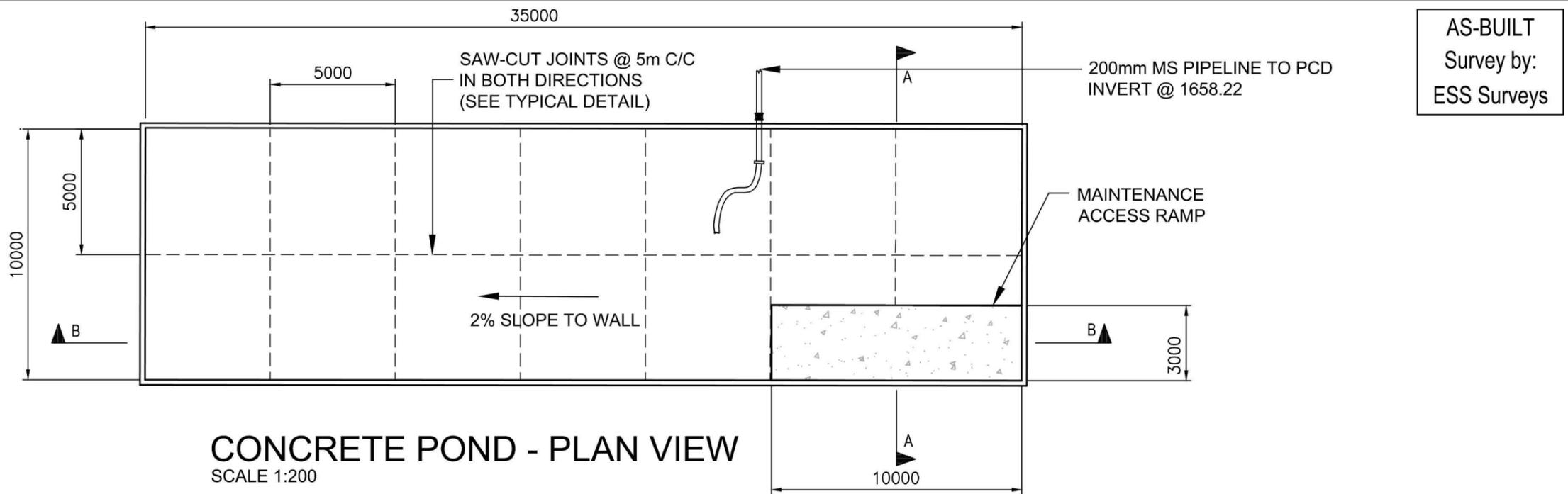
GENERAL DETAILS

|          | Name       | Signature |
|----------|------------|-----------|
| Designed | R WOOLFSON |           |
| Drawn    | R WOOLFSON |           |
| Checked  | PJ GOUWS   |           |
| Approved | PJ GOUWS   |           |
| Pr. No.  | 880061     |           |

Contract No. MP1401

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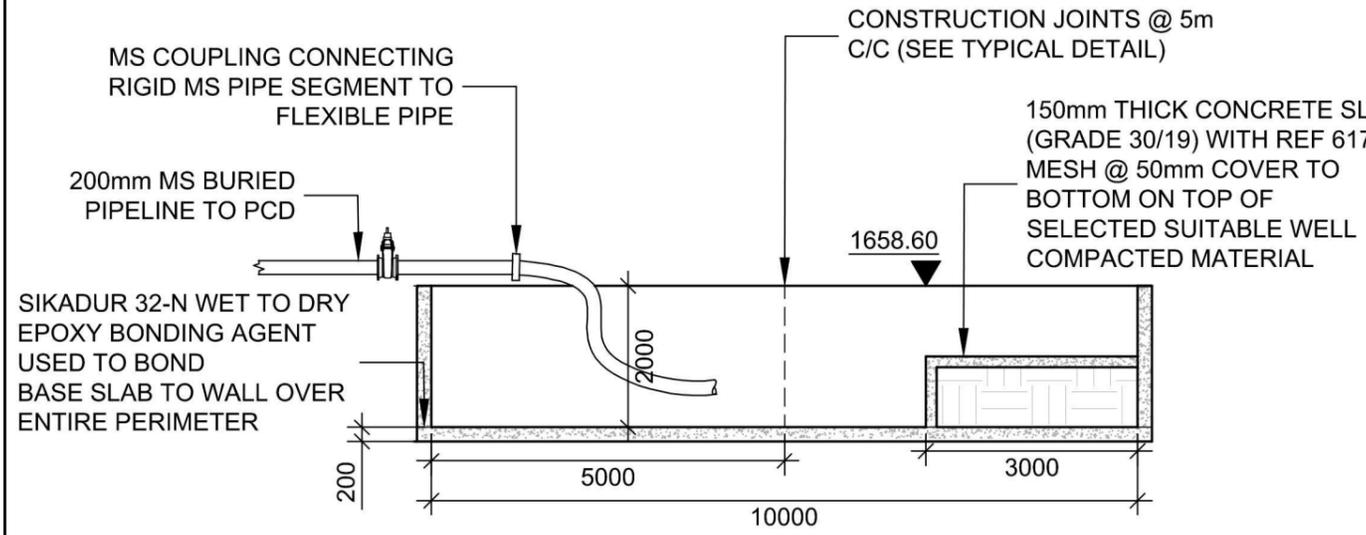
Oak Place, Woodmead Business Park,  
145 Western Service Road, Woodmead, Johannesburg, 2191  
Tel: +27 11 656 3938 Fax: +27 11 656 3962  
E-Mail: info@eceng.co.za

Project

MOOPLAATS COLLIERY

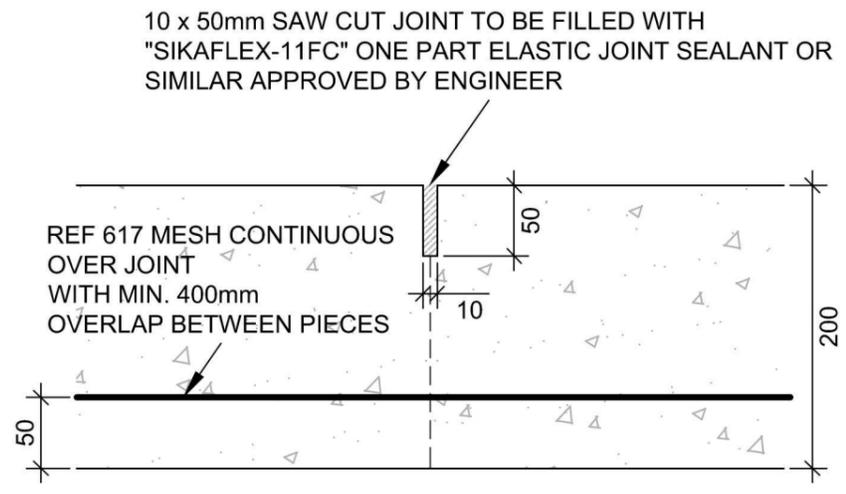
Plan Description

CONCRETE LINED  
COLLECTION POND DETAILS



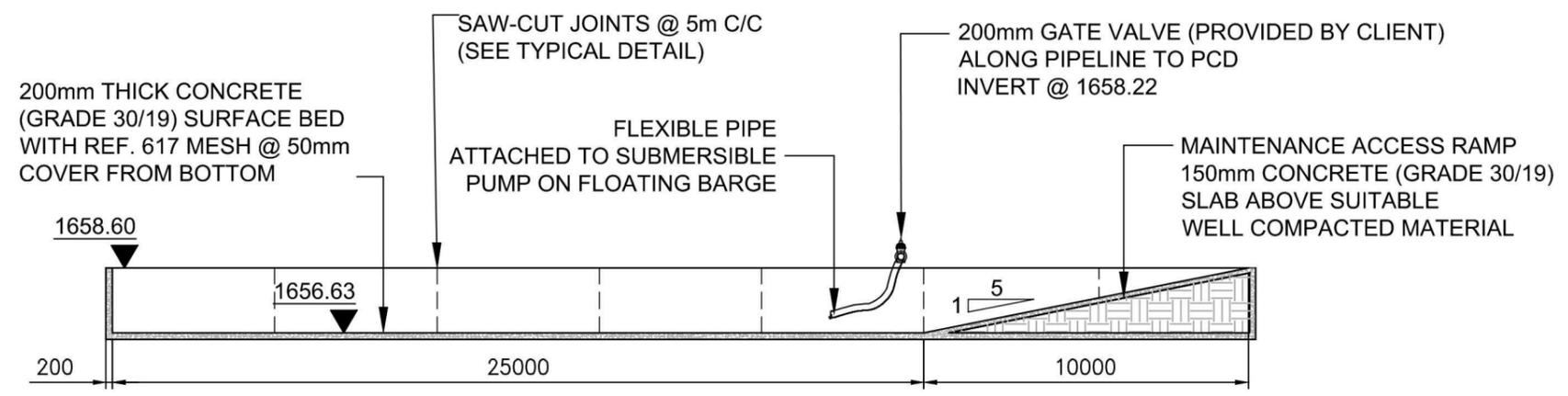
### SECTION A-A

SCALE 1:100



### TYPICAL JOINT DETAIL

SCALE 1:5



### SECTION B-B

SCALE 1:200

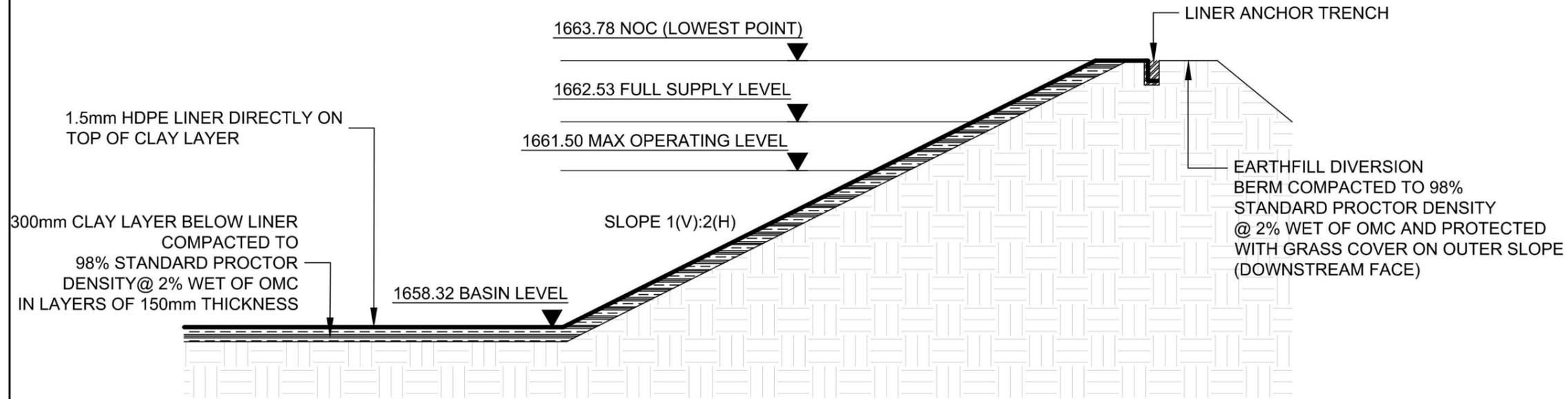
|              | Name       | Signature |
|--------------|------------|-----------|
| Designed     | R WOOLFSON |           |
| Drawn        | R WOOLFSON |           |
| Checked      | PJ GOUWS   |           |
| Approved     | PJ GOUWS   |           |
| Pr. No.      | 880061     |           |
| Contract No. | MP1401     |           |

Drawing No. 140171 / D / 004

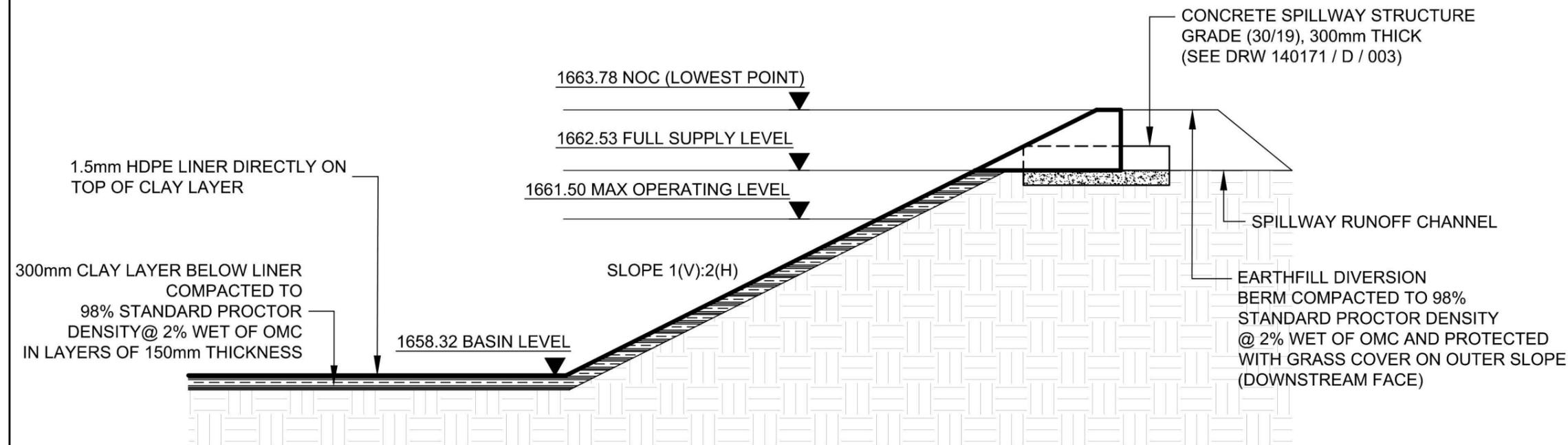
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**TYPICAL SECTION THROUGH PCD**  
SCALE 1:100



**TYPICAL SECTION THROUGH SPILLWAY**  
SCALE 1:100

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Client/Employer

**ELEMENT**  
Consulting Engineers  
A FIFTH DIMENSION TO ENGINEERING

Oak Place, Woodmead Business Park,  
145 Western Service Road, Woodmead, Johannesburg, 2191  
Tel: +27 11 656 3938 Fax: +27 11 656 3962  
E-Mail: info@eceng.co.za

Project

**MOOPLAATS COLLIERY**

Plan Description

**PCD SECTIONS**

|          | Name       | Signature |
|----------|------------|-----------|
| Designed | R WOOLFSON |           |
| Drawn    | R WOOLFSON |           |
| Checked  | PJ GOUWS   |           |
| Approved | PJ GOUWS   |           |
| Pr. No.  |            |           |

Contract No. **MP1401**

Drawing No. **140171 / D / 005** Revision **Z**