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NOZALA COAL

GRUISFONTEIN STORMWATER MANAGEMENT PLAN

DRAFT REPORT
REVISION 01

SEPTEMBER 2019

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DOCUMENT CONTROL

TITLE:	GRUISFONTEIN STORMWATER MANAGEMENT PLAN		
ELECTRONIC FILE LOCATION:	P18054_NOZALA GRUISFONTEIN COAL PROJECT_REPORTS_STORMWATER MASTER PLAN REPORT_REV 01		
REPORT STATUS:	Draft		
REVISION NUMBER:	01		
CLIENT:	Nozala Coal (Pty) Ltd P O Box 68413 Bryanston 2021		
CONSULTANT:	Delta Built Environment Consultants (Pty) Ltd P.O. Box 35703 Menlo Park 0102		
DATE:	September 2019		
REFERENCE NUMBER:	P18054 / R5782		
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DISTRIBUTION LIST:	**COMPANY**	**NAME & SURNAME**	
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RECORD OF REVISIONS

REV. NO.	STATUS	DESCRIPTION OF REVISION	REV. DATE
00	Draft	Issued for comments	23/08/2019
01	Draft	Issued for Comments	10/09/2019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 BACKGROUND

Nozala Coal (Pty) Ltd holds a coal prospecting right over the farm Gruisfontein 230LQ, located in the Limpopo Province approximately 70 km northwest of the town of Lephalale within the Waterberg Coalfield area. A Concept Study report indicating resource statements, the coal quality analysis, covering the Prospecting Rights area, has been prepared by RSV ENCO Consulting (Pty) Ltd.

Nozala Coal (Pty) Ltd requires technical and specialist services conducted to secure the Mining Right, which includes, but not limited to Engineering and Design services, Draft scoping Report, Environmental Impact Assessment Environmental Management Plan and Social Labour Planning.

Delta Built Environment Consultants was appointed by Nozala Coal (Pty) Ltd to perform the consulting engineering services for the Support Infrastructure Services for the Detail Feasibility Study for the Nozala Gruisfontein Coal mine project.

1.2 PURPOSE OF REPORT

Delta Built Environment Consultants (Delta BEC) compiled this document to present the methodologies, and detailed calculations followed during the design process of the stormwater management system of Nozala Gruisfontein Coal Mine.

The report addresses the required legislation through the stormwater infrastructure, services and facilities and provides the Client with the necessary information to prove full compliance regarding the following:

- National Water Act
- Regulation GN 704
- Best Practice Guidelines - G1: Stormwater Management
- IWULA requirements.

1.3 STRUCTURE OF REPORT

The presentation of information is as follows:

- Section 2: Hydrological Characteristics
- Section 3: Preliminary Design
- Section 4: Cost Estimates
- Section 5: Conclusion

2 HYDROLOGICAL CHARACTERISTICS OF PROJECT SITE

2.1 INTRODUCTION

This section of the report will provide necessary hydrological information on the site proposed for the new development. This is required to ensure that the correct base information influences the hydrological calculation. The section will comprise the following:

- Catchment Area
- Regional Topography
- Geology
- Meteorology.

2.2 CATCHMENT AREA

Nozala Gruisfontein Coal Mine is situated in the Limpopo (A) primary drainage region. The majority of the stormwater runoff generated in this area drains utilising surface flow, into the Limpopo River. This river borders the northern part of this region and spills out into the Indian Ocean. On a quaternary drainage level, the mine (indicated by the yellow pin) is situated in the A41E drainage basin (outlined with pink) as displayed in Figure 2-1. The only river that runs through (adjacent to) the catchment area is the Limpopo River and is approximately 5.4 km away from the mine's location.

Figure 2-1: Locality of Proposed site

The stormwater runoff from the Limpopo area surrounding the mine can be described as a flat drainage basin with the area renowned for the underground movement of water. The permeable soil type, relatively low yearly rainfall and the topography of the area results in no distinct perennial water streams running through the area.

2.3 REGIONAL TOPOGRAPHY

The site topography is relatively flat with most slopes between 0% and 3%. The slopes area slopes, and therefore drains, in a north-westerly direction towards the Limpopo River by means of surface flow.

The development of the mine will have a significant impact on the drainage of the area due to the displacement of large quantities of soil. The stormwater network will accommodate these changes as far as practically possible and as required by legislation.

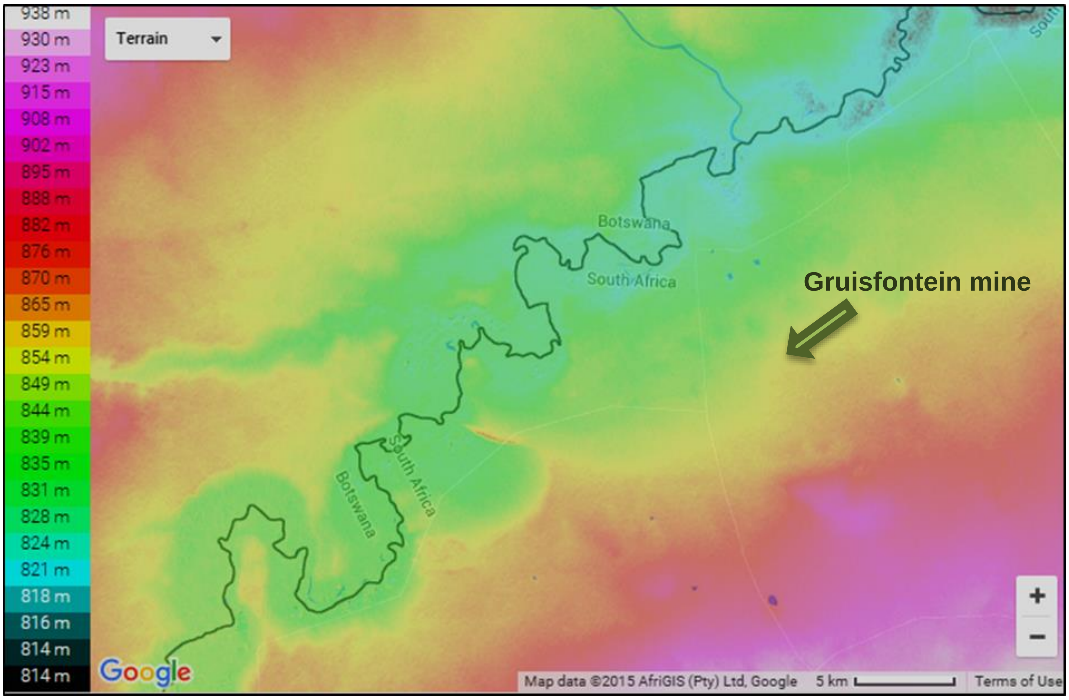


Figure 2-2: Elevation of the project site

2.4 METEOROLOGY

The Nozala Gruisfontein Coal Mine area is at an altitude of ±850m above mean average sea level (m.a.s.l) and the mean annual precipitation (MAP) is estimated to be 440 mm per annum

Monthly rainfall data for the site has been obtained from the waterresourceswr2012.co.za website. This data contains the measured rainfall from 1920 to 2009 for the quaternary drainage region. This was utilised to determine the average rainfall per month for the site area and is represented in Figure 2-3.

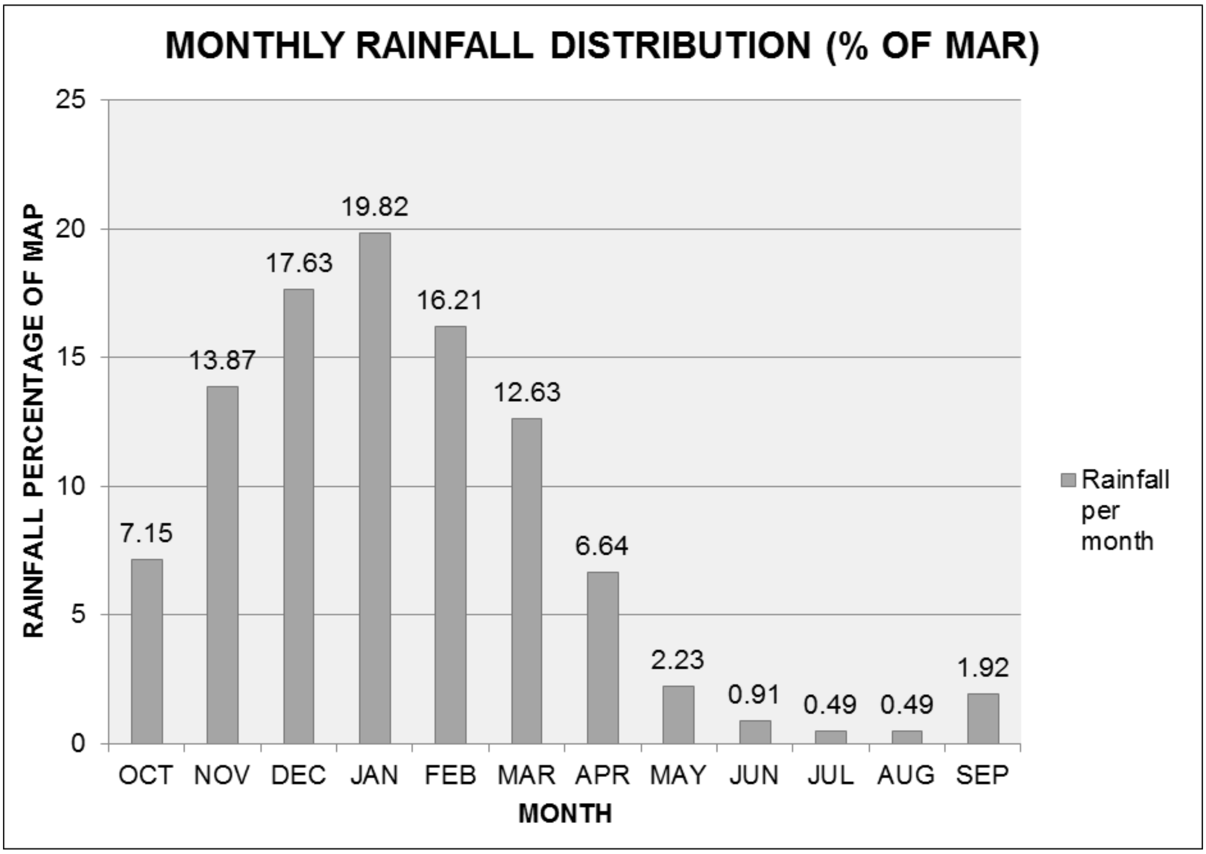


Figure 2-3: Monthly Rainfall Data

From the graph, it can be seen that the higher rainfall season falls between October and April each year, with the remainder of the year experience very little rainfall.

3 LEGISLATION

3.1 INTRODUCTION

This section discusses the legal requirement in terms of stormwater management for South African mines and comprises of the following sub-section:

- Legislation documents
- Compliance.

3.2 LEGISLATION DOCUMENTS

Due to the extreme scarcity of water in South Africa, it is of cardinal importance that the management of this resource is of a responsible and sustainable manner. To achieve the ideals above the design of the stormwater network for any mine has to comply with the following standards and legislation as enforced by the South African government:

- National Water Act
- Regulation GN 704
- Best Practice Guidelines - G1: Stormwater Management
- IWULA requirements.

The compliance with the aforementioned is necessary for the mine to obtain a water use licence.

3.2.1 TERMINOLOGY

The classification of Dirty Water and Clean Water Areas is of critical importance during the design phase of a mine's stormwater management system. The Department of Water Affairs and Forestry's Regulation on Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources and the National Water Act defines clean and dirty water systems as follows:

- 'Clean water system' includes any dam, other forms of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water;
- 'Dirty water system' includes any dam, other forms of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste;
- 'Dirty area' means any area at a mine or activity which causes, has caused, or is likely to cause pollution of a water resource;
- 'Pollution' means the direct or indirect alteration of the physical, chemical or biological properties of a water resource to make it:
- Less fit for any beneficial purpose for which it may reasonably be expected to be used
- Harmful or potentially harmful
- 'Waste' includes any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilt or deposited on

land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause the water resource to be polluted.

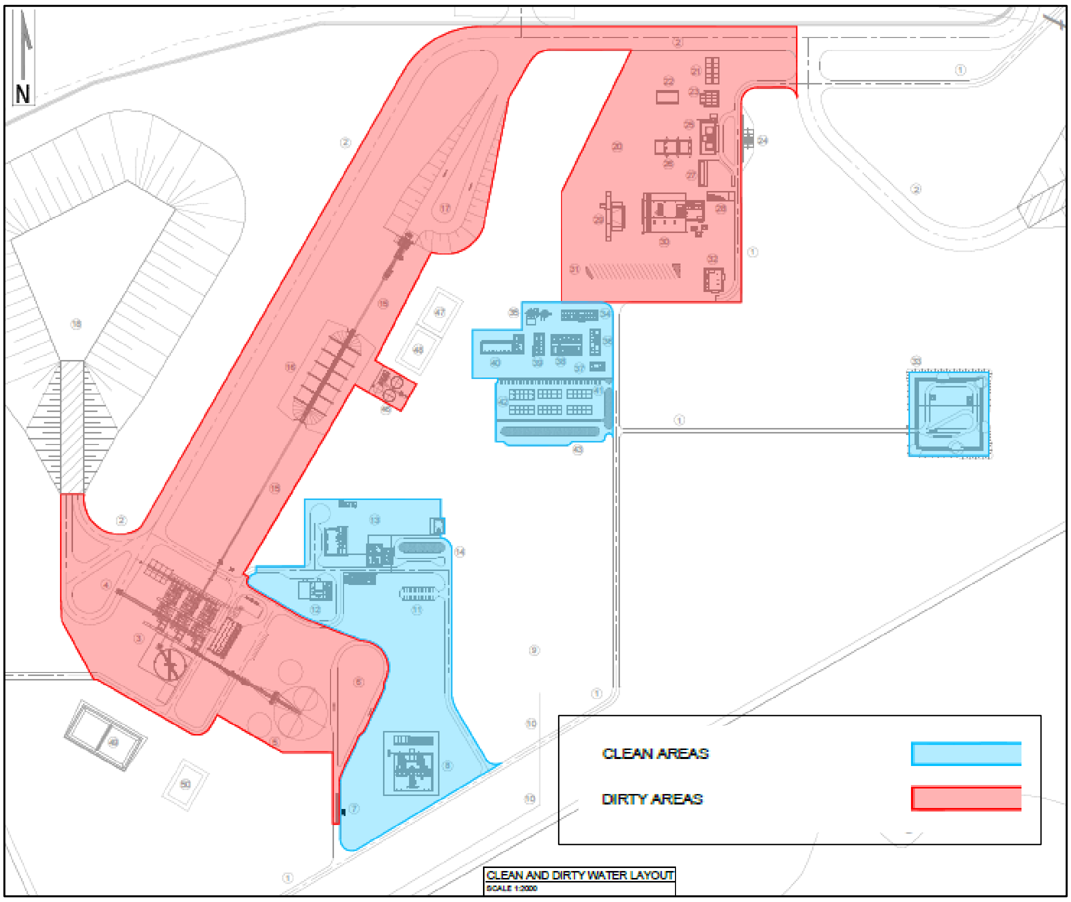


Figure 2-4: Clean & Dirty Water Areas

3.3 COMPLIANCE

Table 2-1 provides the measures implemented to address the requirements of Regulation GN 704 and directs the reader to the specific section of the report detailing the stated implementation.

Table 2-1: Compliance to Regulation GN 704

LEGISLATION	COMMENT
4. Restrictions on locality	
No person in control of a mine or activity may-	
(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 meters from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;	Mine situated ±7 km from the closest natural river (Limpopo River); No wetland areas were identified during the site visit
(b) except concerning a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1: 50-year flood-line or within a horizontal distance of 100 meters from any watercourse or estuary, whichever is the greatest;	Mine situated ±7 km from the closest natural river (Limpopo River); No wetland areas were identified during the site visit
(c) place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or	Discard to be stockpiled on lined area, preventing the seepage of contaminated water into the groundwater.
(d) use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1: 50-year flood-line of any watercourse or estuary.	Mine situated ±7 km from the closest natural river (Limpopo River); No wetland areas were identified during the site visit
5. Restrictions on use of material	
No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or an embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.	Soil removed from mining pit to be used for construction — soil of adequate quality and not polluted.
6. Capacity requirements for clean and dirty water systems	
Every person in control of a mine or activity must-	

LEGISLATION	COMMENT
(a) confine any unpolluted water to a clean water system, away from any dirty area;	Separate stormwater systems design for clean water and dirty water systems.
(b) design, construct, maintain and operate any clean water system at the mine or activity so that it is not likely to spill into any dirty water system more than once in 50 years;	All stormwater infrastructure designed to retain the 1: 50-year flood and prevent the spillage of the dirty water into the clean water system and vice versa.
(c) collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system;	Dirty stormwater system designed with designated lined dirty stormwater ponds. Lining in accordance with South African standards.
(d) 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; and	All stormwater infrastructure designed to retain the 1: 50-year flood and prevent the spillage of the dirty water into the clean water system and vice versa.
(e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 meters above full supply level unless otherwise specified in terms of Chapter 12 of the Act.	All stormwater storage elements designed with a 0.8 m freeboard.
(f) design, construct and maintain all water 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 an average period of recurrence of once in 50 years.	Channels designed to prevent silt sedimentation within the channels. Designated silt traps were designed to remove the silt from the system and to ensure the desired capacity.
7. Protection of water resources	
Every person in control of a mine or activity must take reasonable measures to-	
(a) prevent water containing waste or any substance which causes or is likely to cause pollution of a water resource from entering any water resource, either by natural flow or by seepage, and must retain or collect such substance or water containing waste for use, re-use, evaporation or for purification and disposal in terms of the Act;	All stormwater storage elements designed to contain contaminated water within the mining premises.

LEGISLATION	COMMENT
(b) design, modify, locate, construct and maintain all water systems, including residue deposits, in any area so as to prevent the pollution of any water resource through the operation or use thereof and to restrict the possibility of damage to the riparian or in-stream habitat through erosion or sedimentation, or the disturbance of vegetation, or the alteration of flow characteristics;	Mine constructed far from natural water sources. All system elements subjected to contaminated water will be lined to prevent the possible contamination of groundwater
(c) cause effective measures to be taken to minimise the flow of any surface water or floodwater into mine workings, opencast workings, other workings or subterranean caverns, through cracked or fissured formations, subsided ground, sinkholes, outcrop excavations, adits, entrances or any other openings;	Dirty water areas are minimised using berms, preventing clean water from entering contaminated areas.
(d) design, modify, construct, maintain and use any dam or any residue deposit or stockpile used for the disposal or storage of mineral tailings, slimes, ash or other hydraulic transported substances, so that the water or waste therein, or falling therein, will not result in the failure thereof or impair the stability thereof;	Dams designed to accommodate the 1: 50-year flood in terms of capacity. Structural stability designed assured by the safe discharge of 1: 100-year floods using an overflow structure. Application of strict maintenance manual by the mine to ensure effectivity of the system.
(e) prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources;	Storage dams designed to contain contaminated water. These dams will be lined to avoid seepage through the dam walls.
(f) ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time;	Stormwater storage dams will be emptied to balancing dams to ensure the required capacity during storm events. All dirty water storage dams will be lined to prevent seepage. All dirty water to be captured within the designated dams and to be recycled.
(g) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; and	Strict maintenance manual to be applied. Channels designed to prevent sedimentation as far as possible.

LEGISLATION	COMMENT
a. cause all domestic waste, including wash-water, which cannot be disposed of in a municipal sewage system, to be disposed of in terms of authorisation under the Act.	All wash water to be recycled in a custom-made system removing the oils and recycle the water for reuse — oil to be stored in containers and disposed of by a specialist company.
8. Security and additional measures	
Every person in control of a mine or activity must-	
(a) cause any impoundment or dam containing any poisonous, toxic or injurious substance to be effectively fenced-off to restrict access to it, and must erect warning notice boards at prominent locations to warn persons of the hazardous contents thereof;	All dams to be fenced off with the required safety and warning signs.
(b) ensure access control in any area used for the stockpiling or disposal of any residue or substance which causes, has caused or is likely to cause pollution of a water resource to protect any measures taken in terms of these regulations;	Access control to be applied by mine entrance.
(c) not allow the area contemplated in paragraph (a) and (b) to be used for any other purpose, if such use causes or is likely to cause pollution of a water resource; and	No access
(d) protect any existing pollution control measures or replace any current pollution control measures deleteriously affected, damaged or destroyed by the removing or reclaiming of materials from any residue deposit or stockpile, and establish additional measures for the prevention of pollution of a water resource which might occur, is occurring or has occurred as a result of such operations.	Not applicable until the operation of the mine has started
9. Temporary or permanent cessation of mine or activity	
(1) Any person in control of a mine or activity must at either temporary or permanent cessation of operations ensure that all pollution control measures have been designed, modified, constructed and maintained to comply with these regulations.	Compliance to regulation required before commencement of mine constructions, therefore has to comply beforehand.
(2) Any person in control of a mine or activity must ensure that the in-stream and riparian habitat of any water resource, which may have been affected or altered by a mine or activity, is remedied to comply with these regulations.	None affected. Mine situated ±7 km from the closest natural river (Limpopo River); No wetland areas were identified during the site visit
(3) On either temporary or permanent cessation of a mine or activity, the Minister may request a copy of any surface or underground plans as required in terms of the Minerals Act, 1991.	Will comply upon request thereof.

LEGISLATION	COMMENT
10. Additional regulations relating to winning sand and alluvial minerals from watercourse or estuary	
(1) No person may-	
(a) Extract sand, alluvial minerals or other materials from the channel of a watercourse or estuary, unless reasonable precautions are taken to-	Not applicable
(i) ensure that the stability of the watercourse or estuary is not affected by such operations;	
(ii) prevent scouring and erosion of the watercourse or estuary which may result from such operations or work incidental to it;	
(iii) prevent damage to in-stream or riparian habitat through erosion, sedimentation, alteration of vegetation or structure of the watercourse or estuary, or alteration of the flow characteristics of the watercourse or estuary; or	
(b) establish any slimes dam or settling pond within the 1: 50-year flood-line or within a horizontal distance of 100 metres of any watercourse or estuary.	
(2) Every person winning sand, alluvial minerals or other materials from the bed of a watercourse or estuary must-	
(a) Construct treatment facilities to treat the water to the standard prescribed in Government Notice No. R.991 dated 26 May 1984 as amended or by any subsequent regulation under the Act before returning the water to the watercourse or estuary;	
(b) limit stockpiles or sand dumps established on the bank of any watercourse or estuary to that realised in two days of production, and all other products must be stockpiled or dumped outside of the 1: 50-year flood-line or more than a horizontal distance of 100 metres from any watercourse or estuary; and	
(c) implement control measures that will prevent the pollution of any water resource by oil, grease, fuel or chemicals.	
11. Additional regulations for the rehabilitation of coal residue deposits	
Any person mining or establishing coal residue deposits must rehabilitate such residue deposits so that-	
(a) all residue deposits are compacted to prevent spontaneous combustion and minimise the infiltration of water; and	Mine closure plan required
(b) the rehabilitation of the residue deposits is implemented concurrently with the mining operation.	Mine closure plan required
12. Technical investigation and monitoring	

LEGISLATION	COMMENT
(1) The Minister may, after consultation with the Department of Minerals and Energy and the Department of Environmental Affairs and Tourism, in writing require any person in control of a mine or activity to arrange for a technical investigation or inspection, which may include an independent review, to be conducted on any aspect aimed at preventing pollution of a water resource or damage to the in-stream or riparian habitat connected with or incidental to the operation or any part of the operation of a mine or activity.	Not applicable
(2) Such an investigation must be conducted and a report thereon compiled in the manner and within the time period that the Minister may specify.	
(3) The person in control of the mine or activity must inform the Minister as to the expertise and qualifications of the persons who are to conduct an investigation or inspection contemplated in sub-regulation (1) before the commencement thereof.	
(4) The Minister may in writing require any person in control of a mine or activity to submit a programme of implementation to prevent or rectify any pollution of a water resource or damage to the in-stream, or riparian habitat as recommended by the investigation contemplated in sub-regulation (1) within the time period that the Minister may specify.	
(5) The Minister may in writing direct any person in control of a mine or activity to implement a compliance monitoring network to monitor the programme of implementation contemplated in sub-regulation (4), through establishing, operating and maintaining monitoring installations of a type, at the locations and in the manner specified by the Minister and to submit the monitoring information and results to the Minister for evaluation.	Monitoring network will be implemented along with maintenance and operational manual. Information will be made available upon request
(6) Subject to Chapter 4 of the Act, any person in control of a mine or activity must submit plans, specifications and design reports approved by a professional engineer to the Minister, not later than 60 days before commencement of activities relating to-	Designs included in this report and various other design reports completed by Delta BEC: MIA Report Pavement Design Report Water Balance Report
(a) the construction of any surface dam for the purpose of impounding waste, water containing waste or slurry, to prevent the pollution of a water resource;	Refer to drawing - P18054-CC-01-SWD-002 REV A - POLCON DAM LINING DETAILS SHEET 1
(b) the implementation of any pollution control measures at any residue deposit or stockpile, to prevent the pollution of a water resource; and	Refer to drawing - P18054-CC-01-SWD-002 REV a - POLCON DAM LINING DETAILS SHEET 1 & 2-A1

LEGISLATION	COMMENT
(c) the implementation of any water control measures at any residue deposit or stockpile, to prevent the pollution of a water resource.	Refer to drawing - P18054-CC-01-SWD-002 REV a - POLCON DAM LINING DETAILS SHEET 1 & 2
13. General	
The person in control of a mine or activity must provide the manager with the means and afford him or her every facility required to enable the manager to comply with the provisions of these regulations.	Facilities to form part of the mining designs
14. Offences and penalties	
(1) Any person who contravenes or, subject to regulation 3, fails to comply with regulation 2, 4, 5, 6, 7, 8, 9, 10, 11, 12 or 13 is guilty of an offence and liable on conviction to a fine or to imprisonment for a period not exceeding five years.	Compliance included in this report
(2) Whenever an act or omission by a manager or employee of a mine or activity-	
(a) constitutes an offence in terms of these regulations, and takes place with the express or implied permission of the person in control of a mine or activity, that person is, in addition to the manager or employee, liable to conviction for that offence; or	
(b) would constitute an offence by the person in control of a mine or activity in terms of these regulations that manager or employee is, in addition to that person, liable to conviction for that offence.	

4 STORMWATER METHODOLOGY

4.1 INTRODUCTION

This section discusses the standards and methodologies used in the calculations of the stormwater system for Nozala Gruisfontein Mine and comprises of the following sub-section:

- Design standards and documentation
- Hydrological methodology
- Hydraulic methodology
- Proposed stormwater system.

4.2 DESIGN STANDARDS AND DOCUMENTATION

Secondary to the legislation, the designs of the stormwater infrastructure has to be based on accepted engineering design standards. The designs for Nozala Gruisfontein Mine will be based on the following documentation:

- SANRAL Drainage Manual – 6th Edition
- Best Practice Guideline Series
- Hydraulics in Civil and Environmental Engineering (Chadwick and Merfett)
- Guidelines for Human Settlement Planning and Design – CSIR
- Nozala Coal Mine's operation standard.

4.3 HYDROLOGICAL METHODOLOGY

4.3.1 DESIGN PARAMETERS

Table 4-1 provides the general design parameters for the hydrological calculations.

Table 4-1: Parameters for hydraulic designs

DESIGN PARAMETER	VALUE
Design method	Rational method – Primary method
Minimum time of concentration and runoff co-efficient	According to The South African National Roads Agency Limited Design Manual
Average yearly rainfall	440 mm
General Altitude	850 m

4.3.1.1 RAINFALL DATA

To determine surface water runoff, probabilistic relationships between the average daily rainfall, rainfall intensity, duration and return period are required.

These relationships were estimated by using a regional scale invariance approach named Design Rainfall Estimations in South Africa developed by JC Smithers and RE Schulze.

The project is located at latitude 23º33'S and longitude 27º17'E with an approximate altitude of 850m.a.s.l. The mean annual precipitation (MAP) is assumed at 440mm per annum. The weather stations used to obtain the mean annual rainfall within the project area are presented in Table 4-2.

Table 4-2: Utilised annual rainfall weather stations

AREA	STATION
Ellisras	0674400_w
Grootfontein	0674429_w
Zyferbult	0673645_w
Tambootivlei	0673636_w
Oranjefontein	0718327_w
Sterkfontein	0674207_w

Design rainfall depths, obtained from the above rainfall stations were utilised as shown in Table 4-3.

Table 4-3: Rainfall depths (mm) for different recurrence intervals and storm durations

STORM DURATION	RECURRENCE INTERVAL (YEAR) AND RAINFALL DEPTH (mm)					
	1:2	1:5	1:10	1:20	1:50	1:100
5 minutes	8.1	11.5	13.9	16.3	19.7	22.4
10 minutes	12.6	17.8	21.6	25.4	30.7	34.9
15 minutes	16.4	23.1	28	32.9	39.7	44.2
30 minutes	22.1	31.3	37.8	44.5	53.7	61.1
45 minutes	26.4	37.3	45.1	53.1	64.1	72.9
1 hour	29.9	42.3	51.1	60.1	72.6	82.7
1.5 hours	35.7	50.4	61	71.7	86.7	98.6
2 hours	40.5	57.2	69.1	81.3	98.2	111.7

4.3.2 CALCULATION METHOD

For this design, the Rational method was selected to estimate runoff generated by a specific site. The Rational method is used both internationally and in South Africa. The technique is known to give reasonable estimates of the flood peak design values for small catchments.

The Rational method for smaller catchment areas was used to determine the peak flows for each section.

4.3.2.1 RATIONAL METHOD

The rational method background & calculation methodology is explained in this section.

Since its inception in 1851, the Rational Method has become one of the most widely used methods for determining peak flows from small catchments. The basis of the relationship is the conservation of mass and the premise that the flow rate is directly proportional to the size of the contributing area and rainfall intensity. Rainfall intensity is a function of the return period. Peak flow is obtained by the following relationship:

$$Q = \frac{CIA}{3.6}$$

Where:

Q	=	peak flow (m^3/s)
C	=	runoff coefficient
I	=	average rainfall intensity over catchment (mm/hour)
A	=	effective area of catchment (km^2)
3.6	=	conversion factor.

Despite the Rational Method's shortcomings and widespread criticism, it provides realistic results, especially in combination with other runoff estimation models. Disadvantages of the method include a personal opinion in terms of permeability that reliable hydrographs cannot be calculated and the method is of limited use in flood routing calculations. As mentioned, its results are less accurate if catchment sizes are greater than 25 km^2.

4.3.2.2 ASSUMPTIONS

During the hydrological calculations, the following assumptions were made:

- Future rainfall patterns will be similar to past rainfall patterns
- Rainfall will be uniform over catchment areas
- Soil permeability will be uniform over time across the catchment
- The storm duration will be equal to 3 times the time of concentration
- Topographical conditions will remain constant for the period of the life of mine.

4.4 HYDRAULIC METHODOLOGIES

This section describes the design concept followed. Articles covered:

- Conveyance elements
- Silt traps
- Storage Dams
- Oil-water separators.

4.4.1 CONVEYANCE ELEMENTS

4.4.1.1 DESIGN PARAMETERS

Table 4-4 provides the general parameters used during the conveyance system design.

Table 4-4: Conveyance Elements Design Parameters

DESIGN PARAMETER	VALUE
Stormwater details	According to the Red Book and Drainage Manual
Side slopes	1:2 as defined by the drainage manual for natural channels with concrete lining
Capacity	1 in 50-year storm event
Minimum slope	0.2%
Minimum velocity	1.5 m/s
Dirty water channel lining	Concrete lined
Clean water channel lining	Earth lined or erosion protected
Roughness (k_s)	Concrete = 0.003 m Earth = 0.2 m
Roughness (Manning)	Concrete = 0.013 Earth = 0.03
Pipes	Assume 80% full flow

The majority of the stormwater network for Gruisfontein Mine is designed as an open channel network with separate systems for dirty water areas and clean water areas. The stormwater conveyance elements will include the following items:

- Channels
- Berms
- Culverts.

The open system alleviates the necessary maintenance procedures to keep the network clean of silt, while access to the various structures opposite of the channels will be provided using culvert crossings. The hydraulic properties (flows, velocities, slopes etc.) of the berms and channels around the site have been calculated according to the relevant catchment areas and characteristics. The hydraulic figures of all the berms and channels can be observed on the Gruisfontein Mine Stormwater Drawings provided in Appendix A.

4.4.1.2 CALCULATION METHOD

The conveyance system capacities were calculated using Manning's formula, which is shown below:

$$v = \frac{R^{\frac{2}{3}} S^{\frac{1}{2}}}{n}$$

Equation 4-1: Manning's formula

$v = \frac{Q}{A}$;
$R = \frac{A}{P}$;
$S =$ **average slope of the area under consideration and**
$n =$ **Manning's coefficient, taken as 0.015 (rough concrete surface).**

The relevant information was taken from *Water Engineering* (Meyer, 1995).

4.4.2 SILT TRAP

Sediment traps/basins provide a cost-effective means to reduce the number of suspended solids in surface runoff and reduce the cost of cleaning and maintaining channels. Critical issues to the successful functioning of sediment basins are its design and especially maintenance measures implemented during its design life.

4.4.2.1 DESIGN PARAMETERS

Table 4-5: Silt Trap Design Parameters

DESIGN PARAMETER	VALUE
Standards	Best Practice Guidelines A5: Water management for surface mines. Best Practice Guidelines G1: Stormwater management
Silt trap capacity	1: 50-year storm
Operating capacity	1: 5-year storm
Type structure	Reinforced concrete
Type silt trap	Dual system

The operational sizing of silt traps usually is based on operational flow, since the sizing according to storm events results in excessively sized and expensive structures. However, since the silt trap will form part of the holistic stormwater network, which has to comply with the national legislation, the silt trap will have to be sized to contain the 1: 50-year storm event, while not operating effectively at these high flows.

4.4.2.2 OPERATION PROCESS

The silt trap will function as follows:

- A drain will transfer water into the operational half of the silt trap. The contaminated water will then flow through a baffle wall into a sedimentation compartment.
- The function of the baffle wall is to ensure disruption of flow and hence, dispersion of the suspended silt. This compartment is sized to allow 90% of silt particles of 125µmø or greater to settle out.
- A submersible pump is positioned at the opposite end to the inlet channel to allow for a longer water path in which the silt may settle.

- Once the final *dirty* water reaches the opposite end of the sedimentation basin, it will then be pumped out via a 90mm HDPE pipe into the pollution control dam (PCD).
- The silt sludge that is contained within the compartment is removed by front end loaders and placed on the sludge drying bed on the side of the silt trap. The sludge is allowed to dry and then discarded.
- The removal of silt will be done in a periodic cycle, with the sluice gate closed off, thereby isolating the chamber and allowing the water and sludge to dry out.
- Once the slab is completely dried out, the sluice gate will be re-opened, and operation will continue in the same manner as before.

4.4.3 STORAGE DAMS

Stormwater storage dams serve as the receiving bodies for stormwater runoff from dirty and clean water systems on the mine site. The design and operation of stormwater dams must comply with the legal requirements, including the assessment of the required dam capacity, the location of the dam and the discharge frequency (Government Notice 704 of 4 June 1999).

The stormwater storage dams should, as far as practically possible, receive stormwater inflow only and should be separated from spillage and process water inflow from the plant and other sources. Water retained in the dam may be returned to the process water systems, or the water may be discharged if the water quality meets the water use authorisation requirements.

It is essential to minimise, where possible, the catchments providing runoff into stormwater dams. This can be achieved by locating stormwater dams close to the source of dirty water runoff or using diversion berms.

4.4.3.1 DESIGN PARAMETERS

Table 4-6 provides the design parameters for the stormwater storage dam designs.

Table 4-6: Stormwater Storage Dam Design Parameters

DESIGN PARAMETER	VALUE
Standards	Best Practice Guidelines A4: Pollution control dams Best Practice Guidelines G1: Stormwater management
Design capacity	1: 50-year flood available storage at any time
Freeboard	0.8m
Stormwater volume	Simplified unit hydrograph method
Overflow design	1: 100-year flood

4.4.3.2 DAM TYPES

For a coal mine to comply with legislation and to be fully efficient in terms of water utilisation, different types of storage dams are required with different objectives. The dams can be listed as follows along with their respective purposes:

- Clean water storage dam: This dam acts as an attenuation facility to catch all stormwater runoff from areas within the mine that can be categorised as uncontaminated. Once the dams received stormwater inflow, it needs to be emptied to provide the required storage for the next possible storm event.
- Dirty water storage dam: This dam serves the same purpose as the clean water storage dam, except that it collects stormwater runoff generated within contaminated areas. Once the dams received stormwater inflow, it also needs to be emptied to provide the required storage for the next possible storm event. The dirty water storage dams have been designed as a rectangular shape to facilitate the installation of an oily water separator/skimmer for the dams. The water level in the dams will be monitored and controlled by the mine pump back system, where water will be returned to the plant area to be used as process water.
- Clean water and dirty water balancing dams: When the previous two mentioned dams need to be emptied, the water is pumped into the balancing dams. This water can then be used for operational purposes or be treated and used for domestic use.
- Raw water dam: this dam holds the additional capacity for treatment and domestic use within the MIA area.
- Plant storage dam: This dam serves the same purpose as the Raw water dam, except the water will not be treated and will be used for plant operational purposes.

Of the dams above, only the first two are used as an integral part of the stormwater system. The rest of the dams are classified as water network elements and will be discussed in the water balance report.

For more information regarding the integration between the various dams, please refer to the Water Balance Report done by Delta BEC.

4.4.3.3 DAM LINING

All dirty water storage dams will be lined with the following materials to prevent seepage:

Table 4-7: Dam lining details

ID	LAYER DEPTH	DESCRIPTION
A	2.0 mm	80 % Black Woven Shade Netting
B	2.0-4.0 mm	A 2.0 mm thick HDPE geomembrane (GM)
C	4.0-10.0 mm	A5 BIDIM or similar approved product

ID	LAYER DEPTH	DESCRIPTION
D	10.0 mm-160.0 mm	A 150 mm G7 material compacted to 93 % MOD AASHTO density
E	160.0 mm-310.0 mm	A 150 mm rip and compacted layer compacted to 93 % MOD AASHTO density
F	1 000.0-1200.0 mm	Subsoil drainage system with leak detection pipe approximately 500 mm below the pond bed level. Testing of the installed liner detail will be done after each layer is constructed.

Clean water dams will not be lined with the products mentioned above to prevent high construction costs.

4.4.3.4 SECURITY

All dams are to be fenced off and locked to prevent any uncontrolled access or usage of the facilities. Permission would be required to gain access to the facility and will only be permitted for maintenance purposes and dam inspections.

4.4.4 OIL/WATER SEPARATOR

Oil/Water separators are devices used to remove small amounts of oil and other petroleum products from industrial wastewater and stormwater systems. Oil/Water separators function mainly based on the relatively low solubility of petroleum products in water and the difference between the specific gravity of water and the specific gravities of petroleum compounds.

4.4.4.1 LOCATION

Certain areas on the mine will produce runoff or water discharge containing oils due to their operational requirements. These sources of contaminated water will not be able to be discharged into the other stormwater systems and will, therefore, have to be treated separately. The following areas will be fitted with oil/water separators:

- Workshops
- Wash bays
- Specified plant areas.

4.4.4.2 ULTRA SPIN S1

The areas producing high flows contaminated with oil will discharge into a silt trap that will remove the solids, after which it will discharge into a dedicated oil/water separator chamber. These chambers will be fitted with Ultraspin Oil Skimmers.

The Ultraspin S1 Stainless Steel surface skimmer is designed to remove oil, fats and floating material from tanks, sumps, interceptors and other effluent pits. It may also be used in open waters such as lakes, harbours and lagoons. It is a true self-adjusting, weir-type, oily-water skimmer.

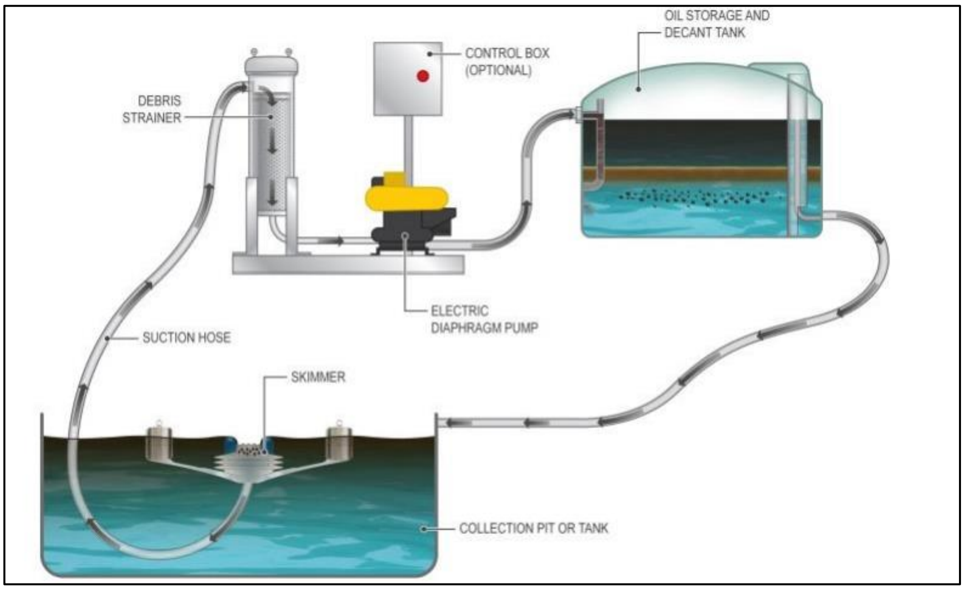


Figure 4-1: Ultraspin Used for Oil Water Separation

4.4.4.3 DRIZIT OILTRAP 5

Workshops producing small volumes of flow will be fitted with Drizit Oiltrap 5. This operational gravity system removes the oil from the water and discharges the clean water into the sewer system.

The Oiltrap 5 (Figure 4-2) requires more regular maintenance per unit of flow when compared to the Ultraspin, but since it will only be used for low flows, maintenance will be minimal.

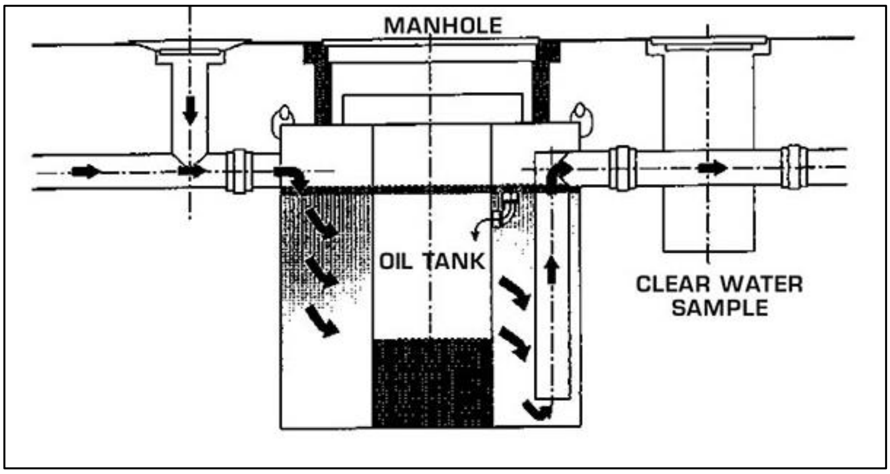


Figure 4-2: Drizit Oiltrap 5 Oil Water Separator

Both of the system mentioned above will require emptying of the oil storage containers at specified intervals. This will be programmed into the mine's maintenance and operational manual.

4.5 MAINTENANCE

All stormwater elements are as effective as the maintenance applied to the system. This is because sediment settles to the surface of these elements and thereby reduces their capacity.

A strict maintenance manual will be drafted for the mine stormwater system on completion of the construction designs and will be implemented across the mine to ensure effective operations throughout the mines operational lifetime.

5 STORMWATER INFRASTRUCTURE DETAIL DESIGN

5.1 INTRODUCTION

The section of the report provides the summarised design calculations completed during the design of the stormwater network. For the detail calculations, please refer to Appendix B. The calculations are presented in the following section:

- Hydrological calculations
- Conveyance systems
- Silt trap
- Stormwater dams
- Oil/water separator.

5.2 HYDROLOGICAL CALCULATIONS

Figure 5-1 presents the catchment areas used during the hydrological

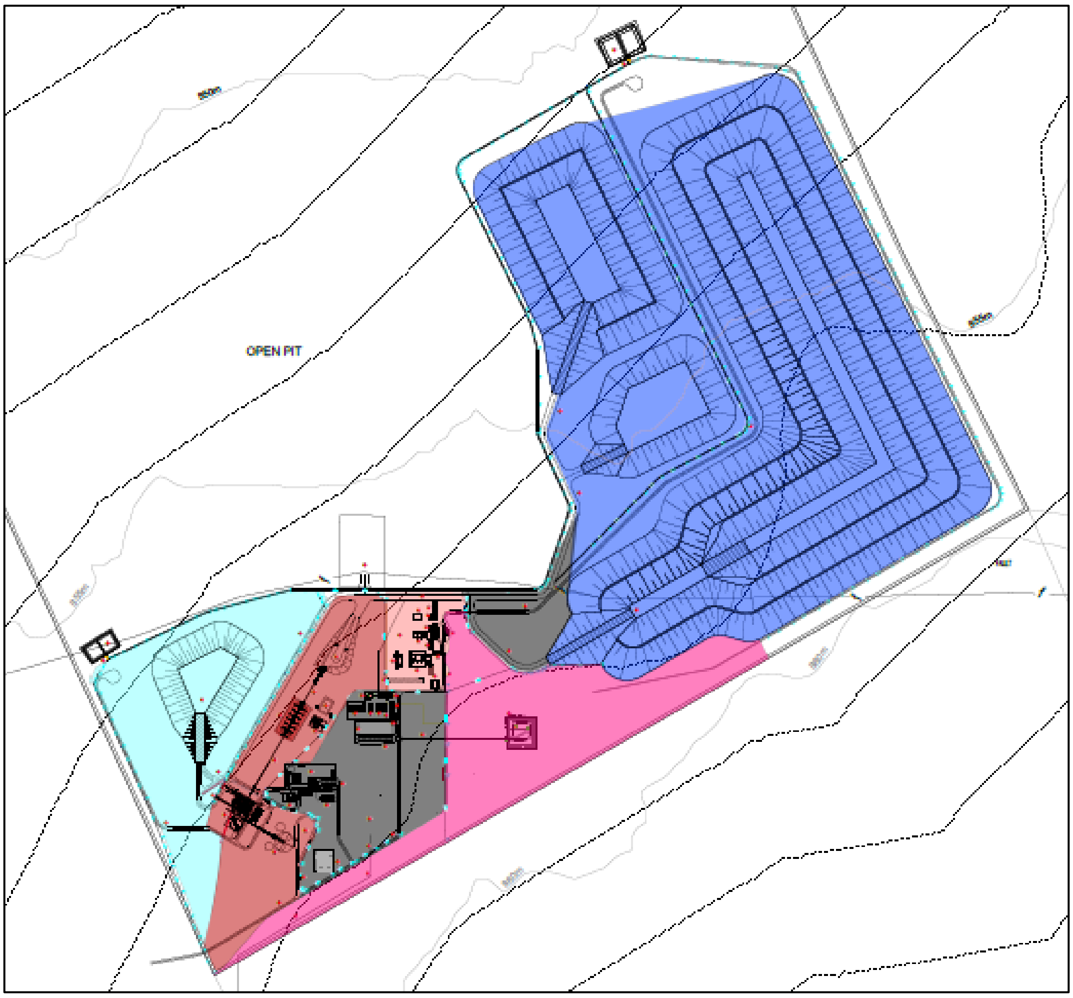


Figure 5-1: Rainfall Catchment Areas

Table 5-1 illustrates the results of the runoff calculation obtained for the seven catchment areas over different return periods. The unit measure of runoff is cubic meter per second, (m^3/s).

Table 5-1: Runoff Calculation Summary

RATIONAL METHOD						
Return Period	2	5	10	20	50	100
Area	Rational Method	Rational Method	Rational Method	Rational Method	Rational Method	Rational Method
Area 1	1.5426	2.2494	2.803	3.4376	4.5313	5.6155
Area 2	3.3085	4.6807	5.6558	6.6586	8.0364	9.142
Area 3	5.5734	7.9455	9.7077	11.565	14.405	16.894
Area 4	1.5373	2.1735	2.6358	3.098	3.7444	4.2568
Area 5	12.034	17.023	20.575	24.211	29.217	33.248
Area 6	0.1424	0.2213	0.292	0.3834	0.5741	0.787
Area 7	23.457	33.311	40.367	47.735	58.192	66.911

5.3 POLLUTION CONTROL DAMS

Table 5-2 provides the volumes and dimensions of the required dams on Nozala Gruisfontein Coal Mine

Table 5-2: Pollution Control Dam Properties

DESCRIPTION	CLEAN WATER DAM 1	DIRTY WATER DAM 1	DIRTY WATER DAM 2
Flood Return Period	1:50	1:50	1:50
Volume (m^3):	120 046	116 164	175 891
Pond free-board:	0.8 m	0.8 m	0.8 m
Side slopes	1:2	1:2	1:2
Pond outside Length	200 m	140 m	200 m
Pond Base Width:	190 m	90 m	98 m
Pond outside Width:	90 m	90 m	98 m
Trapezium Pond Depth:	7 m	9 m	9 m

6 PROPOSED STORMWATER SYSTEM

6.1 INTRODUCTION

This section provides a brief of the proposed stormwater system and presents a discussion on the sectional proposals, risks involved and mitigating measures.

6.2 DESIGN LAYOUT

6.2.1 PROPOSAL FOR MAIN OFFICES – CLEAN WATER AREA

The area around the office buildings is categorised as a Clean Water Area – it is essential to keep the stormwater generated in this area uncontaminated. The blue area represents the clean area.

6.2.2 PROPOSAL FOR PLANT AREA

The area around the workshops are categorised as dirty water areas – it is as essential to ensure that flowing water generated as stormwater or water from processes do not mix with the water from the clean water areas.

Figure 5-2 illustrates the clean and dirty water areas.

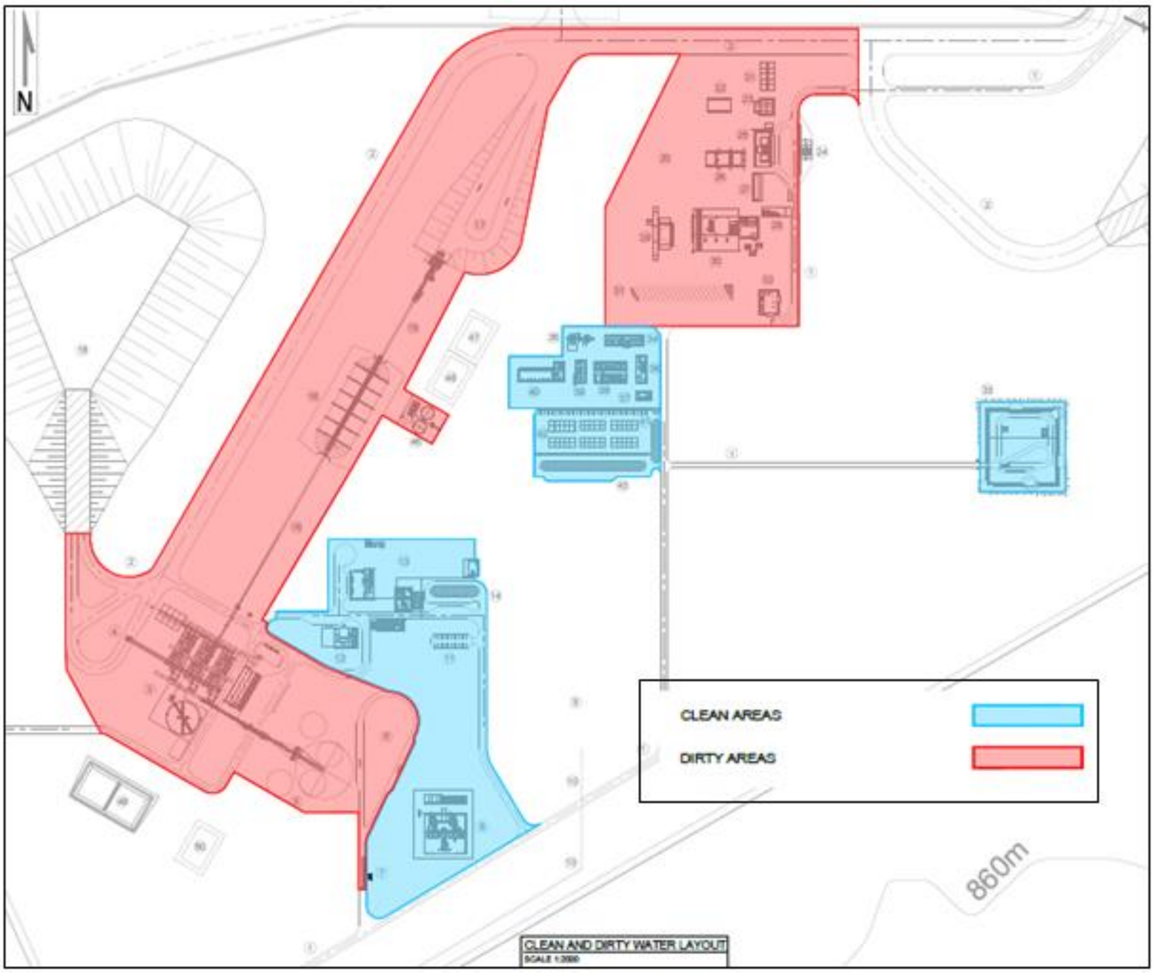


Figure 5-2: Designated clean & dirty water areas

6.2.3 PROPOSAL FOR DISCARD PILE

This area is specified as a dirty water area but includes a section of clean water area that will have to be kept separate from the dirty water. Lined stormwater channels collecting all runoff from the dump side slopes will encompass the discard dump. This water will then be channelled into a silt trap and then into a pollution control dam.

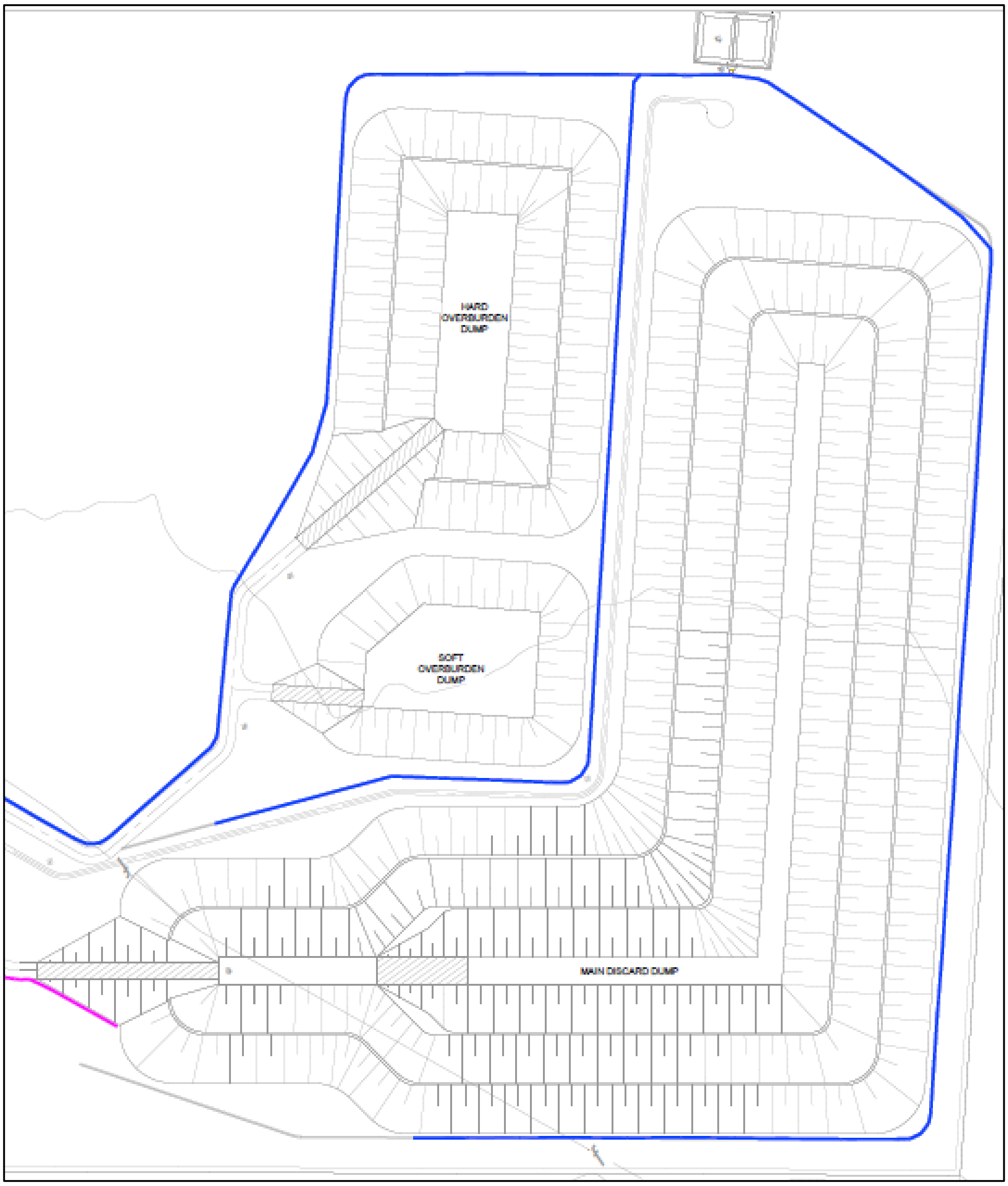


Figure 5-3: Proposed water stormwater network for the discard pile

6.3 ASSUMPTIONS

The development of the proposed stormwater management system assumes the following:

- No new developments will precede the completion of these works other than the current projects disclosed to Delta BEC by the client
- Greenfield land has been categorised as clean water areas. The transportation of coal fines by the wind once operations commence may necessitate the rezoning of the area to dirty water areas
- All future developments will co-ordinate with the proposed stormwater design to ensure the lasting integrity of the system.

6.4 RISKS

The risks associated with the proposed stormwater management system include:

- Interruption of early staged mining operations due to phased construction. Traffic would need to be rerouted during construction. This will have to be closely investigated, and a construction schedule will have to be prepared to ensure a minimal effect on operations.
- Inadequate maintenance leading to inefficiencies in the system. The successful implementation of a proper maintenance manual will enable the proposed new system to operate to the design capacity for the entire design life of the new upgraded system and will thus be an essential part of the design solution.

Rezoning of clean and dirty water areas once mining operations have commenced. All separate networks discharge into different storage pond simplifying the accommodation of these changes. Changes may include rerouting of pond pump lines to the new zone as required.

6.4.1 MITIGATIONS MEASURES

The mitigation measures proposed for the identified risks include:

- The compilation of an in-depth maintenance manual. Strict adherence to this document is essential. The implementation of the standards stated in this document will ensure the sustained efficiency of the system and prolonged operational life.
- The inclusion of maintenance machinery in the capital expenditure for the mine, ensuring that dedicated maintenance tools are available when required.

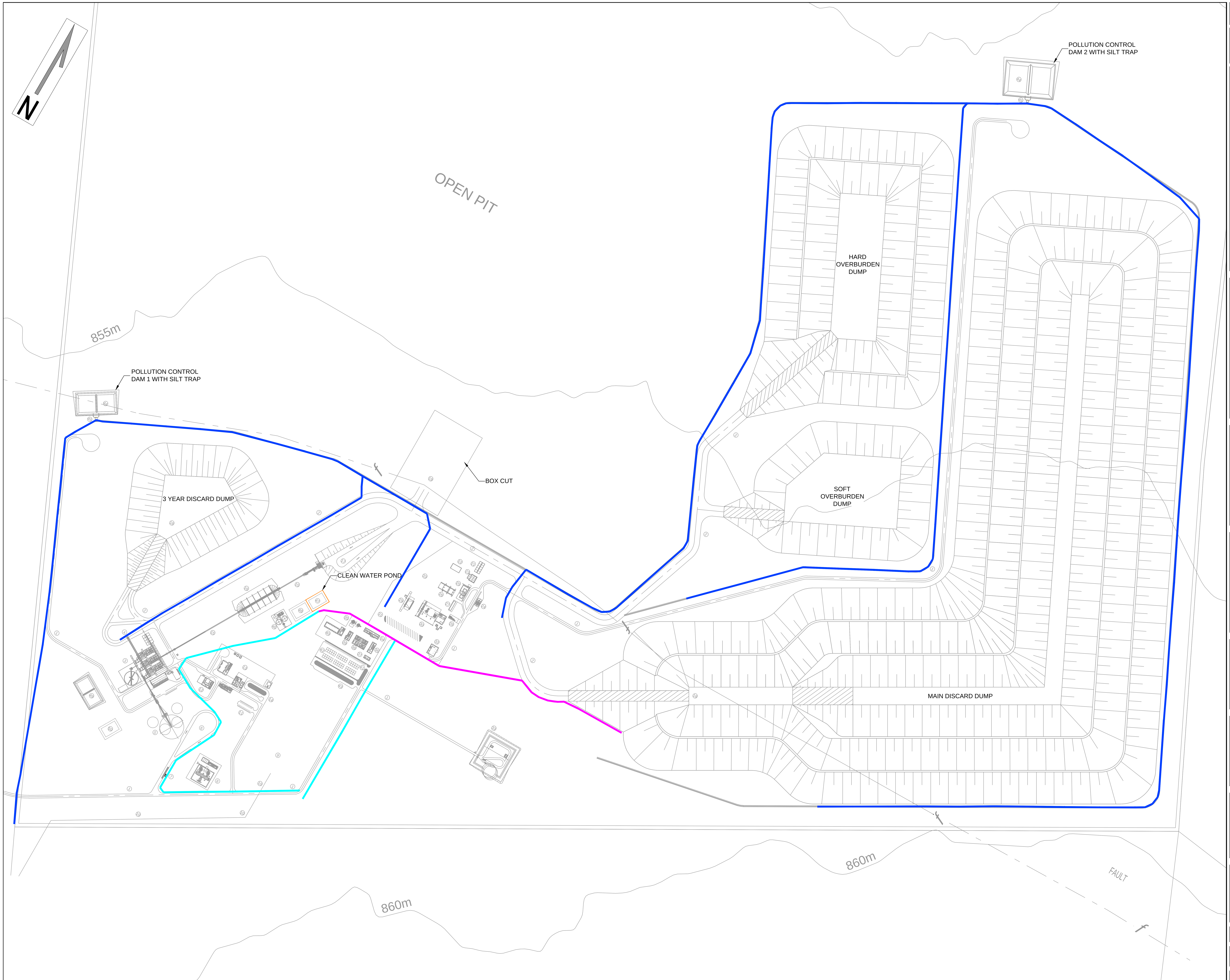
7 CONCLUSION

This report has been drafted to assist Nozala Gruisfontein Coal Mine in obtaining rights to a water use licence. The report presents the design methodology, calculations and layouts of the stormwater system proposed for the Mine. The feasibility of the stormwater design is presented while summarising the implementation highlighting the following:

- Compliance with Regulation GN704 as well as IWULA requirements
- Responsible usage of water as a scarce commodity
- Prevent pollution to the environment
- Proposing designs of all significant stormwater systems to withstand flows generated by a 1: 50-year return flood as necessary
- Separate clean and dirty stormwater systems
- Reinstating all-natural ground surfaces.

The proposed stormwater system is fully compliant with all legislation for mines within South Africa.

APPENDIX A: DRAWINGS



STORMWATER LAYOUT
SCALE 1:5000

Cad File Name:
P18054-CC-01-SW-001 REV a - STORMWATER LAYOUT
DBEC-MRPRO-09-06

LEGEND:

STORMWATER CHANNEL PROFILE A
STORMWATER CHANNEL PROFILE B
STORMWATER CHANNEL PROFILE C

NOTE
FOR STORMWATER CHANNEL PROFILE DETAILS REFER TO DRW P18054-CC-01-SWD-004

CONCEPT

Rev.	Date	Description of changes	By
a	##-##-2018	ISSUED FOR APPROVAL	PDW

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SIGNATURE: NAME: DATE:

Project
GRUISFONTEIN COAL MINE PROJECT

Project Description
GRUISFONTEIN PFS DESIGN

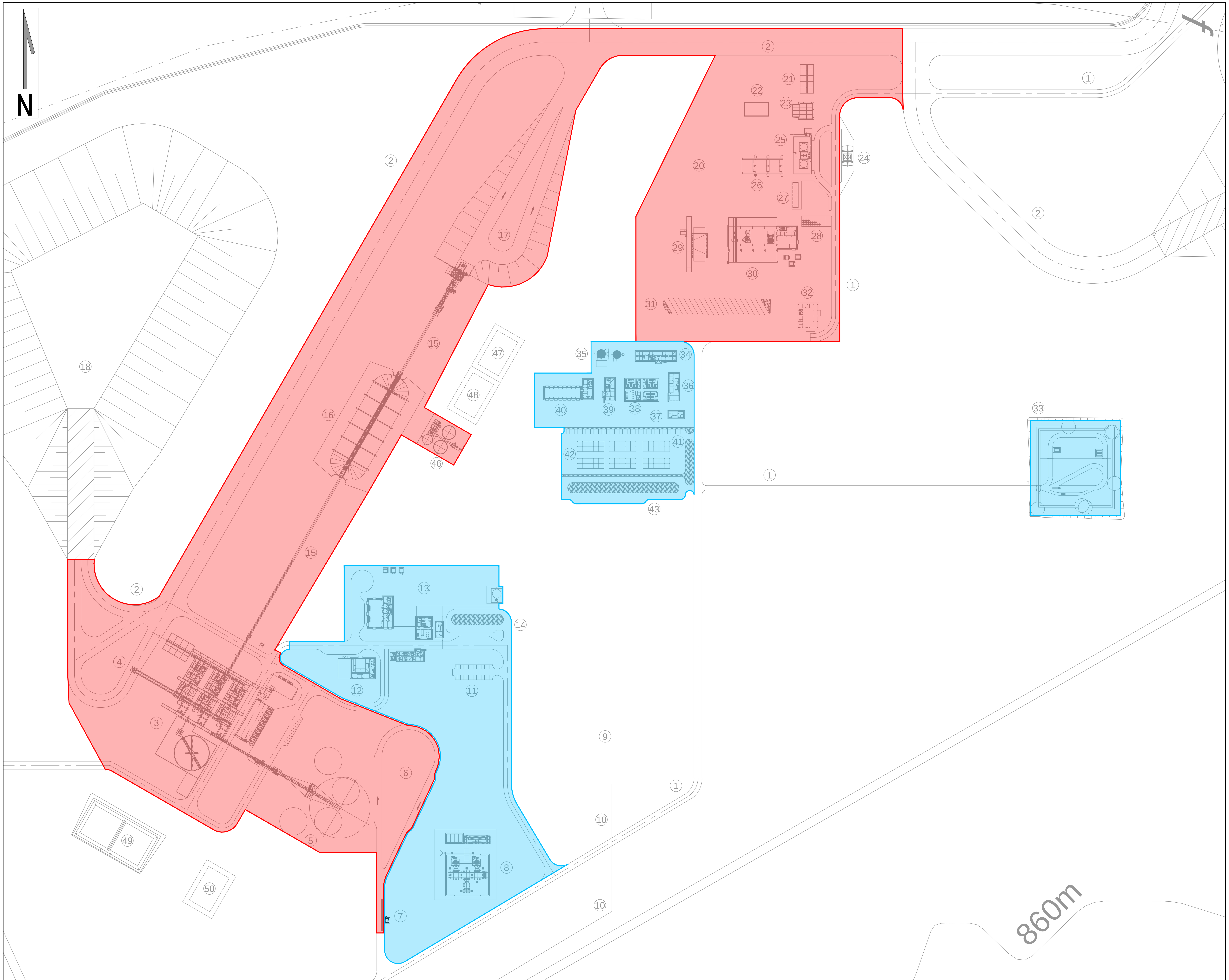
Drawing Title
STORMWATER LAYOUT

Drawing Units	Drawing Size
METERS	A1

Date	Scale	Designed By
AUGUST 2018	AS SHOWN	G GREYLING

Checked By	Drawn By	Approved By
B NDHLOVU	I SMIT	P DE WET

Drawing No. P18054-CC-01-SW-001
Rev a



CLEAN AND DIRTY WATER LAYOUT
SCALE 1:2000

Cad File Name:
P18054-CC-01-SW-002 REV a - CLEAN AND DIRTY WATER AREAS

DBEC-MRPRO-09-06

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CLEAN AREAS
DIRTY AREAS

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Rev.	Date	Description of changes	By
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Drawing Title
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Drawing Units	Drawing Size	
METERS	A1	
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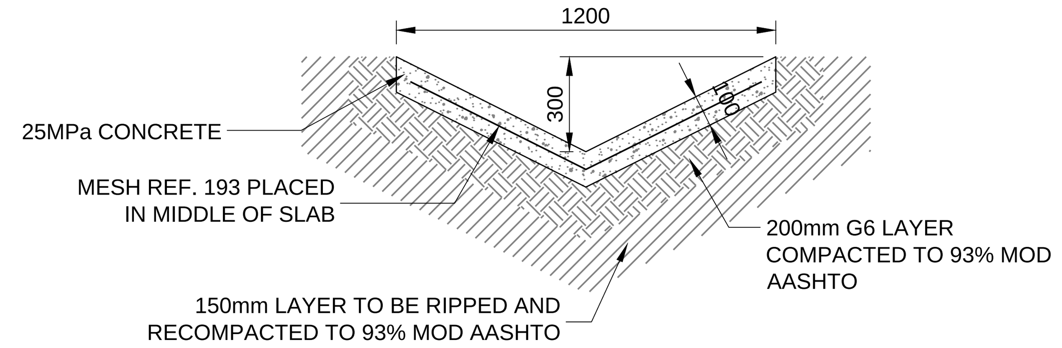
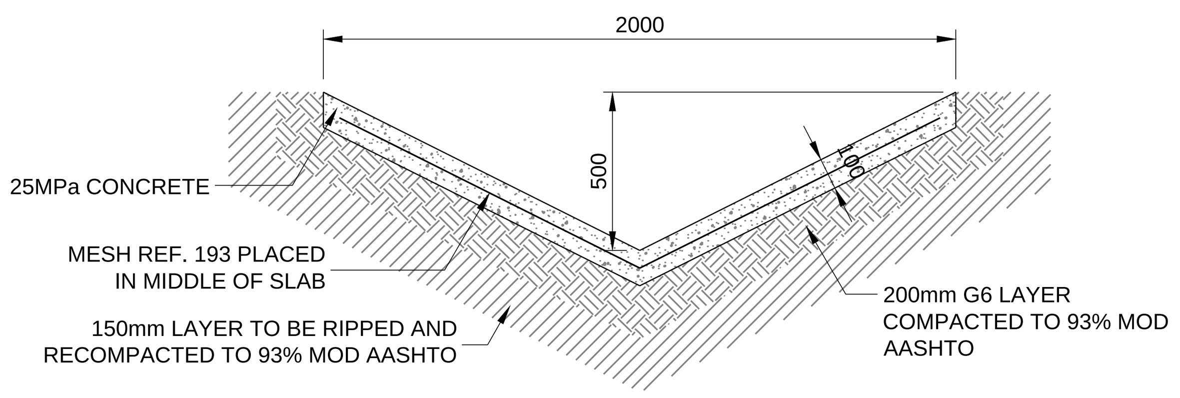
Rev a



300mm DEEP V-DRAIN
SCALE 1:20



500mm DEEP V-DRAIN
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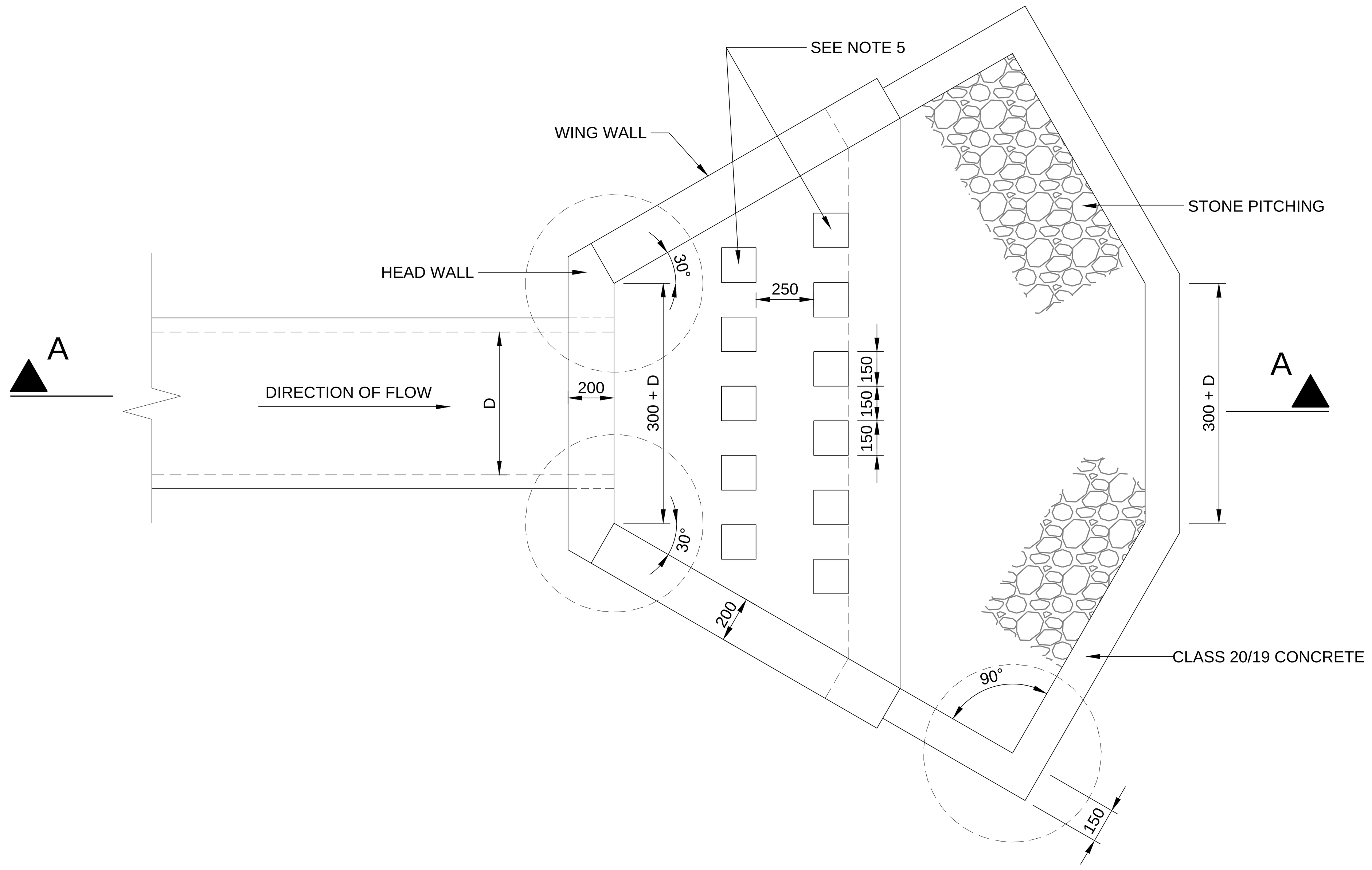
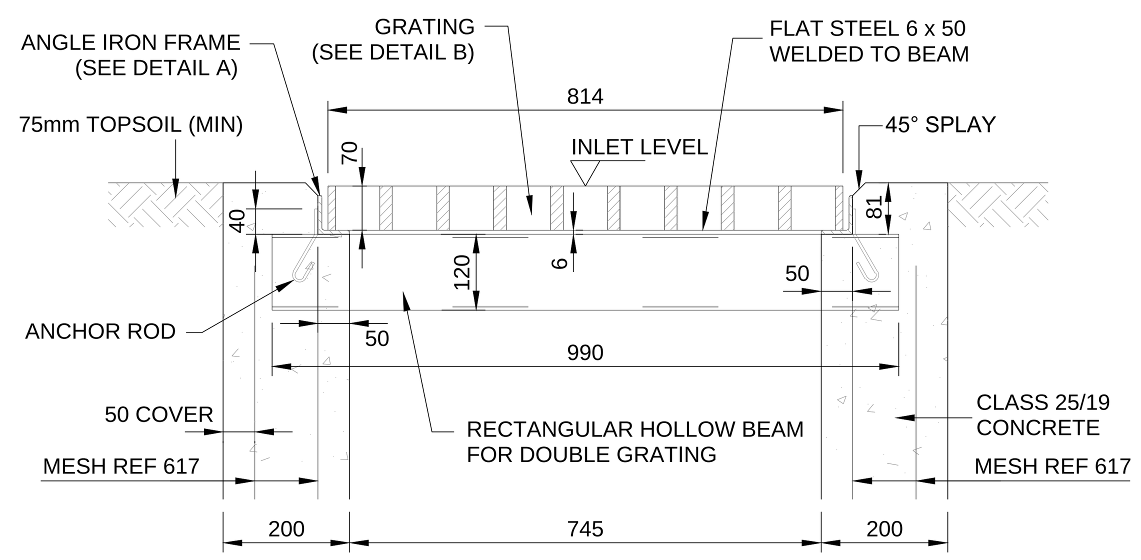
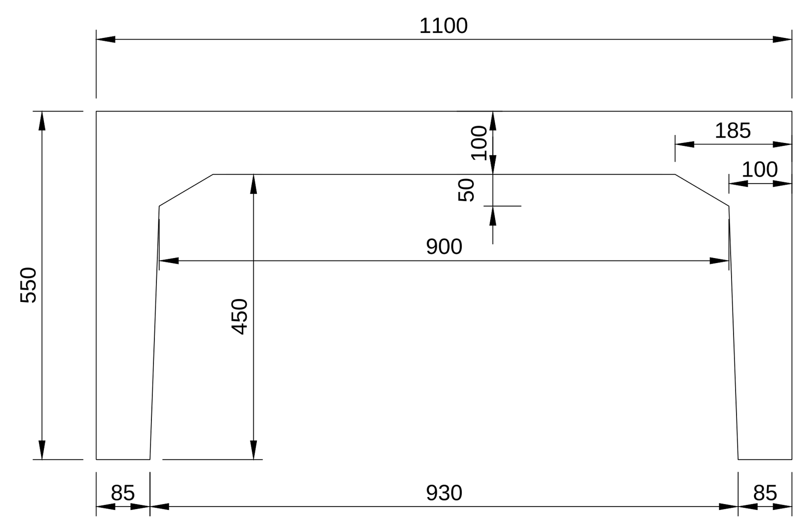


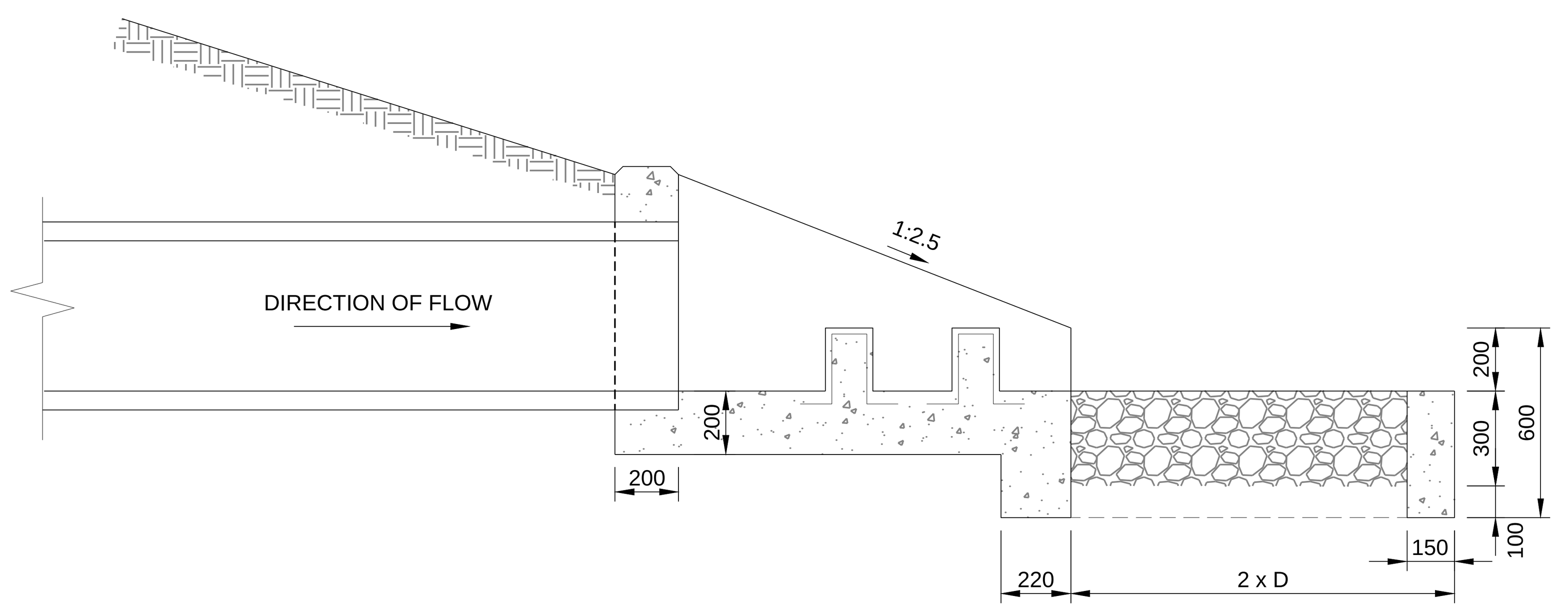
OUTLET STRUCTURE PLAN VIEW
SCALE 1:20



GRID INLET
SCALE 1:10



900x450mm PORTAL CULVERT
SCALE 1:10



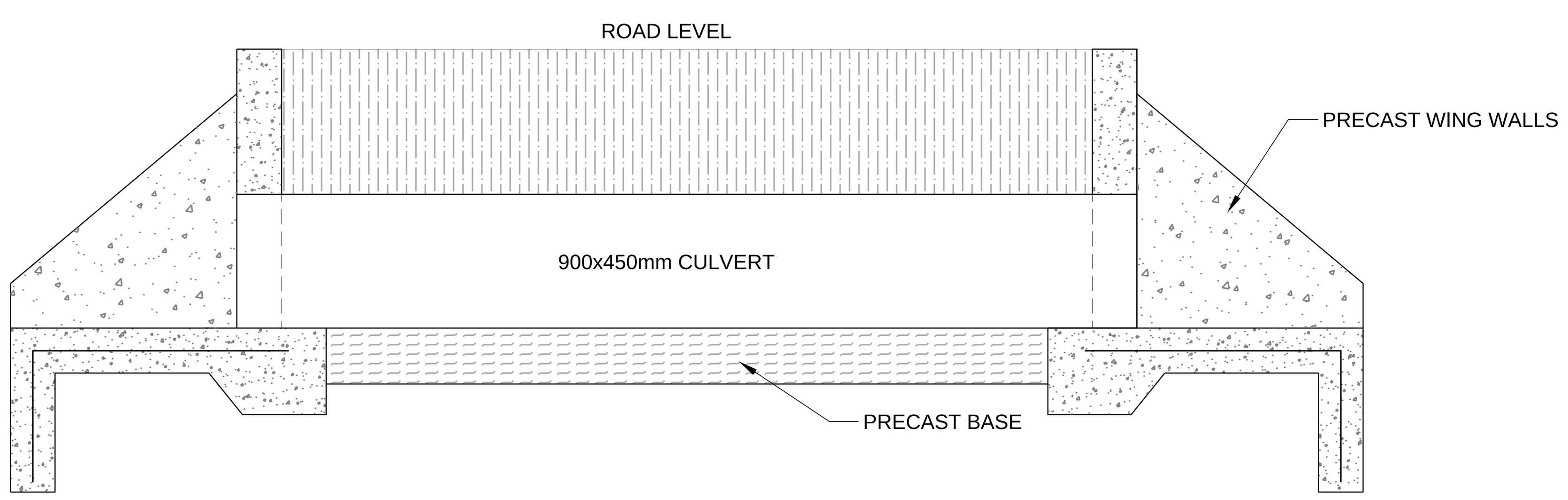
SECTION A-A
SCALE 1:20

NOTES

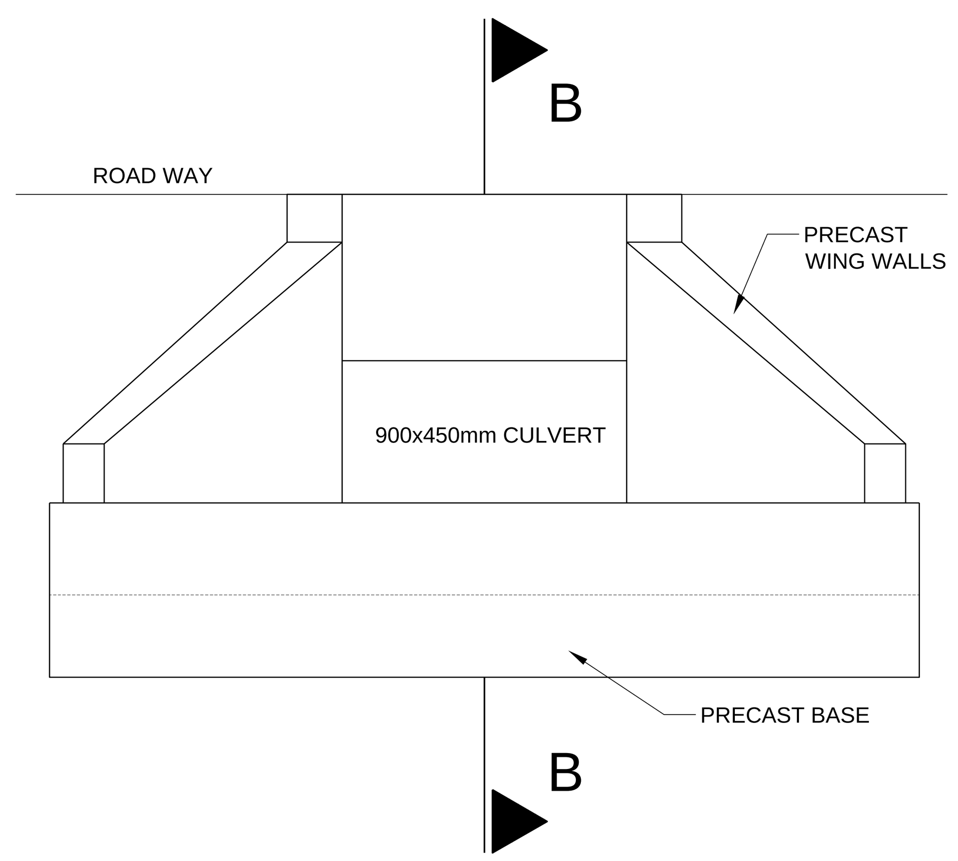
1. ALL CONCRETE TO BE CLASS 20/19
2. EXPOSED CONCRETE TO HAVE CLASS F2 OF U2 SURFACE FINISH
3. STONE PITCHING TO BE ORDINARY TYPE MIN DIMENSION TO BE 150mm DIA AND MIN MASS TO BE 27kg
4. GROUT SHALL CONSIST OF MORTAR WITH A 1/A CEMENT/SAND RATIO. TO FILL LARGE VOIDA A PORTION OF THE SAND SHALL BE REPLACED BY AGGREGATE WITH A MAX SIZE OF 19mm
5. THE THICKNESS OF HEAD-AND WING WALLS TO BE CONFIRMED BY ENGINEER FOR PIPES WITH DIAMETERS LARGER THAN 900mm

NOTES:

1. GRATING AND FRAME SHALL BE PAINTED WITH TWO COATS OF BITUMINOUS PAINT BEFORE INSTALLATION.
2. SIZES OF ANGLE IRON FRAMES VARIES SINGLE GRATING = 648mm DOUBLE GRATING = 1275mm
3. ALL MESH TO OVERLAP 1.5 BLOCKS
4. CONCRETE TO BE 30MPa AFTER 30 DAYS
5. CONCRETE MIX 100% OPC CEM 1. MINIMUM 325kg/m3 CONCRETE. WATER CEMENT RATIO SMALLER THAN 0.55.
6. CONCRETE TO BE VIBRATED TO RELEASECHAPTURED AIR.
7. CONCRETE TO BE CURED A MINIMUM OF FIVE (5) DAYS.



SECTION B-B
N.T.S



FRONT ELEVATION
SCALE 1:20

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GRUISFONTEIN PFS DESIGN

Drawing Title
STORMWATER DETAILS

Drawing Units	METERS	Drawing Size	A1

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AUGUST 2018	AS SHOWN	G GREYLING
Checked By	**Drawn By**	**Approved By**
B NDHLOVU	I SMIT	P DE WET

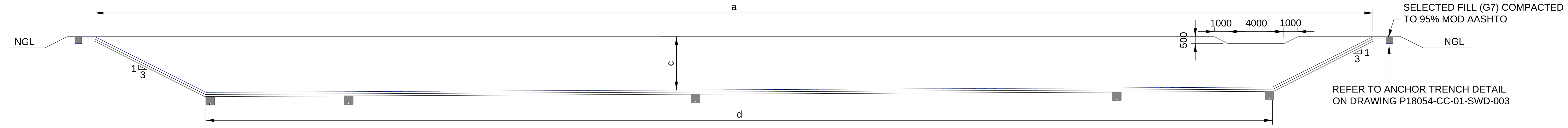
Drawing No. P18054-CC-01-SWD-001 Rev a

LEGEND:

2mm HDPE

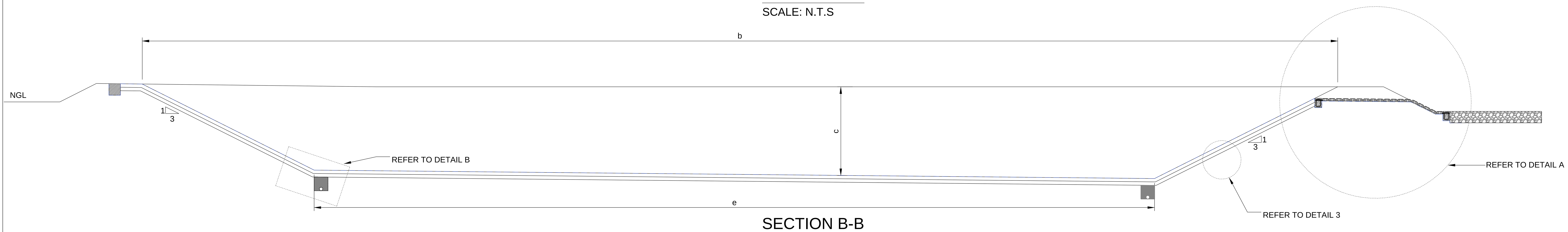
NOTE:

1. FOR DAM DIMENSIONS REFER TO TABLE 1
2. DAMS ARE OPERATED WET WITH STORAGE OF WATER FOR RE-USE



SECTION A-A

SCALE: N.T.S



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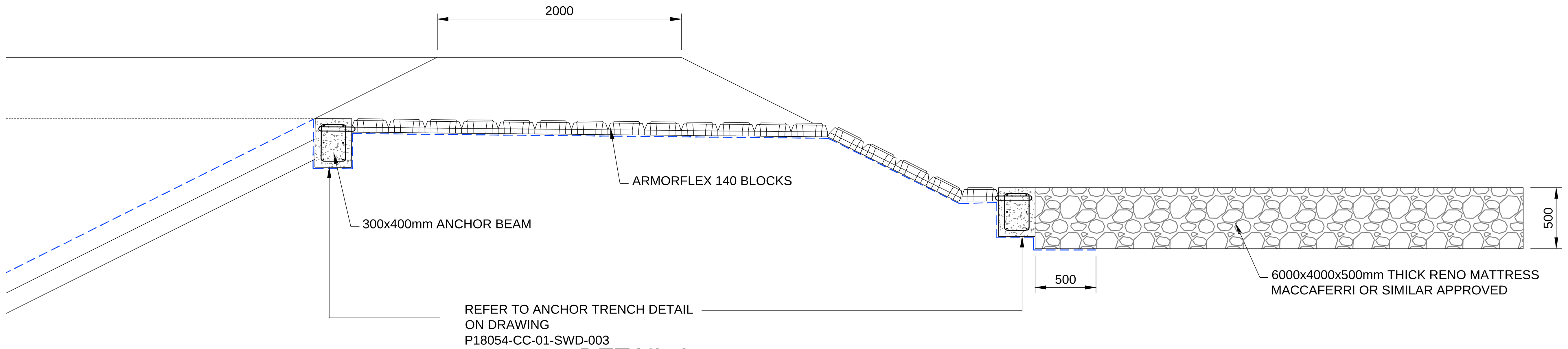

DETAIL A

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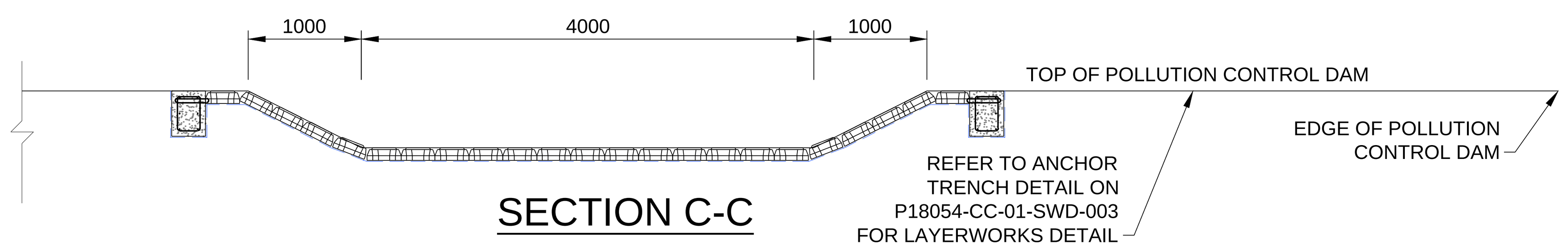
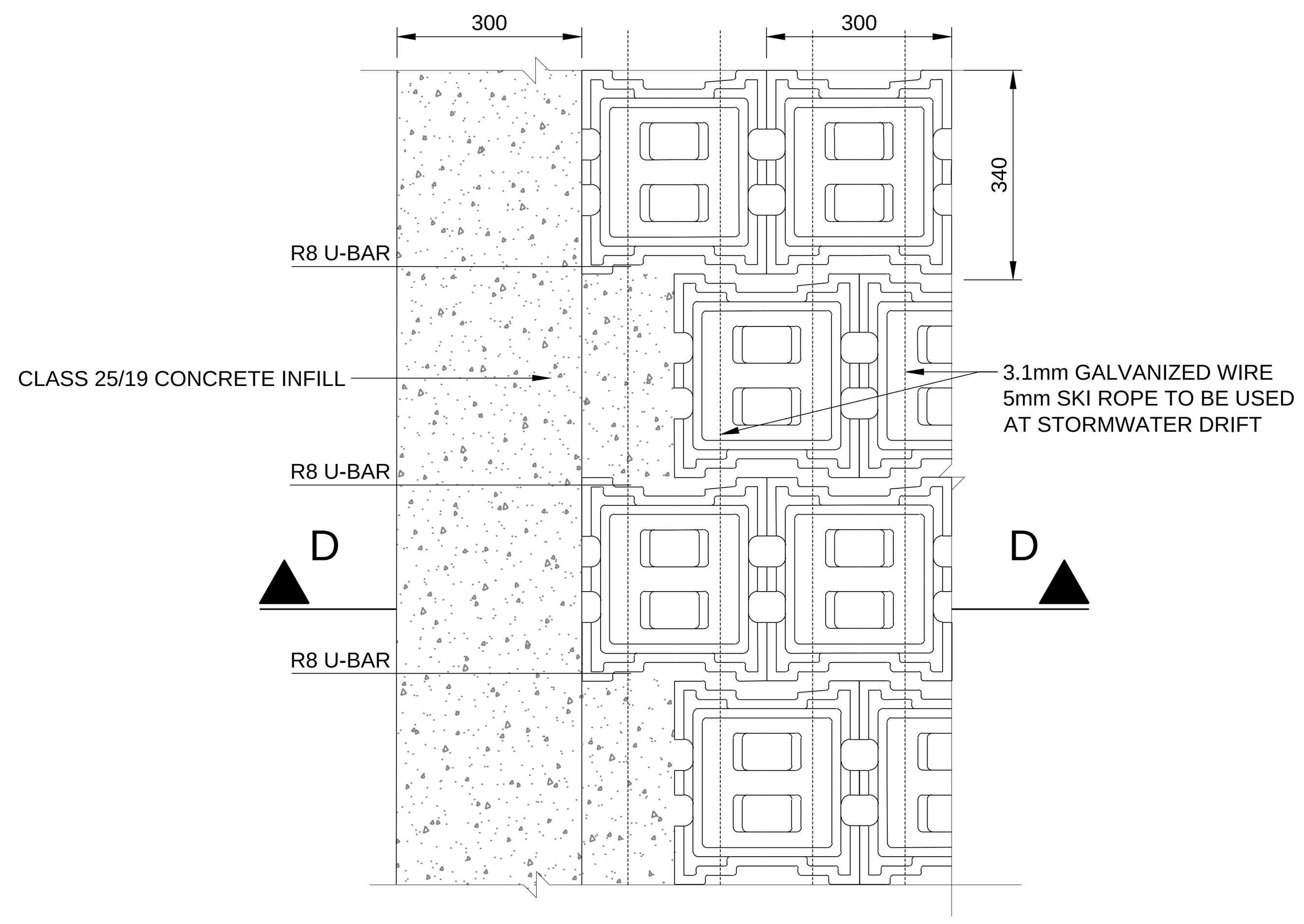


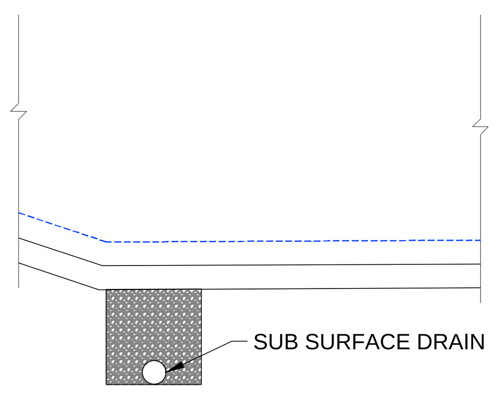
SECTION C-C

SCALE 1:50



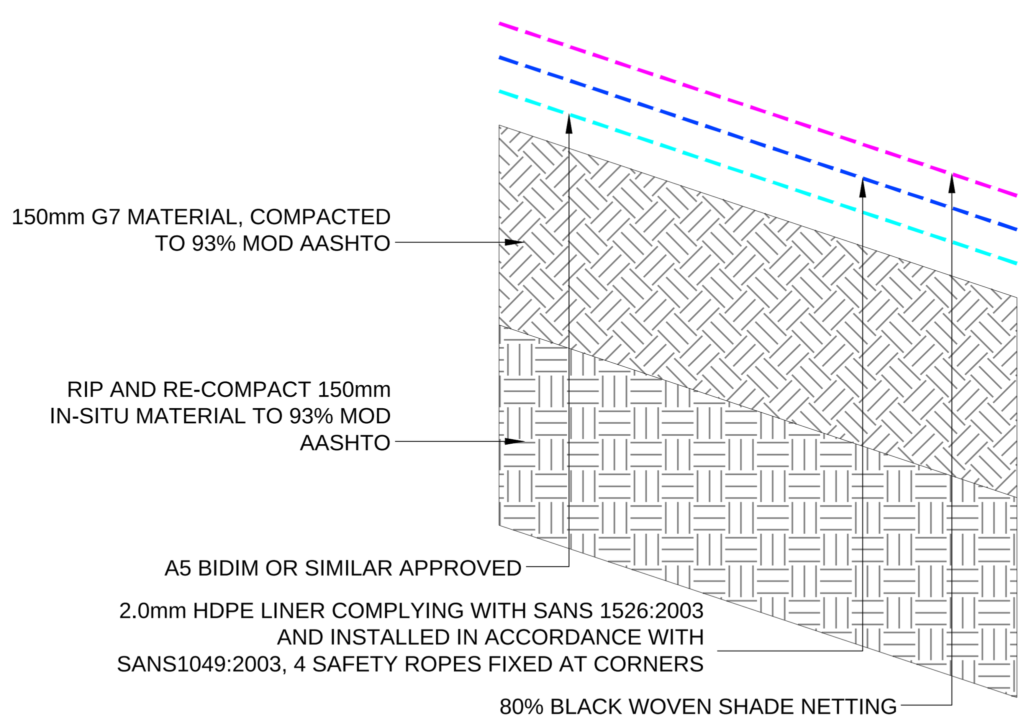
DETAIL FOR CONNECTION TO ANCHOR BEAM

SCALE 1:10



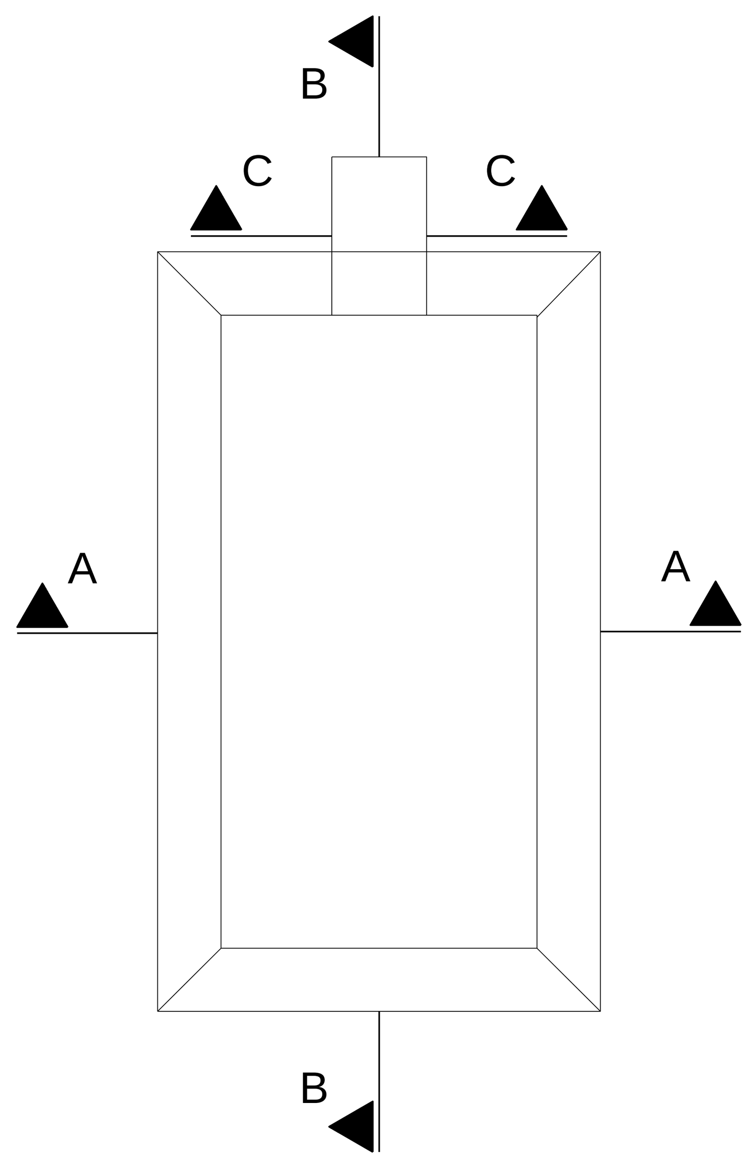
DETAIL B

SCALE 1:40



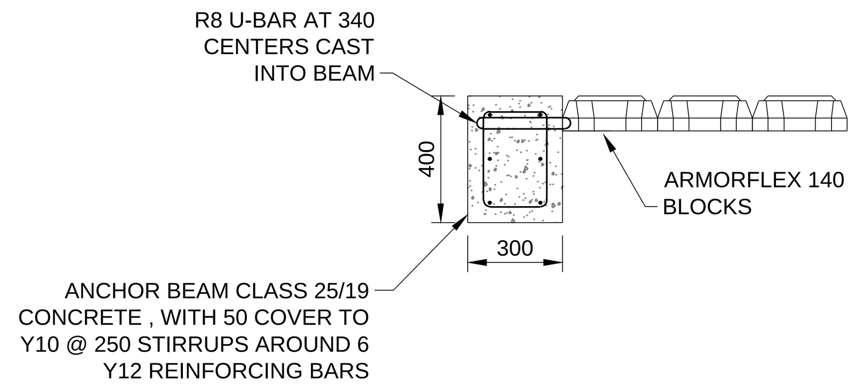
DETAIL 3

SCALE N.T.S



TYPICAL DAM LAYOUT

SCALE N.T.S



SECTION D-D

SCALE 1:20

NOTES:

A: MATERIAL SPECIFICATION

1. WATER
   - WATER SHALL BE CLEAN AND FREE FROM INJURIOUS AMOUNTS OF ACIDS, ALKALIS, ORGANIC MATTER AND OTHER SUBSTANCES THAT MAY IMPAIR THE STRENGTH OR DURABILITY OF THE CONCRETE.
2. AGGREGATES
   - NATURAL "RIVER SAND" IS PREFERRED
   - THE USE OF STONE IS ACCEPTABLE, BUT IT MUST NOT EXCEED 6MM IN SIZE
   - SAND SHALL NOT CONTAIN MORE THAN 5% CLAY
4. REINFORCEMENT
   - WHERE IT IS NOT POSSIBLE TO DRIVE ANCHOR PEGS IN BY HAND, 12MM HOLES SHALL BE DRILLED AND PEGS GROUTED INTO THE DRILLED HOLED.

B: REFER TO THE 'MULTI- CELL GUIDELINES' BY KAYTECH FOR ADDITIONAL INFORMATION, SPECIFICATION, CONSTRUCTION METHOD AND QUALITY CONTROL

NOTE: DUE TO USE OF PLASTIC LINER, STEEL PEGS CAN ONLY BE USED ALONG THE OUTER EDGE OF THE MAT FOR TENSIONING PURPOSES. SAND BAGS SHOULD BE USED FOR HOLDING THE MAT IN PLACE ON TOP OF THE LINER.

5. RENO MATTRESS

   RENO MATTRESSES – MANUFACTURED USING HEXAGONAL WOVEN MESH TYPE, CLASS A GALVANIZED OR WITH A 0.50mm THICKNESS PVC COATING, MESH APERTURE

TABLE 1

DAM DIMENSIONS (m)					
DAM	a	b	c	d	e
POLLUTION CONTROL DAM 1	80.8	47.8	2.8	64	31
POLLUTION CONTROL DAM 2	57.8	40.8	2.8	41	24
POLLUTION CONTROL DAM 3	78.8	47.8	2.8	62	31

CONSTRUCTION NOTES:

1. EXCAVATE DAMS AS PER DIMENSIONS PROVIDED
2. PREPARE 2 x 150mm G7 LAYERS AND COMPACT TO 93% MOD ASSHTO
3. EXCAVATE OVERFLOW, INFLOW FROM SILT TRAP AND ANCHOR TRENCHES
4. APPLY A5 BIDIM AND PLACE IN TRENCH
5. INSERT 2mm HDPE LINER AND PLACE IN TRENCH
6. LAY DOWN SHADE NETTING AND PLACE IN TRENCH
7. FILL TRENCHES AND FINISH OFF SITE WORKS

Cad File Name: P18054-CC-01-SWD-002 REV a - POLCON DAM LINING DETAILS SHEET 1 DBEC-MRPRO-09-06

GREEN BUILDING COUNCIL SA MEMBER ORGANISATION CESA Consulting Engineers South Africa

LEGEND:

CONCEPT

Rev.	Date	Description of changes	By
a	##-##-2018	ISSUED FOR APPROVAL	PDW

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THE MASTER HELD AT DELTA BUILT ENVIRONMENT CONSULTANTS BEARS THE ORIGINAL SIGNATURE OF APPROVAL.

SIGNATURE: NAME: DATE:

Project

GRUISFONTEIN COAL MINE PROJECT

Project Description

GRUISFONTEIN PFS DESIGN

Drawing Title

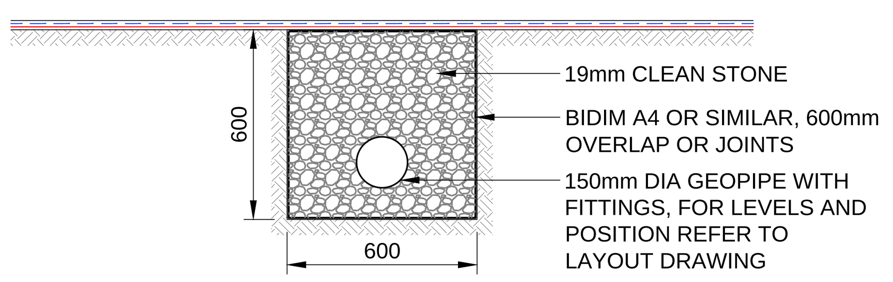
POLLUTION CONTROL DAM LINING DETAILS SHEET 1

Drawing Units	Drawing Size
METERS	A1

Date	Scale	Designed By
AUGUST 2018	AS SHOWN	G GREYLING

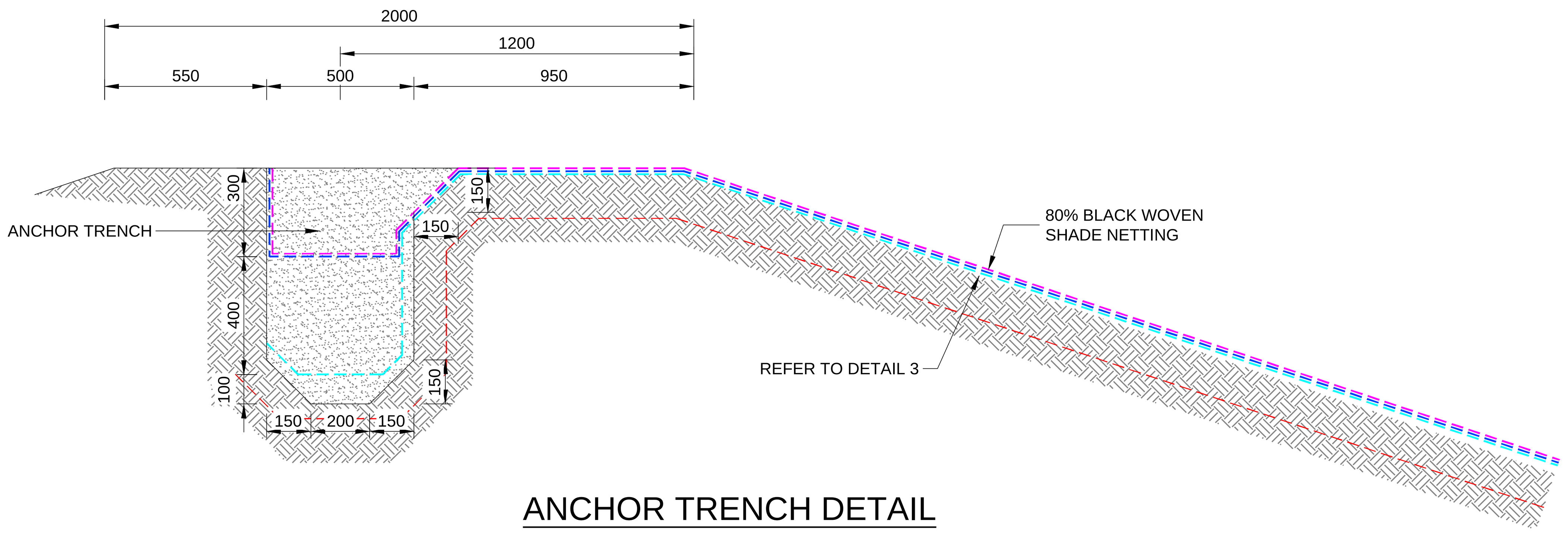
Checked By	Drawn By	Approved By
B NDHLOVU	I SMIT	P DE WET

Drawing No. P18054-CC-01-SWD-002 Rev a



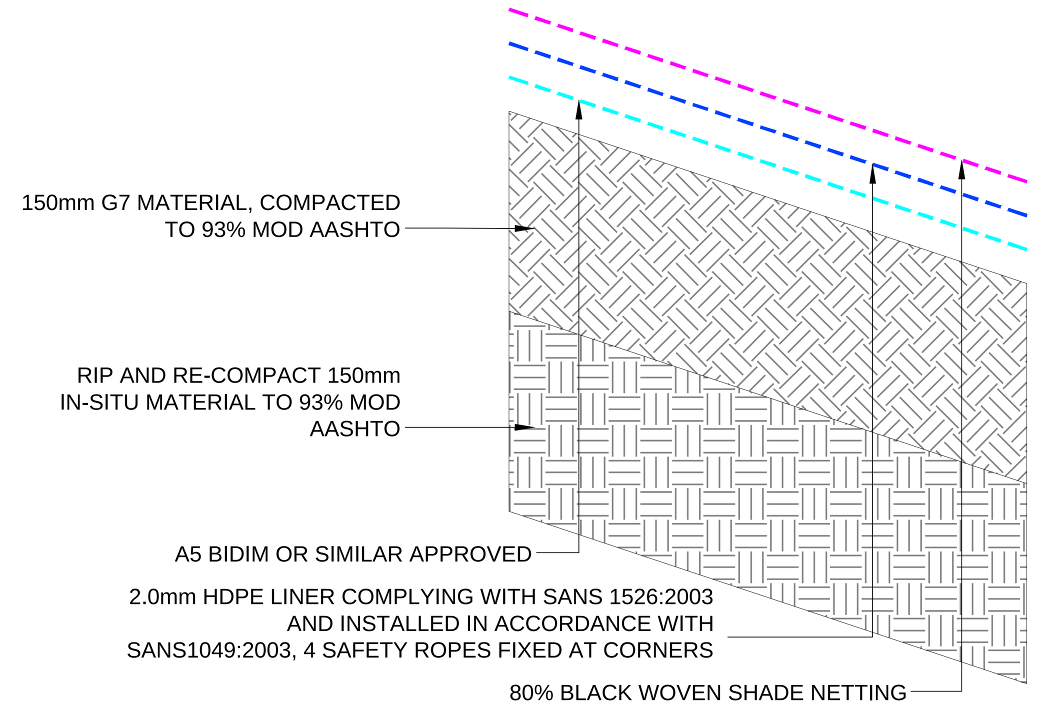
DETAIL 1: SUB-SOIL DRAIN

SCALE 1:20



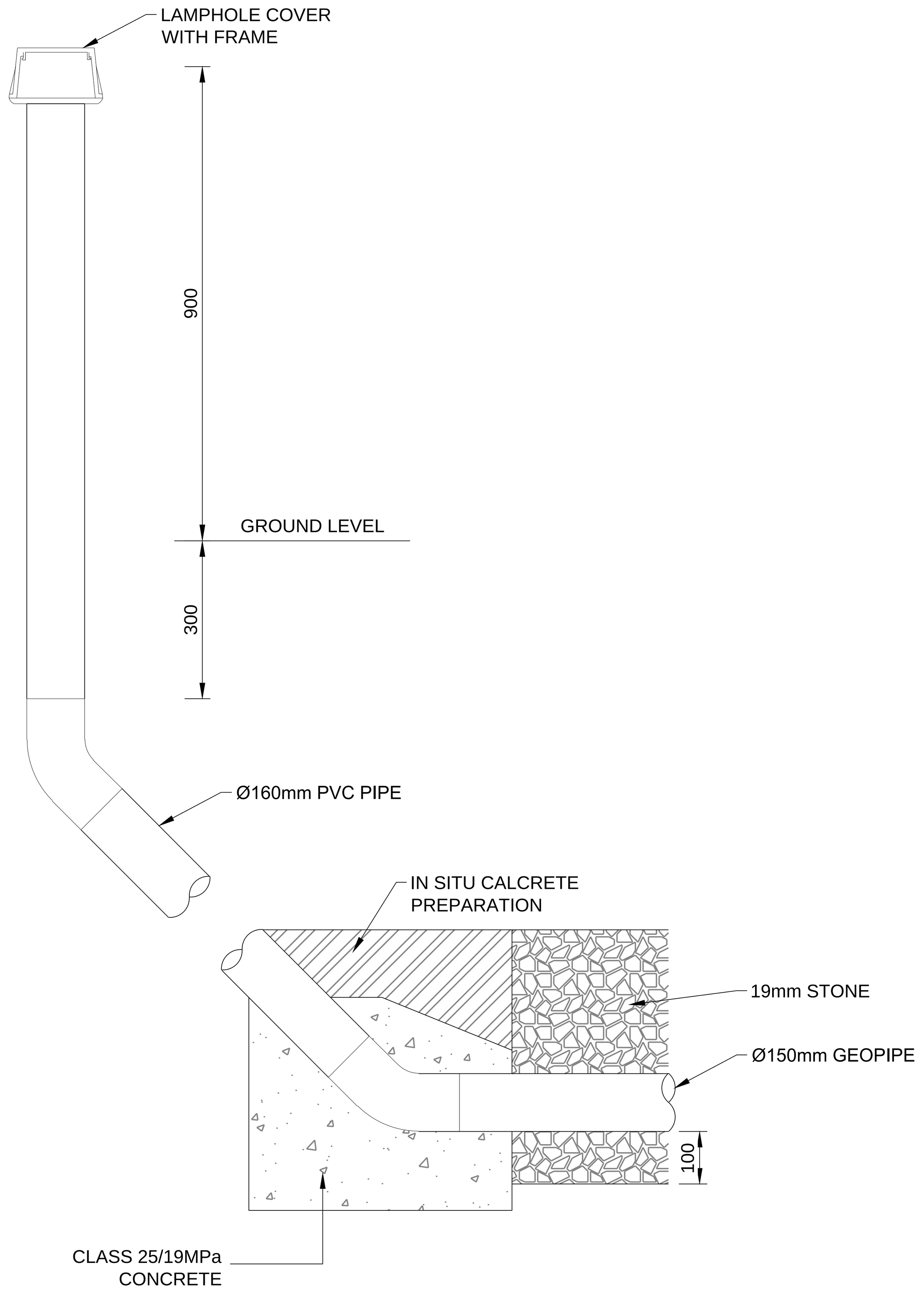
ANCHOR TRENCH DETAIL

SCALE 1:16



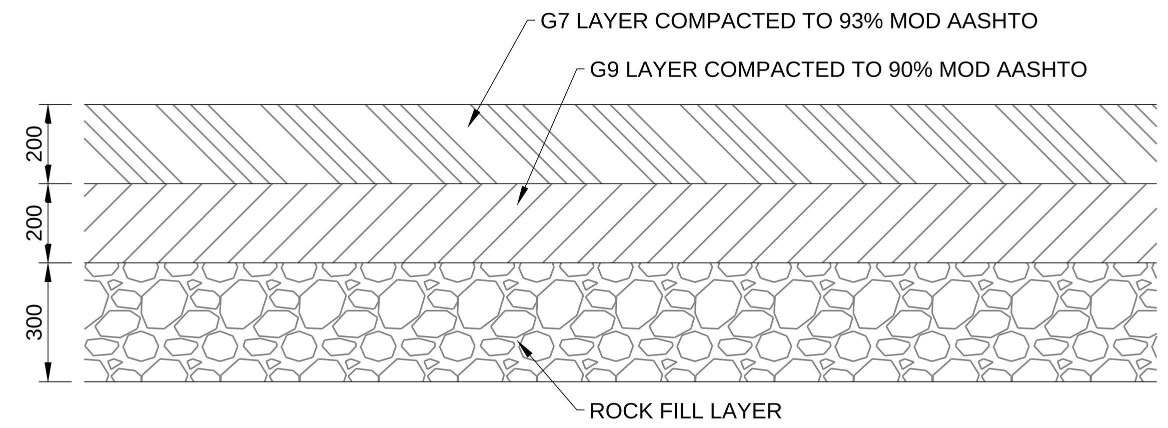
DETAIL 3

SCALE N.T.S



TYPICAL DETAIL OF RODDING EYE:BEGINNING OF SUB-SOIL

SCALE 1:10



SILT TRAP AND LAYERWORKS

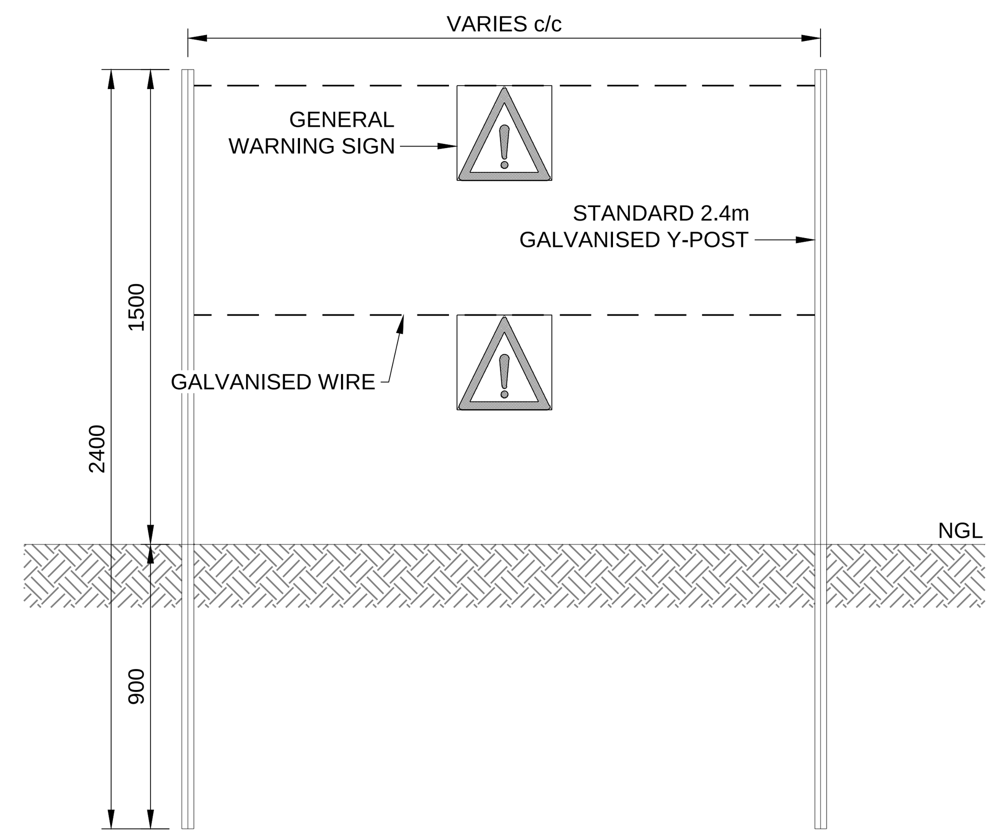
SCALE N.T.S

CONSTRUCTION NOTES:

1. EXCAVATE DAMS AS PER DIMENSIONS PROVIDED
2. PREPARE 2 x 150mm G7 LAYERS AND COMPACT TO 93% MOD ASSHTO
3. EXCAVATE OVERFLOW, INFLOW FROM SILT TRAP AND ANCHOR TRENCHES
4. APPLY A5 BIDIM AND PLACE IN TRENCH
5. INSERT 2mm HDPE LINER AND PLACE IN TRENCH
6. LAY DOWN SHADE NETTING AND PLACE IN TRENCH
7. FILL TRENCHES AND FINISH OFF SITE WORKS

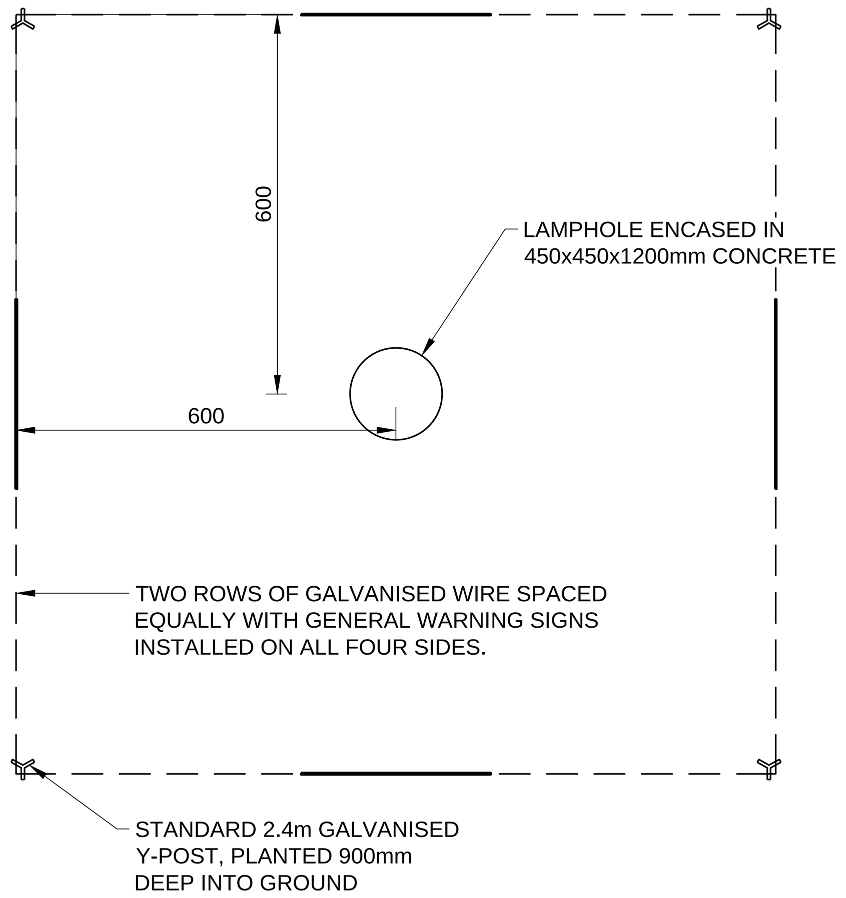
CONSTRUCTION NOTES

1. REMOVE AND STOCKPILE A MINIMUM OF 300mm TOPSOIL
2. EXCAVATE POLLUTION CONTROL DAM ACCORDING TO SANS 1200D, SOFT EXCAVATION IS EXPECTED
3. INSTALL SUB-SOIL DRAINS WITH APPROVED AGGREGATE AND BIDIM
4. RIP AND RE-COMPACT 150mm IN-SITU LAYER
5. FILL AND COMPACT TO LAYERS OF 150mm G7 MATERIAL AND COMPACT TO 93% MOD AASHTO
6. INSTALL A5 BIDIM AND ANCHOR ACCORDING TO TRENCH DETAIL
7. INSTALL 2.0mm HDPE LINER AS PER SANS 1409:2003
8. INSTALL SHADE NETTING AND ANCHOR IN TRENCH AS PER DETAIL



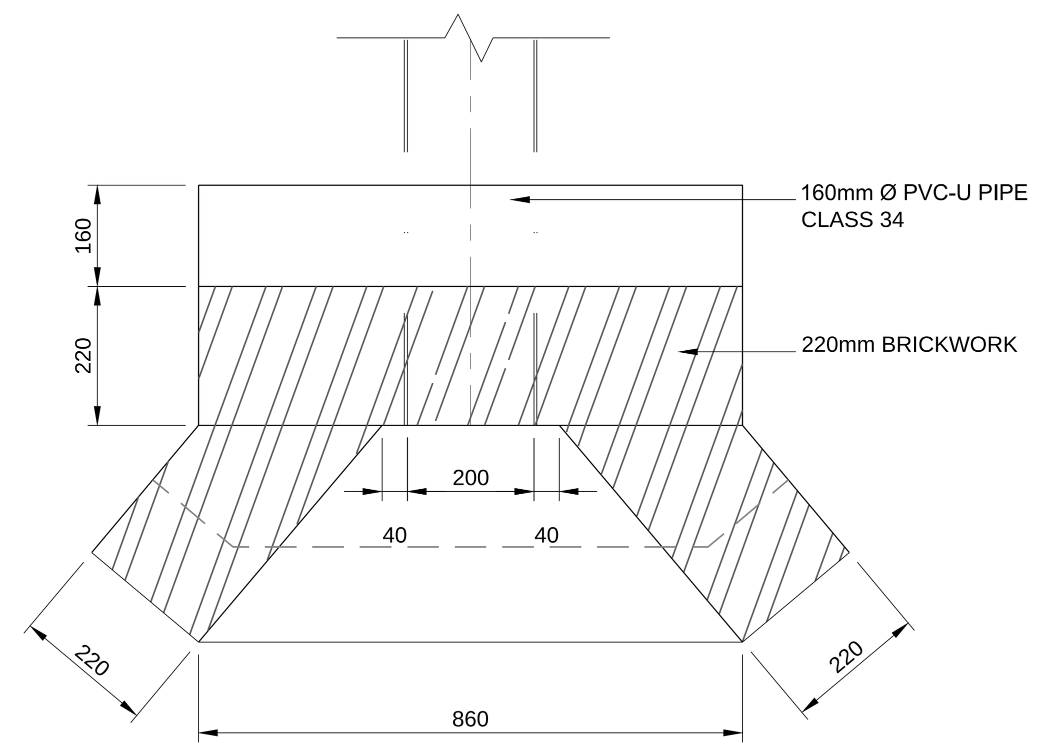
TYPICAL DETAIL OF GENERAL WARNING SIGN INSTALLATION

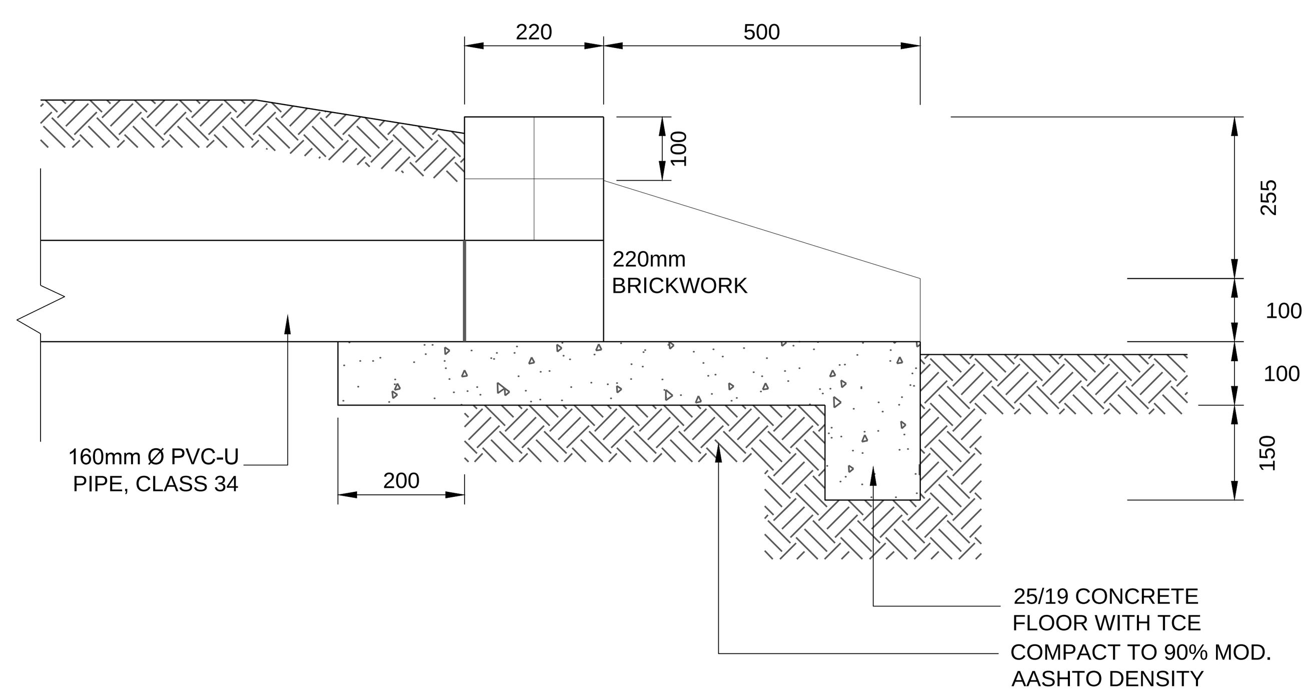
SCALE 1:20



PLAN VIEW OF WARNING SIGN INSTALLATION

SCALE 1:10

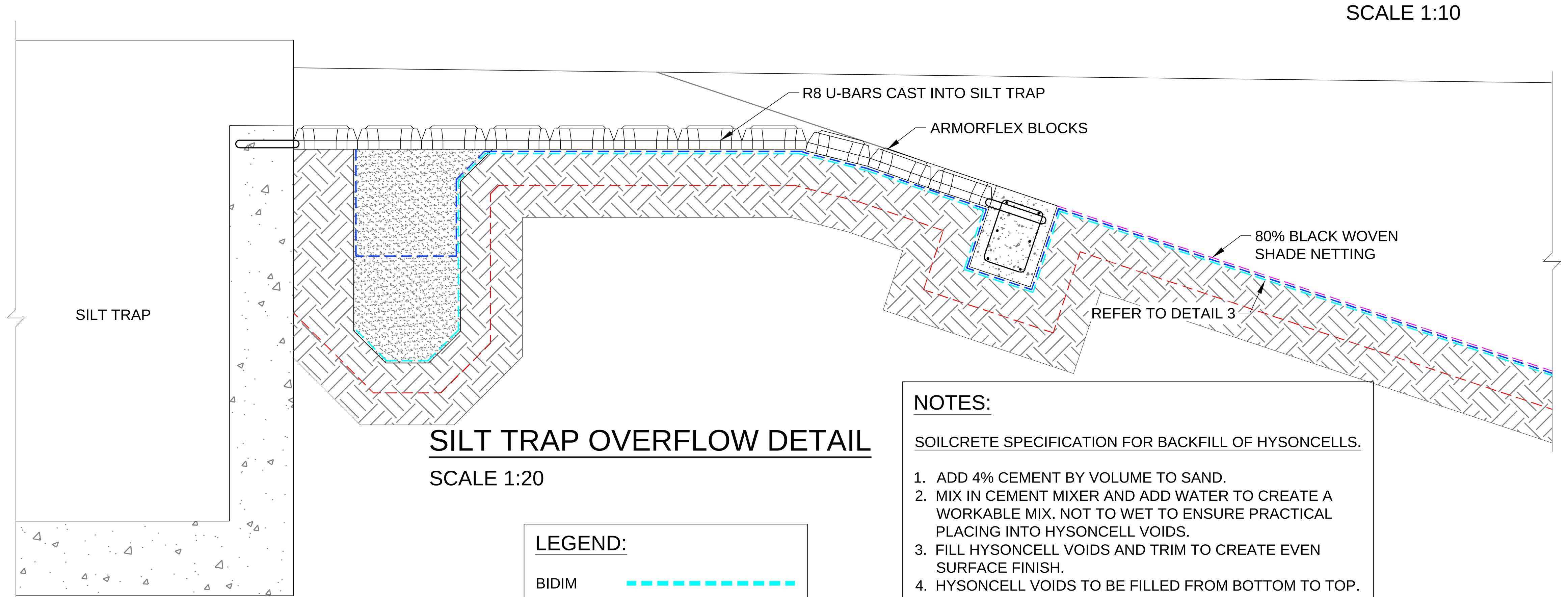




SIDE ELEVATION

SCALE 1:10

OUTLET STRUCTURE FOR SUB-SOIL DRAINS



SILT TRAP OVERFLOW DETAIL

SCALE 1:20

LEGEND:

- BIDIM (cyan dashed line)
- SHADE NET (magenta dashed line)
- 2mm HDPE (blue dashed line)

NOTES:

SOILCRETE SPECIFICATION FOR BACKFILL OF HYSONCELLS.

1. ADD 4% CEMENT BY VOLUME TO SAND.
2. MIX IN CEMENT MIXER AND ADD WATER TO CREATE A WORKABLE MIX. NOT TO WET TO ENSURE PRACTICAL PLACING INTO HYSONCELL VOIDS.
3. FILL HYSONCELL VOIDS AND TRIM TO CREATE EVEN SURFACE FINISH.
4. HYSONCELL VOIDS TO BE FILLED FROM BOTTOM TO TOP. (START WORKING IN DAM FLOOR)
5. ALLOW SOILCRETE TO CURE FOR AT LEAST 7 DAYS BEFORE ALLOWING MOVEMENT ON SURFACE.
6. WET SURFACE DAILY DURING CURING PROCESS.

Cad File Name: P18054-CC-01-SWD-003 REV a - POLCON DAM LINING DETAILS SHEET 2 DBEC-MRPRO-09-06

GREEN BUILDING COUNCIL MEMBER ORGANISATION — CESA

LEGEND:

CONCEPT

Rev.	Date	Description of changes	By
a	##-##-2018	ISSUED FOR APPROVAL	PDW

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APPROVED

THE MASTER HELD AT DELTA BUILT ENVIRONMENT CONSULTANTS BEARS THE ORIGINAL SIGNATURE OF APPROVAL.

SIGNATURE: NAME: DATE:

Project

GRUISFONTEIN COAL MINE PROJECT

Project Description

GRUISFONTEIN PFS DESIGN

Drawing Title

POLLUTION CONTROL DAM LINING DETAILS SHEET 2

Drawing Units	Drawing Size	
METERS	A1	
Date: AUGUST 2018	Scale: AS SHOWN	Designed By: G GREYLING
Checked By: B NDHLOVU	Drawn By: I SMIT	Approved By: P DE WET

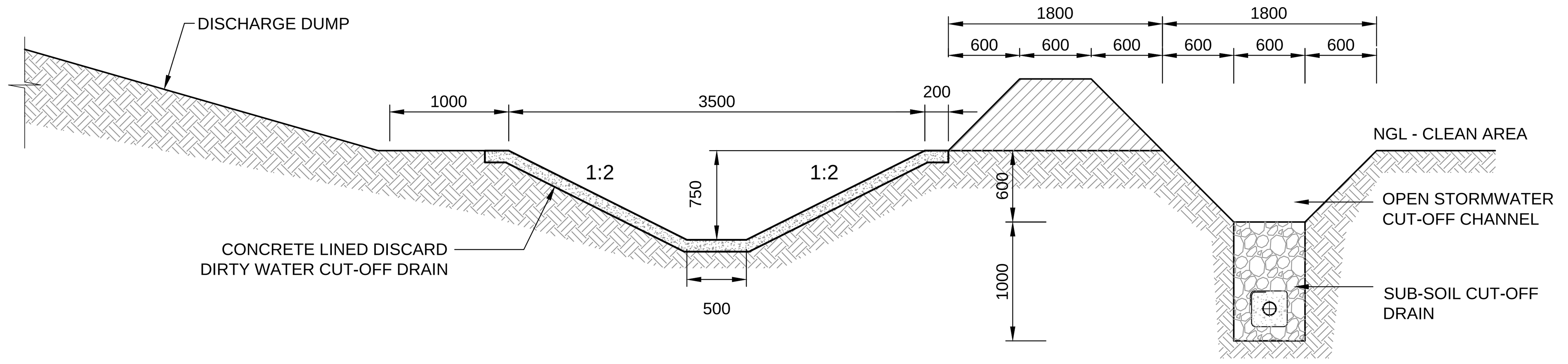
Drawing No. P18054-CC-01-SWD-003 Rev a

NOTES

1. ALL CONCRETE WORK TO BE 25/19 MPa CONCRETE
2. REINFORCEMENT COVERAGE TO BE A MINIMUM 40mm

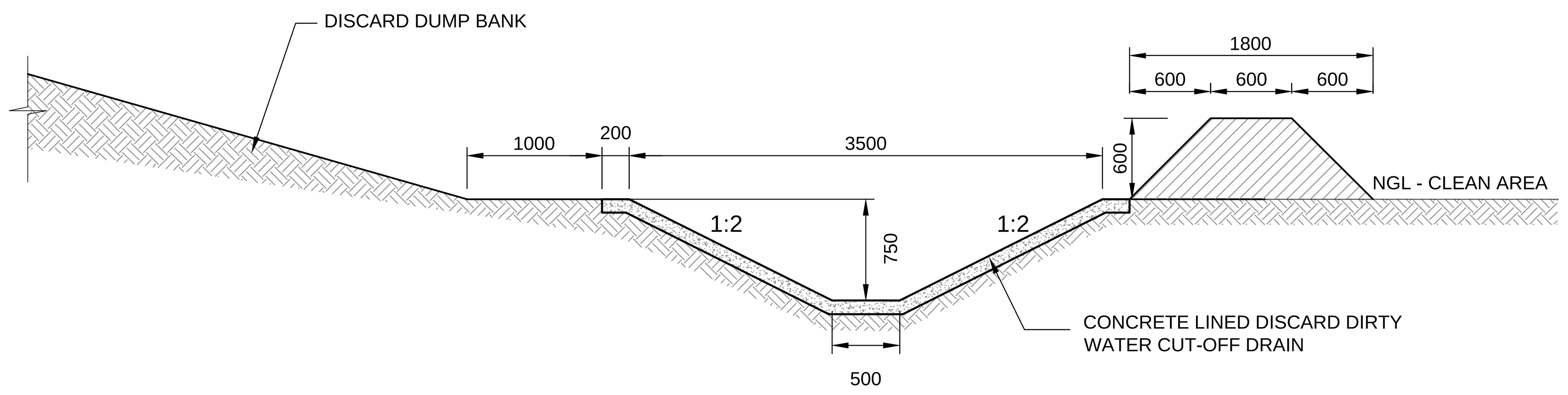
CONSTRUCTION NOTES

1. REMOVE 300mm TOPSOIL AND STOCKPILE
2. ALL COMPACTION TO BE DONE AS PER SANS 1200D AND TO A MINIMUM OF 93% MOD AASHTO
3. WORKS TO COMPLY WITH THE RELEVANT SANS 1200 SPECIFICATIONS
4. MINIMUM DRAINING SLOPE OF 067%



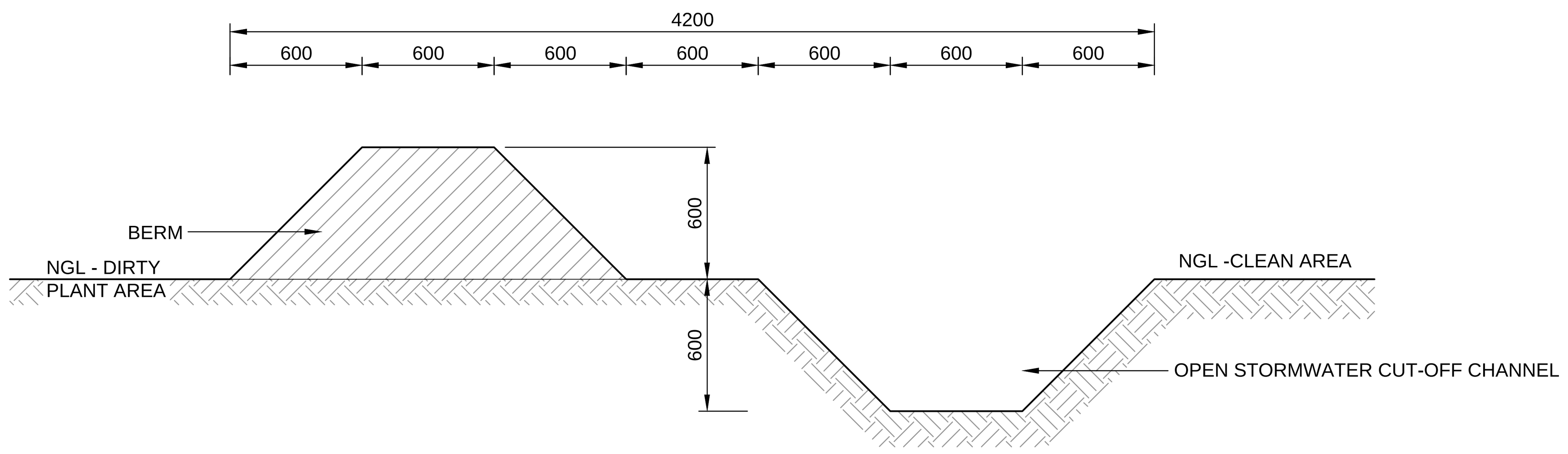
STORMWATER PROFILE A

SCALE: N.T.S



STORMWATER PROFILE B

SCALE: N.T.S



STORMWATER PROFILE C

SCALE 1:25

Cad File Name: DBEC-MRPRO-09-06
P18054-CC-01-SWD-004 REV a - STORMWATER CHANNEL PROFILE DETAILS

GREEN BUILDING COUNCIL MEMBER ORGANISATION CESA

LEGEND:

CONCEPT

Rev.	Date	Description of changes	By
a	##-##-2018	ISSUED FOR APPROVAL	PDW

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Project

GRUISFONTEIN COAL MINE PROJECT

Project Description

GRUISFONTEIN PFS DESIGN

Drawing Title

STORMWATER CHANNELS PROFILE DETAILS

Drawing Units	Drawing Size	
METERS	A1	
Date: AUGUST 2018	Scale: AS SHOWN	Designed By: G GREYLING
Checked By: B NDHLOVU	Drawn By: I SMIT	Approved By: P DE WET

Drawing No. P18054-CC-01-SWD-004 Rev a