ZITHOLELE CONSULTING

KUSILE POWER STATION 60 YEAR ASH DISPOSAL FACILITY: ENGINEERING DETAILED CONCEPT DESIGN REPORT

Report No.: JW140/13/D121 – Rev2

April 2014

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DOCUMENT APPROVAL RECORD

Report No.: JW140/13/D121 – Rev2

ACTION	FUNCTION	NAME	DATE	SIGNATURE
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Approved	Project Director	Danie Brink	06/08/2013	

RECORD OF REVISIONS AND ISSUES REGISTER

Date	Revision	Description	Issued to	Issue Format	No. Copies
07/08/2013	0	Site A Only (Revision 0)	Zitholele Consulting	Hard Format, pdf ,soft copy on CD	1 of each
			Eskom – Kusile Power Station	Hard Format, pdf ,soft copy on CD	1 of each
			The Department of Water Affairs	Hard Format, pdf ,soft copy on CD	1 of each
10/01/2014	1	Final Submission	Zitholele Consulting	Word Format	1 of each
04/04/2014	2	Zitholele comments included	Zitholele Consulting	Hard Format, pdf ,soft copy on CD	1 of each

SYNOPSIS

Kusile Power Station is one of two new coal fired power stations being constructed by Eskom to meet the growing power needs of South Africa. An integral part of the power station is the ash disposal facility that will store the residue of the coal combustion process for the life of the power station.

The ash facility will have a starter platform that will take approximately 5 years to construct from ash. The remaining ash facility will have capacity for approximately 55 years. Therefore the total life of the facility will be 60 years.

A waste classification was carried out on the ash sampled from Kendal Power Station in terms of DEA's draft (at the time) waste classification regulations. The ash is classified as a Type 3 waste (low hazard waste). Therefore the ash requires disposal on a landfill with a Class C barrier system.

Storm water management is divided into clean and contaminated management and includes dams, river diversions, contour drains, pumps and drainage pipes.

On-going rehabilitation occurs behind the advancing face as the dump develops. This ensures only a relatively small window of ash is exposed to the environment. On-going placement of topsoil reduces storm water contamination, dust blow and erosion of the ash.

The project life cycle of the facility consists of the preconstruction phase, the construction phase, the operations phase and the decommissioning phase. Each of these phases contains processes that require discussion.

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1. INTRODUCTION

1.1 Background

Kusile Power Station is one of two new coal fired power stations being constructed by Eskom to meet the growing power needs of South Africa. An integral part of the power station is the ash disposal facility (ADF) that will store the residue of the coal combustion process for the life of the power station.

In order to construct the facility an Environmental Impact Assessment (EIA) is required by South African Environmental Impact Assessment regulations to assess the impact of the facility on the environment. The aim of this process is to ensure that the ash facility is placed in a location that will have the least impact on the environment. This is ensured by identifying possible alternatives and carrying out a comparative analysis of the alternatives.

After a comparative analysis is completed, the preferred site is taken forward and a detailed concept design is carried out. The design report and the drawings provide technical input into the Environmental Impact Report (EIR).

1.2 References

1.2.1 Provided information

The following information was provided and used to carry out the detailed conceptual design:

- Detailed survey of Site A dated June 2013;
- Kusile Railway alignment;
- Recent layout of the Kusile Power Station in Cad Format;

- Wetland delineations in shape file format;
- Panel B Consultants Joint Venture, August 2009. *Kusile Power Station, 10 Year Ash Dump, Slope Stability Analysis, Volume 1*. Report number 5452/10/19 Rev 2.
- Panel B Consultants Joint Venture, December 2010. *Kusile Power Station, Ash Dump Terrace Layer Works Design, Detailed Design Report*. Report number 5452/90/011 Rev5.
- Aqua Earth Consulting, April 2013. Proposed Kusile Ash Dam Facility Bio-physical study: Ground Assessment – (Base Line + Comparative Impacts assessment Version 1). (Draft Copy).

1.2.2 Regulations

The following regulations were referenced during the detailed conceptual design:

- Government Notice 704. 1999. National Water Act, Act 36 of 1998
- Notice 614 of 2012, Department of Environmental Affairs; National Environmental Management: Waste Act (59 of 2008): Draft Waste Classification and Management Regulations.
- Notice 615 of 2012, Department of Environmental Affairs; National Environmental Management: Waste Act (59 of 2008): Draft Standard for Disposal of Waste to Landfill.
- RSA (Republic of South Africa) (2013a) National Environmental Management: Waste Act (59/2008): Waste Classification and Management Regulations. Government Gazette 36784 No. R. 634 of 23 August 2013.
- RSA (Republic of South Africa) (2013b) National Environmental Management: Waste Act (59/2008): National norms and standards for the assessment of waste for landfill disposal.

1.2.3 Jones & Wagener Reports

The following reports were referenced in the detailed conceptual design:

- Jones & Wagener (Pty) Ltd., January 2013. Kusile Power Plant: Ash Disposal Facility: Geotechnical Study: Feasibility Desk Study Report. Report number JW006/13/D121 Rev 0.
- Jones & Wagener (Pty) Ltd., March 2013. Kusile and Kendal Power Stations Ash Disposal Facilities: Waste Classification Report. Report number JW030/13/D121 Rev 2.
- Jones & Wagener (Pty) Ltd., April 2013. Kusile 60 year ash facility EIA: Conceptual design letter report. Rev 0.

1.3 Definitions and abbreviations

1.3.1 Commercial

J&W **J**ones **&** **W**agener (Pty) Ltd – Design Engineers

WCS **W**etland **C**onsulting **S**ervices

1.3.2 Technical

Design:

ADF **A**sh **D**isposal **F**acility

ALR	**A**ction **L**eakage **R**ate
CQA	**C**onstruction **Q**uality **A**ssurance
CQC	**C**onstruction **Q**uality **C**ontrol
CDF	**C**o-**D**isposal **F**acility
HDPE	**H**igh **D**ensity **P**oly**E**thylene
GM	**G**eomembrane
GX	**G**eotextile
GL	**G**round **L**evel
LCS	**L**eachate **C**ollection **S**ystem
LDS	**L**eakage **D**etection **S**ystem
PCD	**P**ollution **C**ontrol **D**am
Other:	
EIA	**E**nvironmental **I**mpact **A**ssessment
EIR	**E**nvironmental **I**mpact **R**eport

1.3.3 Definitions

Back Stack: Ash stacked on top of the front stack (see **front stack**) behind the shiftable conveyor. The back stack is the final height of the facility.

Boom Conveyor: Cantilevered, slewable, luffable conveyor. Final delivery of ash onto the ash facility.

Crawler Mounted Stacker: Mechanised ash stacking machine connecting boom conveyor to the link conveyor.

Emergency Offload Platform: Concrete platform used for temporary ash storage if one or both stackers are out of commission.

Extendable Conveyor: Conveyor that is continuously extended as the ash stack advances. The extendable conveyor supplies ash to the shiftable conveyor and is supplied ash by the overland conveyor at the ash disposal facility transfer house.

First Ash: The first ash that is created by the power station after the first coal is burned.

Free ash: Ash that is placed by a stacker which does not require further dozing.

Front Stack: Ash stacked from the level of the stacker to a lower level – either natural ground or lower ash stack. The front stack is placed in front of the shiftable conveyor.

Link Conveyor: Conveyor between the stacker and the tripper car.

Overland Conveyor: Conveyor that transfers ash from the power station to the ash disposal facility. The overland conveyor connects to the extendable conveyor at the ash facility at a transfer house.

Shiftable Conveyor: Conveyor that is shifted parallel to the direction of advancement or rotated radially about a fixed point. The shiftable conveyor supplies the tripper car with ash and also includes rails for the car to travel on. The shiftable conveyor is supplied ash by the extendable conveyor.

Transfer platform: A platform used to support a transfer point between two or more conveyors when a change in direction is required.

Tripper car: Mechanised machine used to transfer ash from the shiftable conveyor onto the link conveyor which leads to the stacker. The tripper car is able to move along the rails connected to the shiftable conveyor.

1.3.4 Applicable standards to the design

The following standards are applicable to this design and can be obtained from the following sources:

GRI Standards: www.geosynthetic-institute.org/specs.htm

ASTM Standards: www.astm.org

SANS Standards: www.stansa.co.za

ASTM D 4354, Standard practice for sampling of geosynthetics for testing

ASTM D 4437, Practice for determining the integrity of field seams used in joining flexible polymeric sheet geomembranes

ASTM D 4873, Standard Guide for Identification, Storage and Handling of Geosynthetic Rolls

ASTM D 5641, Standard practice for geomembrane seam evaluation by vacuum chamber

ASTM D 5747, Standard practice for tests to evaluate the chemical resistance of geomembranes to liquids

ASTM D 6365, Standard practice for the non-destructive testing of geomembrane seams using the spark test

GRI Test Method GM6, Pressurized air channel test for dual seamed geomembranes

GRI Test Method GM14, Selecting variable intervals for taking geomembrane destructive seam samples using the method of attributes.

GRI Test Method GM19, Seam strength and related properties of Thermally-Bonded Polyolefin Geomembranes.

SANS 1526, Thermoplastics sheeting for use as a geomembrane.

SANS 10409, Design, selection and installation of geomembranes

GRI Test Method GT12 (a) – ASTM Version, Test method and properties for nonwoven geotextiles used as protection (or cushioning) materials

GRI Test Method GT12 (b) – ISO Version, Test method and properties for nonwoven geotextiles used as protection (or cushioning) materials

GRI Test Method GT13 – ASTM Version, Test method and properties for geotextiles used as separation between subgrade soil and aggregate

The following Standardized Specifications for Civil Engineering Construction as approved by the Council of the South African Bureau of Standards shall apply to the construction of the Ash Facility.

SABS 1200 A General

SABS 1200 C Site Clearance

SABS 1200 D Earthworks

SABS 1200 D B Earthworks (Pipe Trenches)

SABS 1200 D M Earthworks (Roads, Subgrade)

SABS 1200 G Concrete (Structural)

SABS 1200 H Structural Steelwork

SABS 1200 L Medium Pressure Pipelines

SABS 1200 L B Bedding (pipes)

SABS 1200 L E Stormwater Drainage

SABS 1200 M Roads (General)

1.4 Site Location

The location of the site is situated midway between Bronkhorstspruit, Emalahleni (Witbank) and Ogies on the border between the Gauteng and Mpumalanga Provinces. See Figure 1.

Approximate co-ordinates for the site are:

Latitude: 25° 55'11.65" S Longitude: 28° 55'34.26" E

Access to the area of investigation can either be from the N12 in the south or the N4 in the north.

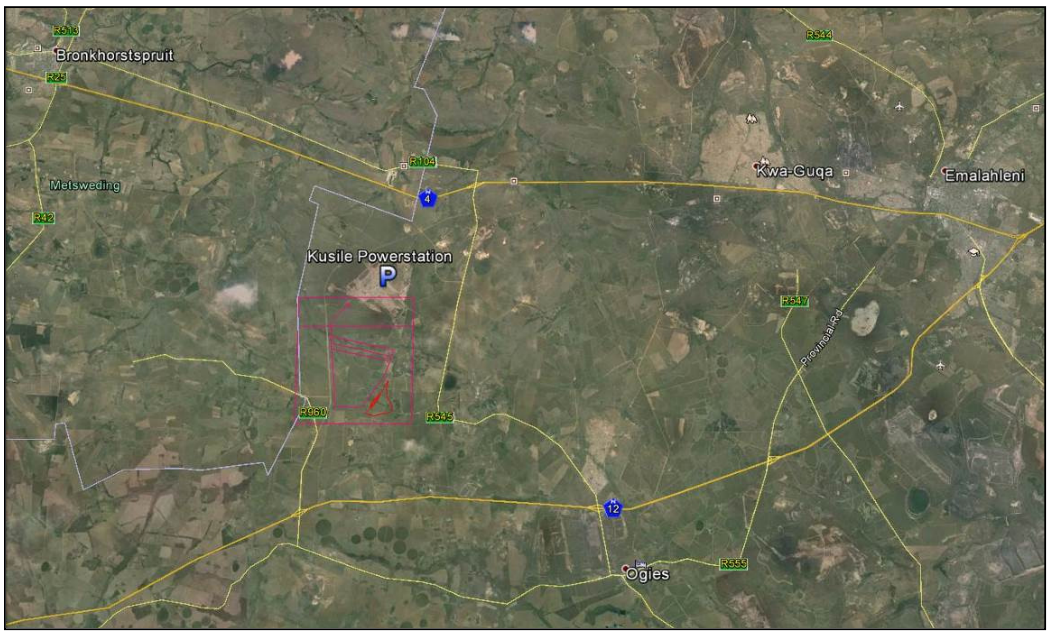

Figure 1: Site Location

2. SITE CONDITIONS

2.1 Survey

The location of Site A was surveyed on 30 May 2013. The survey report is shown Appendix A.

2.2 Site Constraints

The site is constrained by the Main Kusile Access Road, 400 KV power lines and water pipeline on the western side. The Co-disposal Facility forms the northern constraint and the planned Phola Conveyor the eastern constraint.

The southern side is constrained by the wedge nature of the above constraints.

These constraints are indicated on Figure 3.

2.3 Geology

The following extract is taken from the Geotechnical Study by Jones & Wagener [Report No. JW006/13/D121 Rev 0]. Also see Figure 2:

> *Area A is underlain predominantly by tillite of the Dwyka Group (Figure 2). Sandstone and shales of the Ecca Group occur along the southern perimeter of the area. Shales of the Silverton Formation, Pretoria Group, are present along the northern perimeter. Diabase intrusives are present.*

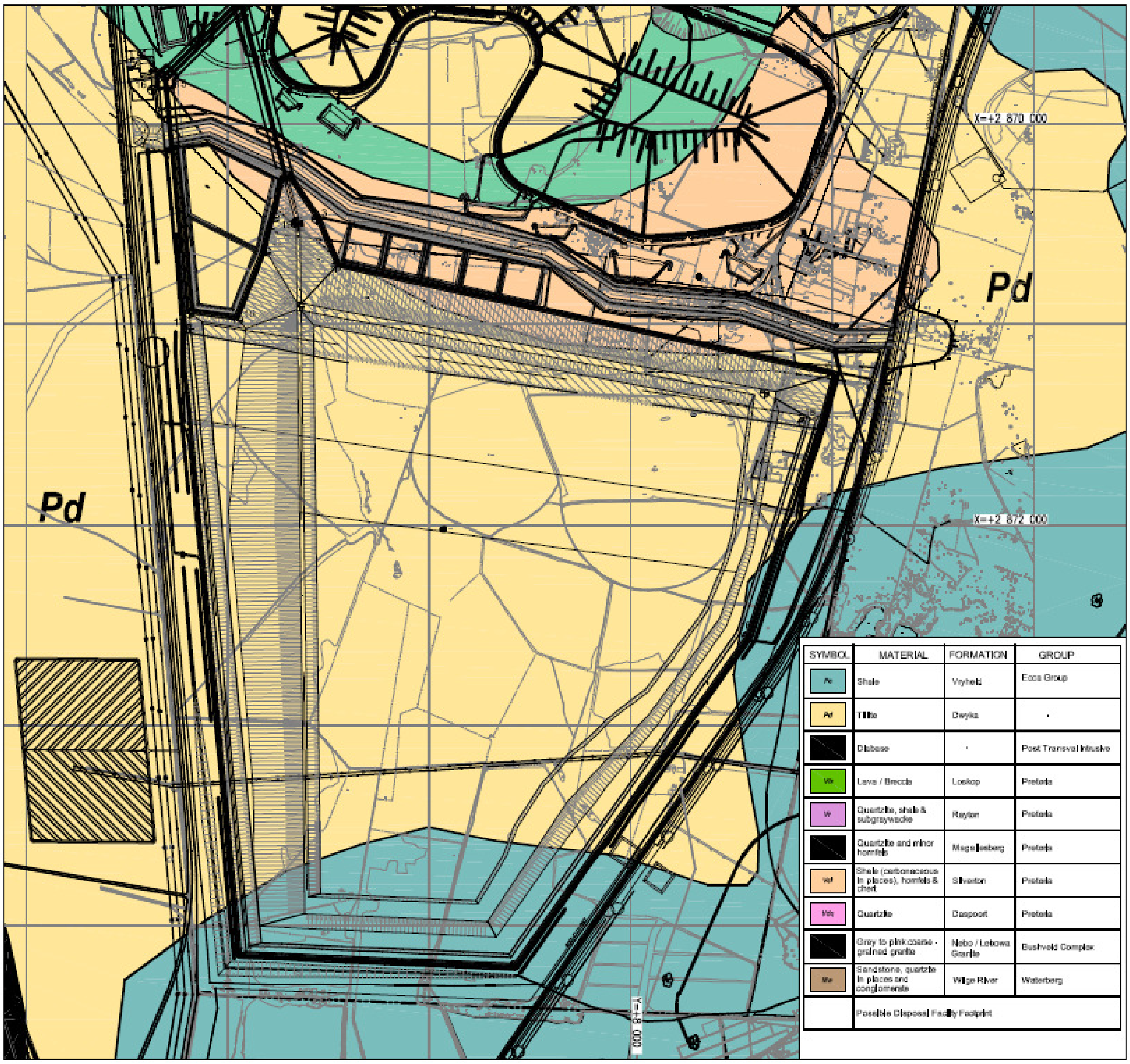

Figure 2: Geology layout of Site A

> *The soil profile expected over the area underlain by the tillites will comprise a transported silty to clayey fine sand overlying a silty clay to clayey silt residual tillite. A basal gravel layer (pebble marker) is expected below the transported horizon varying from 0,3m to about 0,5m thick. The underlying residual tillite may extend to depth of 3,5m to 5,0m.*

Locally diabase may be encountered and where present, the transported materials will be of a similar thickness and the underlying residual diabase, to depths of approximately 2,5m, will comprise a silty clay. Below this depth a friable residual silty sand with diabase cobbles/gravels is expected.

In the north, where the Silverton shales are encountered, the transported horizon will vary from 0,3m to 0,6m thick and will overlie a residual shale gravel. Below a depth of approximately 1m, soft rock shale can be expected.

The transported horizon and the residual tillite and diabase horizons are expected to satisfy the requirements for natural liners as these materials are generally clayey fine sands to silty clays. When compacted (i.e. >98% Proctor at Optimum or up to 3% wet of optimum moisture content), permeabilities are expected to be in the order of 1 x 10^{-7} cm/sec.

A Site Investigation including test pits and material sampling has not yet taken place. A site investigation will be required before the detailed design can commence.Ground Water Conditions

The following are pertinent points extracted from the Ground Water Assessment by Aqua Earth:

- The site is characterized by a semi-confined to unconfined shallow, secondary (weathered and fractured) aquifer;
- Ground water levels range from 1535 to 1460 meters above sea level within bearing features which are 4 to 24 meters below ground level (mbgl) (average 15 mbgl);
- Static ground water levels are 2 to 14 mbgl (average 6 mbgl);
- There is a linear relationship between the ground water levels and the natural ground level;
- Ground water is used in the following applications in the area:
    - Livestock water supply, crop farming, gardening, sand washing and domestic use.

The shallow ground water levels have an effect on the lining design. The ground water may exert a pressure on the lining system from the bottom causing saturation of the clay layers and stability concerns at the interface of the clay and the geomembrane. Therefore a sub-soil drainage system will be required to drain ground water away.

3. PROJECT DESCRIPTION

3.1 Project components and layout

3.1.1 Site Layout

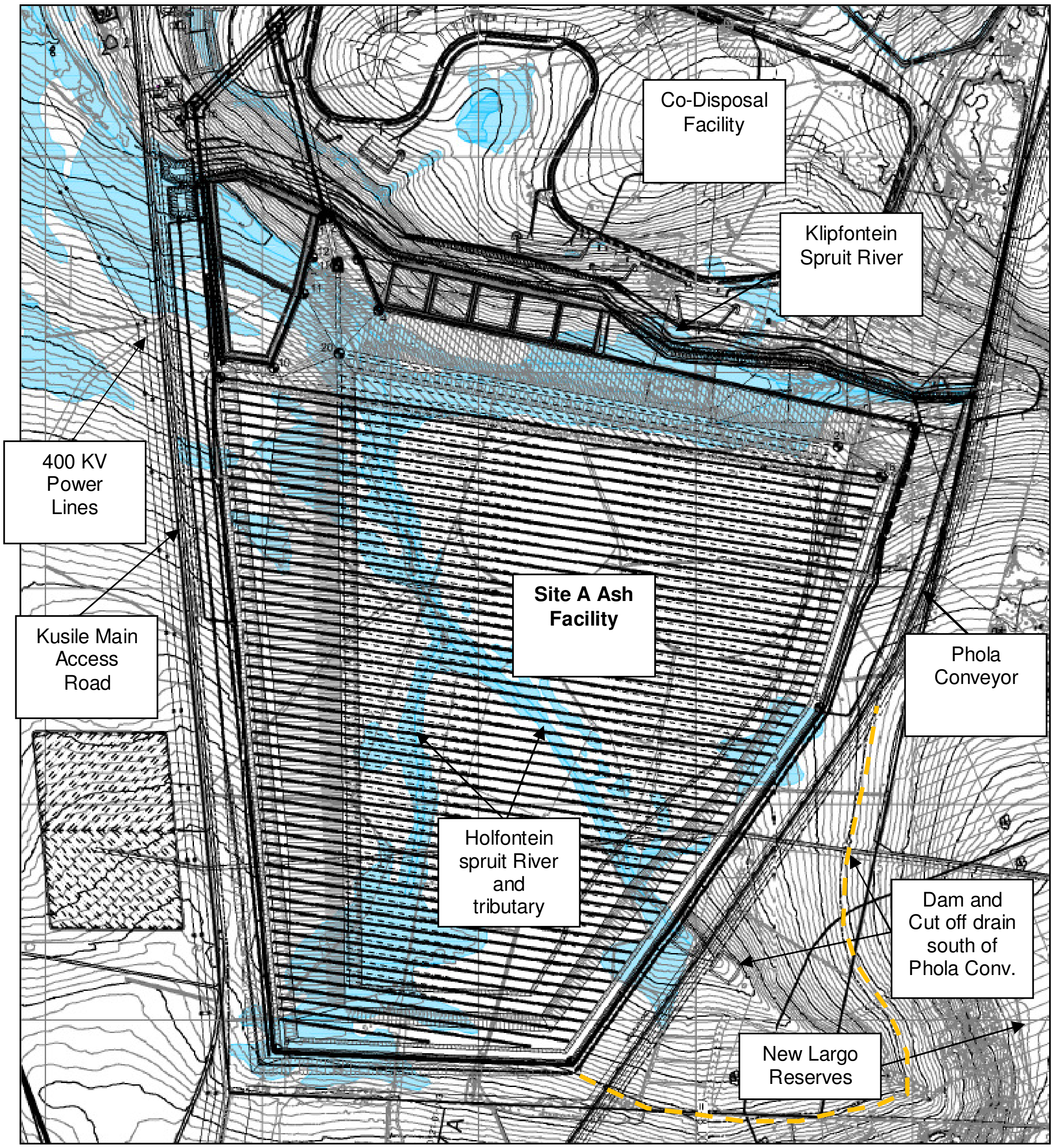

Figure 3: Site A Layout

Site A, as shown in Figure 3, is positioned south of the power station. It is wedge shaped, starting wide in the north and becoming narrower as it develops southwards.

Due to the site constraints the space is limited which leads to the ash stack requiring to start near final height instead of typically starting near ground level and building an approach ramp at a slope of 1[v]:20[h] up to final height. Therefore a substantial starter platform is included in the design. The starter platform will be constructed from ash using a truck and haul operation. The platform will also need to be lined.

Site A is characterised by a valley draining from the south-east to the north-west (forming the Holfonteinspruit). This valley will continue to lead clean storm water into the site for the duration of operations and therefore requires a combination of contour cut-off drains and clean storm water attenuation dams. A dam and a diversion canal system upstream of the New Largo Phola Conveyor will also be required as shown in Figure 3. This has been communicated to Anglo America who owns the property in this area. Anglo America have carried out some conceptual design work on the diversion canals and have also raised concerns that will need to be assessed in the detailed design. Communication by Anglo is attached in Appendix B.

A river diversion will also be required for the Klipfonteinspruit which is located along the northern side of the site.

The detailed conceptual design of the 60 year ash facility at Kusile Power Station consists of the following components:

- A lined starter platform constructed of ash with a storage capacity of 5 years;
- A lined ash facility with a storage capacity of 55 years;
- Clean and contaminated water separation and storage infrastructure including:
    - Pollution control dams (PCDs);
    - Contaminated storm water trench network;
    - Klipfontein river diversion and stilling basin;
    - Clean storm water diversion trenches and berms;
    - Clean storm water contour cut-off drains;
    - Clean storm water holding dams;
    - Clean storm water transfer drains.
- Pipelines:
    - For transporting water between the PCDs and the Power Station;
    - For transporting water for dust suppression and irrigation;
    - For transporting water between the clean water holding dams and the contour drains.
- Access roads around the facility;
- A fence line around the facility;
- Relocation of existing infrastructure including a power line that runs through the site;
- Rehabilitation of the ash facility.

3.2 Footprint and lifespan of facility

The footprint of the starter platform is 120.5ha (1 205 000m^2). Approximate dimensions are 3 500m long by 380m wide.

The footprint of the ash facility is 696.6ha (6 966 300m^2). Approximate dimensions are 3 350m long by 2 825m wide.

The footprint of the first 5 years to be lined is 125.7ha (1 257 000m^2). Approximate dimensions are 3 500m long by 420m wide.

The life span of the starter platform is approximately 5 years.

The life span of the ash facility is approximately 55 years.

More information is available in Section 3.3.1.

3.3 Height, source and volume of waste

The ash facility will consist of four ash layers:

- The bottom stacker front stack: 5m thick
- The bottom stacker back stack: 12m thick
- The top stacker front stack: Varies from a minimum of 30m to a maximum of 94m thick. The average thickness is 51.6m.
- The top stacker back stack: 12m thick

The bottom stacker will follow ground contours therefore the top surface of the bottom stacker's back stack will mimic the ground topography. Additional sloping and dozing may be required to ensure adequate drainage of this layer.

The top stacker will progress at a slope of 1:20 until final height of the ash facility is reached. It will then progress at a slope of 1:300 until the end of the stack is reached. Therefore the top stacker's front stack height varies from a minimum of 30m to a maximum of 94m depending on the topography of the ground level. The thickest part of the front stack occurs where the facility develops over the Holfontein Valley. The average thickness of this layer is 51.6m.

The backstack layer thickness is constrained by the geometric dimensions of the stacker. The back stack is formed from 14m high cones with the top two meters being dozed to form a 12m thick stack.

The thickness of the bottom stacker front stack is dependent on the nature of the site soils. The site soils consist mainly of tillite material which typically has a high clay content. Therefore, it can be expected that the strength of the soil will be insufficient to support a high ash stack due to the generation of high excess water pressures. The strength of the in situ soils increases as the excess pore water pressures dissipate due to the applied load from the front stack. The additional strength is required for the higher top stacker's front stack that later follows.

At this stage of the design, a 5m high front stack for the bottom stacker is assumed.

The total required storage is calculated in Table 1. The figures used in the calculation were taken from the Kusile CDF Design Report (Report number 5452/90/011 Rev 5):

Table 1: Calculation of the required volume of the ash facility

Description:	Value:	Unit:
Load	150	t/hr/unit
Load Factor	0.9	
Availability Factor	0.9	
Result	121.5	t/hr/unit
Factor of Safety	1.1	
Final load	133.65	t/hr/unit
Rounded load	135	t/hr/unit
Daily Load per unit	3,240	t/day/unit
Monthly Load per unit	98,550	t/month/unit
Yearly Load per unit	1,182,600	t/year/unit
Total Load per unit (60 year life)	70,956,000	t/60yr/unit
Total Load of Power station	425,736,000	t/60yr/6units
Bulk Density	0.8	t/m^3
Total Volume	532,170,000	m^3

From Table 1, the storage volume available in the Ash Facility must be greater than 532.170 million cubic meters.

The storage capacity of the designed ash facility is 534 million cubic meters therefore it is large enough to store the required ash volume. The storage capacity is split into the following sections:

- 35.8 million cubic meters in the Starter Platform;
- 113.6 million cubic meters in the Bottom Stack (Volume Split: 23% of Total);
- 385.3 million cubic meters in the Top Stack (Volume Split: 77% of Total).

3.4 Waste classification

The waste classification of the ash is represented in Report number JW030/13/D121 Rev 2. A summary is provided below:

- The waste classification was carried out in terms of DWA's Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste and DEA's draft waste classification regulations published for comment in August 2012 in terms of the provisions of the NEM:WA (Act 59 of 2008). Only the results of the draft regulations are presented below.
- Ash samples were taken from Kendal Power Station as they are considered the closest approximation of the ash expected at Kusile Power Station.

- Total extraction analysis was carried out on the ash sample.
- Australian de-ionised water leach tests were carried out on the ash and an analysis of the leach solution was conducted.
- The ash is classified as a Type 3 waste (low hazard waste). Therefore the ash requires disposal on a landfill with a Class C barrier system.
- This classification was the result of the leachable concentration of boron and the total concentration of barium and fluoride in the ash.

3.5 The barrier system

The barrier is designed according to the National Norms and Standards for the assessment of waste for landfill disposal [2013]. As the ash is classified a Type 3 waste, the barrier has been designed according to the Class C lining specification as shown in Figure 4.

During the design stage, the Department of Water Affairs (DWA) was consulted in order to ensure the direction of the design was acceptable. DWA requested that the design be presented in terms of the new regulations (the regulations were in draft form at that time) (See Appendix C). Therefore, the design does not reference the earlier Minimum Requirements [DWA, 1998] specification that calls for a different specification of liner system. The minutes of the consultation are also in Appendix C.

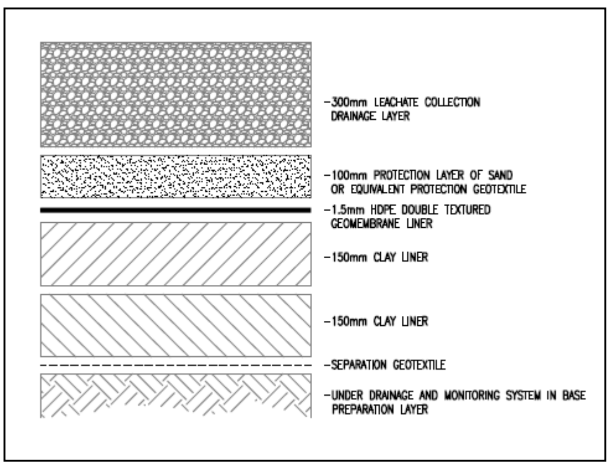

Figure 4: Class C Liner Specification

The liner system includes the following layers from excavation level upwards:

- Substrate preparation layer: The substrate will be ripped and re-compacted to 95% MOD AASHTO with a moisture content of -2 to +2% of optimum moisture content. Subsoil drains will be installed during this period. The detail of the subsoil drains is shown in Figure 5.
- Subsoil Drainage Layer: A 100mm layer of filter sand will be used as a subsoil drainage layer;
- Primary impermeable layer: 2 x 150mm layers of Tillite clay compacted to 98% Standard Proctor with a moisture content of +1 to +3% of optimum moisture content in order to have a permeability co-efficient (k) of less than $1x10^{-7}$cm/s.
- Primary geomembrane layer: 1.5mm HDPE double textured geomembrane layer;
- Leachate collection layer: 300mm layer of filter sand with HDPE pipe drainage network. The detail of the leachate collection drains is also shown in Figure 5.

The subsoil and leachate collection drains as well as the filter sand layers will be graded such that they act as natural filters for ash and the site material.

The geomembrane will require anchoring on the sides of the area to be lined. This necessitates a berm on each side of the area. The berm will also act to divert storm water and retain leachate so that it may be extracted in a controlled manner.

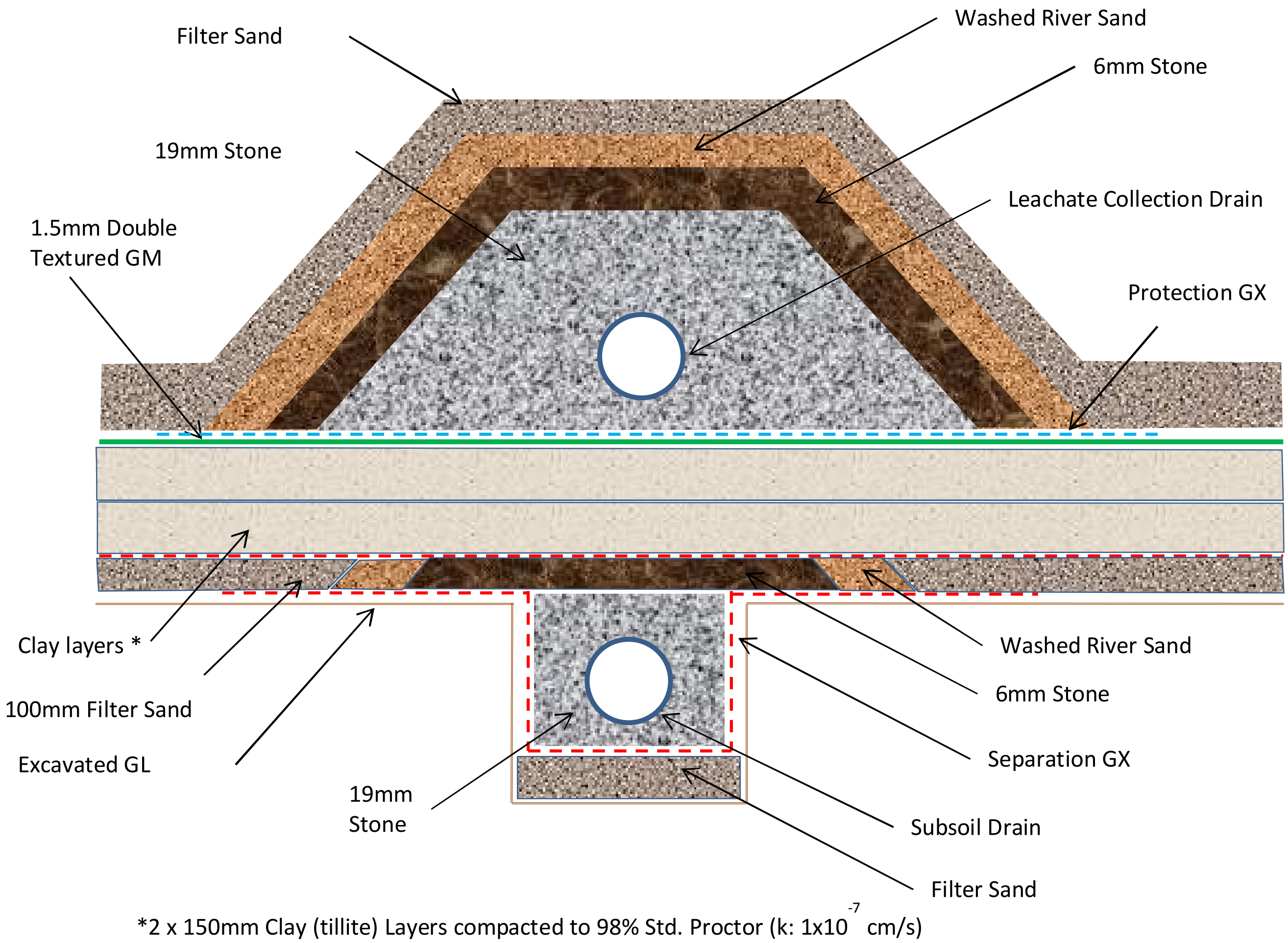

Figure 5: Lining system applied to site conditions showing leachate and sub-soil conditions

The Leachate Collection System

The leachate collection system will be free draining. The average slope of the footprint is 1:30 and ranges from 1:5 in the valleys to 1:100 on the crests.

The transmissivity of the filter sand used in the leachate collection system must be checked for adequate flow through the drainage layer to ensure that a hydrostatic pressure head of leachate does not build up on the geomembrane. The spacing of leachate collection pipes must also be confirmed to ensure adequate drainage.

Risk of leaking from the Ash Disposal Facility and the Pollution Control Dams

The lining systems of the ADF and the PCDs will decrease the potential for leaching to the environment significantly. The ADF has a large buffer capacity meaning that it will take a long time for leachate to generate above the lining system. The lining system will have a leachate collection layer which will help to drain the leachate away before it can form a significant pressure on the lining system.

However, it must be noted that all lining systems leak due to defects in the geomembrane that arise in the manufacturing, transporting and construction stages. For this reason, an expected leakage rate is typically calculated to feed into ground water monitoring models.

A frequently quoted action leakage rate (ALR), above which will require action to reduce the leakage, is 200 litres per hectare per day. This calculates to approximately 25m^3/day for either the Starter Platform or the first 5 year lined area. This is only used as a first estimate during the conceptual design stage. A detailed site specific ALR will be calculated during the detailed design stage. Construction Quality Control and Assurance during liner installation

It is essential that Construction Quality Control (CQC) and Assurance (CQA) take place during the installation of the lining system. These are defined as the following:

> **Construction Quality Control (CQC)**: A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction Quality Control shall be performed by the Lining Contractor or for natural soil materials by the Earthworks Contractor, and is necessary to achieve quality in the constructed or installed system. Construction Quality Control refers to measures taken by the installer or Contractor to determine compliance with the requirements for materials and workmanship as stated in the Drawings and Project Specifications.
>
> The quality control procedure for liner installation is fully described in *SANS 10409:205 Design, selection and installation of geomembranes*.
>
> **Construction Quality Assurance (CQA)**: A planned system of activities that provides the Employer, Engineer and Permitting Authorities assurance that the facility was constructed as specified in the design. Construction Quality Assurance includes inspections, verifications, audits and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction Quality Assurance refers to measures taken by the Engineer to assess if the Lining Contractor is in compliance with the Drawings and Project Specifications. An independent third party CQA inspector may be appointed by the client to oversee the lining installation.

Effect of temperature on the lining system

Literature on the effect of elevated temperatures on geomembranes has indicated that the higher the temperature exposed to the geomembrane the less time it takes to reach its service life[1].

For example, a service life of 100 years at 30 degrees Celsius may be reduced to less than 10 years at 60 degrees Celsius. Temperatures much above 120 degrees will result in the melting of the geomembrane and complete failure of the lining system.

In an ash landfill site heat may be generated by the hydration of ash. Hydration is a function of the composition and amount of cementitious material in the ash and the water cement ratio of the mixture. For hydration to occur free lime (CaO) and Sulphates (SO3) are needed.

[1] The service life of a geomembrane can be defined as the period of time for which the geomembrane performs in accordance with the design.

From the assessment of laboratory tests carried out on ash samples from Kendal Power Station during the design phase, the amount of free lime (CaO) and Sulphates (SO3) are expected to be low – See Appendix D for the lab results. Therefore the risk of hydration is currently low. However, the composition of the ash at the Kusile Power Station may be different to Kendal and will need to be tested when available.

The temperature of the geomembrane will also need to be continuously monitored throughout the facility's lifetime to ensure that it is within a specified range.

3.6 Clean and dirty water separation and containment infrastructure

3.6.1 General Storm Water Management

Storm water that falls on the ash facility or conveyor platforms will be contaminated and will be kept separate from clean storm water. The site will have a network of contaminated storm water collection trenches which will surround the facility and gravity-drain towards seven PCDs located on the northern side of the ash facility.

Upstream clean storm water will be diverted around the ash facility by diversion berms and trenches. The clean storm water will be diverted into the environment downstream of the facility at pre-development flow rates.

The contaminated storm water system is designed according to GN 704 which states that the design should cater for a 1 in 50 year storm event and in addition have a 500mm buffer (freeboard) between it and the clean storm water system.

If a large enough storm (greater than 1 in 50 year storm) falls on the site it is possible that there may be spillage into the clean storm water system and onto the soil surface. However, the greater the storm event considered the less probable that it will occur; therefore the system is designed for a 1 in 50 year storm event as the probability of spillage is considered acceptable when balanced with the cost of designing for this size of storm.

Where two pollution control dams are located next to each other, the upstream dam will spill into the downstream dam which will in turn spill into the environment depending on the size of the rainfall event.

The storm water design philosophy is as follows:

- The dam sizing is based on the longest historic record of the nearest rainfall station. In the case of this design, the closest station that had the largest reliable data set (94 years) was the Wilge Weather Station (0514618W), positioned 13kms away.
- Evaporation data was taken from the Bronkhorstspruit Dam Evaporation Station.
- Various catchment scenarios are assessed. These are listed in a section below. The worst case catchment scenario is designed for.
- The inflows into the dams considered are: Direct rainfall, contaminated or clean storm water run-off and make-up water from the power station.
- The outflows considered are: Evaporation, water pumped out of the dams, abstraction water for dust suppression and irrigation on the facility.
- The size of the dams are sized to ensure that they could safely contain rain from storm events over a 50 year period with the allowance of one spilling event in that period.

Other assumptions used in the calculations are the following:

- The run-off co-efficient for clean storm water flowing over undisturbed catchment = 10%;

- The run-off co-efficient for contaminated storm water flowing over the lining system catchment = 13%;
- Clean storm water dams will have a depth of 3.0m;
- Pump size that will be used is 35l/s as typically used at other power stations.

3.6.2 Clean Storm Water Infrastructure and Management

Clean Storm Water Dams

The site is characterised by three main valleys:

- The Klipfonteinspruit valley that runs along the northern edge of the facility;
- The Holfonteinspruit valley that runs northwards down the centre of the site;
- The tributary valley that runs towards the north west.

The last two valleys will be responsible for transporting storm water from the upstream catchments directly into the site. Therefore it will be essential to cut off as much water upstream as possible to reduce the water heading towards the site. There will always be a requirement for a clean water dam south and upstream of the ash facility.

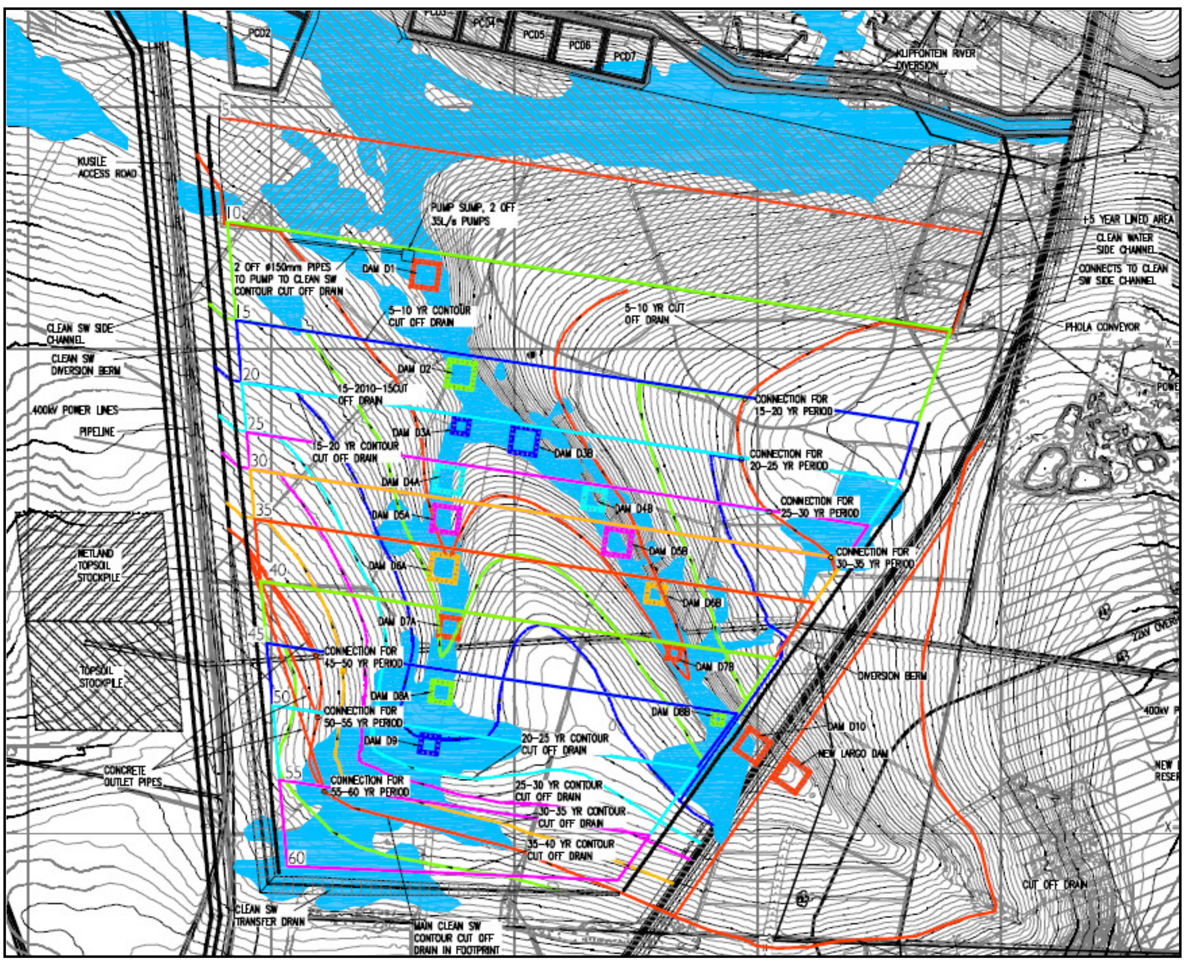

Figure 6: Layout of Clean Storm Water Dams and Pollution Control Dams

As the ash facility develops southwards, the existing clean water dam will become redundant and will need to be demolished as it will be with-in the footprint of the future extension. Before it is demolished, a new dam will be required further upstream to take its place.

Figure 6 shows the 17 clean storm water dams that will be required over the life of the facility.

The clean storm water dams are designed to continuously pump water to an upstream contour cut-off drain. Two 35l/s pumps will be used at each dam so that a back-up system is in place.

The use of pumps reduces the storage volume required so that the dams are smaller. It also reduces the amount of water lost to evaporation. However, it does introduce a dependency on pump systems.

The risks of pump failure are used to introduce worst case scenarios. The following scenarios were considered:

- No pump failure (best case scenario);
- Both pumps fail for a period of 12 hours due to a power failure. This power failure is assumed to be on the day with the highest rainfall event.
- One of the pumps fails and it takes 12 days to correct the failure. This 12 day period is considered over the highest rainfall event. (Worst case scenario).

Table 2 shows the results of the calculation:

Table 2: List of clean water dams including sizes and catchments

Clean SW Dam List		
Description:	**Dam Size:**	**Catchment (ha):**
D1	30 000m^3 100 x 100 x 3m	103
D2	40 000m^3 115 x 115 x 3m	130
D3a	15 000m^3 70 x 70 x 3m	72.4
D3b	30 000m^3 100 x 100 x 3m	104.6
D4a	30 000m^3 100 x 100 x 3m	99
D4b	25 000m^3 90 x 90 x 3m	118
D5a	30 000m^3 100 x 100 x 3m	103
D5b	30 000m^3 100 x 100 x 3m	100.6
D6a	30 000m^3 100 x 100 x 3m	107.4
D6b	19 200m^3 80 x 80 x 3m	78.8
D7a	25 000m^3 90 x 90 x 3m	99.8
D7b	10 800m^3 60 x 60 x 3m	54.9

D8a	25 000m^3 90 x 90 x 3m	95
D8b	7 500m^3 50 x 50 x 3m	32.8
D9	19 200m^3 80 x 80 x 3m	77
D10	30 000m^3 100 x 100 x 3m	116.6
New Largo Dam	30 000m^3 100 x 100 x 3m	100

Management of storm water from the construction area

The removal of topsoil and exposure of soils during the construction of the lined area may lead to an increase in the turbidity of the surface water in the surrounding area. Therefore storm water run-off during construction will need to be managed such that sediment transport is limited.

The management system will consist of cut-off trenches which will lead to unlined storage facilities. These facilities will trap the sediment in the run-off by allowing deposition to take place by controlling the discharge of clean storm water into the environment.

Clean Storm Water Management during rehabilitation

Clean storm water management will also be required during rehabilitation of the dump. The system is needed to capture storm water falling on rehabilitated areas to ensure that it reaches the environment without getting contaminated.

Clean storm water falling on the rehabilitated area will be intercepted by the storm water berms that are placed above the rehabilitated layer at every shift. These berms lead to a down chute which will transport the water down the side slope to the toe of the facility. There are benches included along the rehabilitated side slope that form storm water collection trenches to collect slope run-off. These trenches also lead into the down chute through inlet boxes.

At the bottom of the down chute, energy dissipaters are positioned to reduce the energy of the water. The water then drains into clean storm water collection trenches which divert the water around the site.

3.6.3 Contaminated Storm Water Management

Storm water falling on the conveyor platforms, ash dump or lined area will become contaminated once it is in contact with ash. Conveyor platforms have a cross fall of 2% towards drains situated on each side of the platform as shown in Figure 7. From the facility or lined area, the water is captured in the leachate collection system (LCS) positioned at the top of the liner system. From the LCS, the contaminated water is drained by penstocks that connect to the contaminated storm water trench network.

The contaminated storm water network includes trenches positioned on the eastern and western sides of the ash facility and on the northern side of the starter platform.

Contaminated storm water trenches also run adjacent to the extendible conveyors that are located in the conveyor corridor that collect contaminated water falling within the corridor.

The above trenches all drain towards the pollution control dams.

It is recommended that the conveyors are covered from rain and wind as much as possible to prevent further sources of contamination of the environment.

Figure 7: Overland Conveyor Platform and storm water management infrastructure

Pollution Control Dams

The ash facility has 7 Pollution control dams (PCDs), all of which are planned for the construction of the Starter Platform and the first 5 years of lining. The dams are placed to allow drainage from the lined areas of the facility through the contaminated storm water trench network.

The dams will have the same lining system as the ash facility. However, the leachate collection layer above the lining system is replaced by the following ballast layer:

- Ballast layer: 300mm layer of site sand stabilized with 8% cement content by mass. The stabilized sand will be placed in geocells on the side slopes of the dams.

The layout of the dams is shown in Figure 6.

Complex 1 (PCD 1 and 2)

PCDs 1 and 2 are located west of the conveyor approach ramp and will be the main storage dam complex. PCD 1 will receive the make-up water from the power station and all irrigation and dust suppression water will be pumped from it.

Complex 2 (PCD 3 to 7)

PCDs 3 to 7 are located east of the conveyor approach ramp and will form the other dam complex.

The pollution control dams are designed for the lined area for the 5 to 10 year dump development. This forms the worst case scenario as it is the largest lined area over a 5 year period. See Table 5 for a list of 5 year lined areas over the life of the facility.

The catchment for the 5 to 10 year dump development is 125.7ha; approximately two thirds of the catchment will drain to Complex 1 and the other third to Complex 2.

Table 3 shows relevant information for the 7 pollution control dams.

Table 3: Pollution Control Dams Volume and Area Information

Complex:	Pollution Control Dam:	Catchment (worst case): (Ha)	Volume: (m^3)	Area at FSL: (m^2)
1	PCD 1	84.3	246 600	149 000
	PCD 2		151 200	92 200
2	PCD 3	41.4	62 400	31 900
	PCD 4		60 700	31 100
	PCD 5		61 300	31 400
	PCD 6		62 400	31 900
	PCD 7		60 200	32 200

3.7 The desilting process

Storm water flowing over ash and soil tends to entrain silt along the way. Desilting the water before it reaches the pollution control dams is one of the aims of the design of the storm water management system. This is achieved by the following:

- Placing silt traps at the bottom of transfer boxes / inlet boxes.

Even though the above features will mitigate the amount of silt that enters the pollution control dams, there will be some build-up of silt in the dams. Cleaning of the deposition will be required during the dry winter periods or when deposition has reached 25% of the storage volume of the dam.

Each dam's final layer is a geosynthetic in-filled with cement stabilized sand. This will provide a strong platform for the desilting process.

3.7.1 Erosion protection

Due to the entrainment of silt particles into storm water, there is a high risk for erosion on the site. All trenches on the site have been designed with erosion protection except for cut to fill trenches for clean storm water that may be re-graded from time to time.

Contaminated trenches are first lined with geomembrane and then with geocells that are in-filled either with concrete or cement stabilized sand depending on the application and period of usage. See Figure 8:

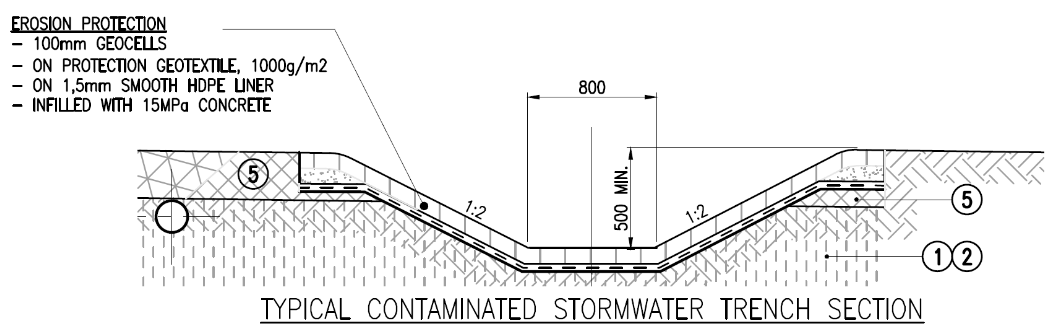

Figure 8: Detail for contaminated storm water canals

Clean storm water trenches that are permanent and will manage high flow rates will be lined with precast concrete blocks (Amorflex). The extent of the blocks will cater for the 1 in 5 year storm event which will be the base load of the flow. The trench will be sized to manage a peak storm event of 1 in 50 years. See Figure 9.

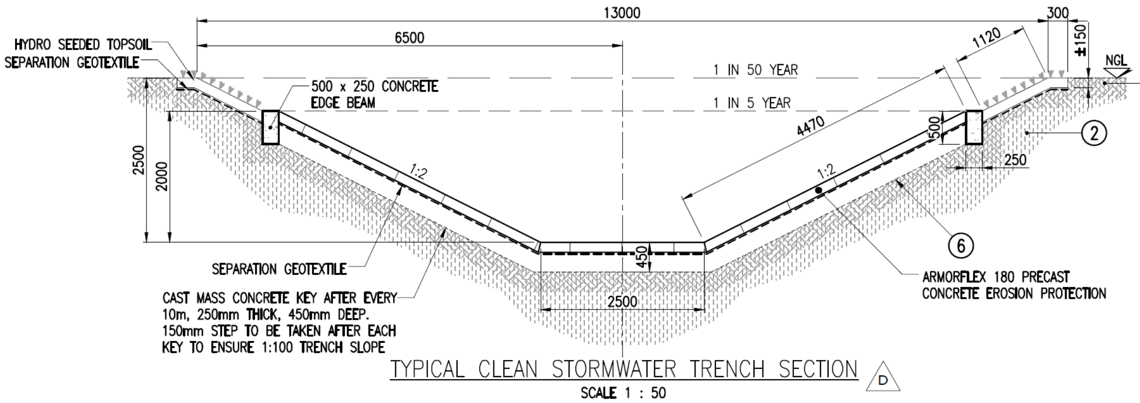

Figure 9: Detail for clean storm water canals

Temporary clean storm water trenches may be lined with cement stabilized soil or may be unlined depending on the application and period of use.

3.7.2 Lined areas still to be developed over

The proposed liner system introduces a risk of erosion of the sand ballast (leachate collection) layer. Preventative solutions and reactive solutions such as on-going correction of displaced sand need consideration.

3.7.3 Recently developed areas of the ash facility

Erosion of recently developed areas can be controlled by doing light compaction of the completed surface. Another alternative is placing a thin layer of sacrificial soil material down on the ash stack which may be less likely to erode than ash.

3.7.4 Rehabilitated areas

Erosion protection in rehabilitated areas will be carried out by the grassed topsoil layer placed over the ash. The clean storm water management system will also prevent erosion by shortening the flow paths over topsoil. Reactive procedures are required when erosion forms gullies that cut through the topsoil and into the ash profile. These gullies will need to be repaired immediately to control further contamination of clean storm water systems.

Once infrastructure is built, identification of storm water management that is not working must be noted. Any infrastructure that is causing on-going maintenance will need reviewing.

3.8 River Diversions

River diversions are required where rivers or tributaries intersect an ash facility footprint. The aim of the diversion is to transfer the water around the facility back to the natural drainage path with causing as little impact on the environment as possible.

The following river diversions are required:

- The Klipfonteinspruit River Diversion.

  The river diversion is divided into 3 sections:

  - Section 1: Gradual slope section (1:200). The diversion reserve is 40m wide. Flow velocities have been limited to less than 2 m/s.

- Section 2: Intermediate slope section (1:100). Steps have been included to reduce the slope to 1:150. The diversion reserve is 60m wide. Flow velocities have been limited to less than 3 m/s.
- Section 3: Steep slope section (1:25). Steps have been included to reduce the slope to 1:150. The diversion reserve is 80m wide. Flow velocities have been limited to less than 4 m/s.

Over Section 1 and 2, the canal will be lined with topsoil from the delineated wetland areas in the footprint; the layer will be 1m thick. Over Section 3, the canal will be lined with rock boulders to add additional roughness to the channel which will decrease the river velocity. It is assumed that the rock will be available from the rock excavation that will be required over Section 1.

The diversion is formed by a wide floodplain, sized for a 1 in 50 storm event. The floodplain contains a concentrated flow channel, sized for a 1 in 2 year storm event. The concentrated flow channel is designed to meander within the floodplain with assistance from gabion baskets that have been strategically placed.

The side slopes of the floodplain are to be seeded with a suitable mix of indigenous Highveld grasses (the wetland topsoil is to be assessed for suitability). Weirs have been included to dissipate flows, trap sediments and create pool habitats.

The river diversion will drain into a large stilling basin which will further reduce flow velocities and allow settling of transported material before the water returns to the natural drainage path.

- The Holfonteinspruit River Diversion.

  This diversion will consist of contour cut-off drains and clean water dams. The cut-off drains will intercept water upstream and drain it around the facility along a contour line. Water downstream of the cut-off drain will collect in a clean water dam in the base of the valley in front of the ash facility. See Section 3.6 and Figure 6 for further information of this diversion system.

3.9 Pipelines

The following applications of pipelines are included in the design:

- Two 315mm HDPE pipelines from a pump house at PCD 01 for dust suppression;
- Two 5" (139.7mm) diameter steel pipelines from a pump house at PCD 01 for irrigation;
- Two pipelines from the pump houses at the clean water dams required throughout the life of the facility. These pipelines will be 150mm in diameter.

3.10 Infrastructure relocations

The following infrastructure relocations will be required:

- An 88 KV power line that runs through the site in an east and west direction.
- The Co-Disposal Facility's security fence.

3.11 Rehabilitation

The aim of rehabilitation is to restore vegetation and gentle the slopes of the ash facility to increase stability and decrease dust blow. The facility will also blend in better with its surroundings.

As the ash stack develops, rehabilitation occurs approximately 2 shifts behind the advancing face ensuring only a relatively small window of ash is exposed to the environment. Ongoing placement of topsoil reduces dust blow and erosion of the ash.

The main reasons for rehabilitation are:

- **Leachate control:** By placing a topsoil cover layer, infiltration of storm water is mitigated and therefore less water is contaminated.
- **Storm water management:** With the incorporation of storm water berms and down chutes, storm water is collected and drained into the environment in a controlled manner which decreases the risk of further contamination.
- **Erosion control:** Vegetation reduces run-off velocity and anchors the topsoil layer to reduce erosion taking place. Infrastructure such as benches shorten the flow path along rehabilitated areas reducing the amount of soil entrained into the storm water which results in reduced erosion.
- **Slope stability:** Excessive leaching, as a result of infiltration, will lead to a build-up of water within the ash body. The additional pore water will decrease the shear strength of the ash reducing the safety factor against slope failure.
- **Risk to liner penetration:** Excessive leaching will lead to a build-up of pore water pressure acting on the liner. The inclusion of the leachate collection layer will prevent hydrostatic pressure developing on the geomembrane. Less leachate in the system will increase the effectiveness of the liner drainage system.
- **Aesthetics:** Rehabilitation of the ash stack, including gentling of slopes and restoration of surrounding vegetation, will allow the facility to better blend into the environment.

Rehabilitation includes the following activities:

- Reshaping:
  - Cut to fill of sideslopes: angle of 40° (1[v] to 1.2[h]) to an average angle of 11.3° (1 to 5);
- Capping:
  - Cover ash stack surface area with 300mm topsoil;
  - Scarification and fertilization of the topsoil layer;
  - Grassing of topsoil area including pioneer and long term grass seeding;
  - Transplanting of existing and new trees and shrubs;
  - Irrigation.
- Installation of storm water measures:
  - Construction of infrastructure including down chute pipes, outlet channels, energy dissipaters, side slope berm trenches, shift berms and crest berms.
- Maintenance of rehabilitated area.

Progressive rehabilitation is illustrated in Figure 10 and 11.

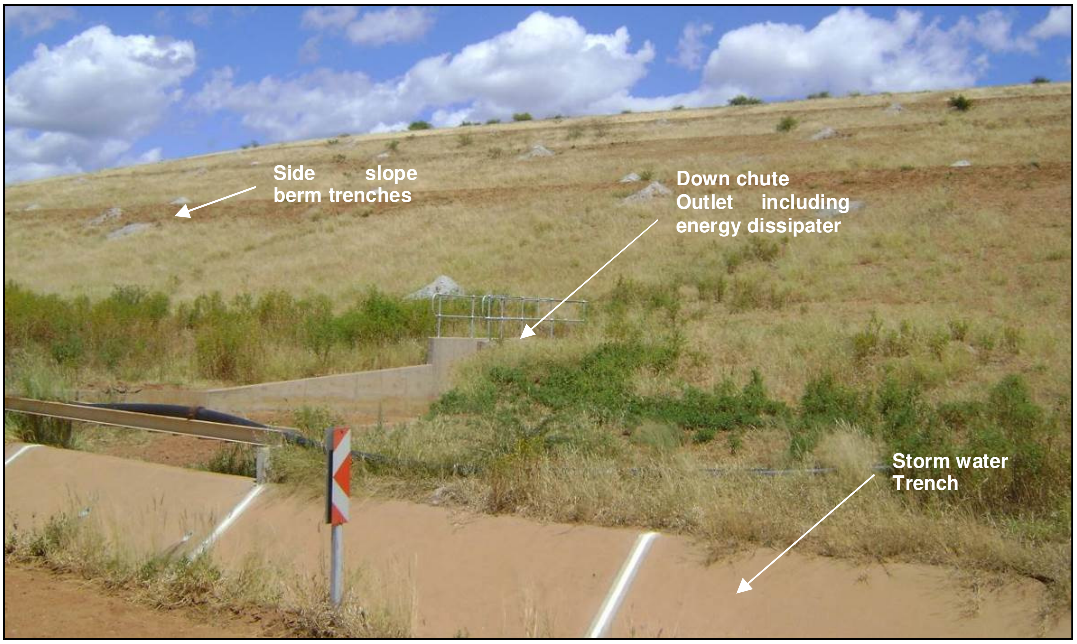

Figure 10: Rehabilitated area on Matimba Powerstation Ash Facility

Figure 11: Rehabilitation of Matimba's ash facility

3.12 Site Facilities

The following site facilities are available:

- **Site office:** The office includes three offices, one 10 seat meeting room, a kitchenette and a dining hall. Male and female ablutions are also provided.
- **Workshop and Store:** A workshop and store, both 6 x 10m in size, with vehicle access, are provided. An oil spillage sump outlet to outside containment facilities is included.
- **Vehicle maintenance:** A service bay and wash bay with oil trap facilities.
- **Contractor Yard**: 50 x 50m yard including one Site Agent Office, kitchenette with attached dining hall and male & female ablutions.

3.13 Access infrastructure

3.13.1 Access roads

Site entry will be through the site office on the northern side of the site. Leading from the office will be the service roads along the conveyors and the patrol road that follows the fence around the site.

At certain points along the patrol road, side roads will branch off toward infrastructure such as storm water trenches or pollution control dams.

There are three conveyor service roads: one on either side of the two conveyors and one that runs between the conveyors. The service roads along the conveyors lead to the starter and erection platforms and then onto the conveyor corridor on the ash facility.

On the rehabilitated back stacks, access roads are included on the western and eastern edges with access berms every fourth shift.

Roads will be used for access to carry out maintenance, inspections, material delivery and construction.

3.13.2 Fencing

The ash facility will be fenced off on the western and eastern sides adjacent to the sides of the dump leaving room for storm water management. The southern side is fenced off at the 15 year facility development stage. The fence on the northern side of the dump will connect to the fence of the co-disposal facility. Sections of the co-disposal fence may need to be relocated where there is a clash with the 60 year ash facility's infrastructure.

The fence is included in the design to prevent unauthorized access. Signs indicating that there is an ash facility on the property and that it is a safety risk area will be displayed.

3.14 Emergency ash platforms.

If one or both stackers are out of commission, ash will temporarily be offloaded onto either of two emergency ash platforms situated at the end of each of the overland conveyors.

The overland conveyors are connected to a moving head system which can extend past the transfer point and deposit ash onto the emergency platform. The extended length is supported by a reinforced concrete wall which also retains the ash until it can be moved by mobile equipment.

The ash is transferred onto the extendable conveyor with the use of plant (e.g. a small bobcat type loader).

4. DESCRIPTION OF DEVELOPMENT ACTIVITIES

4.1 The preconstruction phase

- Feasibility Stage:
  - During the site screening stage, 12 possible sites were identified. These are Site A, B, C, D1 & D2, E, F, G, H1, H2, H3 and I. A matrix that combined technical, environmental and social criteria was used to compare the feasibility of all the sites. The result of the Site Screening exercise is that above-average sites were taken forward into the detailed comparative assessment stage. These are Sites A, B, C, F, G.
  - The result of the comparative assessment is that Site A is the most preferred alternative and therefore this detailed concept is carried out on Site A.
- Design Stage: This stage includes the formulation of the concept design and detailed design.
  - The detailed concept design is fully described in this report. It is carried out as part of the EIA. The detailed concept forms the basis for the detailed design stage.
  - The detailed design is developed from the concept design. Engineering drawings are developed from the concept design such that the project can go out to tender and the facility can be constructed and operated from the drawings. The detailed design is outside the scope of this report.
- Tender Stage: After the detail design is complete, the project will be put out to tender. This will be followed by a tender adjudication and contract negotiations.

4.2 The construction phase

- Construction Stage: The construction stage will consist of three phases:
  - Phase 1: The construction of the starter platform and conveyor access ramp:

    This will consist of the following activities:
    - The construction of the Klipfontein River Diversion including the stilling basin;
    - A haul road to the starter platform from Transfer House 9. This will later be converted into the conveyor platform for the Top Stackers Extendable Conveyor;
    - The construction of the terrace and lining system for the starter platform;
    - Pollution control dams 1 to 7 required for the starter platform;
    - Contaminated Storm Water network around footprint;
    - Topsoil Stockpile area.
  - Phase 2: The construction of the first 5 year lined area:

    This will consist of the construction of the following activities:

    - Conveyor platforms to the facility including access roads and storm water canals along the conveyor;
    - Terrace and lining system for the first 5 years of operation;
    - Clean Storm Water Dam D1 and clean storm water contour cut-off trench;
    - The two emergency stockpile platforms;
    - Access roads and security fence up to the 20 year development line;
    - This stage is estimated to take 2 years and will be required to be completed before ash is delivered to the facility via the conveyor system.
  - Phase 3: The construction of the remaining footprint in 5 year lined area intervals:

    This phase consists of the construction of the following:

    - The terrace and lining system for each 5 year development;
    - Clean Storm Water Dams and contour cut-off dams required for each development;
    - Access roads and security fences when required;

Construction processes required under various development periods are further listed in the Construction and Operations Table in Appendix E.

<u>Construction Water Requirements:</u>

The area of the total lined footprint is used in the calculation of construction water requirements. The figure provided is for the facility over a 60 year life. At this level of detail it is sufficient to assume that this figure is used uniformly over the life of the facility.

The water will need to be sourced from the Raw Water Reservoir at the power station or the pipeline from Kendal Power Station until any of the dams is constructed in which case water will be sourced from local dams.

It is unlikely that this water will be sourced from ground water.

Table 4: Construction Water Requirements

Description:	Construction Water Requirements
Area (ha)	817.4
Depth (m)	0.45
Volume (m^3)	3,678,300
Mass of soil (t)	6,621,000
2% Moisture Content increase (m^3)	132,420

Assumptions:

- Bulk density of soil is 1 800kg/m^3
- In situ moisture content will require an average of 2% additional moisture during compaction

4.3 The operations phase

General operations of conveyor systems and stackers:

Conveyors are used to transport the ash from the power station to the ash facility. At the power station, the ash is deposited onto an overland conveyor at a transfer house. The overland conveyor transports the ash to a transfer house at the ash disposal facility.

The transfer house at the ash facility either deposits the ash onto an extendable conveyor which leads onto the ash facility or onto a cross conveyor which will transport the ash to the transfer house of a second ash facility if required.

The extendable conveyor transports the ash from the transfer house to the starter platform where the shiftable conveyor is set up in the first shift position.

The stacker will do one complete cycle of placing ash in front of the shiftable conveyor followed by placing ash in the back stack behind the conveyor.

Once the first ashing cycle is complete, the shiftable conveyors will be shifted onto the newly placed ash. The extendable conveyors will be extended past the starter platform and onto the placed ash and the next shift's ashing cycle will commence.

Stack Arrangement:

Due to the underlying geology not offering sufficient strength to support a front stack of more than 15m [*10 Year Ash Dump, Slope Stability Analysis, Volume 1*: Report number 5452/10/19 Rev 2] a multi-level stacker setup, similar to the arrangement at Majuba Power Station, will be used.

The setup used in the conceptual modelling was the following:

- Bottom Stacker: Front stack height – 5m;
  Back stack height – 12m;
- Top Stacker: Front stack height – Varies from 30 to 94m (worst case);
  Back stack height – 12m.

The bottom stack will consolidate the underlying clay layers, increasing their strength in time to support the Top Stacker's high front stack and 12m back stack as shown in Figure 12.

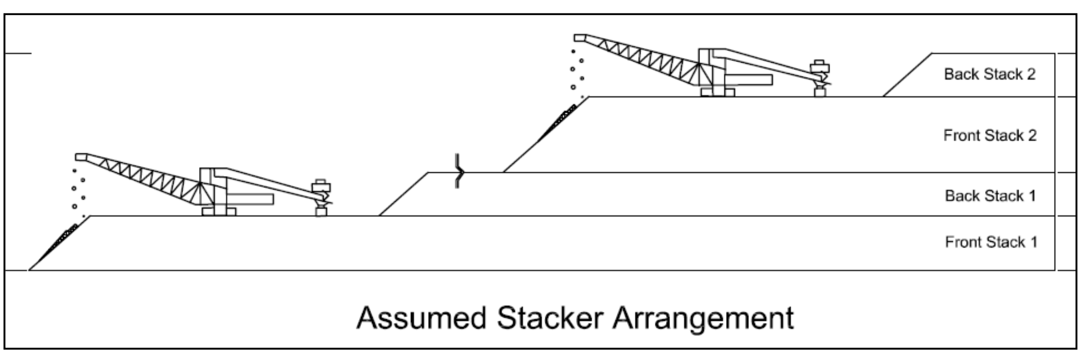

Figure 12: Multi Stacker Philosophy

Stacker setup:

Figures 13 and 14 show the connection of the crawler mounted stacker to the tripper car which runs along tracks on the shiftable conveyor.

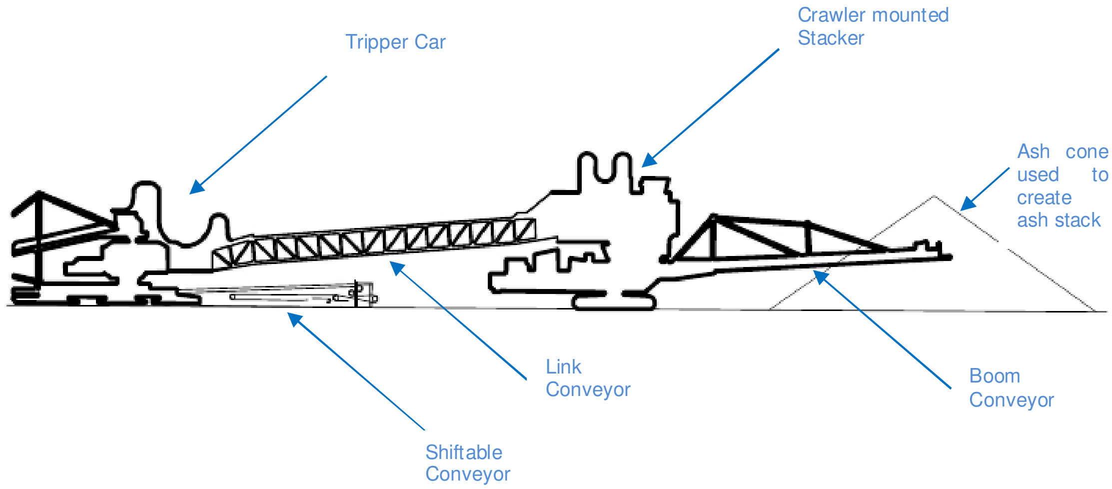

Figure 13 : Stacker setup

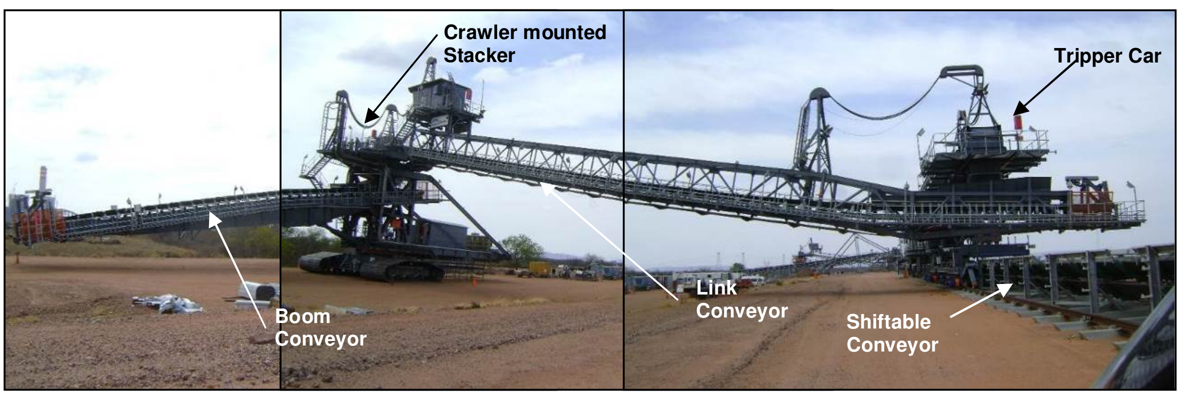

Figure 14: Stacker setup at Medupi Power Station

Mobile Equipment

Where access for the stacker is limited, mobile equipment is used to place the ash and shape it according to the geometry shown on the drawings. The ashing system is arranged so that dozing is kept to a minimum while free ash is maximized. Free ash is defined as ash that is placed by the stacker which does not require further dozing.

Due to the ash being placed at the angle of repose, a large amount of shaping is required at the side slopes during rehabilitation.

Mobile equipment is also used to shift conveyors and carry out similar tasks.

The following mobile equipment is needed:

- **A dozer**: A dozer will be required to move ash to positions outside the reach of the stackers, carry out trimming and profiling of the dump surface, side slopes, and conveyor platforms and to move the head and tail stations during conveyor shifts.

- **D6 (or equivalent) dozer:** This dozer will be fitted with a rail shifting head frame which will be used to shift the shiftable conveyors.
- **Grader:** A grader will be used to do final levelling and shaping of the platforms, advancing front stack slope, side slopes, back stack and rehabilitation topsoil on the final surfaces of the ash dump. It will also be used for minor cleaning operations on the stacker working platforms as well as for grading of roads and excavation of clean storm water cut-off trenches.
- **Compaction Equipment:** A self-propelled or towed vibrating roller will be used to achieve nominal compaction of the dump surface in the stacker working areas as well as on the shiftable conveyor platforms. Compaction of the advancing front stack slope assists in the shifting operation of the shiftable conveyors.
- **Water bowser**: Water bowsers will be used for dust suppression of working areas, roads and, washing down of the mechanical plant. Water bowsers will also be used for dust suppression of advancing slopes where it is difficult to reach with sprinklers or for specific chemical dust suppression applications.
- **Dump Trucks:** Dump trucks will be used for hauling and placing topsoil and fill material on the ash dump.
- **Front End Loader:** Front end loaders will be used for loading dust suppression soil and fill material onto trucks, for general maintenance on and around the ash dump.
- **TLB:** A TLB will be used for cleaning concrete lined canals, digging holes for anchor plates and general maintenance on and around the ash dump.

The Operation Stage will consist of two phases:

- Phase 1: Constructing the starter platform from ash using a truck and haul operation:
    - Trucking the ash via the haul road from Transfer House 9;
    - Placing the ash on the starter platform in 200mm layers.
- Phase 2: Operating the ash facility
    - Ashing operations including management of conveyor systems and stackers;
    - On-going rehabilitation of completed areas of the ash facility and topsoil placement;
    - This stage will continue for the life of the power station – 60 years.

4.3.1 The ash facilities growth plan

The following growth plan is based on the volume and tonnage information shown in Table 1 in Section 3.3. It is also based on the assumption that all 6 units are operational when the 60 year ash facility is commissioned.

A growth plan consists of three graphs:

- Time Vs. Chainage: This graph indicates at what point in time the ash facility will reach a specific chainage.
- Time Vs. Volume: This graph indicates at what point in time the ash facility will reach a specific volume.
- Volume % Vs. Chainage: This graph illustrates the relationship between the volume of the facility and its development in space. I.e. it reaches 50% of its volume after approximately 1 300m of development.

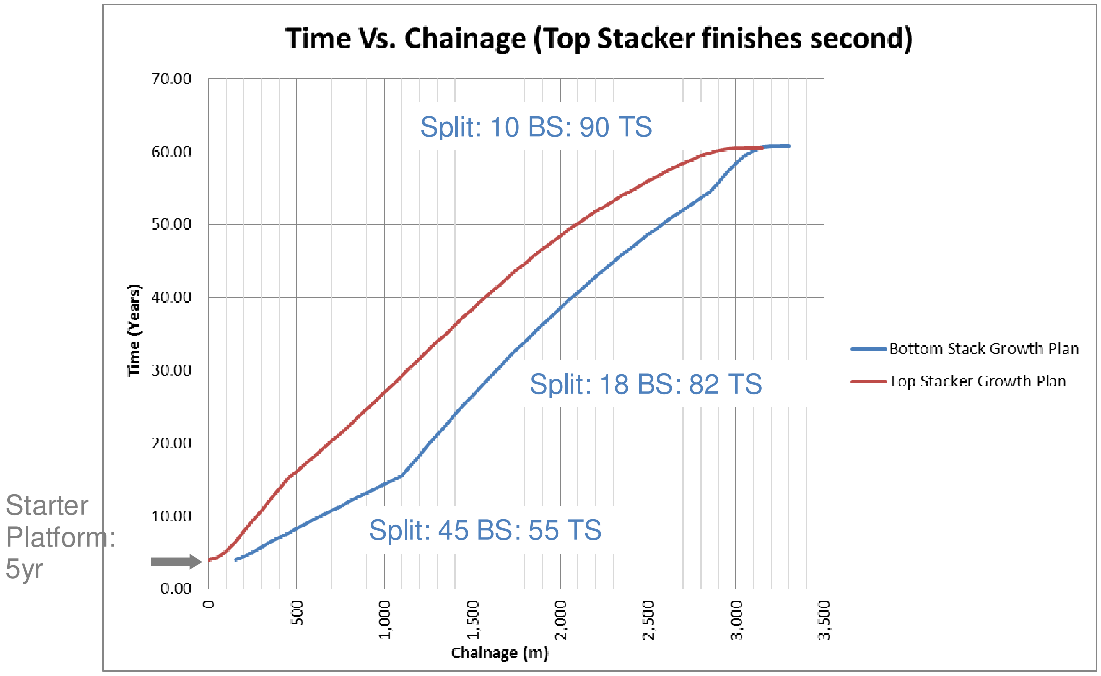

Figure 15: Growth Plan: Time Vs. Chainage

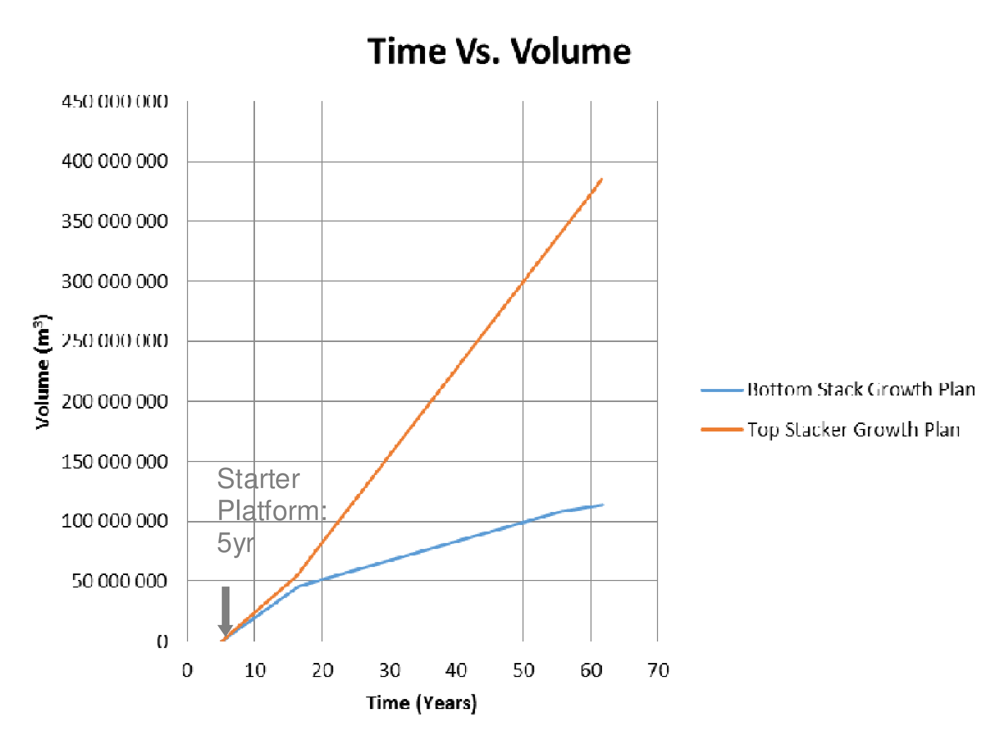

Figure 16: Growth Plan: Time vs. Volume

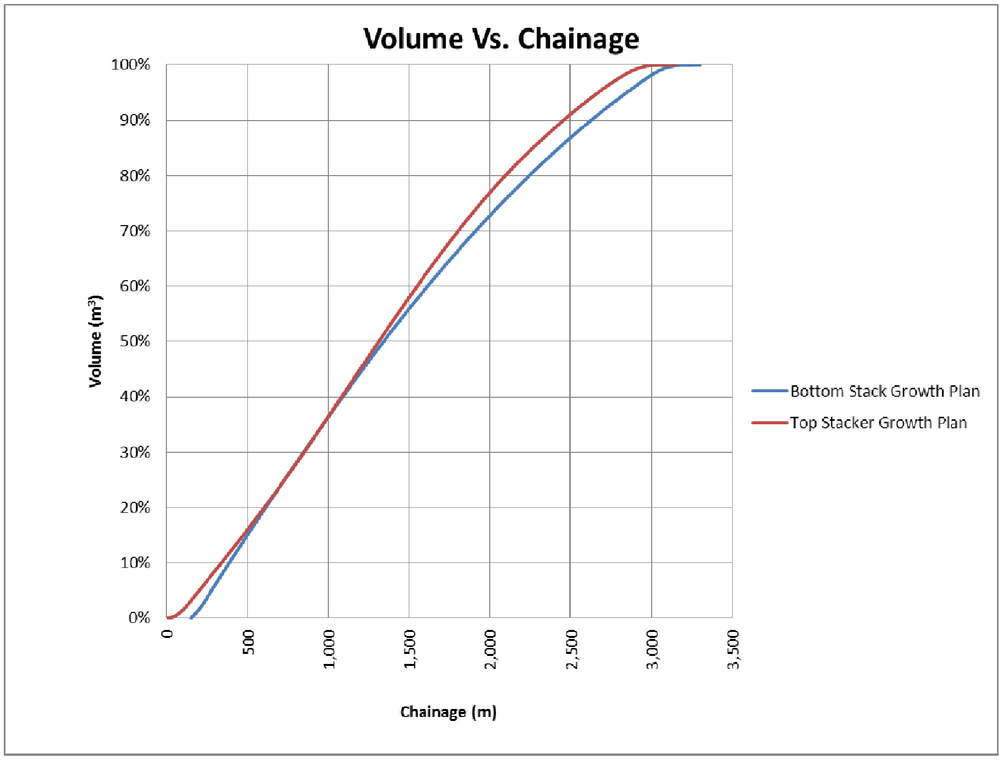

Figure 17: Growth Plan: Volume Vs. Chainage

Table 5 provides a summary of the accumulative volume stored over the lifetime of the facility.

Table 5: Growth Plan Summary for 5 year lined areas

Period:	Accumulated Ash Storage: (million m^3):	Lined Area per period: (Ha)	Accumulated Lined Area: (Ha)
Starter Platform	35.8	120.5	120.5
5 to 10 year	81.5	125.7	246.2
10 to 15 year	122.0	120.1	366.3
15 to 20 year	172.5	67.9	434.2
20 to 25 year	210.5	55.7	489.9
25 to 30 year	260.6	37.2	527.1
30 to35 year	301.8	48.9	576
35 to 40 year	349.8	55.8	631.8
40 to 45 year	388.8	51.1	682.9
45 to 50 year	437.2	46.5	729.4
50 to 55 year	478.9	48.2	777.6
55 to 60 year	534.8	39.8	817.4

The following table indicates the dates at which the percentage splits change throughout the lifetime of the facility.

Table 6: Percentage splits for stacker over life of facility

Life:	Percentage Split	
0 – 3 years	100% truck and haul operation (Development of Starter Platform	
3 – 5 years	50% Truck and haul operation	50% Bottom Stacker
5 – 18 years	55 % Top Stacker	45 % Bottom Stacker
18 – 55.5 years	82 % Top Stacker	18 % Bottom Stacker
55.5 – 60 years	90 % Top Stacker	10 % Bottom Stacker

Cross over between the starter platform and the ash facility

Although the growth plan indicates that the starter platform will take four years to complete it is envisioned that there will be a cross over period where the bottom stacker may start ashing before the starter platform is complete. This will extend the life of the starter platform to 5 years as shown in Table 6.

4.3.2 Progressive Topsoil Management

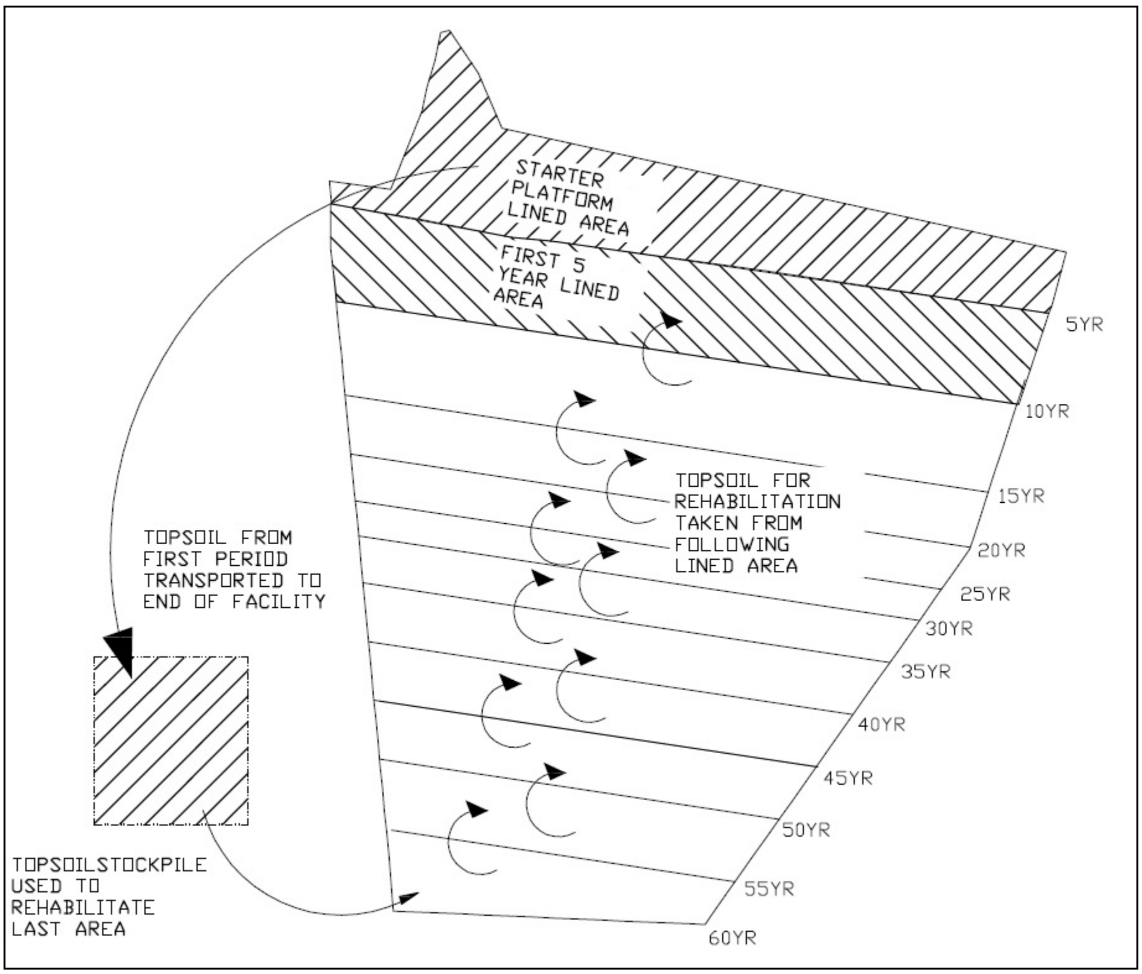

Figure 18: Method of progressive topsoil management

Figure 18 shows the method of progressive topsoil management. The topsoil of the Starter platform and the first 5 years lined area (5 to 10 year development) is stockpiled for later use near the end of the facility.

The topsoil in the footprint of the 10 to 15 year development is used to rehabilitate the initial development of ash facility. This process then repeats itself until the last area (55 to 60 year development). The topsoil in the stockpile is then used to rehabilitate the last area.

There may be a need for additional topsoil during the rehabilitation of the facility. This is logical as the surface area of the facility will be larger than the footprint of the facility. Also, due to the wedge shape of the facility, preceding lined areas are larger than subsequent areas resulting in a reducing availability of topsoil. For these reasons, there may be a topsoil shortage and later areas will need to be covered from a commercial source of topsoil.

A detailed material balance is planned after the site investigation has taken place.

Operations Water Requirements – Dust Suppression and Irrigation:

Figure 19 shows the dust suppression system in operation at the Matimba Power Station. The ash arrives at the facility with a raised moisture content of approximately 10% as shown in Figure 20. The aim of the dust suppression system is to ensure that the moisture content is maintained to reduce dust blow. The source of the dust suppression and irrigation water will likely be sourced from the surrounding pollution control dams.

Figure 19: Dust suppression system at Matimba Power Station

The rate of irrigation and dust suppression are estimated with reference to the Medupi Ash Facility Design. The exposed area for dust suppression and rehabilitated area for irrigation have been calculated based on the assumptions listed below Table 7.

The operations requirement is approximately 900% more volume than the construction requirements as these areas will continuously need to be wetted during operations whereas the area during construction will only require wetting during a single period.

Table 7: Operations Water Requirements

Description:	Operations Water Requirements
No of days of operations (60 yr life)	21,900 days
Exposed Area (requires dust suppression)	2 000 000m^2
Rehabilitated Area (requires irrigation)	316,000m^2
Dust Suppression	3,333m^3/day
Irrigation	1,896m^3/day
Total Dust Suppression over 60 years	73,000,000m^3
Total Irrigation over 60 years	41,500,000m^3

Assumptions:

- Dust suppression and irrigation requirements are 5.0 and 6.0mm/day respectively;
- Dust suppression occurs once every three days for a specific area. The sprinklers are used for a duration of 4 hours;
- Irrigation occurs once a day and the sprinklers are used for a duration of 1.5 hours.
- The area for dust suppression is based on the following assumptions:
  - Rehabilitation has reached 2 shifts behind the advancing face of the Top Stack (shift length 50m);
  - There is a 533m spacing between the top stacker and the toe of the bottom stack;
  - The worst case scenario of the width of ash facility during the 5 to 10 year development area is used (3 160m).
- The area for irrigation is based on the following assumptions:
  - The ash facility is irrigated for 2 shifts width behind the extent of rehabilitation (shift length 50m);
  - The worst case scenario of the width of ash facility during the 5 to 10 year development area is used (3 160m).

Figure 20: Moisture condition (typically 10%) of ash at arrival at the ash facility (Matimba Power Station)

Figure 21 shows the layout of the ash facility during normal operations. The green area represents the rehabilitated area, the blue area represents the area being irrigated and the red area represents the area where dust suppression is taking place.

The dust suppression will cover a larger area than the irrigation system. Therefore larger sprinklers will be used for the dust suppression; these will have a throw radius of 50m. Normal conventional sprinklers will be used for the irrigation system; these will have a throw radius of 10m.

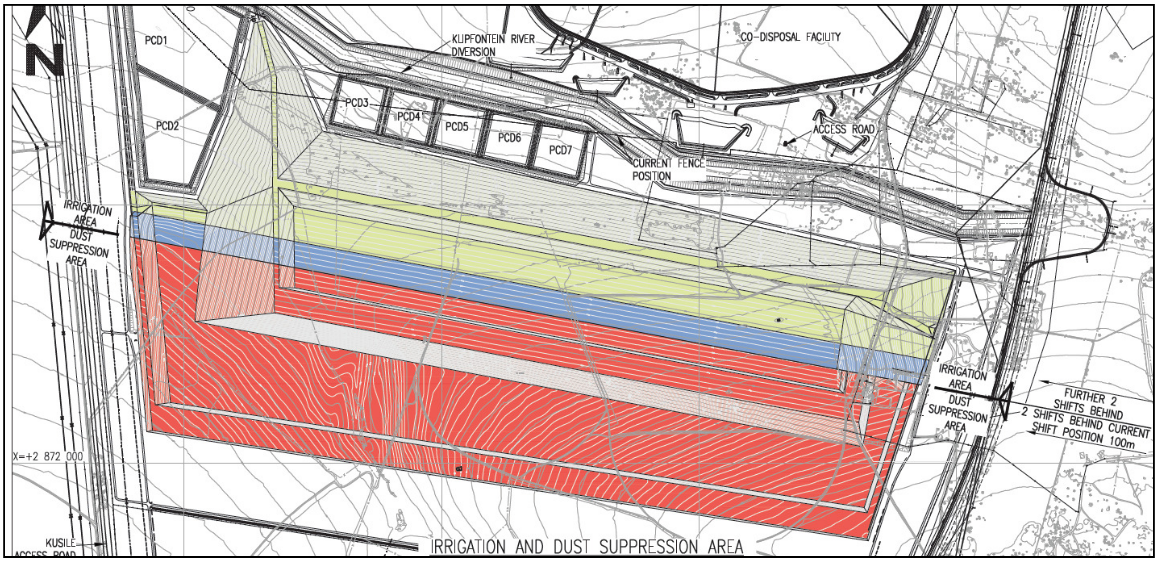

Figure 21: Ongoing rehabilitation, irrigation and dust suppression

4.4 The decommissions phase

- Decommissioning Stage: This stage includes the following items:
    - Rehabilitating final areas of the ash stack;
    - Decommissioning the stackers and the conveyors;
    - Decommissioning pollution control dams that are no longer required (this is assumed to be PCD 4 to 7);
    - Constructing required access roads for continuous maintenance and monitoring.

5. CONCLUSIONS / RECOMMENDATIONS

5.1 Engineer's recommendations

It is Jones & Wagener's opinion that Site A is the most preferable site to take forward to the detailed design stage. This recommendation is based on the following facts:

1. Site A is the closest site to the power station. This simplifies and lowers the expense of operations and ensures that the impact of the power station, co-disposal facility, conveyor corridor and ash facility is contained to the smallest footprint. The ash facility is also easily accessible from the power station.
2. Site A is also furthest from the Wilge River and would not require a large scale river crossing that would be required for Site B.

3. The site geology potentially provides suitable material for use in the lining system;
4. The site topography provides adequate slopes for drainage;
5. Site A has the lowest overall construction and operations cost;
6. No major infrastructure diversions are required;
7. The wide rectangular shape of the site allows for easier operations than a thin rectangular shape.

Charl Cilliers Pr Eng
Project Manager

Danie Brink Pr Eng CEO
Project Director
for Jones & Wagener

10 January 2014

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Document template: repGen_13r1.dotx

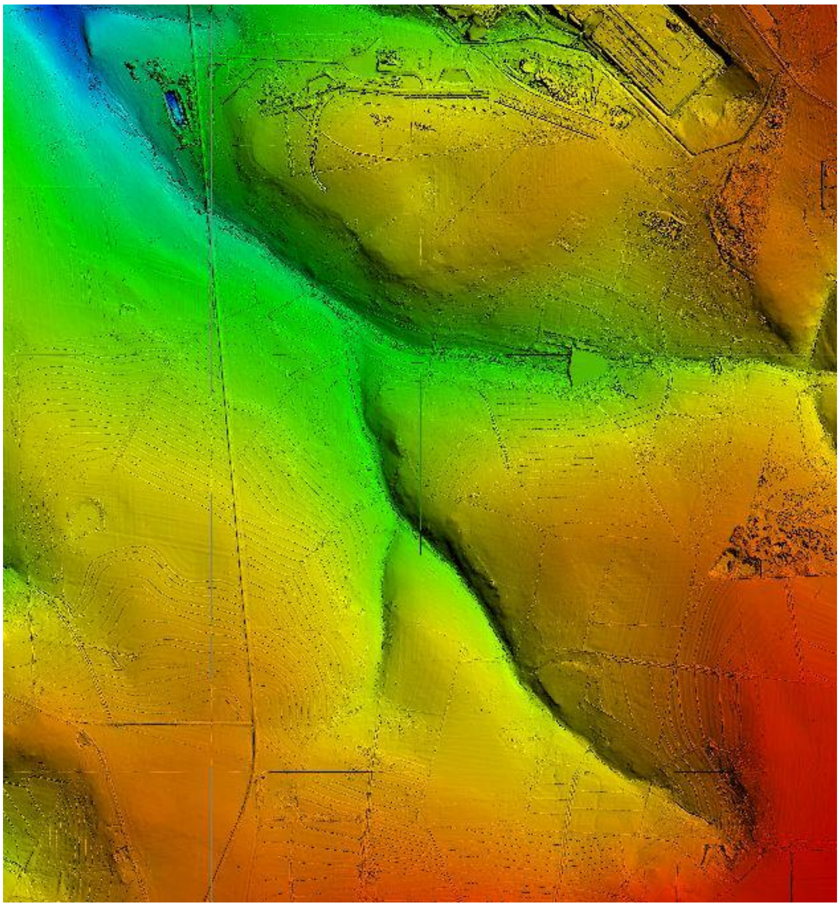
APPENDIX A

SURVEY REPORT FOR SITE A

Kusile Power Station Ash Dump

Zitholele Consulting (Pty) Ltd

LiDAR Project Survey Report



Southern Mapping Geospatial (Pty) Ltd
Reg No. 2010/010712/07
Directors: Bheki Sibiya (Non Executive Chairman), Dumi Sibandze (Managing Director), Carlos Clara, Jannie Engelke, Alex Fortescue, Pontsho Maruping, Sipho Twala

Contents

Southern Mapping Geospatial (Pty) Ltd
Reg No. 2010/010712/07
Directors: Bheki Sibiya (Non Executive Chairman), Dumi Sibandze (Managing Director), Carlos Clara, Jannie Engelke, Alex Fortescue, Pontsho Maruping, Sipho Twala

Project Detail, Overview and Equipment

Project Detail

Survey Project: Kusile Power Station Ash Dump
Date of Survey: 30 May 2013
Client: Zitholele Consulting (Pty) Ltd

Project Overview

The topographical survey was undertaken by Southern Mapping Geospatial (SMG) to produce rectified colour images and a digital terrain model (DTM) of the project area.

The topographical survey was carried out using an aircraft mounted LiDAR system that scanned the ground below with a 100 kHz laser frequency rate, resulting in a dense DTM of the ground surface and objects above the ground.

Digital colour images were also taken from the aircraft and rectified to produce colour orthophotos of the project area.

The survey was flown at a height of approximately 1 200m and orthoimages with a 15cm pixel resolution have been produced.

Equipment Used

Aircraft: Cessna 206.

LiDAR Scanner: Optech ALTM Orion M200 (maximum 200 000 LiDAR ranges per second).

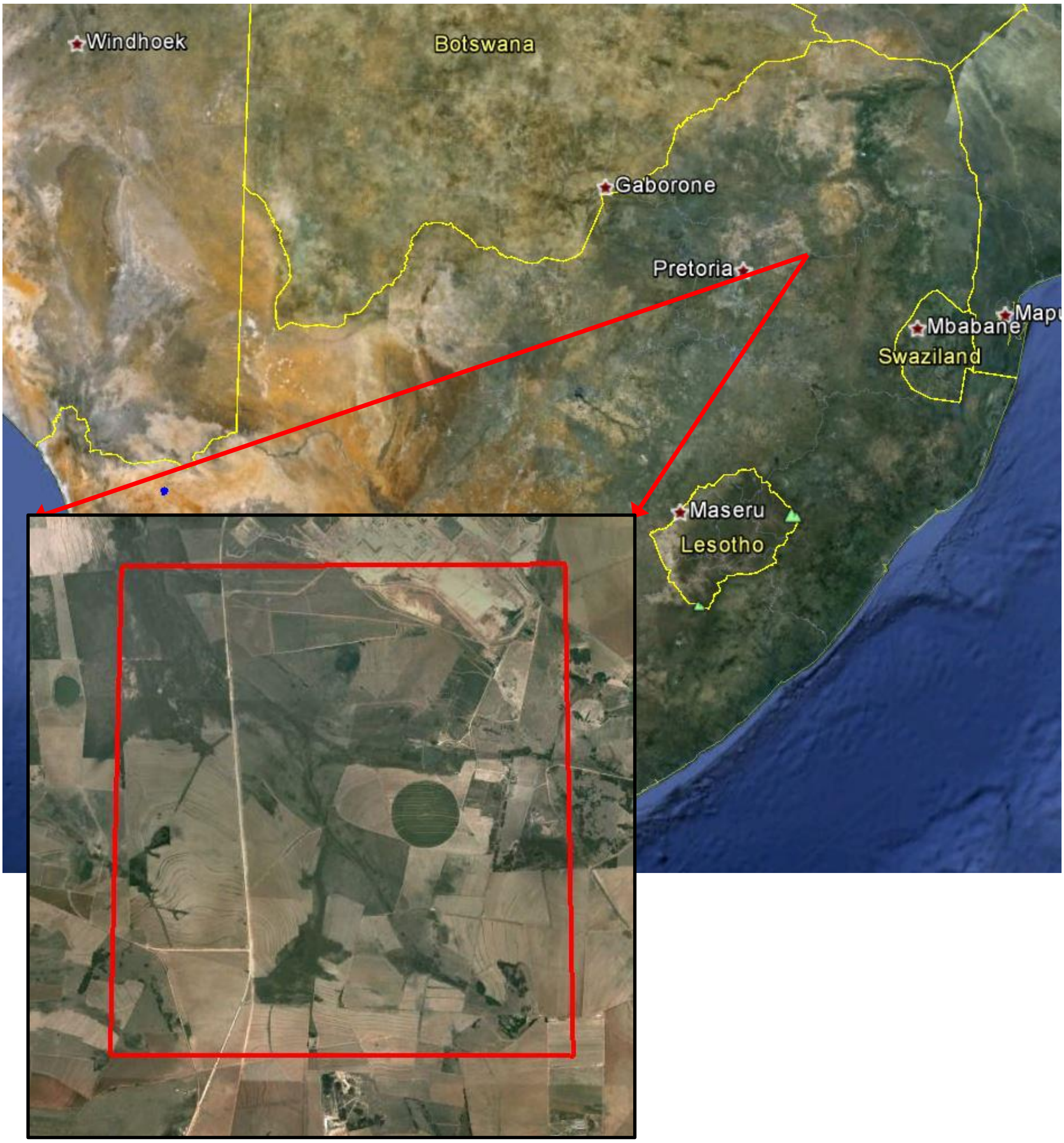
Camera: Rollei AIC with a 65 mega-pixel P65+ Phase One digital CCD.

Weather Conditions

Date	Conditions
30 May 2013	Clear

Project Extent

The project extent covers an area of approximately 3 900Ha.



Locality Map

Check Points

Check Points

Four pre-marked points were placed and surveyed by Southern Mapping and have been used for this project as a check on the horizontal and vertical accuracy.

The coordinates are as follows:

Coordinate system: Hartebeesthoek94 Geographic

Name	Latitude (South)	Longitude (East)	Ellipsoidal Height (m)	Orthometric Height (m)
KFB09	-25 56 13.18	28 53 40.62	1 464.05	1 437.62
KFB15	-25 56 55.42	28 56 01.34	1 509.68	1 483.12
SM13_19_1	-25 58 56.79	28 56 12.34	1 587.57	1 560.76
SM13_19_2	-25 58 53.06	28 53 25.18	1 548.30	1 521.54

Coordinate system: Hartebeesthoek94 WG29

Name	Eastings	Northings	Ellipsoidal Height (m)	Orthometric Height (m)
KFB09	-10 556.25	-2 869 858.60	1 464.05	1 437.62
KFB15	-6 640.01	-2 871 155.86	1 509.68	1 483.12
SM13_19_1	-6 332.27	-2 874 890.91	1 587.57	1 560.76
SM13_19_2	-10 981.75	-2 874 779.10	1 548.30	1 521.54

*Please see accompanying ground survey data.
* Signs have been swapped for CAD purposes.

LiDAR Point Processing, Calibration, Editing and Transformations

LiDAR Point Processing

The trajectory for each flight was post processed using Waypoint DGPS software, which combines the 1 Hz GPS readings with the 200Hz inertial measurement system (IMU) readings and outputs a smoothed "best estimated" trajectory for the laser scanner and camera positions.

LiDAR Calibration

Overlapping LiDAR points from adjacent aircraft trajectories were used to check the LiDAR calibration for heading, roll, pitch and scale.

These values were then used to make small flight-specific adjustments to the LiDAR data.

LiDAR Point Transformations

The LiDAR points were initially calculated based on the ITRF08 datum with ellipsoidal heights.

The LiDAR points were then shifted from the ITRF08 values to Hartebeesthoek94 values using the following shifts, which were calculated, based on the Bronkhorstspruit TrigNET station:

ITRF08 to Hartebeesthoek94	
Eastings Shift	0.28m
Northings Shift	0.38m
Elevation Shift	0.01m

The ellipsoidal height values were then converted to orthometric height values using the SAG2010 geoidal model within TerraScan.

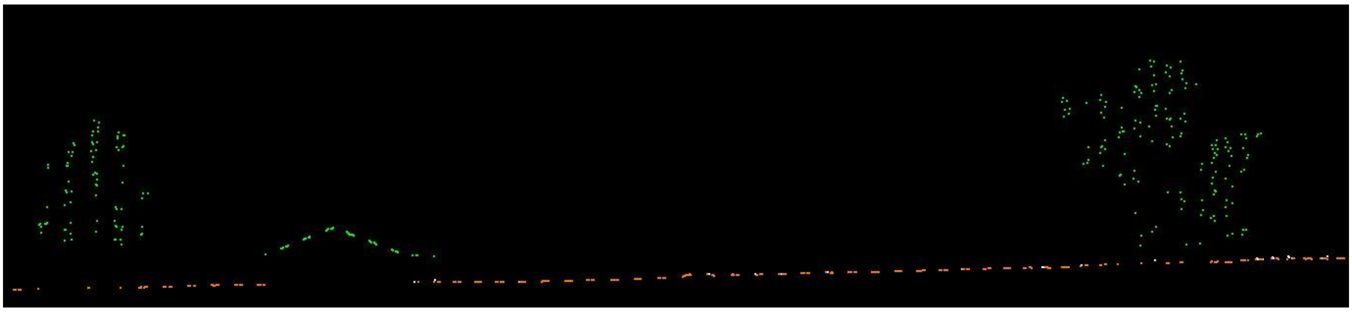
LiDAR Point Editing

A “1st run” automatic classification was carried out on the raw LiDAR points using *TerraSolid’s TerraScan* software to separate the LiDAR points into ground hits and non-ground hits. This results in a greater than 90% correct classification. After this, a manual classification was done over the required area to edit the points with gross classification errors that may have occurred in the automatic classification process.

As requested, the points were also thinned into “key points”.

Ground key points are defined in such a way that where a rapid change in elevation occurs, the density of the points is maintained and as such the slope is always well defined. However, where there is relatively little change in elevation the density of the points is reduced because of the fact that far fewer points are required to accurately define the surface.

Non-ground key points are thinned in such a way that the density of point clusters, such as those that define a tree, will be reduced in a manner that still accurately defines the random shape. Points that define elements with a more linear (and less random) shape, such as a power line, will not be as extensively reduced however, so as to maintain the accuracy in the changes of elevation and position relative to the ground surface.



Laser points classification – Orange = Ground model, and Green = Non-ground features

Orthophoto Rectification Procedure

Images were rectified by identifying common pixel points in overlapping image tiles using a process known as "tie-pointing".

After completion of the "tie-point" process all images were adjusted for optimum heading, roll, pitch and scale values so as to ensure a seamless image mosaic was obtained.

Rectified Image

Southern Mapping Geospatial (Pty) Ltd
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Directors: Bheki Sibiya (Non Executive Chairman), Dumi Sibandze (Managing Director), Carlos Clara, Jannie Engelke, Alex Fortescue, Pontsho Maruping, Sipho Twala

Checkpoints and Accuracies

The four check points, that were surveyed by ground methods, have been compared with the LiDAR ground surface.

The results are as follows:

Name	Easting	Northing	Known Z (Ground Elevation)	LIDAR Z	Dz
KFB09	-10 556.25	-2 869 858.60	1 437.62	1 437.68	+0.06
KFB15	-6 640.01	- 2 871 155.86	1 483.12	1 483.08	-0.04
SM13_19_1	-6 332.27	-2 874 890.91	1 560.76	1 560.72	-0.04
SM13_19_2	-10 981.75	-2 874 779.10	1 521.54	1 521.55	+0.01

Average Dz	**-0.002**
Minimum Dz	**-0.040**
Maximum Dz	**+0.060**
Average magnitude	**0.038**
Root mean square	**0.042**
Std deviation	**0.048**

**Please note that coordinate signs are swapped for CAD purposes*

Horizontal Accuracy

Pre-marked check points were digitized on the orthophotos and the derived coordinates were compared with the ground survey values:

The known point comparison results are as follows.

Name	Orthophoto Easting	Orthophoto Northing	Known Easting	Known Northing	Dx(m)	Dy(m)
KFB09	-10 556.29	-2 869 858.51	-10 556.25	-2 869 858.60	-0.04	0.09
KFB15	-6 640.04	-2 871 155.93	-6 640.01	-2 871 155.86	-0.03	-0.07
SM13_19_1	-6 332.27	-2 874 891.01	-6 332.27	-2 874 890.91	0.00	-0.10
Average from known position					**-0.01**	**-0.02**
Standard Deviation					**0.02**	**0.07**
Standard Deviation (Rectified XY from Known XY)					**0.05**	

**Please note that coordinate signs are swapped for CAD purposes*

Deliverables

- CAD design files in Microstation DGN & DWG formats showing:

  i. Orthophoto tiles layout

  ii. LiDAR point block layout

  iii. Contours at 0.5m, 1m and 5m intervals

  iv. The project area surveyed with boundaries

  **These contours have been smoothed and are merely an aesthetic representation of the ground shape.*

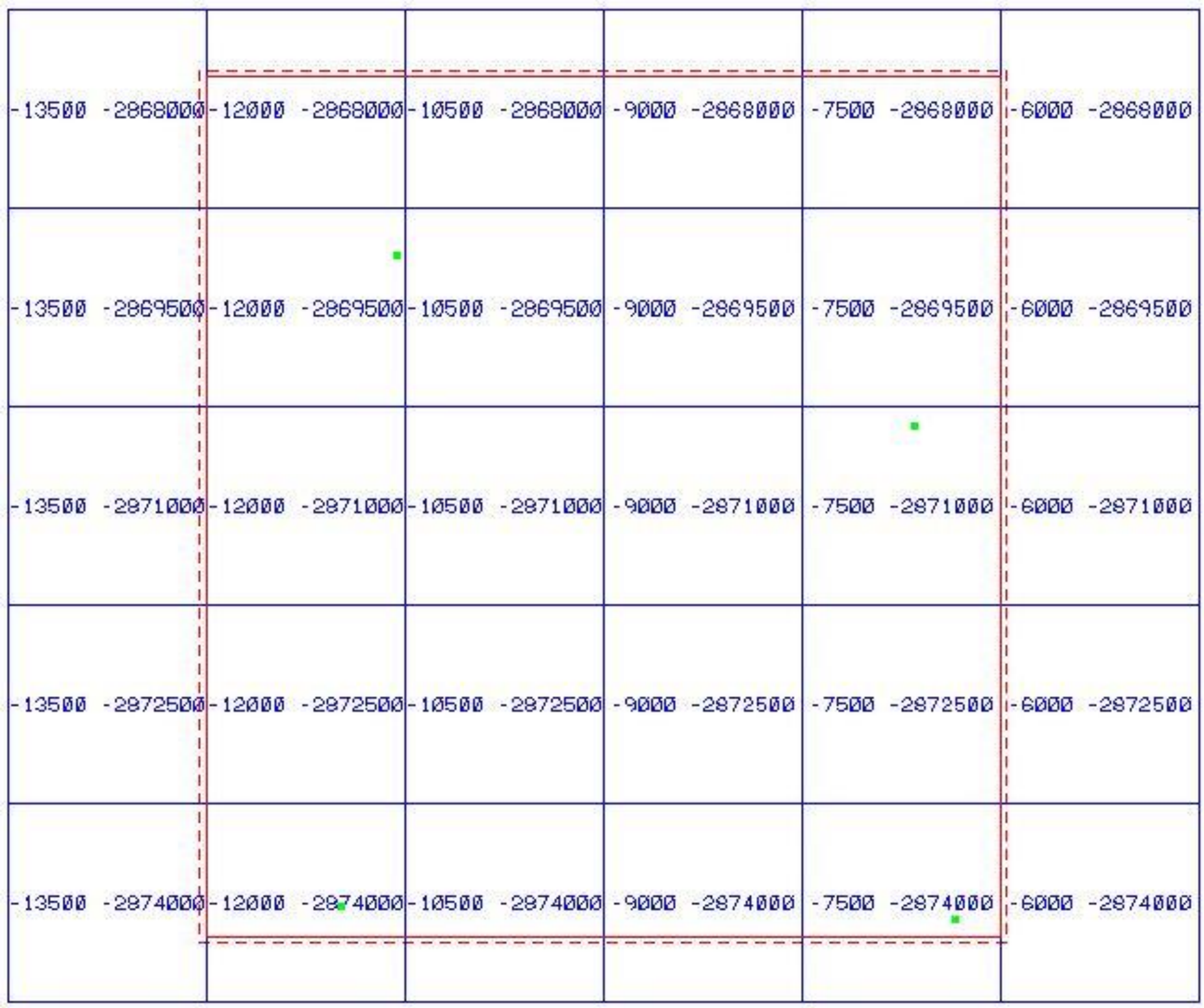
- Ortho-rectified aerial images with a 15cm pixel resolution
- Composite images of the total area survey with a 0.5m pixel resolutions.
- Thinned ground and non-ground LiDAR points in ASCII format.

  *All of the above data are in the **Hartebeesthoek94 Lo29 coordinate system,** with orthometric heights as calculated in TerraScan using the SAG2010 geoidal model.*

- This project report

Southern Mapping Geospatial (Pty) Ltd
Reg No. 2010/010712/07
Directors: Bheki Sibiya (Non Executive Chairman), Dumi Sibandze (Managing Director), Carlos Clara, Jannie Engelke, Alex Fortescue, Pontsho Maruping, Sipho Twala

Project Block Index



Project Layout and Block Index

Queries

In case of any queries please do not hesitate to contact:

Tebogo Senoge 011 467 2609 or 072 347 5885 or tebogo@southernmapping.com

Eduarda Teixeira 011 467 2609 or 082 462 5758 or eduarda@southernmapping.com

APPENDIX B

COMMUNICATION BY ANGLO AMERICA

AngloAmerican

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Anglo Operations Limited
Thermal Coal

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Project Manager
Kusile Project
Eskom

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Mobile: 082 967 5927
e-mail: leon.stapelberg@eskom.co.za

9th May 2012

Dear Sir

Phola-Kusile Overland Conveyor Route: Request on Feasibility of Stormwater Control Measures Adjacent to Flight 5 to Accommodate a Potential Site For Kusile's Proposed 60-Year Ash Disposal Facilities

We refer to your letter dated 26th March 2012 and note that we have reviewed the two alternatives to manage storm water as proposed by your Ash Disposal Consultants for the area between the AAIC coal reserves and the Phola - Kusile Overland Conveyor.

The two alternatives described in your letter comprise:

1. Two open canals running on contours to intercept run-off storm water and divert it around the ash facility, starting within the AATC property. These would need culverts under the conveyor and access road. These canals are shown on the sketch by the arrows: the advantage of these is that pumps and associated energy/costs are never needed.
2. A collection dam and pump station to catch the storm water from below the level of these canals. This would ideally be immediately upstream of the conveyors. If the canals are installed the dam size is reduced, if the canals are not built the dam and pumps have to be bigger to compensate for it.

We are currently well advanced with our design on the Phola-Kusile Overland Conveyor and have provided an environmental gantry at the proposed crossing of the existing stream. We have however reviewed your proposals and comment as follows:

1. North and South cut-off canals will be required to intercept run-off storm water, however the following should be noted:

   NORTH CANAL (refer to drawings 0138- CED-0031 and 0032)

   - The north route has a cut of +/-14m deep, the reason being that it cuts through the "koppie" as clearly shown on the relevant longitudinal section attached whilst maintaining a flat gradient of 1:300. (refer to drawing 0138-CED-0033)
   - This route does not need to cross the conveyor however some complex water control and stream training will be required at the point where it ties into the existing stream.

- The north route flows into the existing river further north as shown on the layout.
- A further alternative of aligning the north canal closer to the conveyor has been looked at, however it moves further down the "koppie" and generates a cut in the region of +/- 23m deep.
- The canal is deep and is located extremely close to the mining area (safety risk).
- A 12m wide farmers crossing has been positioned along the conveyor and this too will need to cross the north canal.

SOUTH CANAL (refer to drawings 0138- CED-0031 and 0032)

- The south canal has a cut of +-8m deep; this route allows us to follow the contours as best as possible maintaining an extremely flat gradient of 1:800.
- This route crosses the conveyor CVY507 and the crossing requirement is for 2 x 36m environmental gantries.
- The south canal daylights at natural ground and will then flow down to a smaller stream that eventually merges with the existing river.

In addition to the two canals, a portion of the catchment will still run towards the conveyor. The conveyor can only be protected by the installation of a smaller type of dam that will require pumping considering that water cannot free drain from this point.

A further concern is the ground water and the relevant environmental sensitive areas and ground water that will be impacted by cutting off this water.

The deviation and training of watercourses, streams and rivers is complex and will require a substantial amount of attention and will be costly.

The topography of the ground is not ideal for the north and south canals however it is the only route a deviation can take.

The management of dirty water from the eastern side of the ash disposal facility could be a problematic.

2. A collection dam and pump station to catch the transfer water from below the level of the canals. With reference to this point we comment as follows:
    - As noted above, a smaller dam together with a pumping system will be required together with the canals.
    - Dams will require an emergency overflow system in the event of a major storm. In this case it would be extremely difficult to free drain the water thus placing the conveyor under extreme risk.

In conclusion after considering your proposal we raise the following concerns:

- Deviation of rivers, streams and watercourses are complex and risky;
- North and south canals will be extremely deep, wide and long (fairly soft material at surface);
- Closeness of the canal to the open pit mine (safety risk);
- Life and importance of the conveyor to supply Kusile;
- Capital required to construct the canals, the tie in points, the dam & pumping system;
- Risk of dam breaching and lack of an overflow facility;

- Effect of the canals on farmers;
- Impact on environmental and groundwater.

It is therefore our recommendation that the alternative sites for the discard dam be pursued.

Yours faithfully

H.A. Lamprecht
Regional Manager Projects
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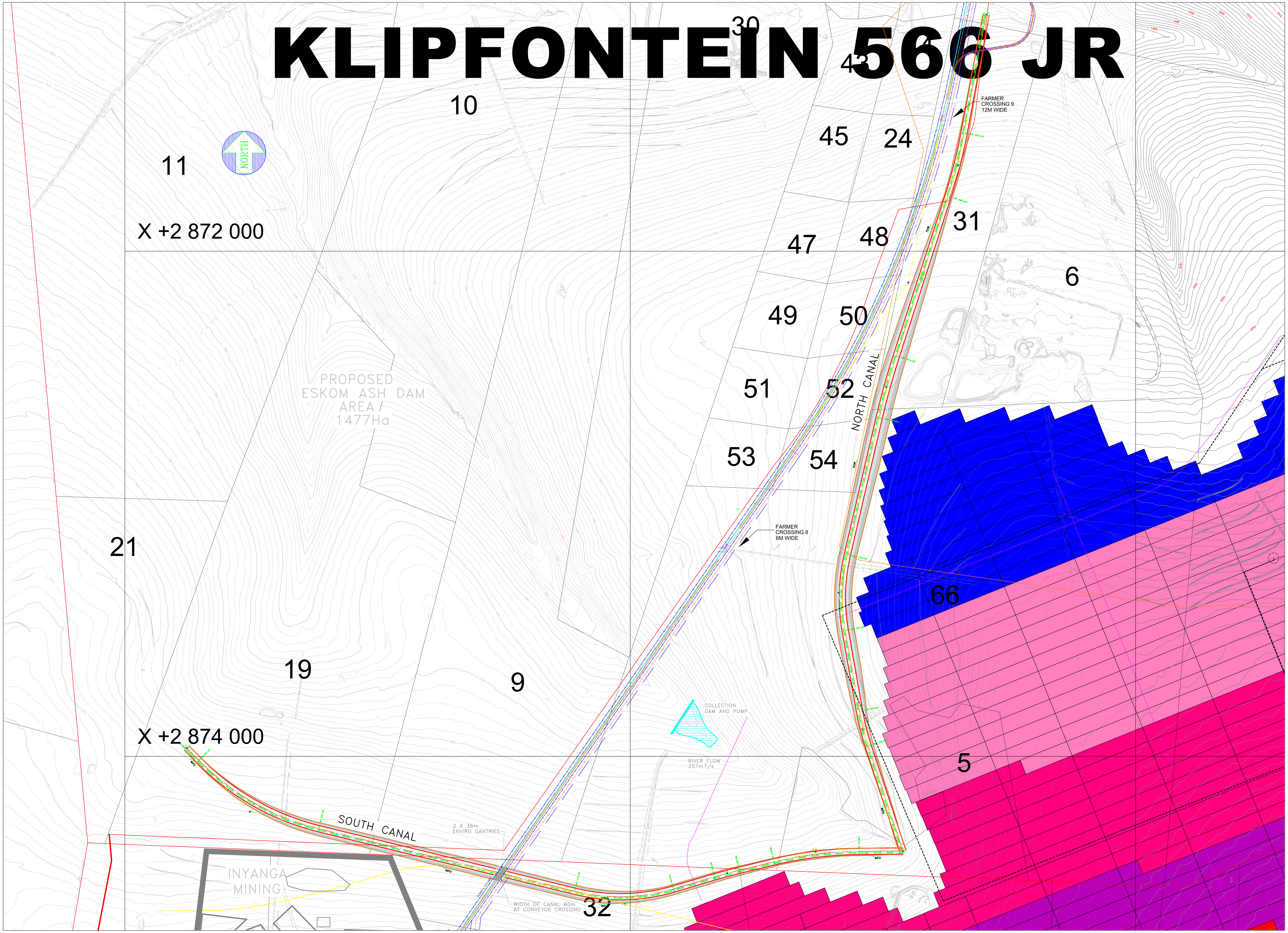

APPROVED BY				
DESIGNED BY				
NAME	SIGNATURE	REGISTRATION	REG.NO.	DATE
CIVIL CALCULATION FILE No.		0000-0130		C000

DESIGNED & APPROVED IN ACCORDANCE
S.A.N.S. 1200 CIVIL ENGINEERING SPECIFICATION
AND AA SPECIFICATIONS WHERE APPLICABLE

CIVIL ENGINEERING

TITLE	DRG No	TITLE	DRG No

REFERENCES

DETAIL	MARK	DATE	INIT	APPV'D

REVISIONS

CONS-APPROVAL	NAME	DATE	SIGNATURE
DRAWN			
CHECKED			
DESIGNED			
PROJ. ENGINEER			
PROJ. MANAGER			
PR. ENG			
PR. ENG. No.			

MINE - NOTED	NAME	DATE	SIGNATURE
PROJECT ENGINEER	P. RAJLAL		
CONSTR. MANAGER	A. BRONNER		
METALLURGY MANAGER	E. DHLAMINI		
PROJECT MANAGER	H. LAMPRECHT		
O.R. MANAGER	B. NCUBE		

ANGLO - NOTED	NAME	DATE	SIGNATURE
H.O.E.	J. COETZEE		
H.O.E. (PROJECTS)			
MECH/STR ENG.	T. SCHMIDT		
ELEC. ENGINEER	P. BATEMAN		
C & I ENGINEER	L. LOUW		
CIVIL ENGINEER	B. von ZYL		
I.M. PROJ MAN.	G. ROSS-SEEGERS		

AngloAmerican Thermal Coal

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COMPANY	NEW LARGO
PROJECT	NEW LARGO PROJECT - IMPLEMENTATION
AREA	
LOCATION	INFRASTRUCTURE
JOB	ESKOM ASH DUMP CANAL
TITLE	OVERALL LAYOUT - ESKOM ASH DUMP NORTH AND SOUTH CANAL DIVERSION

DRG No. 0000-0138-CED-0031

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SCALE:
ORIGINAL DRG. SIZE A0
SHEET
REV. A

No.	DESCRIPTION OF HOLDS	ADDED	REMOVED

HOLDS

semane

SEMANE DRAWING No. 102-NLG-023-R5031

DRAWING No. 0000-0138-CED-0031

No.	DESCRIPTION OF HOLDS	ADDED	REMOVED

HOLDS

semane

SEMANE DRAWING No. 1 0 2 - N L G - 0 2 3 - R S 0 0 3 2

APPROVED BY

DESIGNED BY

NAME	SIGNATURE	REGISTRATION	REG.NO.	DATE

CIVIL CALCULATION FILE No. 0000-0130 C000

DESIGNED & APPROVED IN ACCORDANCE S.A.N.S. 1200 CIVIL ENGINEERING SPECIFICATION AND AA SPECIFICATIONS WHERE APPLICABLE

CIVIL ENGINEERING

TITLE	DRG No	TITLE	DRG No

REFERENCES

DETAIL	MARK	DATE	INIT	APPV'D

REVISIONS

CONS-APPROVAL	NAME	DATE	SIGNATURE
DRAWN			
CHECKED			
DESIGNED			
PROJ. ENGINEER			
PROJ. MANAGER			
PR. ENG			
PR. ENG. No.			

MINE - NOTED	NAME	DATE	SIGNATURE
PROJECT ENGINEER	P. RAJLAL		
CONSTR. MANAGER	A. BRONNER		
METALLURGY MANAGER	E. DHLAMINI		
PROJECT MANAGER	H. LAMPRECHT		
O.R. MANAGER	B. NCUBE		

ANGLO - NOTED	NAME	DATE	SIGNATURE
H.O.E.	J. COETZEE		
H.O.E. (PROJECTS)			
MECH/STR ENG.	T. SCHMIDT		
ELEC. ENGINEER	P. BATEMAN		
C & I ENGINEER	L. LOUW		
CIVIL ENGINEER	B. von ZYL		
I.M. PROJ MAN.	G. ROSS-SEEGERS		

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COMPANY	NEW LARGO
PROJECT	NEW LARGO PROJECT - IMPLEMENTATION
AREA	
LOCATION	INFRASTRUCTURE
JOB	ESKOM ASH DUMP CANAL
TITLE	LAYOUTS - ESKOM ASH DUMP NORTH AND SOUTH CANAL

DRG No. 0000-0138-CED-0032

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SCALE:

ORIGINAL DRG. SIZE A0

SHEET

REV. A

APPENDIX C

COMMUNICATION WITH THE DEPARTMENT OF WATER AFFAIRS

Department of Water Affairs

Private Bag X 313

Pretoria

0001

Date: 11 July 2013

Enquiries: Leon Stapelberg

+27 82 967 5927

NOTES: Discussions with regards to the designs of facilities at Kusile Power Station

Attendance Register

Kelvin Legge	DWA Engineering
Keith Mnisi	DWA Hydrology
Michelle Parker	DWA Engineering
Wilma Moolman	Resource Protection and Waste
Mari Kotze	Eskom Kusile Power Station
Travis Gee	Eskom Kusile Power Station
Tinus Breedt	Eskom Kusile Power Station
Alta van Dyk	AvD Environmental Consultants
Danie Brink	Jones and Wagener
Charl Cilliers	Jones and Wagener
Warren Kok	Zitholele
Mathys Vosloo	Zitholele
Terry Gradidge	Eyethu/Inyanga Coal
Rob Williamson	Knight Piesold

Welcome

Kelvin Legge welcomed all and introduced the team

Item	Design Comments
60 Year Ash Dump	
Geology	• Phase 1 : Site screening (12 Sites) • Phase 2: Detailed API and Impact Assessment (5 Sites) • Phase 3: Geotechnical investigation – not carried out yet • Site A identified as preferred site • Mainly **tillites** (Dwyka Group - Karoo Supergroup) • **Shales and Sandstones** (Ecca Group - Karoo Supergroup) southern boundary • **Shales** (Silverton Formation, Pretoria Group - Transvaal Supergroup) northern boundary
Geohydrology	• Semi confined to unconfined shallow, secondary aquifer • Ground Water (GW) levels range from 1535 to 1460 masl • GW bearing features; 4 to 24 mbgl • Static GW levels 2 to 14 mbgl • Linear relationship between GW and NGL • Drawings were presented to indicate GW depth
Waste classification	• DEA's draft waste classification regulations published for comment in August 2012 in terms of the provisions of the NEM:WA (Act 59 of 2008) used to classify waste • Ash samples from Kendal Power Station was used for the classification • Type 3 Waste • Requires disposal on a landfill with a Class C barrier system • This classification was the result of the leachable concentration of **boron** and the total concentration of **barium** and **fluoride** in the ash
Facility Service life	• Facility will receive ash for a period of 60 years • Total Volume Stored: 534 Million m3 • Deposition rate: 739 124 m3/month/6units • Total lined area of facility: 855.4 ha • Lined over 12 5-year intervals
Ash heat generation	• In ash fill, heat is generated by hydration of ash • Hydration is a function of the composition and amount of cementitious material and the water cement ratio of the mixture • For hydration to occur free lime (CaO) and Sulphates (SO3) are needed • Tests on ash taken from Kendal Power Station show low concentrations of fee lime (±3%) and Sulphates (<0.35%)

Liner Detail (See fig 1)	• Subsoil drains from around pipe outwards
	  o 19mm Stone
	  o 6mm Stone
	  o Washed River Sand
	  o Filter Sand
	• Liner details from bottom upwards
	  o 100mm filter sand
	  o Clay layer (2 x 150mm Clay (tillite) Layers compacted to 98% Std. Proctor (k: 1x10-7 cm/s))
	  o 1.5mm Double textured geomembrane
	  o Protection Geotextile
	  o 300mm Leachate Collection layer formed with filter sand with leachate collection drains with natural graded filters as per the subsoil drains

DWA comments	• Leachate collection system will be free draining • No coal will be mined under the ash facility • Wilna Moolman's offices will confirm the classification of the waste • Heat build-up in ash facilities is still a concern to Kelvin Legge • Kelvin Legge would prefer a V-drain rather than depending on pressure head for drainage • Kelvin Legge appreciates that the new Draft Regulations are being used, but stated that CQA should apply and facility should be monitored • Recommendation: Design conditionally accepted for DWA and NEM:WA processes

	given that the final design would not deviate from what was agreed during this meeting • Design report should be completed and submitted to Kelvin Legge for final sign off • CQA and Heat monitoring to be done throughout the facility's lifetime
10 Year Ash/Gypsum Co-disposal facility	

Foundation layer	• The design of the Ash/Gypsum Co-disposal facility has previously been accepted by DWA engineering
	• A constructability issue have been picked up by quality control inspectors
	• Stones from the foundation layer are impacting on the geomembrane liner
	• An on-site discussion was held to discuss alternative solutions
	• Rob Williamson: solution is to bind the preparation layer by a dust suppression (the product to be used will be Dustex)
	• The compatibility of Dustex have been tested by Aquatan and no problem have been identified – Kelvin Legge agreed that there will be no reaction between the liner and Dustex
	• Kelvin Legge was concerned about the shear strength between the geomembrane and the prepared foundation containing Dustex – however due to the double textured membrane this might not be a problem
	• Rob indicated that a light scarification could be done before Dustex is applied
	• 38 000m^2 geomembrane have been laid down on the facility – the best would be to cut the geomembrane mid-seam, roll it up, fix the foundation layer and then roll down again
	• Kelvin Legge indicated that the construction method is part of the problem – the moisture content of the prepared foundation should be kept high, but at this point the prepared layer dries out before the geomembrane is placed
	• Kelvin Legge suggested that 2 trials should continue
	    o Scarify the prepared foundation and apply Dustex
	    o Investigate alternative construction method (keep moisture content high)
	• Kelvin Legge requested to participate in the trials

Coal Stockyard Settling Tanks and Station Dirty Dam Settling Tanks	

Practical difficulties of design	• The Coal Stockyard Settling Tanks and Station Dirty Dam Settling Tanks have been approved in the meeting held on 16 June 2013
	• Practical difficulties have been picked up in the design at the inlet and outlet – it will be very difficult to install the leakage detection in these areas
	• Rob Williamson to e-mail drawings to Keith Mnisi indicating what difficulties are present and what risks are associated with this
	• Kelvin Legge suggested the following design as an alternative
	    o Single composite liner (GCL and geomembrane)
	    o Cuspated drainage system
	    o Geotextile
	    o Concrete
	This was accepted for the main tank and the inlet and outlet structures

Eyethu/Inyanga	
Waste facilities designs	• Terry Gradidge handed over the signed design reports and drawings for the Klipfontein and Leeuwpoort Colliery

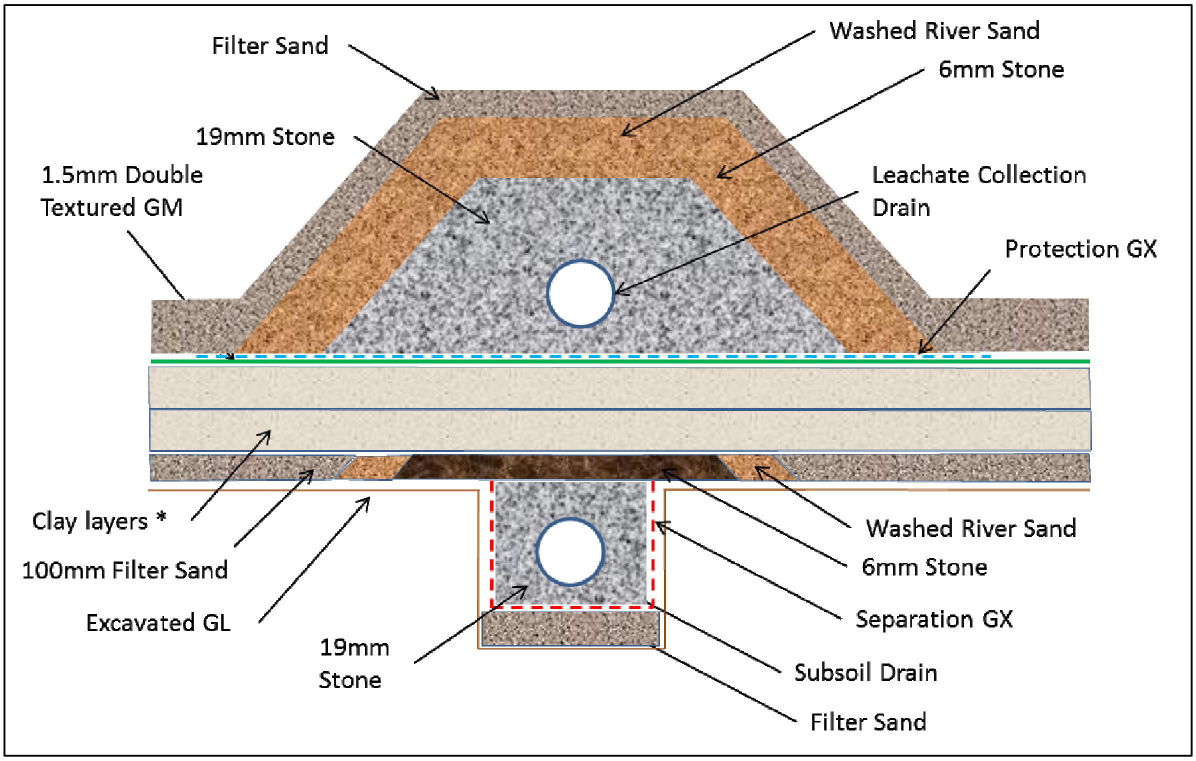

Figure 1: Proposed Liner System for the Eskom Kusile Power Station Project 60 Year Ash Dump

Charl Cilliers

From: Alta van Dyk <alta@avdenvironmental.com>
Sent: 05 July 2013 11:24 AM
To: 'Moolman Wilna'
Cc: 'Parker Michelle'; 'Leon Stapelberg'; cilliers@jaws.co.za; warrenk@zitholele.co.za; Tinus Breedt; KotzeMH@eskom.co.za
Subject: RE: DWA Civil Engineering Schedule for 11 July 2013

Hi Wilna

We confirm that we will be discussing the proposed new 60 year ash dump.

Regards

Alta van Dyk

Alta van Dyk Environmental Consultants cc (2011/059764/23)
VAT No: 4630259952
P.O. Box 1005
Midstream Estates
1692

Tel: (011) 432 6567
Fax: 086 634 3967
Cel: 082 782 4005

BBBEE: Exempted Mico Enterprize

From: Moolman Wilna [mailto:MoolmanW@dwa.gov.za]
Sent: 05 July 2013 11:13 AM
To: Alta van Dyk
Cc: Parker Michelle; Leon Stapelberg
Subject: DWA Civil Engineering Schedule for 11 July 2013

Alta
Please confirm that the Kusile team will attend the meetings in Pretoria with the DWA Civil Engineer on **11 July 2013 10:30 till 12:30** on the design drawings for the relevant waste disposal site at the Sedibeng building room 501, Francis Baard Street (Schoeman street) 185.

The responsible Engineer must present the drawings and it must be based on the new draft Standards. Please see the attached schedule and checklist of information which will be required from the engineer:
Checklist:

- Report and Drawings Signed
- ECSA Registration
- Geology
- Geohydrology
- Waste Classification
- Facility Service Life
- **The Applicant/ Engineer must take notes of the meeting which must be submit to DWA in 10 days after the meeting.**

Regards

Wilna Moolman
Resource Protection and Waste
Source Co-ordination
Department of Water Affairs
ZwaMadaka Building 110
157 Francis Baard Street (Schoeman)
Private Bag X313, Pretoria, 0001
Tel: +27(0)12 336 7557
Fax: +27(0)12 323 0321
Cell: 082 804 2830
e-mail: moolmanw@dwa.gov.za
Fax2mail: 0866206582

APPENDIX D

LAB RESULTS OF ASH SAMPLES FROM KENDAL POWER STATION

WATERLAB (PTY) LTD

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Email: accounts@waterlab.co.za

CERTIFICATE OF ANALYSES
X-RAY DIFFRACTION

Date received: 2012-08-06
Project number: 132
Report number: 36216
Date completed: 2012-08-15
Order number: D651-00

Client name: JONES & WAGENER CONSULTING CIVIL ENGINEERS
Address: P.O. Box 1434 Rivonia 2128
Telephone: 011 - 519 - 0200
Facsimile: 011 - 519 - 0201
Contact person: Talia da Silva
Email: talia@jaws.co.za
Cell:

Composition (%) [s]					
Mineral	Amount (weight %)	Error	**Mineral**	Amount (weight %)	Error
Amorphous	58.97	0.96	Amorphous	59.66	0.96
CaO Lime	0.02	0.04	CaO Lime	0	0
Calcite	0.08	0.26	Calcite	2.13	0.33
Magnetite	2.66	0.13	Magnetite	2.62	0.14
Mullite	24.22	0.75	Mullite	22.57	0.75
Quartz	14.05	0.51	Quartz	13.02	0.54

Composition (%) [s]					
Mineral	Amount (weight %)	Error	**Mineral**	Amount (weight %)	Error
Amorphous	60.09	0.93	Amorphous	56.73	0.93
CaO Lime	0	0	CaO Lime	0	0
Calcite	0.09	0.15	Calcite	1.66	0.29
Magnetite	2.46	0.13	Magnetite	2.37	0.13
Mullite	24.54	0.75	Mullite	26.38	0.75
Quartz	12.82	0.51	Quartz	12.87	0.51

[s] Results obtained from sub-contracted laboratory

E. Botha
Geochemistry Project Manager

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Client name: JONES & WAGENER CONSULTING CIVIL ENGINEERS **Contact person: Talia da Silva**
Address: P.O. Box 1434 Rivonia 2128 **Email: talia@jaws.co.za**
Telephone: 011 - 519 - 0200 **Facsimile: 011 - 519 - 0201** **Cell:**

Note:

After milling, the samples were prepared for XRD analysis using a back loading preparation method after addition of 20 % Si for quantitative determination of amorphous and micronizing in a McCrone micronizing mill.
They were analysed with a PANalytical X'Pert Pro powder diffractometer with X'Celerator detector and variable divergence- and fixed receiving slits with Fe filtered Co-K_ radiation. The phases were identified using X'Pert Highscore plus software.
The relative phase amounts (weight %) were estimated using the Rietveld method (Autoquan program). Errors are on the 3 sigma level in the column to the right of the amount (in weight per cent).

Comment:

- In case the results do not correspond to results of other analytical techniques, please let me know for further fine tuning of XRD results.
- Mineral names may not reflect the actual compositions of minerals identified, but rather the mineral group.
- Errors reported for phases occurring in minor amounts are sometimes larger than that of the quantity reported, indicating the possible absence of those phases.
- No Free CaO was detected, samples 8789 and 8791 contain calcite ($CaCO_3$), which could have formed from free CaO.
- The XRF report will show total CaO concentrations.
  Amorphous phases, if present, were not taken into account in the quantification.

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CERTIFICATE OF ANALYSES
X-RAY FLUORESENCE

Date received: 2012-08-06 **Date completed: 2012-08-15**
Project number: 132 **Report number: 36216** **Order number: D651-00**

Client name: JONES & WAGENER CONSULTING CIVIL ENGINEERS **Contact person: Talia da Silva**
Address: P.O. Box 1434 Rivonia 2128 **Email: talia@jaws.co.za**
Telephone: 011 - 519 - 0200 **Facsimile: 011 - 519 - 0201** **Cell:**

Major Elements	Major Element Concentration (wt %)[s]			
	Fresh Ash	Exposed Ash	Toe of New Stack	Six Month Old Ash
	8788	8789	8790	8791
SiO_2	60.05	59.15	58.94	58.43
TiO_2	1.11	1.08	1.15	1.21
Al_2O_3	25.03	25.04	26.15	26.76
Fe_2O_3	6.83	6.91	6.76	6.36
MnO	<0.09	<0.09	<0.09	<0.09
MgO	0.9	0.82	0.95	0.84
CaO	2.99	3.41	3.22	2.88
Na_2O	0.13	0.08	0.21	0.11
K_2O	0.81	0.84	0.79	0.76
P_2O_5	0.35	0.47	0.41	0.48
Cr_2O_3	<0.04	<0.04	<0.04	<0.04
SO_3	<0.35	<0.35	<0.35	<0.35
LOI	1.41	2.06	1.23	2.01
Total	100.01	100.26	100.19	100.1
H_2O-	1.9	0.78	0.53	0.53

[s] =Results obtained from sub-contracted laboratory

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Cell:

Trace Elements	Trace Element Concentration (ppm) [s]			
	Fresh Ash	Exposed Ash	Toe of New Stack	Six Month Old Ash
	8788	8789	8790	8791
As	14.3	11.1	<1	<1
Ba	1012	1141	264	309
Bi	<0.8	<0.8	<1	<1
Br	1.45	1.46	64	56.1
Cd	<1	<1	93.7	97
Ce	266	302	4.11	1.55
Cl	2.99	<1	52.7	50.9
Co	72.5	63.8	19.3	21
Cr	114	116	2.56	<2.1
Cs	2.97	1.83	4.7	4.51
Cu	48.6	51.2	0.17	0.26
Ga	20	18.7	<18	52.8
Ge	2.19	2.26	1.06	0.63
Hf	4.83	4.74	8.55	5.57
Hg	<0.1	<0.1	27.4	29.1
La	32.4	<18	94.5	108
Lu	0.79	0.76	67.8	68.7
Mo	7.88	6.31	63.7	64.1
Nb	25.3	24.9	57.9	55.9
Nd	94.8	105	<1	<1
Ni	66.6	69.4	13.2	13.4
Pb	62.1	59.8	1.27	<1
Rb	59.8	57.3	5.14	7
Sb	<1	<1	<0.8	4.03
Sc	12.9	14.3	249	276
Se	1.2	1.56	2.78	<1.6
Sm	6.02	6.4	<3.9	<3.9
Sn	4.54	1.92	29.5	28.8
Sr	229	294	<6.6	<6.6
Results continue on next page				

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Telephone: 011 - 519 - 0200 **Facsimile: 011 - 519 - 0201** **Cell:**

Trace Elements	Trace Element Concentration (ppm) [s]			
	Fresh Ash	Exposed Ash	Toe of New Stack	Six Month Old Ash
	8788	8789	8790	8791
Ta	<1.6	3.43	4.74	6.2
Te	<3.9	<3.9	239	240
Th	26.7	28.1	2.4	3.89
Tl	<6.6	<6.6	79.1	83.1
U	5.64	5.07	6.97	5.8
V	229	224	126	105
W	2.23	<1.9	394	414
Y	76.8	81	<14.2	<14.2
Yb	6.48	6.81	<15.5	<15.5
Zn	127	114	<81.6	<81.6
Zr	393	380	112	67.9

[s] =Results obtained from sub-contracted laboratory

E.Botha
Geochemistry Project Manager

APPENDIX E

CONSTRUCTION AND OPERATION CHART

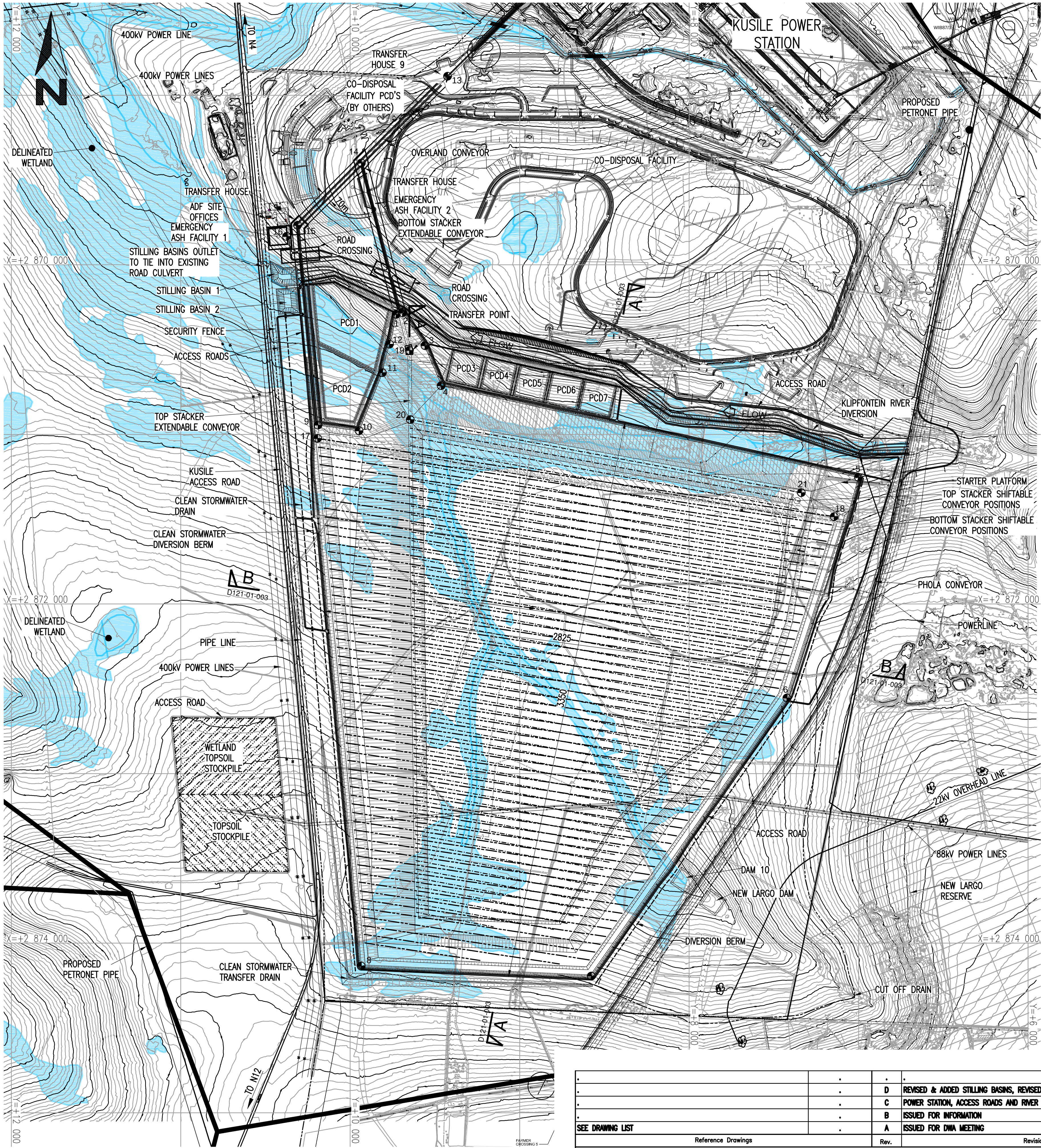
	A	B	C	D	E	F	G	H	I	J
1	**Ash facility operation period:**	**Lined Area: (Ha)**	**Required Pollution Control Dams**	**Clean SW contour cut-off drains**	**Clean Storm Water Infrastructure**	**Access Road**	**Contaminated Storm Water Network**	**Rehabilitation**	**Other**	**Redundant Infrastructure**
2	Starter Wall: 0-5 year life	120.5	PCD 1 - 7	Main Clean SW Contour cut-off drain in footprint and east of Phola Conveyor	- Dam D10 - New Largo Dam - Klipfonteinspruit River Diversion incl. stilling basin - Clean water side drains - Clean water diversion berms	- Access Road around starter platform footprint and along fence up to 20 year development line (+15 yr) - Haul Road to Starter Platform	Northern, eastern and western sides.		- Topsoil Stockpile area	
3	5 – 10	127.5		5 -10 yr Clean SW Contour cut-off drain	- Dam D1	Access Road around footprint	Extend east and western sides	Rehabilitate Starter platform Rehabilitate 5 – 10 year development	- Conveyor platforms up to starter platform - Emergency Stockpile Platforms 1 and 2	
4	10 – 15	120.1		10 -15 yr Clean SW Contour cut-off drain	- Dam D2	Access Road around lined footprint	Extend east and western sides	Rehabilitate 10 – 15 year development		- Dam D1
5	15 – 20	67.9		15 -20 yr Clean SW Contour cut-off drain	- Dam D3A and D3B	Access Road around lined footprint	Extend western side	Rehabilitate 15 – 20 year development		- Dam D2
6	20 – 25	55.7		20 -25 yr Clean SW Contour cut-off drain	- Dam D4A and Dam D4B	Access Road around lined footprint and along fence up to 40 year development line (+35 yr)	Extend western side	Rehabilitate 20 – 25 year development		- Dam D3A and D3B
7	25 – 30	37.2		25 -30 yr Clean SW Contour cut-off drain	- Dam D5A and D5B	Access Road around lined footprint	Extend western side	Rehabilitate 25 – 30 year development		- Dam D4A and Dam D4B
8	30 – 35	48.9		30 -35 yr Clean SW Contour cut-off drain	Dam D6A and D6B	Access Road around lined footprint	Extend western side	Rehabilitate 30 – 35 year development		- Dam D5A and D5B
9	35 – 40	55.8		35 -40 yr Clean SW Contour cut-off drain	Dam D7A and D7B	Access Road around lined footprint		Rehabilitate 35 – 40 year development		Dam D6A and D6B
10	40 – 45	51.1		Main Clean SW Contour cut-off Outlet pipe 1.0m Diameter concrete pipe	Dam D8A and D8B	Access Road around lined footprint and along fence up to 60 year development line (+55 yr)		Rehabilitate 40 – 45 year development		Dam D7A and D7B
11	45 – 50	46.5		Main Clean SW Contour cut-off Outlet pipe 1.0m Diameter concrete pipe	Dam D9	Access Road around lined footprint		Rehabilitate 45 – 50 year development		Dam D8A and D8B
12	50 – 55	48.2		Main Clean SW Contour cut-off Outlet pipe 1.0m Diameter concrete pipe		Access Road around lined footprint		Rehabilitate 50– 55 year development		
13	55 – 60	39.8		Clean SW transfer drain		Access Road around lined footprint		Rehabilitate 55 – 60 year development		
14	Decommissioning	0				Access Road and security fence around entire existing facility		Carry out final rehabilitation		- PCD 2 and PCD 4 to 7

Note:

1. Infrastructure requirements for previous periods apply to subsequent periods unless included in Redundant Infrastructure (Column J)

APPENDIX F

DETAILED CONCEPT DRAWINGS



LIST OF CO-ORDINATES

60 YEAR ASH FACILITY SETTING OUT
(CO-ORD SYSTEM WGS LO 29)

SOP	Y	X	Z
1	9 728.345	2 870 292.800	**
2	9 690.415	2 870 283.070	**
3	9 558.932	2 870 476.440	**
4	9 462.762	2 870 712.220	**
5	7 000.985	2 871 253.130	**
6	7 422.610	2 872 553.980	**
7	8 577.151	2 874 194.760	**
8	9 935.180	2 874 135.220	**
9	10 189.870	2 870 945.500	**
10	9 947.701	2 870 978.780	**
11	9 809.554	2 870 635.620	**
12	9 767.913	2 870 468.150	**

LIST OF CO-ORDINATES

CONVEYOR SETTING OUT
(CO-ORD SYSTEM WGS LO 29)

SOP	Y	X	Z
13	9 425.283	2 868 888.170	**
14	9 934.162	2 869 399.710	**
15	10 310.670	2 869 767.020	**
16	10 375.737	2 869 832.087	**
17	10 192.560	2 871 023.810	**
18	7 144.018	2 871 485.080	**
19	9 650.525	2 870 504.380	**
20	9 645.347	2 870 912.430	**
21	7 338.056	2 871 343.910	**

KEY

- DELINEATED WETLAND
- COAL RESERVES
- AREA RESERVED FOR NORMAL TOPSOIL STORAGE
- AREA RESERVED FOR WETLAND TOPSOIL STORAGE
- ASH CONVEYOR ROUTE
- TOP STACKER SHIFTABLE CONVEYOR POSITIONS
- BOTTOM STACKER SHIFTABLE CONVEYOR POSITIONS

LEGEND

ADF – ASH DISPOSAL FACILITY

INFORMATION

STARTER PLATFORM VOLUME – 35 800 000m^3
AREA – 120,5 ha
ASH FACILITY VOLUME – 499 000 000m^3
AREA – 696,6 ha
TOTAL – 534 800 000m^3
AREA – 817,1 ha
DEPOSITION RATE – 739 125 m^3/MONTH/6UNITS
DENSITY – 800 KG/m^3
LIFE – 60 YEARS
TOTAL HEIGHT–STARTER PLATFORM – 73,5m
– ASH FACILITY – 123m

MECHANICAL INFORMATION

OVERLAND CONVEYOR LENGTH – 1,250 m

EXTENDABLE CONVEYOR
- TOP STACK
  - INITIAL LENGTH – 1,550 m
  - ADDITIONAL LENGTH – 2,906 m
- BOTTOM STACK
  - INITIAL LENGTH – 1,260 m
  - ADDITIONAL LENGTH – 2,990 m

SHIFTABLE CONVEYOR
- TOP STACK
  - LENGTH (RANGE) – 460 TO 2,347 m
  - NUMBER OF SHIFTS – 58
- BOTTOM STACK
  - LENGTH (RANGE) – 686 TO 3,083 m
  - NUMBER OF SHIFTS – 59

DRAWING LIST

D121-01-001	– LAYOUT OF FACILITY AT FULL DEVELOPMENT
D121-01-002	– LAYOUT OF 5 YEAR LINED AREA INCLUDING INFRASTRUCTURE
D121-01-003	– TYPICAL LONG SECTIONS & DETAILS
D121-01-004	– DETAILED LAYOUT OF 5 YEAR LINED AREA
D121-01-005	– LINER DETAILS
D121-01-006	– LEACHATE COLLECTION LAYOUT
D121-01-007	– PCD LAYOUT AND DETAILS
D121-01-008	– CLEAN STORMWATER MANAGEMENT LAYOUT
D121-01-009	– CAPPING LAYOUT
D121-01-010	– SITE OFFICE LAYOUT
D121-01-011	– FINAL REHABILITATION PLAN
D121-01-012	– 0 TO 30 YEAR DEVELOPMENT PLAN
D121-01-013	– 35 TO 60 YEAR DEVELOPMENT PLAN
D121-01-014	– DUST SUPPRESSION & IRRIGATION LAYOUT
D121-01-015	– KLIPFONTEIN RIVER DIVERSION, LAYOUT & DETAILS

Jones & Wagener
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Box 1434 Rivonia 2128 South Africa
Tel. (011) 519-0200
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Email post@jaws.co.za

Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	
Signature		

CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	D	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	26.03.14	C.C.
.	.	C	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
.	.	B	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
SEE DRAWING LIST	.	A	ISSUED FOR DWA MEETING	R.McL.	09.07.13	C.C.

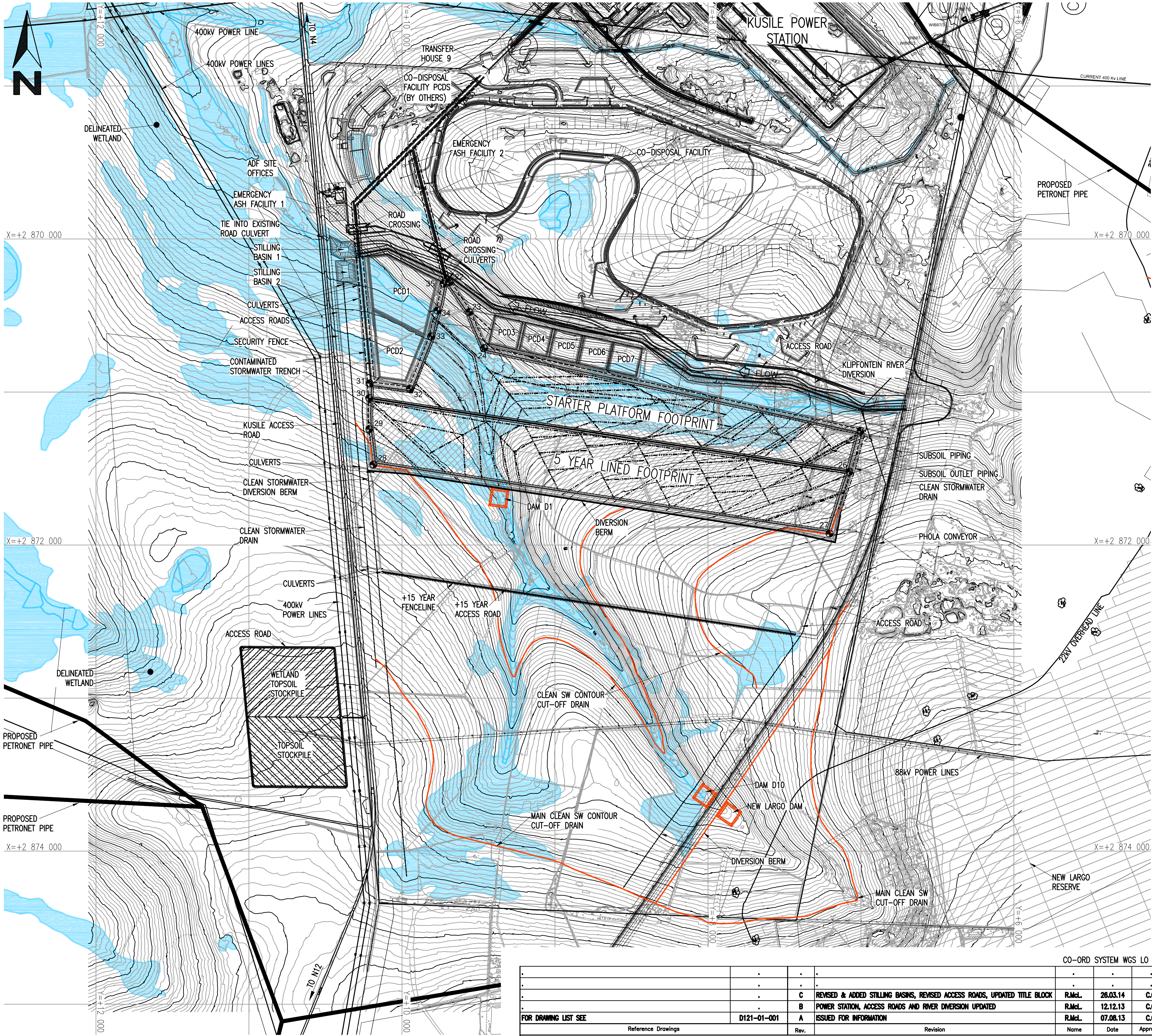
Client **ZITHOLELE CONSULTING**

Project **KUSILE POWER STATION**
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
LAYOUT OF FACILITY AT FULL DEVELOPMENT

Scale 1 : 12 500 A1

Drawing No **D121-01-001**

Revision **D**



KEY

- DELINEATED WETLAND
- COAL RESERVES
- AREA RESERVED FOR NORMAL TOPSOIL STORAGE
- AREA RESERVED FOR WETLAND TOPSOIL STORAGE

LEGEND

ADF – ASH DISPOSAL FACILITY

INFORMATION

DAM D10 VOLUME	– 30 000 m³
NEW LARGO DAM	– 30 000 m³
DAM D1	– 30 000 m³
LINED AREA –STARTER PLATFORM	– 120,5 ha
–5 YEAR LINED AREA	– 125,7 ha

LIST OF CO–ORDINATES

STARTER PLATFORM SETTING OUT
(CO–ORD SYSTEM WGS LO 29)

SOP	Y	X	Z
22	9 690.42	2 870 283.07	**
23	9 558.93	2 870 476.44	**
24	9 462.76	2 870 712.22	**
25	7 000.99	2 871 253.13	**
26	7 073.90	2 871 520.88	**
27	7 204.96	2 871 924.84	**
28	10 186.02	2 871 473.78	**
29	10 213.04	2 871 242.16	**
30	10 213.70	2 871 039.74	**
31	10 211.31	2 870 942.65	**
32	9 947.70	2 870 978.78	**
33	9 809.55	2 870 635.62	**
34	9 767.91	2 870 468.15	**
35	9 728.35	2 870 292.80	**

CO–ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	26.03.14	C.C.
.	.	B	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
FOR DRAWING LIST SEE	D121–01–001	A	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.

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Fax. (011) 519–0201
Email post@jaws.co.za

Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	.
Signature		

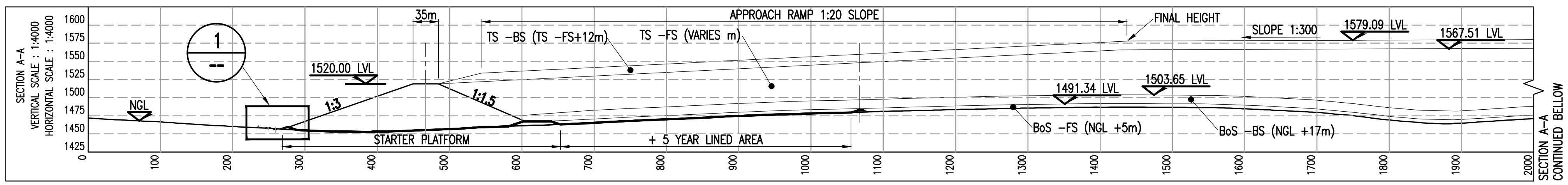
Client **ZITHOLELE CONSULTING**

Project **KUSILE POWER STATION**
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
LAYOUT OF 5 YEAR LINED AREA WITH INFRASTRUCTURE

Scale 1 : 12 500 A1

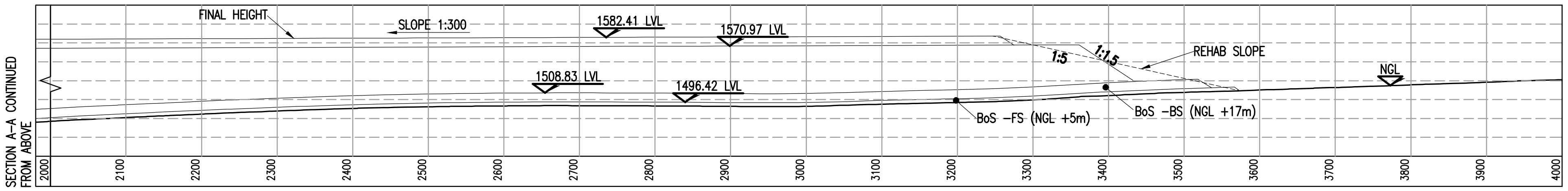
Drawing No **D121-01-002**

Revision **C**



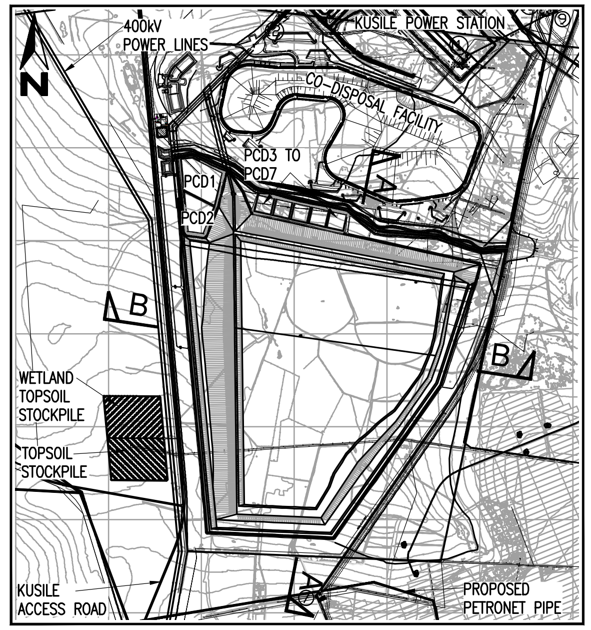
SECTION A-A

1:4000



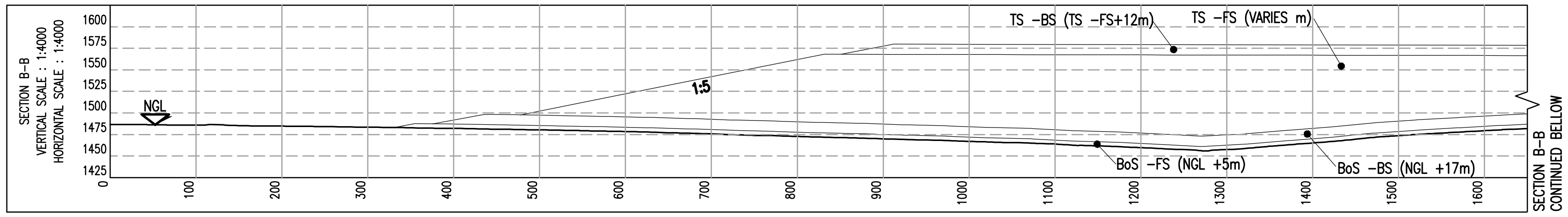
SECTION A-A (CONTINUED)

1:4000



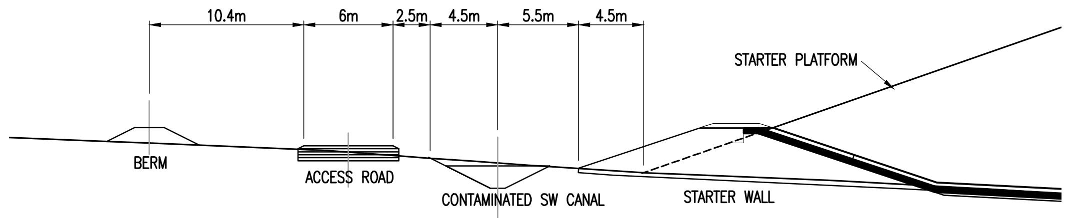
KEY PLAN

SCALE 1 : 40 000



SECTION B-B

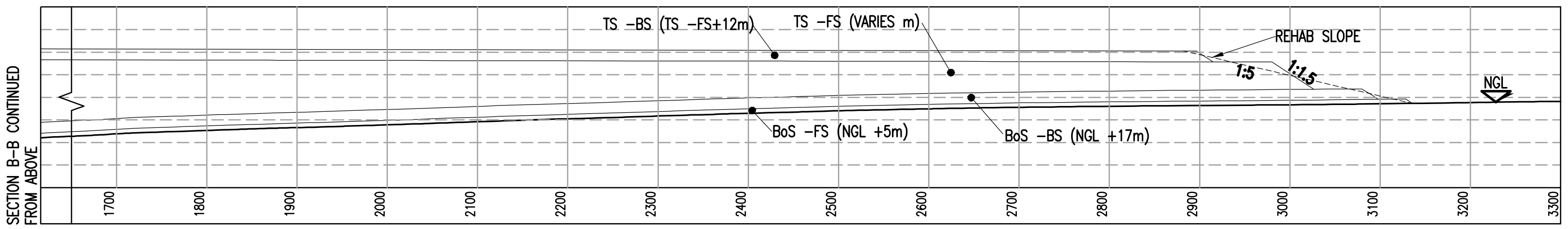
1:4000



DETAIL 1

SCALE 1:250

TYPICAL INFRASTRUCTURE CROSS SECTION



SECTION B-B (CONTINUED)

1:4000

KEY

TS = TOP STACK
BoS = BOTTOM STACK
BS = BACK STACK
FS = FRONT STACK
N.G.L. = NATURAL GROUND LEVEL

CO-ORD SYSTEM WGS LO 29

.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	18.03.14	C.C.
.	.	B	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
Reference Drawings		Rev.	Revision	Name	Date	Approved

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Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	.
Signature		

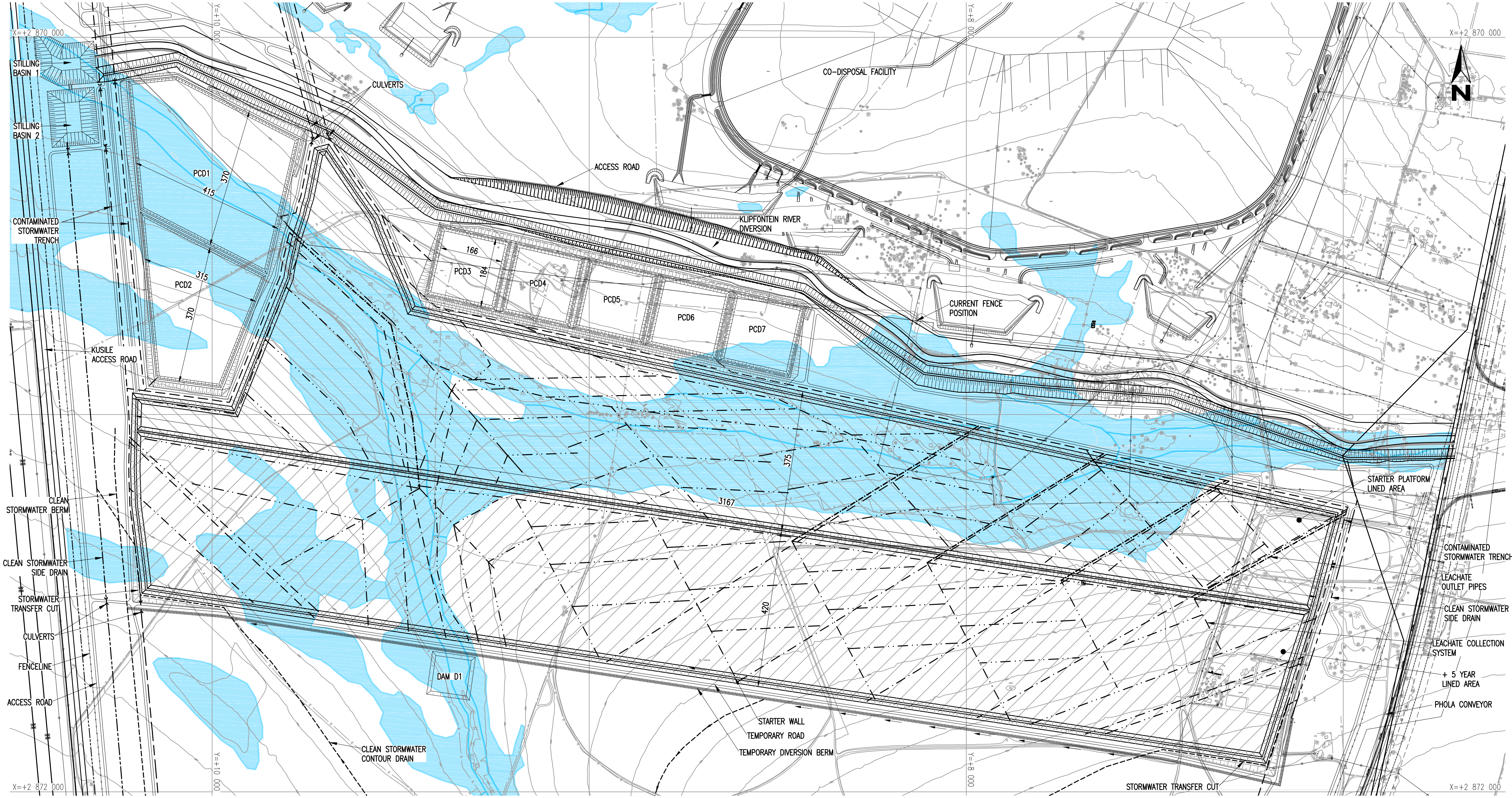
Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
TYPICAL LONG SECTIONS & DETAILS

Scale AS SHOWN A1

Drawing No D121-01-003

Revision C



KEY

- DELINEATED WETLAND

LEGEND

ADF – ASH DISPOSAL FACILITY

NOTE

MORE INFORMATION ON LEACHATE COLLECTION PIPES ON DRAWING D121-01-006

CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	D	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	26.03.14	C.C.
.	.	C	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
.	.	B	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR DWA MEETING	R.McL.	09.07.13	C.C.

Jones & Wagener
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Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	.
Signature		

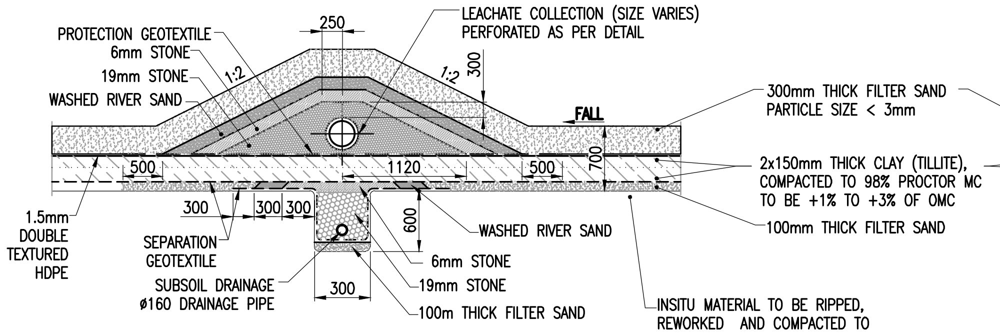
Client: ZITHOLELE CONSULTING

Project: KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
5 YEAR LINED AREA LAYOUT

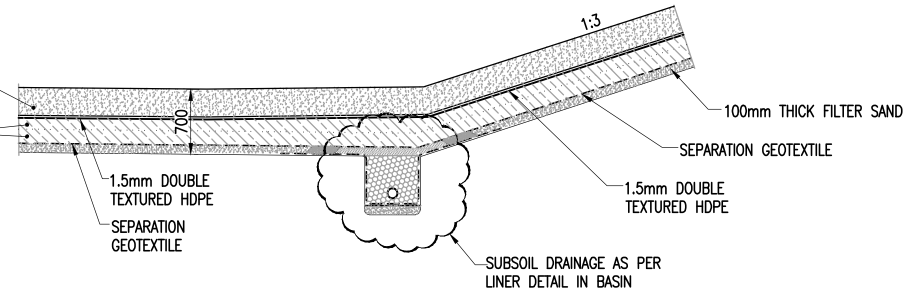
Scale: 1:5000 A1

Drawing No: D121-01-004

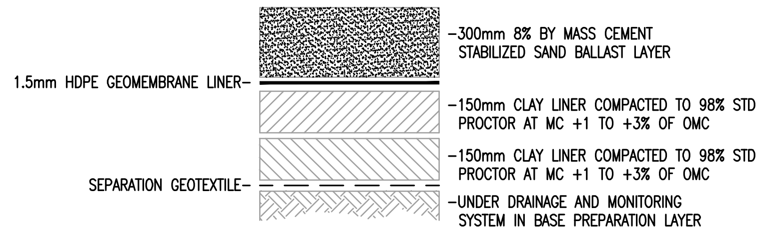
Revision: D



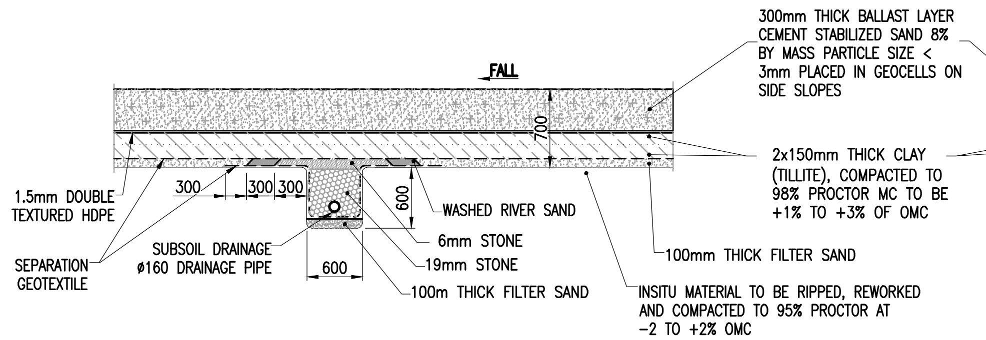
ASH FACILITY LINER
CLASS C LANDFILL SPECIFICATION
SCALE 1 : 40



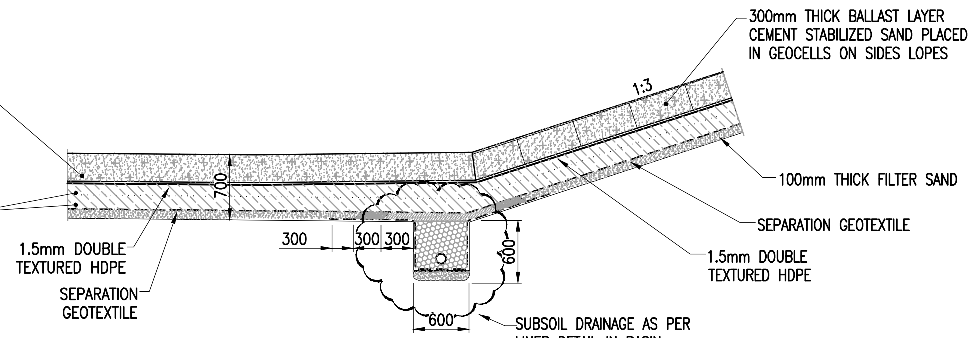
TYPICAL DRAINAGE ARRANGEMENT AT TOE AND TYPICAL LINER DETAIL AT SIDE SLOPE
SCALE 1 : 40



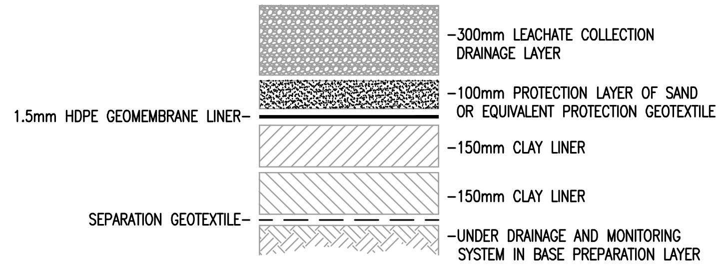
NORMS & STANDARDS (2013) POLLUTION CONTROL DAM LINER CLASS C LANDFILL SPECIFICATION
NOT TO SCALE



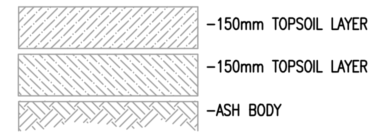
PCD LINER
CLASS C LANDFILL SPECIFICATION
SCALE 1 : 40



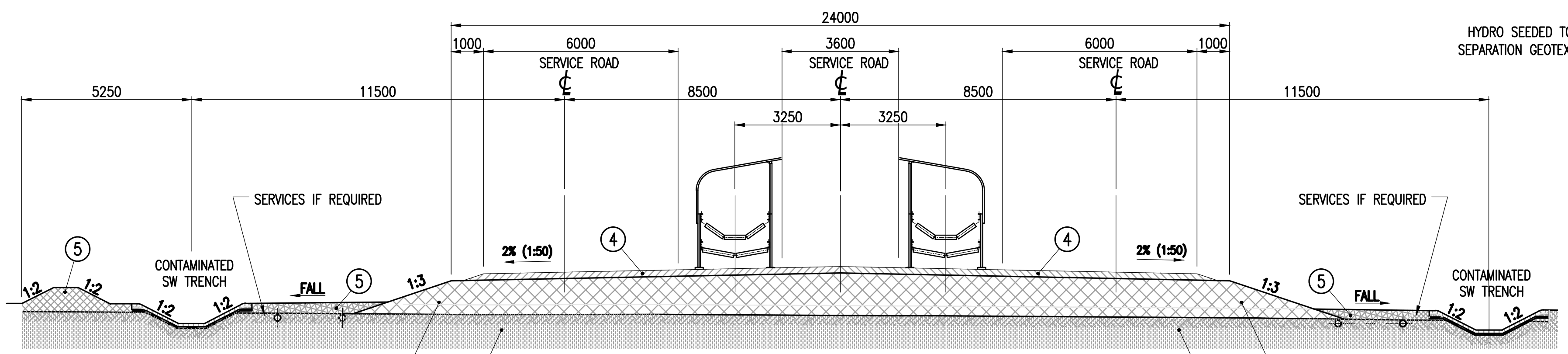
TYPICAL DRAINAGE ARRANGEMENT AT TOE AND TYPICAL LINER DETAIL AT SIDE SLOPE
SCALE 1 : 40



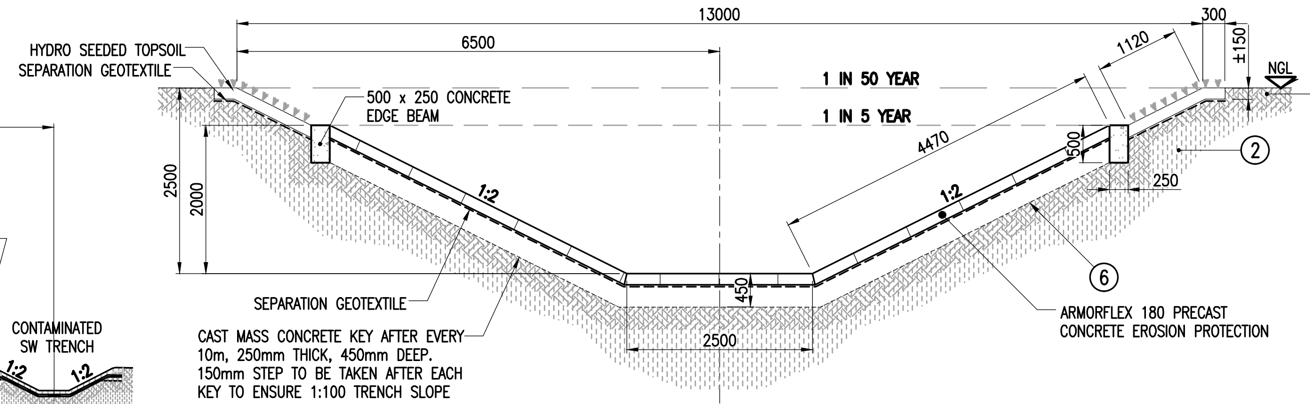
NORMS & STANDARDS (2013) ASH FACILITY LINER CLASS C LANDFILL SPECIFICATION
NOT TO SCALE



TYPICAL REHABILITATION DETAILS
NOT TO SCALE



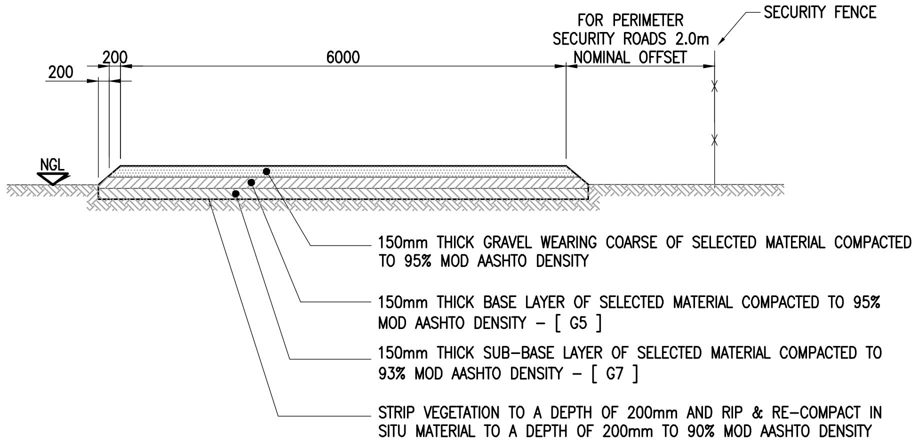
TYPICAL OVERLAND CONVEYOR SECTION
SCALE 1 : 10



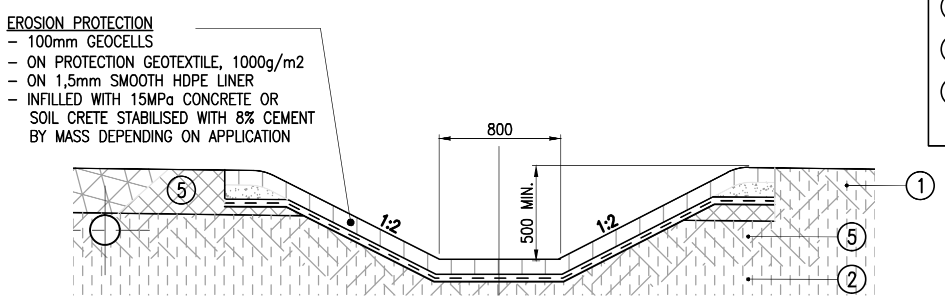
TYPICAL CLEAN STORMWATER TRENCH SECTION
SCALE 1 : 50

EARTHWORKS LEGEND

1. REMOVE 300mm TOPSOIL TO STOCKPILE
2. RIP AND RECOMPACT TO 93% MOD AASHTO AT MC −2 TO +2% OF OMC
3. FILL MADE OF G7 MATERIAL COMPACTED IN 200mm LAYERS TO 95% MOD AASHTO AT MC −2 TO +2% OF OMC
4. WEARING COURSE 200mm LAYER OF G5 MATERIAL COMPACTED TO 95% MOD AASHTO MC −2 TO +2% OF OMC
5. BACKFILL G7 MATERIAL COMPACTED TO 95% MOD AASHTO MC −2 TO +2% OF OMC
6. EXCAVATE AND FILL TO LINES AND LEVELS INDICATED, FILL LAYERS TO BE COMPACTED TO 95% MOD AASHTO AT MC−2 TO +2% OF OMC



TYPICAL ROAD CROSS SECTION
SCALE 1:50



TYPICAL CONTAMINATED STORMWATER TRENCH SECTION
SCALE 1 : 25

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	E	UPDATED TITLE BLOCK	R.McL.	28.03.14	C.C.
.	.	D	TYPICAL CLEAN STORMWATER TRENCH REVISED	R.McL.	13.01.14	C.C.
.	.	C	REVISED AND ADDED DETAILS	R.McL.	05.12.13	C.C.
.	.	B	ISSUED FOR INFORMATION	R.McL.	08.07.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR DWA MEETING	R.McL.	09.07.13	C.C.

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Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	
Signature		

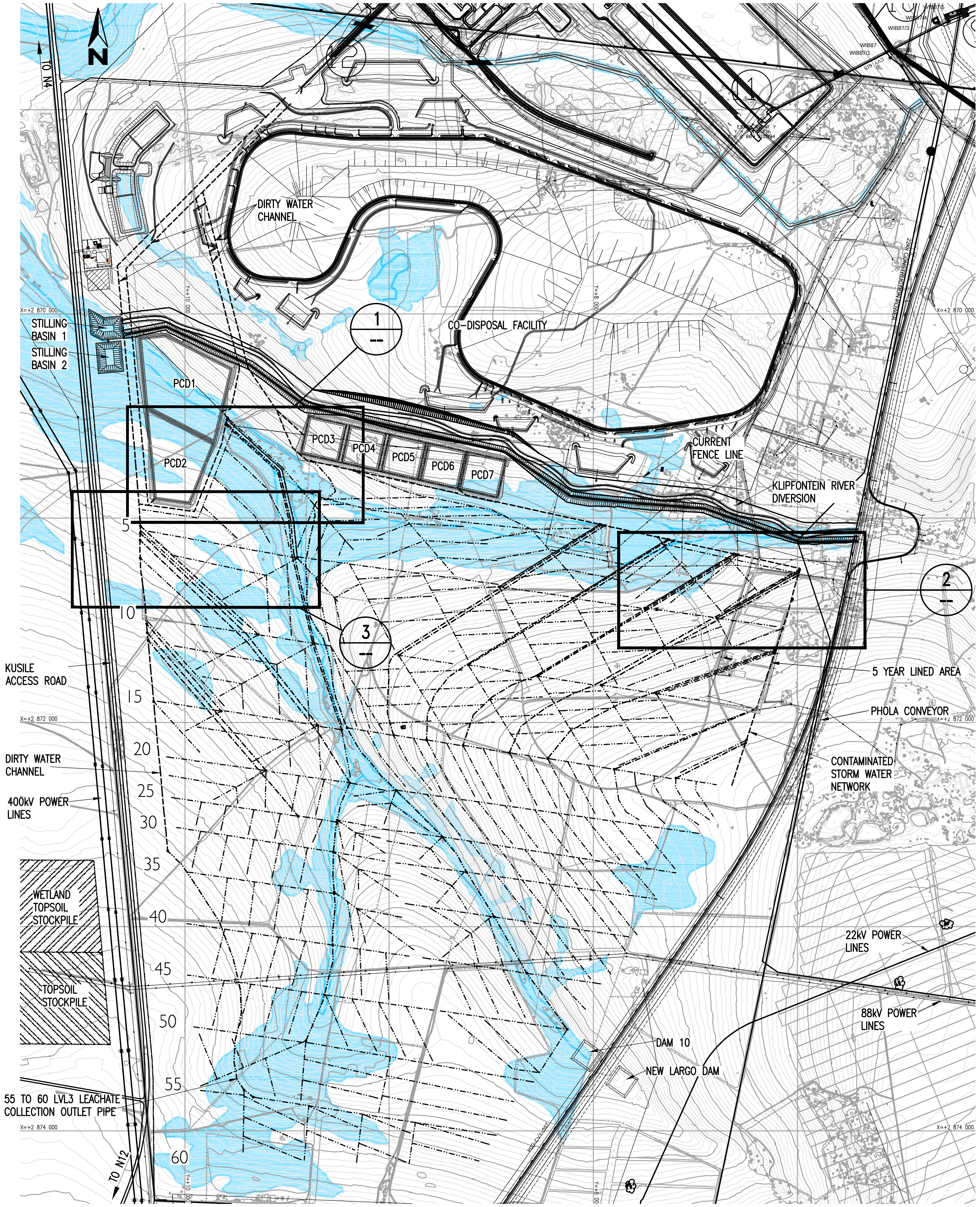
Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
LINER AND OTHER MISCELLANEOUS DETAILS

Scale AS SHOWN A1

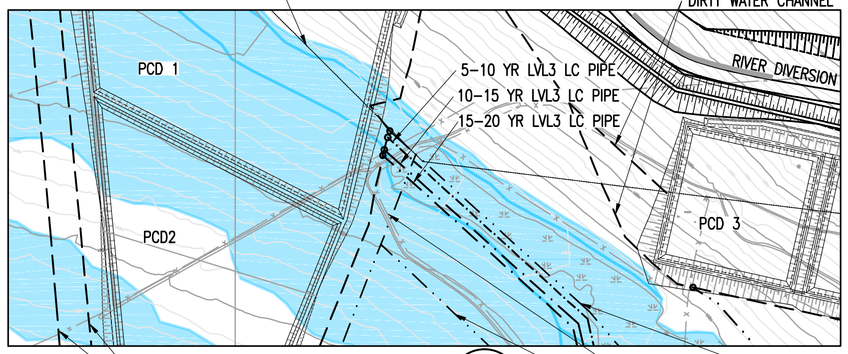
Drawing No D121-01-005

Revision E



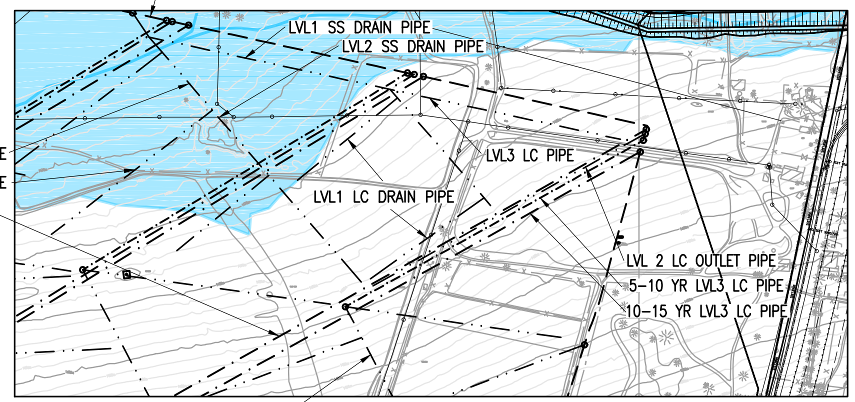
PLAN
1:12 500

CURRENT SECURITY FENCE



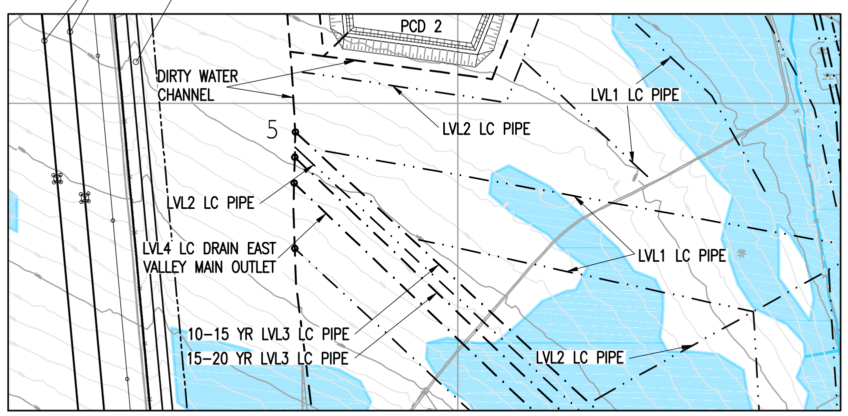
DETAIL 1
SCALE 1:5000

DIRTY WATER NETWORK



DETAIL 2
SCALE 1:5000

400kV POWER LINES
KUSILE ACCESS ROAD



DETAIL 3
SCALE 1:5000

KEY

- DELINEATED WETLAND
- COAL RESERVES
- AREA RESERVED FOR NORMAL TOPSOIL STORAGE
- AREA RESERVED FOR WETLAND TOPSOIL STORAGE

LEGEND

ADF – ASH DISPOSAL FACILITY
LC – LEACHATE COLLECTION
SS – SUB SOIL

INFORMATION

LVL1	LEACHATE COLLECTION PIPES	– ø 160mm HDPE PIPES
LVL2	LEACHATE COLLECTION PIPES	– ø 250mm HDPE PIPES
LVL3	LEACHATE COLLECTION PIPES	– ø 315mm HDPE PIPES
LVL4	LEACHATE COLLECTION PIPES	– ø 500mm HDPE PIPES
LVL1	SUB-SOIL DRAIN PIPES	– ø 160mm HDPE PIPES
LVL2	SUB-SOIL DRAIN PIPES	– ø 250mm HDPE PIPES

NOTE:

1. LVL1 LEACHATE COLLECTION PIPES DRAIN INTO – LVL2 LC PIPES WHICH THEN DRAIN INTO – LVL3 LC PIPES AND THEN INTO – LVL4 LC PIPES.
2. SUBSOIL PIPES PLACED IN SAME LOCATION AS LEACHATE COLLECTION PIPES.

CO-ORD SYSTEM WGS LO 29

		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	D	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	27.03.14	C.C.
.	.	C	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
.	.	B	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR DWA MEETING	R.McL.	25.06.13	C.C.
Reference Drawings						

Jones & Wagener
Engineering & Environmental Consultants
Box 1434 Rivonia 2128 South Africa
Tel. (011) 519-0200
Fax. (011) 519-0201
Email post@jaws.co.za

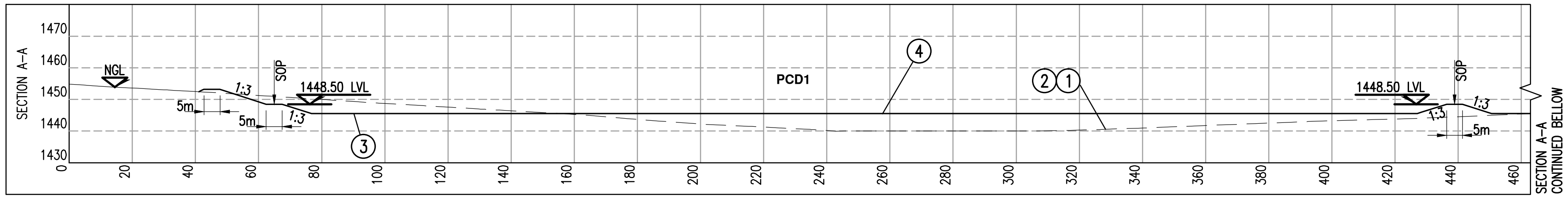
Drawn	R.McL.	25.06.13
Designed	C.C.	JUNE 13
Checked	D.B.	JUNE 13
Pr. Eng. Approval	C.C.	-
Signature		
Scale	AS SHOWN	A1

Client ZITHOLELE CONSULTING

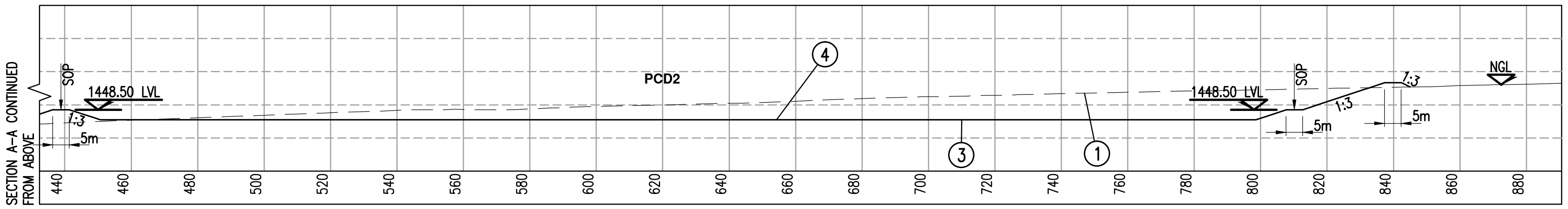
Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPTUAL DESIGN
LC & CONTAMINATED SW LAYOUT FOR 60YEARS

Drawing No D121-01-006

Revision D



SECTION A-A
1:1000



SECTION A-A - (CONTINUED)
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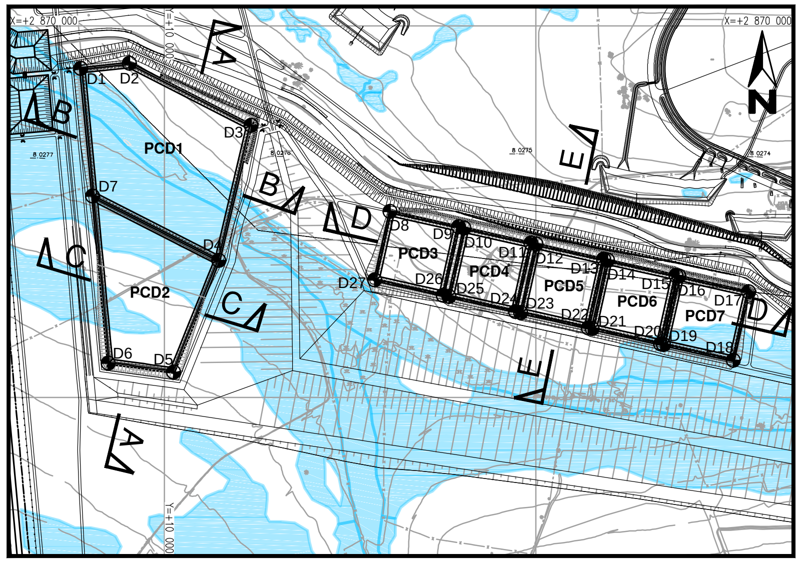
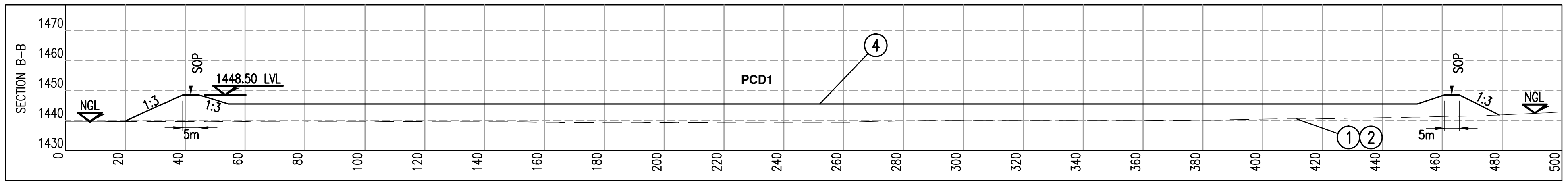


KEY PLAN
1:10 000



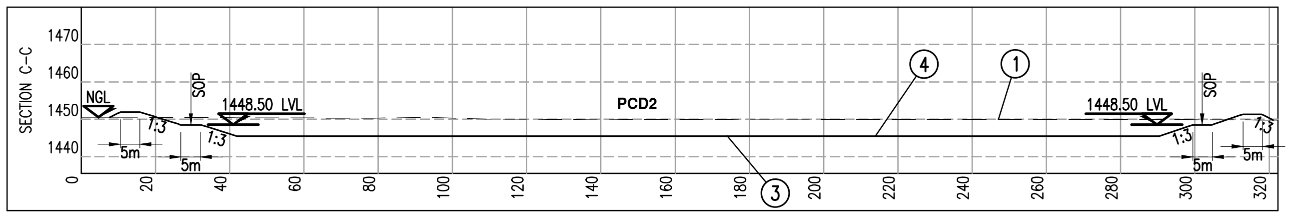
SECTION B-B
1:1000

COMPLEX:	POLLUTION CONTROL DAM:	CATCHMENT (WORST CASE) (HA)	VOLUME (m?)	AREA AT FSL: (m?)
1	PCD 1	85.8	246 600	149 000
	PCD 2		151 200	92 200
2	PCD 3	42.2	62 400	31 900
	PCD 4		60 700	31 100
	PCD 5		61 300	31 400
	PCD 6		62 400	31 900
	PCD 7		60 200	32 200

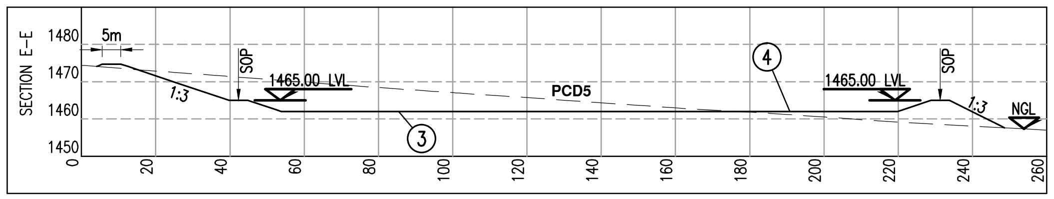
LIST OF CO-ORDINATES

PCD SETTING OUT
(CO-ORD SYSTEM WGS LO 29)

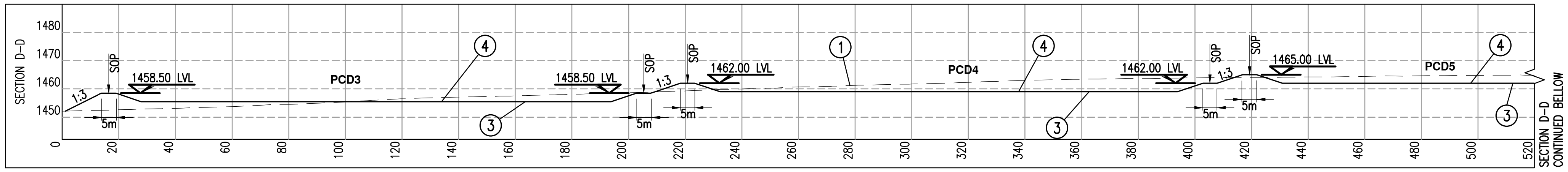
SOP	Y	X	Z
D1	10 225.28	2 870 114.58	**
D2	10 093.63	2 870 100.68	**
D3	9 766.56	2 870 267.30	**
D4	9 853.31	2 870 631.17	**
D5	9 974.64	2 870 931.88	**
D6	10 150.73	2 870 907.84	**
D7	10 192.97	2 870 458.39	**
D8	9 392.42	2 870 499.48	**
D9	9 207.98	2 870 540.77	**
D10	9 192.86	2 870 544.16	**
D11	9 012.81	2 870 584.47	**
D12	8 999.15	2 870 587.53	**
D13	8 817.64	2 870 628.16	**
D14	8 806.91	2 870 630.56	**
D15	8 622.48	2 870 671.86	**
D16	8 614.67	2 870 673.60	**
D17	8 427.31	2 870 715.55	**
D18	8 468.60	2 870 899.98	**
D19	8 655.96	2 870 858.04	**
D20	8 663.77	2 870 856.29	**
D21	8 848.20	2 870 815.00	**
D22	8 858.93	2 870 812.60	**
D23	9 040.44	2 870 771.96	**
D24	9 054.10	2 870 768.90	**
D25	9 234.15	2 870 728.59	**
D26	9 249.27	2 870 725.21	**
D27	9 433.71	2 870 683.92	**



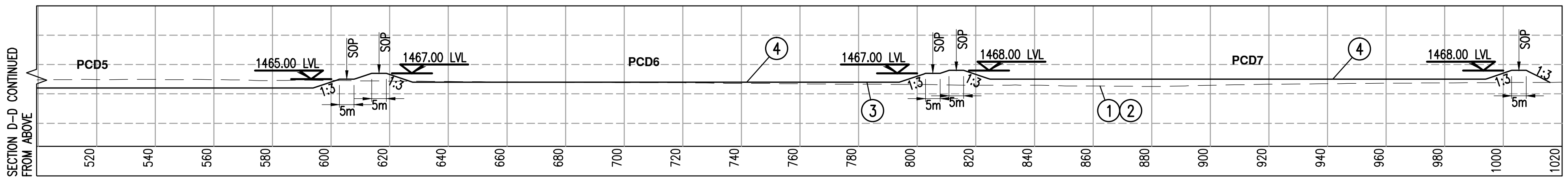
SECTION C-C
1:1000



SECTION E-E
1:1000



SECTION D-D
1:1000



SECTION D-D (CONTINUED)
1:1000

SUB-SOIL DRAINAGE PIPES USED IN PCD DAMS:
LVL1 SUB-SOIL DRAIN PIPES – ø 160mm PERFORATED HDPE PIPES
LVL2 SUB SOIL DRAIN PIPES – ø 250mm PERFORATED HDPE PIPES
LVL3 OUTLET PIPE TO SUMP – ø 250mm SOLID HDPE PIPES

EARTHWORKS LEGEND

1. – REMOVE 300mm TOPSOIL TO STOCKPILE
2. – EXCAVATE AND FILL TO LINES AND LEVELS INDICATED, FILL LAYERS TO BE COMPACTED TO 95% MOD AASHTO AT MC -2 TO +2% OF OMC
3. – RIP AND RECOMPACT EXCAVATED AREAS TO 95% MOD AASHTO AT MC -2 TO +2% OF OMC
4. – INSTALL LINING SYSTEM AS PER DRAWING D121-01-005

CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	28.03.14	C.C.
.	.	B	RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
FOR DRAWING LIST SEE DRAWING	D121-01-001	A	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.

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Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	-
Signature		

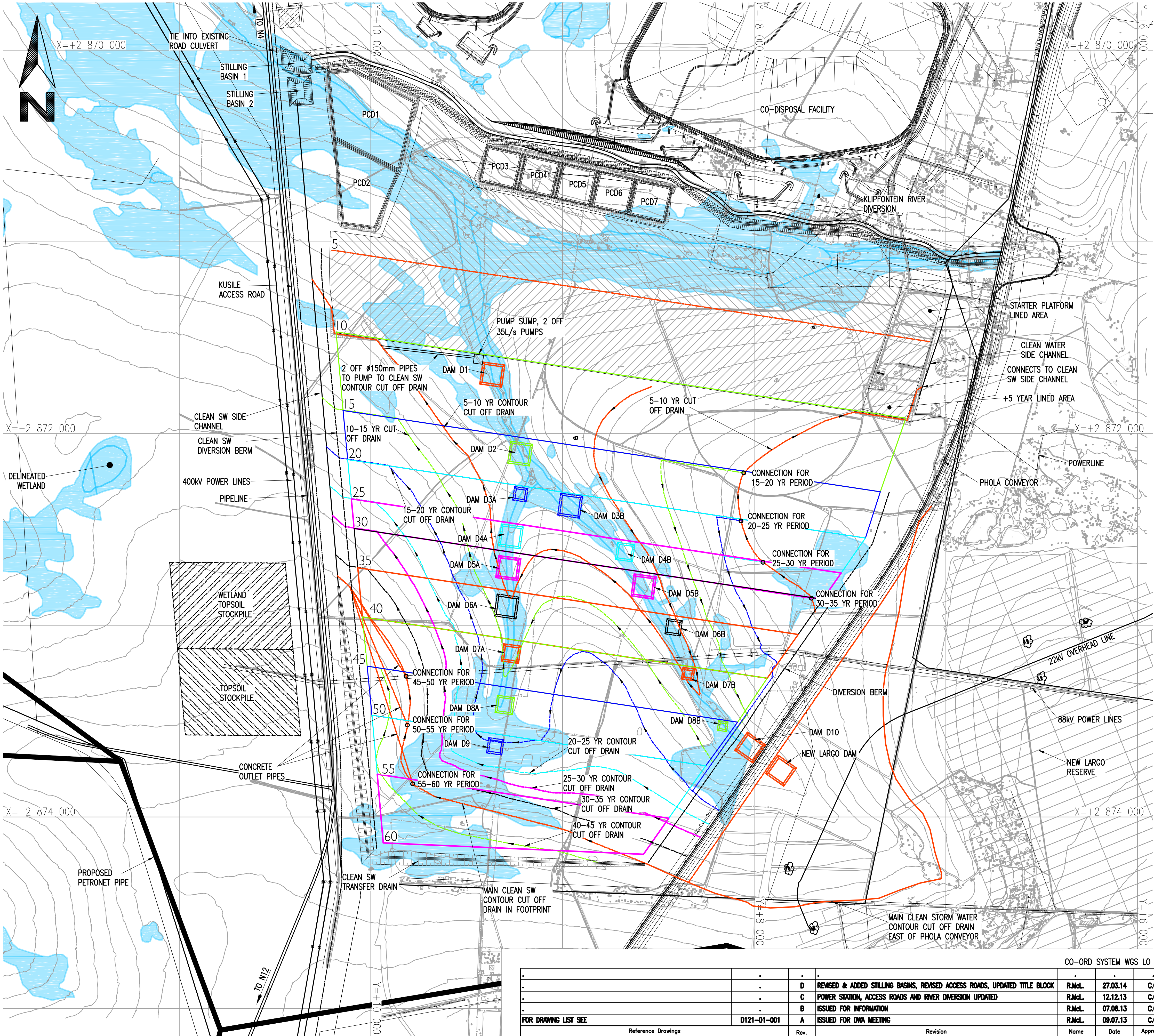
Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
PCD LAYOUT AND SECTIONS

Scale AS SHOWN A1

Drawing No D121-01-007

Revision C



KEY

- DELINEATED WETLAND
- COAL RESERVES
- AREA RESERVED FOR NORMAL TOPSOIL STORAGE
- AREA RESERVED FOR WETLAND TOPSOIL STORAGE

LEGEND

ADF – ASH DISPOSAL FACILITY
SW – STORM WATER

INFORMATION

PUMP SIZE – 35 l/s
PIPE SIZE – ø 150mm HDPE PIPES

DAM	VOLUME (m^3)	CATCHMENT (ha)
D1	30 000	103
D2	40 000	130
D3A	15 000	72.4
D3B	30 000	104.6
D4A	30 000	99
D4B	25 000	118
D5A	30 000	103
D5B	30 000	100.6
D6A	30 000	107.4
D6B	19 200	78.8
D7A	25 000	99.8
D7B	10 800	54.9
D8A	25 000	95
D8B	7 500	32.8
D9	19 200	77
D10	30 000	116.6
NEW LARGO DAM	30 000	100

CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	D	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	27.03.14	C.C.
.	.	C	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
.	.	B	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR DWA MEETING	R.McL.	09.07.13	C.C.

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Drawn	R.McL.	09.07.13
Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	.
Signature		

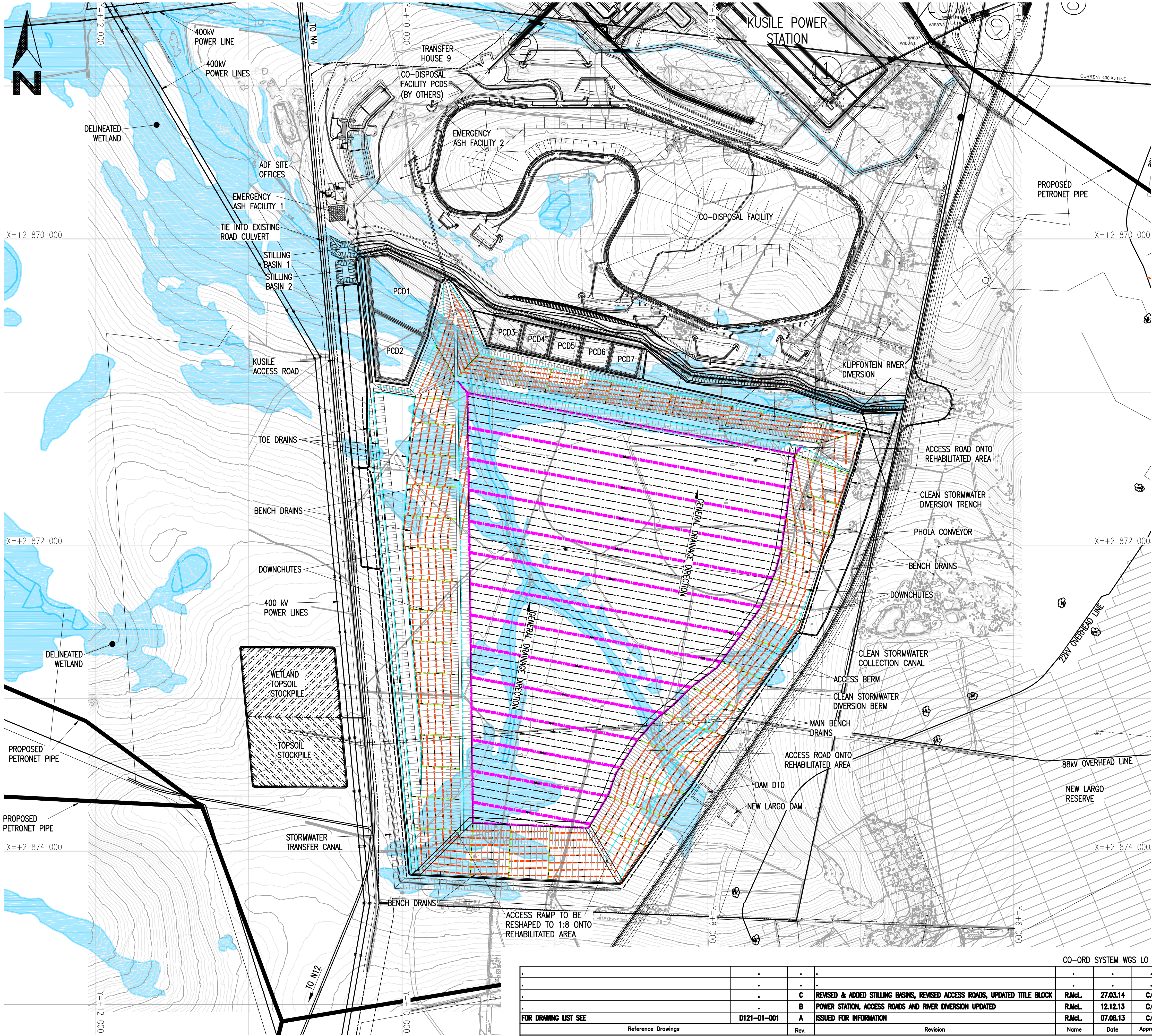
Client **ZITHOLELE CONSULTING**

Project **KUSILE POWER STATION**
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
CLEAN STORMWATER MANAGEMENT LAYOUT

Scale 1 : 10 000 A1

Drawing No **D121-01-008**

Revision **D**



KEY

- DELINEATED WETLAND
- COAL RESERVES
- AREA RESERVED FOR NORMAL TOPSOIL STORAGE
- AREA RESERVED FOR WETLAND TOPSOIL STORAGE
- CLEAN STORMWATER DIVERSION TRENCH
- BENCH DRAINS
- DOWNCHUTES
- MAIN BENCH DRAINS
- ACCESS BERM
- CLEAN STORMWATER COLLECTION CANAL

LEGEND

ADF – ASH DISPOSAL FACILITY

GENERAL NOTES

1. ACCESS BERM AND DOWNCHUTES CONSTRUCTED EVERY 4 SHIFTS
2. ACCESS RAMP TO BE RESHAPED TO 1:8 ONTO REHABILITATED AREA

NOTE:

CLEAN STORMWATER INFRASTRUCTURE WILL CLASH WITH CONTAMINATED STORMWATER NETWORK DURING REHABILITATION. CROSS OVER DETAILS WILL BE REQUIRED

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Designed	C.C.	JUNE 13
Checked	D.B.	JUNE 13
Pr. Eng. Approval	C.C.	.
Signature		

CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	27.03.14	C.C.
.	.	B	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.

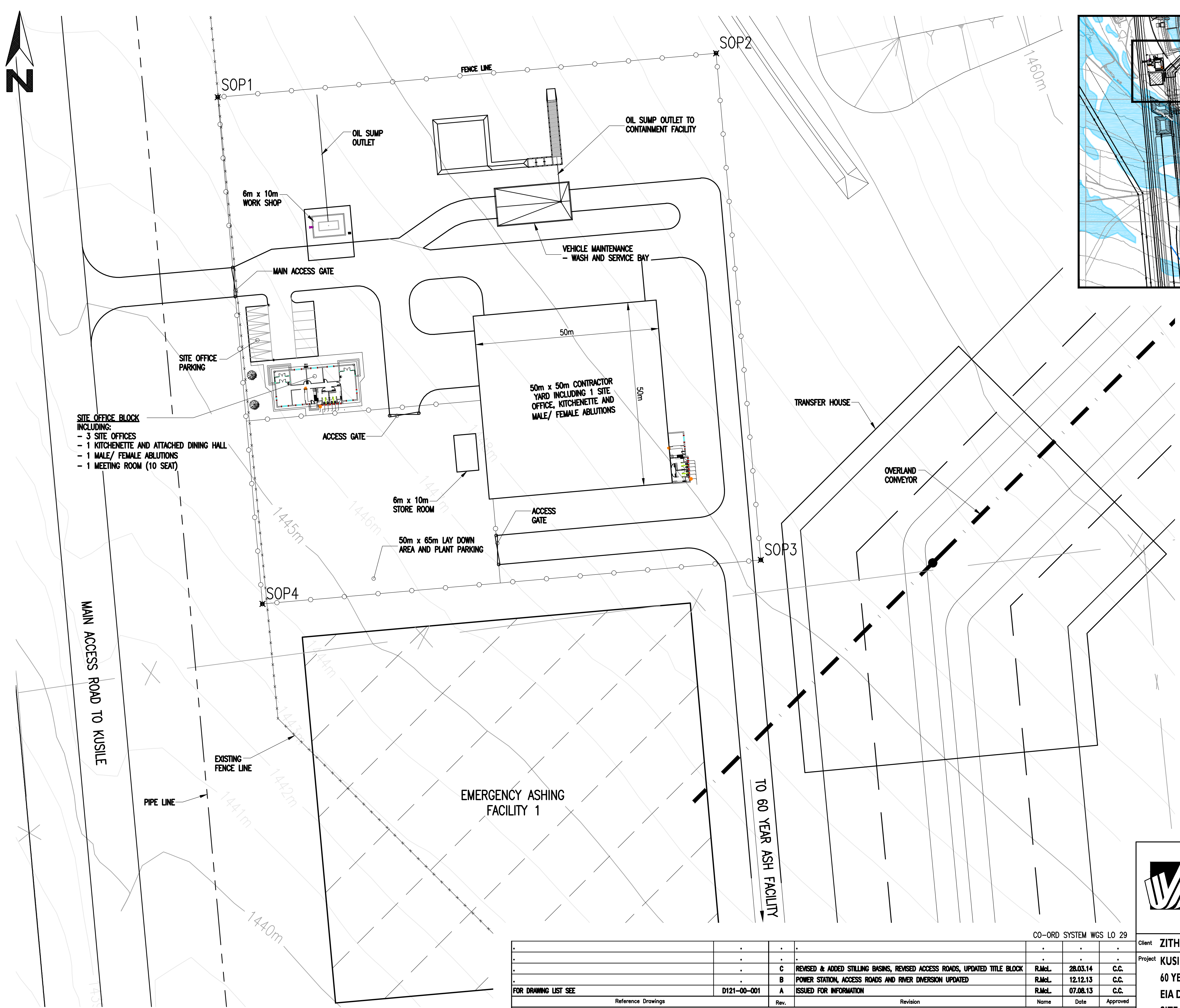
Client: ZITHOLELE CONSULTING

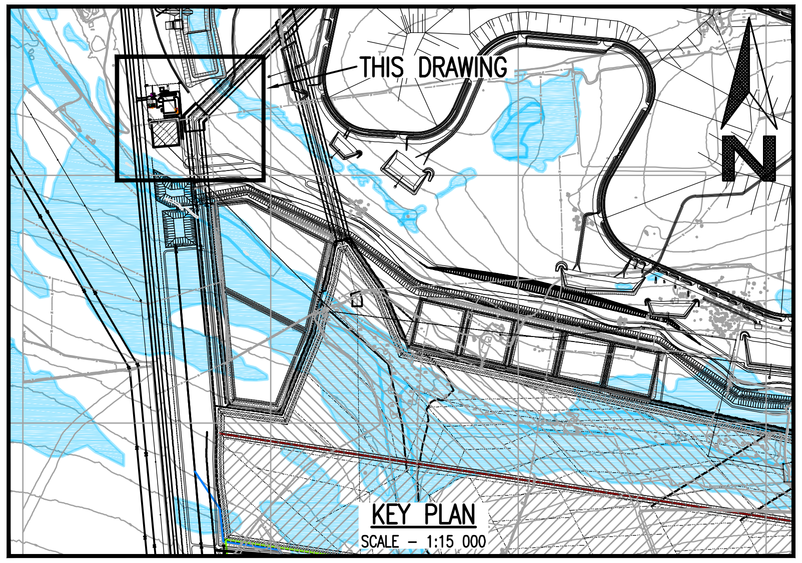
Scale: 1 : 12 500 — A1

Project: KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPTUAL DESIGN
CAPPING LAYOUT

Drawing No: D121-01-009

Revision: C





COORDINATE LIST		
WGS Lo29		
SETTING OUT OF SITE OFFICE		
POINT	Y	X
SOP1	+10 505.285	+2 869 640.218
SOP2	+10 369.636	+2 869 628.245
SOP3	+10 357.457	+2 869 766.225
SOP4	+10 493.105	+2 869 778.198

EARTHWORKS LEGEND

: FOR SITE OFFICE FOOTPRINT

1. - CLEAR TOPSOIL, 300mm TO STOCKPILE
2. - RIP AND RECOMPACT IN SITU MATERIAL TO 93% MOD AASHTO AT MC -2 TO +2% OF OMC
3. - FILL WITH G7 MATERIAL IN 200mm LAYERS, COMPACTED TO 95% MOD AASHTO AT MC -2 TO +2% OF OMC. WHERE REQUIRED

NOTE:

ACCESS ROADS AND PARKING IN OFFICE LAYOUT TO BE ACCORDING TO TYPICAL ROAD DETAIL ON DRAWING D121-01-005

CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	28.03.14	C.C.
.	.	B	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	12.12.13	C.C.
FOR DRAWING LIST SEE	D121-00-001	A	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.

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Drawn	R.McL.	25.06.13
Designed	C.C.	JUNE 13
Checked	D.B.	JUNE 13
Pr. Eng. Approval	C.C.	-
Signature		

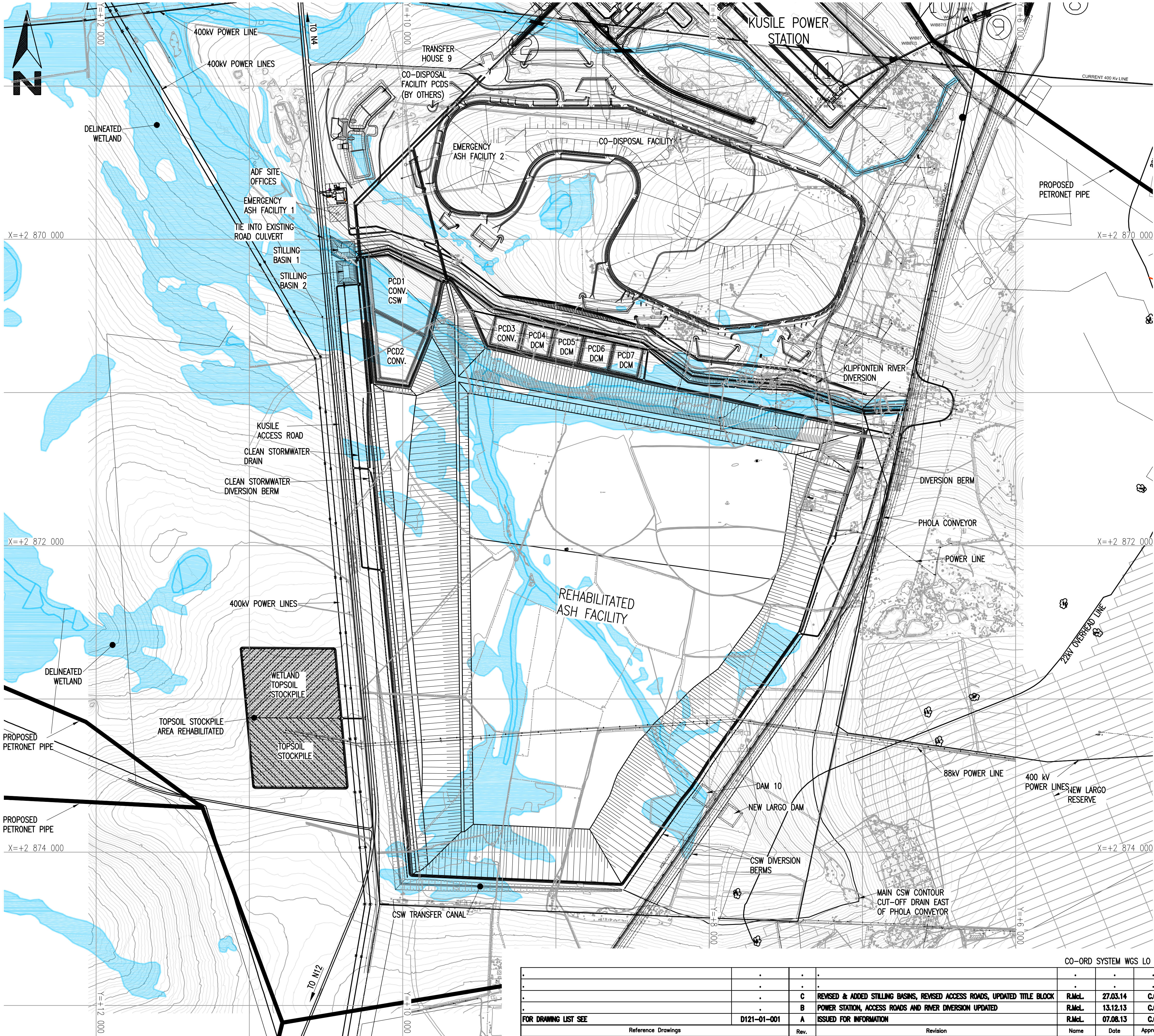
Client: ZITHOLELE CONSULTING

Project: KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED DESIGN
SITE OFFICE LAYOUT

Scale: 1 : 12 500 A1

Drawing No: D121-01-010

Revision: C



KEY

- DELINEATED WETLAND
- COAL RESERVES
- TOPSOIL STOCKPILE AREA REHABILITATED

LEGEND

ADF – ASH DISPOSAL FACILITY
DCM – DECOMMISSION
CSW – CLEAN STORMWATER

INFRASTRUCTURE REQUIRED AFTER DECOMMISSIONING

- PCD 1, 2 & 3 CONVERTED TO CSW ATTENUATION DAMS
- DAM 10 & NEW LARGO DAMS
- CSW DIVERSION BERMS
- CSW TRANSFER CANAL
- CSW SIDE CANAL
- CSW CONTOUR CUT-OFF DRAINS
- FACILITY SECURITY FENCE
- FACILITY ACCESS ROADS
- KLIPFONTEIN RIVER DIVERSION

NOTE:

THIS DRAWING SHOWS FINAL INFRASTRUCTURE REQUIRED AFTER THE FACILITY HAS BEEN DECOMMISSIONED

CO-ORD SYSTEM WGS LO 29

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.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	27.03.14	C.C.
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FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
Reference Drawings		Rev.	Revision	Name	Date	Approved

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Drawn	R.McL.	25.06.13
Designed	C.C.	JUNE 13
Checked	D.B.	JUNE 13
Pr. Eng. Approval	C.C.	-
Signature		

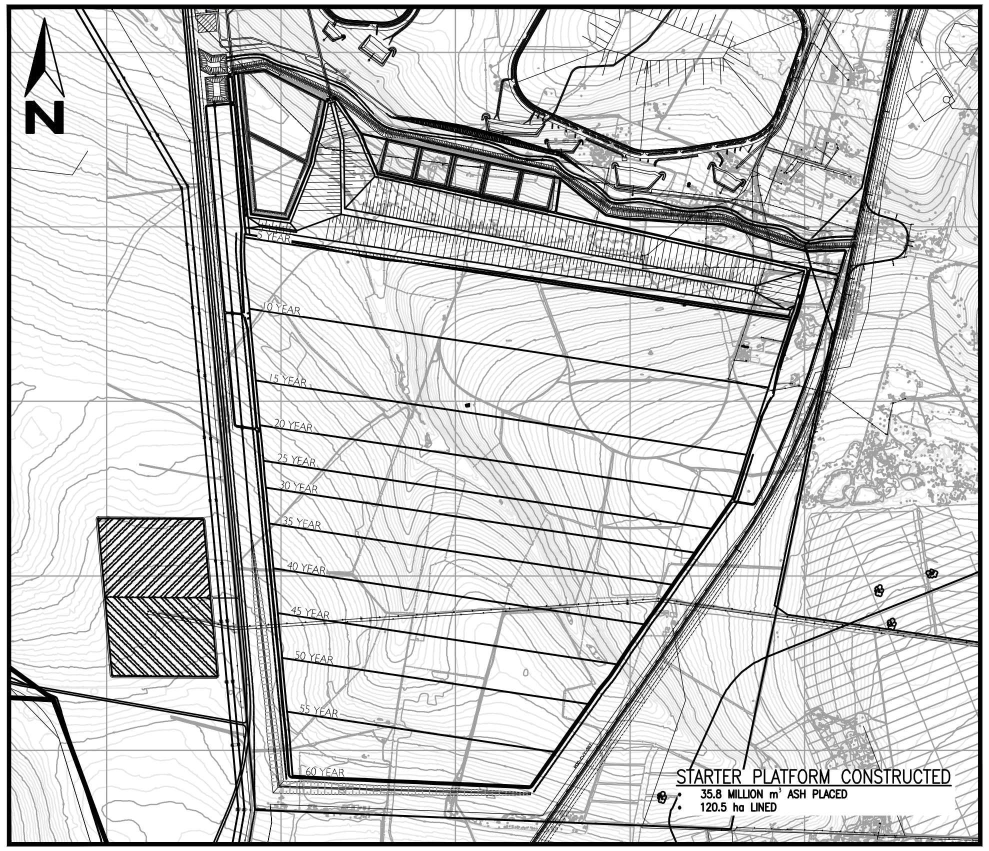
Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED DESIGN
FINAL REHABILITATION PLAN

Scale 1 : 12 500 A1

Drawing No D121-01-011

Revision C



5 YEAR PLAN (STARTER PLATFORM)
1:15 000

10 YEAR PLAN
1:15 000

15 YEAR PLAN
1:15 000

20 YEAR PLAN
1:15 000

25 YEAR PLAN
1:15 000

30 YEAR PLAN
1:15 000

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Designed	C.C.	JULY 13
Checked	D.B.	JULY 13
Pr. Eng. Approval	C.C.	.
Signature		

CO-ORD SYSTEM WGS LO 29

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.	.	C	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	13.12.13	C.C.
.	.	B	ISSUED FOR INFORMATION	R.McL.	07.08.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR DWA MEETING	R.McL.	09.07.13	C.C.

Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
DEVELOPMENT PLAN - 0 TO 30 YEARS DEVELOPMENT

Scale AS SHOWN A0

Drawing No D121-01-012

Revision D

35 YEAR PLAN
1:15 000

40 YEAR PLAN
1:15 000

45 YEAR PLAN
1:15 000

50 YEAR PLAN
1:15 000

55 YEAR PLAN
1:15 000

60 YEAR PLAN
1:15 000

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Pr. Eng. Approval	C.C.	.
Signature		

CO-ORD SYSTEM WGS LO 29

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FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR DWA MEETING	R.McL.	08.07.13	C.C.

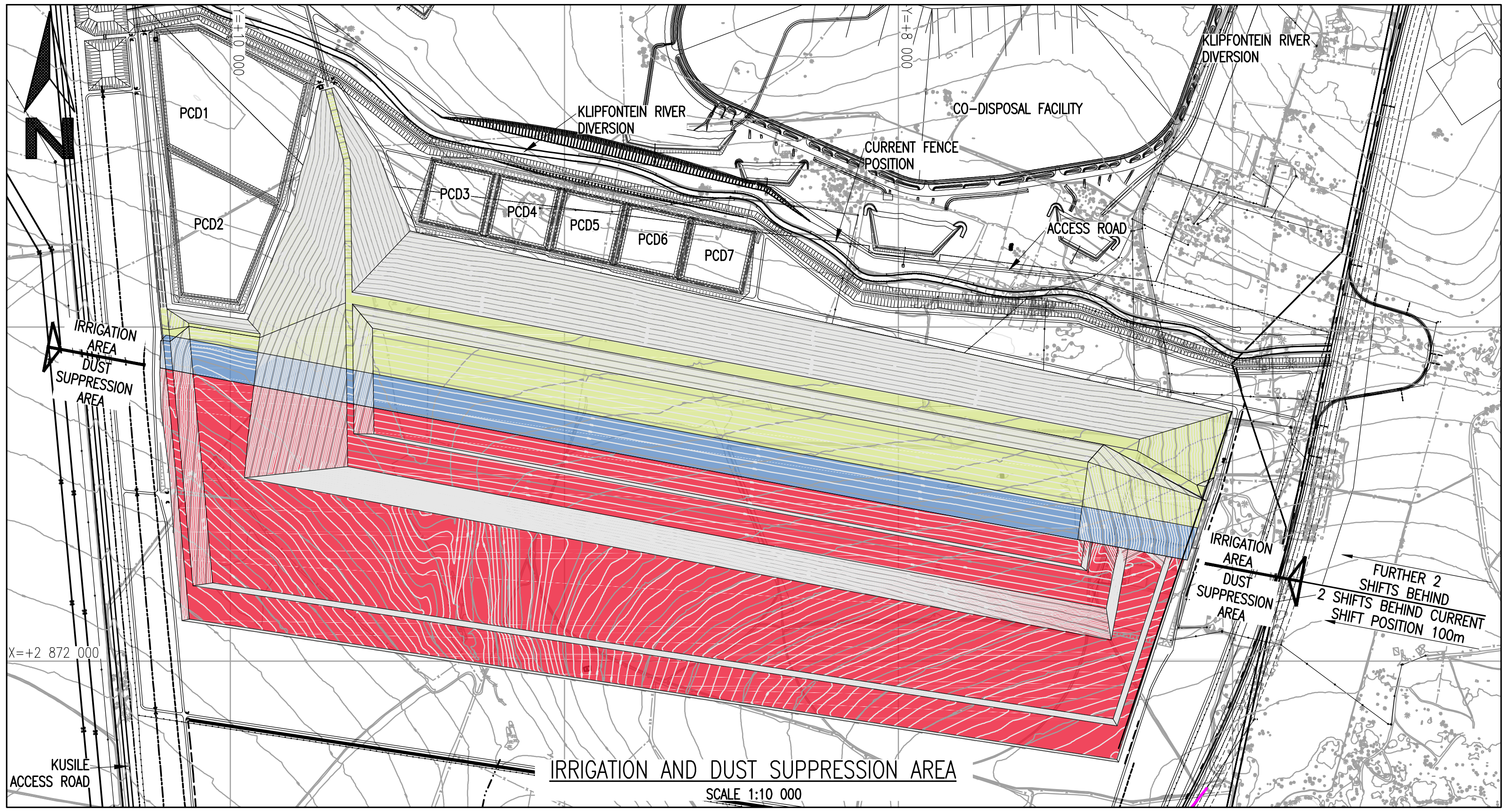
Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
DEVELOPMENT PLAN - 30 TO 60 YEARS DEVELOPMENT

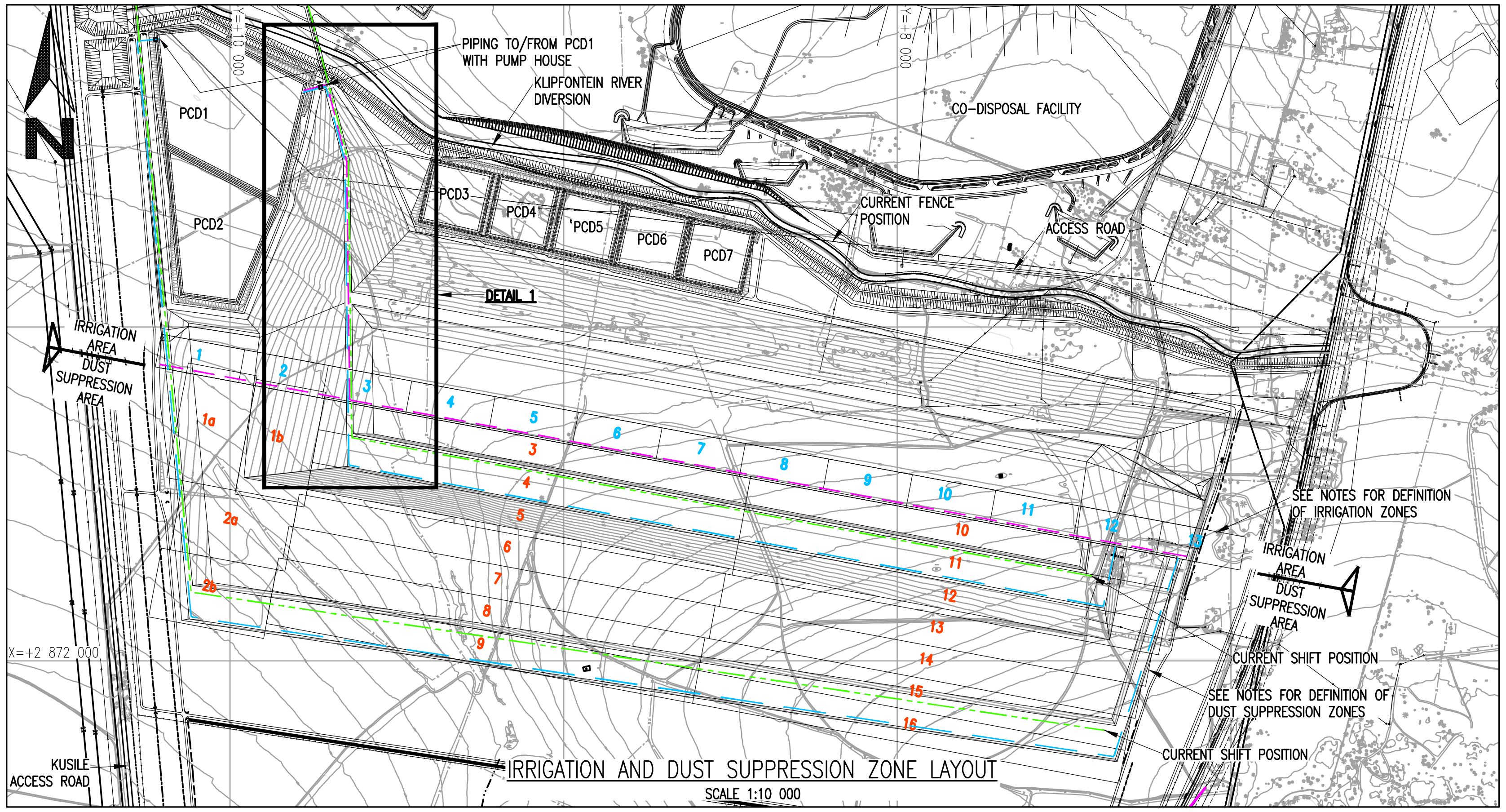
Scale AS SHOWN A0

Drawing No D121-01-013

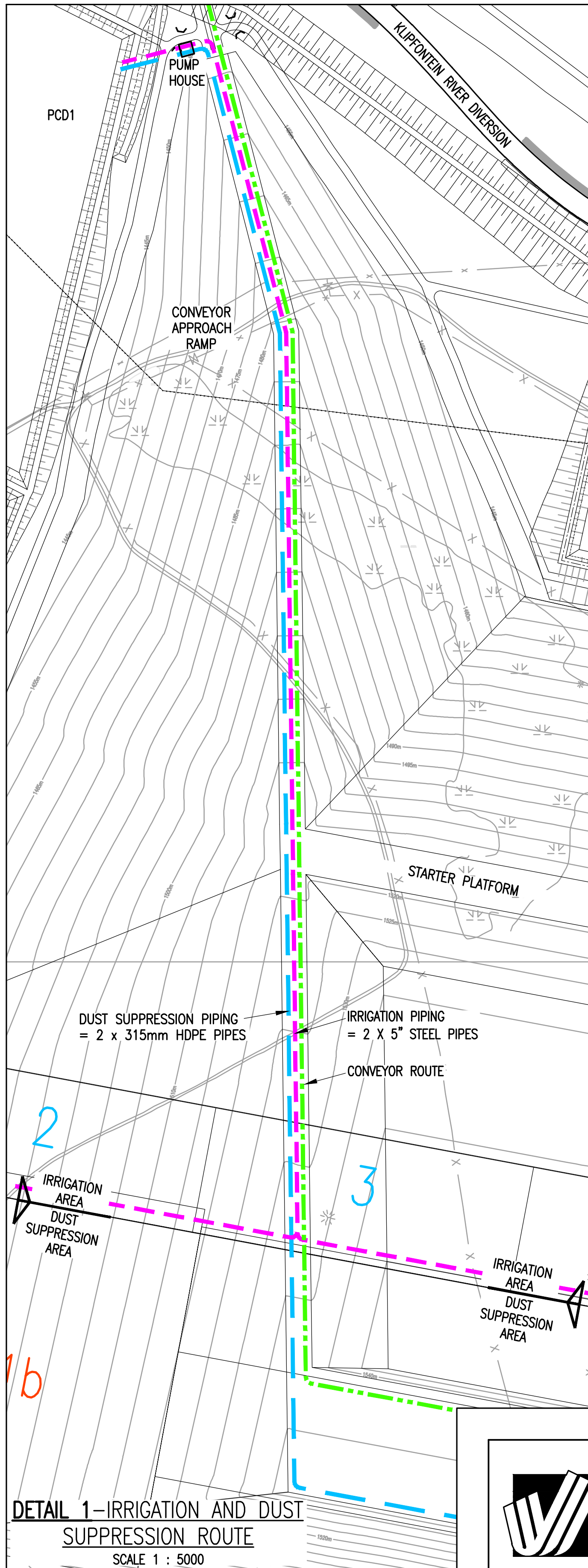
Revision D



IRRIGATION AND DUST SUPPRESSION AREA
SCALE 1:10 000



IRRIGATION AND DUST SUPPRESSION ZONE LAYOUT
SCALE 1:10 000



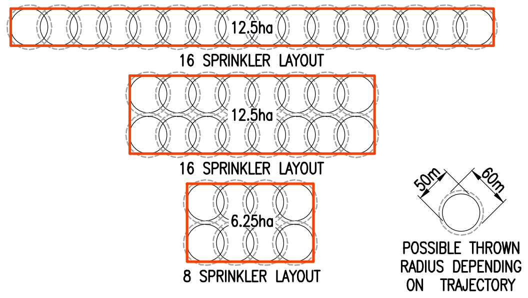
DETAIL 1–IRRIGATION AND DUST SUPPRESSION ROUTE
SCALE 1 : 5000

KEY

- REHABILITATED AREA
- IRRIGATION AREA
- DUST SUPPRESSION AREA
- IRRIGATION PIPING = 2 x 5" (139.7mm) STEEL PIPES
- DUST SUPPRESSION PIPING = 2 x 315mm HDPE PIPES
- CONVEYOR ROUTE

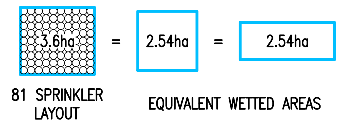
DUST SUPPRESSION

- 16 SPRINKLER SYSTEM
- 50m SPRINKLER RADIUS
- 5mm/Hr PRECIPITATION
- EACH ZONE WETTED FOR 4 HOURS
- NUMBER OF ZONES = 16
- WETTING FREQUENCY = 1 IN 3 DAYS
- FLOW REQUIRED TO WET ONE AREA 175 L/S
- BASED ON "NELSON BIG GUN 150 SERIES"



IRRIGATION SYSTEM

- 81 SPRINKLER SYSTEM (9x9 GRID)
- 10m SPRINKLER RADIUS
- 6mm/Hr PRECIPITATION
- EACH ZONE WETTED FOR 1.5 HOURS
- NUMBER OF ZONES = 13
- WETTING FREQUENCY = 1 / DAY
- FLOW REQUIRED TO WET ONE AREA 42.4 L/S



CO-ORD SYSTEM WGS LO 29

Reference Drawings		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	28.03.14	C.C.
.	.	B	POWER STATION, ACCESS ROADS AND RIVER DIVERSION UPDATED	R.McL.	13.12.13	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR APPROVAL	R.McL.	10.12.13	C.C.

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Drawn	R.McL.	22.11.13
Designed	C.C.	NOV 13
Checked	D.B.	.
Pr. Eng. Approval	C.C.	.
Signature		

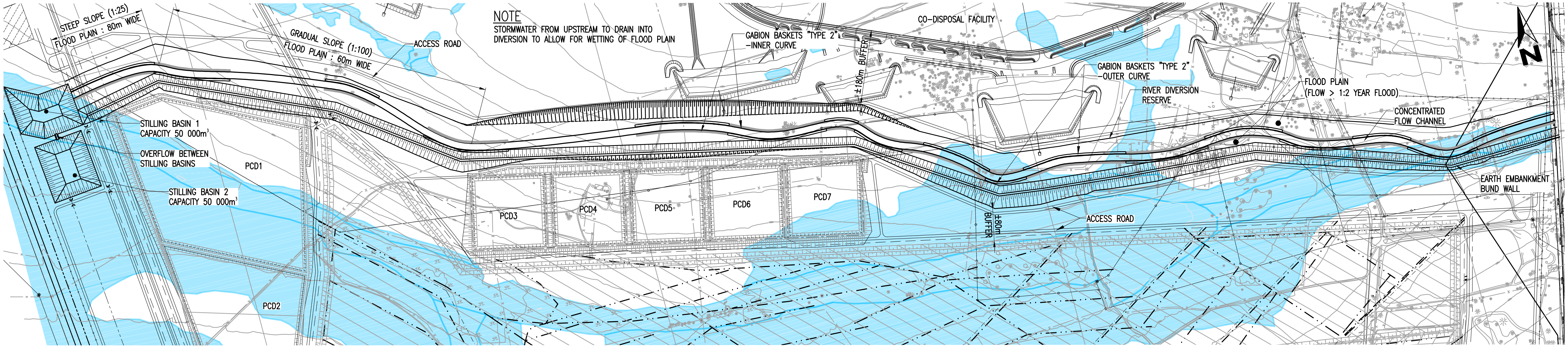
Client ZITHOLELE CONSULTING

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
DUST SUPPRESSION & IRRIGATION LAYOUT

Scale AS SHOWN A1

Drawing No D121-01-014

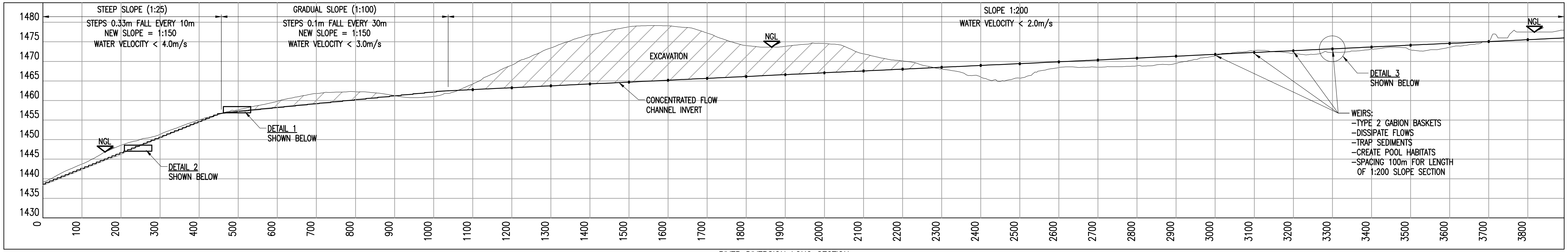
Revision C



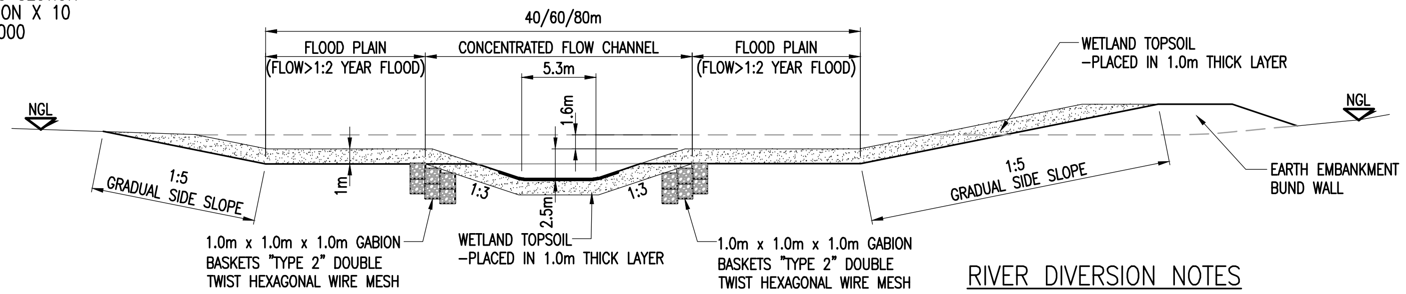
RIVER DIVERSION PLAN

1:5000

– DELINEATED WETLAND

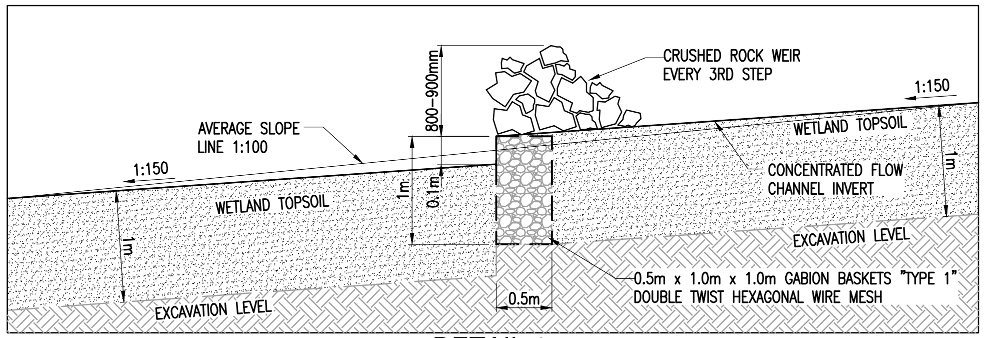


RIVER DIVERSION LONG SECTION
VERTICAL EXAGGERATION X 10
SCALE : 1 : 5000



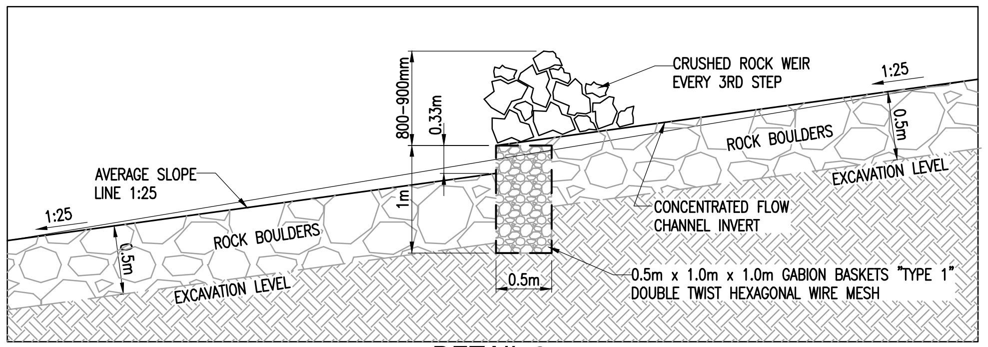
TYPICAL CROSS SECTION

1:250



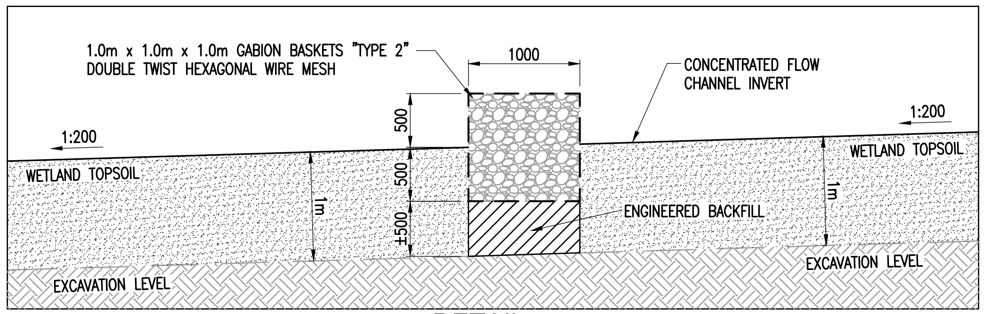
DETAIL 1

NOT TO SCALE



DETAIL 2

NOT TO SCALE



DETAIL 3

NOT TO SCALE

RIVER DIVERSION NOTES

- FLOOD PLAIN TO BE LANDSCAPED TO REMOVE ALL OBSTACLES AND RUTS THAT COULD FORM PREFERENTIAL FLOW PATHS
- SIDE SLOPES TO BE SEEDED WITH SUITABLE MIX OF INDIGENOUS HIGHVELD GRASSES
- WETLAND TOPSOIL ON SIDE SLOPES TO BE ASSESSED FOR SUITABILITY FOR ESTABLISHMENT OF HIGHVELD GRASSES
- FLOOD PLAIN SIZED FOR A 1:50YEAR STORM EVENT

CO-ORD SYSTEM WGS LO 29

		Rev.	Revision	Name	Date	Approved
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	C	REVISED & ADDED STILLING BASINS, REVISED ACCESS ROADS, UPDATED TITLE BLOCK	R.McL.	03.04.14	C.C.
.	.	B	REVISED SECTIONS AND DETAILS	R.McL.	25.03.14	C.C.
FOR DRAWING LIST SEE	D121-01-001	A	ISSUED FOR COMMENT	R.McL.	05.03.14	C.C.
Reference Drawings						

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Designed	C.C.	MAR 14
Checked	D.B.	MAR 14
Pr. Eng. Approval	C.C.	.
Signature		

Client ZITHOLELE CONSULTING

Scale AS SHOWN A1

Project KUSILE POWER STATION
60 YEAR ASH FACILITY
EIA DETAILED CONCEPT DESIGN
KLIPFONTEIN RIVER DIVERSION, LAYOUT & DETAILS

Drawing No D121-01-015

Revision C