Proposed Coal Mine on the Farm Droogenfontein 241 IR Portions 26, 46 and 47

Hydrological Assessment Report – Revision 1 (January 2014)

Nurizon Consulting (Pty) Ltd.

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Executive Summary

Ngululu Resources plans to develop an open cast coal mine on Portion 26 of Farm Droogenfontein 241, located near the town of Delmas, Mpumalanga Province.

Ngululu Resources appointed Shangoni Management Services to oversee the mining rights and related approval processes. Shangoni Management Services in turn appointed Nurizon Consulting (Pty) Ltd to undertake a hydrological assessment for the proposed mine and develop a water balance system.

This water balance system is presented in this report, inclusive of the design methodologies, criteria and assumptions.

A cost estimate of this conceptual design (water balance system) is furthermore included in this report.

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Glossary of Abbreviations and Definitions

AVK	Valve supplier
Fe	Iron
FC	Fibre Cement
HDV	Heavy duty vehicle
kl	Kilolitre
kPa	Kilopascals
kW	Kilowatt
l	Litre
LDV	Light duty vehicle
l/min	Litre per minute
l/p/d	Litres per person per day
l/s	Litres per second
m	Meter
MAP	Mean Annual Precipitation
Mbgl	Meters below ground level
MHSA	Mine Health and Safety Act (Act No. 29 of 1996)
m/s	Meter per second
m^2	Square meter
m^2/d	Square meter per day
m^3	Cubic meter
Ml	Mega litre
Mtpa	Million tonnes per annum
N	Nitrogen
Ngululu Resources	Ngululu Resources (Pty) Ltd
NH4	Ammonium
NO3	Nitrate
Nurizon Consulting	Nurizon Consulting (Pty) Ltd
NWA	National Water Act (Act No. 36 of 1998)
OZ-Kan	Valve supplier
PN	Pressure rating
Red Book	Guidelines for Human Settlement Planning and Design (CSIR)

ROM	Run-off Mine
SANS 241	SANS 241: 2006 Drinking Water
SANS 241-1	SANS 241-1:2011 Drinking Water Part 1. Microbiological, physical, aesthetic and chemical determinants
SANS 241-2	SANS 241-2:2011 Drinking Water Part 2. Application of SANS 241-1
SANS 1200	Standard Specification for Civil Engineering Construction
Shangoni	Shangoni Management Services (Pty) Ltd.
WWTW	Waste Water Treatment Works

1. Introduction

1.1 BACKGROUND

Ngululu Resources plans to develop a coal mine on the Farm Droogenfontein 241, IR Portions 26 (133.9ha), 46 and 47 (no envisaged mining activities are planned for Portions 46 and 47), located near Delmas Town in the Victor Kanye Local Municipality, as part of the Nkangala District Municipality, Mpumalanga Province (refer to **Figure 1.1**, **Figure 1.2** and **Figure 1.3**). The estimated Life of Mine is 20 years.

Ngululu Resources appointed Shangoni to oversee the mining rights applications and related mining approval processes. Shangoni appointed Nurizon Consulting (Pty) Ltd [Nurizon] to undertake a hydrological assessment for the proposed coal mine and to develop a water balance system.

Shangoni furthermore appointed VBKom Consulting Engineers (mining engineers) to develop the mine plan. Nurizon used the mine plan as a basis for the hydrological assessment.

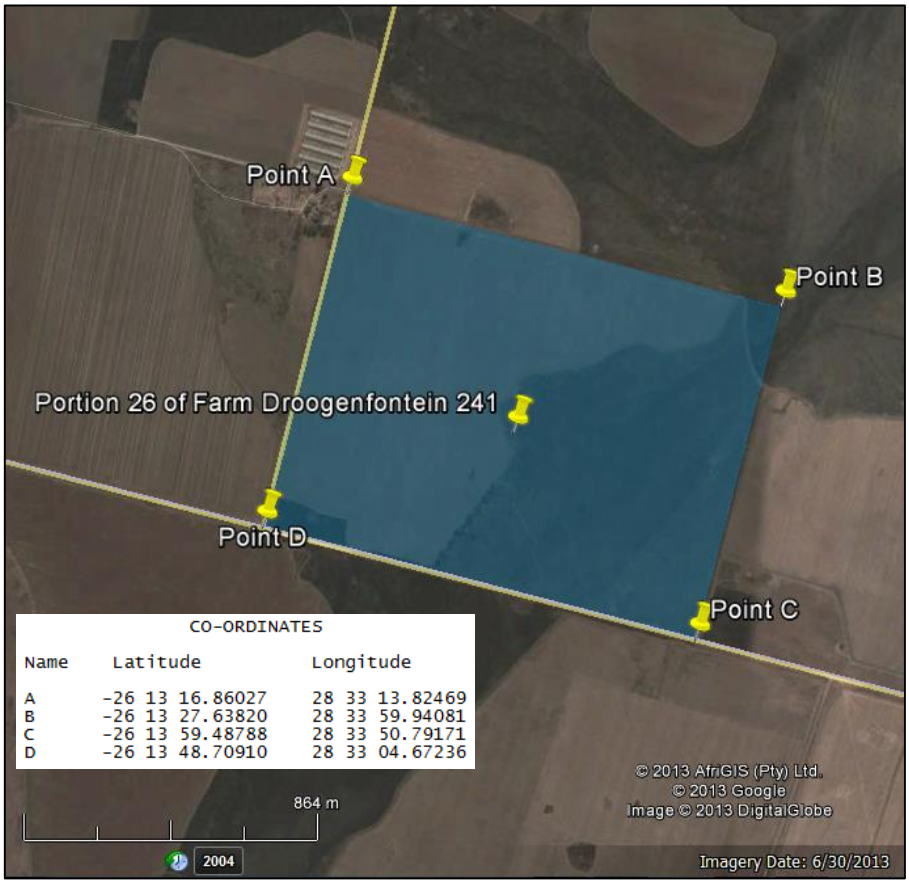

Figure 1.1 – Portions 26, 46 & 47 of Farm Droogenfontein (Map data from Google, 2013)

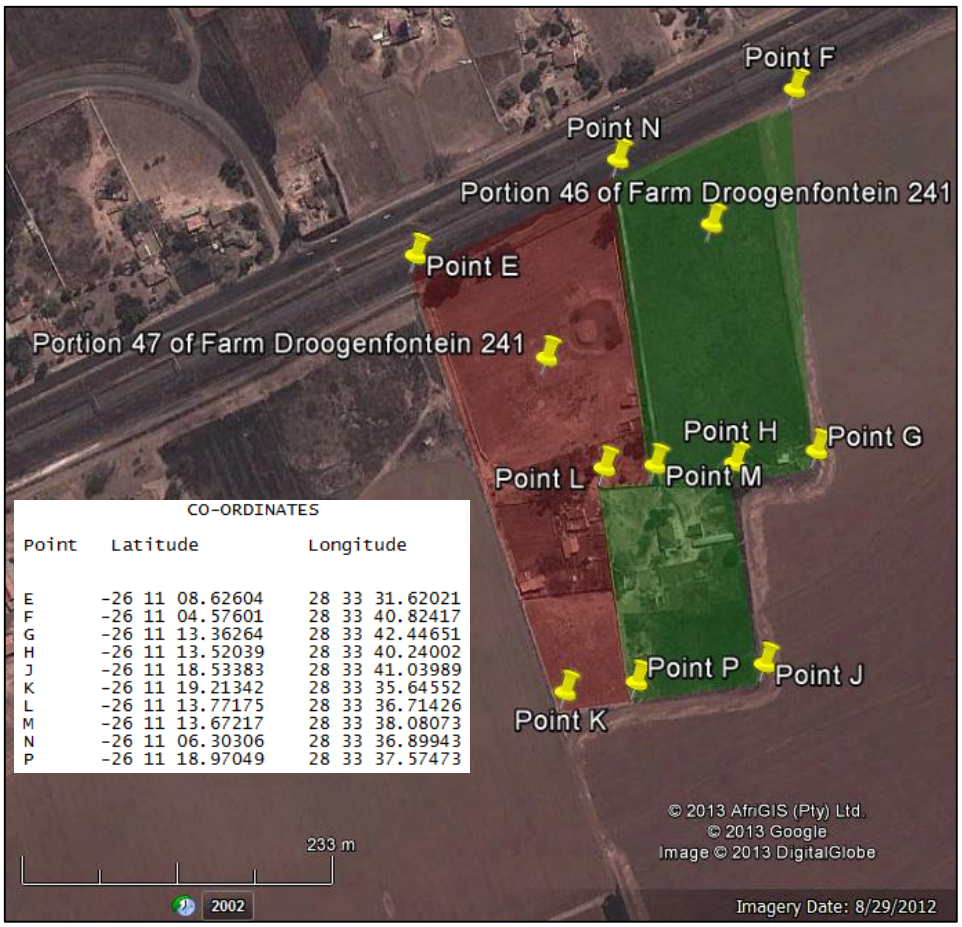

Figure 1.2 – Portions 46 & 47 of Farm Droogenfontein (Map data from Google, 2013)

1.2 ASSOCIATED DOCUMENTS

The following reports and information were referenced and reviewed as part of the information provided by Shangoni:

1. Ngululu Resources Ltd., October 2012, *Mining Work Programme*;
2. Shangoni Management Services (Pty) Ltd., August 2013, *Environmental Scoping Report - Portion 26, 46, and 47 of the farm Droogenfontein 242 IR*; and
3. Shangoni AquiScience (Pty) Ltd., November 2013, *Geohydrological Investigation on the farm Droogenfontein, Portion 26*.

1.3 PURPOSE OF REPORT

The purpose of this report is to present the hydrological assessment undertaken for Farm Droogenfontein 241, IR Portions 26, 46 and 47 and the development of the water balance system.

Figure 1.3 – Portions 26, 46 & 47 of Farm Droogenfontein (Map data from Google, 2013)

2. Regulation 704 (National Water Act, 1998) Requirements

In term of Regulation 704 (4 June 1999) of the National Water Act (Act No. 36 of 1998), any person or company intending to operate a mine must comply with the requirements of this regulation to ensure conservation of South Africa's water resources (Refer to **Appendix A** for a copy of NWA Regulation 704). This hydrological study and subsequent water balance system is based on the requirements of Regulation 704.

The relevant clauses, in terms of this hydrological study, are listed below as well as the steps to be taken to ensure compliance (**Table 2-1**).

Table 2-1 Regulation 704 Requirements and Compliance

Clause	Requirement	Compliance
4. Restrictions on locality		
4(a)	No residue deposit, dam, reservoir and associated infrastructure must be located within the 1:100 year flood line or within 100m from any water course, estuary, borehole or well.	Flood lines must be determined as part of the detail design phase. All water related infrastructure will be positioned outside of these flood lines (as well as outside of the 100m requirement).
4(d)	No sanitary convenience, fuel depots, reservoir or depots that can cause pollution of a water resource must be located within the 1:50 year flood line of any watercourse.	After floodline determination, the infrastructure will be positioned to ensure compliance with this clause. The stormwater run-off from dirty water areas will furthermore be collected in a dirty water dam (pollution control dam) from where it will be re-used or released once treated to acceptable standards as per the Water Act.
5. Restrictions on use of material		
5	Material that is likely to cause pollution may not be used in the construction of any dam or other impoundment.	Selected engineering material will be specified for the construction of the pollution control dam. The dam will furthermore be lined with an impervious HDPE lining.

Clause	Requirement	Compliance
6. Capacity requirements of clean and dirty water systems		
6(a)	Unpolluted water must be confined to a clean water system, away from a dirty water area.	The mine will be divided into clean and dirty water areas. The clean water areas will be released into the environment, whereas the dirty water areas will drain to a dirty water dam.
6(b)	The clean water system must be designed, constructed, maintained and operated to ensure that the clean water does not spill into the dirty water areas for a flood recurrence of 1:50 years.	The clean and dirty water areas will be kept separate by means of channels, culverts, berms and platforms. These infrastructure will be designed to cater for the 1:50 year flood occurrence.
6(c)	Water arising from a dirty area must be collected in a dirty water system.	The dirty areas of the mine will be confined and drained to a dirty water dam. The ground water from the opencast pit will be pumped (pit dewatering) to the dirty water dam. An oil-water separator will be constructed upstream of the dirty water dam.
6(d)	The dirty water system must be designed, constructed, maintained and operated to ensure that the clean water does not spill into the dirty water areas for a flood recurrence of 1:50 years.	The clean and dirty water areas will be kept separate by means of channels, culverts, berms and platforms. These infrastructure will be designed to cater for a 1:50 year flood occurrence.
6(e)	The dirty water dam must have a freeboard of 800mm.	The dirty water dam will be designed to have a freeboard of 800mm for a 1:50 year flood occurrence.
6(f)	The water systems must be designed, constructed and maintained to guarantee the serviceability of such conveyances for a 1:50 year flood occurrence.	The dirty water areas will be designed for a 1:50 year flood occurrence. Allowance will be made for maintenance and serviceability requirements.
7. Protection of water resources		
7(a)	Any water that is likely to cause pollution of a water resources must	The water collected in the dirty water areas will be conveyed to the dirty water dam by means

Clause	Requirement	Compliance
	be prevented from entering a water resource.	of pipe and box culverts as well as suitably lined channels. This dirty water dam will be HDPE lined.
7(b)	All water systems and residue deposits must be designed, modified, located, constructed and maintained so as to prevent the pollution of any water resource through the operation or use thereof.	All dirty water reticulation systems will be adequately lined to ensure containment.
7(c)	The flow of any surface water or floodwater must be minimised into the opencast pit.	A cut-off berm must be constructed upstream of the opencast pit to divert stormwater away from it.
7(d)	The mine's tailings storage facility must be designed, modified, constructed and maintained to ensure that water or waste therein will not cause the failure thereof.	The mine will only undertake primary screening and crushing on site and transport the product to a beneficiation plant of site. There will therefore not be a tailing storage facility on site.
7(e)	The erosion and leaching of the residue deposit must be prevented from entering and polluting any water course.	Dirty water from the waste stockpile will be collected and conveyed to the dirty water dam.
7(f)	Water used in any process or activity is recycled as far as possible.	The water balance system for the mine will be designed as a semi-closed water system. The water from the dirty areas will be collected for re-use in dirty water dam. The stormwater from the clean water areas will be released into the environment.
7(g)	The water systems must be kept free from any matter or obstruction which may affect the efficiency.	The infrastructure will be designed to allow for easy access and maintenance.
7a.	All domestic waste (including wash water) must be disposed of in terms of an authorisation under the Act.	All effluent will be treated in a waste water treatment work (to General Limits as per the NWA and conveyed to the dirty water dam for re-use.

Clause	Requirement	Compliance
8. Security and additional measures		
8(a)	Any dam containing harmful substances must be effectively fenced-off.	Although the water collected in the dirty water dam is not expected to be harmful, it is recommended that all dams be fenced-off to restrict access in terms of the MHSA.
8(b)	Access control is required for the stockpiling area.	The access routes to the stockpiling area will be classified as dangerous and specific inductions will be required to enter this area.
8(c)	The areas mentioned in 8(a) and 8(b) may only be used for its intended purpose.	The mine will operate and maintain these areas as per their intended purposes.

3. Methodology and Design Assumptions

3.1 METHODOLOGY

The water requirements for the proposed coal mine comprise bulk (raw) water (untreated) and potable water, the latter for human consumption, change houses and general maintenance and operations. Bulk and potable water requirements are determined based on the size of the mining activity and subsequent workforce.

The mine will be operated with a semi-closed loop water management system, i.e. the majority of the dirty areas stormwater and wastewater will be collected, treated (where applicable) and re-used. The stormwater from the clean areas will be released into the environment.

Reference should be made to **Section 4** for a breakdown of the water balance system.

3.2 MINE PLAN AND DESIGN ASSUMPTIONS

3.2.1 Information from the Mine Plan

The conceptual mine plan was developed by VBKom Consulting Engineers. The following information was gathered from the mine plan and used in the hydrological assessment:

- Mining Volumes (ROM):
  - Year 1: 300,000 tonnes in-situ;
  - Year 2: 700,000 tonnes in-situ;
  - Year 3: 1,400,000 tonnes in-situ;
  - Year 4 – 19: 3,000,000 tonnes in-situ (3Mtpa);
  - Year 20: 2,945,000 tonnes in-situ
- Mining method:
  - Open cast mine pit;
  - Primary screening and crushing only. The product will be transported (haul trucks) to a beneficiation plant (wash plant) off-site;
  - The waste stockpile will be located in the south west corner of portion 26 (Farm Droogenfontein 241). The volume of the waste stockpile is approximately 3,100,000m^3 (***Option B – fast ramp-up as per the Mine Plan***) (Surface area is approximately 138,000m^2);

- Mining Plant and Equipment:
  - CAT 777G Off-Highway Truck: 11 of;
  - CAT 740B Articulated Truck: 7 of;
  - CAT HEX 6030 Hydraulic Shovel: 2 of;
  - CAT HEX 6030 hydraulic Excavator: 1 of;
  - CAT 992K Wheel Loader: 1 of;
  - Pantera 1500 hydraulic drilling rig: 1 of;
  - Atlas Copco PV235 blasthole drilling rig: 1 of;
  - CAT D10T Track-Type Tractor (Dozer): 7 of;
  - CAT 844H Wheel Dozer: 1 of;
  - CAT 740B Water Truck: 1 of;
  - CAT 740B Diesel Truck: 1 of;
  - CAT 430F Backhoe Loader 1 of; and
  - CAT 16M Motor Grader: 2 of.
- Mine Hours
  - Mining days/annum: 311 days;
  - Annual Closure: -15 days;
  - Weather, strikes, etc.: -10 days;
  - **Operating days available:** **286 days**;
  - Operating hours / days per week: 24/7;
  - Number of shifts: 3 shifts;
  - Hours per shift: 8 hours; and
  - **Operating hours per annum:** **6864 hours.**

3.2.2 Design Assumptions

The following design assumptions were made regarding the mine plan:

- The following mine support infrastructure will be required:
  - Security gatehouse and induction facility;
  - Weighbridges;
  - Management Staff Offices;
  - Management Change House;
  - Male Change Houses;

- Female Change Houses;
- Maintenance Offices;
- Clinic;
- Canteen;
- Warehouse and Welding Shop;
- General Store;
- Chemical, Gas, Hazardous Material and Flammable Store;
- HDV and LDV Wash Bays;
- Tyre Bays and Storage.

- Zero washing of the product will occur on site (only primary screening and crushing);
- Bulk water is not required for process or mining operations as the mine will only undertake primary screening and crushing. Allowance will however be made for dust control / suppression;
- Personnel numbers (based on similar sized mines):
  - Managerial Personnel: 200;
  - Shift Staff: 3500;

3.3 GEOTECHNICAL INFORMATION AND EXPECTED GROUND WATER LEVEL

3.3.1 Geotechnical Information

The site is underlain by rocks of the Madzaringwe Formation, Ecca Group and Karoo Supergroup. The rocks are primarily classified as sandstone, shale and coal with Dolerite dykes and sills present. The bedrock is covered predominantly with a variable thickness, reddish sandy soil.

3.3.2 Ground Water Level

Boreholes (rotary core drilling) were drilled by Malatleng Mining cc. in September 2012. Geoline Services undertook wireline logging of these boreholes. The water level was encountered at the following depths below natural ground level:

- Borehole DN 14: 7.5m;
- Borehole DN 15: 5.5m;
- Borehole DN 16: 0m (at surface);
- Borehole DN 18: 1.95m;
- Borehole DN 19: 6.0m;

It is therefore assumed that the water level is between 2 and 8m below natural ground level.

4. Water Balance System

4.1 GENERAL

A water balance investigation is critical in achieving a high level of confidence in the calculated demands. The water usage has been designed to operate as a semi-closed loop water system; therefore the majority of dirty water on site will be captured and re-used. The stormwater from the clean areas will be released into the environment.

The water balance system was designed to cater for the following:

- Wastewater – Generated sewage will be treated in a WWTW. The treated effluent will then pumped to the dirty water dam from where it will be used as bulk water supply; and
- Stormwater – The dirty areas stormwater will be collected and conveyed to the dirty water dam. The stormwater from the clean areas will be released into the environment. Clean and dirty stormwater run-off areas will therefore be separated.

The water balance encourages the recycling of water, minimises water losses, and re-uses water from various sources in order to attain a semi-closed water balance system.

The contribution elements of the water balance system are:

- Municipal water supply;
- Boreholes drilled on site for water supply (backup supply to be confirmed by the Client);
- Potable and fire water storage reservoirs;
- WWTW;
- Dirty stormwater dam and bulk storage dam (pollution control dam) (stormwater from the Mine Infrastructure Areas (dirty areas only)); and
- Mine pit dewatering

4.2 WATER REQUIREMENTS

The estimated make-up water requirements were calculated at approximately 1,500m^3/day (1.5Mℓ/day), which corresponds to 0.55 million m^3/annum. The dust suppression represents the principal water consumption.

The water use figures for the main facilities which form part of this projected demands are summarised in **Table 4-1** for years 4 to 20 (largest water requirement).

Table 4-1 Water Requirements

Component	Water Use Facilities	Criteria	Bulk Water (m^3/day)	Potable Water (m^3/day)
Mining	Primary Crushing and Screening	* Dust suppression only (included in Waste Stockpile)	*	
	Dust Suppression - Roads	2ℓ/m^2/day	750	
	Dust Suppression - Waste Stockpile	2ℓ/m^2/day	276	
Total (Mining)			***1 026***	***0***
Mine Support Infrastructure	Wash Bays		10	
	Workshops			20
	Fuel Depot			2
	Service Bay			2
Total (Mine Support Infrastructure)			***10***	***24***
Mine Management Area	Offices	200 office staff at 50ℓ/p/d		10
	Change Houses	3500 workers at 80ℓ/p/d		280
	Laundry			10
	Canteen			5
	Lab			1
	Induction Centre			1
	Clinic			1
Total (Mine Management Area)			***0***	***308***
Losses	Water storage evaporation		30	
	Water Treatment (Allowance only)			33
	Reticulation potable			17
	Distribution Bulk Water		21	
Total (Losses)			***51***	***50***
Water Generated within project area	Dewatering of groundwater ingress	Unknown (0m^3/day is the worst case scenario)	0	0
	Stormwater runoff	Unknown (0m^3/day is the worst case scenario)	0	0
Total (Water Generated within project area)			***0***	***0***
TOTAL (m^3/day)			**1 087**	**382**
COMBINED TOTAL (m^3/day) (*rounded up*)			**1 500**	

4.3 METHODOLOGY

As discussed previously, the water usage for the mine has been designed to operate as a semi-closed loop water system and therefore the majority of water (dirty water) on site will be captured and re-used. The water balance operation for the mine has therefore been developed in such a way to encourages the recycling of water, minimises water losses, and reuses water from various sources.

The water balance has two main subsystems, i.e. water supply and water usage as described below. The schematic layout of the water balance is presented in **Figure 4.1**.

4.3.1 Bulk Water Supply

Bulk water supply will be obtained from the following main sources, i.e.:

- Municipal supply. The initial bulk water required will be obtained from the municipal supply, where after the sources below will govern.
- Bulk water is extracted from boreholes drilled on the site and pumped to a bulk water storage dam (backup supply to be confirmed by the Client).
- The bulk water storage dam (pollution control dam) is sized for two days' storage capacity (3,000m^3).
- The bulk water will be supplemented by ground water (and stormwater) pumped from the opencast pit (mine dewatering) into the dirty water dam, as well as;
- Stormwater run-off from the dirty areas:
    - Dirty area stormwater. The dirty area stormwater runoff is collected and conveyed to a dirty water storage dam (with silt trap and oil-water separator). From the dirty water dam, the stormwater is conveyed to the bulk water storage dam (pollution control dam); and
- Sewer. Generated sewage is treated in a WWTW. The treated effluent is pumped to the dirty water dam. From the dirty water dam, the treated effluent is conveyed to the bulk water storage dam (pollution control dam);

4.3.2 Water Usage

Bulk water stored in the bulk water storage dam (pollution control dam) will be used for:

- Dust control at the primary screening and crushing;
- Fire water. The bulk water is pumped from the bulk water storage dam (pollution control dam) to the ground level storage tanks; and
- Water will be transported (water bowsers) from the bulk water storage dam (pollution control dam) to be used for dust suppression (roads and stockpile areas);

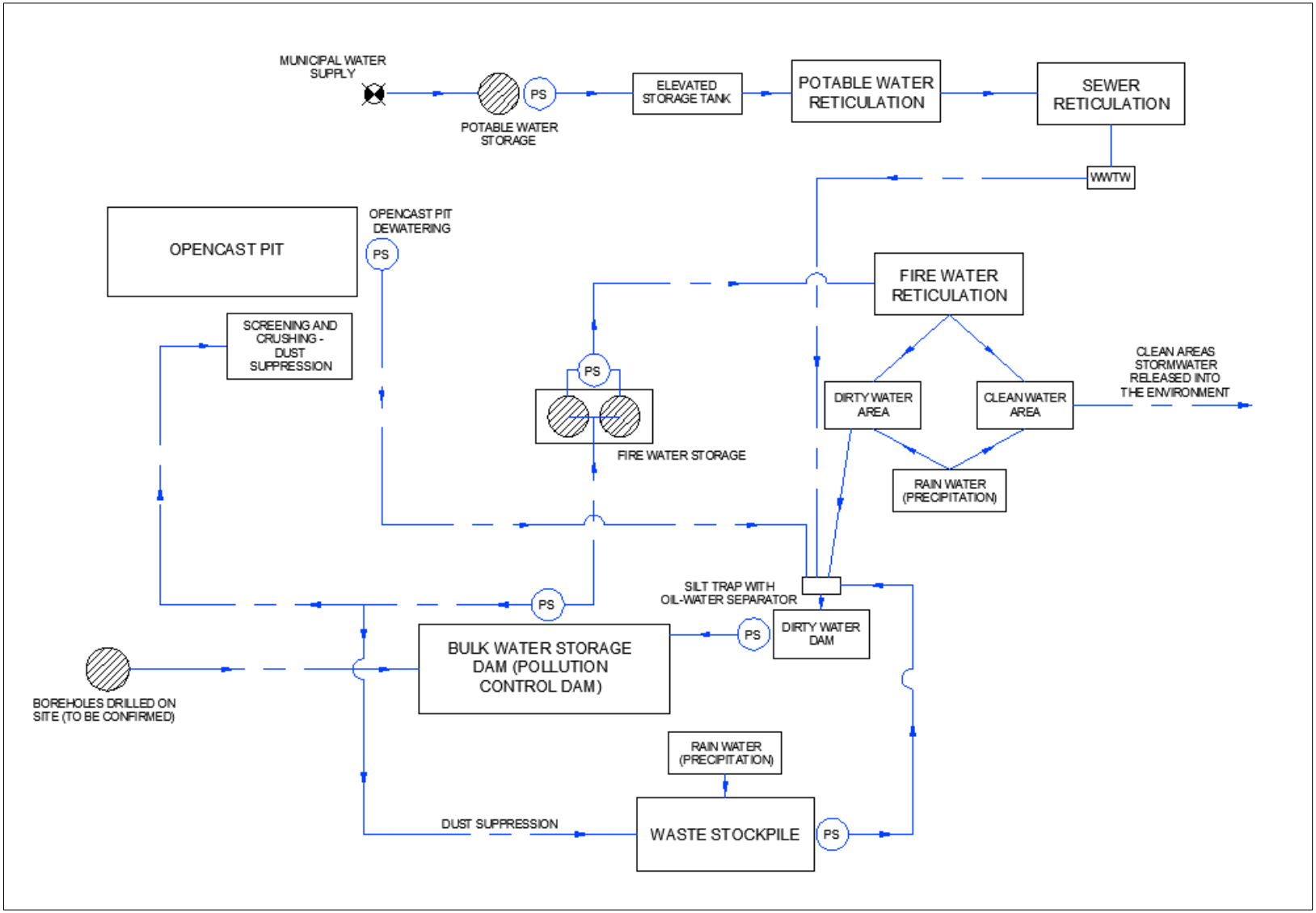

Figure 4.1 – Water Balance Diagram

5. Hydrological Assessment

5.1 WATER RETICULATION

The water reticulation system for the proposed development consists of the following sub-systems:

- Bulk Water Supply
- Process Water
- Potable Water
- Fire Water
- Mine Dewatering

5.1.1 Bulk Water Supply

5.1.1.1 Methodology

The bulk water will be obtained from the municipal water supply (initially) and boreholes drilled on site (to be confirmed) to a 3,000m^3 bulk water storage dam (pollution control dam). The dam is sized to provide 2 days bulk water demand capacity.

Treated dirty water, inclusive of the opencast pit dewatering (from the dirty water dam), will be pumped to the bulk water storage dam (pollution control dam) to supplement the water supply.

The water will then pumped from the bulk water storage dam (pollution control dam) to the fire water storage tanks (1.44Mℓ capacity) and to the mining operations (for dust control).

5.1.1.2 Requirements

The selection of the most feasible water source development option is governed by the total water requirements of the project, geophysical characteristic of the project area, climate and by the location, available yield and quality of the existing resources.

The water requirement for the proposed development was calculated at approximately 1,500m^3/day.

The main source of water supply identified for the development is municipal supply. From the water demand calculations the following demands per year will be required (Refer to **Table 4-1** and **Table 5-1**).

Table 5-1 Water Requirements in terms of flow

Year	Total Water Required	Flow (including dust suppression)	Flow (excluding dust suppression)
1-20	1,500m^3/day	17ℓ/s	6ℓ/s

The bulk water demand was therefore modelled based on a flow of 6 ℓ/s to 17ℓ/s.

5.1.1.3 Availability

Section 5.1.1.3 *and* ***5.1.1.4*** *deals with the option to make use of boreholes for water supply purposes. The use of boreholes must however still be confirmed as municipal water supply was earmarked as the main source of water supply*.

From the geohydrological report (*Shangoni AquiScience, Nov 2013*) it can be seen that three types of aquifers are present on the site, i.e.:

- Unconfined aquifer;
- Fractured semi-confined Karoo aquifer
- Dolomitic confined aquifer

The different types of aquifers and expected groundwater yields are described in the geohydrological report as follows:

- Unconfined aquifer – "*A shallow unconfined aquifer occurs within the soil horizon above the weathered bedrock zone. This unconfined or semi-confined aquifer is formed as a result of vertical seepage of water through the soil profile where it reaches the relatively impermeable clayey layer occurring at approximately 5mbgl. The water will then seep horizontally in a down-gradient direction at this contact zone. This layer is sometimes referred to as a perched aquifer. Usually this layer is poorly developed and is generally not considered as an aquifer given its inability to sustain reasonable, or useful, quantities of groundwater.*"

  The expected groundwater yields for the unconfined aquifer is **<0.05ℓ/s**.

- Fractured semi-confined Karoo aquifer – "*The second aquifer system is an intergranular and fractured, semi-confined Karoo type aquifer of Ecca (shale/sandstone/tillite) origins occurring between 10 and 15mbgl and with a thickness of approximately 80-100m. Groundwater is confined to joints and fractures and flow in the matrix rock and usually has very low hydraulic conductivity and low yields. However, high yields do occasionally occur especially where dolerite intrusions (of Karoo age) have resulted in significant fracturing of the host rock. Of all un-weathered sediments in the fractured aquifer, the coal seam often has the highest hydraulic conductivity.*

  The aquifer can be regarded as heterogeneous having a good fracture network formed in the consolidated and mostly impervious matrix as a result of tectonic and depositional stresses. Movement of groundwater is mostly restricted to fracture and aperture flow although the sandstone/shale matrix may also contribute to the aquifer albeit very little. The transmissivity for the Karoo fractured aquifer is relatively low with a value of 3.9 m^2/d and a yield of approximately ***0.5 – 1.0ℓ/s****.*"

- Dolomitic confined aquifer – "*Although no dolomite was intersected during the exploration phase, dolomite is expected to be present at approximately 80 – 100mbgl. This assumption is made based upon the fact that boreholes drilled in similar and nearby environments did intersect dolomite at approximately 80 – 100mbgl.*

*Single well drawdown tests were conducted on two farm boreholes located just adjacent to the northern perimeter of Droogenfontein portion 26 and the proposed open pit. The water supply of these 2 boreholes is sourced from the Karoo fractured and Malmani dolomite aquifers with yields of approximately **0.5ℓ/s** and **18ℓ/s**, respectively.*

*Boreholes drilled deep enough (>100m) may also intersect the Malmani dolomites which on average yield **>5lℓ/s** and up to **40ℓ/s**."*

From these extracts it can be seen that the required yield (24l/s to 36l/s) can be obtained from the dolomitic confined aquifer at a depth of approximately 100m mbgl.

It must be noted that the initial water make-up requirement will be approximately 19ℓ/s (including for dust suppression), but will increase to approximately 36lℓ/s (including for dust suppression) for year 4 to 20.

As operations at the mine commence, the bulk water storage dam (pollution control dam) will be filled and supplement the water requirements of the mine.

5.1.1.4 Quality

From the hydrocensus (*Shangoni AquiScience, Nov 2013*) it can be seen that the majority of the water quality parameters measured are well within the SANS 241 guidelines and can be classified as Ideal (class 0) with neutral, non-saline and soft to very hard water.

However, high levels of inorganic N, NH4, NO3 and Fe was encountered in some of the boreholes.

The water from the boreholes, if used, will only be used for dust suppression and fire water requirements and not for human consumption. The water will therefore not be treated.

5.1.1.5 Distribution

A schematic layout of the bulk water distribution is shown in **Figure 5.1**.

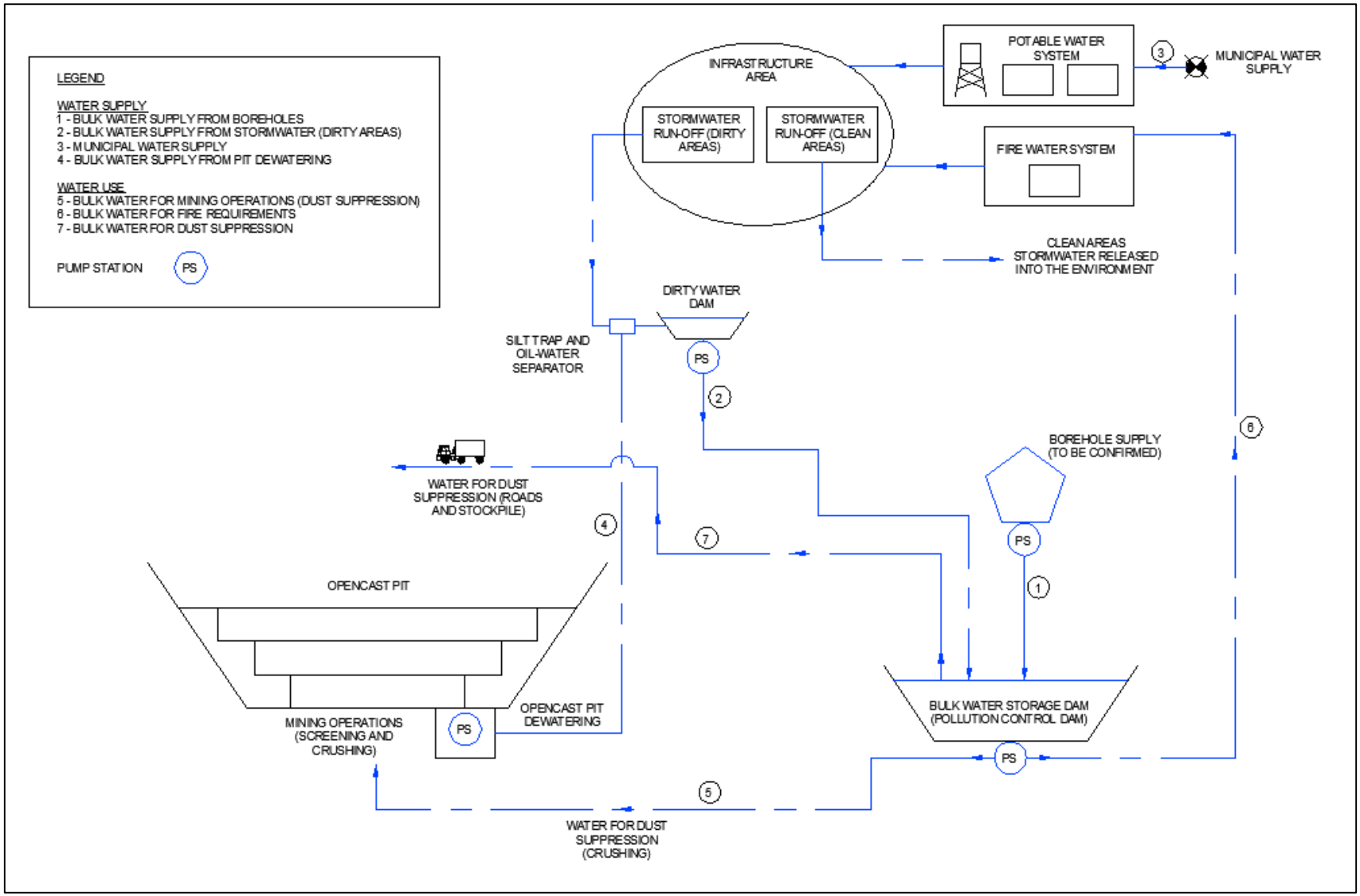

Figure 5.1 – Bulk Water Distribution System

5.1.2 Process Water (Mining processes)

5.1.2.1 Methodology

The mining process will only entail primary screening and crushing and all product washing (beneficiation) will be done off-site. The only process water requirement is therefore for dust control.

The water for dust suppression will be collected from the bulk water storage dam (pollution control dam) via water bowsers which will be used to spray the required areas. Pipework might be incorporated as well for dust suppression during the crushing process.

5.1.2.2 Design Philosophy

The proposed functionality of the water reticulation system, based on the water balance philosophy is listed below (Refer to **Figure 5.1**):

- The bulk water will be obtained from the municipal water supply (initially) and boreholes drilled on site (to be confirmed) to a 3,000m^3 bulk water storage dam (pollution control dam); and
- The water is conveyed from the bulk water storage dam (pollution control dam) to the screening and crushing areas, roads and stockpile areas for dust control and suppression purposes.

5.1.2.3 Design Criteria

The same design criteria as adopted for the potable water reticulation is applicable for the process water reticulation - refer to **Section 5.1.3.3**.

5.1.2.4 Demand Calculation

The water demand, in terms of mining operations, is listed in **Table 4-1**.

. The main contributing elements are:

- Dust suppression for internal and haul roads. The volume was estimated at 2ℓ/m2/day, i.e. **750m^3/day**; and
- Dust suppression for the screening and crushing area and waste stockpile. The volume was estimated at 2ℓ/m2/day, i.e. **276m^3/day**;
- The total water demand for mining operations is therefore estimated at **1,026m^3/day**.

5.1.2.5 Water Storage

Allowance was made for 2 days of total water storage (bulk and potable water), i.e. 2 * 1,500m^3/day = **3,000m^3/day**.

5.1.3 Potable Water

5.1.3.1 Methodology

The following options are available regarding potable water supply, i.e.:

- Municipal supply;
- Potable water may be transported to the site from outside sources (trucked); and
- Potable water is supplied via boreholes on site

It is assumed that, for the purpose of this study, potable water will be obtained from the municipal supply (Refer to **Section 5.1.1**).

The conceptual design of the water reticulation network was undertaken according to the general design parameter for water reticulation and supply, as defined in the *Guidelines for Human Settlement Planning and Design* (Red Book), compiled under the patronage of the Department of Housing by CSIR Building and Construction Technology, as well as the requirements of the City of Local Municipalities (SADEC Region).

The following methodology was adopted in the design of the water reticulation system:

- The demands for the system were calculated;
- The sizing of the required water tanks for potable and fire water was conducted;
- The design criteria and assumptions were set out;

The demands have been calculated considering the Mine Plan,, areas obtained on the layout drawing and the design criteria obtained from the Red Book.

5.1.3.2 Design Philosophy

The proposed functionality of the water reticulation system, based on the water balance philosophy is listed below (Refer to **Figure 5.2**):

- The municipal potable water supply is discharged in a ground level storage tank from where it is pumped into a 100kℓ elevated storage tank (galvanised). The height of the elevated tank is dependent on the minimum pressure allowed in the network. The tank will be approximately 30m high;
- The water is then distributed (gravity) via the potable water reticulation network;

5.1.3.3 Design Criteria

The typical technical design criteria and assumptions used in the design of the potable and fire water reticulation systems are summarised in **Table 5-2**.

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Table 5-2 Potable (and fire water reticulation) system design criteria and assumptions

Design Element	Criteria
Average Annual Daily Demand (AADD)	310kℓ/day
Gross Average Annual Daily Demand (GAADD)	Allow 10% losses
Summer peak factor (SPF)	1,5
Daily Peak Factor	3,0
Design Peak Flow Rate (DPFR) for domestic flows	GAADD x SPF x DPF
Maximum static head	90m
Minimum residual head under conditions of domestic peak flows	24m
Maximum linear flow velocity under conditions	1,5m/s
Pipe type	uPVC pressure pipes
Minimum pipe class	Class 12
Fire flow at any one hydrant under the condition of peak flows	1,500ℓ/min
Potable water storage capacity	48 hours
Fire water storage capacity	24 hours
Fire risk category	Medium risk (600l/s)

- Standards

  The following standards were used to design the water reticulation system:

  - SANS 1200-1986: Standardized specification for Civil Engineering Construction;
  - SANS 10400-1990: Code of Practice for the application of the National Building Regulations; and
  - SANS 10252-1:2004: Water supply and drainage for buildings – Part 1: Water supply installations for buildings.

- Design Analysis
  - The design of the water reticulation (potable and fire) will be done using Civil Designer and Epanet software (during the design stage of the project);

- Design Parameters
  - Pressures

    The following minimum pressures are required for the water reticulation networks:

    – Potable water: 24m pressure

    – Fire water: 15m pressure

    The maximum allowable static pressure (for both systems) is 90m.

- Design criteria (External)
    - All pipes installed will be able to resist an operating pressure of at least 1,200kPa. Therefore a minimum pipe class of PN 12 will be used. No FC- or glass reinforced pipes will be used;
    - External pipes will have a cover of at least 1.0m when crossing streets and 0.8m minimum when no services are present;
    - The external pipes will be installed on a flexible bedding according to SANS 1200 LB;
    - AVK, Oz-Kan or similar approved gate valves will be used. The gate valves will be of resilient seal type;
    - No air valves will be required on the potable water reticulation network;
    - Scour valves will be placed at all low-lying points on feeder or discharge pipelines. Fire hydrants will be used as scour valves;
    - All required valve boxes will be constructed as per the "Human Settlement Planning and Design (Red Book)" drawings. Placement of valves in the roadway should be avoided where possible. All valves and bends should be adequately anchored as per the Engineer's design; and
    - The pipe network will be tested according to SANS 1200L Clause 7.3. Testing shall only commence after the thrust blocks have attained their specified strength (28 days).
- Design Criteria (Internal – ***for information only, not part of the hydrological study***)
    - All domestic water piping will be copper, class "0" pipes to SANS 460 with capillary soldered joints and fittings;
    - 15mm diameter air release valves will be installed on all high points.
    - Static water pressure will be limited to 600kPa for the water reticulation;
    - The velocity of the water in the piping is to be limited to 1.5 - 2m/s, to reduce noise levels in the pipes;
    - Piping will be bracketed by means of steel brackets with rubber inserts. The brackets will be installed to either the soffits of the concrete slabs or onto the internal walls; and
    - Installation of the piping will be strictly in accordance with SANS 10400, SANS 10252 – Part 1 and SANS 1200.

5.1.3.4 Demand Calculation

The design demand for the mine was calculated based on the individual demand for office staff members and mine workers as well as demands per buildings for similar sized mining operations.

The demand calculation criteria used in the calculation of the demands were:

- 200 office staff at 0.05m^3/person/day (50ℓ/person/day);
- 3,500 mine workers at 0.08m^3/person/day (80ℓ/person/day);
- Laundry – 10m^3/day;
- Canteen – 5m^3/day;
- Laboratory – 1m^3/day
- Induction Center – 1m^3/day; and
- Clinic – 1m^3/day.

The demand was therefore calculated, taking into account the individual demands listed above and is presented in **Table 4-1**.

5.1.3.5 Water Storage

Based on this information (**Section 5.1.3.4**), the total potable water demand for the mine is approximately 310m^3/day (310kℓ/day). Taking into account a two day storage capacity, a 0.62Mℓ (620m3) storage capacity is required (prestressed panel type construction ground level storage tank).

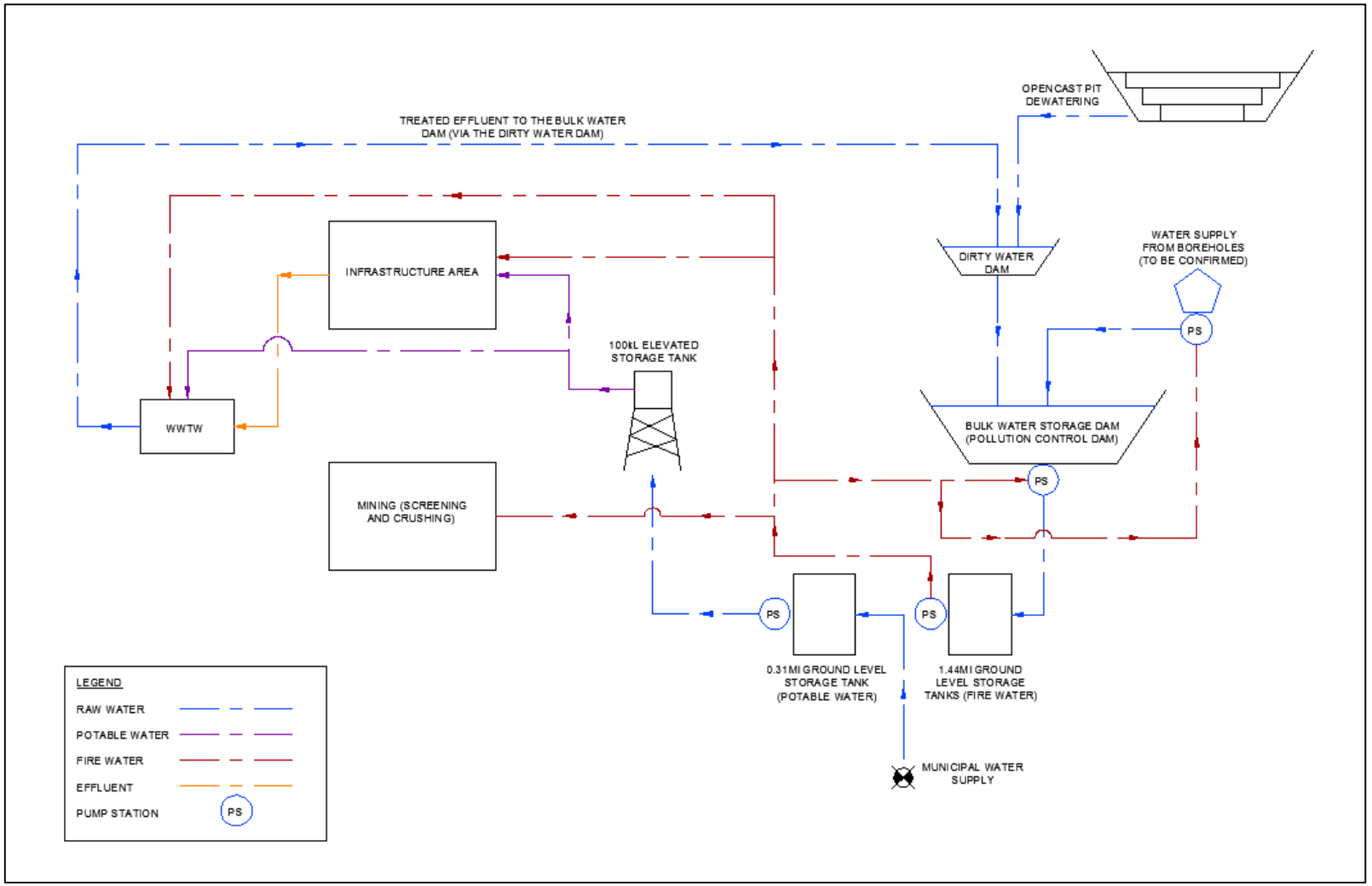

Figure 5.2 – Potable and Fire Water System

5.1.4 Fire Water

5.1.4.1 Methodology

Fire water will be pumped from the bulk water storage dam (pollution control dam) into fire water storage tanks. The fire water will be pumped from the tanks as described below.

5.1.4.2 Design Philosophy

The proposed functionality of the fire water reticulation system, based on the water balance philosophy is listed below (Refer to **Figure 5.2**):

- The bulk water will be obtained from the municipal water supply (initially) and boreholes drilled on site (to be confirmed) to a 3,000m^3 bulk water storage dam (pollution control dam);
- The water will then be pumped from the bulk water storage dam (pollution control dam) to the fire water storage tanks (1.44Mℓ capacity) (Refer to **Section 5.1.4.5**).
- Fire Reticulation:
    - The fire water is pumped directly from the storage tanks into the fire reticulation network;
    - The pump station is fitted with 2 fire pumps (duty and standby) as well as a jockey pump;
    - The jockey pump is set to keep the pressure in the fire reticulation network to a prescribed minimum pressure, therefore accounting for losses, leaks, etc.;
    - As soon as a hydrant is opened, the pressure in the system will drop (below a prescribed pressure) and the fire pump will start;

5.1.4.3 Design Criteria

The same design criteria as adopted for the potable water reticulation is applicable for the fire water reticulation. Refer to **Section 5.1.3.3**.

5.1.4.4 Demand Calculation

The mine is classified as a 'moderate' fire risk category. Therefore, a design flow of 6,000ℓ/min was used, with a minimum hydrant flow rate of 1,500ℓ/min. Taking into account the design fire flow duration of 4 hours (for 'moderate' fire risk category), a fire storage volume of **1.44Mℓ** is required.

5.1.4.5 Water Storage

As indicated in **Section 5.1.4.4**, the following water volumes need to be stored:

- Fire Water: 1.44Mℓ

Therefore a 1.44Mℓ ground level storage tank (prestressed panel type construction) must be provided.

5.1.5 Mine Pit Dewatering

The opencast pit needs to be dewatered during the operational phase of the mine to allow access to the coal seams. It is presumed that dewatering sumps (with pumps) will be constructed at the mine floor elevation from where the water, i.e. groundwater as well as stormwater, will be pumped.

This water will be pumped to the dirty water dam via dewatering reticulation pipelines for re-use (Refer to **Figure 5.1**)

5.2 STORMWATER RETICULATION

5.2.1.1 General

Stormwater reticulation is required to intercept stormwater run-off from all areas of the mine and has to be managed in a strategic manner in order to eliminate the possibilities of flooding, during storm events.

The separation and control of different stormwater run-off types, classified as dirty stormwater and clean stormwater, should be managed and maintained in the stormwater drainage system.

The site (Portion 26) has a gentle slope ranging between 1580m.a.s.l and 1600m.a.s.l.

5.2.1.2 Design Philosophy

The methodology which has been followed in the design of the stormwater drainage and management system is as follows (work to be carried out during the design stages of the project):

- Classification of “dirty” and “clean” stormwater catchment areas;
- Calculation of stormwater run-off from dirty and clean stormwater catchment areas;
- Stormwater flow paths and destination points (stormwater control dams);
- Terrace platform sloping in order to direct stormwater run-off to the appropriate location;
- Sizing of stormwater channels; and
- Sizing of stormwater control dams;

5.2.1.3 Design Criteria

The typical technical design criteria and assumptions used in the design of the stormwater reticulation system are summarized in **Table 5-3**.

Table 5-3 Stormwater reticulation system design criteria and assumptions

Design Element	Criteria
MAP	691mm/annum (Refer to **Table 5-4**)
Stormwater channel type	Concrete Trapezoidal channels
Dirty Stormwater Areas	Rom Pad and Mine Red Zones
Clean Stormwater Areas	Mine Green zones
Stormwater control dam depth	Varies
Stormwater control dam shape	Rectangular
Stormwater design period (Clean)	1:5 year
Stormwater design period (Dirty)	1:50 years
Stormwater channel bottom slopes	Minimum = 0.67%
Run-off calculation method	Rational and SCS method (Detail design)
Stormwater channels side slopes	Typically 1:1, maximum 1:2.5

- Minimum pipe size: 450mm diameter;
- Minimum pipe gradient: 0.67%;
- Design Method – Rational Method;
- The site will be drained by means of a surface stormwater system (i.e. above-grade) on paved parking areas and slopes ditches towards a combination of kerb inlets and grid inlets located along kerb lines; and
- The kerb inlets allocated along the kerb lines are also designed to accept and drain all roof water generated from the building structures. The stormwater drained from the roof structure of the buildings will be discharged onto the surfaced areas though down pipes and full bore systems.

5.2.1.4 Design outcomes

Two main stormwater catchment areas have been identified, namely, clean stormwater area and dirty stormwater area.

The clean stormwater area is the area where the mine buildings, warehouses, change houses etc. are located.

Dirty stormwater area is the area where the hardstand, wash-bays, refuelling etc. are located.

5.2.1.5 Mean Annual Precipitation

The MAP for the proposed site is approximately 691mm per annum (Refer to **Table 5-4**).

Table 5-4 Mean Annual Precipitation (mm)

Month	Precipitation (mm)
January	128 4
February	143.5
March	102
April	39.6
May	5
June	3
July	1
August	3
September	5
October	78.9
November	18
December	151
Mean	**45.8**

5.2.1.6 Stormwater cut-off channels and berms

It is recommended that a stormwater cut-off berm with channel be constructed upstream of the opencast pit and infrastructure area to divert stormwater from higher lying areas around the mine.

The stormwater cut-off berm with channel will be used based on the MAP and corresponding run-off.

5.2.1.7 Stormwater and bulk water storage dam (pollution control dam)

A dirty stormwater and bulk water storage dam (pollution control dam) are required to store the stormwater run-off from all dirty areas. Stormwater run-off needs to be managed in a strategic manner in order to eliminate the possibilities of severe flooding. Stormwater from the clean areas will be released into the environment.

The separation and control of different stormwater run-off types, classified as “dirty stormwater” and “clean stormwater”, should be managed and maintained in the stormwater drainage system.

The methodology which has been followed in the design of the stormwater control dam is as follows:

- Classification of “dirty” stormwater control dam (dirty water dam);
- Calculation of stormwater run-off from “dirty” and “clean” stormwater channels;
- Destination points from the stormwater channels (dirty water dam);
- Stormwater flow paths from the stormwater control dam (dirty water dam) to the bulk water storage dam (pollution control dam);
- Sizing of stormwater control dam (dirty water dam); and
- Sizing of bulk water storage dam (pollution control dam).

The following design criteria and assumptions that have been used in the design of the stormwater (dirty water dam) and bulk water storage dam (pollution control dam) are shown in **Table 5-5**.

Table 5-5 Dirty stormwater and bulk water storage dam (pollution control dam) design criteria and assumptions

Design Element	Criteria
Stormwater (Dirty) control dam type	HDPE lining
Bulk water control dam (pollution control dam) type	HDPE lining
Number of clean stormwater control dams	0
Number of dirty stormwater control dams	1
Number of bulk water control dams (pollution control dam)	1
Stormwater design period (Clean)	1:5 year
Stormwater design period (Dirty)	1:50 year
Stormwater control dam capacity	24 Hours
Bulk water control dam capacity	48 Hours
Dirty stormwater control dam shape	Rectangular
Bulk water control dam shape	Rectangular
Dirty stormwater control dam depth	To be determined during the design phase
Bulk water control dam depth	To be determined during the design phase
Dirty stormwater control dam side slopes	1:2.5
Bulk water control dam side slopes	1:2.5

Two main stormwater control dams have been identified, i.e. a dirty stormwater dam and a bulk water dam (pollution control dam). The water from the dirty stormwater dam is pumped to the bulk water control dam (pollution control dam) as described in the water balance operation.

The dirty stormwater control dam will be sized for a 1:50 year flood (48 hours).

5.3 SEWERAGE RETICULATION

5.3.1.1 General

The design of the sewer drainage system and the calculations of demands have been done according to the "Guidelines for Human Settlement Planning and Design (Red Book)" compiled under the patronage of the Department of Housing by CSIR Building and Construction Technology. The Local Municipality (SADEC Region) "Guidelines for the design and construction of water and sanitation systems" book has been utilized as a guideline to compare the results attained from the sewer drainage system design.

The following methodology has been followed in the design of the sewer drainage system;

- The demands for the system were calculated;
- The design criteria and assumptions were set out; and

The internal sewer drainage network will be designed as a gravity system as far as possible. Low lying area that will be impossible to gravity drain will be fitted with sewer pump stations. These pump stations will typically be constructed from 1.8m diameter manhole rings and fitted with submersible sewage pumps (duty and standby)

Special measures must be adopted at the re-fuelling, filling stations and workshops to avoid fat, oil, grease, fuel etc. contamination of sewage discharged to the WWTW.

5.3.1.2 Design Philosophy

The design philosophy of the sewer drainage system is as follows:

- Sewage collected from the infrastructure areas will be gravity fed, via the internal sewage reticulation network, to the WWTW;
- The sewage is treated "General Limits", as per the 'General Authorisation in terms of Section 39 of the National Water Act (Act No. 36 of 1998)';
- The treated effluent is then pumped to the dirty stormwater dam; and
- The water from the dirty water dam (stormwater and treated effluent) is then pumped back into the bulk water dam (pollution control dam).

5.3.1.3 Design Criteria

The typical technical design criteria and assumptions used in the design of the sewer drainage system are summarized in **Table 5-6**.

Table 5-6 Sewer drainage system design criteria and assumptions

Design Element	Criteria
Average Annual Daily flow	310kℓ/day
Peak Factor	2,5
Capacity of Sewer	50% full flow, excluding stormwater infiltration (for sewers < 300 mm diameter)
Sewer pipe type	Structure wall uPVC pipes SABS 1601, class 400 up to 250 mm diameter
Minimum velocity	0,6m/s
Minimum pipe diameter	110mm
Minimum depth of cover	1,0m in street reserve
Minimum pipe gradients	100mm diameter = 1:120; 160mm diameter = 1:200; 200mm diameter = 1:300; and 250mm diameter = 1:400.

- Standards

  The following standards were used to design the water reticulation system:

  - "SANS 1200-1986: Standardized specification for Civil Engineering Construction";
  - "SANS 10400-1990: Code of Practice for the application of the National Building Regulations"; and
  - "SANS 10252-2:2004: Water supply and drainage for buildings – Part 2: Drainage installations for buildings".

- Design Parameters

  - The ablution facilities contain water closets, urinals and wash hand basins. The sewage (brown and grey) water will be collected from the ablution facilities and will gravitate to the connection manholes via the internal and external sewer network at the building. The sewage will gravitate via the existing network to the WWTW.

- Design Criteria (External)

  - The external sewer network will be designed according to the "Human Settlement Planning and Design (Red Book)" and "SANS 10252-2:2004: Water supply and drainage for buildings – Part 2: Drainage installations for buildings";

- PVC (400kPA heavy duty) sewer pipes will be used according to SANS 1601 for the outer reticulation;
- Minimum depth to invert of pipes should be minimum 1.2m in mid-blocks and 1.5m in road reserves (or runway / apron areas);
- The pipes will be installed on a flexible bedding according to SANS 1200 LB;
- The minimum allowable flow in the pipelines is 0.6m/s at full flow. A minimum grade of 1:100 is specified for the 110mm diameter pipes. All pipes with a diameter less than 110mm (internal reticulation) will be installed with a minimum slope of 1:60;
- Manholes shall be spaced at a maximum distance of 80m to 100m apart. The distance will decrease on steep grades to ensure that the head on any part of the sewer does not exceed 6m under blockage conditions. Where a sewer line crosses a road, at least one manhole must be positioned in the road reserve. Manholes should be constructed strictly in accordance with the standard drawings; and
- Installation of the sewer reticulation will be according to SANS 10400 and 10252.

- Design Criteria (Internal – **for information only, not part of the hydrological study**)
  - The internal sewer network was designed according to "SANS 10252-2:2004: Water supply and drainage for buildings – Part 2: Drainage installations for buildings";
  - The pipes, fittings, sanitary fixtures and materials were selected to operate effectively under all normal conditions likely to be encountered in the specific installation for the anticipated life of the installations;
  - The u-PVC drain and sewer pipes shall comply with the relevant requirements of SANS 791;
  - The sanitary fixtures shall be made of impermeable, non-corrosive material, have a smooth and readily cleanable surface and be so constructed and fitted as to discharge through a trap into a soil pipe;
  - The water closets used shall comply with the requirements of SANS 497. Each of the water closets shall be served by its own separate flushing device;
  - The urinals will be fitted with flushing devices. The joints between parts of any urinal shall be urine resistant and watertight; and
  - The internal system was designed as a one-pipe system, i.e. the brown and grey water will drain into a single stub stack.

- Design Outcomes
    - The external network will consist of 450kPa sewer pipes connected via 1m diameter concrete manholes. The concrete manholes will be fitted with Type 2A cover and frames;
    - The external network will be fitted with cleaning and inspection eyes at 15m c/c. The external network will be cleaned (if required), via the manholes and cleaning eyes;
    - The internal sewer reticulation will be designed according to SANS 10400 and SANS 10252. The piping will be installed according to SABS 967. 110mm diameter soil pipes will be installed for all the water closets, whereas 50mm diameter soil pipes will be installed for the urinals and wash-hand basins. The pipes will be installed at a slope of 1:60 and 1:80. Each ablution facility is fitted with a services area where the services will drain to. This area will be equipped with a 100mm diameter stab stack which will drop down to under the ground floor level from where the 110mm diameter pipe will fall at a slope of 1:80 (minimum) to connect to the external reticulation network. Each connection will be fitted with a cleaning and inspection eye for maintenance purposes;
    - Piping with a diameter less than or equal to 50mm will be joined by means of solvent weld joints and fittings. All the piping larger than 50mm will be joined by means of rubber ring seal joints and fittings;
    - No sewer pipelines to be smaller than 75mm diameter; and
    - All the bend and fittings (above ground) will be fitted with access cleaning eyes for maintenance purposes.

5.3.1.4 WWTW

The sewage flow generated by the mine is estimated at approximately **310kℓ/day**.

A package plant type, wastewater treatment works is recommended for the treatment of effluent from the mine.

The proposed system will normally comprise of three SBR's (sequential batch reactors). The reactors will be manufactured from 3CR12 stainless steel and located in standard refurbished 12 H-cube shipping containers. A total of 8 to 10 standard shipping containers will be required.

Effluent treatment will typically be achieved in five stages, i.e.:

- Fill;
- React;
- Settle;
- Decant; and

- Idle.

The plant will therefore have an aeration phase, an anoxic phase (zero oxygen), a settlement phase and a chlorine contact phase.

The package plant will include the following elements:

- The package plant will be fitted with a manual screen;
- 6 SBR Reactors, fitted with an aeration system, which comprises a bubble aerator system complete (will be housed in 6 standard containers);
- Auxiliary process equipment, like pumps, blowers, pipes, intermediate storage and valves, including the electrical supply and the chlorine contact system (housed in 2 standard containers); and
- Sludge drying beds.

The sewage will be treated to achieve the minimum "General Limits", as per the 'General Authorisation in terms of Section 39 of the National Water Act (Act No. 36 of 1998)';

5.4 SOLID WASTE MANAGEMENT

5.4.1.1 General

The solid waste management practices as per the recommendations below have been developed with the aim of providing an appropriate level of conformance to the mining activities and operational costs.

It is assumed that there will be no permanent general waste disposal facilities on site. General waste shall be stored in a waste container and disposed at a licensed disposal area.

Waste is commonly defined as any substance that is surplus, unwanted, rejected, discarded, abandoned, or disposed of. Waste is a substance for which the user has no further use.

It is generally accepted that the most environmentally responsible and sustainable method of managing waste is accomplished by following the waste management hierarchy. The waste management hierarchy is ranked according to levels, the first being the most preferable method (option 1) and the last (option 6) being the least preferred method of waste management, i.e.:

- Option 1: Reduce;
- Option 2: Reuse;
- Option 3: Recycle;
- Option 4: Recover;
- Option 5: Treat; and
- Option 6: Dispose.

The following sections describe the recommendations that have been developed to ensure sustainable solid waste management practices are implemented:

- At-Source Separation;
- On-Site Waste Sorting;
- Disposal and Recycling; and
- Waste Management Monitoring.

5.4.1.2 At source separation

Minimisation of waste generation should be encouraged amongst all mine employees and contractors. Separation of waste at the source of generation should be enforced. Centralised bins should be made available at areas where the majority of waste is generated, for example at a centralised location within the office areas. These bins should be used only to store recyclables (paper, plastic, glass and metal).

General waste should be kept separated from recyclable waste to avoid contamination. The separation of waste at the source of generation will also create awareness and will ensure that the sorting of waste can take place as effectively as possible.

5.4.1.3 On site waste sorting

Waste must be collected from points of generation on a regular basis and taken to an on-site waste sorting facility. It is recommended that the waste management employees (either employees of the mine or an appointed waste management company) manually sort the incoming waste into the following waste streams:

- General waste;
- Cardboard;
- Paper;
- Newspapers;
- Magazines;
- HDPE (plastic);
- LDPE (plastic);
- PET (plastic);
- Glass;
- Ferrous metals;
- Non-ferrous metals;
- Printer cartridges;
- Light bulbs;

- Batteries; and
- Etc.

The types of equipment that will be required to effectively sort the waste includes sorting tables, bins or skips (6m^3), cleaning equipment, etc.

5.4.1.4 Disposal and recycling

It is recommended that a licensed waste management company be appointed to collect the general waste from the on-site waste sorting facility. The waste should be collected and disposed at a registered and licensed landfill site. This service should be provided on a regular, scheduled basis.

It is recommended that it is agreed upon between the mine and the appointed waste management company that waybills are provided to the mine on a monthly basis as proof of appropriate disposal.

It may be required that a number of waste recycling companies are appointed to collect and recycle the sorted recyclables. This service should also be provided on a regular, scheduled basis. It is recommended that the mine obtains proof from the appointed companies of recycling.

It should be noted that some waste recycling companies offer rebates for various recyclables and therefore the mine may generate some income due to effective recycling.

5.4.1.5 Waste management monitoring

There are a number of records that should be kept to ensure that the solid waste operations are carried out in an environmentally sound manner. These records should be collected and captured in monthly reports and should include the following:

- Total waste generated;
- Total waste being disposed of;
- Total waste being recycled;
- Waybills as proof of disposal;
- Certificates of safe disposal (hazardous waste); etc.

6. Cost Estimate

The cost estimate in terms of this hydrological assessment was compiled based on a similar type (and size) of development. The estimate is therefore based on the high level conceptual design and will be defined in greater detail during the feasibility and design stages.

The bill of quantities for this cost estimate is included in **Appendix B** and is summarised in **Table 6-1**.

Table 6-1 Cost Estimate Summary

Description	Amount
SECTION 1. Groundwater Supply: Boreholes	R 0.00*
SECTION 2. Groundwater Supply: Boreholes Characterisation	R 0.00*
SECTION 3. Bulk (Raw) Water Distribution	R 11 822 138.00
SECTION 4. Pollution Control Dam	R 2 745 575.00
SECTION 5. Potable Water Supply	R 3 197 905.00
SECTION 6. Potable Water Tanks	R 1 634 102.00
SECTION 7. Sewer	R 10 291 855.00
SECTION 8. Stormwater	R 1 750 000.00
SECTION 9. Fire Water	R 7 312 520.70
SECTION 10. Dirty Water Dam	R 543 320.00
TOTAL EXCLUDING VAT:	**R 39 297 415.70**
VAT @ 14%:	**R 5 501 638.20**
TOTAL INCLUDING VAT:	**R 44 799 053.90**

** The cost for the boreholes was removed from the summary above, but is kept in the cost estimate for reference. This cost amounted to **R 7 627 300.00** for the installation of the boreholes and **R 1 074 620.00** for the borehole characterisation.*

7. Drawings

The conceptual drawings relating to this hydrological assessment is included in **Appendix C**.

The drawings include:

- General layout;
- Water Balance Diagram;
- Schematic Layout – Bulk Water Distribution;
- Schematic Layout – Potable and Fire Water System;
- Typical Water Reticulation Details;
- Typical Sewer Reticulation Details; and
- Typical Stormwater Reticulation Details.

8. Conclusions

This hydrological assessment report presents the water balance system for the new proposed open cast coal mine on the Farm Droogenfontein 241, IR Portion 26.

The methodology in terms of bulk, process, potable and fire water demand and supply is described as well as the treatment and disposal of sewage, stormwater and general waste.

A cost estimate based on the water balance system was developed and included in the report.

APPENDIX A

Regulation 704 (NWA)

GOVERNMENT GAZETTE, 4 JUNE 1999

(Vol. 408, No. 20119)

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

No. 704 4 June 1999

NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) REGULATIONS ON USE OF WATER FOR MINING AND RELATED ACTIVITIES AIMED AT THE PROTECTION OF WATER RESOURCES

The Minister of Water Affairs and Forestry has, under the powers vested in him by section 26(1) (b), (g) and (i) of the National Water Act, (Act No. 36 of 1998), made the regulations contained in the Schedule in respect of use of water for mining and related activities aimed at the protection of water resources

EXPLANATORY NOTE

The Minister of Water Affairs and Forestry is responsible for the protection, use, development, conservation, management and control of the water resources of South Africa on a sustainable basis. The requirements prescribed in terms of the regulations must be seen as minimum requirements to fulfill this goal.

The Department subscribes to the principles of co-operative governance and recognises the role of the Department of Minerals and Energy to co-ordinate environmental management within the mining industry and the role of the Department of Environmental Affairs and Tourism as the lead agent on matters affecting the environment. The roles of Environmental Management Programme Reports and Environmental Management Programme Performance Assessment Reports required in terms of the Minerals Act, 1991 (Act No. 50 of 1991), and Environmental Impact Assessment Reports required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989) are recognised and supported by the Department. Any information, obligations, programmes, permissions and commitments contained in the above reports, procedures, consultation requirements and decision-making processes will be recognised by the Department. To promote coordination, copies of relevant exemptions from the requirements of the regulations will be forwarded to the Department of Minerals and Energy and the Department of Environmental Affairs and Tourism.

Implementation of the regulations will be delegated to the appropriate level as soon as the necessary capacity has been created at regional level or catchment level.

SCHEDULE

1. Definitions

In these regulations any expression to which a meaning has been assigned in the Act, shall have the meaning so assigned, and unless the context indicates otherwise-

"activity", means-

a) any mining related process on the mine including the operation of washing plants, mineral processing facilities, mineral refineries and

extraction plants, and

b) the operation and the use of mineral loading and off-loading zones, transport facilities and mineral storage yards, whether situated at the mine or not,

(i) in which any substance is stockpiled, stored, accumulated or transported for use in such process; or

(ii) out of which process any residue is derived, stored, stockpiled, accumulated, dumped, disposed of or transported;

"clean water system", includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water;

"dam", includes any settling dam, slurry dam, evaporation dam, catchment or barrier dam and any other form of impoundment used for the storage of unpolluted water or 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;

"dirty water system", includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste;

"environmental management programme", means an environmental management programme submitted in terms of section 39 of the Minerals Act, 1991 (Act No. 50 of 1991);

"facility", in relation to an activity, includes any installation and appurtenant works for the storage, stockpiling, disposal, handling or processing of any substance;

"manager", "mine" and "mineral", have the meanings assigned to them in the Mine Health and Safety Act, 1996 (Act No. 29 of 1996);

"person in control of a mine or activity", in relation to a particular mine or activity, includes the owner of such mine or activity, the lessee and any other lawful occupier of the mine, activity or any part thereof; a tributer for the working of the mine, activity or any part thereof; the holder of a mining authorisation or prospecting permit and if such authorisation or permit does not exist, the last person who worked the mine or his or her successors-in-title or the owner of such mine or activity; and if such person is not resident in or not a citizen of the Republic of South Africa, an agent or representative other than the manager of such a mine or activity must be appointed to be responsible on behalf of the person in control of such a mine or activity;

"residue", includes any debris, discard, tailings, slimes, screenings, slurry, waste rock, foundry sand, beneficiation plant waste, ash and any other waste product derived from or incidental to the operation of a mine or activity and which is stockpiled, stored or accumulated for potential re-use or recycling or which is disposed of;

"residue deposit", includes any dump, tailings dam, slimes dam, ash dump, waste rock dump, in-pit deposit and any other heap, pile or accumulation of residue;

"stockpile", includes any heap, pile, slurry pond and accumulation of any substance where such substance is stored as a product or stored for use at any mine or activity;

"the Act", means the National Water Act, 1998 (Act No. 36 of 1998);

"water system", includes any dam, any other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of water;

2. Information and notification

(1) Any person intending to operate a new mine or conduct any new activity must notify the Department of such intention not less than 14 days before the start of such operation or activity.

(2) Any person in control of an existing mine or activity must-

(a) submit a copy of all amendments of their environmental management programme to the Department;

(b) notify the Department in writing 14 days before the temporary or permanent cessation of the operation of a mine or the conducting of an activity, or the resumption of such operation or activity;

(c) notify the Department by the fastest possible means of any emergency incident or potential emergency incident involving a water resource at or incidental to the operation of a mine or the conducting of any activity, furnishing information regarding-

(i) the date and time of the incident;

(ii) a description of the incident;

(iii) the source of the pollution or potential pollution;

(iv) the impact or potential impact on the water resource and the relevant water users;

(v) remedial action taken or to be taken by the person in control of the mine or activity to remedy the effects of the incident; and

(d) within 14 days after the date of an incident contemplated in paragraph (c) inform the Department in writing of measures taken to correct and prevent a recurrence of such incident.

3. Exemption from requirements of regulations

The Minister may in writing authorise an exemption from the requirements of regulations 4, 5, 6, 7, 8, 10 or 11 on his or her own initiative or on application, subject to such conditions as the Minister may determine.

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 metres 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;

(b) except in relation to 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 metres from any watercourse or estuary, whichever is the greatest;

(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

(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.

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 any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.

6. Capacity requirements of clean and dirty water systems

Every person in control of a mine or activity must-

(a) confine any unpolluted water to a clean water system, away from any dirty area;

(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;

(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;

(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

(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 metres above full supply level, unless otherwise specified in terms of Chapter 12 of the Act.

(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.

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;

(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;

(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;

(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;

(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;

(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;

(g) at all times keep any water system free from any matter or obstruction which may affect the efficiency thereof; and

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 an authorisation under the Act.

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 so as to restrict access

thereto, and must erect warning notice boards at prominent locations so as to warn persons of the hazardous contents thereof;

(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 so as to protect any measures taken in terms of these regulations;

(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

(d) protect any existing pollution control measures or replace any existing 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.

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 so as to comply with these regulations.

(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 so as to comply with these regulations.

(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.

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-

(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 thereto;

(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 production 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 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

(b) the rehabilitation of the residue deposits is implemented concurrently with the mining operation.

12. Technical investigation and monitoring

(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.

(2) Such 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 subregulation (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 subregulation (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 subregulation (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.

(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 prior to commencement of activities relating to-

(a) the construction of any surface dam for the purpose of impounding waste, water containing waste or slurry, so as to prevent the pollution of a water resource;

(b) the implementation of any pollution control measures at any residue deposit or stockpile, so as to prevent the pollution of a water resource; and

(c) the implementation of any water control measures at any residue deposit or stockpile, so as to prevent the pollution of a water resource.

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.

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.

(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.

15. Repeal of regulations

The regulations published under Government Notice No. R.287 of 20 February 1976

are hereby repealed.

16. Commencement

These regulations will take effect on the date of publication.

APPENDIX B

COST ESTIMATE

BoQ Summary Sheet: Farm Droogenfontein 241 - Hydrological Assessment Report - Rev 00

Description	Amount
SECTION 1. GROUNDWATER SUPPLY: Boreholes	R 7 627 300.00
SECTION 2. GROUNDWATER SUPPLY: Boreholes Characterisation	R 1 074 620.00
SECTION 3. Raw Water Distribution	R 11 822 138.00
SECTION 4. Pollution Control Dam	R 2 745 575.00
SECTION 5. Potable Water Supply	R 3 197 905.00
SECTION 6. Potable Water Tanks	R 1 634 102.00
SECTION 7. Sewer	R 10 291 855.00
SECTION 8. Stormwater	R 1 750 000.00
SECTION 9. Fire Water	R 7 312 520.70
SECTION 10. Dirty Water Dam	R 543 320.00
TOTAL EXCLUDING VAT:	**R 47 999 335.70**
VAT @ 14%:	**R 6 719 907.00**
TOTAL INCLUDING VAT:	**R 54 719 242.70**

SECTION 1. GROUNDWATER SUPPLY: Boreholes

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
1.1		**GEOPHYSICS - BOREHOLE SITING**				
1.1.1		Geophysical Equipment Hire (EM34)	Day	14.00	R 1 500.00	R 21 000.00
1.1.2		Geophysical Equipment Hire (magnetometer)	Day	14.00	R 400.00	R 5 600.00
1.1.3		Geophysicist	Day	14.00	R 6 500.00	R 91 000.00
1.1.4		Geophysical Technician	Day	14.00	R 3 000.00	R 42 000.00
1.1.5		Technical Reporting	Hr	40.00	R 650.00	R 26 000.00
1.2		**DRILLING**				
1.2.1		Mobilization/Demobilization	Project	1.00	R 50 000.00	R 50 000.00
1.2.2		Inter Hole Moves	BH	29.00	R 1 000.00	R 29 000.00
1.2.3		Materials Transport	Project	1.00	R 80 000.00	R 80 000.00
1.2.4		Water Transport	BH	30.00	R 3 000.00	R 90 000.00
1.2.5		Material Supply (caps, cement, name plate)	BH	20.00	R 1 500.00	R 30 000.00
1.2.6		10" Mild Steel (12 m per BH)	m	240.00	R 780.00	R 187 200.00
1.2.7		8" uPVC Casing (Class 12)	m	2 000.00	R 575.00	R 1 150 000.00
1.2.8		Gravel Pack (Graded Silica)	Bag	1 440.00	R 95.00	R 136 800.00
1.2.9		Bentonite Seal	BH	20.00	R 1 650.00	R 33 000.00
1.2.10		Rigging up	BH	30.00	R 2 300.00	R 69 000.00
1.2.11		Drilling 10"	m	3 000.00	R 650.00	R 1 950 000.00
1.2.12		Borehole Development	Hr	40.00	R 1 000.00	R 40 000.00
1.2.13		Foam	BH	30.00	R 1 000.00	R 30 000.00
1.2.14		Centralizers	BH	250.00	R 65.00	R 16 250.00
1.2.15		Standing Time	Hr	0.00	R 1 000.00	
1.2.16		Drilling Supervision	Hr	750.00	R 600.00	R 450 000.00
1.2.17		Technical Reporting	Hr	50.00	R 650.00	R 32 500.00
1.3		**AQUIFER TESTING**				
1.3.1		Mobilization/Demobilization	Project	1.00	R 40 000.00	R 40 000.00
1.3.2		Setup of Plant	BH	20.00	R 1 000.00	R 20 000.00
1.3.3		Inter hole moves	BH	20.00	R 500.00	R 10 000.00
1.3.4		Installation of Equipment for < 10 L/s	BH	20.00	R 2 500.00	R 50 000.00
1.3.5		Step Test (4 x 60 minutes)	Hr	80.00	R 365.00	R 29 200.00
1.3.6		Constant Rate Test (72 hrs)	Hr	1 440.00	R 365.00	R 525 600.00
1.3.7		Recovery Test (24 hrs per borehole)	Hr	480.00	R 150.00	R 72 000.00
1.3.8		Data Collection & Reports	Test	20.00	R 500.00	R 10 000.00
1.3.9		Site Clean Up	Site	20.00	R 300.00	R 6 000.00
1.3.10		Technical Reporting	Hr	50.00	R 650.00	R 32 500.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 5 354 650.00**

SECTION 1. GROUNDWATER SUPPLY: Boreholes

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 5 354 650.00**
1.4		**EQUIPPING BOREHOLES**				
1.4.1		SP17-12 Grundfos Submersible Pump & Motor	Pump	20.00	R 49 000.00	R 980 000.00
1.4.2		Control Box	BH	20.00	R 3 850.00	R 77 000.00
1.4.3		4 mm Electric Cable	m	2 000.00	R 25.00	R 50 000.00
1.4.4		Safety Rope	m	2 000.00	R 2.50	R 5 000.00
1.4.5		Splice Kit	Kit	20.00	R 300.00	R 6 000.00
1.4.6		Boreline (2.5")	m	2 000.00	R 245.00	R 490 000.00
1.4.7		SS 304 Coupling	BH	20.00	R 2 750.00	R 55 000.00
1.4.8		Baseplate & Goosneck	BH	20.00	R 1 650.00	R 33 000.00
1.4.9		Pressure Gauge	BH	20.00	R 1 500.00	R 30 000.00
1.4.10		Installation	BH	20.00	R 15 000.00	R 300 000.00
1.4.11		Electrics	BH	20.00	R 1 500.00	R 30 000.00
1.4.12		Technical Reporting	Hr	16.00	R 650.00	R 10 400.00
1.5		**NUMERICAL MODELLING**				
1.5.1		Numerical Modelling	Hr	275.00	R 750.00	R 206 250.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 7 627 300.00**

SECTION 2. GROUNDWATER SUPPLY: Boreholes Characterisation

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
2.1		**GEOPHYSICS - BOREHOLE SITING**				
2.1.1		Geophysical Equipment Hire (EM34)	Day	7.00	R 1 500.00	R 10 500.00
2.1.2		Geophysical Equipment Hire (magnetometer)	Day	7.00	R 400.00	R 2 800.00
2.1.3		Geophysicist	Day	7.00	R 6 500.00	R 45 500.00
2.1.4		Geophysical Technician	Day	7.00	R 3 000.00	R 21 000.00
2.1.5		Technical Reporting	Hr	24.00	R 650.00	R 15 600.00
2.2		**DRILLING 8 BOREHOLES**				
2.2.1		Mobilization/Demobilization	Project	1.00	R 50 000.00	R 50 000.00
2.2.2		Inter Hole Moves	BH	7.00	R 1 000.00	R 7 000.00
2.2.3		Materials Transport	Project	1.00	R 35 000.00	R 35 000.00
2.2.4		Water Transport	BH	8.00	R 3 000.00	R 24 000.00
2.2.5		Material Supply (caps, cement, name plate)	BH	8.00	R 1 500.00	R 12 000.00
2.2.6		Steel casing 177 mm x 3 mm thickness (12 m per BH)	m	96.00	R 355.00	R 34 080.00
2.2.7		uPVC Casing (Class 12) 146 mm ID	m	400.00	R 450.00	R 180 000.00
2.2.8		Gravel Pack (Graded Silica)	Bag	160.00	R 135.00	R 21 600.00
2.2.9		Bentonite Seal	BH	8.00	R 1 650.00	R 13 200.00
2.2.10		Rigging up	BH	8.00	R 2 300.00	R 18 400.00
2.2.11		Drilling 8.5"	m	400.00	R 375.00	R 150 000.00
2.2.12		Borehole Development	Hr	24.00	R 1 000.00	R 24 000.00
2.2.13		Foam	BH	8.00	R 1 000.00	R 8 000.00
2.2.14		Centralizers	BH	120.00	R 65.00	R 7 800.00
2.2.15		Standing Time	Hr	0.00	R 1 000.00	
2.2.16		Drilling Supervision	Hr	160.00	R 600.00	R 96 000.00
2.2.17		Technical Reporting	Hr	32.00	R 650.00	R 20 800.00
2.3		**AQUIFER TESTING 8 BOREHOLES**				
2.3.1		Mobilization/Demobilization	Project	1.00	R 40 000.00	R 40 000.00
2.3.2		Setup of Plant	BH	8.00	R 1 000.00	R 8 000.00
2.3.3		Inter hole moves	BH	7.00	R 500.00	R 3 500.00
2.3.4		Installation of Equipment for < 10 L/s	BH	8.00	R 2 500.00	R 20 000.00
2.3.5		Step Test (4 x 60 minutes)	Hr	32.00	R 365.00	R 11 680.00
2.3.6		Constant Rate Test (48 hrs)	Hr	384.00	R 365.00	R 140 160.00
2.3.7		Recovery Test (12 hrs per borehole)	Hr	96.00	R 150.00	R 14 400.00
2.3.8		Data Collection & Reports	Test	8.00	R 500.00	R 4 000.00
2.3.9		Site Clean Up	Site	8.00	R 300.00	R 2 400.00
2.3.10		Sample Analysis	Sample	8.00	R 1 550.00	R 12 400.00
2.3.11		Technical Reporting	Hr	32.00	R 650.00	R 20 800.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 1 074 620.00**

SECTION 3. Raw Water Distribution

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**				
3.1	**8.3.1**	**SITE CLEARANCE AND REMOVAL OF TOPSOIL**				
3.1.1		a) Clear vegetation and trees of girth up to 1 m (3 m wide strip)	m	15 090.00	R 6.00	R 90 540.00
3.1.2		b) Clear trees of girth over 1,0 m and designated obstacles	number	20.00	R 1 500.00	R 30 000.00
3.1.3		c) Remove Topsoil (Strip to 150 mm deep x 1 m wide) (on pipeline centre line, stockpile and prevent dust nuisance)	m^2	30 180.00	R 6.00	R 181 080.00
3.2	**PSDB 8.3.2**	**EXCAVATION**				
		a) Excavate in all materials for trenches, backfill, compact and dispose of surplus material (base width up to 950 mm) Excavation depth: over and up to				
3.2.1		0.0 m 1.5 m	m	12 072.00	R 100.00	R 1 207 200.00
3.2.2		1.5 m 2.5 m	m	3 018.00	R 150.00	R 452 700.00
	8.3.2	**b) Extra-over item (a) above for:**				
3.2.3		1) Intermediate excavation	m^3	50.00	R 50.00	R 2 500.00
3.2.4		2) Hard rock excavation	m^3	100.00	R 400.00	R 40 000.00
3.2.5		**c) Excavate and dispose of unsuitable material from trench bottom (provisional)**	**m^3**	**100.00**	**R 50.00**	**R 5 000.00**
3.3	**8.3.3**	**Excavation Ancillaries**				
	8.3.3.1	**Make up deficiency in backfill material (provisional)**				
3.3.1		a) From other necessary excavations on site	m^3	200.00	R 45.00	R 9 000.00
3.3.2	8.3.3.2	Opening and closing down of designated borrow pit	Sum	1.00	R 250 000.00	R 250 000.00
3.3.3	8.3.3.3	Compaction in road reserves	m^3	40.00	R 45.00	R 1 800.00
	8.3.3.4	**Overhaul** No overhaul will be paid for material within the MEP boundary				
	SABS 1200 L	**SECTION 3: MEDIUM PRESSURE PIPELINES**				
3.4	**8.2.1**	**Supply, Lay, Join and Bed Pipes HDPE pipes to SABS**				
3.4.1		110 mm OD Class 12	m	0.00	R 120.00	
3.4.2		315 mm OD Class 12 (slurry return)	m	0.00	R 420.00	
3.4.3		200 mm OD Class 12	m	3 018.00	R 350.00	R 1 056 300.00
3.4.4		315 mm OD Class 12	m	7 545.00	R 420.00	R 3 168 900.00
3.4.5		450 mm OD Class 12	m	4 527.00	R 550.00	R 2 489 850.00
3.5	**8.2.5**	**Pump stations, complete with pumps (duty and standby), electrical and pipework and manhole (dewatering)**	No	2.00	R 250 000.00	R 500 000.00
3.6	**PSL 8.2.17**	**ISOLATION VALVE ASSEMBLY**				
		Rates include supply, lay and bed Class 16 RSV socket ended, clockwise closing gate valves to SABS 664 with non-rising spindles, valve chamber and connections				
3.6.1		355 mm	number	16.00	R 20 000.00	R 320 000.00
3.6.2		200 mm	number	10.00	R 12 500.00	R 125 000.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 9 929 870.00**

SECTION 3. Raw Water Distribution

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 9 929 870.00**
3.7	**PSL 8.2.18**	**SCOUR VALVE ASSEMBLY** **Scour assembly complete in galvanised steel piping, flanged RSV clockwise closing gate valve, scour tee and tail piece to ground level, valve chamber and other fittings**				
3.7.1		355 mm	number	6.00	R 30 000.00	R 180 000.00
3.7.2		200 mm	number	8.00	R 16 500.00	R 132 000.00
3.8	**PSL 8.2.19**	**AIR VALVE ASSEMBLY** **Complete air valve assembly with isolating valve, T-piece, valve chamber, etc as indicated on drawing MEPINFRA-WC-WAT-303.** 50 mm Double Orifice Air Valve on the following pipe diam:				
3.8.1		355 mm	number	20.00	R 15 000.00	R 300 000.00
3.8.2		200 mm	number	20.00	R 12 500.00	R 250 000.00
	SABS 1200 LB	**SECTION 4: BEDDING (PIPES)**				
3.9	**8.2.1**	**Provision of bedding from trench excavation**				
3.9.1		a) Selected granular material	m³	7 612.00	R 44.00	R 334 928.00
3.9.2		b) Selected fill material	m³	2 815.00	R 36.00	R 101 340.00
	8.2.2	Supply only of bedding by importation				
3.1	**8.2.3**	**Concrete Bedding Cradle**	m³	0.00	R 1 300.00	
3.11	**8.2.4**	**Encasing of pipes in concrete**	m³	80.00	R 1 800.00	R 144 000.00
		RAW, RETURN WATER AND DEWATERING PUMPS				
3.12		Raw and return water pumps	Provisional Sum	1.00	R 450 000.00	R 450 000.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 11 822 138.00**

SECTION 4. Pollution Control Dam

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SABS 1200 A	**GENERAL**				
4.1	**9**	**Sums stated provisionally by the Engineer:**				
	8.5a)	Works executed by the Contractor:				
4.1.1		1. Underdrainage pump sump complete with M&E equipment	Prov Sum	1.00	R 150 000.00	R 150 000.00
4.1.2		2. Process water pump sump complete with M&E equipment	Prov Sum	1.00	R 200 000.00	R 200 000.00
4.1.3		3. Outlet structure	Prov Sum	1.00	R 30 000.00	R 30 000.00
4.1.4		4. Stormwater drains inlet structures	Prov Sum	1.00	R 40 000.00	R 40 000.00
4.1.5		5. Emergency overflow	Prov Sum	1.00	R 20 000.00	R 20 000.00
4.1.5		6. Pumping main discharge outlet	Prov Sum	1.00	R 20 000.00	R 20 000.00
4.2	**SABS 1200 C**	**SITE CLEARANCE**				
4.2.1	**8.2.1**	**Clear and grub:**				
		1. Areas	ha	2.00	R 10 000.00	R 20 000.00
4.2.2	**8.2.10**	**Remove topsoil to nominal depth of 150 mm and stockpile**	m³	300.00	R 20.00	R 6 000.00
4.3	**SABS 1200 D**	**EARTHWORKS**				
	8.3.2 & 8.3.4	**Bulk excavation:** 1. Excavate for dam in all materials and use for embankment or backfill as ordered from:				
		1.1 Necessary excavations:				
4.3.1		1.1.1 Anchor trenches	m³	150.00	R 80.00	R 12 000.00
4.3.2		1.1.2 Dam	m³	0.00	R 50.00	
4.3.3		2. Excavate in all materials and dispose:	m³	19 000.00	R 35.00	R 665 000.00
		Extra over items 140.01.01 and140.01.02 above for:				
4.3.4		2.2 Hard rock excavation	m³	1 200.00	R 400.00	R 480 000.00
4.4	**8.3.10**	**Topsoiling**	m²	1 500.00	R 15.00	R 22 500.00
4.5	**8.3.11**	**Grassing or other vegetation cover:**				
4.5.1		1. Planting of grass cuttings	m²	750.00	R 25.00	R 18 750.00
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**				
		TRENCHES FOR OUTLET- AND DISCHARGE PIPES				
4.6	**8.3.2**	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 125 mm dia up to 400 mm dia for depths:				
4.6.1		1. Up to 1,0 m	m	800.00	R 80.00	R 64 000.00
4.6.2		2. Over 1,0 m up to 2,0 m	m	240.00	R 90.00	R 21 600.00
4.6.3		3. Over 2,0 m up to 3,0 m	m	60.00	R 100.00	R 6 000.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 1 775 850.00**

SECTION 4. Pollution Control Dam

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 1 775 850.00**
		Extra over item 142.21 above for:				
4.6.4		1. Intermediate excavation	m³	200.00	R 200.00	R 40 000.00
4.6.5		2. Hard rock excavation	m³	100.00	R 400.00	R 40 000.00
		TRENCHES FOR SUBSURFACE DRAINS				
4.7	**8.3.2**	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Trenches of width less than 600 mm for depths:				
4.7.1		1. Up to 1,0 m	m	225.00	R 80.00	R 18 000.00
4.7.2		2. Over 1,0 m up to 2,0 m	m	40.00	R 90.00	R 3 600.00
		Extra over item 142.51 above for:				
4.7.3		1. Hard rock excavation	m³	15.00	R 400.00	R 6 000.00
	SABS 1200 LB	**BEDDING (PIPES)**				
4.8	**8.2.1**	**Provision of bedding from trench excavations:**				
4.8.1		1. Selected granular material	m³	75.00	R 75.00	R 5 625.00
4.8.2		2. Selected fill material	m³	120.00	R 75.00	R 9 000.00
	SABS 1200 LE	**STORMWATER DRAINAGE**				
4.9	**PSLE 8.2.14**	**Pipes in subsurface drains:**				
		Supply and Install Geopipe pipes complete with couplings:				
4.9.1		1. 110 mm internal dia, perforated	m	150.00	R 75.00	R 11 250.00
4.9.2		2. 160 mm internal dia, perforated	m	75.00	R 100.00	R 7 500.00
4.10		**PE 100 class PN10 HDPE pipes complete with couplings:**				
4.10.1		1. 160 mm dia	m	150.00	R 120.00	R 18 000.00
4.10.2		2. 300 mm dia	m	0.00	R 450.00	
4.11	**PSLE 8.2.15**	**Geofabric, needle punched non-woven, Bidim A4 or similar approved**	m²	750.00	R 18.00	R 13 500.00
4.12	**PSLE 8.2.16**	**Crushed stone in subsurface drains, 19 mm clean washed**	m³	75.00	R 350.00	R 26 250.00
4.13		**HDPE Lining**				
4.13.1		Install by specialized contractor 1.5mm HDPE lining complete with joining	m²	7 500.00	R 80.00	R 600 000.00
4.13.2		Overheads, charges and profit on item item 215.01 above	% sum	1.00	15%	R 90 000.00
4.14		**Fencing**				
4.14.1		Supply material and construct 1.2 m high galvanized stock-proof fencing complete with excavation and concrete foundations around dam's perimeter	m	375.00	R 200.00	R 75 000.00
4.14.2		Supply and install access gate	No	2.00	R 3 000.00	R 6 000.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 2 745 575.00**

SECTION 5. Potable Water Supply

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**				
5.1	**8.3.1**	**SITE CLEARANCE AND REMOVAL OF TOPSOIL**				
5.1.1		a) Clear vegetation and trees of girth up to 1 m (3 m wide strip)	m	11 250.00	R 6.00	R 67 500.00
5.1.2		b) Clear trees of girth over 1,0 m and designated obstacles	number	20.00	R 1 500.00	R 30 000.00
5.1.3		c) Remove Topsoil (Strip to 150 mm deep x 1 m wide) (on pipeline centre line, stockpile and prevent dust nuisance)	m²	22 500.00	R 6.00	R 135 000.00
5.2	**PSDB 8.3.2**	**EXCAVATION**				
		a) Excavate in all materials for trenches, backfill, compact and dispose of surplus material (base width up to 950 mm)				
		Excavation depth: over and up to				
5.2.1		0.0 m 1.5 m	m	10 687.50	R 100.00	R 1 068 750.00
5.2.2		1.5 m 2.5 m	m	562.50	R 150.00	R 84 375.00
	SABS 1200 L	**SECTION 3: MEDIUM PRESSURE PIPELINES**				
	8.2.1	Supply, Lay, and Bed Pipes Complete with Couplings				
5.3		**uPVC pipes to SABS 966 Part 1**				
5.3.1		110 mm OD Class 12	m	6 750.00	R 120.00	R 810 000.00
5.3.2		160 mm OD Class 12	m	0.00	R 180.00	
5.3.3		75 mm OD Class 12	m	4 500.00	R 80.00	R 360 000.00
5.4		**Polyethylene (PE 80) Pipes to SABS ISO 4427 with couplings**				
5.4.1		80 mm ND PE 80 PN 12.5	m	0.00	R 90.00	
	8.2.2	**EXTRA-OVER 8.2.1 FOR THE SUPPLYING, LAYING, AND BEDDING OF SPECIALS COMPLETE WITH COUPLINGS**				
5.6		**BENDS: uPVC Class 16 (SABS 966 Part 1) socket ended**				
5.6.1		110 mm OD 11.25 deg.	number	40.00	R 310.00	R 12 400.00
5.6.2		160 mm OD 11.25 deg.	number	0.00	R 600.00	
5.6.3		110 mm OD 22.5 deg.	number	30.00	R 320.00	R 9 600.00
5.6.4		160 mm OD 22.5 deg.	number	0.00	R 610.00	
5.6.5		110 mm OD 45 deg.	number	30.00	R 340.00	R 10 200.00
5.6.6		160 mm OD 45 deg.	number	0.00	R 650.00	
5.6.7		110 mm OD 90 deg.	number	20.00	R 340.00	R 6 800.00
5.6.8		160 mm OD 90 deg.	number	0.00	R 650.00	
		uPVC pipe system socket ended, Grade 14 C.I. fittings epoxy coated and lined, class 16, 1 600 kPa working pressure. Rates inclusive of short pipe pieces to join when required:				
5.7		**TEES**				
5.7.1		160 x 160 mm	number	0.00	R 800.00	
5.7.2		110 x 110 mm	number	30.00	R 500.00	R 15 000.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 2 609 625.00**

SECTION 5. Potable Water Supply

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 2 609 625.00**
5.8		**FLANGE ADAPTORS**				
5.8.1		160 mm	number	0.00	R 230.00	
5.8.2		110 mm	number	30.00	R 110.00	R 3 300.00
5.9		**REDUCERS**				
5.9.1		160 x 110 mm	number	0.00	R 850.00	
5.9.2		110 x 75 mm	number	30.00	R 550.00	R 16 500.00
5.10		**REPAIR COUPLINGS**				
5.10.1		160 mm	number	0.00	R 300.00	
5.10.2		110 mm	number	40.00	R 100.00	R 4 000.00
5.11		**SADDLE FOR uPVC PIPE WITH 40 mm ND FEMALE THREADED SOCKET**				
5.11.1		160 mm	number	0.00	R 350.00	
5.11.2		110 mm	number	30.00	R 180.00	R 5 400.00
5.12	**PSL 8.2.17**	**ISOLATION VALVE ASSEMBLY**				
		Rates include supply, lay and bed Class 16 RSV socket ended, clockwise closing gate valves to SABS 664 with non-rising spindles, valve chamber and connections complete as indicated on drawing MEPINFR-WC-WAT-302				
5.12.1		160 mm	number	0.00	R 10 000.00	
5.12.2		110 mm	number	45.00	R 8 000.00	R 360 000.00
5.13	**PSL 8.2.11**	**ANCHOR/THRUST BLOCKS AND PEDESTALS**	m³	30.00	R 1 350.00	R 40 500.00
5.14	**PSL 8.2.16**	**PIPELINE MARKERS**	number	0.00	R 400.00	
	SABS 1200 LB	**BEDDING (PIPES)**				
5.15	**8.2.1**	**Provision of bedding from trench excavation**				
5.15.1		a) Selected granular material	m³	2 322.00	R 44.00	R 102 168.00
5.15.2		b) Selected fill material	m³	1 567.00	R 36.00	R 56 412.00
	8.2.2	Supply only of bedding by importation				
	TOTAL CARRIED FORWARD TO SUMMARY					**R 3 197 905.00**

SECTION 6. Potable Water Tanks

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		ELEVATED POTABLE WATER TANK - 10 kl				
6.1	**SABS 1200D**	**EARTHWORKS**				
6.1.1	8.3.1.1	Clear and strip site	m2	1 600.00	R 3.00	R 4 800.00
	8.3.3	**Restricted excavation**				
6.1.2		a) Excavate for restricted foundations, footings and pipe trenches and dispose	m³	3.00	R 84.00	R 252.00
		b) Extra-over for				
6.1.3		1) Intermediate excavation	m³	1.00	R 145.00	R 145.00
6.1.4		2) Hard rock excavation	m³	1.00	R 380.00	R 380.00
6.1.5		3) Boulder excavation, Class A	m³	1.00	R 450.00	R 450.00
6.1.6		4) Boulder excavation, Class B	m³	1.00	R 450.00	R 450.00
6.2	**SABS 1200 G**	**CONCRETE (STRUCTURAL)**				
6.2.1	8.3.1	High-tensile steel bars	t	0.30	R 13 000.00	R 3 900.00
6.2.2	PSG 8.4.2 (a)	Blinding layer in class 15/19 concrete (50 mm thick)	m³	1.50	R 1 350.00	R 2 025.00
6.2.3	8.4.3	Strength concrete grade 30/19 (tanks stand foundations)	m³	3.00	R 1 650.00	R 4 950.00
	8.4.4	Unformed surface finishes				
6.2.4		a) Wood floated finish	m2	50.00	R 15.00	R 750.00
		100 KL POLYETHYLENE TANK ON STAND				
6.3	**PPSA 16.1**	**ELEVATED WATER TANK AND STAND**				
6.3.1	PPSA 16.1.1	Supply, delivery, erection, cand disinfection of 100 kl Polyethylene tank with 5 m high stand, cover, access, 4 pipe connections	number	1.00	R 250 000.00	R 250 000.00
6.3.2	PPSA 16.4	Watertightness testing	Sum	1.00	R 25 000.00	R 25 000.00
6.4	**PPSA 16.6**	**PIPE WORK AND ACCESSORIES**				
		Supply, handle, install, test and disinfect galvanised medium duty pipes, as indicated on drawings, underground wrapped with tape:				
6.4.1		a) Inlet pipe work as indicated on drawing	number	1.00	R 5 500.00	R 5 500.00
6.4.2		b) Outlet pipe work as indicated on drawing	number	1.00	R 5 500.00	R 5 500.00
6.4.3		c) Scour pipe work as indicated on drawing	number	1.00	R 6 500.00	R 6 500.00
6.4.4		d) Overflow pipe work as indicated on drawing	number	1.00	R 6 500.00	R 6 500.00
6.5	**PPSA 16.7**	**VALVE CHAMBERS**				
		Rates inclusive of additional excavation, provision of all materials and construction of valve chambers as shown on drawings				
6.5.1		a) Isolation valve chamber as per drawing	number	2.00	R 8 500.00	R 17 000.00
6.6		**1.5 ML FIRE WATER STORAGE TANKS**				
6.6.1		Supply, delivery, erection, cand disinfection of 1.5Ml Pressed Steel tanks (2No) complete with ring foundations, pipework and testing	number	2.00	R 400 000.00	R 800 000.00
6.6.2		Pump station, complete with pumps, electrical and work for potable and fire water reticulation	Sum	1.00	R 500 000.00	R 500 000.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 1 634 102.00**

SECTION 7. Sewer

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SEWER RETICULATION				
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**				
7.1	**8.3.1**	**SITE CLEARANCE AND REMOVAL OF TOPSOIL**				
7.1.1		a) Clear vegetation and trees of girth up to 1 m (1.5 m wide strip)	m	10 570.00	R 6.00	R 63 420.00
7.1.2		b) Clear trees of girth over 1,0 m and designated obstacles	number	15.00	R 820.00	R 12 300.00
7.1.3		c) Remove topsoil (Strip to 150 mm deep x 1 m wide)	m²	21 140.00	R 6.00	R 126 840.00
7.2	**PSDB 8.3.2**	**EXCAVATION**				
		a) Excavate in all materials for trenches, backfill, compact and dispose of surplus.				
		Base width up to 950 mm				
		Excavation Depth:				
		over and up to				
7.2.1		0.0 m 1.5 m	m	6 342.00	R 100.00	R 634 200.00
7.2.2		1.5 m 2.0 m	m	2 114.00	R 150.00	R 317 100.00
7.2.3		2.0 m 2.5 m	m	1 585.50	R 300.00	R 475 650.00
7.2.4		2.5 m 3.0 m	m	528.50	R 450.00	R 237 825.00
7.3	**8.3.2**	**b) Extra-over item (a) above for:**				
7.3.1		1) Intermediate excavation	m³	20.00	R 145.00	R 2 900.00
7.3.2		2) Hard rock excavation	m³	2 098.00	R 400.00	R 839 200.00
7.3.3		c) Excavate and dispose of unsuitable material from trench bottom (provisional)	m³	50.00	R 50.00	R 2 500.00
7.4	**8.3.3**	**EXCAVATION ANCILLARIES**				
	PSDB 8.3.4	**Particular Items**				
7.4.1	PSDB 8.3.4 (a)	Shore trench due to deep excavation	m	300.00	R 250.00	R 75 000.00
	SABS 1200L	**MEDIUM PRESSURE PIPELINES (Rising Main)**				
7.5	**8.2.1**	**Supply, Lay, and Bed Pipes Complete with Couplings**				
		HDPE PN80 Class 16				
7.5.1		1) 110 mm ND Class 12	m	2 700.00	R 150.00	R 405 000.00
7.6	**SABS 1200 LD**	**SEWERS**				
	8.2.1	**Supply, Lay, Joint, Bed and Test Pipeline uPVC solid wall sewer pipes to SABS 791: Class 34 (Heavy Duty)**				
7.6.1		110 mm ND	m	3 148.00	R 100.00	R 314 800.00
7.6.2		160 mm ND	m	4 722.00	R 150.00	R 708 300.00
7.7	**8.2.3**	**Manholes (Complete with cover slab and lid as indicated on drawings)**				
7.7.1		1,5 m deep	number	50.00	R 10 000.00	R 500 000.00
7.7.2		2,0 m deep	number	25.00	R 15 000.00	R 375 000.00
7.7.3		2,5 m deep	number	15.00	R 20 000.00	R 300 000.00
7.7.4		3,0 m deep	number	15.00	R 25 000.00	R 375 000.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 5 765 035.00**

SECTION 7. Sewer

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 5 765 035.00**
7.8	**8.2.6**	**Erf Connections (Refer to Drawing MEPINFRA-WC-WAT-520)**				
7.8.1		Type A	number	50.00	R 300.00	R 15 000.00
7.8.2		Type B	number	50.00	R 450.00	R 22 500.00
	PPSE	**SEWAGE TREATMENT PACKAGE PLANTS**				
7.9	**PPSE 8.1**	**SUPPLY AND INSTALLATION OF SEWAGE TREATMENT PACKAGE PLANT**	Sum	1.00	R 4 000 000.00	R 4 000 000.00
7.9.1		Septic/ Conservancy Tank and soak away	Sum	1.00	R 80 000.00	R 80 000.00
	SABS 1200 LB	**BEDDING (PIPES)**				
7.10	**8.2.1**	**Provision of bedding from trench excavation**				
7.10.1		a) Selected granular material	m^3	2 580.00	R 44.00	R 113 520.00
7.10.2		b) Selected fill material	m^3	1 550.00	R 36.00	R 55 800.00
	8.2.2	**Supply only of bedding by importation**				
7.11	**8.2.5**	**Pump stations, complete with submersible pumps (duty and standby), electrical and pipework in 1.8m diamter manholes**	No	4.00	R 60 000.00	R 240 000.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 10 291 855.00**

SECTION 8. Stormwater

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
8.1		**Oil Separator and transfer pump station**	Prov Sum	2.00	R 400 000.00	R 800 000.00
8.2		**Stormwater Diversion channals and berms**	Prov Sum	1.00	R 400 000.00	R 400 000.00
8.3		**Stormwater pipes (450mm Concrete culverts incl catch pits)**	Prov Sum	1.00	R 550 000.00	R 550 000.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 1 750 000.00**

SECTION 9. Fire Water

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SABS 1200 DB	**EARTHWORKS (PIPE TRENCHES)**				
9.1	**8.3.1**	**SITE CLEARANCE AND REMOVAL OF TOPSOIL**				
9.1.1		a) Clear vegetation and trees of girth up to 1 m (3 m wide strip)	m	12 150.00	R 6.00	R 72 900.00
9.1.2		b) Clear trees of girth over 1,0 m and designated obstacles	number	25.00	R 820.00	R 20 500.00
9.1.3		c) Remove Topsoil (Strip to 150 mm deep x 1 m wide) (on pipeline centre line, stockpile and prevent dust nuisance)	m²	24 300.00	R 6.00	R 145 800.00
9.2	**PSDB 8.3.2**	**EXCAVATION**				
		a) Excavate in all materials for trenches, backfill, compact and dispose of surplus material (base width up to 950 mm)				
		Excavation depth: over and up to				
9.2.1		0.0 m 1.5 m	m	11 542.50	R 100.00	R 1 154 250.00
9.2.2		1.5 m 2.5 m	m	607.50	R 150.00	R 91 125.00
9.3	**8.3.2**	**b) Extra-over item (a) above for:**				
9.3.1		1) Intermediate excavation	m³		R 50.00	
9.3.2		2) Hard rock excavation	m³		R 400.00	
9.3.3		c) Excavate and dispose of unsuitable material from trench bottom (provisional)	m³		R 50.00	
	SABS 1200 L	**SECTION 3: MEDIUM PRESSURE PIPELINES**				
	8.2.1	Supply, Lay, and Bed Pipes Complete with Couplings				
9.4		**uPVC pipes to SABS 966 Part 1**				
9.4.1		110 mm OD Class 16	m	2 430.00	R 150.00	R 364 500.00
9.4.2		160 mm OD Class 16	m	3 645.00	R 200.00	R 729 000.00
9.4.3		250 mm OD Class 16	m	2 430.00	R 440.00	R 1 069 200.00
9.4.4		315 mm OD Class 16	m	3 645.00	R 600.00	R 2 187 000.00
	8.2.2	**EXTRA-OVER 8.2.1 FOR THE SUPPLYING, LAYING, AND BEDDING OF SPECIALS COMPLETE WITH COUPLINGS**				
9.5		**BENDS: uPVC Class 16 (SABS 966 Part 1) socket ended**				
9.5.1		110 mm OD 11.25 deg.	number	20.00	R 310.00	R 6 200.00
9.5.2		160 mm OD 11.25 deg.	number	10.00	R 600.00	R 6 000.00
9.5.3		250 mm OD 11.25 deg.	number	10.00	R 1 450.00	R 14 500.00
9.5.4		315 mm OD 11.25 deg.	number	5.00	R 3 228.74	R 16 143.70
9.5.5		110 mm OD 22.5 deg.	number	10.00	R 320.00	R 3 200.00
9.5.6		160 mm OD 22.5 deg.	number	10.00	R 610.00	R 6 100.00
9.5.7		250 mm OD 22.5 deg.	number	10.00	R 1 490.00	R 14 900.00
9.5.8		315 mm OD 22.5 deg.	number	5.00	R 3 340.00	R 16 700.00
9.5.9		110 mm OD 45 deg.	number	20.00	R 340.00	R 6 800.00
9.5.10		160 mm OD 45 deg.	number	10.00	R 650.00	R 6 500.00
9.5.11		250 mm OD 45 deg.	number	10.00	R 1 590.00	R 15 900.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 5 947 218.70**

SECTION 9. Fire Water

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 5 947 218.70**
9.5.12		315 mm OD 45 deg.	number	5.00	R 3 550.00	R 17 750.00
9.5.13		110 mm OD 90 deg.	number	20.00	R 340.00	R 6 800.00
9.5.14		160 mm OD 90 deg.	number	15.00	R 650.00	R 9 750.00
9.5.15		250 mm OD 90 deg.	number	10.00	R 1 590.00	R 15 900.00
9.5.16		315 mm OD 90 deg.	number	5.00	R 3 550.00	R 17 750.00
		uPVC pipe system socket ended, Grade 14 C.I. fittings epoxy coated and lined, class 16, 1 600 kPa working pressure. Rates inclusive of short pipe pieces to join when required:				
9.6		**TEES**				
9.6.1		315 x 315 mm	number	10.00	R 3 500.00	R 35 000.00
9.6.2		200 x 200 mm	number	10.00	R 1 200.00	R 12 000.00
9.6.3		160 x 160 mm	number	10.00	R 800.00	R 8 000.00
9.6.4		110 x 110 mm	number	10.00	R 500.00	R 5 000.00
9.7		**FLANGE ADAPTORS**				
9.7.1		315 mm	number	10.00	R 1 150.00	R 11 500.00
9.7.2		250 mm	number	10.00	R 570.00	R 5 700.00
9.7.3		160 mm	number	5.00	R 230.00	R 1 150.00
9.7.4		110 mm	number	5.00	R 110.00	R 550.00
9.8		**REDUCERS**				
9.8.1		315 x 250 mm	number	15.00	R 850.00	R 12 750.00
9.8.2		250 x 160 mm	number	15.00	R 550.00	R 8 250.00
9.8.3		160 x 110 mm	number	10.00	R 550.00	R 5 500.00
9.9		**HYDRANTS COMPLETE WITH FITTINGS, RISER, TEE, THRUST BLOCK AND PAINT**				
9.9.1		Fire Hydrants	number	20.00	R 5 000.00	R 100 000.00
9.1	**PSL 8.2.17**	**ISOLATION VALVE ASSEMBLY**				
		Rates include supply, lay and bed Class 16 RSV socket ended, clockwise closing gate valves to SABS 664 with non-rising spindles, valve chamber and connections complete as indicated on drawing MEPINFR-WC-WAT-302				
9.10.1		355 mm	number	10.00	R 20 000.00	R 200 000.00
9.10.2		250 mm	number	15.00	R 15 000.00	R 225 000.00
9.10.3		160 mm	number	15.00	R 10 000.00	R 150 000.00
9.10.4		110 mm	number	30.00	R 8 000.00	R 240 000.00
9.11	**PSL 8.2.11**	**ANCHOR/THRUST BLOCKS AND PEDESTALS**	m^3	16.00	R 1 350.00	R 21 600.00
	SABS 1200 LB	**BEDDING (PIPES)**				
9.12	**8.2.1**	**Provision of bedding from trench excavation**				
9.12.1		a) Selected granular material	m^3	4 181.00	R 44.00	R 183 964.00
9.12.2		b) Selected fill material	m^3	1 983.00	R 36.00	R 71 388.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 7 312 520.70**

SECTION 10. Dirty Water Dam

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SABS 1200 A	**GENERAL**				
10.1	**9**	**Sums stated provisionally by the Engineer:**				
	8.5a)	Works executed by the Contractor:				
10.1.1		1) Outlet structure	Prov Sum	1.00	R 30 000.00	R 30 000.00
		2) Emergency overflow	Prov Sum	1.00	R 20 000.00	R 20 000.00
		3) Pumping main discharge outlet	Prov Sum	1.00	R 20 000.00	R 20 000.00
	SABS 1200 C	**SITE CLEARANCE**				
10.2	**8.2.1**	**Clear and grub:**				
10.2.1		1. Areas	ha	0.10	R 10 000.00	R 960.00
10.2.2	**8.2.10**	**Remove topsoil to nominal depth of 150 mm and stockpile**	m³	144.00	R 20.00	R 2 880.00
	SABS 1200 D	**EARTHWORKS**				
	8.3.2	**Bulk excavation:**				
10.3	**&** **8.3.4**	1. Excavate for dam in all materials and use for embankment or backfill as ordered from:				
		1.1 Necessary excavations:				
10.3.1		1.1.1 Anchor trenches	m³	100.00	R 80.00	R 8 000.00
10.3.2		2. Excavate in all materials and dispose:	m³	6 240.00	R 35.00	R 218 400.00
		Extra over items above for:				
10.3.3		2.1 Hard rock excavation	m³	936.00	R 80.00	R 74 880.00
		TRENCHES FOR SUBSURFACE DRAINS				
10.4	**8.3.2**	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Trenches of width less than 600 mm for depths:				
10.4.1		1. Up to 1,0 m	m	150.00	R 80.00	R 12 000.00
10.4.2		2. Over 1,0 m up to 2,0 m	m	20.00	R 90.00	R 1 800.00
		Extra over item 142.51 above for:				
10.4.3		1. Hard rock excavation	m³	10.00	R 350.00	R 3 500.00
10.4	**PSLE 8.2.15**	**Geofabric, needle punched non-woven, Bidim A4 or similar approved**	m²	960.00	R 18.00	R 17 280.00
10.5	**PSLE 8.2.16**	**Crushed stone in subsurface drains, 19 mm clean washed**	m³	50.00	R 350.00	R 17 500.00
10.6		**HDPE Lining**				
10.6.1		Install by specialized contractor 1.5mm HDPE lining complete with joining	m²	960.00	R 80.00	R 76 800.00
10.6.2		Overheads, charges and profit on item item 215.01 above	% sum	1.00	15%	R 11 520.00
	TOTAL CARRIED FORWARD TO NEXT PAGE					**R 515 520.00**

SECTION 10. Dirty Water Dam

ITEM	SANS PAYMENT ITEM	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	TOTAL CARRIED FORWARD FROM PREVIOUS PAGE					**R 515 520.00**
10.7		**Fencing**				
10.7.1		Supply material and construct 1.2 m high galvanized stock-proof fencing complete with excavation and concrete foundations around dam's perimeter	m	124.00	R 200.00	R 24 800.00
10.7.2		Supply and install access gate	No	1.00	R 3 000.00	R 3 000.00
	TOTAL CARRIED FORWARD TO SUMMARY					**R 543 320.00**

APPENDIX C

DRAWINGS

DRAWING LIST

DRAWING NO:	DESCRIPTION:	REVISION NO:
GENERAL		
P0164-CIV-TEN-GEN-01	LIST OF DRAWINGS	A
LAYOUT		
P0164-CIV-BP-LAY-01	GENERAL LAYOUT	A
P0164-CIV-BP-LAY-02	WATER BALANCE DIAGRAM	A
P0164-CIV-BP-LAY-03	BULK WATER DISTRIBUTION SYSTEM	A
P0164-CIV-BP-LAY-04	POTABLE AND FIRE WATER DISTRIBUTION SYSTEM	A
WATER RETICULATION		
P0164-CIV-BP-WAR-01	WATER RETICULATION - WATER METER DETAIL	A
P0164-CIV-BP-WAR-02	WATER RETICULATION - THRUST BLOCK DETAILS	A
P0164-CIV-BP-WAR-03	WATER RETICULATION - VALVE BOX DETAIL	A
P0164-CIV-BP-WAR-04	WATER RETICULATION - FIRE HYDRANT DETAIL	A
P0164-CIV-BP-WAR-05	WATER RETICULATION - ERF CONNECTION DETAILS	A
SEWER RETICULATION		
P0164-CIV-BP-SEW-01	SEWER RETICULATION - ERF CONNECTION DETAILS	A
P0164-CIV-BP-SEW-02	SEWER AND WATER RETICULATION - TYPICAL TRENCH DETAILS	A
P0164-CIV-BP-SEW-03	SEWER RETICULATION - MANHOLE DETAILS	A
P0164-CIV-BP-SEW-04	SEWER RETICULATION - PUMPSTATION DETAIL	A
STORMWATER RETICULATION		
P0164-CIV-BP-SWR-01	STORMWATER RETICULATION - JUNCTION BOX DETAILS	A
P0164-CIV-BP-SWR-02	STORMWATER RETICULATION - INLET AND OUTLET DETAILS	A
P0164-CIV-BP-SWR-03	STORMWATER RETICULATION - ACCESS MANHOLE DETAILS	A
P0164-CIV-BP-SWR-04	STORMWATER RETICULATION - CHANNEL DETAILS	A
P0164-CIV-BP-SWR-05	STORMWATER RETICULATION - TYPICAL STORMWATER DAM SECTIONS	A
P0164-CIV-BP-SWR-06	STORMWATER RETICULATION - STORMWATER DAM DETAILS	A
P0164-CIV-BP-SWR-07	STORMWATER RETICULATION - TYPICAL SILT TRAP DETAILS	A

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A	2013/11/11	HYDROLOGICAL STUDY	M.E.

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

LIST OF DRAWINGS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
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CO-ORDINATE SYSTEM	REVISION
WGS 84	A

DWG NO

P0164-CIV-BP-GEN-01

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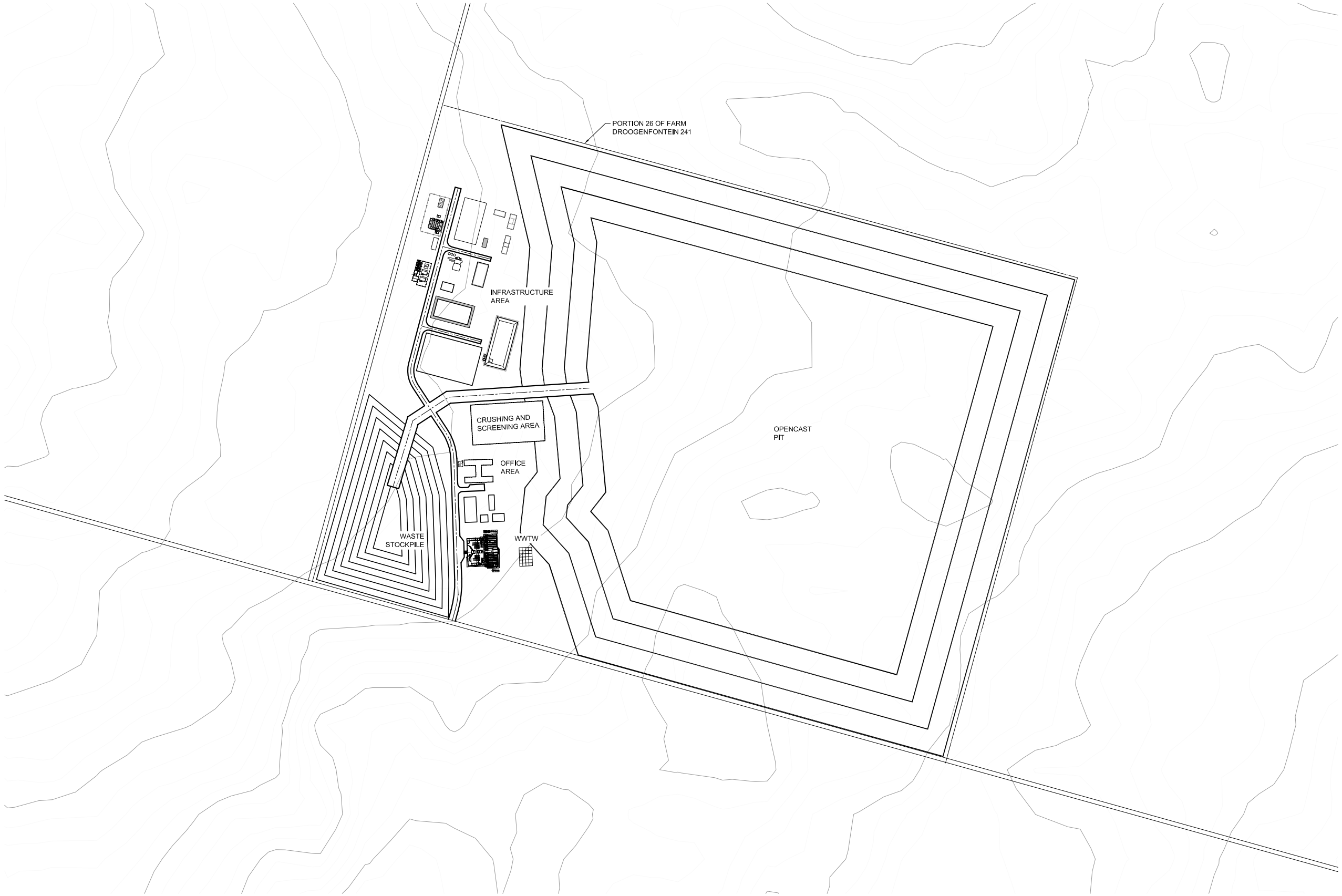

GENERAL LAYOUT

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TITLE

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P0164-CIV-BP-LAY-01

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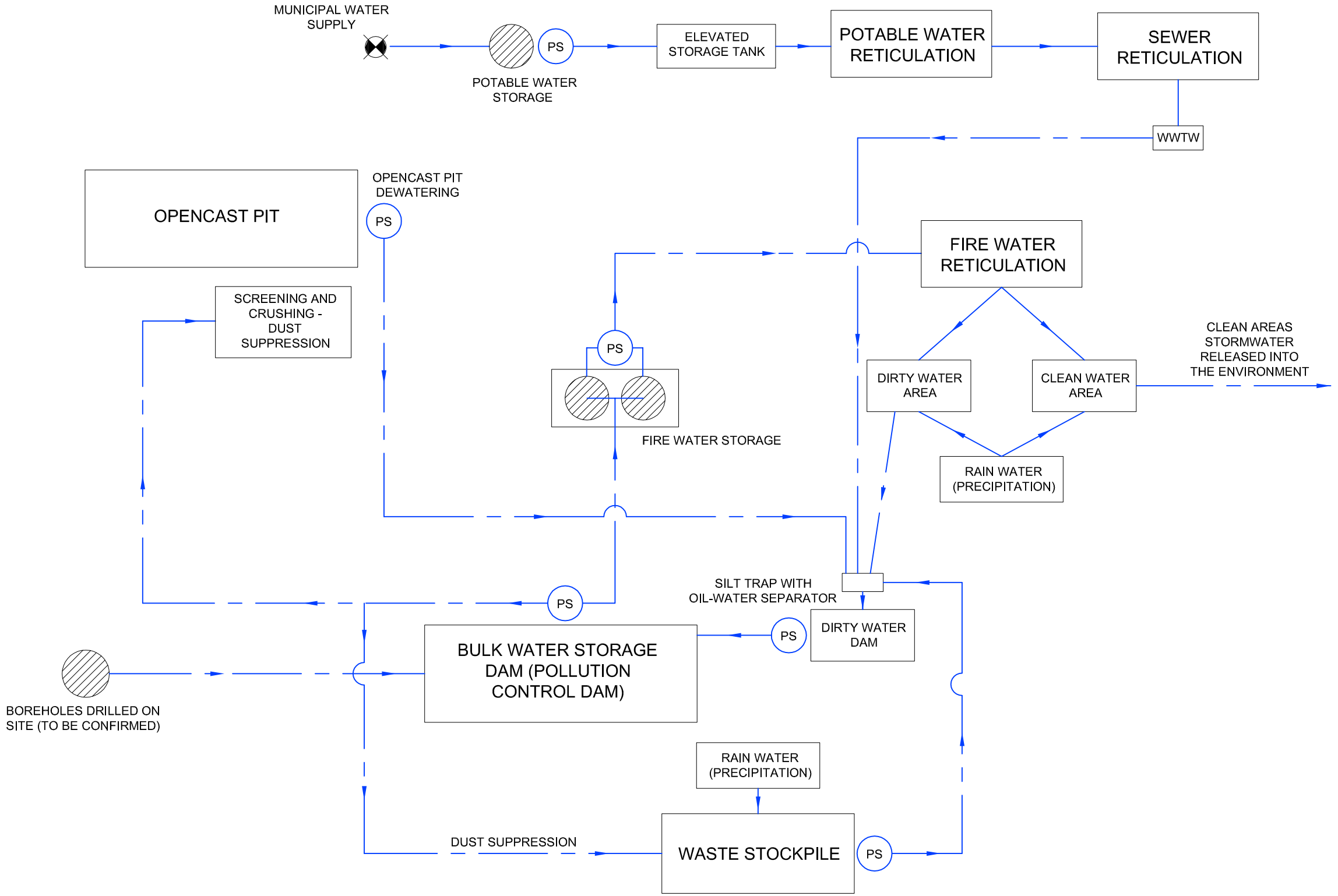

WATER BAIANCE DIAGRAM

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

WATER BALANCE DIAGRAM

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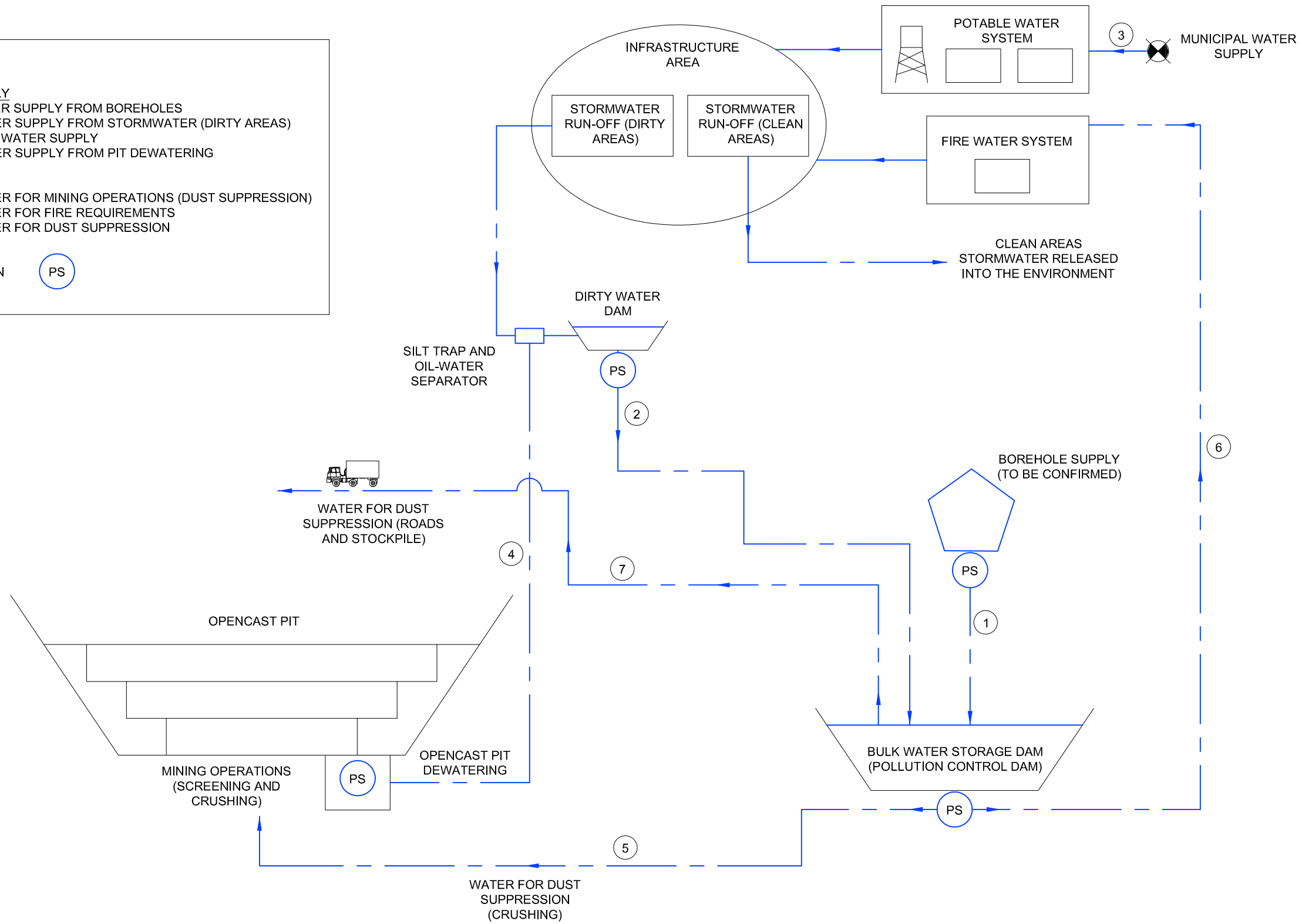
LEGEND

WATER SUPPLY
1 - BULK WATER SUPPLY FROM BOREHOLES
2 - BULK WATER SUPPLY FROM STORMWATER (DIRTY AREAS)
3 - MUNICIPAL WATER SUPPLY
4 - BULK WATER SUPPLY FROM PIT DEWATERING

WATER USE
5 - BULK WATER FOR MINING OPERATIONS (DUST SUPPRESSION)
6 - BULK WATER FOR FIRE REQUIREMENTS
7 - BULK WATER FOR DUST SUPPRESSION

PUMP STATION (PS)



BULK WATER DISTRIBUTION SYSTEM SCHEMATIC LAYOUT

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PROJECT DESCRIPTION
COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE
BULK WATER DISTRIBUTION SYSTEM - SCHEMATIC LAYOUT

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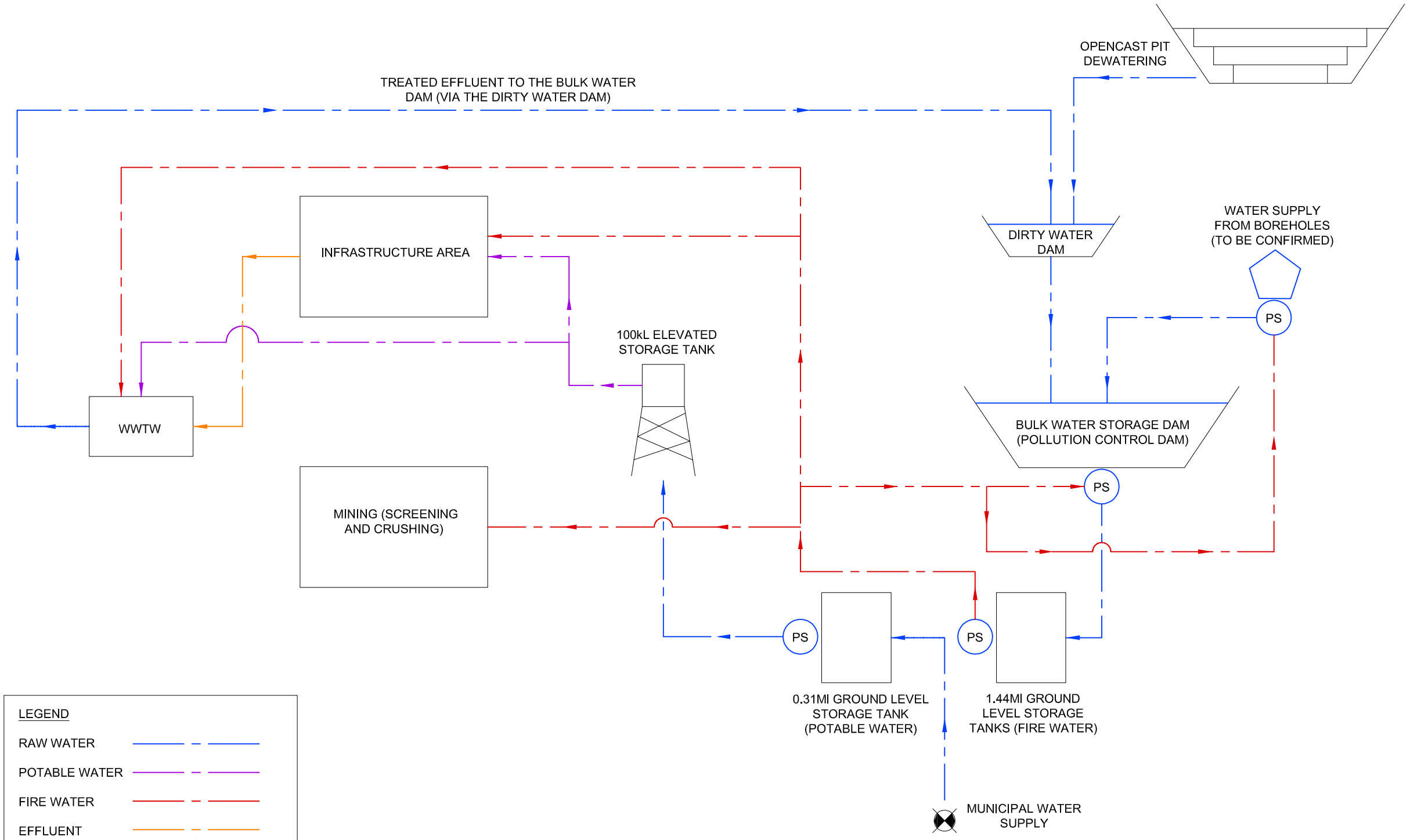

POTABLE AND FIRE WATER DISTRIBUTION SYSTEM
SCHEMATIC LAYOUT

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A	2013/12	HYDROLOGICAL STUDY	M.E.

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PROJECT DESCRIPTION
COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE
POTABLE AND FIRE WATER DISTRIBUTION SYSTEM - SCHEMATIC LAYOUT

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

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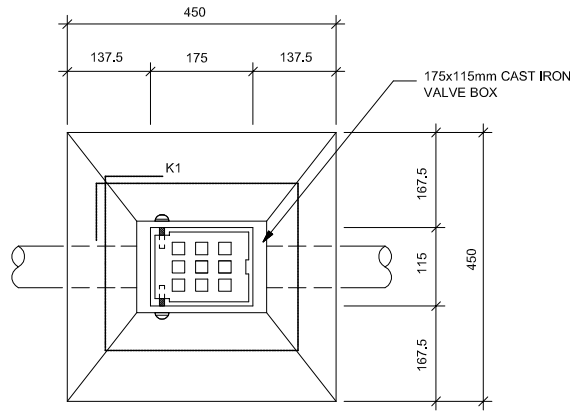
NOTES:

1. ALL GALVANISATION: MEDIUM GRADE SABS 62.
2. ALL DIMENSIONS IN MILLIMETERS.
3. BOX LENGTH TO BE PLACED IN THE DIRECTION OF THE PIPE.
4. CONCRETE STRENGTH - 20 MPa (28 DAYS.) CONCRETE COVER - 50mm.
5. WHERE THE VALVE BOX IS PLACED IN THE ROAD OR PAVEMENT, THE TOP OF THE CONCRETE COLLAR MUST BE FLAT.

BENDING SCHEDULE

Type Mark & size	Qty.	Cut Length mm	Form Code	A mm	B mm	Mass kg
1 - R8 - K1	1	1 400	60	300	300	0.553



PLAN : VALVE BOX
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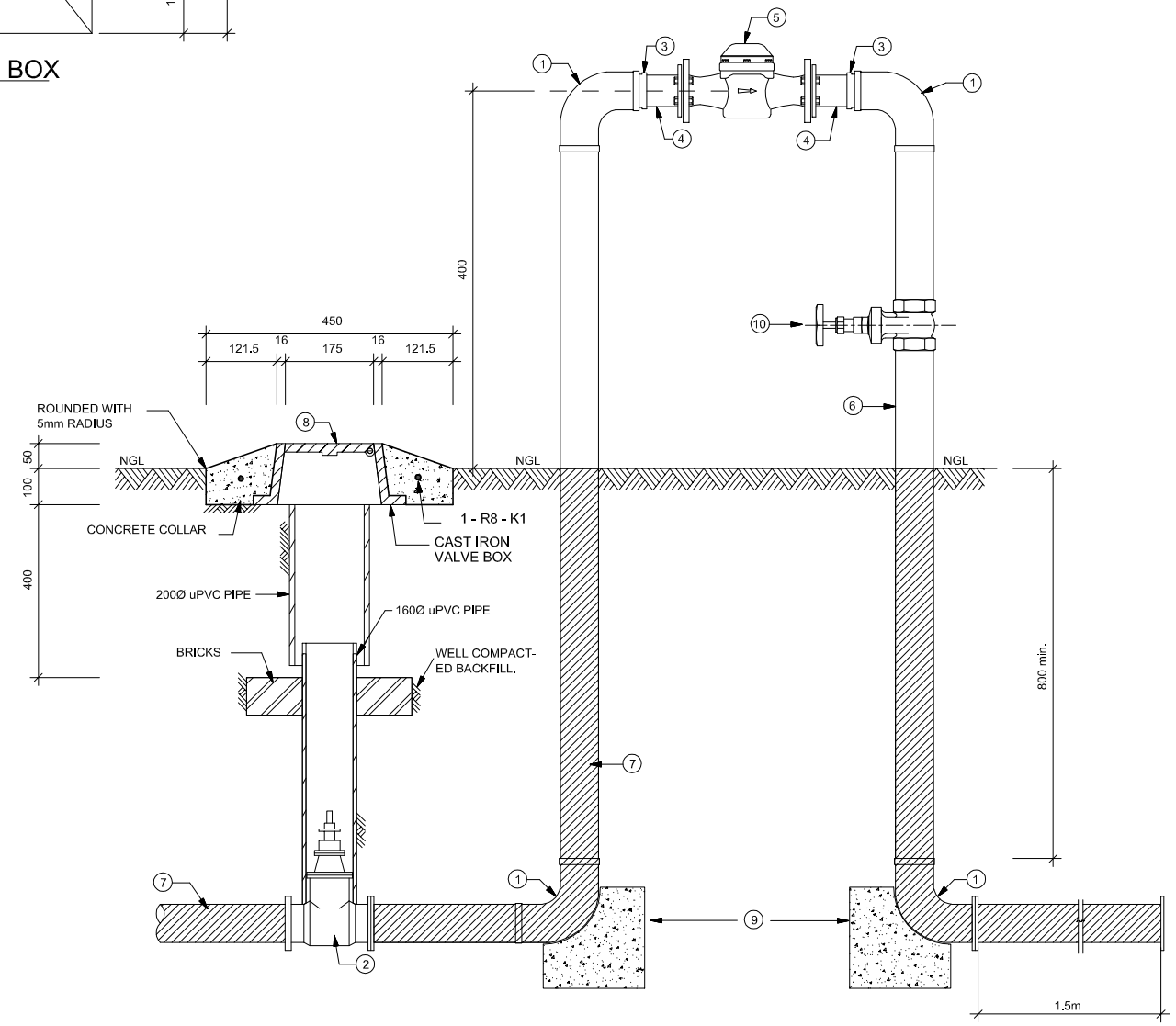

WATER METER CONNECTION DETAIL
N.T.S.

No.	ITEM DESCRIPTION	WATER CONNECTION SIZES			
		50Ø (Meter)	80Ø (Meter)	100Ø (Meter)	150Ø (Meter)
1	ELBOWS, GALV.	80Ø	100Ø	150Ø	200Ø
2	VALVE	RSV 80Ø	RSV 100Ø	RSV 150Ø	RSV 200Ø
3	REDUCING BUSCH	80-50Ø	100-80Ø	150-100Ø	200-150Ø
4	NIPPLE	50Ø	80Ø	100Ø	200Ø
5	WATER METER	50Ø	80Ø	100Ø	150Ø
6	PIPE, GALV.	80Ø	100Ø	150Ø	200Ø
7	"DENSOTAPE" WRAPPING	YES	YES	YES	YES
8	CONCRETE VALVE BOX	YES	YES	YES	YES
9	ANCHOR BLOCKS	YES	YES	YES	YES
10	WHEEL VALVE	80Ø	100Ø	150Ø	200Ø

WATER METER DETAIL
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PROJECT DESCRIPTION
COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE
WATER RETICULATION - WATER METER DETAIL

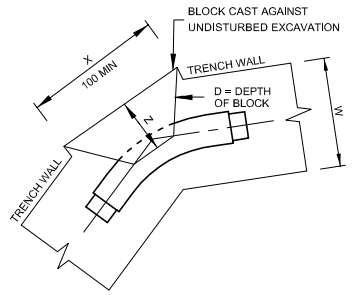
DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO
P0164-CIV-BP-WAR-01

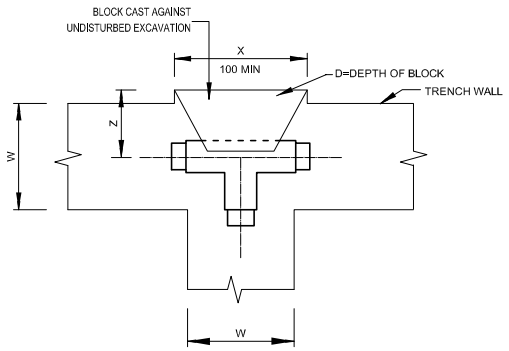
D:\Projects Related\P0164 Shangoni Hydrological Study\Drawings\06-10. P0164-CIV-BP-WAR-01 To 05 Rev A Water Reticulation.dwg LAST MODIFIED: MICHAEL ON 10.12.2013



THRUST BLOCK FOR 45° BEND

NOMINAL DIAMETER Ø (mm)	DEPTH OF BLOCK D (mm)	MAXIMUM TESTING PRESSURE 900 kPa X (mm)	900 kPa A (m²)	1350 kPa X (mm)	1350 kPa A (m²)	1800 kPa X (mm)	1800 kPa A (m²)
300	1200	450	0,49	650	0,74	850	0,98
250	1000	350	0,34	550	0,51	700	0,68
200	800	300	0,22	450	0,33	550	0,44
150	600	250	0,13	350	0,91	450	0,25
100	400	150	0,06	250	0,09	300	0,11
75	300	100	0,03	150	0,05	200	0,06
50	200	100	0,02	100	0,02	150	0,03

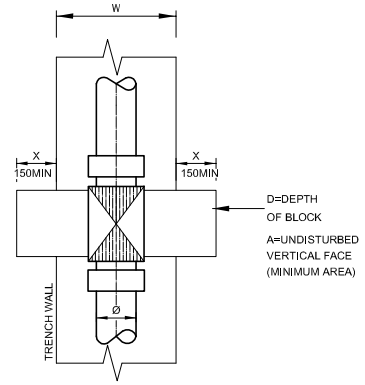
1. THIS TABLE IS VALID FOR 100 kPa EARTH BEARING PRESSURE
2. X- DIMENSION MAY BE REDUCED FOR HIGHER EARTH BEARING PRESSURES
3. Z SHALL BE THE MINIMUM OF X/2 OR W/2
4. HALF OF THE DEPTH OF THE BLOCK SHALL BE BELOW THE PIPE AXIS
5. KEEP COUPLINGS AND FLANGES 25mm CLEAR FROM CONCRETE



THRUST BLOCK FOR TEE

NOMINAL DIAMETER Ø (mm)	DEPTH OF BLOCK D (mm)	MAXIMUM TESTING PRESSURE 900 kPa X (mm)	900 kPa A (m²)	1350 kPa X (mm)	1350 kPa A (m²)	1800 kPa X (mm)	1800 kPa A (m²)
300	1200	550	0,64	800	0,96	1100	1,27
250	1000	450	0,44	700	0,67	900	0,89
200	800	350	0,29	550	0,43	700	0,57
150	600	300	0,16	400	0,24	550	0,32
100	400	200	0,07	300	0,11	350	0,14
75	300	150	0,04	200	0,06	300	0,08
50	200	100	0,02	150	0,03	200	0,04

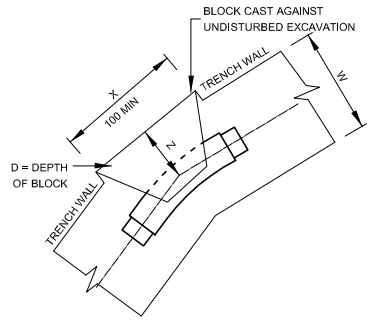
1. THIS TABLE IS VALID FOR 100 kPa EARTH BEARING PRESSURE
2. X- DIMENSION MAY BE REDUCED FOR HIGHER EARTH BEARING PRESSURES
3. Z SHALL BE THE MINIMUM OF X/2 OR W/2
4. HALF OF THE DEPTH OF THE BLOCK SHALL BE BELOW THE PIPE AXIS
5 KEEP COUPLINGS AND FLANGES 25mm CLEAR FROM CONCRETE



THRUST BLOCK FOR GATE VALVE

NOMINAL DIAMETER Ø (mm)	DEPTH OF BLOCK D (mm)	MAXIMUM TESTING PRESSURE 900 kPa X (mm)	900 kPa A (m²)	1350 kPa X (mm)	1350 kPa A (m²)	1800 kPa X (mm)	1800 kPa A (m²)
300	500	500	0,64	850	0,96	1150	1,27
250	450	350	0,45	600	0,67	850	0,89
200	400	250	0,29	400	0,43	600	0,57
150	350	150	0,16	200	0,24	350	0,32
100	300	150	0,07	150	0,11	150	0,14
75	250	150	0,04	150	0,06	150	0,08
50	200	150	0,02	150	0,03	150	0,04

1. THIS TABLE IS VALID FOR 100 kPa EARTH BEARING PRESSURE
2. X- DIMENSION MAY BE REDUCED FOR HIGHER EARTH BEARING PRESSURES
3. X - DIMENSION SHALL BE 150mm MINIMUM
4. THE BLOCK DEPTH SHALL BE MEASURED FROM THE PIPE AXIS DOWNWARDS
5 KEEP COUPLINGS AND FLANGES 25mm CLEAR OF CONCRETE

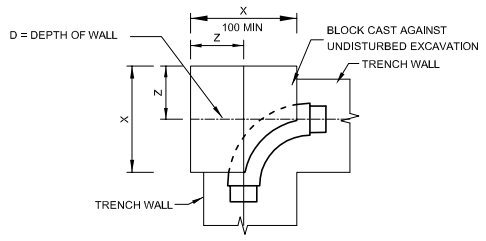


THRUST BLOCK FOR 22,5° AND 11,25° BEND

(X AND A TO BE HALVED FOR 11,25° BENDS)

NOMINAL DIAMETER Ø (mm)	DEPTH OF BLOCK D (mm)	MAXIMUM TESTING PRESSURE 900 kPa X (mm)	900 kPa A (m²)	1350 kPa X (mm)	1350 kPa A (m²)	1800 kPa X (mm)	1800 kPa A (m²)
300	1200	250	0,25	350	0,38	450	0,50
250	1000	200	0,18	300	0,26	350	0,35
200	800	150	0,11	250	0,17	300	0,22
150	600	100	0,06	200	1,00	250	0,13
100	400	100	0,04	100	0,04	150	0,06
75	300	100	0,03	100	0,03	100	0,03
50	200	100	0,02	100	0,02	100	0,02

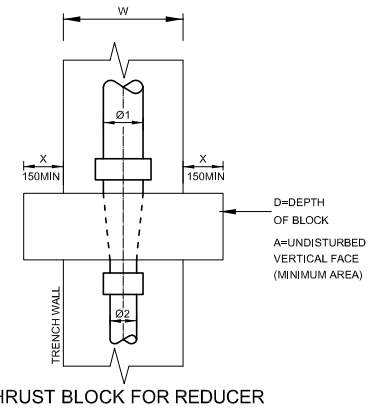
1. THIS TABLE IS VALID FOR 100 kPa EARTH BEARING PRESSURE
2. X- DIMENSION MAY BE REDUCED FOR HIGHER EARTH BEARING PRESSURES
3. Z SHALL BE THE MINIMUM OF X/2 OR W/2
4. HALF OF THE DEPTH OF THE BLOCK SHALL BE BELOW THE PIPE AXIS
5 KEEP COUPLINGS AND FLANGES 25mm CLEAR FROM CONCRETE



THRUST BLOCK FOR 90° BEND

NOMINAL DIAMETER Ø (mm)	DEPTH OF BLOCK D (mm)	MAXIMUM TESTING PRESSURE 900 kPa X (mm)	900 kPa A (m²)	1350 kPa X (mm)	1350 kPa A (m²)	1800 kPa X (mm)	1800 kPa A (m²)
300	1200	750	0,90	1150	1,35	1550	1,81
250	1000	650	0,63	950	0,94	1250	1,26
200	800	500	0,40	750	0,60	1000	0,81
150	600	400	0,23	600	0,34	750	0,46
100	400	250	0,10	400	0,15	500	0,20
75	300	200	0,06	300	0,09	400	0,12
50	200	150	0,03	200	0,04	250	0,05

1. THIS TABLE IS VALID FOR 100 kPa EARTH BEARING PRESSURE
2. X- DIMENSION MAY BE REDUCED FOR HIGHER EARTH BEARING PRESSURES
3. Z SHALL BE THE MINIMUM OF X/2 OR W/2
4. HALF OF THE DEPTH OF THE BLOCK SHALL BE BELOW THE PIPE AXIS
5. KEEP COUPLINGS AND FLANGES 25mm CLEAR FROM CONCRETE



THRUST BLOCK FOR REDUCER

NOMINAL DIAMETER Ø1 (mm)	NOMINAL DIAMETER Ø2 (mm)	DEPTH OF BLOCK D (mm)	MAXIMUM TESTING PRESSURE 900 kPa X (mm)	900 kPa A (m²)	1350 kPa X (mm)	1350 kPa A (m²)	1800 kPa X (mm)	1800 kPa A (m²)
350	300/250	750	300	0,43	450	0,64	600	0,85
300	250/200	700	250	0,35	400	0,53	550	0,71
250	200/150	650	250	0,29	350	0,43	450	0,57
200	150/100	600	200	0,22	300	0,32	400	0,43
150	100/75	500	150	0,12	200	0,18	250	0,24
100	75/50	400	150	0,06	150	0,08	150	0,11
75	50	300	100	0,03	150	0,04	150	0,05

1. THIS TABLE IS VALID FOR 100 kPa EARTH BEARING PRESSURE
2. X- DIMENSION MAY BE REDUCED FOR HIGHER EARTH BEARING PRESSURES
3. X- DIMENSION SHALL BE 150mm MINIMUM
4. HALF OF THE DEPTH OF THE BLOCK SHALL BE BELOW THE PIPE AXIS
5 KEEP COUPLINGS AND FLANGES 25mm CLEAR OF CONCRETE

THRUST BLOCK DETAILS DETAIL

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NURIZON CONSULTING ENGINEERS

REV	DATE	DESCRIPTION	BY
A	2013/12	HYDROLOGICAL STUDY	M.E.

REVISIONS

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

WATER RETICULATION - THRUST BLOCK DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

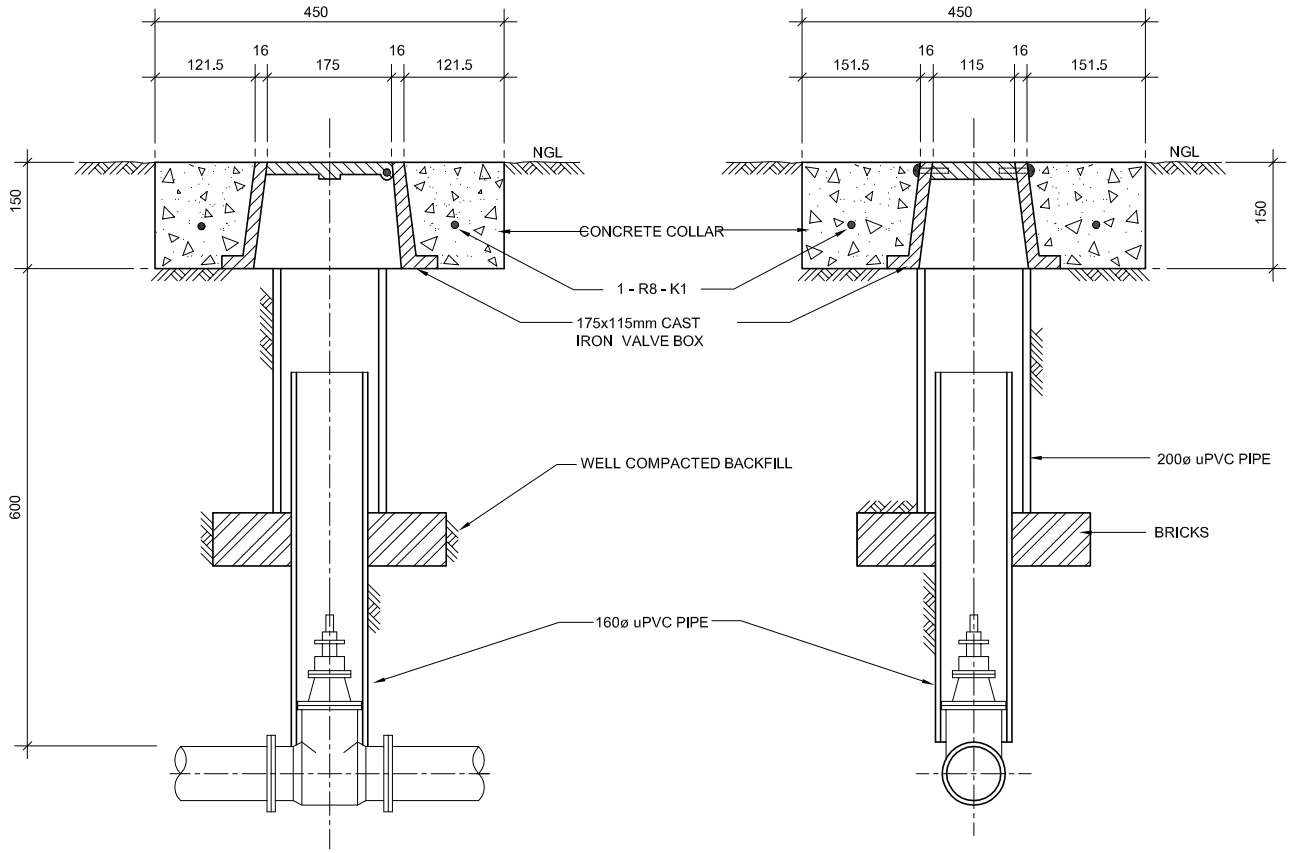
BASIC PLANNING

SCALE	PAPER SIZE
AS SHOWN	(A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-WAR-02

D:\Projects Related\P0164 Shangoni Hydrological Study\Drawings\06-10. P0164-CIV-BP-WAR-01 To 05 Rev A Water Reticulation.dwg LAST MODIFIED: MICHAEL ON 10.12.2013

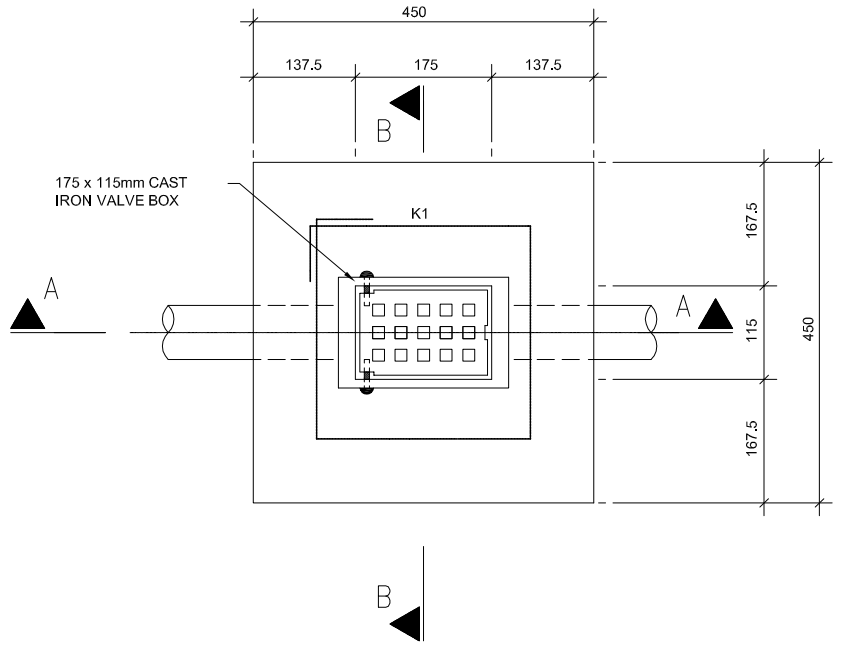


SECTION A–A

NTS

SECTION B–B

NTS



PLAN – VALVE BOX

NTS

NOTES:

1. VALVE BOXES & CONCRETE COLLARS MUST BE PAINTED WITH PVA APPROVED WHITE PAINT.
2. TO INDICATE VALVE BOX POSITION A 400x300mm WHITE BLOCK WITH ROAD MARKING PAINT MUST BE PAINTED ON THE KERB WHERE APPLICABLE.
3. THE LETTER "V" IS TO BE FORMED IN THE CONCRETE KERB (WHERE APPLICABLE) TO IDENTIFY THE POSITION OF THE VALVE BOX.
4. BOX LENGTH TO BE PLACED IN THE DIRECTION OF THE PIPE.
5. CONCRETE STRENGTH - 20 MPa (28 DAYS)

BENDING SCHEDULE

Type Mark & size	Qty.	Cut Length (mm)	Form Code	A (mm)	B (mm)	Mass (kg)
1 - R8 - K1	1	1 400	60	300	300	0.553

VALVE BOX DETAIL

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REV	DATE	DESCRIPTION	BY
A	2013/12	HYDROLOGICAL STUDY	M.E.

REVISIONS

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

WATER RETICULATION - VALVE BOX DETAIL

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-WAR-03

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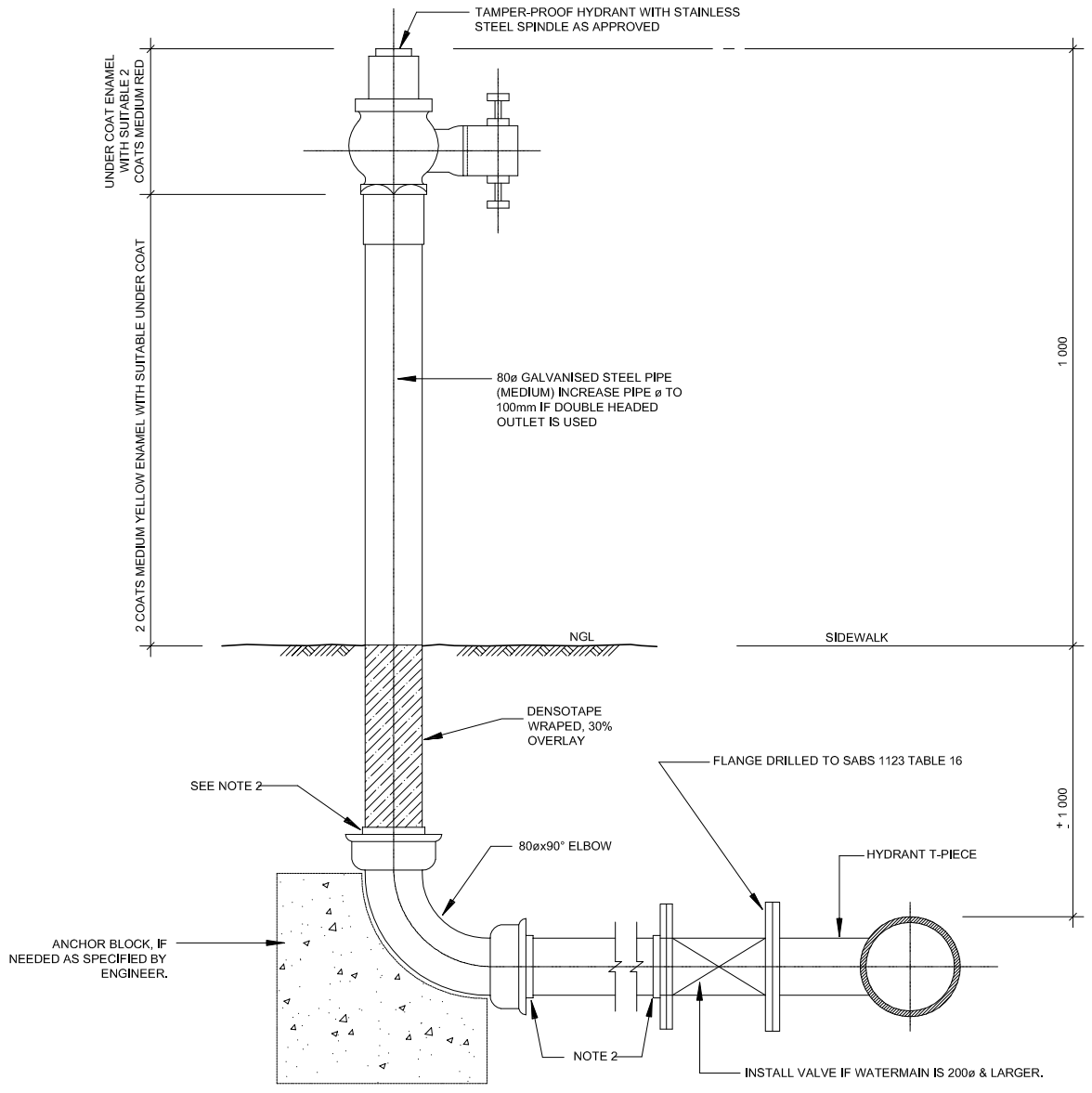

FIRE HYDRANT DETAIL

N.T.S

NOTE:

1. HYDRANTS MUST BE LOCATED AT POSITIONS INDICATED BY THE ENGINEER.
2. ALL THREADED CONNECTIONS BELOW GROUND MUST BE TAPED WITH DENSOTAPE OR SIMILAR, 30% OVERLAY.

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

WATER RETICULATION - FIRE HYDRANT DETAIL

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-WAR-04

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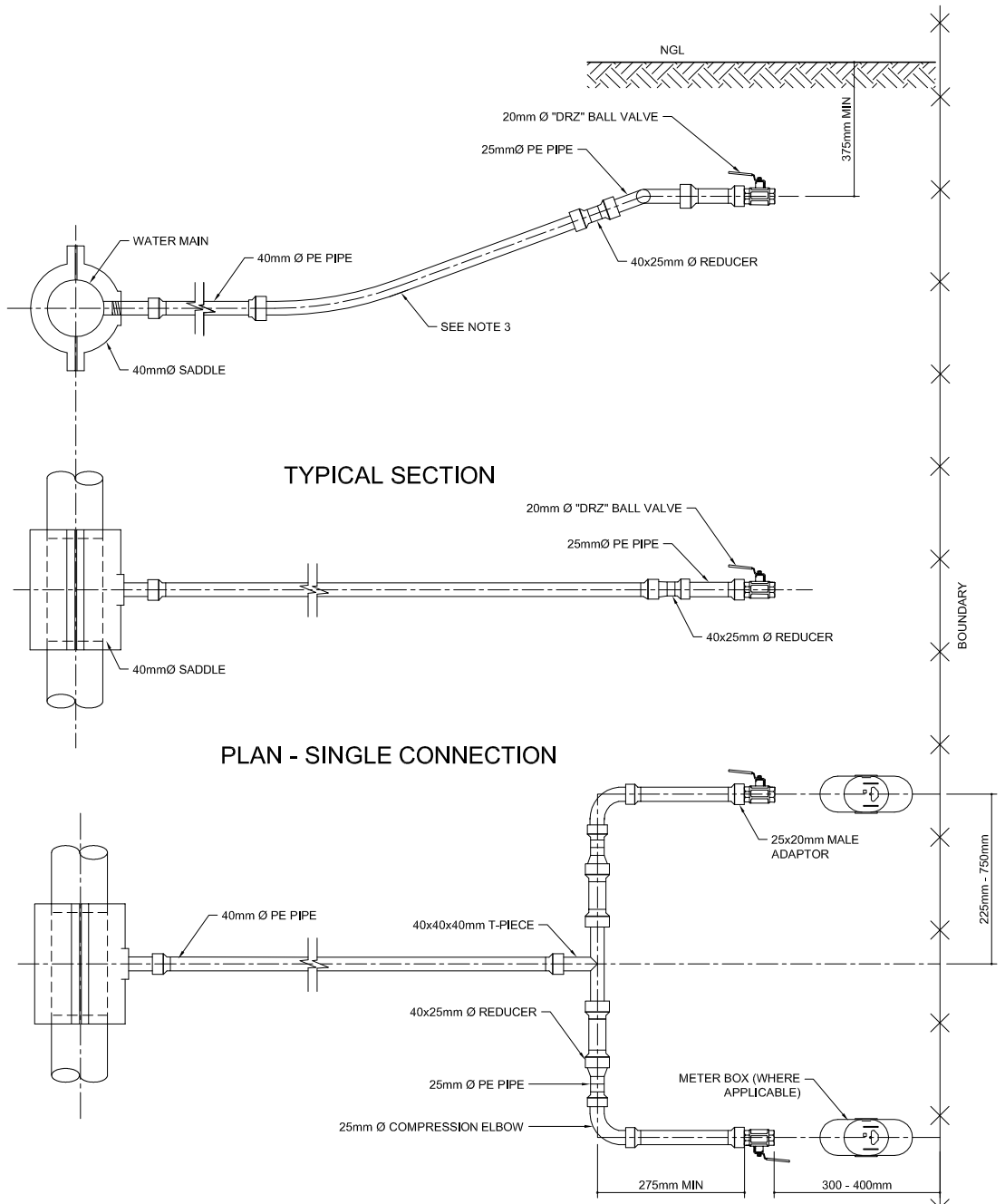

TYPICAL SECTION

PLAN - SINGLE CONNECTION

PLAN - DOUBLE CONNECTION

NOTES - ERF CONNECTION:

1. ALL PIPES AND FITTINGS SHALL COMPLY WITH SANS 4427 AND SHALL BE ONE OF THE FOLLOWING:
   - PE 100 PN12,5 FOR MAX. POTENTIAL STATIC
   - PRESSURE OF BETWEEN 800kPa AND 1200kPa.
   - PE 100 PN10 FOR MAX. POTENTIAL STATIC PRESSURE < 800kPa.
2. 1m COVER ON PIPES CROSSING ROADS.
3. TRANSITION OF PIPE DEPTH FROM 1m TO 0,375m TO BE OVER A LENGTH OF 3m (1:5 GRADIENT) TO PRECLUDE ANY KINKS IN PIPE. IF SIDEWALK IS TOO NARROW, APPROPRIATE BENDS SHALL BE USED.
4. VALVES MUST BE ISO OR SANS APPROVED.

ERF CONNECTION DETAIL

N.T.S

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

WATER RETICULATION - ERF CONNECTION DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-WAR-05

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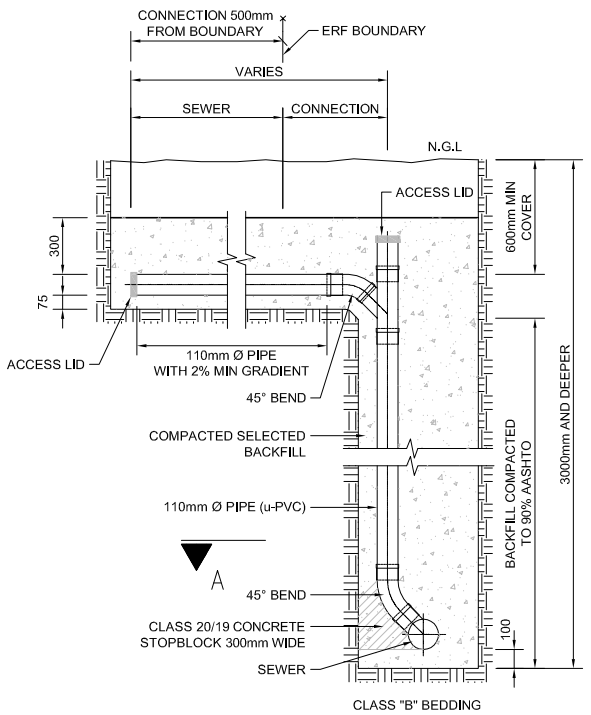
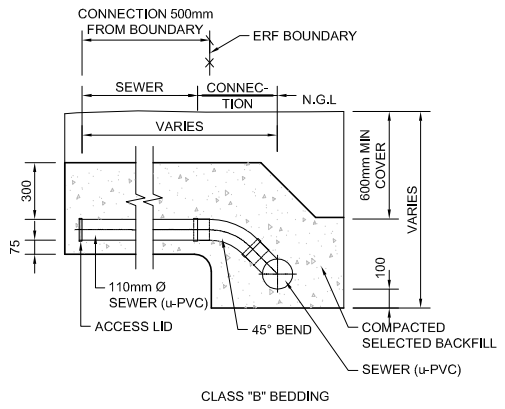


SECTION
NTS



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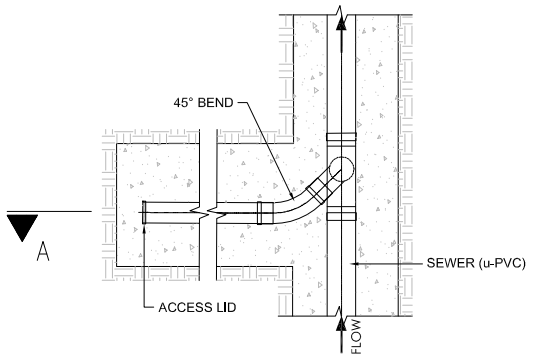
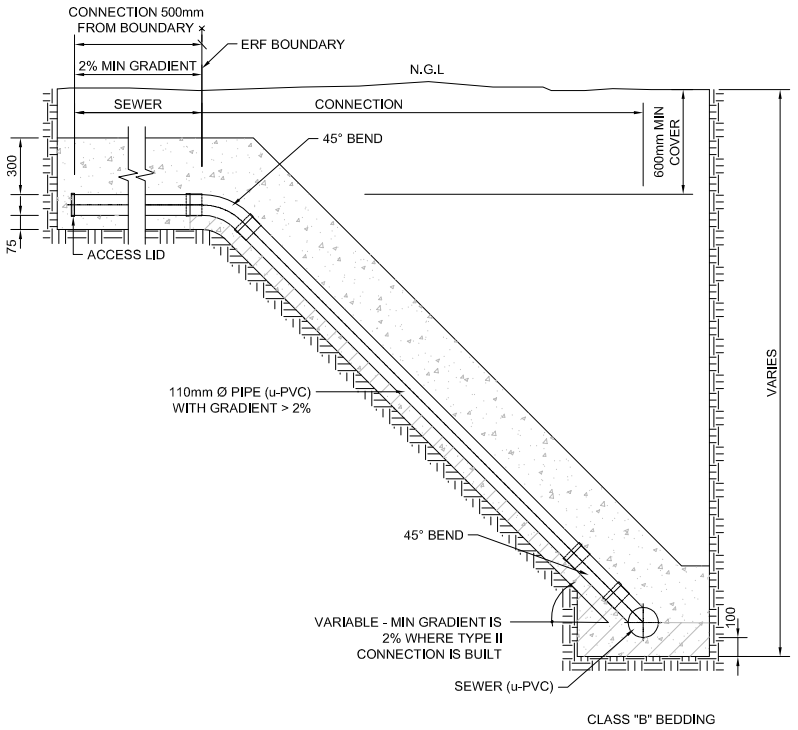
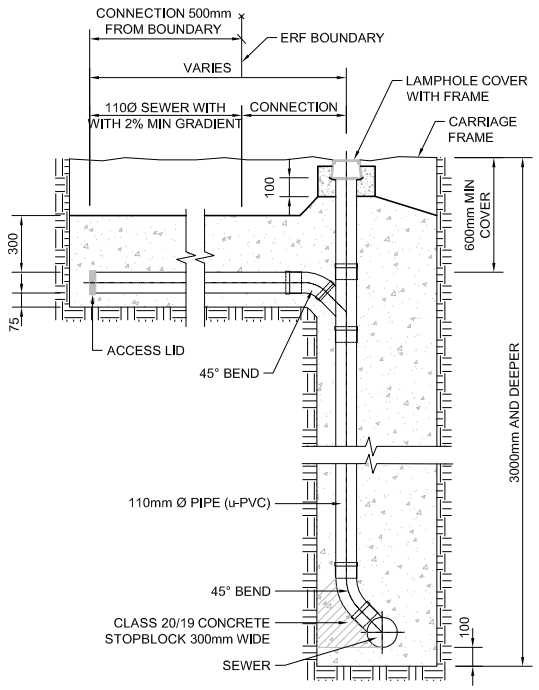


PLAN
HOUSE CONNECTION TYPE 2
N.T.S

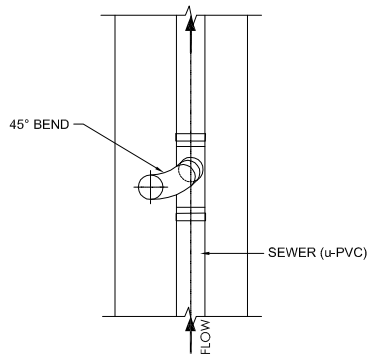


CONCRETE BEDDING CLASS "A" AND FLEXIBLE JOINTS ON SLOPES STEEPER THAN 30°

SECTION
HOUSE CONNECTION TYPE 3
N.T.S



SECTION
HOUSE CONNECTION TYPE 4
N.T.S

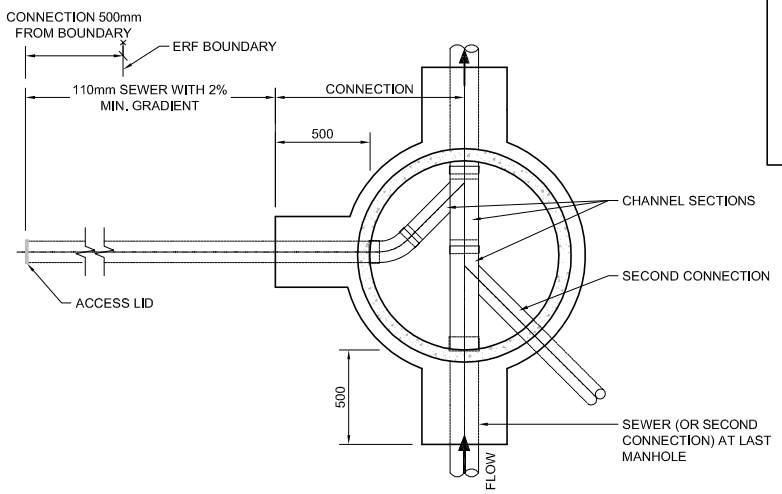


DETAIL
NTS

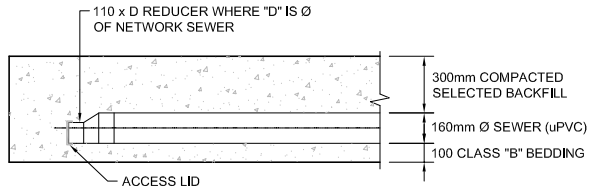
HOUSE CONNECTION TYPE 1
N.T.S

NOTES:

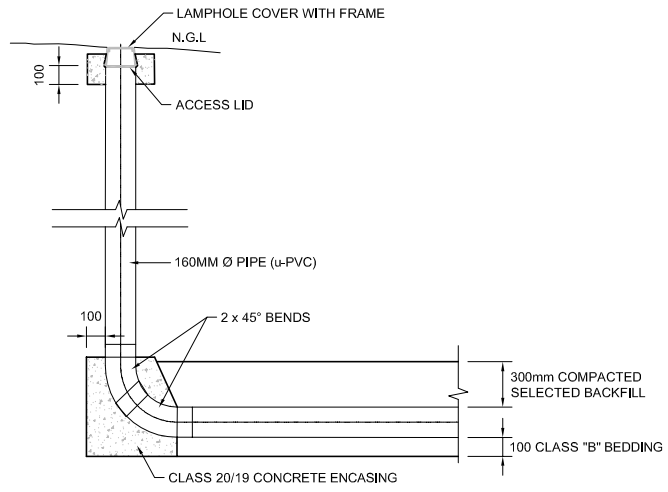
1. HOUSE CONNECTION TYPE 1 IS BUILT WHERE SEWER IS DEEPER THAN 3000 BUT NOT SITUATED UNDERNEATH CARRIAGE WAY.
2. HOUSE CONNECTION TYPE 2 IS BUILT WHERE SEWER IS SHALLOWER THAN 3000 AND IS GENERALLY USED.
3. HOUSE CONNECTION TYPE 3 IS ONLY TO BE BUILT ON WRITTEN INSTRUCTION OF THE ENGINEER IN THE CASES WHERE SEWER IS TO DEEP FOR TYPE 2 AND TOO SHALLOW FOR TYPE 1.
4. HOUSE CONNECTION TYPE 4 IS BUILT WHERE SEWER IS SITUATED UNDER CARRIAGE WAY AND DEEPER THAN 3 000.
5. IN CASES WHERE SEWER UNDER CARRIAGE WAY IS SHALLOWER THAN 3 000, TYPE 2 OR 3 HOUSE CONNECTION IS BUILT.
6. HOUSE CONNECTION TYPE 5 IS BUILT WHERE HOUSE CONNECTION AND MANHOLE POSITION IS THE SAME.
7. MINIMUM COVER FOR MAIN SEWER IS 1 000mm.
8. PIPES AND FITTINGS TO BE CLASS 34 u-PVC.
9. NB: REINFORCED CONCRETE COVER AND FRAME OR SANS TYPE 4 REINFORCED MANHOLE FRAME AND COVER MAY USED IN LIEU OF CAST IRON LAMPPOLE COVER AND FRAME.



PLAN
HOUSE CONNECTION TYPE 5
N.T.S



SECTION - STOPEND DETAIL
NTS



SECTION - CLEANING EYE DETAIL
NTS

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REV	DATE	DESCRIPTION	BY
A	2013/12	HYDROLOGICAL STUDY	M.E.

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

SEWER RETICULATION - ERF CONNECTION DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-SEW-01

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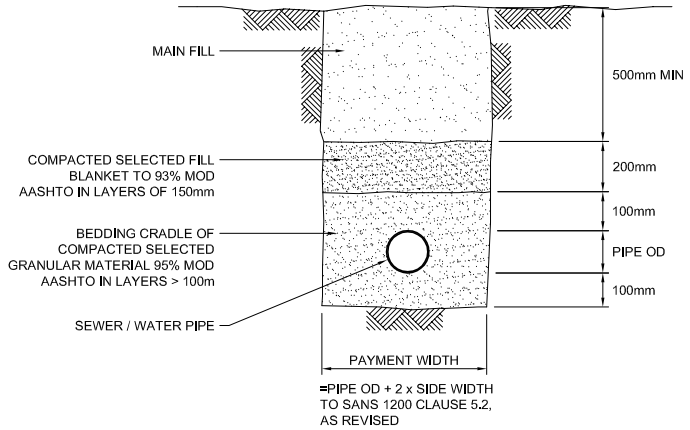
SELECTED GRANULAR MATERIAL
SHALL BE OF GRANULAR, NON COHESIVE NATURE THAT IS SINGULARLY GRADED BETWEEN 0,6mm AND 19mm, IS FREE DRAINING AND HAS A COMPACTABILITY FACTOR (SECTION LB OF PART 3 OF SANS 1200) NOT EXCEEDING 0,4 AND SHALL BE OF RIVER SAND ORIGIN.

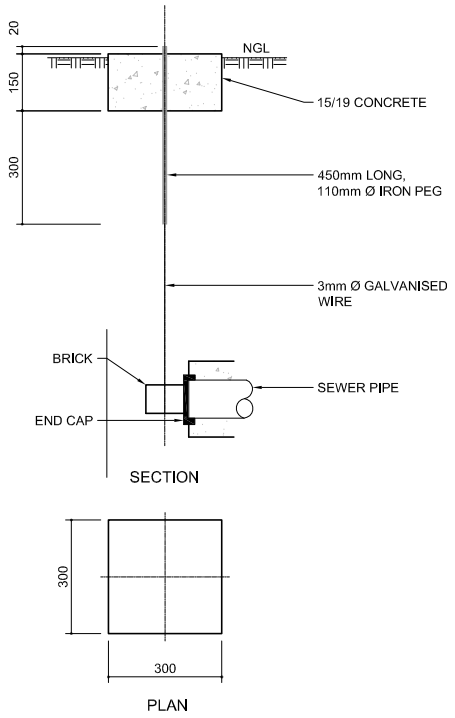
SELECTED FILL MATERIAL
SHALL BE MATERIAL WITH PI < 6, FREE FROM VEGETATION AND LUMPS AND STONES EXCEEDING 30mm.

NOTE:
UNDER ROADWAYS AND PARKING AREAS, THE MAIN FILL SHALL COMPRISE SELECTED FILL MATERIAL. ALL INSTALLATIONS ARE TO BE IN ACCORDANCE WITH SANS 1200 LB BEDDING (PIPES) AND SANS 1200 DB EARTHWORKS (PIPE TRENCHES).



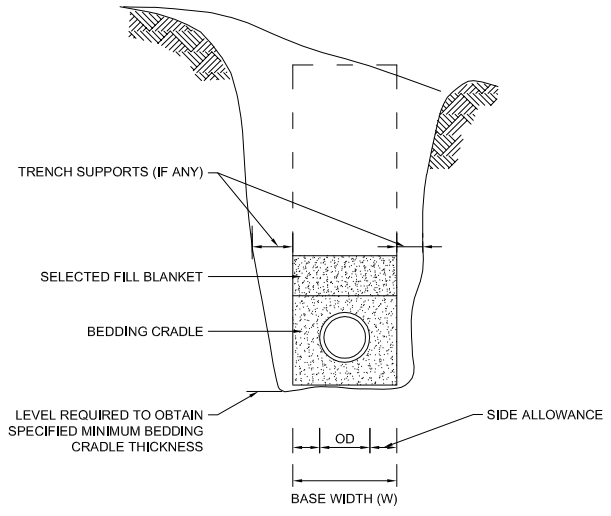
CROSS SECTION THROUGH TRENCH SMALL DIAMETER FLEXIBLE PIPES

N.T.S



MARKER BLOCK TO SHOW POSITION (4m) OF CONNECTION

N.T.S



MEASUREMENT OF BEDDING

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REVISIONS

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PROJECT DESCRIPTION
COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE
SEWER AND WATER RETICULATION - TYPICAL TRENCH DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
AS SHOWN	(A1)
CO-ORDINATE SYSTEM	REVISION
WGS 84	A

DWG NO
P0168-CIV-BP-SEW-02

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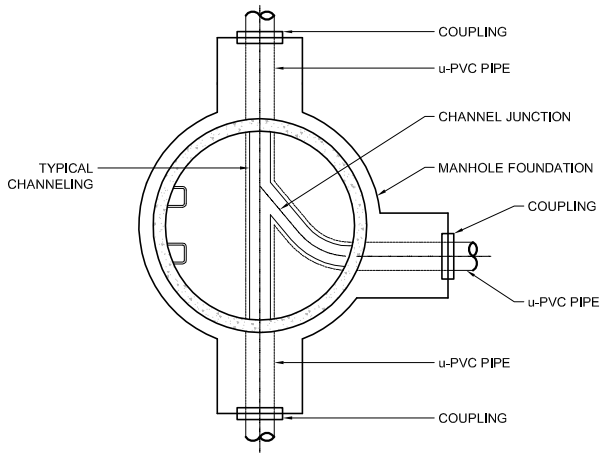
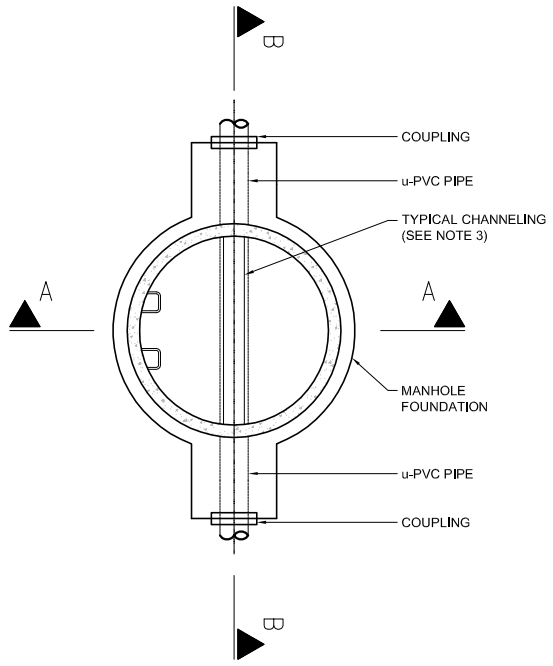


PLAN LAYOUT OF MANHOLE SINGLE PIPELINE

SCALE 1:20

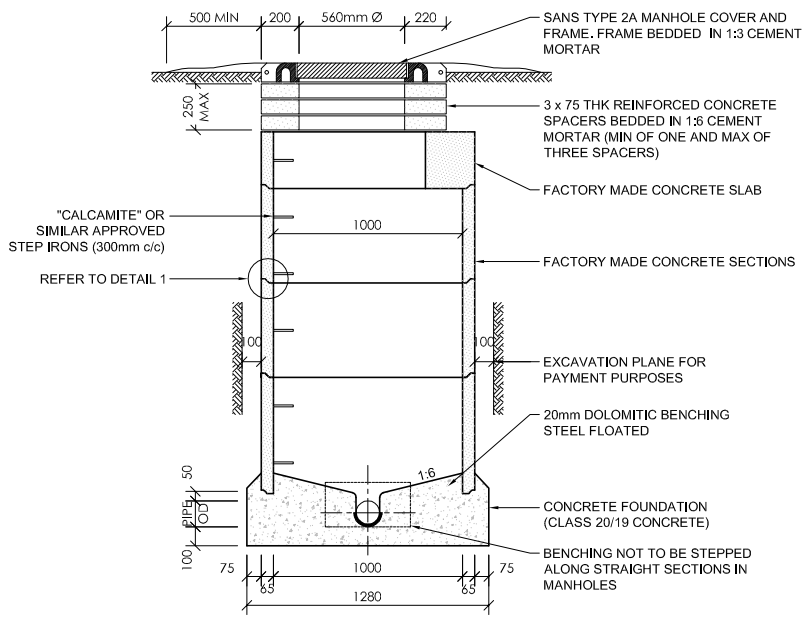
NOTES:

1. CONCRETE FOR MANHOLES MUST BE OF DOLOMITIC ORIGIN.
2. STEP IRONS SHALL BE 'CALCAMITE' OR APPROVED EQUIVALENT.
3. CHANNELING MUST BE BUILT WITH GLAZED EARTHENWARE PIPES.
4. CONCRETE SECTIONS MUST BE FIXED WITH AN EPOXY AND SILICA MIXTURE (WHICH HAS BEEN APPROVED BY AN EINGINEER).
5. MANHOLE COVERS SHALL COMPLY WITH THE REQUIREMENTS OF SABS 558 -1965.
6. FACTORY MADE MANHOLE SECTIONS MUST BE IN ACCORDANCE WITH S.A.B.S. 1924-1981.
7. OVER EXCAVATION MAY ONLY BE FILLED AFTER APPROVAL BY THE ENGINEER WITH GRADE 20/19 CONCRETE OR SUITABLE MATERIAL AS DIRECTED BY THE ENGINEER.
8. NO PART OF THE MANHOLE MAY BE FINISHED OFF WITH CEMENT-WASH OR MORTAR.
9. ALL CONNECTING PIPES TO MANHOLES SHALL HAVE A MAXIMUM LENGTH OF 500mm.



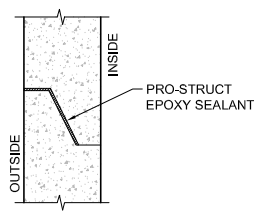
PLAN LAYOUT OF MANHOLE MULTIPLE PIPELINES

SCALE 1:20



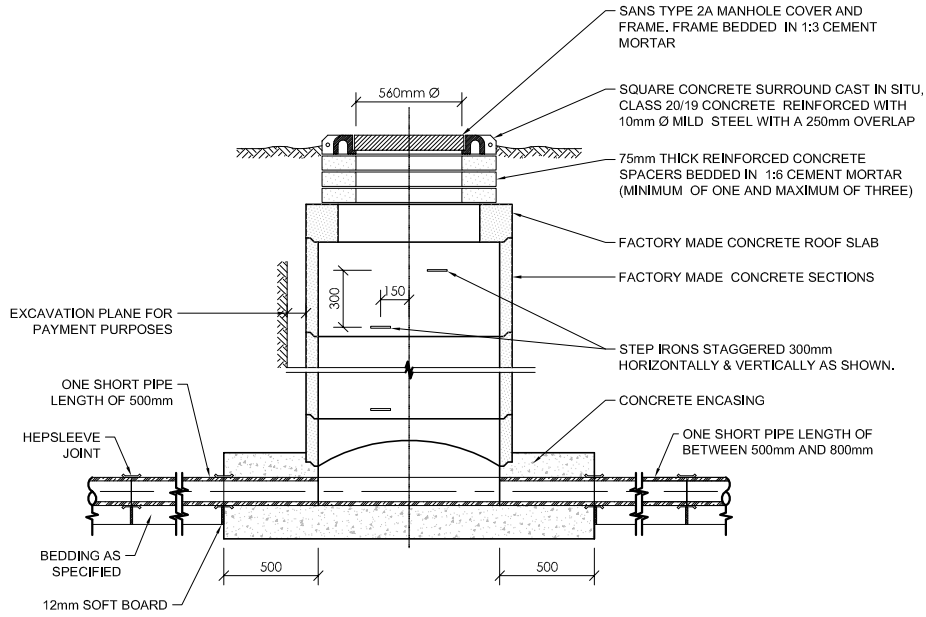
SECTION A-A TYPICAL SECTION THROUGH MANHOLE

SCALE 1:20



DETAIL 1

NTS



SECTION B-B TYPICAL SECTION THROUGH MANHOLE

SCALE 1:20

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REVISIONS

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

SEWER RETICULATION - MANHOLE DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
AS SHOWN	(A1)
CO-ORDINATE SYSTEM	REVISION
WGS 84	A

DWG NO

P0168-CIV-BP-SEW-03

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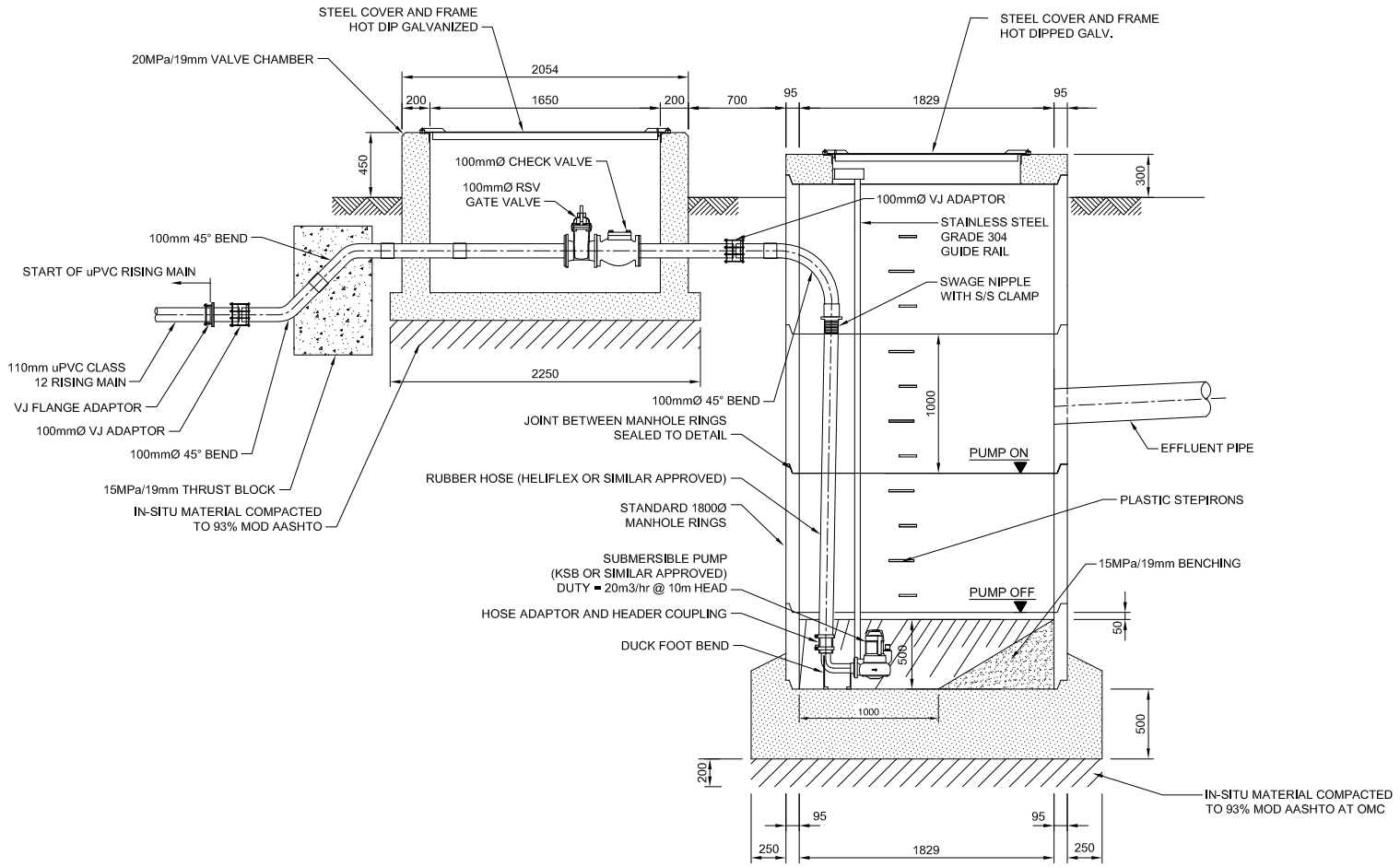
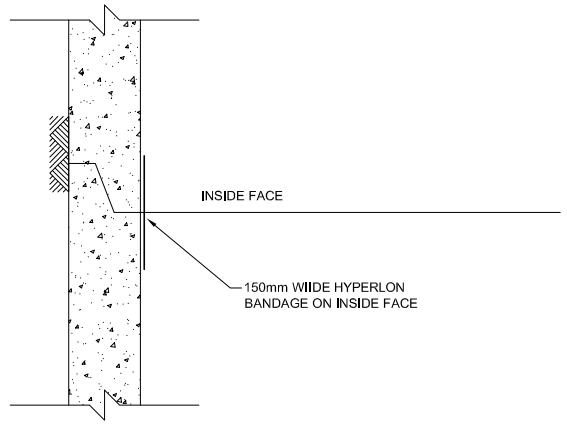


CL SECTION
SEWER PUMPSTATION

SCALE 1:25



SEALING DETAIL
TO MANHOLE RING

SCALE 1:5

NOTES:

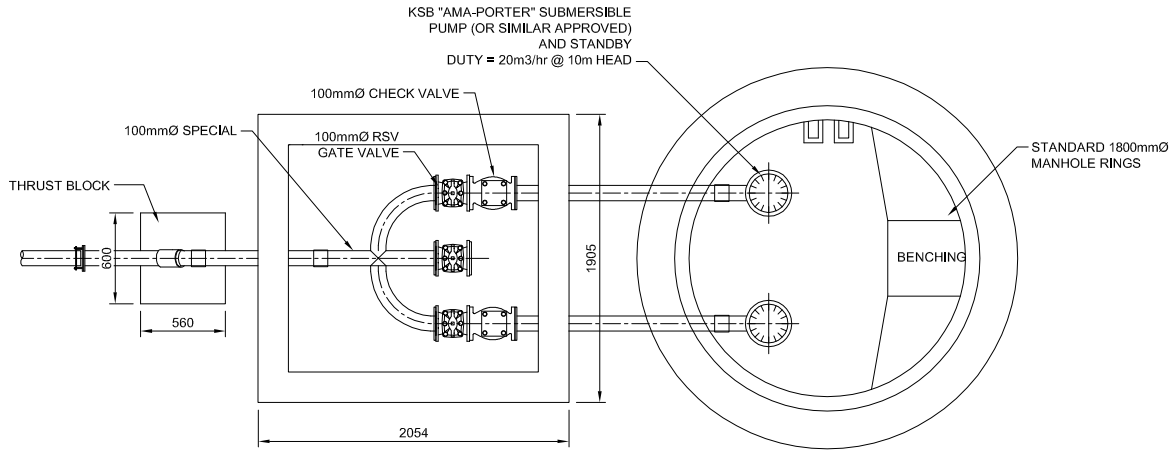
1) ALL STEEL ITEMS BELOW THE BROWN WATER LEVEL TO BE STAINLESS STEEL GRADE 316, 250 MICRON COPON COATED AND LINED.

2) ALL STEEL ITEMS ABOVE THE BROWN WATER LEVEL TO BE MILD STEEL GRADE 300W, HOT DIP GALVANISED TO 90 MICRON THICKNESS IN ACCORDANCE WITH SABS SPEC. NO. 1461.

3) FLANGE DRILLING TABLE SHALL BE SABS TABLE 1000/3. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT ALL FLANGE SIZES AND DRILLING MATCH.

4) TOTAL LENGTH OF 100mmØ STEEL PIPES (BSP TREADED), INCLUDING BENDS, = 7 000mm.

5) TOTAL LENGTH OF RUBBER HOSE = 6 000mm (MAXIMUM).



PLAN
SEWER PUMPSTATION

SCALE 1:25

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

SEWER RETICULATION - PUMPSTATION DETAIL

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
AS SHOWN	(A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-SEW-04

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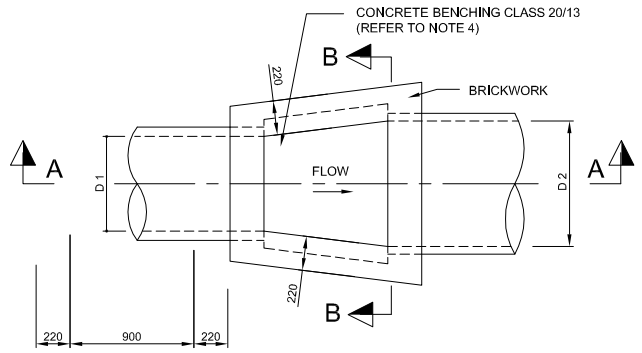
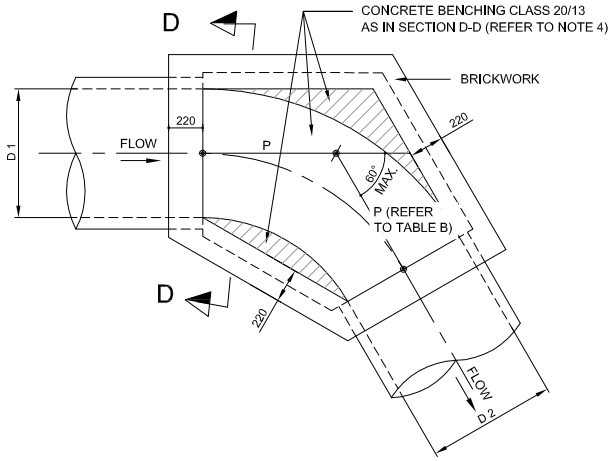


PLAN OF TYPE D JUNCTION BOX (WITHOUT COVER SLAB)

D 1 < D 2

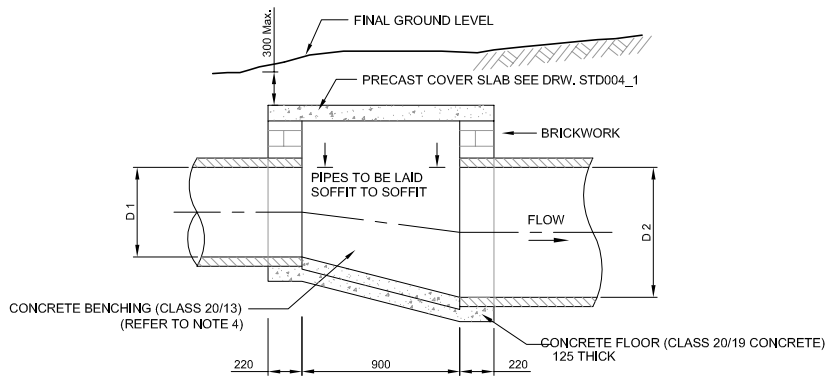
TABLE B

D 2 DIAMETER OF DOWN STREAM PIPE	DISTANCE P
450	700
525	700
600	750
675	780
750	800
825	825
900	850
1050	870
1200	925
1350	1000
1500	1100



PLAN OF TYPE D JUNCTION BOX (WITHOUT COVER SLAB)

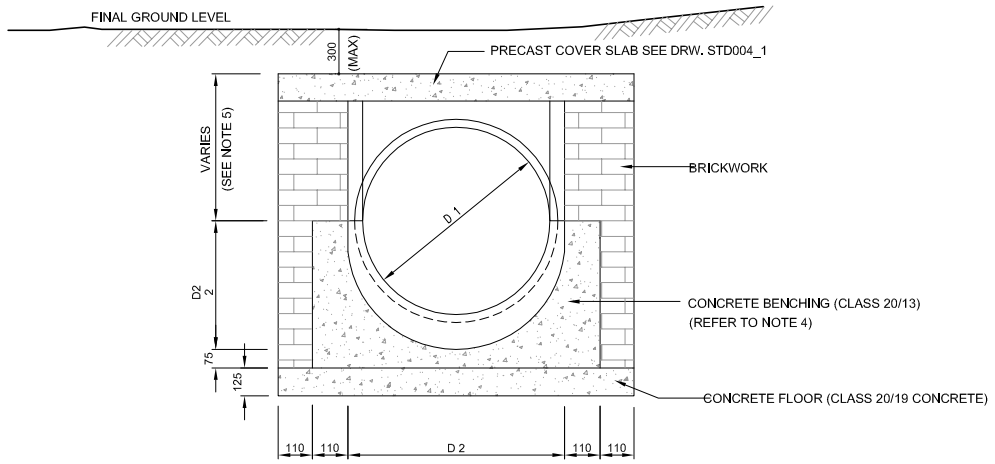
D 1= D 2 OR D 1 < D 2



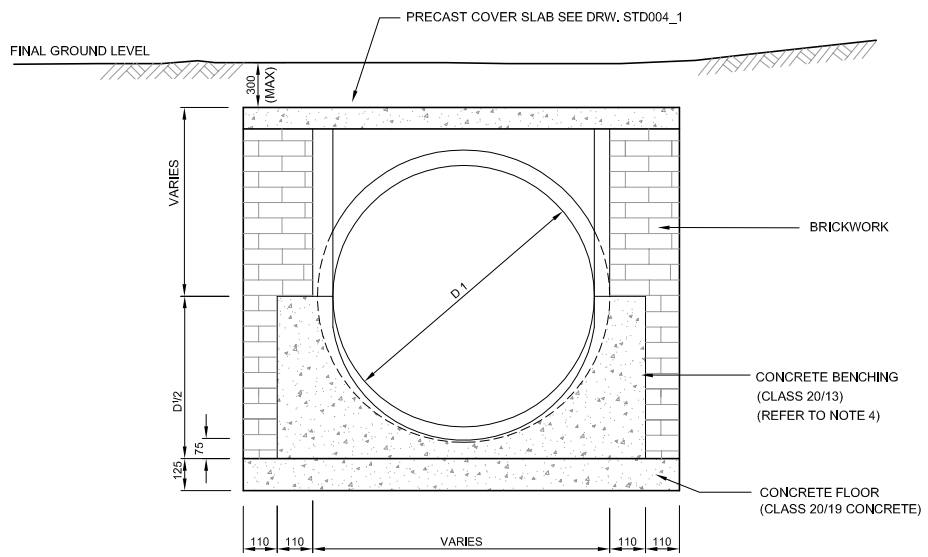
SECTION A-A

NOTES:

1. ALL STORMWATER PIPES TO BE LAID SOFFIT TO SOFFIT
2. MINIMUM PIPE DIAMETER OF ALL PIPES IS 450mm.
3. MAXIMUM ANGLE BETWEEN ADJOINING PIPES IS 60°.
4. WHERE A PIPE WALL IS AT LEAST 75mm FROM THE NEAREST JUNCTION BOX WALL, THE CONCRETE BENCING CAN BE STARTED ADJACENT TO THE DOUBLE BRICK WALL.
5. WHERE THE TOTAL DEPTH OF THE JUNCTION BOX (INVERT LEVEL TO FINISHED GROUND LEVEL) EXCEEDS 2,0m A STRUCTURAL DESIGN MUST BE SUBMITTED BY A PROFESSIONAL ENGINEER.
6. ALL BRICKS SHALL COMPLY WITH SABS 227 AND SHALL BE ENGINEERING UNITS OF CLASS FBS (FACE BRICK STANDARD) WITH A NOMINAL COMPRESSIVE STRENGTH OF 12 MPa.
7. ALSO REFER TO SABS 1200LE



SECTION B-B



SECTION D-D

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

STORMWATER RETICULATION - JUNCTION BOX DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
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CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

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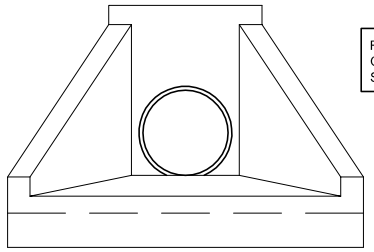
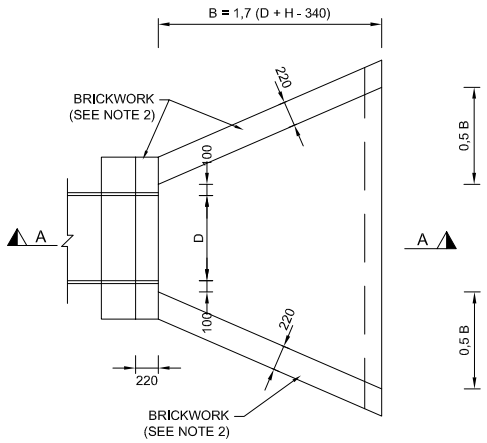
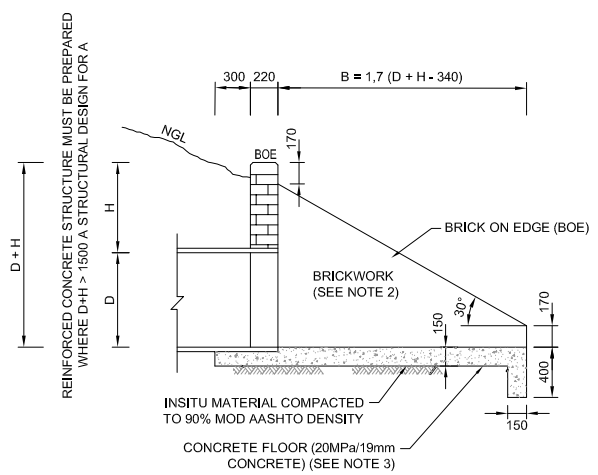


REFER TO NOTE 1 FOR APPLICATION OF TYPICAL STORMWATER OUTLET STRUCTURE

ELEVATION OF TYPICAL STORMWATER OUTLET STRUCTURE



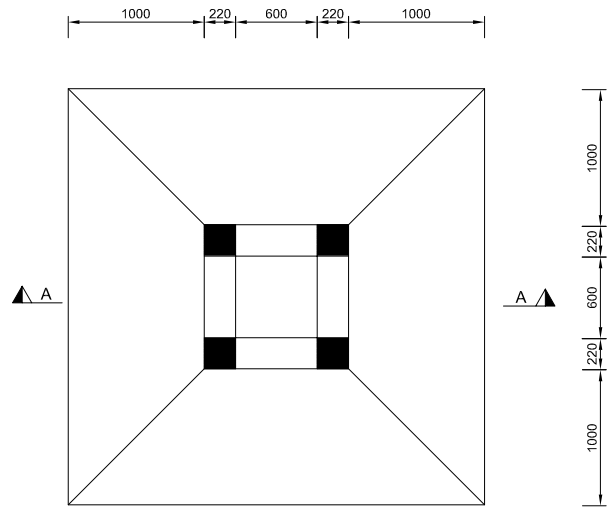
PLAN OF TYPICAL STORMWATER OUTLET STRUCTURE



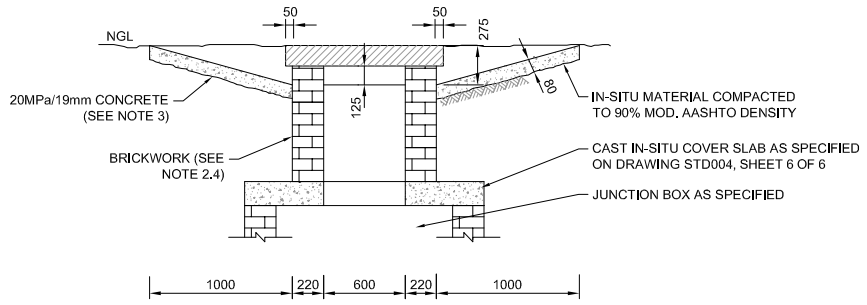
SECTION A–A

NOTES:

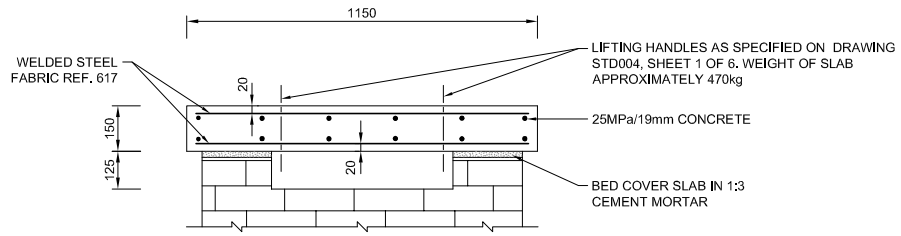
1. APPLICATION OF TYPICAL OUTLET STRUCTURE.
   - 1.1 THE TYPICAL STORMWATER OUTLET STRUCTURE MAY ONLY BE USED WHERE: - SPECIFIED BY THE ENGINEER -THE FLOW VELOCITY AT THE OUTLET PERMITS THE USE - -D + H < 1500.
   - 1.2 FOR HIGHER FLOW VELOCITIES THE STRUCTURE MUST BE MODIFIED OR ANOTHER TYPE OF STRUCTURE MUST BE USED, ACCORDING TO THE SPECIFICATIONS OF THE ENGINEER.
   - 1.3 NO SCOURING OR EROSION MAY OCCUR DOWNSTREAM OF THE OUTLET STRUCTURE.
   - 1.4 FOR LARGER STRUCTURES A STRUCTURAL REINFORCED CONCRETE DESIGN IS REQUIRED. MASONRY WALLS OF OUTLET STRUCTURE.
2. MASONRY
   - 2.1 MASONRY WALLING SHALL CONFORM IN ALL RESPECTS TO THE REQUIREMENTS OF SANS 10164-1.
   - 2.2 MORTAR SHALL BE CLASS II (COMPRESSIVE STRENGTH OF 7 MPa AT 28 DAYS),
   - 2.3 THE REQUIREMENTS SET OUT IN APPENDIX B OF SANS 10164-1; SHALL BE ADHERED TO UNLESS OTHERWISE APPROVED OR DIRECTED BY THE ENGINEER.
   - 2.4 ALL BRICKS SHALL COMPLY WITH SANS 227 AND SHALL BE ENGINEERING UNITS OF CLASS FBS (FACE BRICK STANDARD) WITH A NOMINAL COMPRESSIVE STRENGTH OF 12 MPa.
3. CONCRETE
   - 3.1 ALL CONCRETE TO BE CURED FOR A MINIMUM PERIOD OF 7 DAYS.



PLAN OF FIELD INLET (Without cover slab)



SECTION B–B



DETAIL OF PRECAST COVER SLAB

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

STORMWATER RETICULATION - INLET AND OUTLET DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
AS SHOWN	(A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-SWR-02

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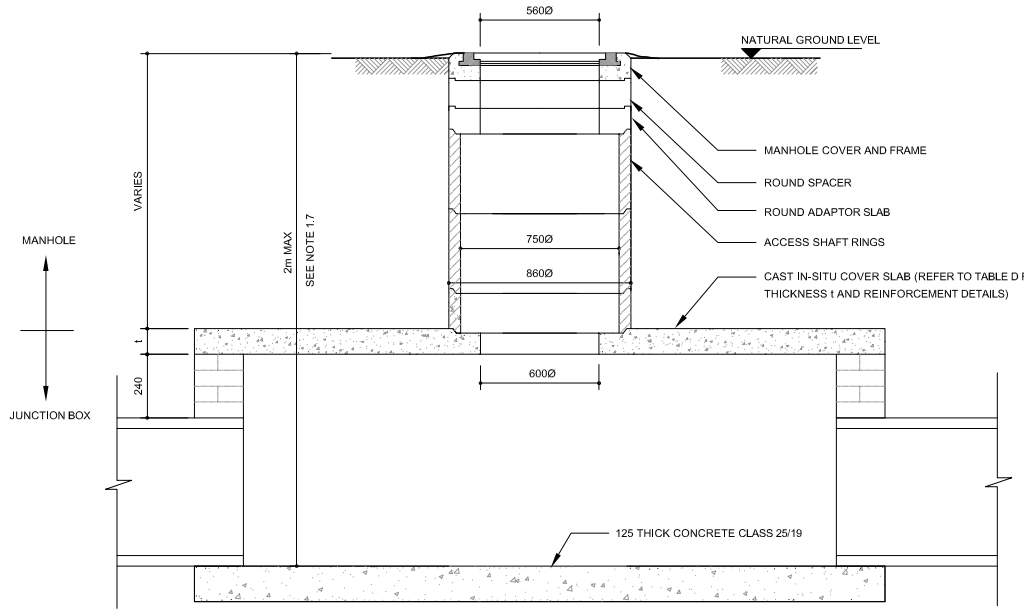
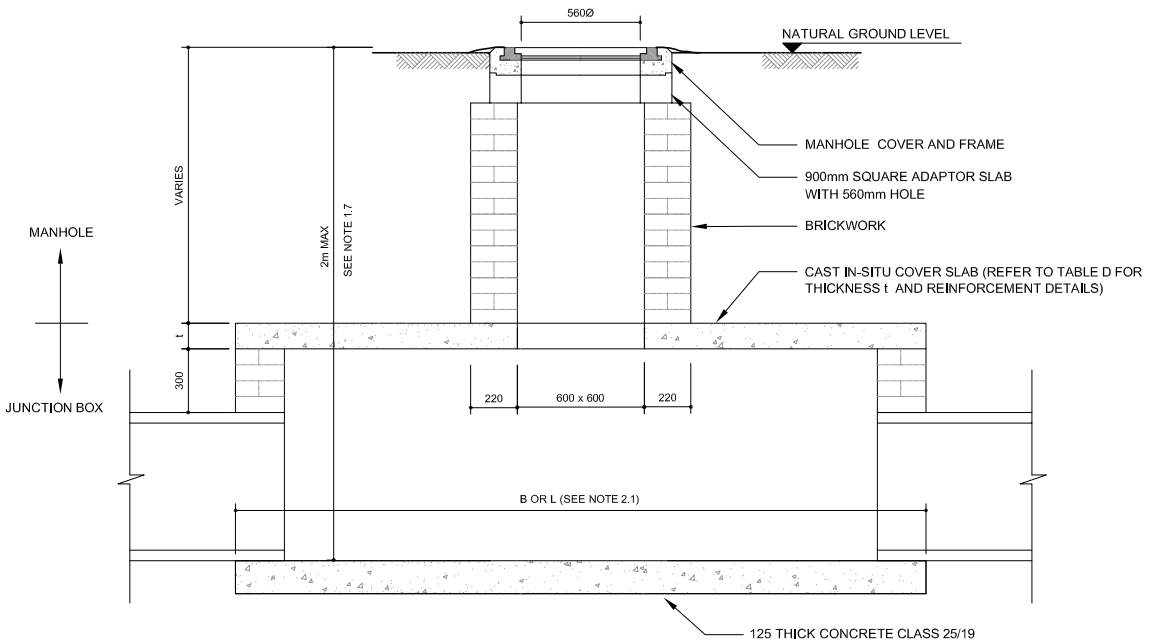
NOTES

1. MANHOLE
   - 1.1 ALL PRECAST MANHOLE SECTIONS SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF SANS 1294.
   - 1.2 NO STEP IRONS SHALL BE REQUIRED UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
   - 1.3 DIMENSIONS OF PRECAST MANHOLE SECTIONS ARE APPROXIMATE AND MAY VARY SLIGHTLY ACCORDING TO DIFFERENT MANUFACTURER'S SPECIFICATIONS.
   - 1.4 POSITION OF MANHOLES SHALL BE DIRECTLY ABOVE THE PI OF ADJOINING STORMWATER PIPES.
   - 1.5 THE FUNCTION OF THE COMBINATION PRECAST CONCRETE/CAST IRON MANHOLE COVER IS TO REPLACE LOST CAST IRON COVERS, UNLESS OTHERWISE SPECIFIED.
   - 1.6 ALL CONCRETE MANHOLE COVERS SHALL HAVE THE LETTERS "SW" FORMED OR ENGRAVED ON TOP. EACH LETTER SHALL BE 50mm WIDE, 75mm HIGH AND 5mm THICK.
   - 1.7 MANHOLE COVERS AND FRAMES MADE OF OTHER MATERIALS, LIKE POLYMER CONCRETE, MUST COMPLY WITH THE RELEVANT SANS-SPECIFICATIONS, BE APPROVED BY THE ENGINEER IN WRITING AND BE INSTALLED ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
   - 1.8 WHERE THE TOTAL DEPTH OF THE JUNCTION BOX/MANHOLE COMBINATION (INVERT LEVEL TO FINISHED GROUND LEVEL) EXCEEDS 2,0m, A STRUCTURAL DESIGN MUST BE SUBMITTED BY A PROFESSIONAL ENGINEER.
   - 1.9 ALL BRICKS SHALL COMPLY WITH SANS 227 AND SHALL BE ENGINEERING UNITS OF CLASS FBS (FACE BRICK STANDARD) WITH A NOMINAL COMPRESSIVE STRENGTH OF 12 MPA.
2. CAST IN-SITU COVER SLABS
   - 2.1 MEASUREMENT B IS ALWAYS SMALLER THAN L.
   - 2.2 CONCRETE TO BE CLASS 25/19.
   - 2.3 CONCRETE TO BE CURED FOR A MINIMUM PERIOD OF 7 DAYS.
   - 2.4 MINIMUM COVER TO REINFORCEMENT IS 20mm.
   - 2.5 TYPE, BAR AND SPACING OF REINFORCEMENT AS SPECIFIED IN TABLE D.
   - 2.6 MAIN REINFORCEMENT TO BE SHAPE CODE 38, WITH HOOK LENGTH (A- DIMENSION) NOT LESS THAN T MINUS 60, EXCEPT FOR SLABS WITH A SPAN NOT EXCEEDING 1000, WHERE NO HOOKS ARE REQUIRED AND SHAPE CODE 20 IS USED.



MANHOLE WITH PRECAST SHAFT

NTS



MANHOLE WITH MASONARY SHAFT

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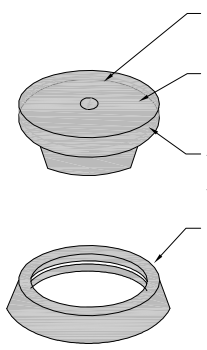
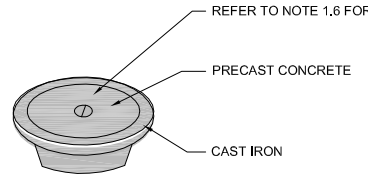
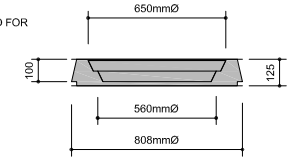
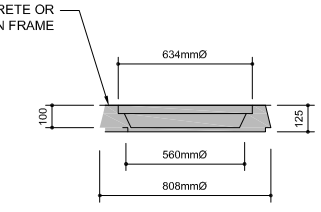






PRECAST CONCRETE FRAME AND COVER

NTS



COMBINATION PRECAST CONCRETE/ CAST IRON FRAME AND COVER

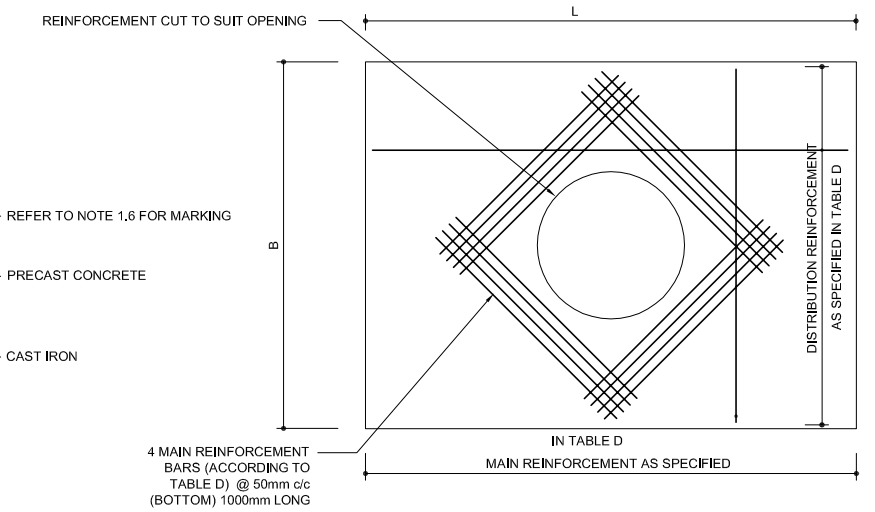
NTS (SEE NOTE 1.5)

TABLE C: USE OF MANHOLES AT JUNCTION BOXES

APPLICATION	TYPE OF COVER AND FRAME
AT JUNCTION BOXES FALLING UNDERNEATH THE CARRIAGE WAY.	SABS TYPE 4 CAST IRON HEAVY DUTY
AT LEAST EVERY 100m ON LONG INACCESSIBLE STORMWATER LINES.	SABS TYPE 4 PRECAST CONCRETE MEDIUM DUTY
AT JUNCTION BOXES FALLING UNDERNEATH BLOCK OR CONCRETE PAVING ON THE SIDEWALK.	SABS TYPE 4 PRECAST CONCRETE MEDIUM DUTY
AT JUNCTION BOXES WHERE THE MAIN STORMWATER LINE CHANGES COURSE	SABS TYPE 4 PRECAST CONCRETE MEDIUM DUTY
AT JUNCTION BOXES INDICATED OTHERWISE ON THE DRAWINGS OR SPECIFIED BY THE ENGINEER.	SABS TYPE 4 AS SPECIFIED

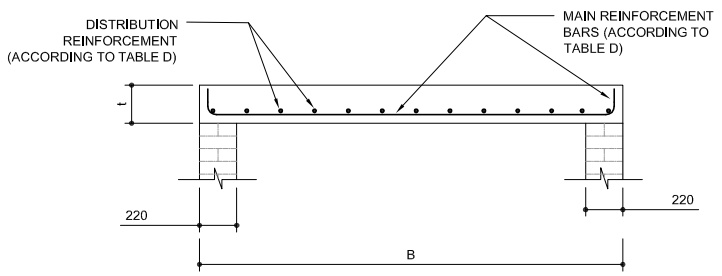
TABLE D: REINFORCEMENT DETAILS FOR CAST IN-SITU COVER SLABS (NOTE: B < L)

SPAN (B) (MM)	THICKNESS (T) (MM)	MAIN REINFORCEMENT
UP TO 1500	175	Y12 - 120
UP TO 2500	200	Y16 - 150
UP TO 3000	225	Y16 - 150
> 3000	DESIGN TO BE SUBMITTED	
DISTRIBUTION REINFORCEMENT: Y12 BARS @ 200 C/C		
REFER TO NOTES FOR BENDING DETAILS.		



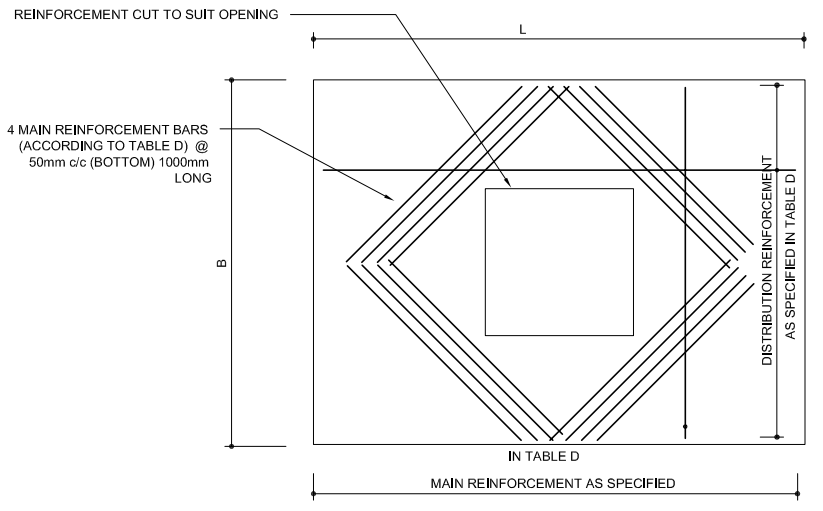
CAST INSITU COVER SLAB FOR CIRCULAR SHAFT SECTION

NTS



CROSS SECTION

NTS (NOT INDICATING REINFORCEMENT AROUND HOLE)



CAST INSITU COVER SLAB FOR SQUARE SHAFT SECTION

NTS

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

STORMWATER RETICULATION - ACCESS MANHOLE DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-SWR-03

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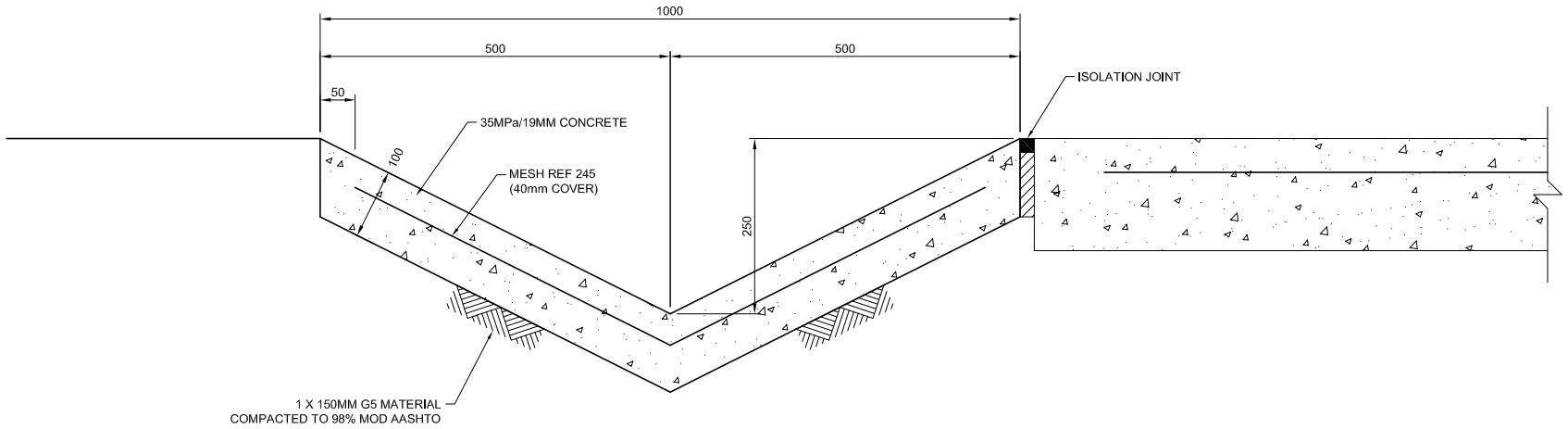

STORMWATER CHANNEL
TYPICAL SECTION

SCALE 1:5

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

STORMWATER RETICULATION - CHANNEL DETAIL

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE: AS SHOWN	PAPER SIZE: (A1)
CO-ORDINATE SYSTEM: WGS 84	REVISION: A

DWG NO

P0164-CIV-BP-SWR-04

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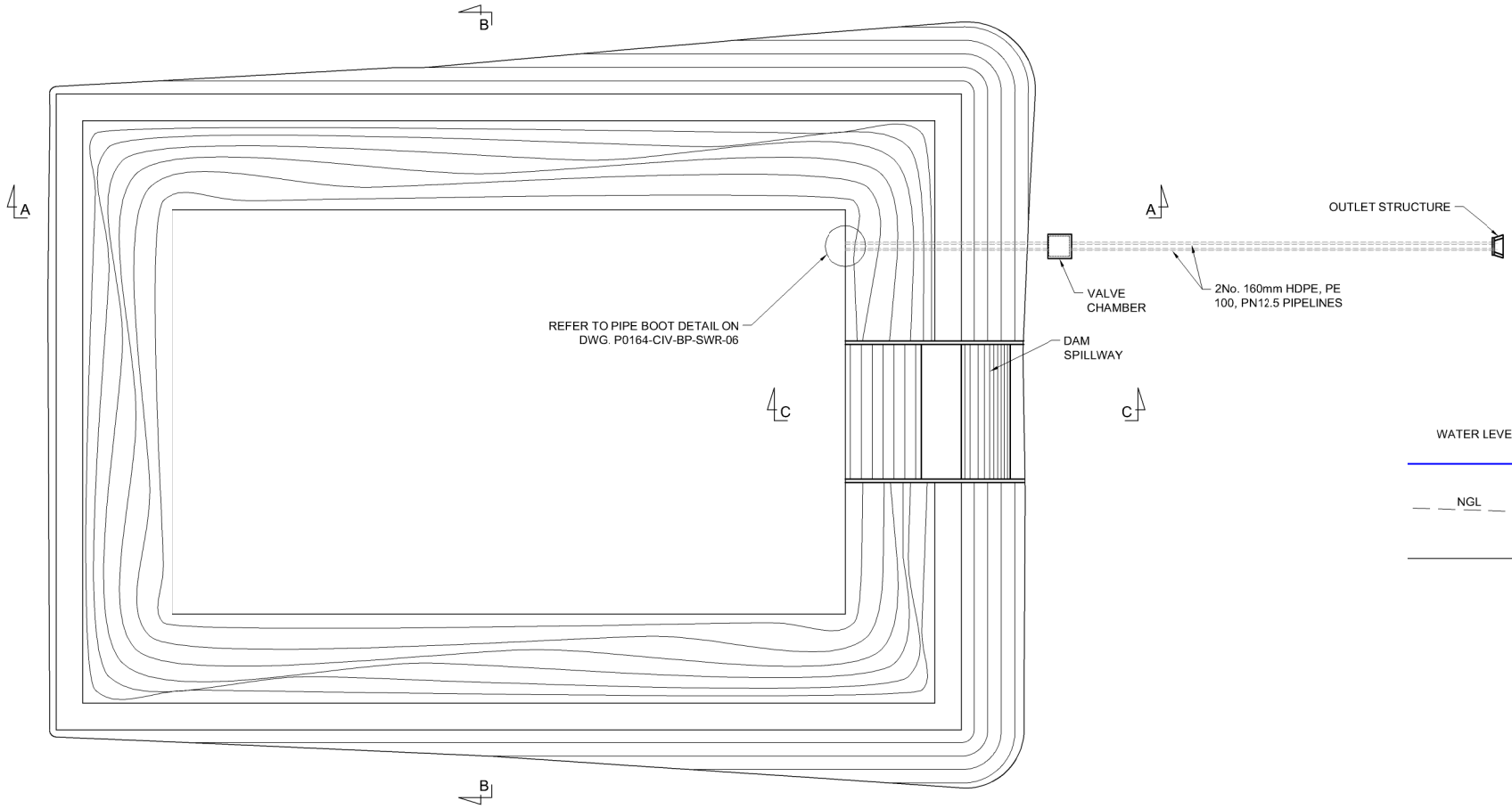
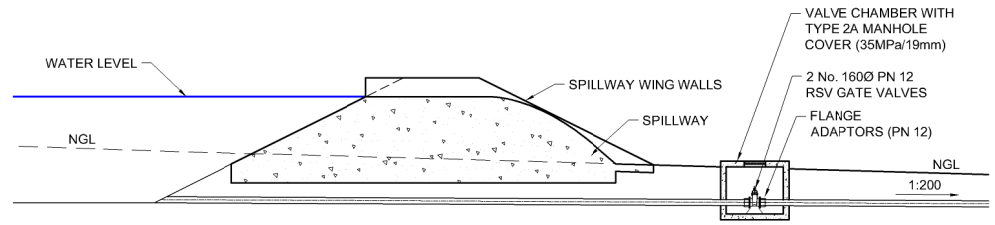
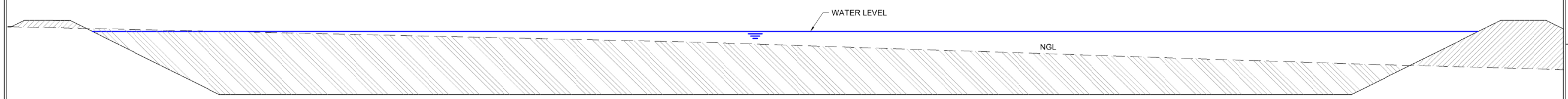


STORMWATER DAM
LAYOUT
SCALE 1:250



STORMWATER DAM
SECTION C-C (SPILLWAY AND VALVE CHAMBER)
SCALE 1:100



STORMWATER DAM
SECTION A-A (LONG AXIS)
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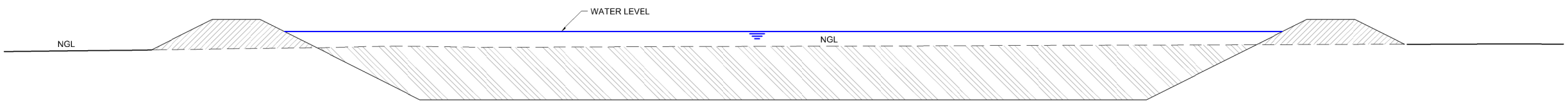

STORMWATER DAM WALL
SECTION B-B (SHORT AXIS)
SCALE 1:100

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

STORMWATER RETICULATION - TYPICAL STORMWATER DAM SECTIONS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

SCALE	PAPER SIZE
AS SHOWN	(A1)
CO-ORDINATE SYSTEM	REVISION
WGS 84	A

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P0161-CIV-BP-SWR-05

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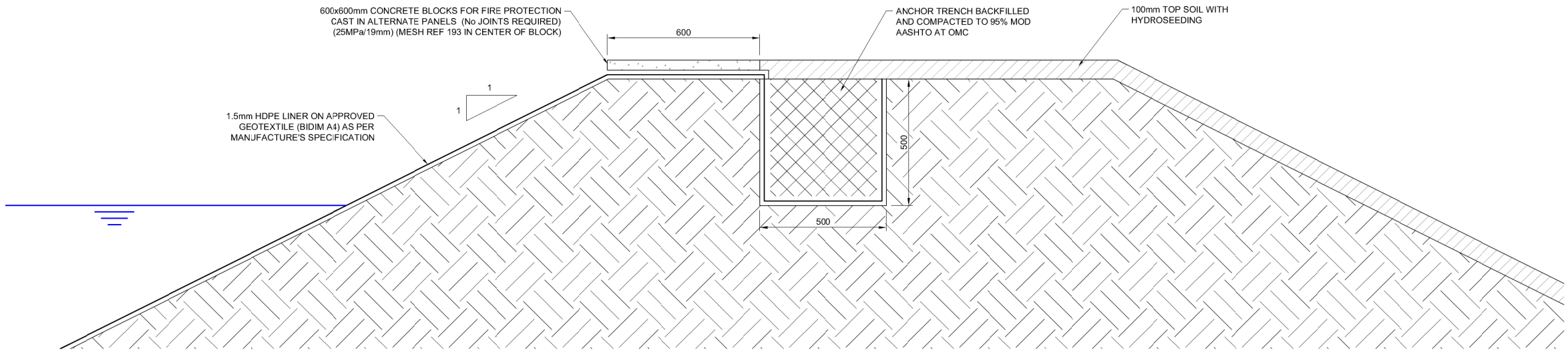
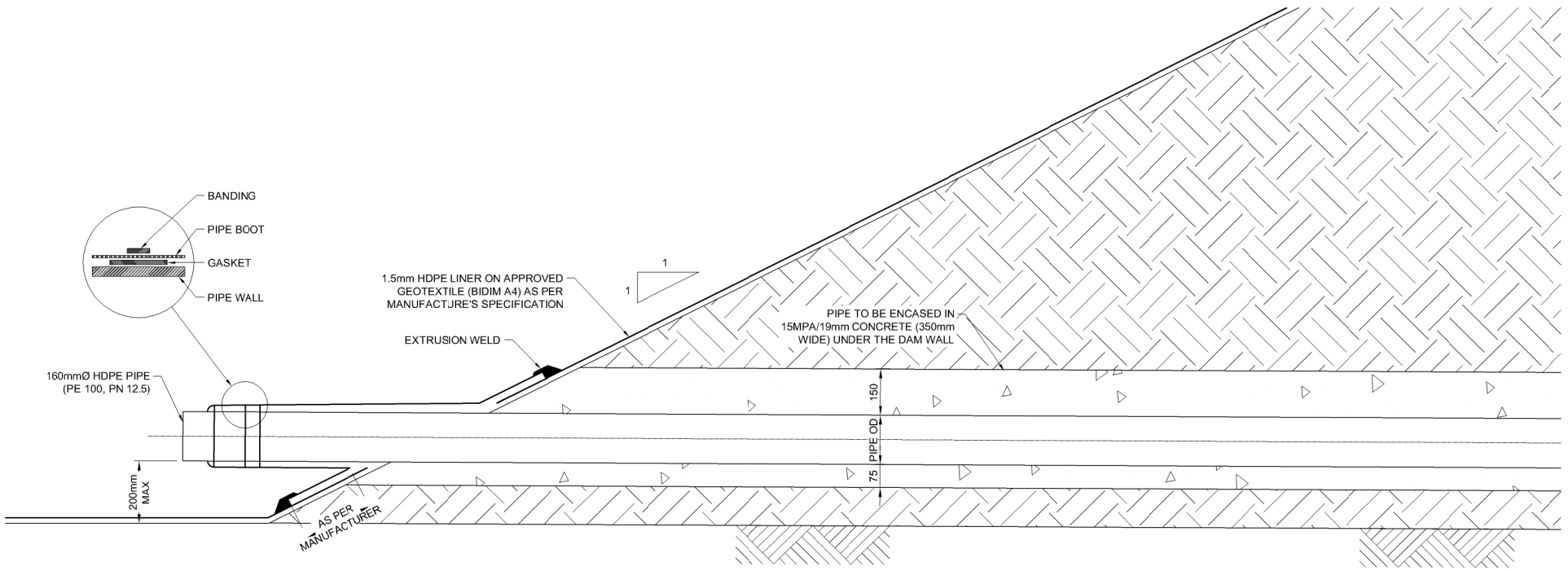


STORMWATER DAM WALL
LINING AND FINISHING DETAIL

SCALE 1:10



STORMWATER DAM WALL
PIPE BOOT DETAIL

SCALE 1:10

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PROJECT DESCRIPTION

COAL MINE ON THE FARM DROOGENFONTEIN 241 IR PORTION 26, 46 AND 47

TITLE

STORMWATER RETICULATION - STORMWATER DAM DETAILS

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DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
SIGNED		SIGNED	
DRAWN DATE	DECEMBER 2013	APPROVED DATE	DECEMBER 2013

BASIC PLANNING

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CO-ORDINATE SYSTEM	REVISION
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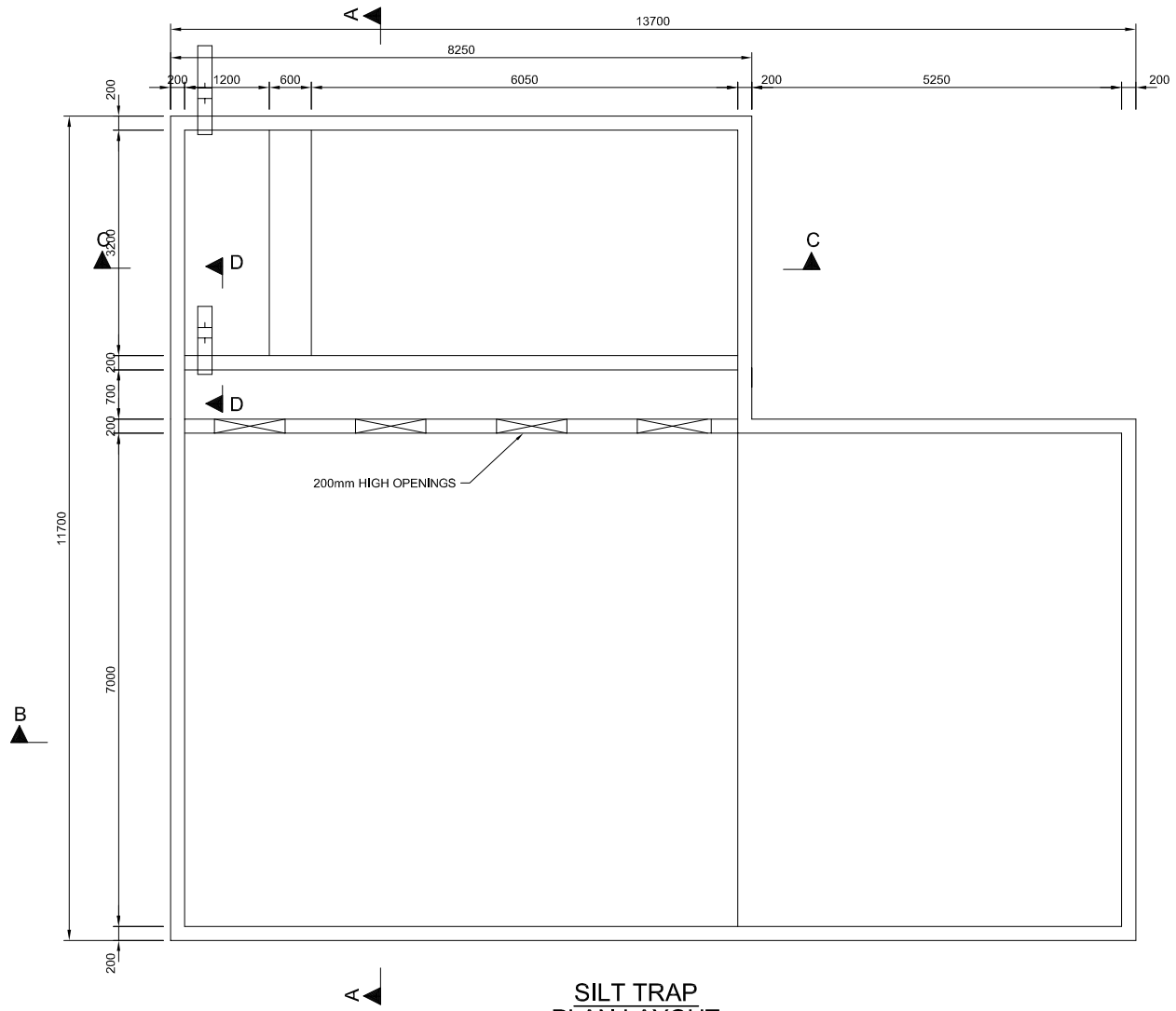
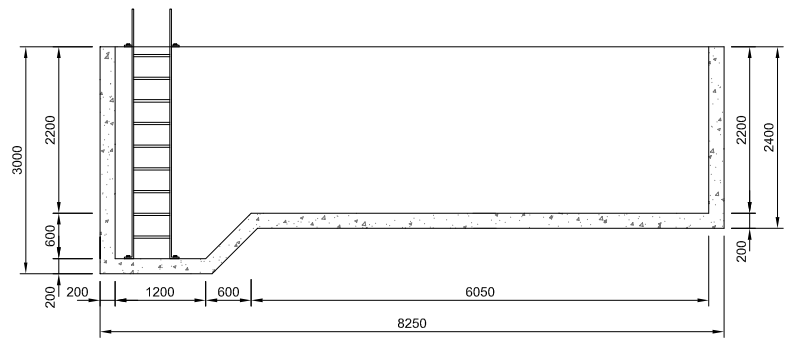


SILT TRAP PLAN LAYOUT

SCALE 1:10



SECTION C-C

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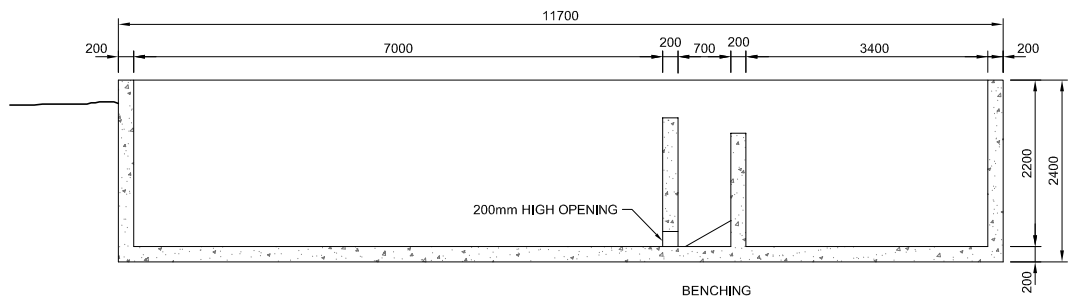

SECTION A-A

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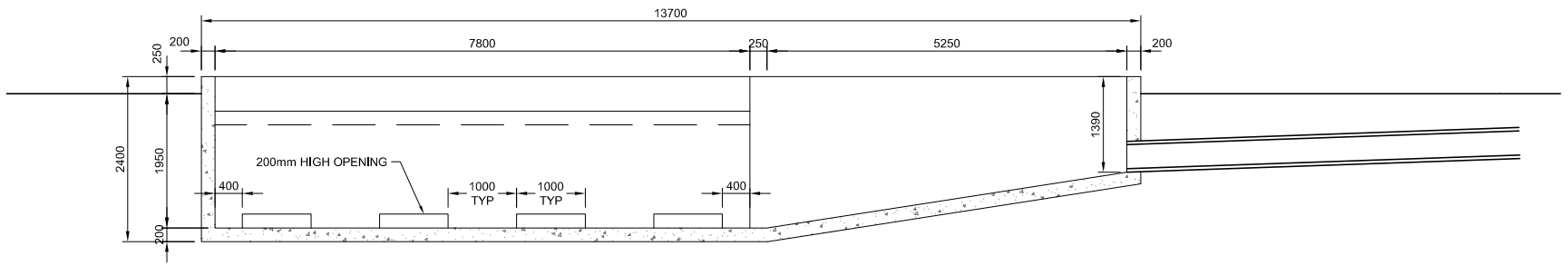

SECTION B-B

SCALE 1:50

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TITLE

STORMWATER RETICULATION - TYPICAL SILT TRAP DETAILS

DESIGN BY	M EINKAMERER	DRAWN BY	M EINKAMERER
DESIGN CHECKED	S COETZEE	DWG CHECKED	S COETZEE
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BASIC PLANNING

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DWG NO

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