Belfast Coal Project

Feasibility Design of Coarse Discard Disposal Facility

epoch resources (pty) ltd

mine residue and environmental engineering consultants

PROJECT No.000-176 REPORT NO.000-176-02 January 2014

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Feasibility Design of Coarse Discard Disposal Facility

Prepared For

Aurecon (Pty) Ltd

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BELFAST COAL PROJECT
FEASIBILITY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

1. INTRODUCTION

Exxaro is evaluating the feasibility of developing a coal mining and processing operation approximately 18km south west of the town of Belfast in the Mpumalanga Province of South Africa. The mine is expected to comprise of an open cast mining operation, coal washing plant and associated infrastructure including a coarse discard disposal facility. The project is referred to as the Belfast Coal Project (T*he Project*) and is expected to have a total life of mine of 16 years.

Aurecon (Pty) Ltd (*Aurecon*) and Epoch Resources (Pty) Ltd (*Epoch*) have been appointed to complete a feasibility design of a Discard Disposal Facility (*the facility*) required for the development of the project. The area available for the development of the facility is limited due to the extent of the proposed mining operations and the presence of existing and proposed roads as well as a network of wetlands associated with the drainage of the project site and surrounds.

This document describes the design of the Mine Residue Disposal Facilities for the project in accordance with the requirements of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) as described in Government Notice 527 (23rd April 2004). The design process has included:

- Confirmation of the design criteria for the discard facility
- A review of the available information on the project site
- The development of a site layout to for the proposed discard disposal facility
- Development of a site development strategy for the facility
- Characterisation of the coal discard based on information supplied as well as previous project experience
- Feasibility design of the works required for the development, operation, and closure of the facility
- The compilation of a set of drawings describing the development of the facility
- The compilation of a life of mine estimate of costs associated with the development, operation, and closure of the facility
- The collation of the work carried out into this Feasibility Design Report.

The project EIA / EMP documentation has been completed and approved by the relevant authorities. Details of the project approvals received to date are contained in the following documents:

- MPRDA Ref No. MP 30/5/1/2/3/2/1 (431) EM dated 9 October 2013
- NEMA Ref No. MPP/EIA/0000304/2012 dated 4 July 2013

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Associate Consultant: Prof G Heyman

2. PROJECT SETTING AND LAND USE

The proposed mine site is located approximately 18 km south west of the town Belfast as shown in Figure 2-1. The site layout is shown in Figure 2-2 which shows the extent of the wetland areas and a stream which flows from north west to south east through the site.

FIGURE 2-1 : BELFAST COAL MINE – LOCALITY PLAN

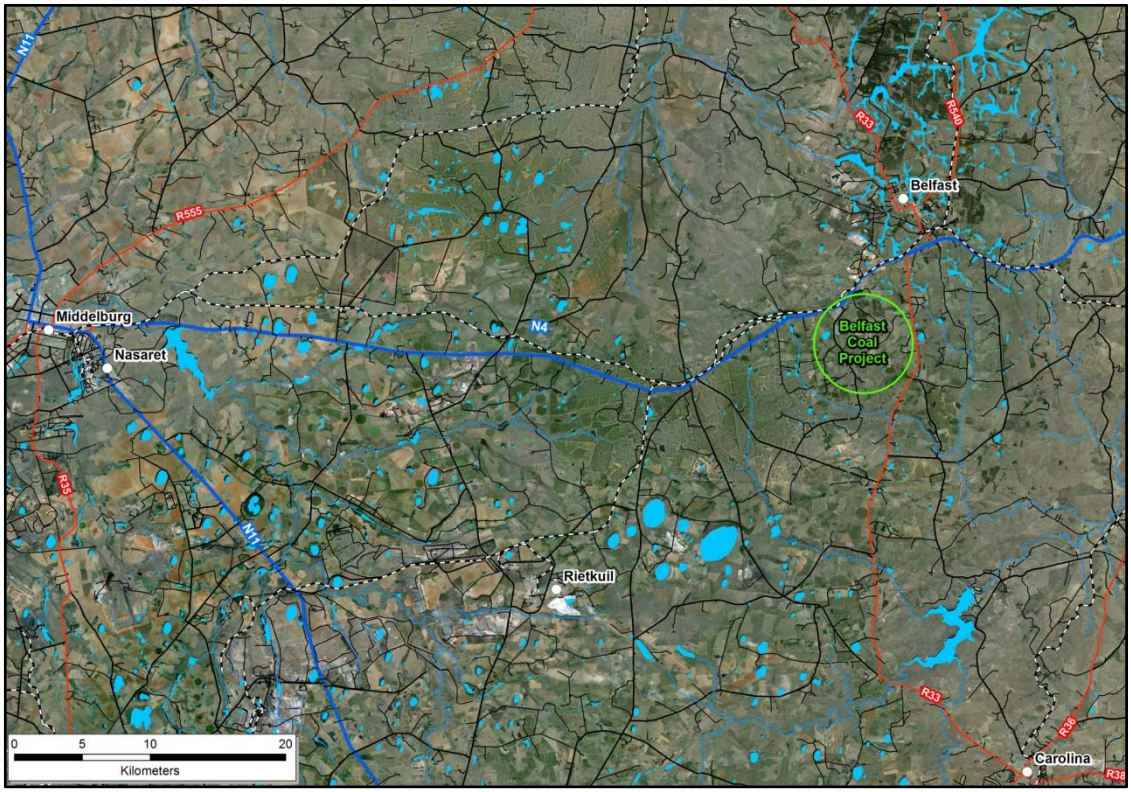
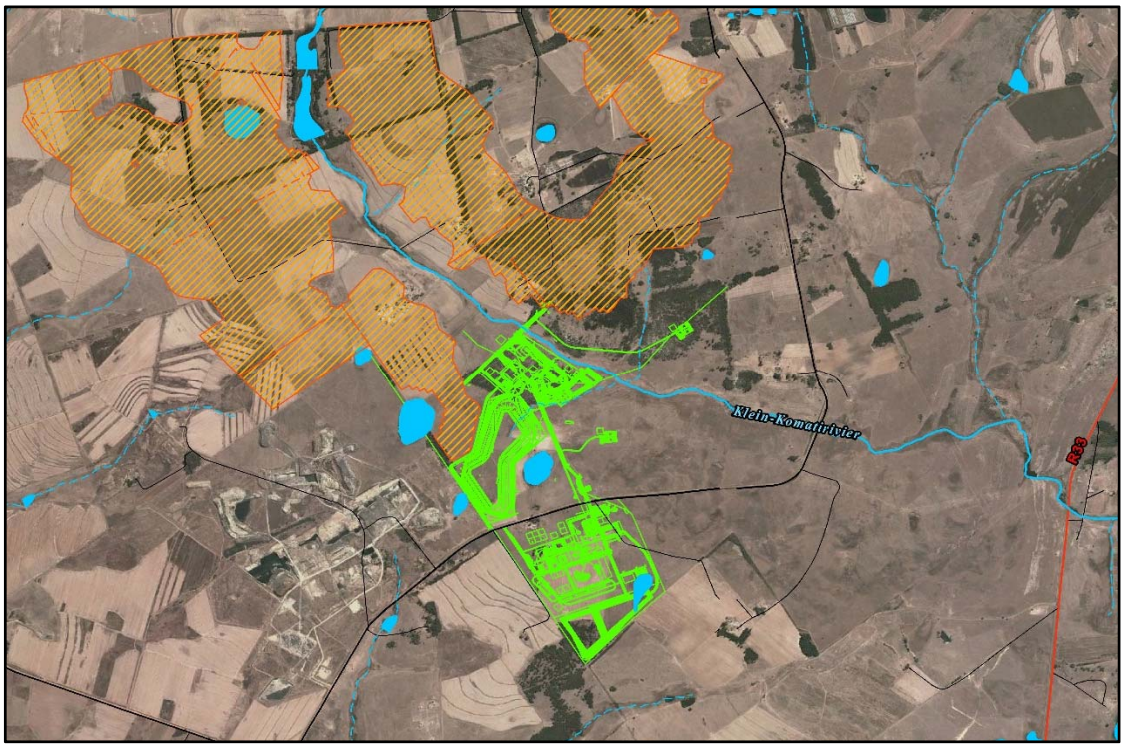


FIGURE 2-2: BELFAST COAL MINE - SITE LAYOUT



The project site is located within a gently sloping valley surrounded by gently undulating topography. The proposed site of the discard disposal facility slopes to the north east towards the proposed site of the washing pland and, ultimately, the stream draining the area.

The south western boundary of the discard dump site is located near the crest of a gentle ridge while the north eastern section appears to overly a wetland formed by a drainage line running in a north easterly direction towards the stream.

The natural vegetation of the area is grassland with some trees located on parts of the site of the discard disposal facility. The predominant land use on the project site is grazing with some ploughed fields on a portion of the discard disposal facility footprint.

3. FRAMEWORK FOR DESIGN OF MINE RESIDUE DISPOSAL FACILITIES

The criteria for the design of the residue disposal facility are described below together with a summary description of the information provided and the legislative requirements applicable to it's design, operation, rehabilitation and closure.

3.1. TERMS OF REFERENCE

The terms of reference for the project call for the feasibility design of a Coarse Discard Disposal Facility to accept discards generated in the coal washing process. The mine is expected to have a life of 16 years during which it is expected to generate a total of 7.5 million tons of coarse discards.

The design is required conform to all applicable legislative requirements and should include the design of all surface water diversion and containment works as called for in such legislation. It is expected that the feasibility design of the facility would generate an estimate of its life of mine costs for inclusion in the overall financial model used to assess the project viability. It is understood, based on the information provided, that:

- The facility will not be required to accept coal fines from the washing plant in slurry form
- A site for the development of the facility has been demarcated on the site plan and is large enough to accommodate the life of mine production of coarse discard
- Environmental permitting and the compilation and submission of the necessary Water Use License Applications for the facility are being carried out by a specialist environmental consultant to the project

3.2. BATTERY LIMITS FOR DESIGN

The battery limits for the design of the facility have been agreed with the project team as follows:

- The point where the haul road from the plant crosses over the perimeter road to the discard disposal facility
- The downstream toe of the silt trap and storm water control dam where overflow water will enter a channel flowing towards the plant area
- The boundary fence around the site of the facility.

In terms of the overall site water management strategy all storm water runoff will be collected at a single storm water control dam below the plant site, the design of which is excluded from the design of the discard dump and is being addressed as part of the design of the site infrastructure.

3.3. DESIGN CRITERIA

The life of mine plan discard production plan for the mine is summarised in Table 3-1 based on the life of mine plan supplied by the project team and an estimated in-situ dry density of discards of 1.575t/m^3 based on:

- Specific gravity for the discard of 1.89t/m^3
- A void ratio after placement and compaction of 0.2

A total of 7.493 million tons of discard is expected to be generated by the mine and processing operation at rates of between 334 and 564 ktpa which translates to a required storage volume of 4.757 million m^3.

TABLE 3-1 : SUMMARY DISCARD PRODUCTION PLAN

YEAR	DISCARD PRODUCTION (KTPA)	PLACED VOLUME OF DISCARD ('000M^3 PER ANNUM)	CUMULATIVE DISCARD PRODUCTION (KTPA)	CUMULATIVE VOLUME OF PLACED DISCARD ('000M^3 PER ANNUM)
1	335	213	335	213
2	486	308	820	521
3	458	291	1 279	822
4	456	290	1 735	1102
5	499	317	2 234	1419
6	475	302	2 710	1721
7	477	303	3 187	2 024
8	466	296	3 654	2 320
9	426	271	4 080	2 591
10	412	262	4 492	2 852
11	474	301	4 967	3 153
12	475	302	5 442	3 455
13	423	269	5 865	3 724
14	518	329	6 383	4 053
15	546	347	6 929	4 399
16	564	358	7 493	4 758
TOTAL	**7 493**	**4 758**		

3.4. INFORMATION USED IN THE DESIGN PROCESS

Information used in the site selection process has been supplied by Exxaro, as well as others involved in the feasibility study as follows:

- Arup have supplied a site plan showing the proposed layout of the surface infrastructure associated with the project and also the site boundaries
- Exxaro supplied details of the discard production rates and life of mine and also a particle size distribution for the discard materials
- Exxaro have supplied details of two preliminary geotechnical investigations of the project site which included details relevant to the proposed site of the discard disposal facility
- Aurecon have supplied a summary report on the geotechnical conditions on site based on a site walkover and a review of previous geotechnical investigations in the area
- Geotechnical properties of the discard have been based on related project experience and will be confirmed based on planned testing of representative samples

- Summaries of specialist reports undertaken for the baseline environmental impact assessment are in the process of being compiled. These are expected to include information on:
  - Surface and Ground Water
  - Discard geochemistry
  - Fauna and flora
  - Aesthetic impact assessment and air quality studies

3.5. LEGISLATIVE REQUIREMENTS

The legislative requirements for the design, operation and closure of MRD's are contained in Government Notice 527 (23rd April 2004) published in terms of the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002). The MPRDA Regulations requires that the process by which the proposed site of the facility is selected must be documented and take into account certain considerations as listed in the Introduction of this document. The manner in which the regulations are structured means that approval for the construction and operation of such facilities is linked to the approval of the EIA / EMPR documentation for the overall project. Additional legislative requirements are contained in:

- Section 20 of the Environmental Conservation Act (Act 73 of 1989) which specifies that the disposal of waste materials with the potential to generate leachate requires a permit;
- Section 21(g) of the National Water Act (Act 36 of 1998) which classifies the disposal of tailings as a water use. The objective of the National Water Act (NWA) in terms of the design of mine residue deposits is to reduce and prevent pollution and degradation of water resources, thereby protecting aquatic and associated ecosystems and their biological diversity;
- Regulation 4 of GN 704 which regulates the management of surface water on and around mining and related operations and requires that ; “No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 meters from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground or ground likely to become waterlogged, undermined, unstable or cracked”. However the Minister may in writing authorise an exemption from the requirements of regulations relating to restrictions in locality on his or her own initiative or on application, subject to such conditions as the Minister may determine;
- National Environmental Management Act 107 of 1998 (NEMA). Sustainable development should be promoted thereby avoiding the disturbance of ecosystems and loss of biological diversity, preventing or minimising the pollution and degradation of the environment as well as minimising the disturbances to landscapes and sites which constitute the nation’s cultural heritage;
- National Heritage Resources Act 25 of 1999. This Act provides a system for the management of national heritage resources. Therefore if any heritage object is discovered on the site, the relevant authorities must be notified.

4. SCOPE OF WORK

The scope of work carried out in addressing the terms of reference as outlined above has included:

- An inspection of the proposed mine site, review of available information and confirmation of the design criteria for the discard disposal facility
- Review of a preliminary geotechnical review of the project site carried out by Jeffares & Green as well as a subsequent investigation by Exxaro (Brink, 2013)
- Confirmation of the suitability of the preferred site for the construction of the facility and the development of a site layout plan and site development strategy for the facility and its associated infrastructure
- Feasibility design of the discard disposal facility and related infrastructure to include:
  - Stage capacity calculations and site development strategy
  - A desktop assessment of seepage and slope stability
  - An assessment of the site hydrology and surface water management requirements
  - Sizing and design of surface water containment and diversion works
- The compilation of a feasibility design report on the design of the facility including:
  - A life of mine estimate of costs associated with the development, operation and closure of the facility
  - Site layout drawings and typical sections describing the development and operation of the facility

Comprehensive geotechnical investigation of the site of the facility was not possible due to time and logistical constraints and is scheduled for the next phase of the project. Reference has instead been made to previous geotechnical investigations of the surrounding site.

5. CHARACTERISATION OF COARSE DISCARD

The MPRDA requires that mining residues are characterised in terms of their physical and geochemical characteristics as part of the design of facilities for their disposal. The characterisation of the Belfast residue products have as yet not been completed. For the purposes of the feasibility design the discards have been characterised based on the information supplied and on information for similar discard products.

5.1. PHYSICAL CHARACTERISATION OF THE COAL DISCARDS

The physical characteristics of the tailings products are described in terms of their particle specific gravity (PSG) and particle size distribution (PSD). These characteristics are significant in that they will influence the in-situ dry density of the placed discard as well as the behaviour of the material during transportation, placement and compaction. The expected physical characteristics of the discards are summarised as follows:

- The particle size distribution of the coarse discard is expected to vary. The potential variability is illustrated in Table 5-1 which shows that the discard is expected to comprise particles varying in size from sands to gravel
- Based on previous experience it is expected that the particle specific gravity of the discards will be approximately 1.89t/m^3

- After placement, spreading and compaction to the specified void ratio of 20% it is calculated that the discard would have an in-situ dry density of 1.575t/m^3
- The expected geotechnical characteristics of the placed coarse discards are presented in Table 5-2 based on previous project experience

TABLE 5-1 : PARTICLE SIZE DISTRIBUTION - COARSE DISCARDS

SIEVE SIZE (MM)	CUMULATIVE % PASSING		
	FINE DISCARDS	AVERAGE DISCARD	COARSE DISCARD
80	100	100	100
50	100	97	95
25	80	69	61
12	58	44	35
6	39	29	22
3	21	15	12
0.15	0	0	0

TABLE 5-2 : EXPECTED GEOTECHNICAL PARAMETERS FOR COAL DISCARDS

MATERIAL	BULK UNIT WEIGHT (KN/M^3)	SATURATED CONDUCTIVITY (K_Y) (M/S)	K_Y/K_X	EFFECTIVE FRICTION ANGLE (ϕ')	EFFECTIVE COHESION (C') (KPA)
Coarse Residue	13.0 (±2.0)	$1.0x10^{-7}$	1/2	33.0 (±5.0)	0

5.2. GEO-CHEMICAL CHARACTERISATION OF THE COAL DISCARDS

The geochemical characteristics of the discards are in the process of being confirmed as part of the large core diameter drilling and testing program and the environmental permitting and water use licensing of the project. For feasibility design purposes it has been assumed that:

- The discards have the potential to generate AMD which can be managed by the compaction of the material and the capping of the dump to limit the availability of oxygen and moisture
- The discards have the potential for spontaneous combustion
- Runoff and seepage from the discard facility would contain elevated levels of suspended solids and salts, making it necessary to control all such seepage and runoff

The characterisation of the discards should be confirmed by the collection and testing of representative samples from the large core diameter program by means of some or all of the following tests as deemed necessary based on the samples collected:

- Static ABA Tests to determine the potential for Acid generation including
  - chemical composition (whole rock and elemental analysis – ICP or XRF)
  - mineralogical analysis (XRD)
  - acid base accounting (ABA)
  - net acid generation (NAG)
  - water extraction (batch extraction) tests - with solution assay (TCLP or SA acid rain leach test) this will determine Metal Leaching (ML)

- Kinetic Tests to supplement the static tests and determine the potential rate of AMD generation
  - humidity cell leach testing
  - column leach testing
  - Mineralogical examination
  - Total analysis, including XRF
  - Acid rain leach testing (ARLP) as per the South African Department of Water Affairs and Forestry (DWAF) minimum requirements.

6. GEOTECHNICAL INVESTIGATION AND SITE GEOHYDROLOGY

Site investigations have not formed part of the feasibility design process due to logistical and time constraints. The available information on previous geotechnical investigations in the area and the potential impact of the development of the discard disposal facility on the local geohydrology are summarised below.

6.1. GEOTECHNICAL INVESTIGATION

Previous geotechnical investigations of the area have been conducted by Exxaro (Exxaro, October 2009) and Jeffares & Green (Jeffares & Green, July 2011). Jeffares & Green excavated 4 test pits (TP20 to TP23) on the proposed discard dump site to depths of between 0,12 and 1,80 m and reported that trial pit (TP21) refused at shallow depth (0,10 m) on hardpan ferricrete while the remaining trial pits were advanced to depths of between 1,30 and 1,80 m.

The results of foundation indicator and Atterberg Limit Tests carried out on samples retrieved from the test pits are summarised in Table 6-1.

TABLE 6-1 : FOUNDATION INDICATOR AND ATTERBERG LIMIT TESTS

TP NO AND DEPTH		DESCRIPTION	PARTICLE SIZE DISTRIBUTION (%)				ATTERBERG LIMITS %			GM	HP
			CLAY	SILT	SAND	GRAVEL	LL	PI	LS		
TP 20	0,30-0,70	Silty sand (colluvium)	6	25	67	2	NP	NP	0.0	0.87	Low
TP 20	1,05-1,20	Silty gravelly sand (colluvium)	5	14	37	43	20	6	2.5	1.76	Low
TP 22	1,00-1,75	Silty sand (residual sandstone)	8	24	49	19	27	8	4.0	1.13	Low
TP 23	0,95-1,80	Slightly clayey silty sand (residual sandstone)	11	27	58	5	26	10	4.0	0.82	Low

LL- Liquid Limit GM - Grading Modulus LS - Linear Shrinkage PI - Plasticity Index HP – Heave Potential
Heave Potential – assessed according to the Van der Merwe method (Williams & Donaldson 1980)

Based on the investigation and associated laboratory testing the soil profile in the vicinity of the discard facility was summarised as described in section 6.1.1 to 6.1.3 below.

6.1.1. COLLUVIAL SOILS

With the exception of TP21, broadly similar colluvial soils were observed to extend from surface to depths of between 0,95 and 1,20m. An upper horizon of light brown, loose, silty fine sand was observed from surface to between 0,30 and 0,35 m. This was underlain by pale orange to orange brown, loose, silty sand to a depth of 0,70 m in all three trial pits. A soil horizon containing gravel (interpreted to be a gravel marker) was observed in all three trial pits.

6.1.2. PEDOGENIC SOILS - FERRICRETE

Weakly cemented honeycomb ferricrete was encountered in TP20 between 1,20 m and the refusal depth of the TLB at 1,30 m. The TLB refused on hardpan ferricrete at a depth of 0,12 m at TP21.

6.1.3. RESIDUAL SANDSTONE SOILS

Residual soils are formed from the complete in-situ weathering of the underlying bedrock. Residual sandstone soils described as pale orange, medium dense to dense, silty fine sand was observed in TP22 and TP23 to depths of 1,75 and 1,80 m, respectively. Sandstone rock was not encountered in the trial pits.

Jeffares & Green describe the soils encountered during the investigation as predominantly sandy in composition. The laboratory test results indicate that the soils have low heave potential and problematic ground conditions arising from expansive soils are not expected. The colluvial silty fine sand encountered in TP23 (0,35 – 0,70 m) was described as open voided. This texture is characteristic of a potentially collapsible soil. Further investigations were recommended to determine the collapse potential of the soils. Problems associated with dispersive soils were not however anticipated.

6.1.4. GEOTECHNICAL PARAMETERS FOR FOUNDATION SOILS

Based on tests conducted by Jeffares & Green on samples retrieved from test pits on the it is expected that the foundations soils would have geotechnical parameters as follows when compacted to 95% Proctor Density:

- Effective Strengths (Internal angles of Friction) of approximately 30º to 35º
- Cohesion of at least 10kPa
- Hydraulic conductivities in the range of 1 to 5 x 10^{-8}m/s

6.1.5. SUPPLEMENTARY GEOTECHNICAL INVESTIGATION

Subsequent to the original geotechnical investigation of the site an additional investigation was carried out by Exxaro (Brink, 2013) which concluded that geotechnical conditions in the area are expected to vary as the site straddles the geological contact between the Dwyka and Vryheid Formation, grading into either residual and highly to completely weathered sandstone at shallow depth in some areas or refusing in dense nodular to honeycomb ferricrete. The investigation yielded a summary soil profile for the discard dump area as presented in Table 6-2 below.

The very loose and voided sandy silt to silty sand colluvium material extends to an average depth of 0.90m over this area, but in some test pits were found to a depth of up to 1.40m. This material was described as being very loose and voided, and high levels of settlement can be expected if left in-situ or untreated. This is typically underlain by a nodular to honeycomb ferricrete horizon of loose to dense consistency to depths of >2.50m (where excavation efforts refused) in some of the test pits. Due to the variation in the nature and consistency of the ferricrete horizon, differential settlement might also pose a

problem if this horizon is left untreated. It was recommended that a controlled test strip be set up on site prior to making a final decision on compaction methods and specifications.

TABLE 6-2 : TYPICAL SOIL PROFILE (BRINK, 2013)

AVERAGE DEPTH (M)	DESCRIPTION
0.0-0.30	Slightly moist, dark brown, very loose, voided with open root channels, fine sandy silt. Abundant fine roots. Topsoil.
0.30-0.90	Slightly moist, dull orange, dark red or dull grayish brown, very loose, pinhole voided, silty sand. Colluvium. Scattered roots OR Abundant rounded fine to medium gravel sized Fe/Mn nodules and quartz gravel in a dark orange brown, fine sandy silt matrix. Overall consistency is medium dense. Nodular ferricrete.
0.90-2.40	Orange red mottled yellow and black, dense ferricrete gravel and boulders and fine to coarse quartz gravel in a moist, orange brown silty sand matrix. Nodular to honeycomb ferricrete OR Grayish white stained and streaked yellow and pink, highly to completely weathered very soft rock sandstone.

6.1.6. GENERAL

While further investigation and testing of samples is expected to be required to facilitate the detailed design of the discard disposal facility it is not expected that the foundation conditions described would present any insurmountable problems in the development of the discard facility. The soil horizons described are considered competent and suitable for the founding of the discard disposal facility. Should the foundation conditions prove to be less competent than anticipated, the slopes of the facility could be flattened or its height limited. Both of these alternatives would however reduce the available storage discard disposal capacity of the facility.

6.2. SITE GEOHYDROLOGY

The geohydrological investigation of the project site was carried out in 2009 and is currently being updated to reflect the latest site layout with specific reference to the development of the open pit and the configuration of the discard dump. Based on the site topography and observation made in the reports on the geohydrological and geotechnical investigations referred to above, it is expected that:

- Shallow perched aquifers may be encountered during excavations on the discard dump site
- Shallow weathered and deeper fractured Karoo aquifers are likely to underlie the site
- The local water table is likely to be drawn down by the dewatering of the adjacent open pit. This is expected to result in potential seepage flows from the discard facility reporting to the open pit which is likely to form a local groundwater sink.

Ongoing geohydrological investigations and modelling are focussed on assessing the potential impact of the discard disposal facility on the ground water environment. The assessment is expected to assess the potential contribution of the discard disposal facility to the deterioration of the groundwater environment when seen in conjunction with the other project activities to enable a final decision to be taken on a strategy for the control of potential seepage flows from the discard dump. For purposes of feasibility design and based on the assumption that the discards' AMD potential is low to moderate it is proposed that the design of the facility include provisions for:

- The compaction of the foundation of in-situ materials in the foundation of the discard dump
- The installation of an HDPE liner and seepage collection drains beneath the discard dump
- The installation of leakage detection drains to the base of the discard dump

- The containment and collection of surface runoff from the facility for re-use in the coal washing plant
- Progressive rehabilitation of the outer slopes of the facility to limit contact between rainfall and the discards

7. SITE DEVELOPMENT PLAN AND STAGE CAPACITY CALCULATIONS

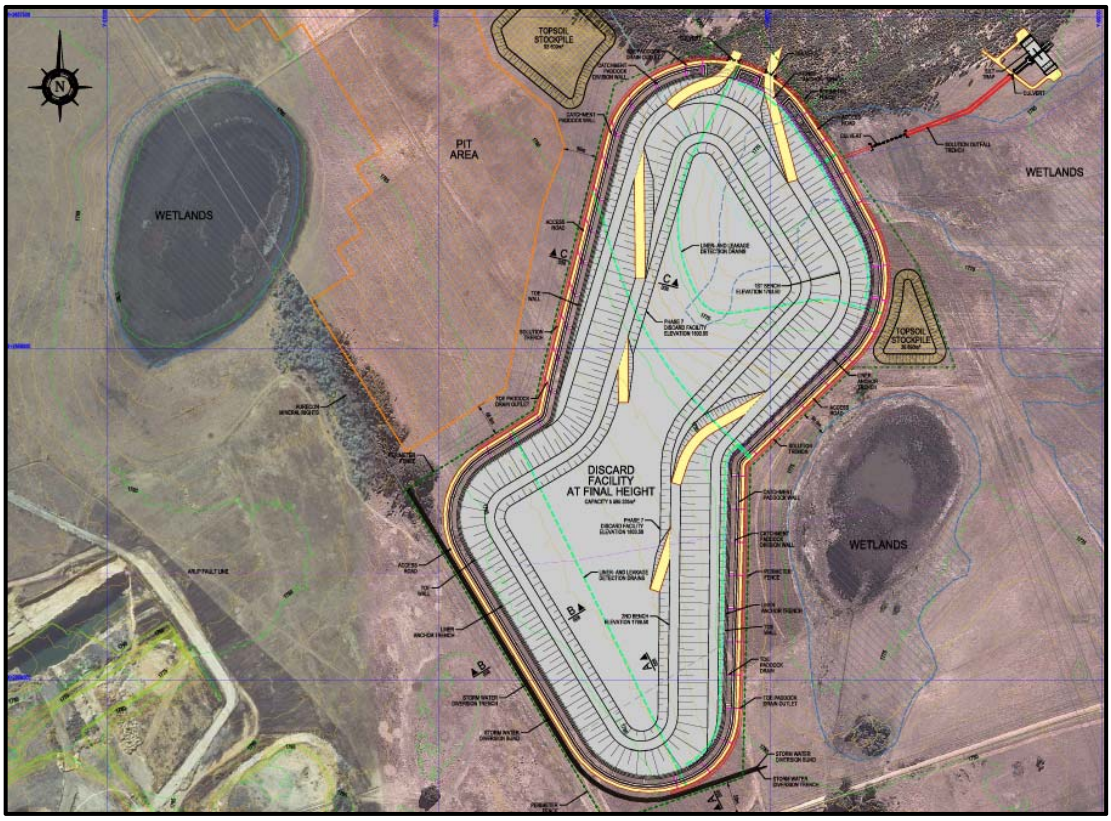
The plan for the development of the discard dump is described below in terms of the area available for development, the strategy for optimising the use of the available area, and the resulting deposition capacity.

7.1. AREA AVAILABLE FOR DEVELOPMENT OF DISCARD DISPOSAL FACILITY

The area available for the development of the proposed discard disposal facility is shown in Figure 7-1. The proposed layout of the facility has been dictated by:

- The extent of the proposed open pit mining operations to the north west
- Existing and proposed roads to the south west and south
- The wetland area to the east
- The plant layout to the north east

FIGURE 7-1: BELFAST COAL MINE - AREA AVAILABLE FOR DEVELOPMENT OF DISCARD DISPOSAL FACILITY



7.2. STAGED DEVELOPMENT PLAN AND CAPACITY OF DISCARD DISPOSAL FACILITY

The staged development of the discard disposal facility is summarised in Table 7-1 and is illustrated in Figure 7-2 to Figure 7-8. It is proposed that the discard facility be developed from the low point of the site progressing in stages towards the south west. The discard discards will be placed, spread and compacted in layers of 300 to 500mm depending on the type of compaction equipment available. The outer slopes of the facility will have a slope of 1V:3H with 15m wide step-ins at 15m vertical intervals.

The incremental and cumulative storage capacity of the discard disposal facility is summarised in Table 7-1 with the estimated time to completion of each stage based on an average rate of discards deposition of 40 ktpm. The summary illustrates that the facility has the capacity to store up to 8 813kt of discards at

a maximum height above datum of 35m. This is in excess of the required capacity of 7 493kt which allows for the extension of the life of mine to 18.3 years assuming a discard production rate of 40ktpm.

TABLE 7-1: SUMMARY OF STAGE CAPACITY CALCULATIONS.

PHASE	CREST ELEVATION (M.A.M.S.L.))	STORAGE VOLUME ('000M^3)	STORAGE CAPACITY (KT)	CUM STORAGE VOLUME ('000M^3)	CUM STORAGE CAPACITY (KT)	TIME TO COMPLETION (MONTHS)
1	1773.5	135	213	135	213	5
2	1778.5	470	741	606	954	24
3	1783.5	857	1 349	1 462	2 304	58
4	1788.5	1 281	2 018	2 744	4 321	108
5	1793.5	1175	1 852	3 919	6 173	154
6	1798.5	1001	1 577	4 920	7 750	194
7	1803.5	675	1 063	5 595	8.813	220

FIGURE 7-2: PHASE 1 BELFAST DISCARD DISPOSAL FACILITY (T = 5 MONTHS)

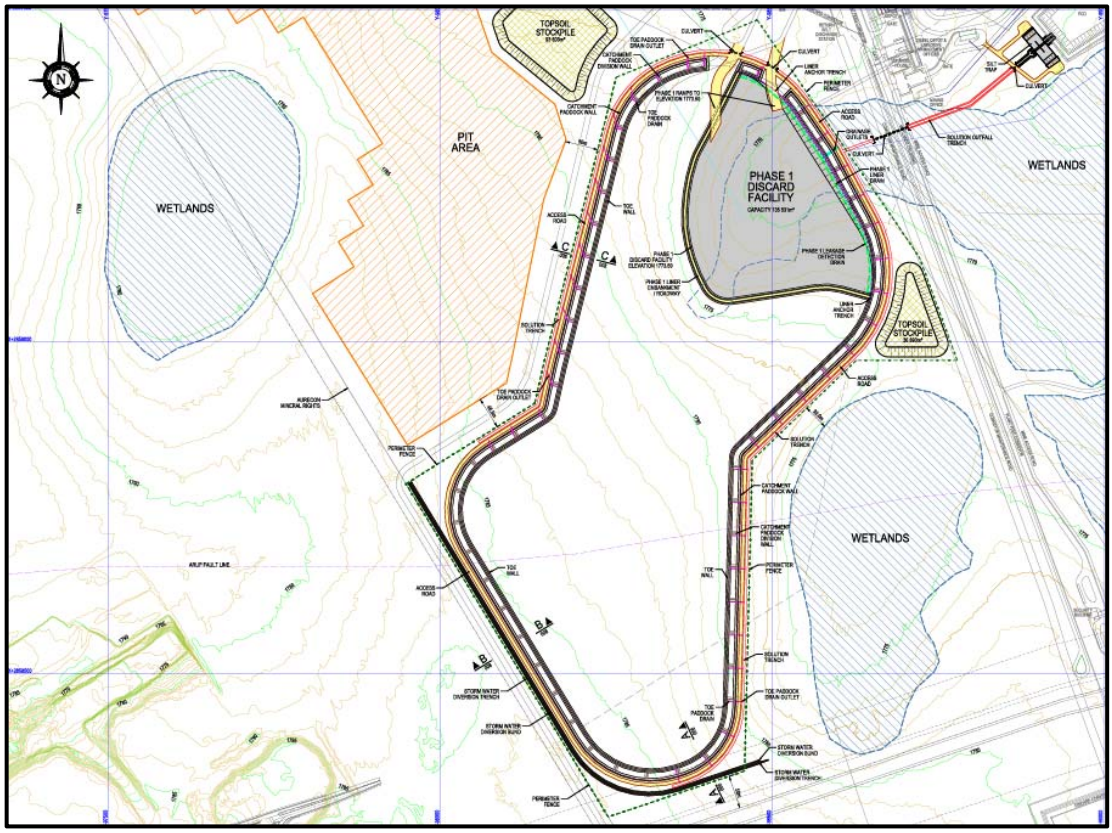


FIGURE 7-3: PHASE 2 BELFAST DISCARD DISPOSAL FACILITY (T = 24 MONTHS)

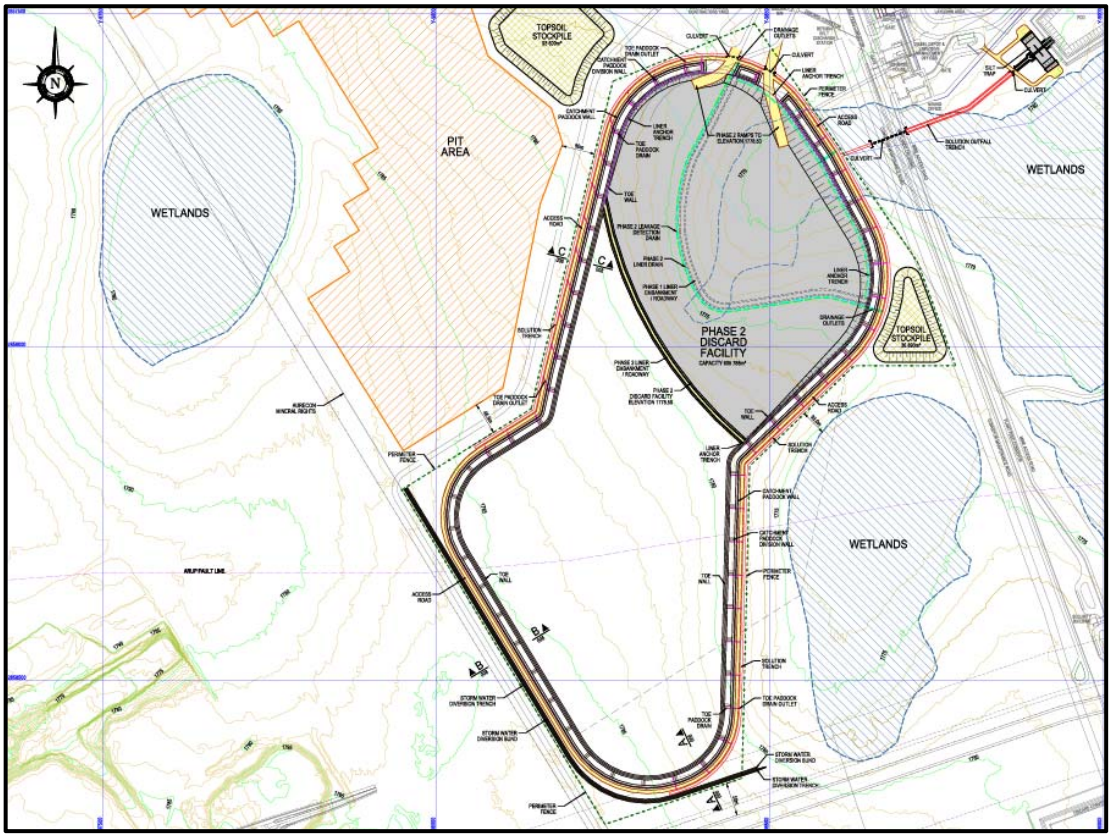


FIGURE 7-4: PHASE 3 BELFAST DISCARD DISPOSAL FACILITY (T = 58 MONTHS)

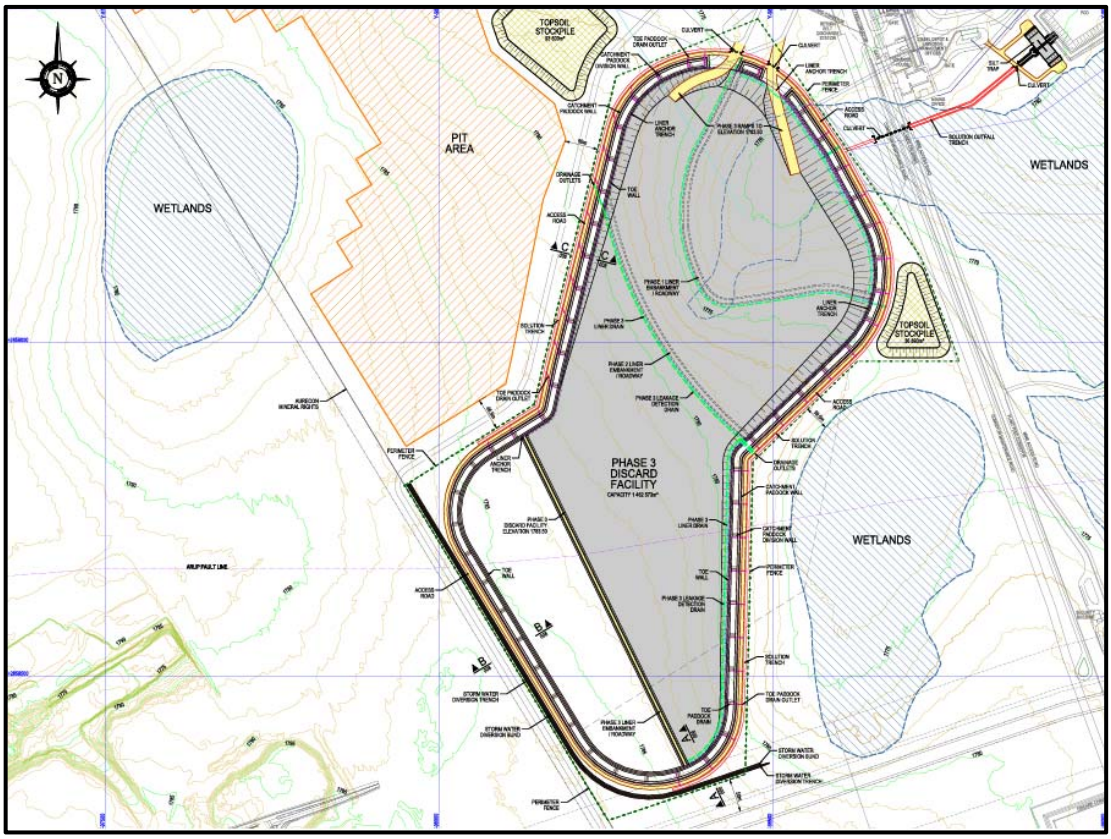


FIGURE 7-5: PHASE 4 BELFAST DISCARD DISPOSAL FACILITY (T = 108 MONTHS)

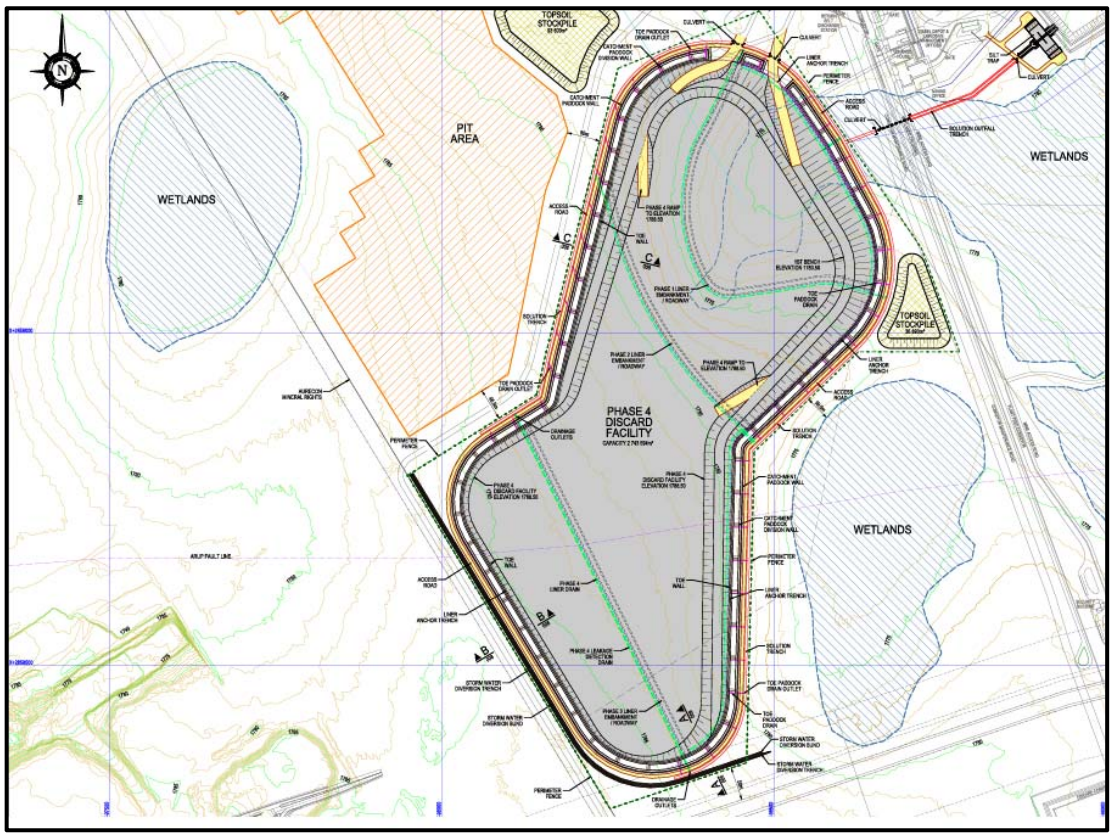


FIGURE 7-6: PHASE 5 BELFAST DISCARD DISPOSAL FACILITY (T = 154 MONTHS)

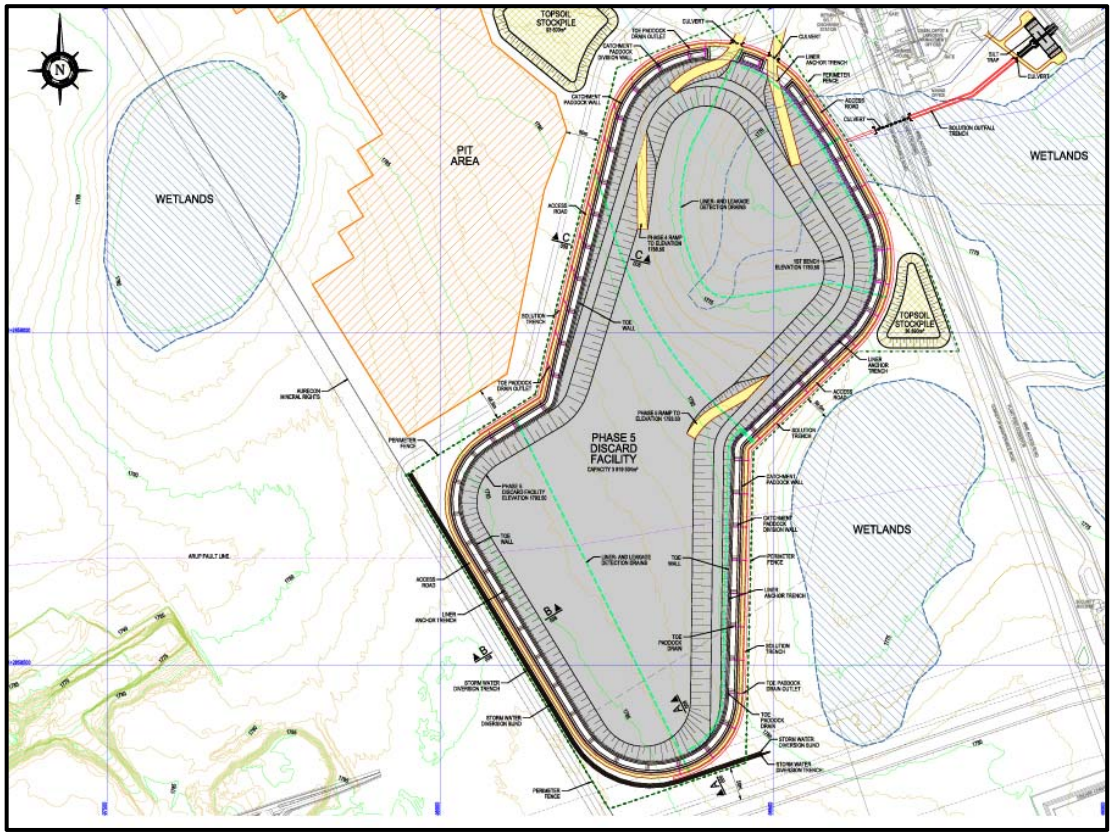


FIGURE 7-7: PHASE 6 BELFAST DISCARD DISPOSAL FACILITY (T = 194 MONTHS)

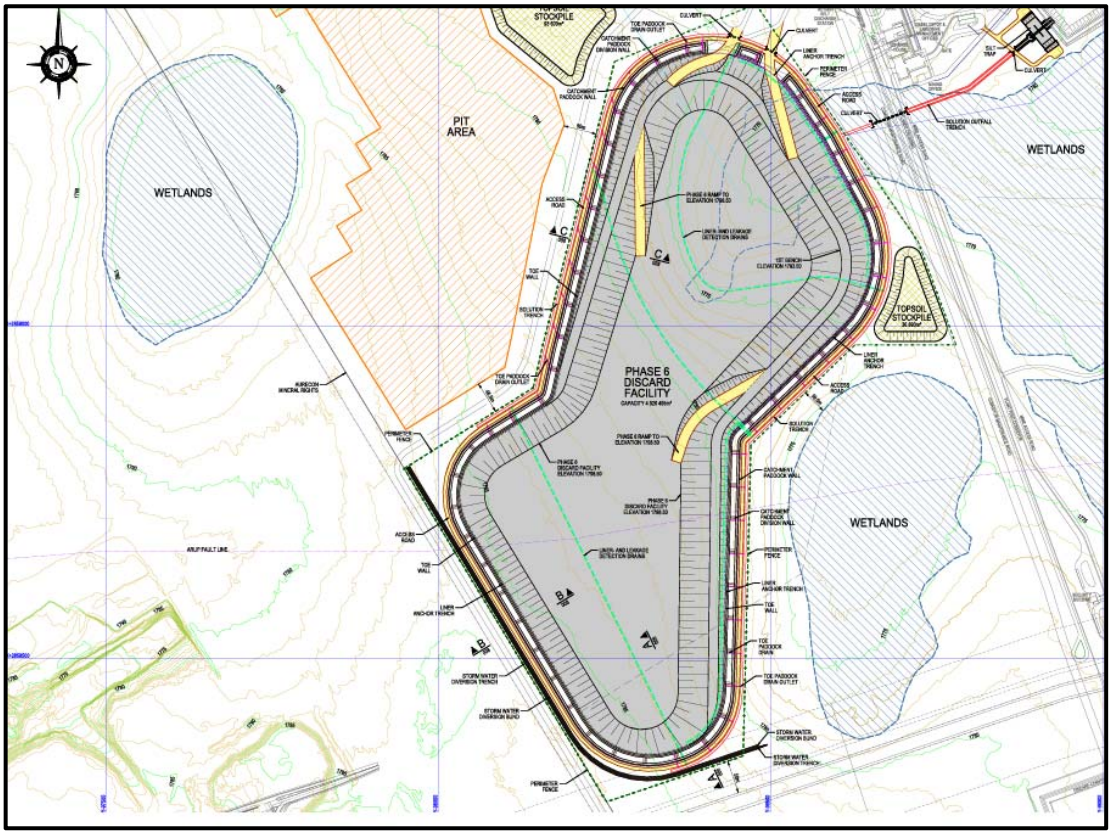
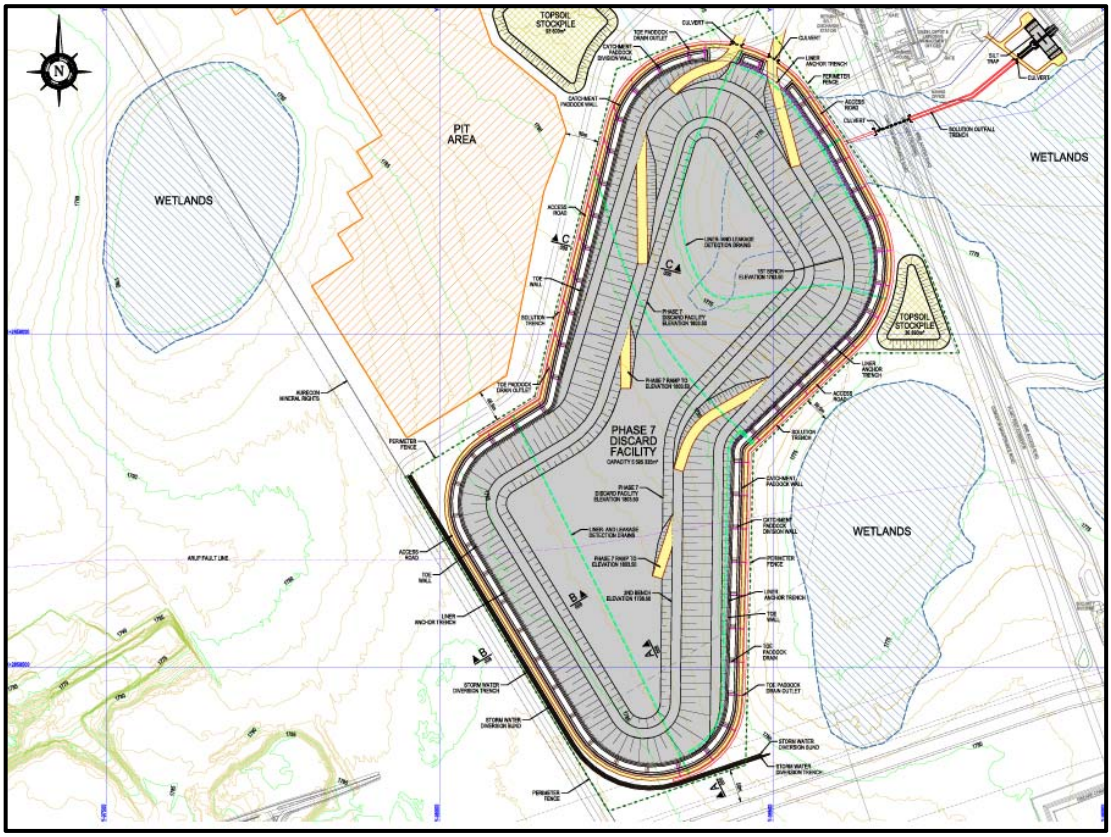


FIGURE 7-8: PHASE 7 BELFAST DISCARD DISPOSAL FACILITY (T = 220 MONTHS)



8. FEASIBILITY DESIGN OF DISCARD DISPOSAL FACILITY

A summary description of work carried out in support of the feasibility design of the discard disposal facility is presented below and should be read in conjunction with the applicable drawings and calculations contained in appendices to the report.

8.1. SEEPAGE AND SLOPE STABILITY ANALYSIS

Seepage and slope stability analyses of the proposed facility have not yet been carried out due to a lack of representative geotechnical information. Based on the available information and the proposed configuration of the discard disposal facility it is not expected however that any problems will be experienced with its structural integrity.

The nature of the discards, which will to all intents and purposes be deposited dry, and the absence of any water inputs to the facility other than infiltration associated with rainfall, make it likely that conditions within the dump will remain unsaturated. This will retard the migration of infiltration through the dump and make it unlikely that a phreatic surface would develop within the discards. It is therefore also unlikely that there would be any seepage to the foundation materials underlying the discard dump.

8.2. HYDROLOGY AND SURFACE WATER MANAGEMENT

The overall site water management strategy dictates that runoff from the discard disposal site will not be retained at the facility but will be allowed to flow to the main storm water control dam which is intended to retain all surface water runoff from the project site as per the requirements of GN704. The emphasis of the assessment of the surface water hydrology of the site has therefore been on ensuring that runoff from the site is managed in such a way as to maximise the retention of material eroded from the discards or rehabilitated areas.

Basic calculations (Appendix B) have been carried out for the facility to estimate the volumes of runoff from the site and the maximum likely discharge rates for a range of recurrence intervals and event durations. The calculations have been based on rainfall figures for the area as presented in Table 8-2 and Table 8-3 based on data sourced from the Belfast - POS Station weather station which has a rainfall record of 94 years.

The surface water hydrology calculations illustrate that:

- Total runoff from the site may be as high as 50 000m^3 in extreme events (Ref : Table 8-3)
- The peak discharge rate for a 1 in 100 year recurrence interval event could be as high as:
  - 17m^3/s based on the catchment area of 424 000m^2 and a maximum rainfall intensity of 102 mm/hr (based on a Time of Concentration of 1.0 hrs)
  - 11.55m^3/s based on the catchment area of 424 000m^2 and a peak rainfall intensity of 69 mm/hr (based on a Time of Concentration of 1.5 hrs)
  - 8.5m^3/s based on the catchment area of 424 000m^2 and a peak rainfall intensity of 52 mm/hr (based on a Time of Concentration of 2.0 hrs)

Based on the results of the surface water hydrology assessment it has been confirmed that the site storm water control dam has sufficient storage capacity to accept and retain the expected volumes of surface water runoff from the discard disposal facility. It is expected also that the proposed storm water control measures for the discard dump will result in runoff flows from the site being attenuated. This is expected to reduce both the volumes of storm water runoff leaving the sites as well as the associated peak flow rates.

TABLE 8-1 : AVERAGE MONTHLY RAINFALL AND EVAPORATION

	AVERAGE MONTHLY RAINFALL AS % OF MAP	AVERAGE MONTHLY RAINFALL (MM)	MONTHLY EVAP AS % OF MAE	EVAP (A PAN)	EVAP ADJUSTMENT FACTOR	EVAP (ADJUSTED) (MM)	SURPLUS / (DEFICIT) (MM)
OCTOBER	9.46	74.0	10.78	239.1	0.81	193.7	-120
NOVEMBER	16.86	131.8	10.17	225.6	0.82	185.0	-53
DECEMBER	16.57	129.6	11.20	248.4	0.83	206.2	-77
JANUARY	17.73	138.6	11.00	244.0	0.84	204.9	-66
FEBRUARY	13.49	105.5	9.17	203.4	0.88	179.0	-73
MARCH	10.69	83.6	9.05	200.7	0.88	176.6	-93
APRIL	6.53	51.1	6.96	154.4	0.88	135.8	-85
MAY	2.33	18.2	5.86	130.0	0.87	113.1	-95
JUNE	1.06	8.3	4.76	105.6	0.85	89.7	-81
JULY	0.81	6.3	5.21	115.6	0.83	95.9	-90
AUGUST	0.95	7.4	6.90	153.0	0.81	124.0	-117
SEPTEMBER	3.52	27.5	8.94	198.3	0.81	160.6	-133
TOTAL	**100**	**782**	**100**	**2218**		**1865**	**-1,083**

SOURCE : Catchment B41A & Evaporation Zone 4A: WRC: Surface Water Resources of SA 1990 (WRC Report 298/1.1/94)

Evap Adjustment Factors for False Bushveld: Appendix 3.3: Pan and crop factors (WRC Report)

TABLE 8-2 : RAINFALL DEPTH AS A FUNCTION OF RECURRENCE INTERVAL AND EVENT DURATION

EVENT DURATION (DAYS)	RECURRENCE INTERVAL (YRS)						
	2	5	10	20	50	100	200
	P[OCCURRENCE] BASED ON PLANNED OPERATIONAL LIFE OF 16 YRS						
	100%	97%	81%	56%	28%	15%	8%
1	48.1	63.8	75.2	86.8	103.1	116.7	131.1
2	61.0	79.4	91.9	104.6	121.5	134.6	148.9
3	70.3	91.0	104.7	117.9	135.3	148.8	161.3
7	82.8	106.7	122.4	138.0	158.1	173.4	188.8

TABLE 8-3 : STORM WATER RUNOFF VOLUME AS A FUNCTION OF RECURRENCE INTERVAL AND EVENT DURATION

EVENT DURATION (DAYS)	RECURRENCE INTERVAL (YRS)						
	2	5	10	20	50	100	200
	P[OCCURRENCE] BASED ON PLANNED OPERATIONAL LIFE OF 16 YRS						
	100%	97%	81%	56%	28%	15%	8%
1	13 706	19 392	24 285	29 680	37 212	44 338	50 022
2	17 382	24 133	29678	35 767	43 853	51 138	56 814
3	20 032	27 659	33 812	40 314	48 834	56 533	61 545
7	23 594	32 431	39 528	47 187	57 063	65 880	72 038

9. HAZARD CLASSIFICATION OF DISCARD DISPOSAL FACILITY

The classification of the discard disposal facility in terms of the requirements of the SABS Code of Practice for Mine Residue Deposits (SABS 0286:1998) is documented below.

9.1. SAFETY CLASSIFICATION

The safety classification of the facility has been carried out in accordance with the requirements of SABS 0286:1998: Code of Practice for Mine Residue. The safety classification system serves to provide a consistent means of differentiating between high, medium and low hazard deposits on the basis of their potential to cause harm to life or property. The classification system furthermore provides a basis for the implementation of safety management practices for specified stages of the life cycle of mine residue disposal facilities. The code prescribes the aims, principles and minimum requirements that apply to the classification procedure and the classification in turn gives rise to minimum requirements for investigation, design, construction, operation and decommissioning.

The approximate area that may be affected by a flow slide originating from a residue deposit is usually determined based on the guideline values from the Code of Practice and the topography of the area. Based on the nature of the discards however it is not expected that the facility would ever be subject to a flow slide and the associated release of discards. It is not expected therefore that the zone of influence would extend beyond the perimeter road of the facility.

Based on the zone of influence as defined and the criteria specified in the code, the discard disposal facility has been classified as a low hazard facility as shown in Table 9-1 below.

TABLE 9-1: BELFAST DISCARD DISPOSAL FACILITY - SAFETY CLASSIFICATION.

1	2	3	4	5
NO. OF RESIDENTS IN ZONE OF INFLUENCE	NO. OF WORKERS IN ZONE OF INFLUENCE [1]	VALUE OF 3RD PARTY PROPERTY IN ZONE OF INFLUENCE [2]	DEPTH TO UNDERGROUND MINE WORKINGS [3]	CLASSIFICATION
0	< 10	0 – R 2 m	> 200 m	Low Hazard
1 – 10	11 – 100	R2 m – R 20 m	50 m – 200 m	Medium Hazard
> 10	> 100	> R20 m	< 50 m	High Hazard

1. Not including workers employed solely for the purpose of operating the deposit
2. The value of third party property should be in the replacement value in 1996 terms.
3. The potential for collapse of the residue deposit into the underground workings effectively extends the zone of influence to below ground level.

Source : SABS 0286:1998, Table 2 – Safety Classification Criteria

9.2. ENVIRONMENTAL CLASSIFICATION

The environmental impacts associated with the development, operation and closure of mine residue disposal facilities relates to:

- Their potential to contaminate surface water resources due to uncontrolled runoff of water from their side slopes or releases of water from their return water systems
- Their potential to contaminate groundwater due to seepage
- Their potential to cause contamination of soils
- The change in land use associated with the development of the facility
- Their potential to generate dust
- Their aesthetic impact on their surroundings

These risks are discussed below, with specific reference to the potential impacts associated with the development and operation of the Belfast Discard Disposal facility and the mitigation measures required to ameliorate those risks. The assessment for each environmental risk issue covers the life cycle of the facility as well as the construction and operational phases which are seen as being part of the preparation for the closure and aftercare phase.

9.2.1. SURFACE WATER

The discard facility is located near a watershed to the south west and can therefore be isolated from the upstream surface water environment. Surface water runoff from the surface of the facility will be intercepted to prevent it reporting to the wetland to the east of the site. This is easily achieved by means of a solution trench which will enable the collection and recycling of runoff back to the plant as make-up water. The main surface water impact associated with the facility is expected to be due to the potential disturbance of the perched aquifer beneath the site and the catchment reporting to the wetland. This is likely to reduce the inflows to the wetland and may ultimately affect the water quality in the wetland.

The impacts on the surface water environment are expected to be of moderate severity, limited to the wetland area immediately down slope of the facility and of long term short duration.

9.2.2. GROUND WATER

The infiltration of contaminated water to groundwater is expected to be limited by the compaction of discards as well as the dump footprint and the installation of and HDPE liner and subsoil drains to the footprint of the facility. The potential for the discard dump to impact on the local ground water environment is considered to be limited but is being assessed in detail as part of an ongoing hydrogeological investigation.

9.2.3. LAND USE

The development of the discard dump will result in a change in the land use of the immediate area upon which it is established. It is possible, given the nature of the site, that post closure the facility could be rehabilitated in such a way as to derive economic benefit from the land without risk of damage to the chemical, social or ecological sustainability.

9.2.4. AESTHETIC IMPACTS

The facility will have an impact on the aesthetics of the area for as long as it is in existence. Given the limited height (<35m) and irregular shape of the facility it is considered possible that the facility could be rehabilitated in such a way as to blend into the surrounding post closure landscape. This should limit the impact of the facility on the aesthetics of the surrounding area.

9.2.5. ATMOSPHERIC POLLUTION

The facility will, as with all discard disposal sites, have the potential to generate windblown dust. The compaction and ongoing rehabilitation of the facility is however likely to mitigate the effects of wind on the facility.

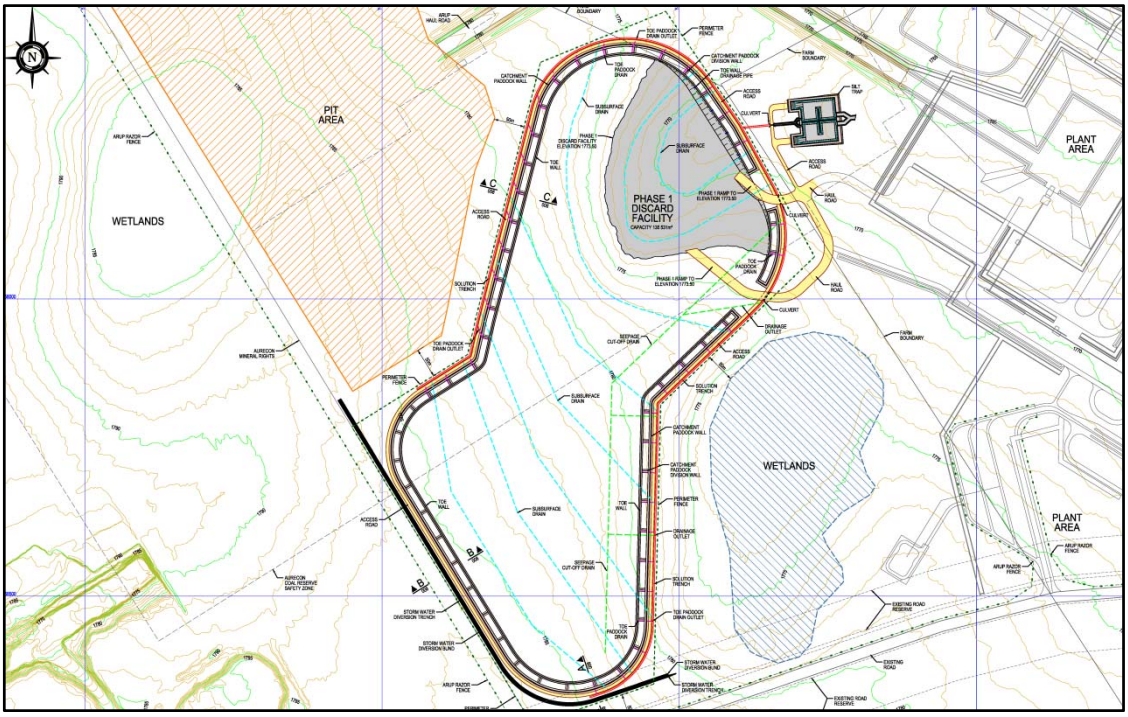
9.2.6. GENERAL

Based on the assessment as outlined above it is concluded that the facility will have the potential to impact on the surrounding environment and care has been taken to minimise those impacts, particularly on the surface and ground water environments.

10. DESCRIPTION OF CAPITAL WORKS FOR ESTABLISHMENT OF MRDF

A summary description of the various components of the capital works required for the establishment of the discard disposal facility is presented below. The works are described also in the schedules of costs (Appendix C) and drawings (Appendix D) included to this report. A site layout showing the proposed preparatory works is shown in Figure 10-1.

FIGURE 10-1: BELFAST DISCARD DISPOSAL FACILITY SHOWING PREPARATORY WORKS



10.1. SITE CLEARANCE AND TOPSOIL STRIPPING

The site will be cleared of vegetation and topsoil will be stripped to an estimated average depth of 300mm and stockpiled within 2km of the site for use in rehabilitation. Some of the site clearance and topsoil stripping costs can potentially be deferred to occur immediately ahead of the advancing discards. The site clearance and topsoil stripping is expected to take place in four phases as the footprint of the facility expands.

A summary of the expected quantities of available topsoil and the areas from which it will be stripped is presented in Table 10-1 together with a summary of the areas to be rehabilitated. This shows a total of 137 432m^3 of available topsoil if the entire area is stripped and a total topsoil requirement of 107 449m^3 for the placement of a 0.3m layer of topsoil to the side slopes, benches and crest of the discard dump. There is therefore a surplus of 29 984m^3 of topsoil available for placement of a slightly thicker layer to the discard dump or for use in other miscellaneous rehabilitation works on the site.

10.2. PREPARATION OF THE DISCARD DISPOSAL FACILITY FOOTPRINT

The preparation of the discard disposal facility is expected to comprise the phased preparation of the footprint for the deposition of discards by ripping and re-compacting the in-situ soils remaining after stripping of the topsoil to a depth of at least 300mm. The preparation of the footprint will include also the construction of a nominal toe wall to the perimeter of the area on which discards are to be placed to ensure that such deposition does not encroach on the areas designated for the development of the toe paddocks.

TABLE 10-1: SUMMARY TOPSOIL BALANCE

DESCRIPTION OF AREA STRIPPED	AREA (M^2)	DEPTH OF TOPSOIL (M)	TOPSOIL VOLUME (M^3)
Phase 1 Discard Dump Footprint	68 416	0.3	20 525
Phase 2 Discard Dump Footprint	78 971	0.3	23 691
Phase 3 Discard Dump Footprint	132 231	0.3	39 669
Phase 4 Discard Dump Footprint	62 367	0.3	18 710
Discard Dump Toe Wall	11 960	0.3	3 588
Toe Paddocks	58 164	0.3	17 449
Access Road	14 925	0.3	4 478
Solution Trench	15 300	0.3	4 590
Silt Trap	6 654	0.3	1 996
Haul Road	4 020	0.3	1 206
Stormwater Diversion Trench	2 550	0.3	765
Stormwater Diversion Bund Wall	2 550	0.3	765
TOTAL	**458 108**		**137 432**
DESCRIPTION OF REHABILITATION AREA	**AREA (M^2)**	**DEPTH OF TOPSOIL (M)**	**TOPSOIL VOLUME (M^3)**
Discard Dump Slope 1	36 501	0.3	10 950
Discard Dump Bench 1	25 273	0.3	7 582
Discard Dump Slope 2	110 016	0.3	33 005
Discard Dump Bench 2	32 853	0.3	9 8569
Discard Dump Slope 3	33 140	0.3	9 942
Discard Dump Bench 3	120 380	0.3	36 114
TOTAL	**358 163**		**107 449**

10.3. LINER AND UNDERDRAINAGE SYSTEM

A 1.5mm HDPE liner will be installed to the footprint of the discard dump in phases as the development of the facility proceeds. The liner would be placed on top of a protective layer of geofabric placed onto the prepared footprint of the facility. The liner would then be covered with another layer of protective geotextile and a 200mm layer of selected sand to protect against damage during placement and compaction of the first layer of discards. Discards will be placed and compacted in 300 to 500mm layers from the edge of the lined area and working inwards so as to minimise the chances of damaging the liner.

A series of under drains will be installed to the footprint of the discard disposal facility. These drains will comprise shallow trenches into which slotted drainage pipes and filter stone are placed to form the drains. The drains will be wrapped in geofabric and will discharge to the solution trench surrounding the facility. The drain outlets will be equipped with 45º bends to ensure that ingress of air into the pipe, and to the foundation of the discards, is prevented by the presence of drainage water. At closure the pipe outlets m sealed and fitted with end caps to prevent the ingress of oxygen to the drains.

10.4. LEAKAGE DETECTION SYSTEM

A series of leakage detection drains has been allowed for to assist in monitoring the performance of the liner. The drains will be located so as to intercept potential seepage flows and will comprise slotted drainage pipes within a crushed drain stone and surrounding geofabric. The leakage detection pipes will discharge to the solution trench and will be clearly marked so as to distinguish them from the seepage underdrainage collection pipes.

10.5. SURFACE WATER CONTAINMENT SYSTEM

The system proposed for the containment of surface water runoff from the discard disposal facility will comprise:

- A series of toe paddocks and toe paddock cross walls intended to collect runoff from the side slopes of the discard facility. These paddocks will serve also as a means to settle and collect eroded discards and soils
- A series of sub-surface drains located at the low side of each paddock intended to allow water collected in the paddock to drain into the solution trench, leaving behind the settled solids to be cleaned out as and when required
- A concrete lined solution trench into which seepage water from the under drainage system and water draining from the toe paddocks will report. The solution trench will carry all such water to the silt trap / storm water attenuation dam located at to the north west of the discard disposal facility. The solution trench has been sized to facilitate access by small earthmoving equipment to facilitate cleaning of accumulated silt as required.

In addition to the collection of potentially contaminated water from the facility the system described above is intended to facilitate the control of material eroded from the dump and will also have the effect of retarding the flow of runoff from the facility, thereby reducing the peak flow and storm water containment requirements.

10.6. SURFACE WATER DIVERSION WORKS

A surface water diversion will be constructed to the western perimeter of the discard disposal facility to divert water from the small upstream catchment into the wetland area. The diversion will comprise a shallow earth lined trench and berm which will be vegetated and blended into the topography to become a permanent feature of the post closure landscape.

Gabion baskets will be installed at 1m vertical intervals along the diversion trench to assist in the prevention and control of erosion, especially until the vegetation within the channel is established. Provision has been made for the trench and diversion berm to be top soiled and vegetated during the construction phase of the project:

10.7. PERIMETER ACCESS ROAD AND HAUL ROAD

An access road will be constructed to the perimeter of the discard disposal facility to facilitate access to the site for operational, maintenance and security personnel. The road is aligned to fit outside of the toe paddocks but inside of the solution trench. This is intended to ensure that the road is inside of the surface water containment system and to enable cleaning of the toe paddocks as and when required: The road is expected to comprise:

- The excavation of unsuitable material to an estimated depth of 0.15m after removal of topsoil
- The construction of the road surfaces using a 0.30m layer of selected rock fill sourced from the open pit and compacted to form a road approximately 0.15m above the surrounding ground level

10.8. Silt Trap and Storm water Control Dam

Potentially contaminated surface water runoff and seepage flows will report, via the concrete lined solution trench, to a silt trap and storm water control dam. The facility is not intended to store all runoff from the discard disposal facility but is intended to allow for the settlement of solids remaining in the water flows and to attenuate the flow of runoff to the main site storm water control dam located east of the plant area. Features of the proposed facility include:

- Mesh reinforced concrete lining and access ramps to facilitate cleaning as required
- Two chambers which can be isolated from one another to enable drying of accumulated silt while still allowing flow through the system
- Spillways from each chamber of the facility discharging into a channel that will link into the plant storm water control system
- Internal walls to prevent short circuiting of flows and enhance the effectiveness of the facility as a silt trap

10.9. Culvert Crossings

Provision has been made for the installation of two culvert crossings to the solution trench for the haul road and one for the perimeter access road to the silt traps. The proposed culvert crossings will comprise 2 x 450 ND Class 100D reinforced concrete spigot and socket pipes bedded in a selected granular fill over which the access roadways will be constructed. The culverts will feature also mesh reinforced concrete headwalls and wing walls

10.10. Access Control and Safety

The estimate of costs associated with the development of the facility include provisions for the following measures to assist in the control of access to the site and to ensure the safety of all those that may inadvertently enter the area include:

- The installation of a 6 strand barbed wire fence to the perimeter of the site
- Warning signage at 100m centres to the perimeter of the site

10.11. Rehabilitation of Disturbed Areas

Areas surrounding the discard disposal facility disturbed during the construction process will be rehabilitated as part of the site dis-establishment by the earthworks and civils contractor. The faces of the toe walls and cross walls, surface water diversion trench and berm, and silt trap walls will be covered with a layer of topsoil and seeded with a mixture of indigenous grass seeds.

10.12. Construction and Rehabilitation Materials Balance

A summary of the construction materials balance for the works as described above has been compiled and is summarised in Table 10-2. The summary shows a deficit of 18 550m^3 of material that would have to be sourced from elsewhere on the mine to enable the completion of the works.

The analysis of topsoil stripped and required as previously shows a small surplus of topsoil stripped over what is required for rehabilitation purposes (29 984m^3). An additional 430 000m^3 of subsoil will be required to be sourced to make up the total cover thickness of 1.5m over the surface area of the discard dump (358 163m^2) to be rehabilitated. It is expected that when suitable materials are encountered in the development of the open pit or other areas of the mine they will be stockpiled adjacent to the discard dump for later use in the rehabilitation process.

TABLE 10-2: SUMMARY CONSTRUCTION MATERIAL BALANCE

DESCRIPTION OF EXCAVATION / WORK SCOPE ITEM	UNITS	MATERIAL EXCAVATED (M^3)	CONSTRUCTION MATERIAL (M^3)	SURPLUS / DEFICIT (M^3)
Discard Dump Toe Wall	m^3	0	6 651	-6 651
Solution Trench	m^3	8 890	0	8 890
Toe Paddock Walls	m^3	0	11 000	-11 000
Toe Paddock Cross Walls	m^3	0	1 243	-1 243
Stormwater Diversion Trench	m^3	850	0	850
Stormwater Diversion Bund Wall	m^3	0	850	-850
Access Road Box Cut	m^3	2 239	0	2 239
Houal Road Box Cut	m^3	2 010	0	2 010
Silt Trap	m^3	1 845	240	1 605
Phase 1 Liner Embankment Roadway	m^3	0	5 600	-5 600
Phase 2 Liner Embankment Roadway	m^3	0	4 000	-4 000
Phase 3 Liner Embankment Roadway	m^3	0	4 800	-4 800
TOTAL	**M^3**	**15 834**	**34 384**	**-18 550**

11. LIFE OF MINE COSTS

An estimate of the life of mine costs associated with the development, operation and rehabilitation and closure of the discard disposal facility has been compiled and is presented in Appendix C. These costs are summarised and discussed briefly below.

11.1. CAPITAL COSTS

The estimated capital costs associated with the phased construction of the discard disposal facility as described above have been compiled based on a schedule of quantities describing the works and prices of recent works of a similar nature. The estimated total capital cost associated with the construction of the facility is R105.330m as summarised in Table 11-1. The costs are inclusive of allowances for:

- A contingency of 10% of the value of the measured works
- Contractors preliminary and general costs at 30% of the value of measured works and contingencies

While it is possible to defer some of the capital expenditure the first three phases of the development are expected to be required within the first 2 years of the operation of the facility. The costs associated with establishing contractors on site will therefore probably dictate that the initial construction of the works includes Phases 1 to 3.

TABLE 11-1: SUMMARY ESTIMATE OF CAPITAL COSTS (R'M)

DESCRIPTION OF CAPITAL WORKS	PHASE 1 (Y0)	PHASE 2 (Y1)	PHASE 3 (Y2)	PHASE 4 (Y7)	TOTAL
Site Clearance and Topsoil Stripping	1.938	0.829	1.388	0.655	**4.810**
Preparation of Discard Disposal Facility	1.097	0.829	1.388	0.655	**3.970**
Under Drainage System	0.153	0.239	0.348	0.210	**0.951**
Surface Water Containment Works	8.095	0.000	0.000	0.000	**8.095**
Surface Water Diversion Works	0.149	0.000	0.000	0.000	**0.149**
Perimeter Access Road and Haul Road	0.412	0.000	0.000	0.000	**0.412**
Silt Trap	2.204	0.000	0.000	0.000	**2.204**
Culvert Crossings	0.317	0.000	0.000	0.000	**0.317**
Miscellaneous	0.257	0.000	0.000	0.000	**0.257**
Liner	11.296	12.598	20.754	9.423	**54.071**
SUB-TOTAL : MEASURED WORKS	**25.918**	**14.496**	**23.879**	**10.942**	**75.235**
Contingency @10%	2.592	1.450	2.388	1.094	**7.524**
Contractors P&G Costs @30%	7.775	4.349	7.164	3.283	**22.571**
TOTAL	**36.285**	**20.294**	**33.431**	**15.319**	**105.330**

11.2. OPERATING COSTS

Operating costs for the discard disposal facility have been estimated on prices associated with recent works of a similar nature and comprise:

- An estimated cost for the site establishment of s specialist discard dump operating contractor of R1.0m. This cost would include for:
  - The establishment of the necessary discard hauls trucks and compaction equipment on site
  - The establishment of office and workshop facilities

- Costs associated with site inductions and medicals.

- An estimated cost for the maintenance of the site establishment at R0.62m per month. This cost would include for all the fixed costs associated with the loading, hauling, placement and compaction of the discards to form the discard disposal facility, including:
  - Salaries and accommodation for management and machine operators
  - The fixed costs associated with all the equipment required for the operation of the facility
  - The fixed costs associated with the on-site workshop facilities
  - Insurance
- An estimate of the variable costs (R6.36/ton of discards) associated with the loading, hauling, placement and compaction of the discards to form the discard disposal facility, including:
  - Fuel and lubricants
  - Machine maintenance

11.3. REHABILITATION AND CLOSURE

The estimated cost of rehabilitation and closure of the discard disposal facility has been estimated for each phase of the operation on the assumption the process would include:

- The placement of a 1m layer of soil to the facility to serve as a cap and moisture retention cover at a rate of R32/m^3 of material placed
- The placement of a 0.3m layer of topsoil to the sides, benches and crest of the facility at a rate of R32/m^3 of topsoil placed
- The establishment of vegetation to the surface of the discard disposal facility at a rate of R5/m^2 of established vegetation

Based on the assumptions outlined above and the proposed geometry of the discard disposal facility it is estimated that the total costs of rehabilitating the discard disposal facility would be R24 278m split between the side slopes of the dump which would be rehabilitated during the operational life (R11.972m) and the crest of the facility (12.306m). The estimated costs equate to approximately R600k per hectare of the facility, inclusive of allowances for:

- A contingency of 10% of the value of the measured works
- Contractors preliminary and general costs at 30% of the value of measured works and contingencies

11.4. ENGINEERING AND MANAGEMENT

The estimated life of mine costs for the facility include estimates of the costs of engineering design and management of the facility. Allowances have been made for:

- Design and construction supervision of capital and rehabilitation and closure works at 5% of the estimated value of the works
- Quarterly inspections and review of the operation of the discard disposal facility and rehabilitation and closure works at R50k per quarter (200k annually)
- Annual inspections and review of the operation of the discard disposal facility and rehabilitation and closure works at R50k per annum (50k annually)

12. CONCLUSIONS

Based on the review of available information and the design of the discard disposal facility as described it is concluded that:

- The proposed facility has sufficient storage capacity to accommodate the anticipated life of mine discard disposal requirements
- Based on the information provided and previous experience on similar problems it is expected that the primary concern associated with the establishment of the facility would be the prevention of spontaneous combustion. While the material is expected to have the capacity to generate AMD it is expected that this can be prevented by the compaction of the discards and it's capping with a layer of selected soil cover to prevent the ingress of oxygen
- As an added precaution against the possibility of contaminated seepage from the discard dump allowance has been made for the installation of a 1.5mm HDPE liner and seepage collection system to the footprint of the facility. The liner will be protected against damage in the placement of the first layers of discard by a geofabric and a layer of selected sand
- Based on inspection of the site and the available geotechnical information it is not expected that there are any geotechnical issues that would adversely impact the development of the facility on the proposed site
- Given the potential for spontaneous combustion of the coarse discard it is recommended that the discard be deposited in layers not thicker than 300 - 500mm depending on the type of compaction equipment utilized so as to reduce the volume of air voids to the recommended 20%
- The potential for the facility to impact on the groundwater environment is being assessed as part of ongoing work being carried out on the geochemical characterisation of the discard and also the geohydrological modelling of the project site. The groundwater protection measures incorporated in the design will be re-evaluated and amended if necessary based on the outcome of these investigations
- Seepage and surface runoff water emanating from the site is expected to show signs of contamination and provisions have been incorporated into the design of the facility to ensure that all surface water runoff from the facility is retained and channelled to the plant storm water control dam from where is can be used in the coal washing plant.

13. RECOMMENDATIONS

Based on the feasibility design as described above it is recommended that finalisation of the design of the discard disposal facility include:

- Confirmation of the physical and geochemical characteristics of the discards as soon as representative samples becomes available with specific reference to the potential for AMD generation and leachability of contaminants
- Review of the design of the facility based on the outcome of the specialist investigations being carried out in support of the environmental permitting and water use licensing processes. Specific attention should be paid to the potential for contamination of ground water
- Confirmation of the geotechnical properties of the foundation and discard materials based on laboratory testing of representative samples of discards and soils collected from test pits on the proposed site of the facility

- Confirmation that the financial provisions for the development, operation and closure of the discard disposal facility include appropriate allowances for.
  - The capital works required for the development of the facility
  - The operation of the facility
  - The ongoing and final rehabilitation and closure of the facility.
  - Monitoring of the quality of surface water both within the discard disposal facility and in the diversion works to ensure that any contamination of surface water is detected and addressed
  - Monitoring of the extent and quality of ground water seepage emanating from the discard disposal facility and its abstraction, if necessary, by means of dewatering boreholes.

Report Author	Project Manager	Reviewer
GJ Wiid Pr.Eng	GJ Wiid Pr.Eng	AC Savvas

APPENDIX A : STAGE CAPACITY CALCULATIONS

BELFAST COAL PROJECT
FEASIBILITY DESIGN OF DISCARD DUMP

SUMMARY STAGE CAPACITY CALCULATIONS

Bench	Phase	Elevation (m.a.m.s.l.)	Incremental Fill Volume (m^3) Excluding Ramp Cut Volumes	Ramp Cut Volumes (m^3)		Remaining Incremental DD Fill Volume (m^3)	Remaining Cumulative DD Capacity (m^3)
1 - NGL to 1783.50	1	1768.50	0.00	0.00	0.00	0.00	0.00
		1769.50	4 599.33	4.05	0.00	4 595.28	4 595.28
		1770.50	15 281.03	0.57	0.00	15 280.45	19 875.73
		1771.50	26 443.75	158.29	0.00	26 285.46	46 161.20
		1772.50	38 337.81	436.47	0.00	37 901.34	84 062.54
		1773.50	51 931.22	462.56	0.00	51 468.66	135 531.19
		Sub-total	**136 593.13**	**1 061.94**	0.00	**135 531.19**	
	2	1774.50	66 324.42	517.67		65 806.75	201 337.94
		1775.50	81 151.83	569.20	142.90	80 439.73	281 777.67
		1776.50	95 738.23	608.58	353.24	94 776.40	376 554.07
		1777.50	109 397.32	639.19	410.58	108 347.54	484 901.61
		1778.50	122 035.90	664.45	486.10	120 885.35	605 786.96
		Sub-total	**474 647.69**	**2 999.09**	**1 392.83**	**470 255.77**	
	3	1779.50	133 228.25	673.14	548.52	132 006.59	737 793.55
		1780.50	148 667.90	680.20	598.73	147 388.96	885 182.51
		1781.50	169 554.00	681.79	637.07	168 235.14	1 053 417.65
		1782.50	192 648.75	682.13	663.61	191 303.00	1 244 720.65
		1783.50	219 215.10	683.24	679.86	217 852.01	1 462 572.65
		Sub-total	**863 313.98**	**3 400.50**	**3 127.79**	**856 785.69**	
2 - 1783.50 to 1798.50	4	1784.50	228 854.68	399.89	391.34	228 063.45	1 690 636.11
		1785.50	261 116.69	483.05	455.91	260 177.73	1 950 813.84
		1786.50	272 441.23	560.68	513.71	271 366.84	2 222 180.68
		1787.50	265 596.18	616.66	557.97	264 421.55	2 486 602.23
		1788.50	258 264.71	672.14	600.44	256 992.14	2 743 594.37
		Sub-total	**1 286 273.50**	**2 732.42**	**2 519.36**	**1 281 021.71**	
	5	1789.50	250 879.07	698.20	631.71	249 549.16	2 993 143.52
		1790.50	243 683.03	735.61	655.77	242 291.65	3 235 435.18
		1791.50	236 543.16	759.92	673.33	235 109.92	3 470 545.10
		1792.50	229 459.47	773.60	680.75	228 005.12	3 698 550.21
		1793.50	222 431.95	784.54	693.51	220 953.91	3 919 504.13
		Sub-total	**1 182 996.67**	**3 751.85**	**3 335.06**	**1 175 909.76**	
	6	1794.50	215 345.02	770.54	682.88	213 891.61	4 133 395.74
		1795.50	208 430.78	760.43	676.18	206 994.17	4 340 389.91
		1796.50	201 572.71	744.75	682.36	200 145.59	4 540 535.50
		1797.50	194 770.81	733.51	682.67	193 354.64	4 733 890.14
		1798.50	188 025.10	735.47	684.30	186 605.33	4 920 495.47
		Sub-total	**1 008 144.42**	**3 744.69**	**3 408.38**	**1 000 991.34**	
3 - 1798.50 to 1803.50	7	1799.50	148 614.19	391.55	402.00	147 820.64	5 068 316.11
		1800.50	142 241.51	456.60	464.11	141 320.80	5 209 636.91
		1801.50	135 925.40	511.00	517.93	134 896.46	5 344 533.37
		1802.50	129 665.84	559.75	564.21	128 541.89	5 473 075.26
		1803.50	123 462.86	599.91	602.91	122 260.04	5 595 335.29
		Sub-total	**679 909.80**	**2 518.82**	**2 551.16**	**674 839.82**	
		TOTAL	**5 631 879.19**	**20 209.32**	**16 334.58**	**5 595 335.29**	**5 595 335.29**

APPENDIX B : SURFACE WATER MANAGEMENT CALCULATIONS

BELFAST COAL PROJECT

FEASIBILITY DESIGN OF DISCARD DUMP

SIZING OF SURFACE WATER CONTAINMENT WORKS

1 INPUT DATA

1.1 Planned Life of Mine 16 years

1.2 Discard Dump Catchment (m^2)

Crest	Benches	Slopes	Toe Padddocks	Soln Trench - Toe Wall	TOTAL
120 380	58 126	169 035	58 164	18 248	**423 953**

1.3 Rainfall Depth (mm) as a Function of Event Duration and Recurrence Interval

EVENT DURATION (days)	RECURRENCE INTERVAL (yrs)						
	2	5	10	20	50	100	200
	P[Occurrence] BASED ON PLANNED LIFE OF FACILITY						
	100%	97%	81%	56%	28%	15%	8%
1	48.1	63.8	75.2	86.8	103.1	116.7	131.1
2	61.0	79.4	91.9	104.6	121.5	134.6	148.9
3	70.3	91.0	104.7	117.9	135.3	148.8	161.3
7	82.8	106.7	122.4	138.0	158.1	173.4	188.8

Station :	Belfast - POS	0517072_W		**MAP**	782	**Lat**	25 41
Record (yrs) :	94			**MAE**	2218	**Long**	30 02

1.4 Monthly Rainfall and Evaporation

	Average Monthly as	Average Monthly	Monthly Evap	Evap (A Pan)	Evap Adjustment	Evap (Adjusted)	Surplus / (Deficit)
	% of MAP	mm	% of MAE	mm	Factor	mm	mm
October	9.46	74.0	10.78	239.1	0.81	193.7	-120
November	16.86	131.8	10.17	225.6	0.82	185.0	-53
December	16.57	129.6	11.20	248.4	0.83	206.2	-77
January	17.73	138.6	11.00	244.0	0.84	204.9	-66
February	13.49	105.5	9.17	203.4	0.88	179.0	-73
March	10.69	83.6	9.05	200.7	0.88	176.6	-93
April	6.53	51.1	6.96	154.4	0.88	135.8	-85
May	2.33	18.2	5.86	130.0	0.87	113.1	-95
June	1.06	8.3	4.76	105.6	0.85	89.7	-81
July	0.81	6.3	5.21	115.6	0.83	95.9	-90
August	0.95	7.4	6.90	153.0	0.81	124.0	-117
September	3.52	27.5	8.94	198.3	0.81	160.6	-133
TOTAL	**100**	**782**	**100**	**2218**		**1865**	**-1 083**

Source : Catchment B41A & Evaporation Zone 4A: WRC: Surface Water Resources of SA 1990 (WRC Report 298/1.1/94)

Evap Adjustment Factors for False Bushveld: Appendix 3.3: Pan and crop factors (WRC Report)

1.5 Calculation of Adjusted Surface Water Runoff Coefficient

Component		Slope Category	C Value	Catchment Breakdown		C_{ave}	Comment
C_y	Steepness (%)	<1	0	0%			
		1 - 3	0.1	10%			Area outside toe
		3 - 10	0.18	45%	100%	0.22	Top and Benches
		10 - 30	0.28	45%			Slopes
		30 - 50	0.4	0%			
		>50	0.45	0%			
C_p	Permeability of Soil	Very Permeable	0.08	0%			
		Permeable	0.15	50%	100%	0.23	
		Semi - Permeable	0.3	50%			
		Impermeable	0.44	0%			
C_v	Vegetation	Forest Plantation	0.08	0%			
		Dense Bush & Wood	0.08	0%			
		Thin Bush	0.28	0%	100%	0.37	
		Cultivated Land	0.28	0%			
		Grassland	0.34	50%			
		Bare Surface	0.4	50%			
				Weighted Average C		**0.812**	

1.6 Adjusted Runoff Coefficient as a Function of Storm Recurrence Interval

	2	5	10	20	50	100
Weighted Average Runoff Coefficient C	0.812	0.812	0.812	0.812	0.812	0.812
(Ft) (Steep and impermeable catchments)	0.75	0.80	0.85	0.90	0.95	1.00
(Ft) Flat and permeable catchments	0.50	0.55	0.60	0.67	0.83	1.00
Area Reduction Factor	1.104	1.104	1.104	1.104	1.104	1.104
Adjusted Runoff Coefficient	**0.672**	**0.717**	**0.762**	**0.807**	**0.851**	**0.896**

1.7 Area Reduction Factor **1.104**

Time of Concentration (T_c)	hrs	0.75
Catchment Area	km^2	0.424

2 FLOOD ROUTING CALCULATIONS

2.1 Rainfall Data (mm) as a Function of Event Duration and Recurrence Interval

Event Duration (days)	Recurrence Interval (years)						
	2	5	10	20	50	100	200
	P [Occurrence] Based on Planned Life of Facility						
	100%	97%	81%	56%	28%	15%	8%
	Runoff Coefficient as Function of Recurrence Interval						
	0.67	0.72	0.76	0.81	0.85	0.90	0.90
1	48	64	75	87	103	117	131
2	61	79	92	105	122	135	149
3	70	91	105	118	135	149	161
7	83	107	122	138	158	173	189
	Runoff Volumes (m3)						
1	13 706	19 392	24 285	29 680	37 212	44 338	50 022
2	17 382	24 133	29 678	35 767	43 853	51 138	56 814
3	20 032	27 659	33 812	40 314	48 834	56 533	61 545
7	23 594	32 431	39 528	47 187	57 063	65 880	72 038
	Estimated Peak Rainfall Intensity (mm/hr)						
1	4.01	5.32	6.27	7.23	8.59	9.73	10.93
2	2.54	3.31	3.83	4.36	5.06	5.61	6.20
3	1.95	2.53	2.91	3.28	3.76	4.13	4.48
7	0.99	1.27	1.46	1.64	1.88	2.06	2.25
	Estimated Peak Flow Rate (m^3/s)						
1	0.32	0.45	0.56	0.69	0.86	1.03	1.16
2	0.20	0.28	0.34	0.41	0.51	0.59	0.66
3	0.15	0.21	0.26	0.31	0.38	0.44	0.47
7	0.08	0.11	0.13	0.16	0.19	0.22	0.24

APPENDIX C : LIFE OF MINE ESTIMATE OF COSTS

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SUMMARY OF LIFE OF MINE EXPENDITURE

			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19
				DISCARD DEPOSITION RATE (KT PER ANNUM)																		
		0.0	0.0	334.9	485.5	458.3	456.6	499.2	475.6	477.8	466.3	426.3	412.1	474.1	475.3	422.9	518.0	546.2	564.5			
	BREAKDOWN OF EXPENDITURE	**TOTAL**																				
1	**Capital Expenditure**	**R 105.330**	**R 36.285**	**R 20.294**	**R 33.431**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 15.319**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**	**R 0.000**
1.1	Phase 1	R 36.285	R 36.285																			
1.2	Phase 2	R 20.294		R 20.294																		
1.3	Phase 3	R 33.431			R 33.431																	
1.4	Phase 4	R 15.319								R 15.319												
2	**Operating Expenditure**	**R 167.890**	**R 1.000**	**R 9.582**	**R 10.540**	**R 10.367**	**R 10.356**	**R 10.627**	**R 10.477**	**R 10.490**	**R 10.417**	**R 10.163**	**R 10.073**	**R 10.467**	**R 10.475**	**R 10.142**	**R 10.746**	**R 10.926**	**R 11.042**	**R 0.000**	**R 0.000**	**R 0.000**
2.1	Site Establishment	R 1.00	R 1.000																			
2.2	Fixed Cost (R/annum)	R 119.23		R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452	R 7.452			
2.3	Variable Cost (R/ton Discards)	R 47.66		R 2.130	R 3.088	R 2.915	R 2.904	R 3.175	R 3.025	R 3.038	R 2.965	R 2.711	R 2.621	R 3.015	R 3.023	R 2.690	R 3.294	R 3.474	R 3.590			
3	**Rehabilitation and Closure**	**R 25.063**	**R 0.000**	**R 0.257**	**R 0.051**	**R 0.645**	**R 0.129**	**R 1.399**	**R 0.280**	**R 0.000**	**R 0.000**	**R 2.225**	**R 0.445**	**R 0.000**	**R 0.000**	**R 2.398**	**R 0.480**	**R 0.000**	**R 2.315**	**R 12.109**	**R 2.329**	**R 0.000**
3.1	Rehabilitation of Phase 1 Slope	R 0.257		R 0.257																		
3.2	Rehabilitation of Phase 2 Slope	R 0.645				R 0.645																
3.3	Rehabilitation of Phase 3 Slope	R 1.399						R 1.399														
3.4	Rehabilitation of Phase 4 Slope	R 2.225										R 2.225										
3.5	Rehabilitation of Phase 5 Slope	R 2.398														R 2.398						
3.6	Rehabilitation of Phase 6 Slope	R 2.315																	R 2.315			
3.7	Rehabilitation of Phase 7 Slope	R 0.000																				
3.8	Rehabilitation of Discard Dump Crest	R 11.646																		R 11.646		
3.9	Aftercare and Maintenance	R 4.177		R 0.000	R 0.051	R 0.000	R 0.129	R 0.000	R 0.280	R 0.000	R 0.000	R 0.000	R 0.445	R 0.000	R 0.000	R 0.000	R 0.480	R 0.000	R 0.000	R 0.463	R 2	R 0
4	**Design and Engineering**	**R 9.565**	**R 3.678**	**R 0.263**	**R 0.253**	**R 0.282**	**R 0.256**	**R 0.320**	**R 0.264**	**R 0.250**	**R 0.250**	**R 0.361**	**R 0.272**	**R 0.250**	**R 0.250**	**R 0.370**	**R 0.274**	**R 0.250**	**R 0.366**	**R 0.855**	**R 0.250**	**R 0.250**
4.1	Detailed Design and Construction Supervision of Capital Works	R 3.428	R 3.428	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000	R 0.000
4.2	Quarterly Reviews of Operation	R 3.400	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200	R 0.200			
4.3	Annual Review of Operation	R 0.850	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050	R 0.050			
4.3	Detailed Design & Supervision of Closure Works	R 1.137	R 0.000	R 0.013	R 0.003	R 0.032	R 0.006	R 0.070	R 0.014	R 0.000	R 0.000	R 0.111	R 0.022	R 0.000	R 0.000	R 0.120	R 0.024	R 0.000	R 0.116	R 0.605		
4.3	Supervision of Rehabilitation and Closure	R 0.600																		R 0.200	R 0.200	R 0.200
4.3	Annual Review of Rehabilitation and Closure Works	R 0.150																		R 0.050	R 0.050	R 0.050
	TOTAL	**R 307.85**	**R 40.96**	**R 30.40**	**R 44.28**	**R 11.29**	**R 10.74**	**R 12.35**	**R 11.02**	**R 26.06**	**R 10.67**	**R 12.75**	**R 10.79**	**R 10.72**	**R 10.73**	**R 12.91**	**R 11.50**	**R 11.18**	**R 13.72**	**R 12.96**	**R 2.58**	**R 0.25**

NOTES TO ESTIMATE OF LIFE OF MINE COSTS

1 Capital costs based on stage construction as per schedule of quantities and are inclusive of allowances for:

Contractors Preliminary and General Costs at **30%** of the value of the measured works

Contingencies at **10%** of the value of the measured works and Contractors P&G Costs

2 Operating Costs are based on the assumption the facility will be operated by an appropriately qualified and experienced Contractor. Allowance has been made for:

Operating Contractors Site Establishment Costs of **R 1.00** m (Sum)

Monthly Fixed Cost of: **R 0.62** m (per month)

Load, Haul, Place Spread and Compact Discard as Specified to form Discard Dump **R 6.36** per ton

3 Provision for Detailed Design and Construction Supervision of Capital Works is made at **R 3.428** i.e. **3.25%** of the estimated value of the Capital Works

4 Provision for Detailed Design and Construction Supervision of Capital Works is made at **5.00%** of the estimated value of the Closure Works

5 Provision has been made for inspection of the construction and operation of the facility during the operational phase of the mine as follows:

Quarterly Inspection and Review of Operations at **R 0.050** m

Annual Inspection and Review of Operations at **R 0.050** m

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SUMMARY OF LIFE OF MINE EXPENDITURE

6 Closure Costs based on :

					SIDE SLOPES AND BENCHES OF DISCARD DISPOSAL FACILITY							CREST
				Phase	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**(at Phase)**
				Timing (Y)	**0.4**	**2.0**	**4.8**	**9.0**	**12.9**	**16.1**	**18.4**	**6**
Load, haul and place drainage layer to Side Slopes, Benches and Crest of Discard Facility	**0**	m @	**R 40.00**	/m3 =	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Load, haul and place moisture retention cover to Side Slopes, Benches and Crest of Discard Facility	**1.0**	m^3 @	**R 32.00**	/m3 =	R 130 656	R 327 328	R 710 048	R 1 129 088	R 1 216 640	R 1 174 784	R 1 060 480	R 5 909 536
Load, haul and place layer of topsoil to Side Slopes, Benches and Crest of Discard Facility	**0.3**	m^3 @	**R 32.00**	/m3 =	R 39 197	R 98 198	R 213 014	R 338 726	R 364 992	R 352 435	R 318 144	R 1 772 861
Vegetation establishment to Side Slopes, Benches and Crest of Discard Disposal Facility		m^2 @	**R 2.50**	/m2 =	R 10 208	R 25 573	R 55 473	R 88 210	R 95 050	R 91 780	R 82 850	R 461 683
				Sub-Total	R 180 060	R 451 099	R 978 535	R 1 556 024	R 1 676 682	R 1 618 999	R 1 461 474	R 8 144 079
			Contingency	**10%**	R 18 006	R 45 110	R 97 853	R 155 602	R 167 668	R 161 900	R 146 147	R 814 408
Aftercare and maintenance of civil works at **2%** of the value of the civil works			Contractors P&G Costs	**30%**	R 59 420	R 148 863	R 322 917	R 513 488	R 553 305	R 534 270	R 482 286	R 2 687 546
Aftercare and maintenance of vegetation at **20%** of the value of the vegetation establishment works				**TOTAL**	R 257 486	R 645 071	R 1 399 305	R 2 225 115	R 2 397 655	R 2 315 169	R 2 089 908	R 11 646 033

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SUMMARY

MEASURED WORKS				PHASE I	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7
SCHEDULE	A	SITE CLEARANCE AND TOPSOIL STRIPPING		R 1 937 660	R 829 196	R 1 388 426	R 654 854	R 0	R 0	R 0
SCHEDULE	B	PREPARATION OF DISCARD DISPOSAL FACILITY		R 1 097 475	R 829 196	R 1 388 426	R 654 854	R 0	R 0	R 0
SCHEDULE	C	UNDERDRAINAGE SYSTEM		R 153 244	R 239 247	R 348 245	R 209 791	R 0	R 0	R 0
SCHEDULE	D	SURFACE WATER CONTAINMENT WORKS		R 8 094 655	R 0	R 0	R 0	R 0	R 0	R 0
SCHEDULE	E	SURFACE WATER DIVERSION WORKS		R 149 177	R 0	R 0	R 0	R 0	R 0	R 0
SCHEDULE	F	PERIMETER ACCESS ROAD AND HAUL ROAD		R 412 054	R 0	R 0	R 0	R 0	R 0	R 0
SCHEDULE	G	SILT TRAP		R 2 203 701	R 0	R 0	R 0	R 0	R 0	R 0
SCHEDULE	H	CULVERT CROSSINGS		R 317 117	R 0	R 0	R 0	R 0	R 0	R 0
SCHEDULE	I	MISCELLANEOUS		R 257 045	R 0	R 0	R 0	R 0	R 0	R 0
SCHEDULE	J	LINER		R 11 295 889	R 12 598 085	R 20 754 252	R 9 422 902	R 0	R 0	R 0
				R 25 918 015	**R 14 495 723**	**R 23 879 348**	**R 10 942 399**	**R 0**	**R 0**	**R 0**
CONTINGENCIES MEASURED AS A PERCENTAGE OF VALUE OF MEASURED WORKS			10%	R 2 591 801.53	R 1 449 572	R 2 387 935	R 1 094 240	R 0	R 0	R 0
P&G's MEASURED AS A PERCENTAGE OF VALUE OF MEASURED WORKS			30%	R 7 775 404.58	R 4 348 717	R 7 163 804	R 3 282 720	R 0	R 0	R 0
TOTAL				**R 36 285 221**	**R 20 294 012**	**R 33 431 087**	**R 15 319 359**	**R 0**	**R 0**	**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE A SITE CLEARANCE AND TOPSOIL STRIPPING

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			SITE CLEARANCE																
A 1	1.1	**PA & SANS 1200 C**	*Clear and grub site, including removal of trees up to 1.0m girth (spoil to be spread neatly within 2.0 km as directed by Engineer)*																
A 1.1			Phase 1 Discard Dump Footprint	m^2	**R 1.50**	68 416	R 102 624												
A 1.2			Phase 2 Discard Dump Footprint	m^2	R 1.50			78 971	R 118 457										
A 1.3			Phase 3 Discard Dump Footprint	m^2	R 1.50					132 231	R 198 347								
A 1.4			Phase 4 Discard Dump Footprint	m^2	R 1.50							62 367	R 93 551						
A 1.5			Discard Dump Toe Wall	m^2	R 1.50	11 960	R 17 940												
A 1.6			Toe Paddocks	m^2	R 1.50	58 164	R 87 246												
A 1.7			Access Road	m^2	R 1.50	14 925	R 22 388												
A 1.8			Solution Trench	m^2	R 1.50	15 300	R 22 950												
A 1.9			Silt Trap	m^2	R 1.50	6 654	R 9 981												
A 1.10			Haul Road	m^2	R 1.50	4 020	R 6 030												
A 1.11			Stormwater Diversion Trench	m^2	R 1.50	2 550	R 3 825												
A 1.12			Stormwater Diversion Bund Wall	m^2	R 1.50	2 550	R 3 825												
A 2	1.2		*Remove top soil to an average depth of 300mm and stockpile within 2 km as directed by the Engineer*																
A 2.1			Phase 1 Discard Dump Footprint	m^3	**R 30.00**	20 525	R 615 744												
A 2.2			Phase 2 Discard Dump Footprint	m^3	R 30.00			23 691	R 710 739										
A 2.3			Phase 3 Discard Dump Footprint	m^3	R 30.00					39 669	R 1 190 079								
A 2.4			Phase 4 Discard Dump Footprint	m^3	R 30.00							18 710	R 561 303						
A 2.5			Discard Dump Toe Wall	m^3	R 30.00	3 588	R 107 640												
A 2.6			Toe Paddocks	m^3	R 30.00	17 449	R 523 476												
A 2.7			Access Road	m^3	R 30.00	4 478	R 134 325												
A 2.8			Solution Trench	m^3	R 30.00	4 590	R 137 700												
A 2.9			Silt Trap	m^3	R 30.00	1 996	R 59 886												
A 2.10			Haul Road	m^3	R 30.00	1 206	R 36 180												
A 2.11			Stormwater Diversion Trench	m^3	R 30.00	765	R 22 950												
A 2.12			Stormwater Diversion Bund Wall	m^3	R 30.00	765	R 22 950												
			SUB TOTAL CARRIED TO SUMMARY				**R 1 937 660**		**R 829 196**		**R 1 388 426**		**R 654 854**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE B PREPARATION OF DISCARD DISPOSAL FACILITY

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			EARTHWORKS																
B 1	2.10		*Base preparation of insitu material (Rip and compact 500mm deep or as specified by the Engineer) to:*																
B 1.1			Phase 1 Discard Dump Footprint	m^3	**R 21.00**	34 208	R 718 368												
B 1.2			Phase 2 Discard Dump Footprint	m^3	R 21.00			39 486	R 829 196										
B 1.3			Phase 3 Discard Dump Footprint	m^3	R 21.00					66 116	R 1 388 426								
B 1.4			Phase 4 Discard Dump Footprint	m^3	R 21.00							31 184	R 654 854						
B 1.5			Discard Dump Toe Wall	m^3	R 21.00														
			CONSTRUCTION AND BACKFILLING																
B 2	2.11		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
B 2.1			Discard Dump Toe Wall	m^3	**R 57.00**	6 651	R 379 107												
			SUB TOTAL CARRIED TO SUMMARY				**R 1 097 475**		**R 829 196**		**R 1 388 426**		**R 654 854**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE C UNDERDRAINAGE SYSTEM

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			EARTHWORKS																
C 1	2.3	**PA & SANS D & GA**	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
C 1.1			Phase 1 Liner Drain	m^3	**R 100.00**	103	R 10 275												
C 1.2			Phase 1 Leakage Detection Drain	m^3	R 100.00	103	R 10 275												
C 1.3			Phase 2 Liner Drain	m^3	R 100.00			162	R 16 163										
C 1.4			Phase 2 Leakage Detection Drain	m^3	R 100.00			162	R 16 163										
C 1.5			Phase 3 Liner Drain	m^3	R 100.00					238	R 23 763								
C 1.6			Phase 3 Leakage Detection Drain	m^3	R 100.00					238	R 23 763								
C 1.7			Phase 4 Liner Drain	m^3	R 100.00							143	R 14 325						
C 1.8			Phase 4 Leakage Detection Drain	m^3	R 100.00							143	R 14 325						
C 2	2.8		*Base preparation of insitu material in trench (compact insitu material with Wacker or similar approved) to:*																
C 2.1			Phase 1 Liner Drain	m^2	**R 3.50**	206	R 719												
C 2.2			Phase 1 Leakage Detection Drain	m^2	R 3.50	206	R 719												
C 2.3			Phase 2 Liner Drain	m^2	R 3.50			323	R 1 131										
C 2.4			Phase 2 Leakage Detection Drain	m^2	R 3.50			323	R 1 131										
C 2.5			Phase 3 Liner Drain	m^2	R 3.50					475	R 1 663								
C 2.6			Phase 3 Leakage Detection Drain	m^2	R 3.50					475	R 1 663								
C 2.7			Phase 4 Liner Drain	m^2	R 3.50							287	R 1 003						
C 2.8			Phase 4 Leakage Detection Drain	m^2	R 3.50							287	R 1 003						
			DRAINAGE																
C 3	3.1	**PA & SANS DK**	*Supply and install Bidim A4 geofabric, or similair approved geotextile to: (Rate to include for cutting, strapping, wastage and stitching)*																
C 3.1			Phase 1 Liner Drain	m^2	**R 9.00**	988	R 8 888												
C 3.2			Phase 1 Leakage Detection Drain	m^2	R 9.00	988	R 8 888												
C 3.3			Phase 2 Liner Drain	m^2	R 9.00			1 548	R 13 928										
C 3.4			Phase 2 Leakage Detection Drain	m^2	R 9.00			1 548	R 13 928										
C 3.5			Phase 3 Liner Drain	m^2	R 9.00					2 278	R 20 498								
C 3.6			Phase 3 Leakage Detection Drain	m^2	R 9.00					2 278	R 20 498								
C 3.7			Phase 4 Liner Drain	m^2	R 9.00							1 363	R 12 263						
C 3.8			Phase 4 Leakage Detection Drain	m^2	R 9.00							1 363	R 12 263						
C 4	3.5		*Supply and place selected washed 6.7 mm stone to specification to:*																
C 4.1			Phase 1 Liner Drain	m^3	**R 400.00**	30	R 11 850												
C 4.2			Phase 2 Liner Drain	m^3	R 400.00			46	R 18 570										
C 4.3			Phase 3 Liner Drain	m^3	R 400.00					68	R 27 330								
C 4.4			Phase 4 Liner Drain	m^3	R 400.00							41	R 16 350						
			SUB TOTAL CARRIED FORWARD				**R 51 614**		**R 81 013**		**R 119 177**		**R 71 531**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE C UNDERDRAINAGE SYSTEM (Cont)

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			SUB TOTAL BROUGHT FORWARD				**R 51 614**		**R 81 013**		**R 119 177**		**R 71 531**		**R 0**		**R 0**		**R 0**
C 5	3.6		*Supply and place selected washed 19 mm stone to specification to:*																
C 5.1			Phase 1 Liner Drain	m^3	**R 400.00**	69	R 27 650												
C 5.2			Phase 1 Leakage Detection Drain	m^3	R 400.00	99	R 39 500												
C 5.3			Phase 2 Liner Drain	m^3	R 400.00			108	R 43 330										
C 5.4			Phase 2 Leakage Detection Drain	m^3	R 400.00			155	R 61 900										
C 5.5			Phase 3 Liner Drain	m^3	R 400.00					159	R 63 770								
C 5.6			Phase 3 Leakage Detection Drain	m^3	R 400.00					228	R 91 100								
C 5.7			Phase 4 Liner Drain	m^3	R 400.00							95	R 38 150						
C 5.8			Phase 4 Leakage Detection Drain	m^3	R 400.00							136	R 54 500						
C 6	3.8	**PA & SANS DK & LD**	*Supply and install 160 mm diameter **non-slotted HDPE Drainex pipes** or similar approved with joints to SABS standard (including all jointing material and fittings)*																
C 6.1			Phase 1 Liner Drain	m	**R 40.00**	40	R 1 600												
C 6.2			Phase 1 Leakage Detection Drain	m	R 40.00	40	R 1 600												
C 6.3			Phase 2 Liner Drain	m	R 40.00			60	R 2 400										
C 6.4			Phase 2 Leakage Detection Drain	m	R 40.00			60	R 2 400										
C 6.5			Phase 3 Liner Drain	m	R 40.00					80	R 3 200								
C 6.6			Phase 3 Leakage Detection Drain	m	R 40.00					80	R 3 200								
C 6.7			Phase 4 Liner Drain	m	R 40.00							60	R 2 400						
C 6.8			Phase 4 Leakage Detection Drain	m	R 40.00							60	R 2 400						
C 7	3.7	**PA & SANS DK & LD**	*Supply and install 160 mm diameter **slotted HDPE Drainex pipes** or similar approved with joints to SABS standard (including all jointing material and fittings)*																
C 7.1			Phase 1 Liner Drain	m	**R 36.00**	395	R 14 220												
C 7.2			Phase 1 Leakage Detection Drain	m	R 36.00	395	R 14 220												
C 7.3			Phase 2 Liner Drain	m	R 36.00			619	R 22 284										
C 7.4			Phase 2 Leakage Detection Drain	m	R 36.00			619	R 22 284										
C 7.5			Phase 3 Liner Drain	m	R 36.00					911	R 32 796								
C 7.6			Phase 3 Leakage Detection Drain	m	R 36.00					911	R 32 796								
C 7.7			Phase 4 Liner Drain	m	R 36.00							545	R 19 620						
C 7.8			Phase 4 Leakage Detection Drain	m	R 36.00							545	R 19 620						
C 9	3.9		*Extra Over Items C 6 and C 7 for supply of T-Pieces, Elbows etc*																
C 9.1			T Pieces	No.	**R 160.00**	5	R 800												
C 9.2			90^0 Bends	No.	R 160.00	5	R 800	9	R 1 440	2	R 320								
C 9.3			45^0 Bends	No.	R 160.00	5	R 800	9	R 1 440	5	R 800	5	R 800						
			SUB TOTAL CARRIED FORWARD				**R 152 804**		**R 238 491**		**R 347 159**		**R 209 021**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE C UNDERDRAINAGE SYSTEM (Cont)

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			SUB TOTAL BROUGHT FORWARD				**R 152 804**		**R 238 491**		**R 347 159**		**R 209 021**		**R 0**		**R 0**		**R 0**
C 10	2.9		*Supply and place selected material nominally compacted to specification to:*																
C 10.1			Phase 1 Liner Drain Outlet Trench	m^3	**R 55.00**	4	R 220												
C 10.2			Phase 1 Leakage Detection Drain Outlet Trench	m^3	R 55.00	4	R 220												
C 10.3			Phase 2 Liner Drain Outlet Trench	m^3	R 55.00			7	R 378										
C 10.4			Phase 2 Leakage Detection Drain Outlet Trench	m^3	R 55.00			7	R 378										
C 10.5			Phase 3 Liner Drain Outlet Trench	m^3	R 55.00					10	R 543								
C 10.6			Phase 3 Leakage Detection Drain Outlet Trench	m^3	R 55.00					10	R 543								
C 10.7			Phase 4 Liner Drain Outlet Trench	m^3	R 55.00							7	R 385						
C 10.8			Phase 4 Leakage Detection Drain Outlet Trench	m^3	R 55.00							7	R 385						
			SUB TOTAL CARRIED TO SUMMARY				**R 153 244**		**R 239 247**		**R 348 245**		**R 209 791**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE D SURFACE WATER CONTAINMENT WORKS

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			CONSTRUCTION AND BACKFILLING																
D 1	2.12		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
D 1.1			Solution Outfall Trench to Silt Trap	m^3	**R 61.00**	350	R 21 350												
			EARTHWORKS																
D 2	1.2	**SANS DA & DE**	*Selected bulk excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
D 2.1			Solution Trench	m^3	**R 30.00**	8 890	R 266 709												
D 3	2.3	**PA & SANS D & GA**	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
D 3.1			Toe Paddock Drains	m^3	**R 100.00**	82	R 8 190												
D 4	2.4		*Base preparation of insitu material (Rip and compact 500mm deep or as specified by the Engineer) to:*																
D 4.1			Solution Trench	m^3	**R 15.00**	9 234	R 138 516												
D 4.2			Toe Paddocks Area	m^3	**R 15.00**	29 082	R 436 230												
D 5	2.8		*Base preparation of insitu material in trench (compact insitu material with Wacker or similar approved) to:*																
D 5.1			Toe Paddock Drains	m^3	**R 3.50**	82	R 287												
			CONSTRUCTION AND BACKFILLING																
D 6	2.11		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
D 6.1			Toe Paddock Walls	m^3	**R 57.00**	11 000	R 627 000												
D 6.2			Toe Paddock Cross Walls	m^3	**R 57.00**	1 243	R 70 851												
			MATERIALS																
D 7	5.6		*Supply and Install Mesh REF 617 to:*																
D 7.1			Solution Trench	m^2	**R 90.00**	18 469	R 1 662 186												
			CONCRETE WORKS																
D 8	5.3		*Supply, Place and level 150mm thick 25MPa/19mm concrete to.:*																
D 8.1			Solution Trench	m^3	**R 1 470.00**	3 153	R 4 634 631												
			SUB TOTAL CARRIED FORWARD				**R 7 844 599**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE D SURFACE WATER CONTAINMENT WORKS (Cont)

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			SUB TOTAL CARRIED FORWARD				**R 7 844 599**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**
			DRAINAGE																
D 9	3.1	**PA & SANS DK**	*Supply and install Bidim A4 geofabric, or similair approved geotextile to: (Rate to include for cutting, strapping, wastage and stitching)*																
D 9.1			Toe Paddock Cross Walls	m^2	**R 9.00**	513	R 4 617												
D 10	3.5		*Supply and place selected washed 6.7 mm stone to specification to:*																
D 10.1			Toe Paddock Cross Walls	m^3	**R 400.00**	11	R 4 560												
D 11	3.6		*Supply and place selected washed 19 mm stone to specification to:*																
D 11.1			Toe Paddock Drains	m^3	**R 400.00**	11	R 4 560												
D 12	2.9		*Supply and place selected material nominally compacted to specification to:*																
D 12.1			Toe Paddocks Drain Outlet Trenches	m^3	**R 55.00**	48	R 2 624												
D 13	3.7	**PA & SANS DK & LD**	*Supply and install 160 mm diameter **slotted HDPE Drainex pipes** or similar approved with joints to SABS standard (including all jointing material and fittings)*																
D 13.1			Toe Paddock Drains	m	**R 36.00**	380	R 13 680												
D 14	3.8	**PA & SANS DK & LD**	*Supply and install 160 mm diameter **non-slotted HDPE Drainex pipes** or similar approved with joints to SABS standard (including all jointing material and fittings)*																
D 14.1			Toe Paddock Drains	m	**R 40.00**	530	R 21 200												
D 15	3.9		*Extra Over Items D 10 and D 11 for supply of T-Pieces, Elbows etc*																
D 15.1			T Pieces	No.	**R 160.00**														
D 15.2			90^0 Bends	No.	R 160.00														
D 15.3			45^0 Bends	No.	R 160.00	17	R 2 720												
			REHABILITATION																
D 16	7.1		*Load from Stockpile, Haul, Place and Spread 150mm layer topsoil in preparation for the re-establishment of vegetation to:*																
D 16.1			Toe Paddock Walls	m^3	**R 40.00**	3 021	R 120 840												
D 16.2			Toe Paddock Cross Walls	m^3	R 40.00	440	R 17 580												
D 17	7.2		*Supply and Place Mixture of Selected Indigenous Grasses to Topsoiled Areas (Rate to include for testing of soils as necessary, supply and application of ameliorants and fertilisers, and the re-seeding of areas where germination fails)*																
D 17.1			Toe Paddock Walls	m^2	**R 2.50**	20 140	R 50 350												
D 17.2			Toe Paddock Cross Walls	m^2	R 2.50	2 930	R 7 325												
			SUB TOTAL CARRIED TO SUMMARY				**R 8 094 655**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE E SURFACE WATER DIVERSION WORKS

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			EARTHWORKS																
E 1	1.2	**SANS DA & DE**	*Selected bulk excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
E 1.1			Stormwater Diversion Trench	m^3	**R 30.00**	850	R 25 500												
E 2	2.4		*Base preparation of insitu material (Rip and compact 500mm deep or as specified by the Engineer) to:*																
E 2.1			Stormwater Diversion Trench	m^3	**R 15.00**	1 375	R 20 625												
E 2.2			Stormwater Diversion Bund Wall	m^3	R 15.00	1 275	R 19 125												
			CONSTRUCTION AND BACKFILLING																
E 3	2.12		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
E 3.1			Stormwater Diversion Bund Wall	m^3	**R 61.00**	850	R 51 850												
			GABIONS AND RENO MATTRESSES																
E 4	3.3	**PA & SANS DK**	*Supply and install Bidim A6 geofabric, or similair approved geotextile to: (Rate to include for cutting, strapping, wastage and stitching)*																
E 4.1			Stormwater Diversion Trench	m^2	**R 13.00**	54	R 702												
E 5	4.2	**SABS 1200 DK**	*Supply and install 0.5m x 0.5m x 1m Gabion Baskets (rate to include for sourcing, selection from mine waste rock dump, loading, haulage, and placing of rock, slope preparation, wire mesh cage, binder connectors, forming of baskets etc.)*																
E 5.1			Stormwater Diversion Trench	No.	**R 320.00**	25	R 8 000												
			REHABILITATION																
E 6	7.1		*Load from Stockpile, Haul, Place and Spread 150mm layer topsoil to in preparation for the re-establishment of vegetation to:*																
E 6.1			Stormwater Diversion Bund Wall	m^3	**R 40.00**	413	R 16 500												
E 7	7.2		*Supply and Place Mixture of Selected Indigenous Grasses to Topsoiled Areas (Rate to include for testing of soils as necessary, supply and application of ameliorants and fertilisers, and the re-seeding of areas where germination fails)*																
E 7.1			Stormwater Diversion Bund Wall	m^2	**R 2.50**	2 750	R 6 875												
			SUB TOTAL CARRIED TO SUMMARY				**R 149 177**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE F PERIMETER ACCESS ROAD AND HAUL ROAD

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			EARTHWORKS																
F 1	1.2	**SANS DA & DE**	*Selected bulk excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
F 1.1			Access Road Box Cut	m^3	**R 30.00**	2 239	R 67 163												
F 1.2			Haul Road Box Cut	m^3	R 30.00	603	R 18 090												
F 2	2.4		*Base preparation of insitu material (Rip and compact 500mm deep or as specified by the Engineer) to:*																
F 2.1			Access Road Box Cut	m^3	**R 15.00**	7 463	R 111 938												
F 2.2			Haul Road Box Cut	m^3	R 15.00	2 010	R 30 150												
F 3	2.7		*Supply and Place selected compacted waste rock with wearing coarse (rate to include sourcing, loading, haul within 2km, placing, spreading, levelling, watering, forming etc) to:*																
F 3.1			Access Road	m^3	**R 65.00**	2 239	R 145 519												
F 3.2			Haul Road	m^3	R 65.00	603	R 39 195												
			SUB TOTAL CARRIED TO SUMMARY				**R 412 054**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE G SILT TRAP

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			CONSTRUCTION AND BACKFILLING																
E 3	2.12		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
E 3.1			Silt Trap	m^3	**R 61.00**	240	R 14 640												
			EARTHWORKS																
G 1	2.1	**SANS DA & DE**	*Selected bulk excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
G 1.1			Silt Trap	m^3	**R 21.00**	1 238	R 25 990												
			EARTHWORKS																
G 2	2.2	**PA & SANS D & GA**	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
G 2.1			Silt Trap Inlet Channel	m^3	**R 180.00**	273	R 49 140												
G 2.2			Silt Trap Spillway	m^3	R 180.00	334	R 60 134												
G 3	2.4		*Base preparation of insitu material (Rip and compact 500mm deep or as specified by the Engineer) to:*																
G 3.1			Silt Trap	m^3	**R 15.00**	597	R 8 957												
G 3.2			Silt Trap Inlet Channel	m^3	R 15.00	231	R 3 465												
G 3.3			Silt Trap Spillway	m^3	R 15.00	254	R 3 808												
			MATERIALS																
G 4	3.1	**PA & SANS DK**	*Supply and install Bidim A4 geofabric, or similair approved geotextile to: (Rate to include for cutting, strapping, wastage and stitching)*																
G 4.1			Silt Trap	m^2	**R 9.00**	1 238	R 11 138												
G 5	5.6		*Supply and Install Mesh REF 617 to:*																
G 5.1			Silt Trap	m^2	**R 90.00**	1 194	R 107 489												
G 5.2			Silt Trap Inlet Channel	m^2	R 90.00	462	R 41 580												
G 5.3			Silt Trap Spillway	m^2	R 90.00	508	R 45 692												
			CONCRETE WORKS																
G 6	5.4		*Supply, Place and level 200mm thick 25MPa/19mm mass concrete to:*																
G 6.1			Silt Trap	m^3	**R 3 000.00**	248	R 742 560												
G 6.2			Silt Trap Inlet Channel	m^3	R 3 000.00	92	R 277 200												
G 6.3			Silt Trap Spillway	m^3	R 3 000.00	102	R 304 613												
			SUB TOTAL CARRIED FORWARD				**R 1 681 765**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE G SILT TRAP (Cont)

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			SUB TOTAL CARRIED FORWARD				**R 1 681 765**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**
G 7	11.1		*Supply and install cast in sluice gate to suite solution trench silt trap inlets and outlets:*																
G 7.1			Silt Trap Inlet and Outlet Channels	No.	**R 229 468.00**	2	R 458 936												
G 8	12.1		*Supply and install cast in railway rail to Silt trap (rate to include for cutting) to:*																
G 8.1			Silt Trap	m	**R 180.00**	350	R 63 000												
			SUB TOTAL CARRIED TO SUMMARY				**R 2 203 701**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE H CULVERT CROSSINGS

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			CONSTRUCTION AND BACKFILLING																
H 1	2.11		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
H 1.1			Culvert Access Road Crossing	m^3	**R 57.00**	12	R 661												
H 1.2			Culvert Haul Road Crossing	m^3	R 57.00	46	R 2 599												
			CONCRETE WORKS																
H 2	5.7		*Supply and Install Mesh REF 395 to:*																
H 2.1			Culvert Headwalls	m^2	**R 70.00**	241	R 16 884												
H 2.2			Culvert Wing Walls	m^2	R 70.00	54	R 3 780												
H 2.3			Culvert Headwall Bases	m^2	R 70.00	306	R 21 420												
H 3	5.4		*Supply, Place 30MPa/19mm concrete (Rate to include for any and all formwork required and finishing as specified) to:*																
H 3.1			Culvert Headwalls	m^3	**R 3 000.00**	30	R 90 450												
H 3.2			Culvert Wing Walls	m^3	R 3 000.00	7	R 20 250												
H 3.3			Culvert Headwall Bases	m^3	R 3 000.00	38	R 114 750												
			MATERIALS																
H 4	2.9		*Supply and place selected granular material to (rate to include sourcing, loading, haul within 2km, placing, spreading, levelling, watering, forming etc):*																
H 4.1			Pipe Bedding material	m^3	**R 55.00**	17	R 913												
H 5	2.7		*Supply and Place selected compacted rock backfill (rate to include sourcing from approved borrow pits, loading, haul within 2km, placing, spreading, levelling, watering, forming etc) to:*																
H 5.1			Access Road	m^3	**R 65.00**	53	R 3 453												
H 6	2.9		*Supply and place selected material compacted to specification to (rate to include sourcing from approved borrow pits, loading, haul within 2km, placing, spreading, levelling, watering, forming etc):*																
H 6.1			Backfill material	m^3	**R 55.00**	8	R 457												
			PIPING																
H 7	9.1		*Supply and install 450 NB Class 100D spigot and socket reinforced concrete pipeline in 2.44m standard lengths (rate to include for testing and rubber seals) to:*																
H 7.1			Access & Haul Road Crossings	m	**R 500.00**	83	R 41 500												
			TOTAL CARRIED TO SUMMARY				**R 317 117**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT
FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE I MISCELLANEOUS

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			WARNING SINAGE AND SAFETY																
I 1	6.2		*Supply and Install 6 Strand Barbed Wire Fence to:*																
I 1.1			Perimeter Fence	m	**R 65.00**	3 077	R 200 005												
I 2	6.1		*Supply and install galvanised pole (2.5m long) complete with warning sign (Warning signs to be 1.0m x 0.5m) cast into a 1m³ mass concrete block at 50m interval to: (Rate to include for excavation of 1m³ in Class B material)*																
I 2.2			Perimeter Fence	No.	**R 920.00**	62	R 57 040												
			TOTAL CARRIED TO SUMMARY				**R 257 045**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE J LINER

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			EARTHWORKS																
J 1	2.3	**PA & SANS D & GA**	*Restricted excavation in Class A material. Material to be used for backfill, stockpile, fill, construction of embankments or disposed of as directed by Engineer within 2km haul distance (Rate to allow for shoring, cutting back, dewatering, trimming to uniform lines, grades and levels etc.)*																
J 1.1			Phase 1 Liner Anchor Trench	m^3	**R 100.00**	99	R 9 900												
J 1.2			Phase 2 Liner Anchor Trench	m^3	**R 100.00**			108	R 10 800										
J 1.3			Phase 3 Liner Anchor Trench	m^3	**R 100.00**					189	R 18 900								
J 1.4			Phase 4 Liner Anchor Trench	m^3	**R 100.00**							117	R 11 700						
J 1.5			Phase 1 Liner Embankment Roadway/Anchor Trench	m^3	**R 100.00**	1 225	R 122 500												
J 1.6			Phase 2 Liner Embankment Roadway/Anchor Trench	m^3	**R 100.00**			875	R 87 500										
J 1.7			Phase 3 Liner Embankment Roadway/Anchor Trench	m^3	**R 100.00**					1 050	R 105 000								
			CONSTRUCTION AND BACKFILLING																
J 2	2.11		*Construct compacted embankment walls and fills with selected and approved material from borrow pits, excavations, stockpiles and compact to required specification (rate to include for sourcing, loading, haul within 2km, placing, spreading, levelling, watering, tie-ing in, forming side slopes etc) to form:*																
J 2.1			Phase 1 Liner Embankment Roadway	m^3	**R 57.00**	5 600	R 319 200												
J 2.2			Phase 2 Liner Embankment Roadway	m^3	**R 57.00**			4 000	R 228 000										
J 2.3			Phase 3 Liner Embankment Roadway	m^3	**R 57.00**					4 800	R 273 600								
			MATERIALS																
J 3	3.1		*Supply and install Bidim A4 geofabric, or similar approved geotextile to: (Rate to include for cutting, strapping, wastage and stitching)*																
J 3.1			Phase 1 Liner	m^2	**R 9.00**	73 639	R 662 747												
J 3.2			Phase 2 Liner	m^2	**R 9.00**			83 181	R 748 625										
J 3.3			Phase 3 Liner	m^2	**R 9.00**					137 862	R 1 240 754								
J 3.4			Phase 4 Liner	m^2	**R 9.00**							63 615	R 572 531						
J 4	10.2		*Specialist sub-contractor to supply all materials, labour and plant including QA testing equipment and install 1500micron HDPE liner (rate to supply and lay flexible membrane to include for all bonds and sealing at specified points) to :*																
J 4.1			Phase 1 Liner	m^2	**R 64.00**	73 639	R 4 712 864												
J 4.2			Phase 2 Liner	m^2	**R 64.00**			83 181	R 5 323 552										
J 4.3			Phase 3 Liner	m^2	**R 64.00**					137 862	R 8 823 136								
J 4.4			Phase 4 Liner	m^2	**R 64.00**							63 615	R 4 071 328						
J 5	3.3		*Supply and install Bidim A6 geofabric, or similar approved geotextile to: (Rate to include for cutting, strapping, wastage and stitching)*																
J 5.1			Above Phase 1 Liner	m^3	**R 13.00**	13 683	R 177 882												
J 5.2			Above Phase 2 Liner	m^3	**R 13.00**			15 794	R 205 325										
J 5.3			Above Phase 3 Liner	m^3	**R 13.00**					26 446	R 343 801								
J 5.4			Above Phase 4 Liner	m^3	**R 13.00**							12 473	R 162 154						
			TOTAL CARRIED TO FORWARD				**R 6 005 092**		**R 6 603 801**		**R 10 805 190**		**R 4 817 713**		**R 0**		**R 0**		**R 0**

BELFAST COAL PROJECT

FEASIBILITY STUDY DESIGN OF COARSE DISCARD DISPOSAL FACILITY

SCHEDULE J LINER (Cont)

						Phase I		Phase 2		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
Item	**Unit Rate**	**Pay Ref**	**Description**	**Unit**	**Rate**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
			SUB TOTAL CARRIED FORWARD				**R 6 005 092**		**R 6 603 801**		**R 10 805 190**		**R 4 817 713**		**R 0**		**R 0**		**R 0**
J 6	10.1		*Supply and place 200mm sand, or similar approved material to: (Rate to include for sourcing, loading haul within 2km, levelling, spreading, wastage)*																
J 6.1			Phase 1 Liner Cushion Layer	m^3	**R 53.00**	13 683	R 725 210												
J 6.2			Phase 2 Liner Cushion Layer	m^3	**R 53.00**			15 794	R 837 093										
J 6.3			Phase 3 Liner Cushion Layer	m^3	**R 53.00**					26 446	R 1 401 649								
J 6.4			Phase 4 Liner Cushion Layer	m^3	**R 53.00**							12 473	R 661 090						
J 7	10.3		*Specialist sub-contractor to supply all materials, labour and plant including QA testing equipment and install Geosynthetic Clay Liner (rate to supply and lay of Liner to include for all bonds and sealing at specified points) to :*																
J 7.1			Phase 1 Liner	m^2	**R 62.00**	73 639	R 4 565 587												
J 7.2			Phase 2 Liner	m^2	**R 62.00**			83 181	R 5 157 191										
J 7.3			Phase 3 Liner	m^2	**R 62.00**					137 862	R 8 547 413								
J 7.4			Phase 4 Liner	m^2	**R 62.00**							63 615	R 3 944 099						
			TOTAL CARRIED TO SUMMARY				**R 11 295 889**		**R 12 598 085**		**R 20 754 252**		**R 9 422 902**		**R 0**		**R 0**		**R 0**

APPENDIX D : DRAWINGS

DESIGN DETAIL DRAFTING CC
P O Box 1432, Noordheuwel. 1756
Tel : 084 581 4179
Email : niel@3ddd.co.za / sonja@3ddd.co.za

DRAWING REGISTER

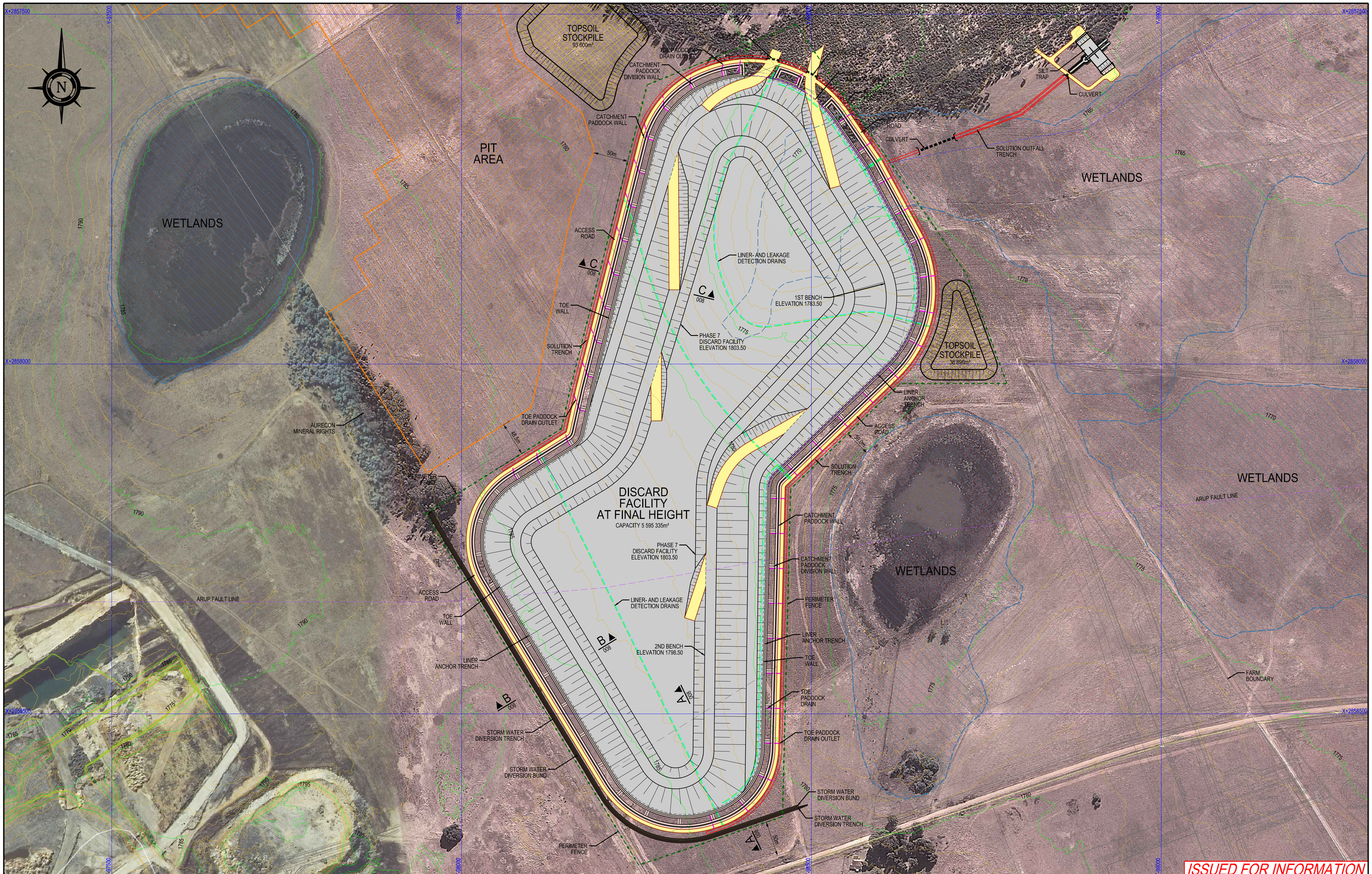
Client/Company: ***EPOCH RESOURCES***

Project name: ***BELFAST COAL PROJECT DISCARD FACILITY***

Project no: ***000-176***

Revision: ***E*** ***Date:*** ***2014/01/14***

Drawing number	**Description**	**Revision**	**Date**
	BELFAST COAL PROJECT DISCARD FACILITY		
000-176-000	LAYOUT WITH BACKGROUND	E	Jan-14
000-176-001	PHASE 1 GENERAL ARRANGEMENT	E	Jan-14
000-176-002	PHASE 2 GENERAL ARRANGEMENT	E	Jan-14
000-176-003	PHASE 3 GENERAL ARRANGEMENT	E	Jan-14
000-176-004	PHASE 4 GENERAL ARRANGEMENT	E	Jan-14
000-176-005	PHASE 5 GENERAL ARRANGEMENT	E	Jan-14
000-176-006	PHASE 6 GENERAL ARRANGEMENT	E	Jan-14
000-176-007	PHASE 7 GENERAL ARRANGEMENT	E	Jan-14
000-176-008	EARTHWORKS SECTIONS	D	Nov-13
000-176-009	EARTHWORKS DETAILS	D	Nov-13
000-176-010	DRAINAGE DETAILS	D	Nov-13
000-176-011	TOE PADDOCK DRAIN DETAILS	D	Nov-13
000-176-012	CULVERT DETAILS	B	Feb-13
000-176-013	SILT TRAP DETAILS	C	Nov-13
000-176-014	SLIT TRAP SPILLWAY DETAILS	C	Nov-13
000-176-015	PERIMETER FENCE & GATE DETAILS	A	Dec-12
000-176-016	AT FINAL HEIGHT SECTION & DETAILS	C	Nov-13



ISSUED FOR INFORMATION

.	.		
DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

	MADE	DATE
03	APPD	DATE
02	APPD	DATE
01	APPD	DATE
00	APPD	DATE
0E	3D	2014-01-13
	APPD	DATE
- GENERAL UPDATES		
0D	3D	2013-11-18
	APPD	DATE
- GENERAL UPDATES		
0C	3D	2013-10-01
	APPD	DATE
- GENERAL UPDATES		

PROFESSIONAL REGISTRATION

NAME:

PR.ENG.No.

DATE:

SIGNED:

ISSUED FOR:
- MANUFACTURE ☐
- CONSTRUCTION ☐
- APPROVAL ☐
- COMMENT ☐
- PRICING ☐
- INFORMATION ☐

DATE:

SIGNED:

DRAWN	3D
DATE	DEC 2012
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
CAPE DATUM Lo.29	A1 1:2500
	A3 1:5000

epoch resources (pty) ltd

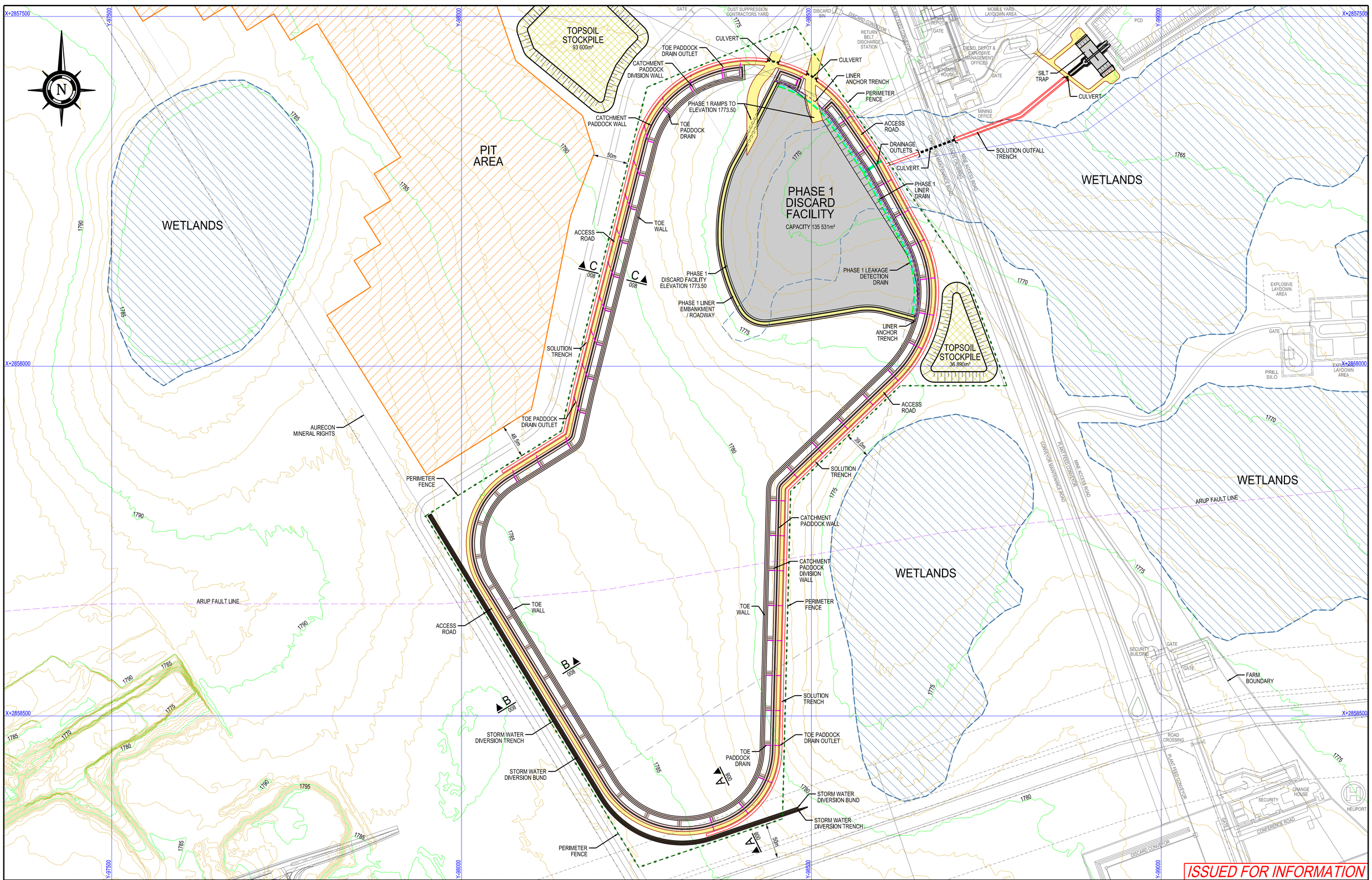
mine residue and environmental engineering consultants

TITLE

BELFAST COAL PROJECT
DISCARD FACILITY
LAYOUT AT FINAL HEIGHT
WITH BACKGROUND

DRG No. 000-176-000

REV. E



ISSUED FOR INFORMATION

000-176-002	PHASE 2 - GENERAL ARRANGEMENT	000-176-011	TOE PADDOCK DRAIN DETAILS
000-176-003	PHASE 3 - GENERAL ARRANGEMENT	000-176-012	CULVERT DETAILS
000-176-004	PHASE 4 - GENERAL ARRANGEMENT	000-176-013	SILT TRAP DETAILS
000-176-005	PHASE 5 - GENERAL ARRANGEMENT	000-176-014	SLIT TRAP SPILLWAY DETAILS
000-176-006	PHASE 6 - GENERAL ARRANGEMENT	000-176-015	PERIMETER FENCE & GATE DETAILS
000-176-007	PHASE 7 - GENERAL ARRANGEMENT	000-176-016	FINAL HEIGHT SECTION & DETAILS
000-176-008	EARTHWORKS SECTIONS		
000-176-009	EARTHWORKS DETAILS		
000-176-010	DRAINAGE DETAILS		
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0D	3D	2013-11-18		- GENERAL UPDATES
0C	3D	2013-10-01		- GENERAL UPDATES

PROFESSIONAL REGISTRATION
NAME:
PR.ENG.No.
DATE:
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MANUFACTURE ☐
CONSTRUCTION APPROVAL ☐
COMMENT ☐
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CAPE DATUM Lo.29	A1 1:2500
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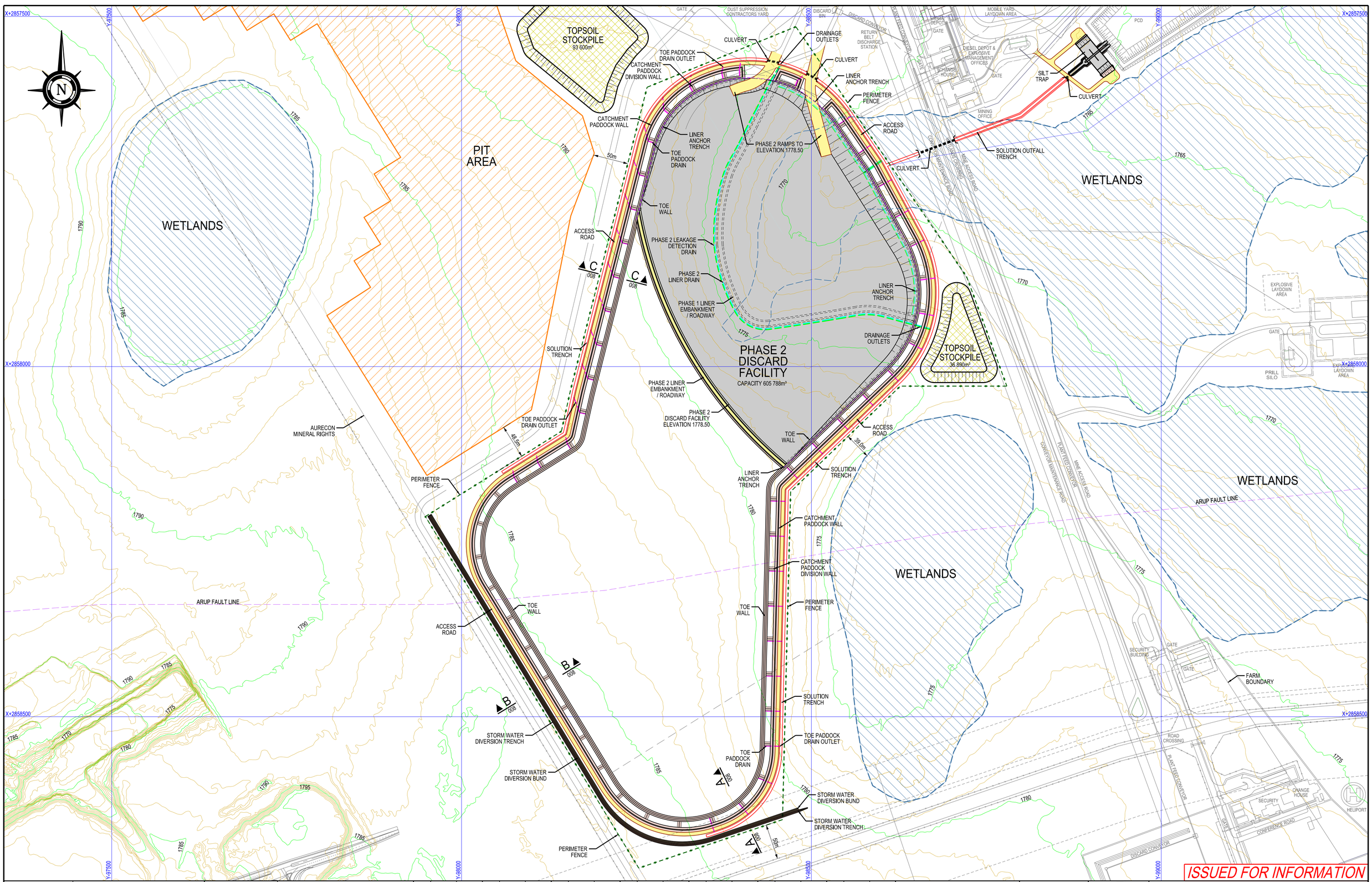
epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 1
GENERAL ARRANGEMENT

DRG No. 000-176-001
REV. E



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000-176-003	PHASE 3 - GENERAL ARRANGEMENT	000-176-012	CULVERT DETAILS
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PROFESSIONAL REGISTRATION
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COMMENT ☐
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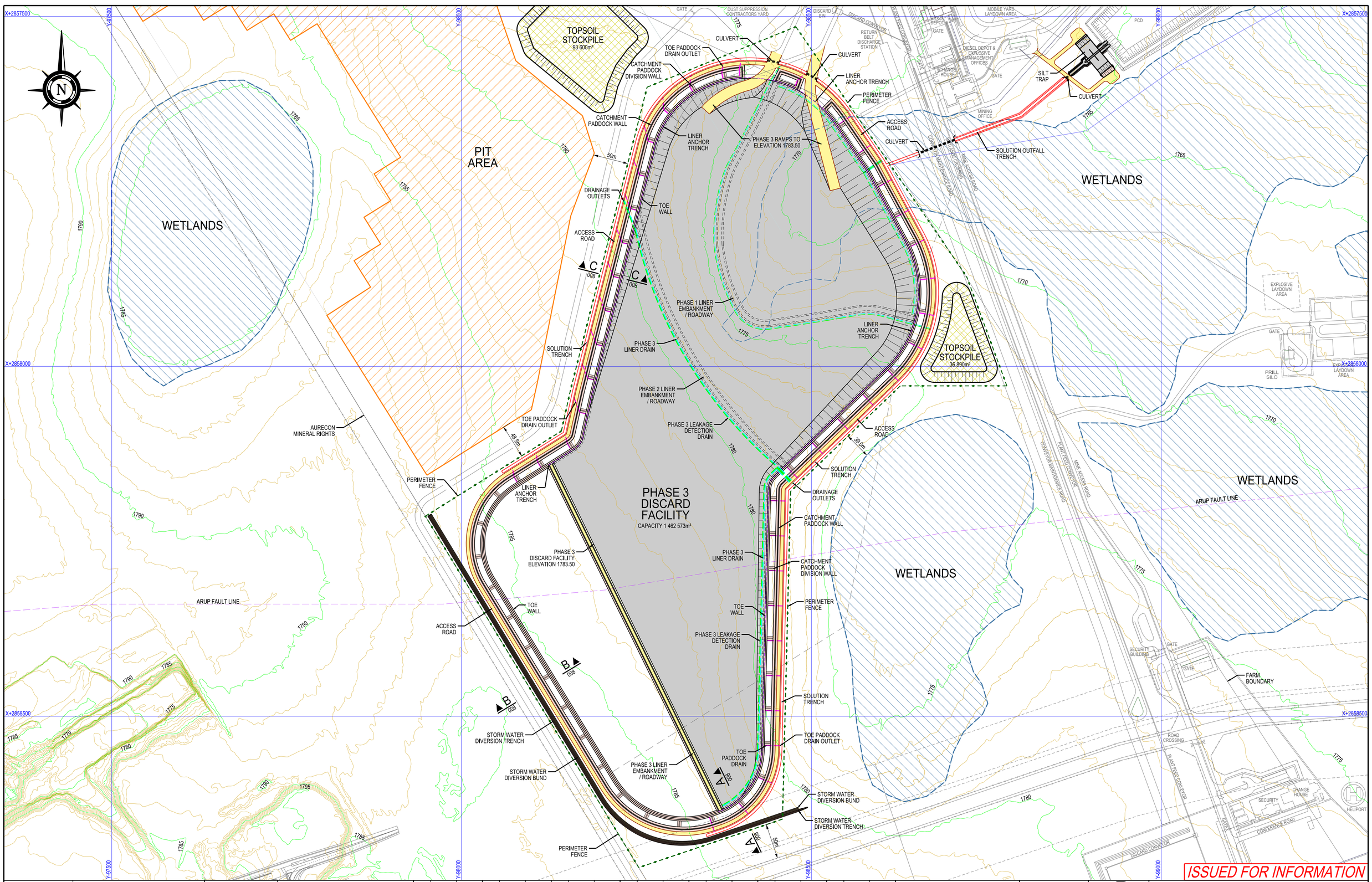
epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 2
GENERAL ARRANGEMENT

DRG No. 000-176-002
REV. E



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PROFESSIONAL REGISTRATION
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epoch resources (pty) ltd
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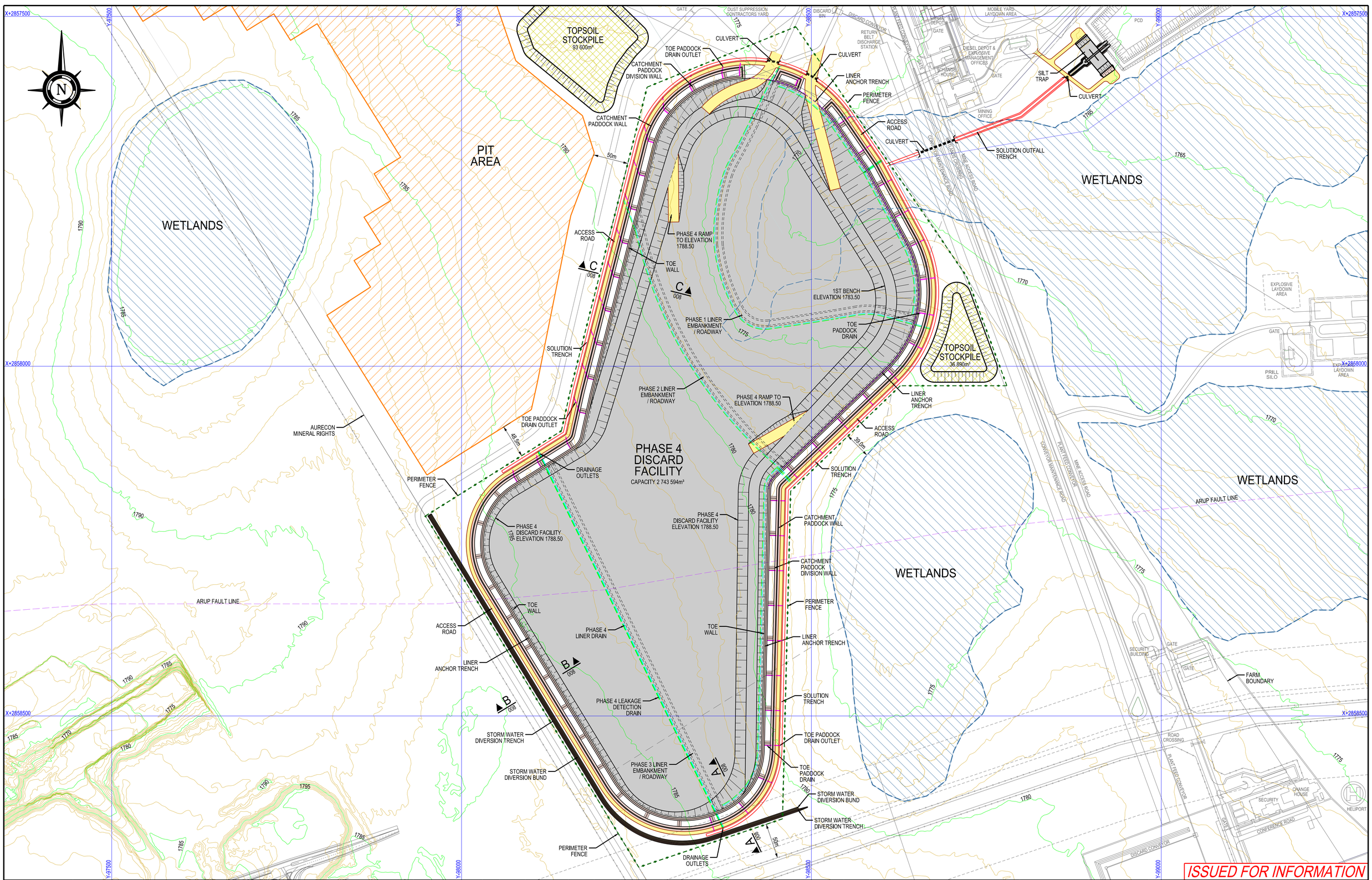
TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 3
GENERAL ARRANGEMENT

DRG No. 000-176-003
REV. E



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- 0D - GENERAL UPDATES
- 0C - GENERAL UPDATES

PROFESSIONAL REGISTRATION
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- CONSTRUCTION ☐
- APPROVAL ☐
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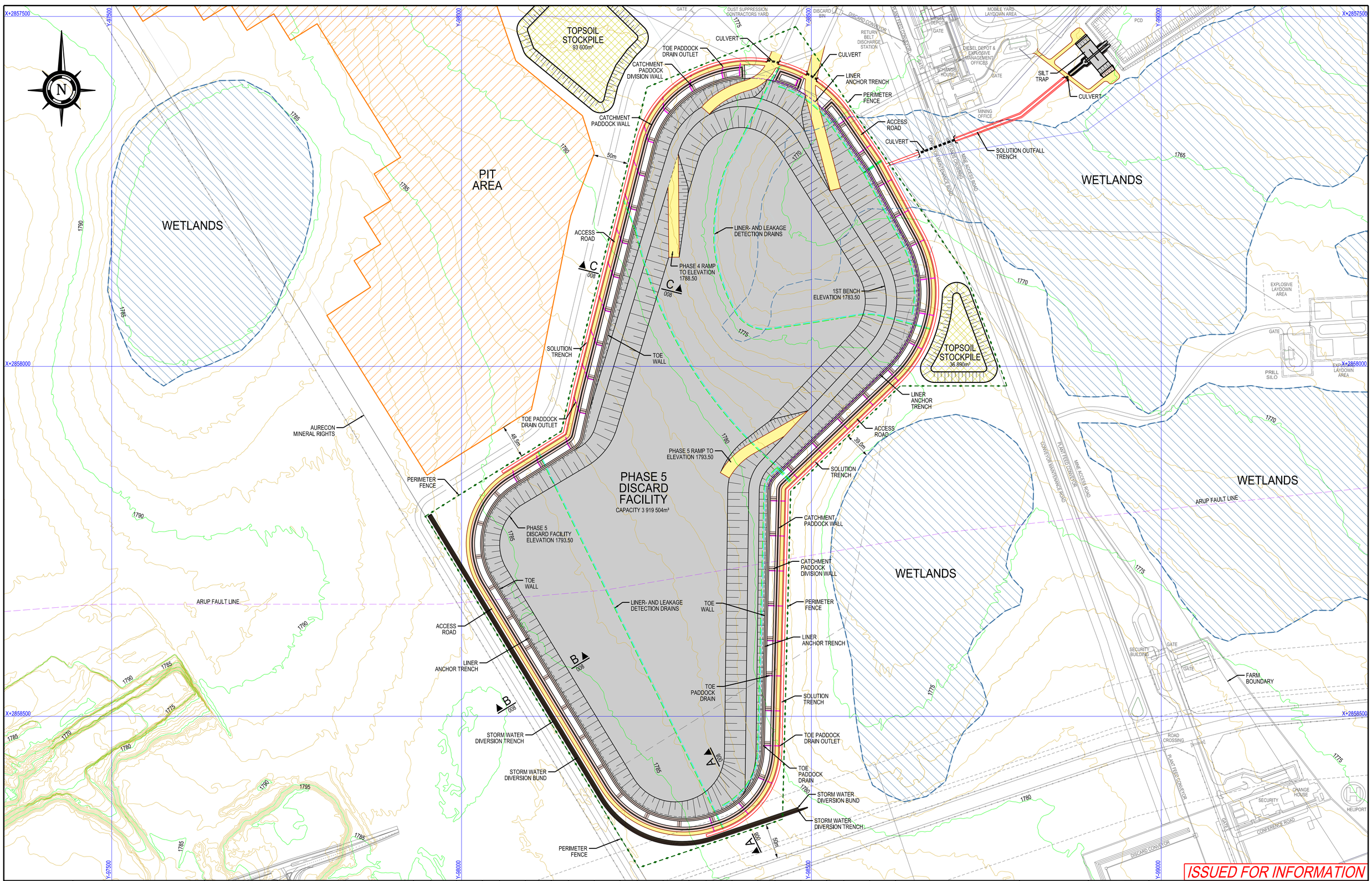
epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 4
GENERAL ARRANGEMENT

DRG No. 000-176-004
REV. E



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- COMMENT ☐
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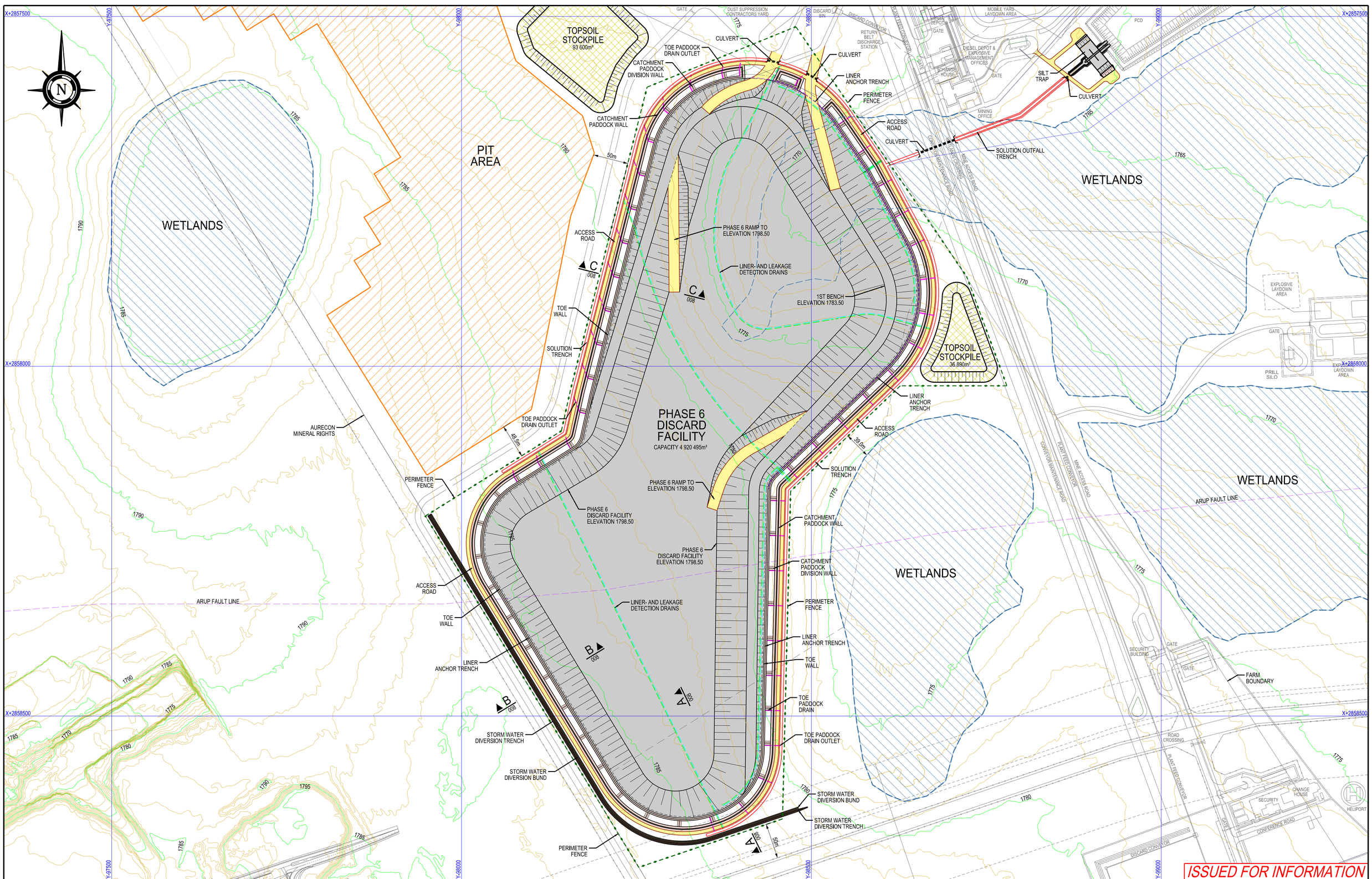
epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 5
GENERAL ARRANGEMENT

DRG No. 000-176-005
REV. E



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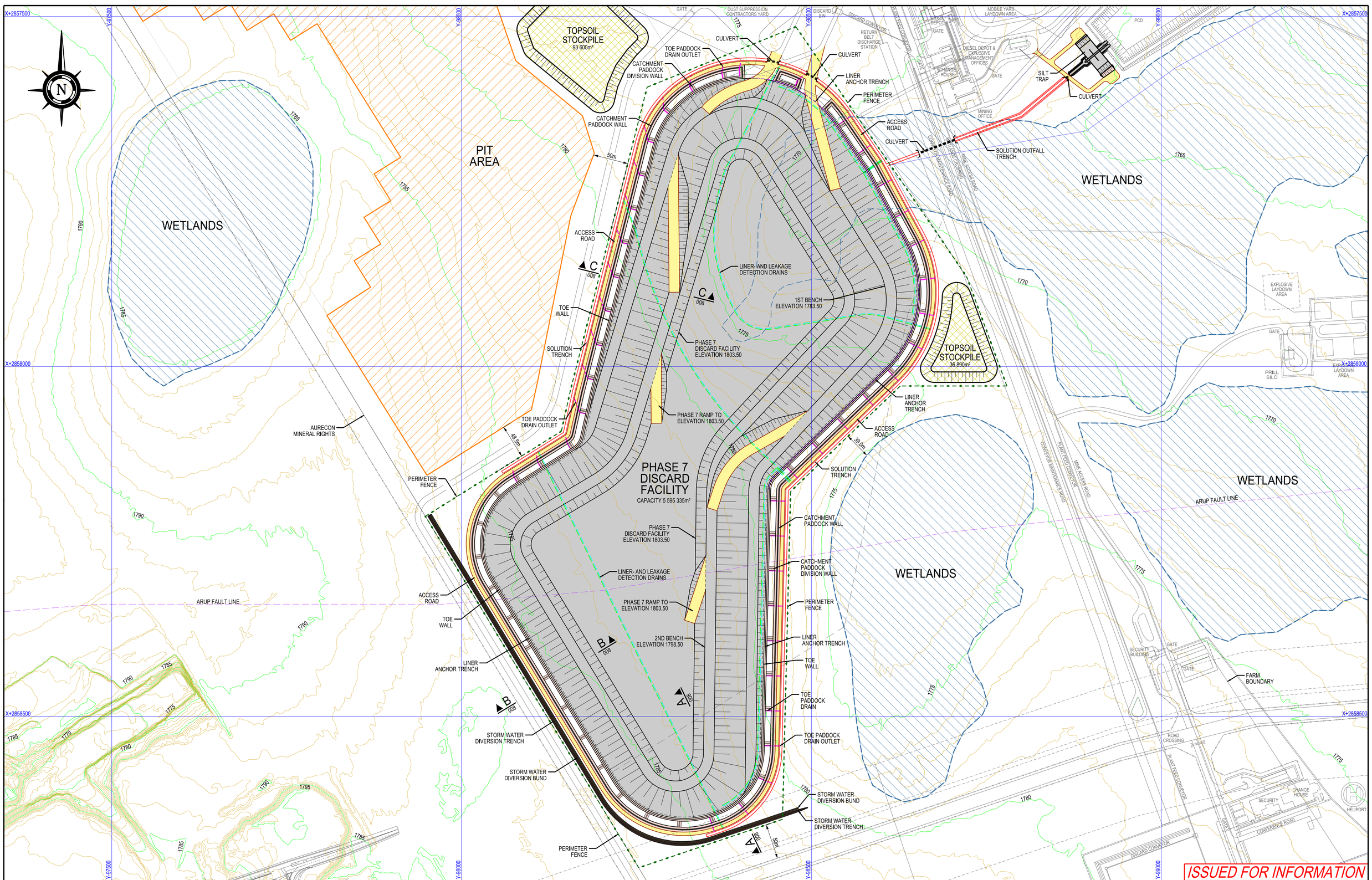
epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 6
GENERAL ARRANGEMENT

DRG No. 000-176-006
REV. E



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- GENERAL UPDATES				

PROFESSIONAL REGISTRATION

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epoch resources (pty) ltd

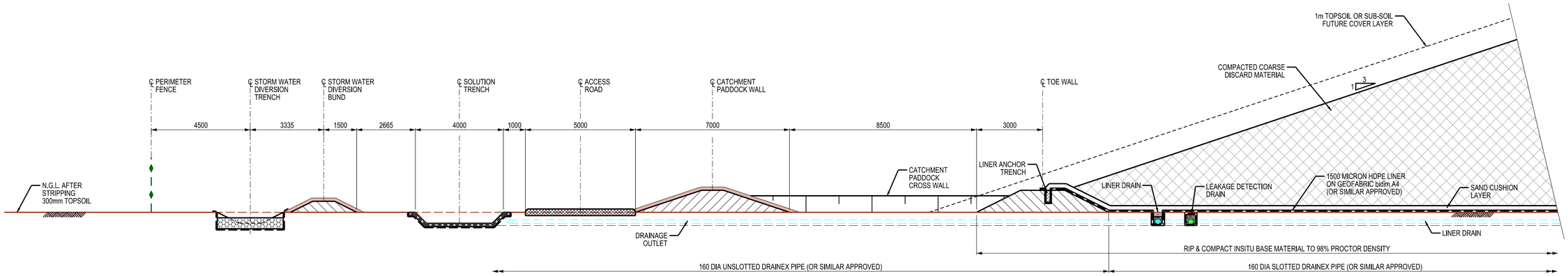
mine residue and environmental engineering consultants

TITLE

BELFAST COAL PROJECT
DISCARD FACILITY
PHASE 7
GENERAL ARRANGEMENT

DRG No. 000-176-007

REV. E



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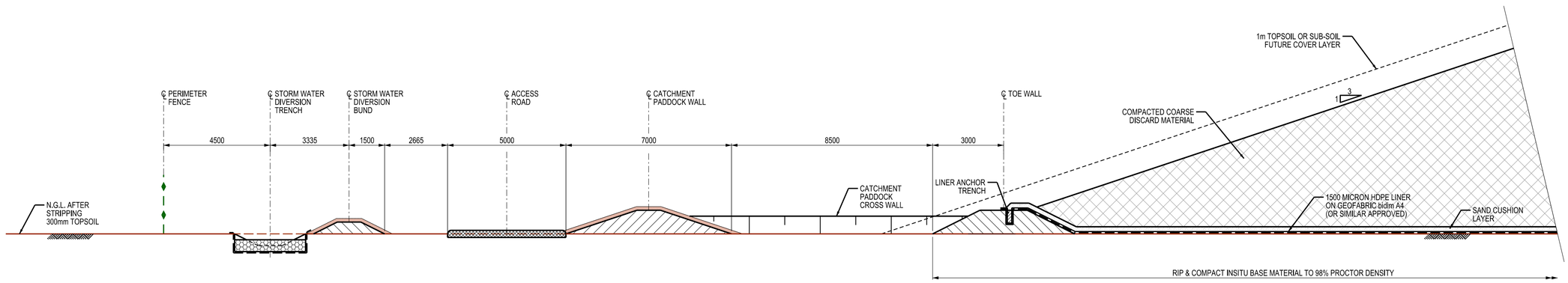

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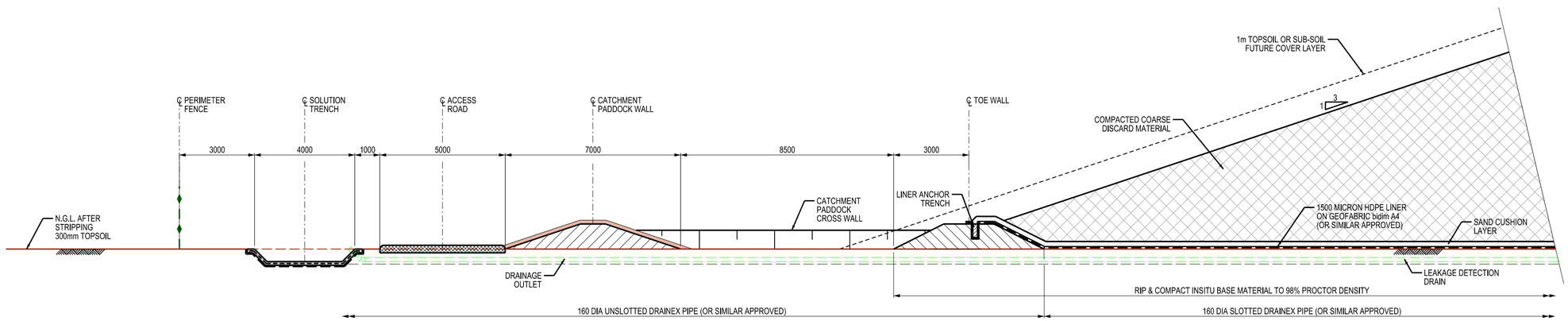

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000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
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0C	3D	2013-10-03			- LINER DETAILS ADDED - TOE WALL WIDENED
0B	3D	2013-02-19			- SOLUTION TRENCH UPDATED

PROFESSIONAL REGISTRATION
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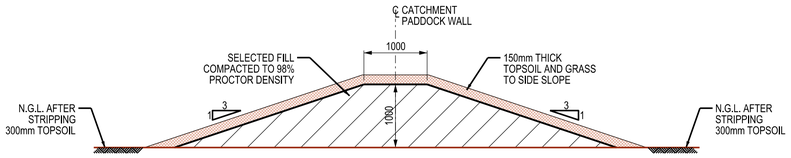
epoch resources (pty) ltd
mine residue and environmental engineering consultants

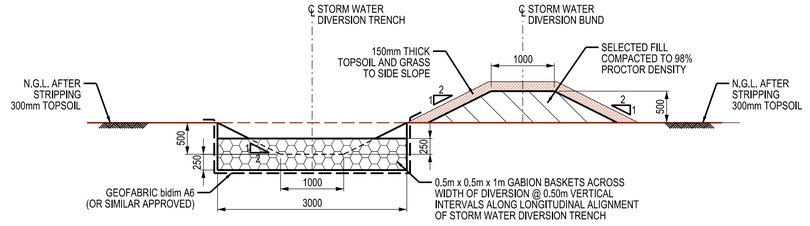
TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
EARTHWORKS SECTIONS

DRG No. 000-176-008
REV. D



SECTION - CATCHMENT PADDOCK WALL

SCALE 1:50



SECTION - STORM WATER DIVERSION TRENCH & BUND

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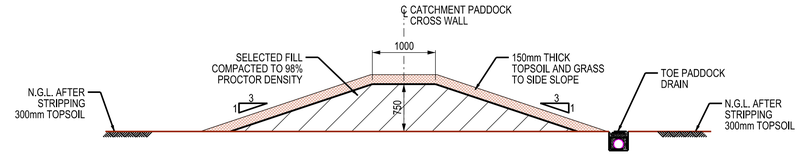

SECTION - CATCHMENT PADDOCK CROSS WALL

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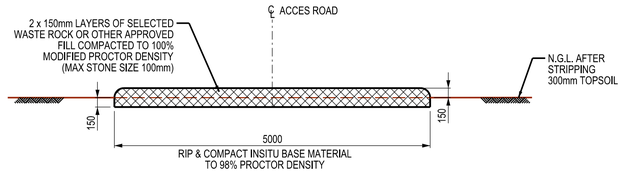

SECTION - ACCESS ROAD

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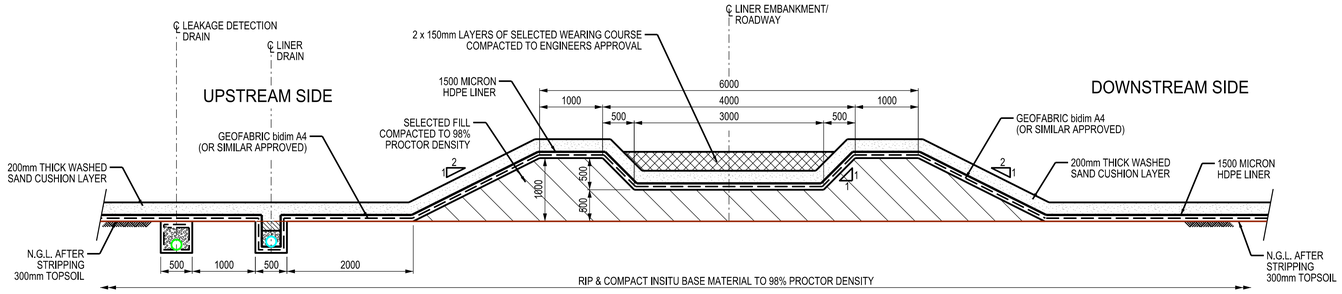

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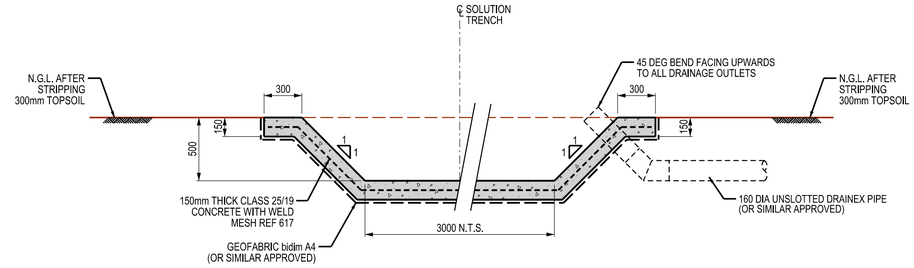

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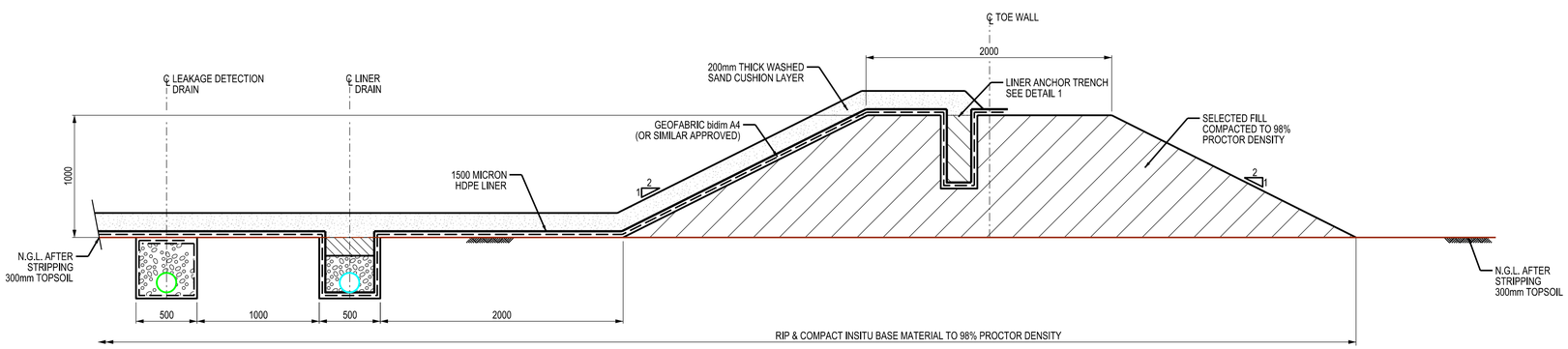

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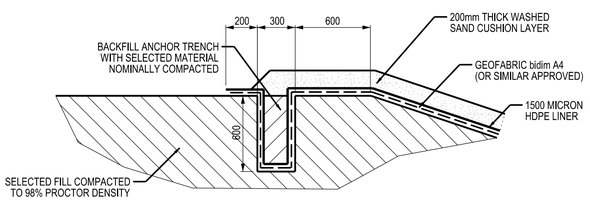

DETAIL 1 - LINER ANCHOR TRENCH

SCALE 1:25

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PROFESSIONAL REGISTRATION

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epoch resources (pty) ltd

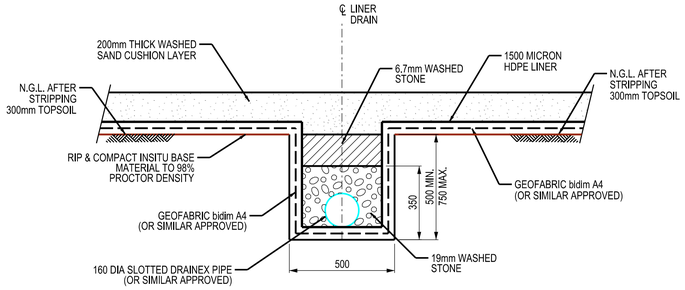
mine residue and environmental engineering consultants

TITLE

BELFAST COAL PROJECT DISCARD FACILITY EARTHWORKS DETAILS

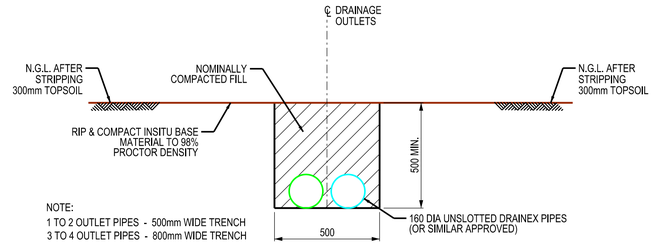
DRG No. 000-176-009

REV. D



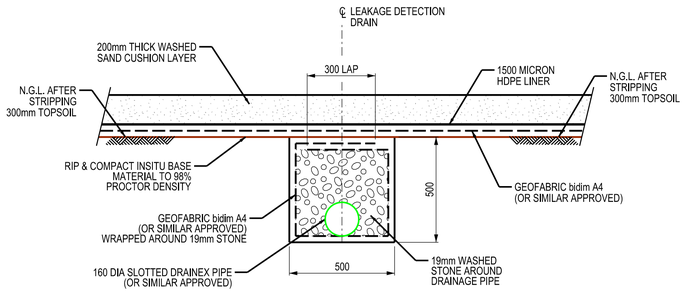
SECTION - LINER DRAIN

SCALE 1:15



SECTION - DRAINAGE OUTLETS

SCALE 1:15



SECTION - LEAKAGE DETECTION DRAIN

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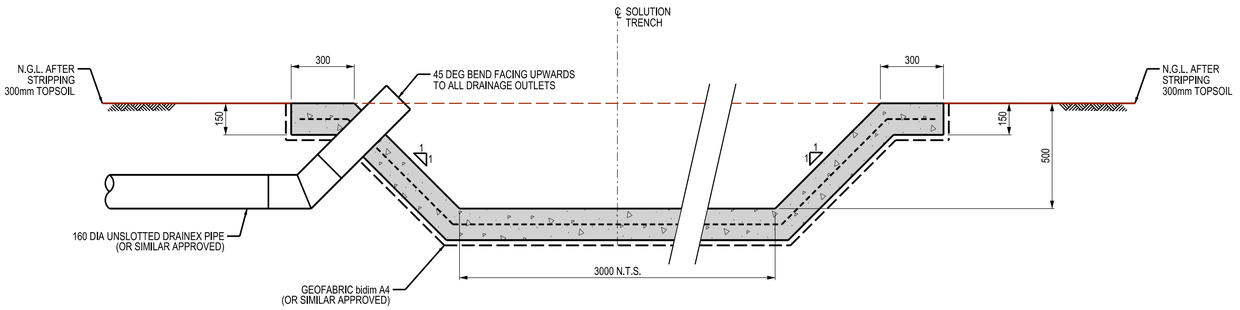

SECTION - DRAINAGE OUTLETS ENTERING SOLUTION TRENCH

SCALE 1:15

ISSUED FOR INFORMATION

000-176-001	PHASE 1 - GENERAL ARRANGEMENT		
000-176-002	PHASE 2 - GENERAL ARRANGEMENT		
000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
000-176-004	PHASE 4 - GENERAL ARRANGEMENT		
000-176-005	PHASE 5 - GENERAL ARRANGEMENT		
000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

	MADE	DATE	
03	APPD	DATE	
02	APPD	DATE	
01	APPD	DATE	
00	APPD	DATE	
0D	3D	2013-11-18	- GENERAL UPDATES
0C	3D	2013-10-03	- DRAINAGE DETAILS ALTERED
0B	3D	2013-02-19	- SOLUTION TRENCH UPDATED

PROFESSIONAL REGISTRATION

NAME:

PR.ENG.No.

DATE:

SIGNED:

ISSUED FOR:
- MANUFACTURE ☐
- CONSTRUCTION APPROVAL ☐
- COMMENT ☐
- PRICING INFORMATION ☐

DATE:

SIGNED:

DRAWN	3D
DATE	DEC 2012
CHECKED BY	
DATE	
APPROVED (ENG)	
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APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
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	A3 1:30

epoch resources (pty) ltd

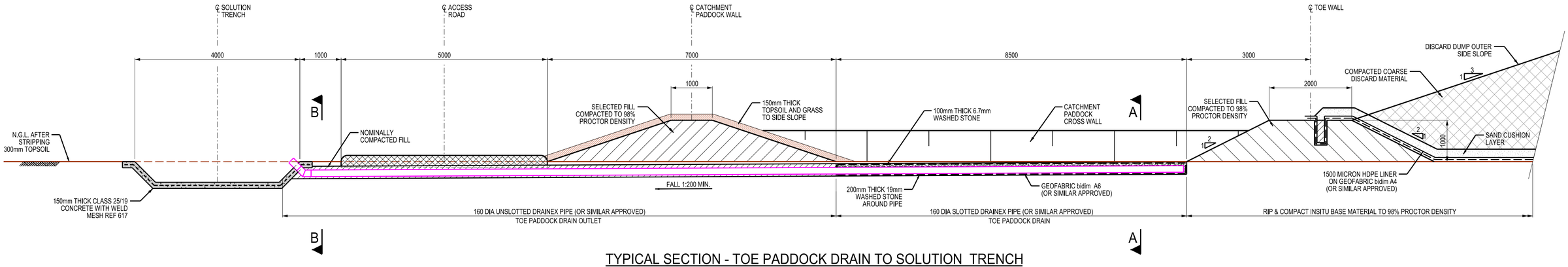
mine residue and environmental engineering consultants

TITLE

BELFAST COAL PROJECT
DISCARD FACILITY
DRAINAGE DETAILS

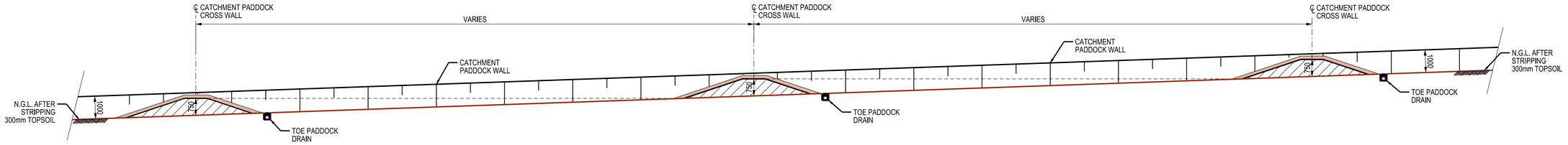
DRG No. 000-176-010

REV. D



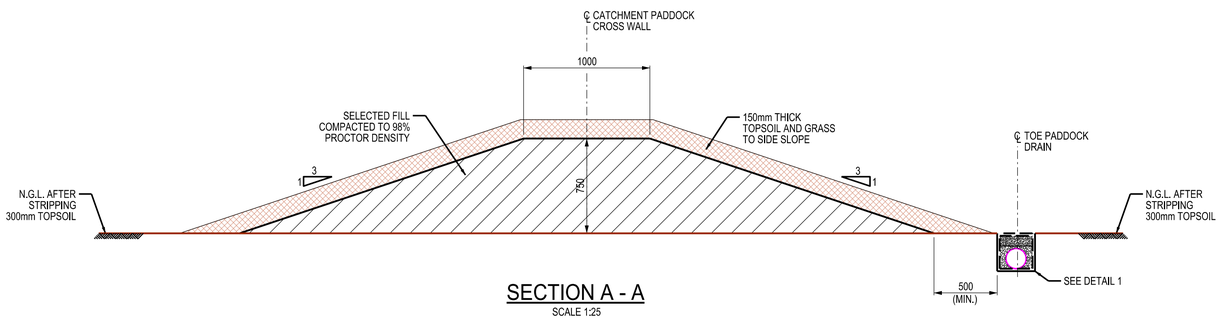
TYPICAL SECTION - TOE PADDOCK DRAIN TO SOLUTION TRENCH

SCALE 1:50



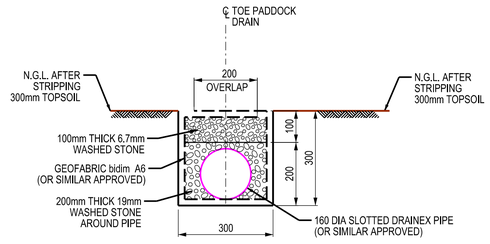
LONGITUDINAL SECTION - CATCHMENT PADDOCK CROSS WALLS

SCALE 1:100



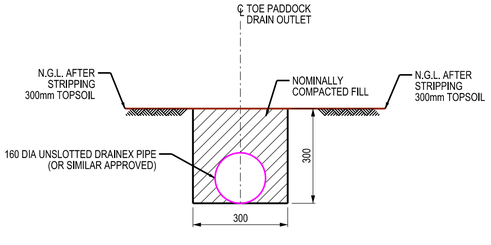
SECTION A - A

SCALE 1:25



DETAIL 1

SCALE 1:10



SECTION B - B

SCALE 1:10

ISSUED FOR INFORMATION

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000-176-002	PHASE 2 - GENERAL ARRANGEMENT		
000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
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000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

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	APPD	DATE	
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00			
0D		2013-11-18	- GENERAL UPDATES
0C		2013-10-03	- TOE WALL WIDENED
0B		2013-02-20	- SOLUTION TRENCH UPDATED

PROFESSIONAL REGISTRATION
NAME:
PR.ENG.No.
DATE:
SIGNED:

ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☐
DATE:
SIGNED:

DRAWN	3D
DATE	DEC 2012
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
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	A3 100

epoch resources (pty) ltd
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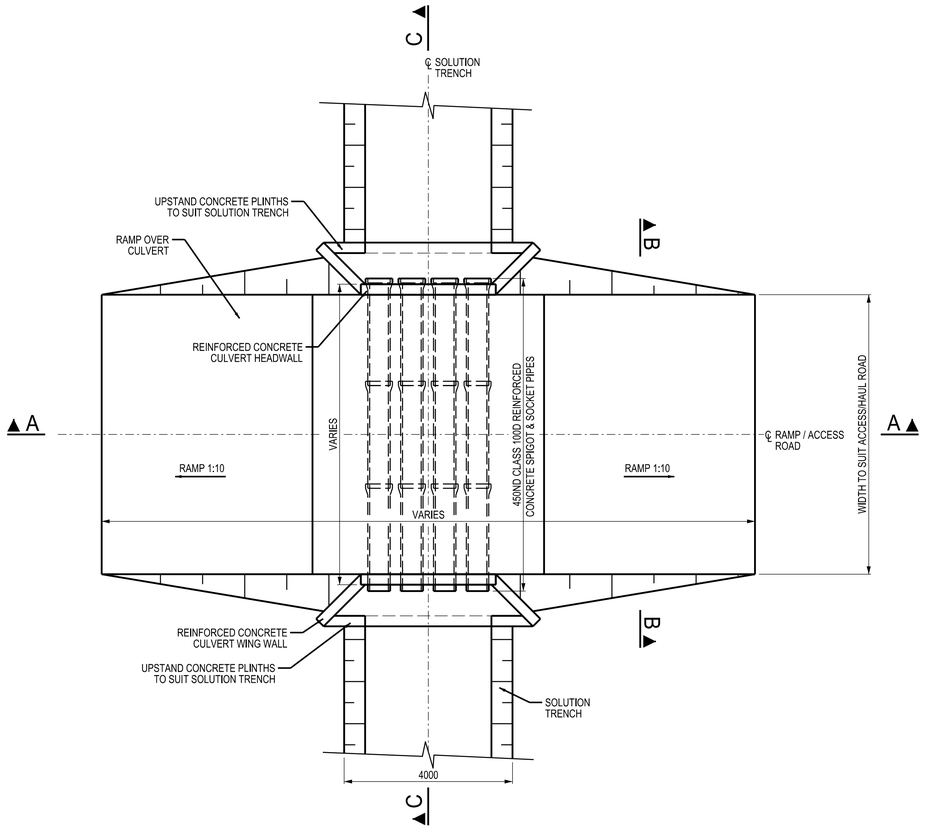
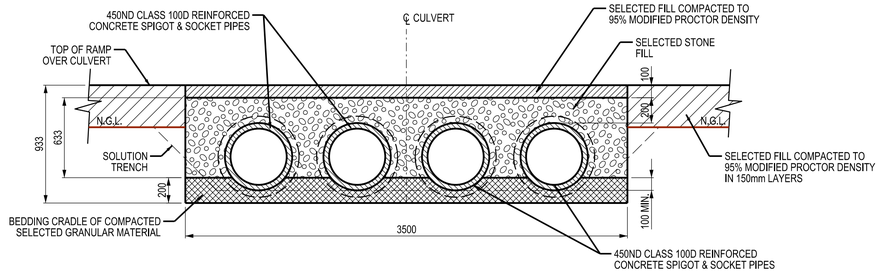
TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
TOE PADDOCK DRAIN DETAILS

DRG No. 000-176-011
REV. D



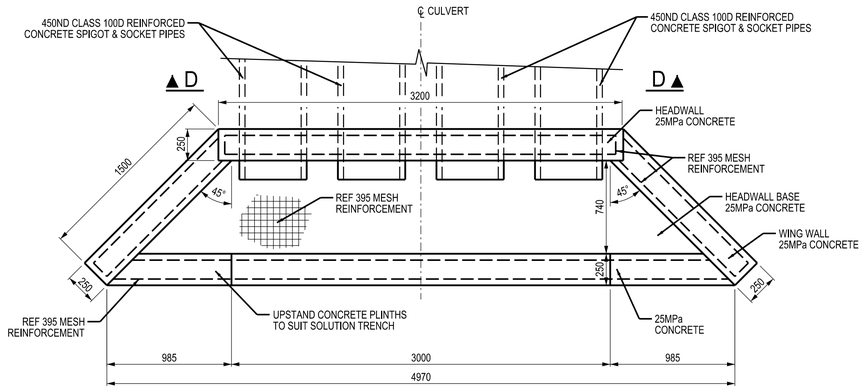
PLAN - CULVERT FOR SOLUTION TRENCH

SCALE 1:75



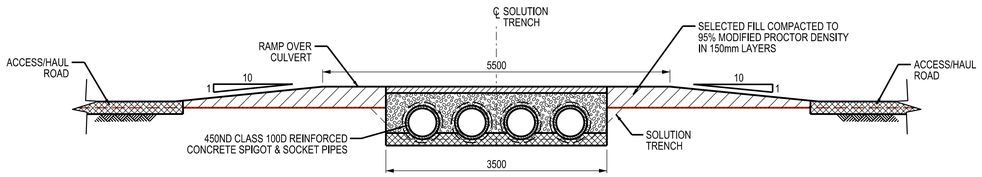
SECTION D - D
450ND CLASS 100D SPIGOT & SOCKET REINFORCED CONCRETE PIPES

SCALE 1:25



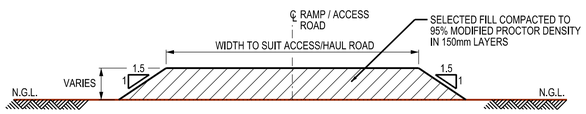
PLAN - CULVERT HEADWALL

SCALE 1:25



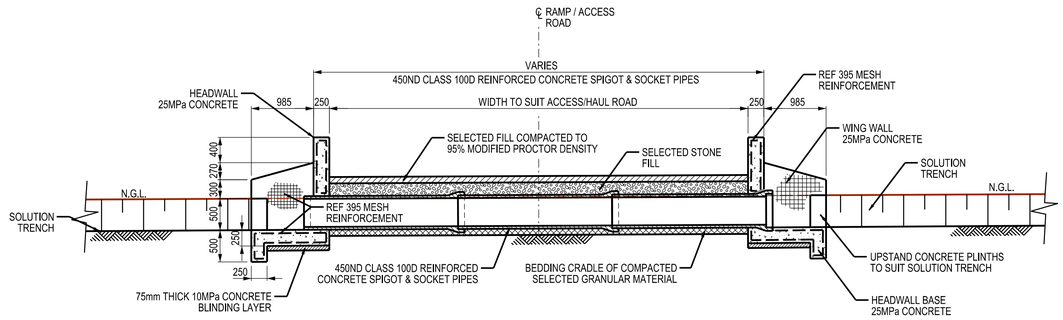
SECTION A - A

SCALE 1:50



SECTION B - B

SCALE 1:75



SECTION C - C

SCALE 1:50

GENERAL NOTES

1) THESE NOTES SERVE AS AN ADDENDUM TO THE SPECIFICATION IN THE BILL OF QUANTITIES FOR THIS PROJECT. IN CASES WHERE THE SPECIFICATIONS IN THE BILL OF QUANTITIES DIFFER FROM THESE NOTES, THESE NOTES SHALL TAKE PREFERENCE.
2) THE CONTRACTOR SHALL COMPLY WITH ALL STANDARDS/ SPECIFICATIONS WHICH ARE REFERRED TO IN THESE NOTES.
3) DRAWINGS SHALL BE CHECKED BY THE CONTRACTOR AND ANY DISCREPANCIES IN DIMENSIONS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE WORK IS COMMENCED.
4) DRAWINGS MAY NOT BE SCALED.

CONCRETE

EXCEPT WHERE MENTIONED OTHERWISE, THE CONCRETE WORK SHALL COMPLY WITH SABS 1200 G LATEST REVISION.

CONCRETE STRENGTHS

STRUCTURAL ELEMENT	CHARACTERISTIC 28 DAY STRENGTH (MPa)
BLINDING	IF REQUIRED - 75mm MAX

FOUNDATIONS

1) BACKFILLING:
ALL BACKFILLING TO FOUNDATIONS TO BE COMPACTED TO 95% Mod. AASHTO DENSITY (min).
2) BLINDING:
ALL BASES TO BE PROVIDED WITH 75mm BLINDING.
3) ALL SPECIFIED FOUNDING LEVELS ARE PROVISIONAL AND NEED TO BE CONFIRMED BY THE ENGINEER ON SITE

NOTES

1) CULVERT TYPES
450ND CLASS 100D SPIGOT & SOCKET REINFORCED CONCRETE PIPES AS DETAILED
2) CONSTRUCTION AND INSTALLATION CODES
PER SABS 1200 OR PROJECT SPECIFICATION.
3) FOUNDATIONS
A BEARING CAPACITY OF 200 kpa IS ASSUMED TO BE AVAILABLE.
4) FINISHING
VISIBLE SURFACES - WOOD FLOAT (ie TOP OF SLAB FOR FOUNDATIONS).
5) REINFORCING
FLOOR SLABS - MESH REF No 395
WING WALLS - MESH REF No 395
} ALL HIGH YIELD
6) JOINTS
JOINTS BETWEEN PRECAST UNITS TO BE SEALED WITH bidim A6 OR SIMILAR.

ISSUED FOR INFORMATION

DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
000-176-001	PHASE 1 - GENERAL ARRANGEMENT		
000-176-002	PHASE 2 - GENERAL ARRANGEMENT		
000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
000-176-004	PHASE 4 - GENERAL ARRANGEMENT		
000-176-005	PHASE 5 - GENERAL ARRANGEMENT		
000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

	MADE	DATE	
03	APPD	DATE	
02	APPD	DATE	
01	APPD	DATE	
00	APPD	DATE	
0C	APPD	DATE	
OB	3D	2013-02-19	- GENERAL UPDATES
0A	3D	2012-10-08	- ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION
NAME:
PR.ENG.No.
DATE:
SIGNED:

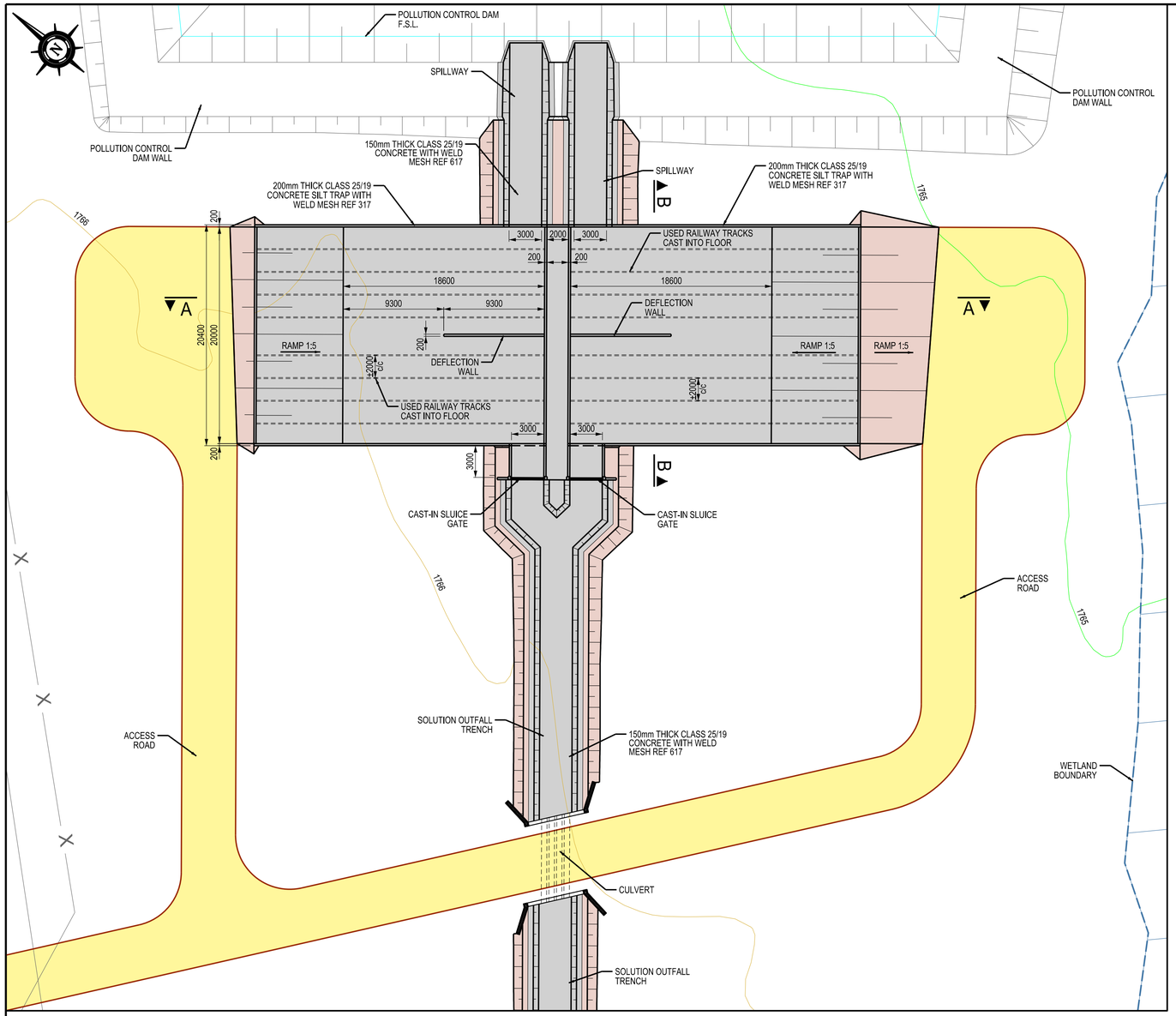
ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION APPROVAL ☐
COMMENT ☐
PRICING INFORMATION ☐
DATE:
SIGNED:

DRAWN	3D
DATE	DEC 2012
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
	A1 1:75
	A3 1:150

epoch resources (pty) ltd
mine residue and environmental engineering consultants

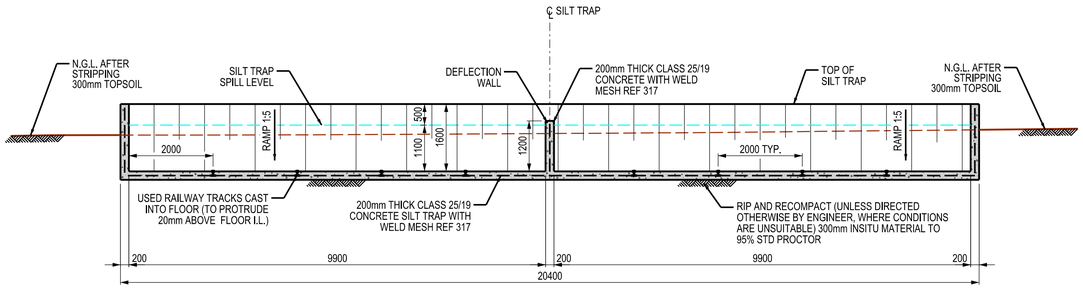
TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
CULVERT DETAILS

DRG No. 000-176-012
REV. B



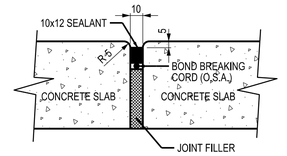
GENERAL ARRANGEMENT OF SILT TRAP

SCALE 1:250



SECTION B - B

SCALE 1:75

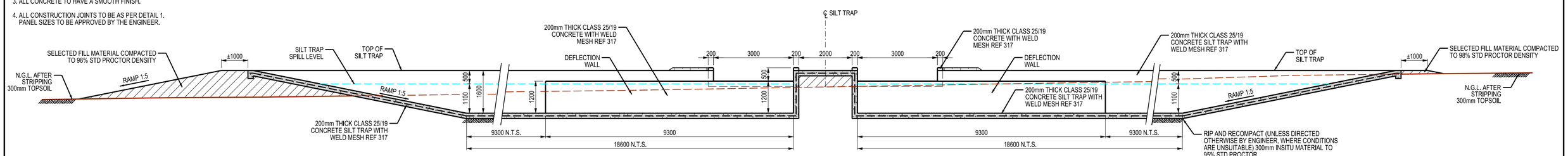


DETAIL 1
CONSTRUCTION JOINT

N.T.S.

NOTES :

1. SETTING OUT TO BE CONFIRMED BY THE ENGINEER PRIOR TO COMMENCEMENT OF EXCAVATION.
2. EARTH ADJACENT TO CONCRETE TO BE COMPACTED.
3. ALL CONCRETE TO HAVE A SMOOTH FINISH.
4. ALL CONSTRUCTION JOINTS TO BE AS PER DETAIL 1. PANEL SIZES TO BE APPROVED BY THE ENGINEER.



SECTION A - A

SCALE 1:75

ISSUED FOR INFORMATION

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000-176-002	PHASE 2 - GENERAL ARRANGEMENT		
000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
000-176-004	PHASE 4 - GENERAL ARRANGEMENT		
000-176-005	PHASE 5 - GENERAL ARRANGEMENT		
000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
000-176-014	SILT TRAP SPILLWAY DETAILS		
DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

	MADE	DATE	APPD	DATE	
03					
02					
01					
00					
0C	3D	2013-11-20			- SILT TRAP ALTERED
0B	3D	2013-02-19			- SPILLWAYS UPDATED
0A	3D	2012-10-08			- ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION

NAME:

PR.ENG.No.

DATE:

SIGNED:

ISSUED FOR:
- MANUFACTURE ☐
- CONSTRUCTION APPROVAL ☐
- COMMENT ☐
- PRICING INFORMATION ☐

DATE:

SIGNED:

DRAWN	3D
DATE	DEC 2012
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
CAPE DATUM Lo.29	A1 1:250
	A3 1:500

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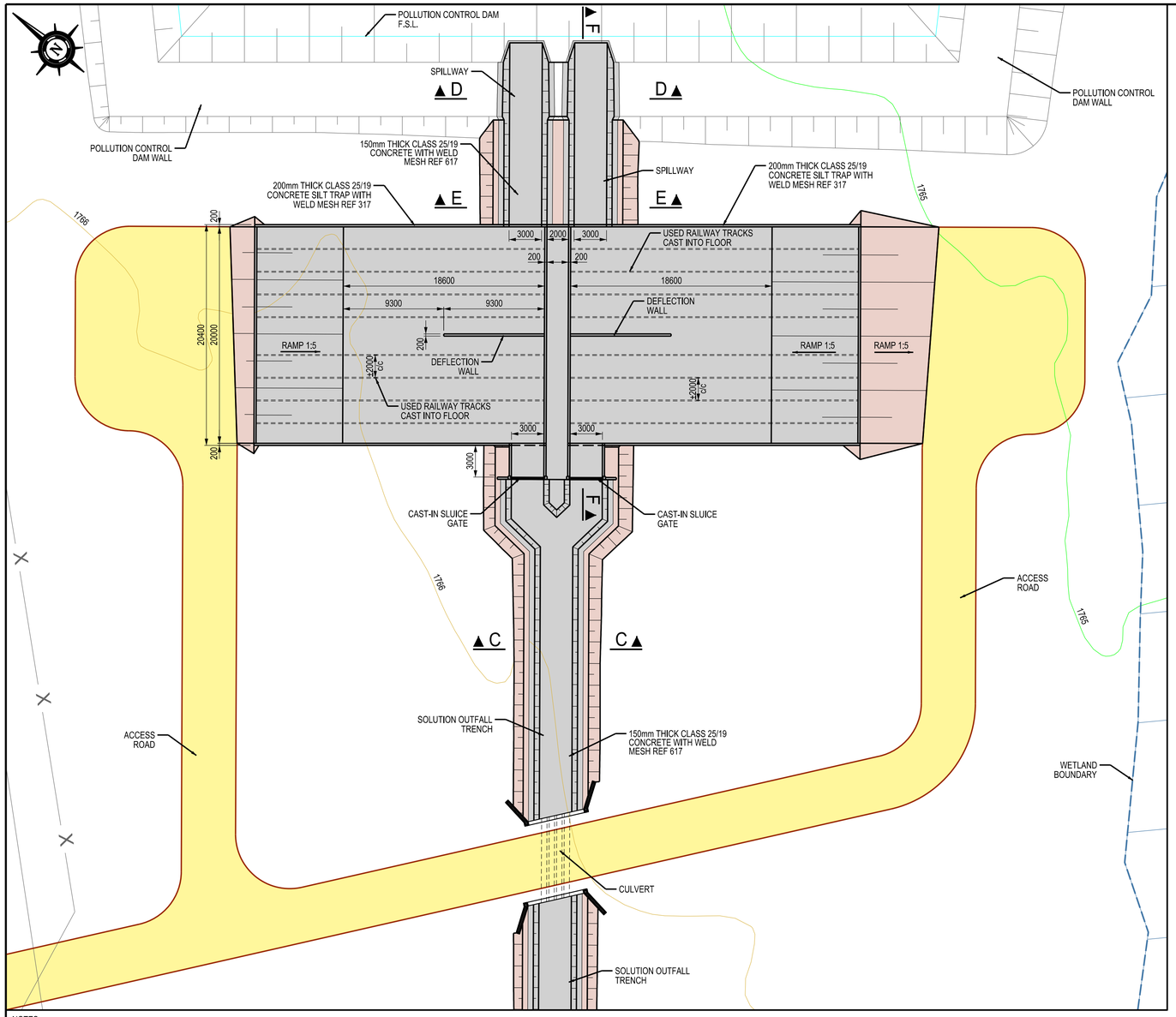
mine residue and environmental engineering consultants

TITLE

BELFAST COAL PROJECT
DISCARD FACILITY
SILT TRAP DETAILS

DRG No. 000-176-013

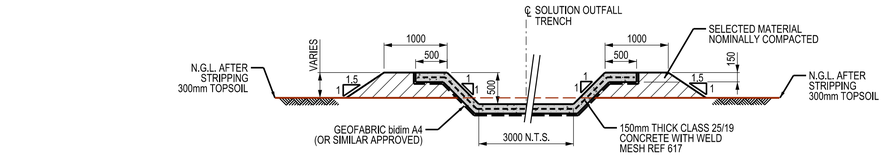
REV. C



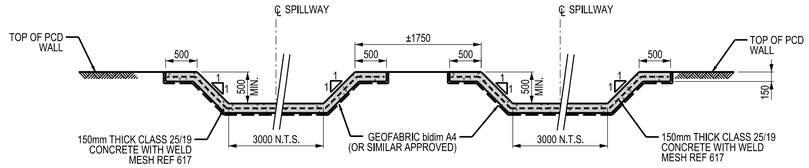
GENERAL ARRANGEMENT OF SILT TRAP
SCALE 1:250

NOTES :

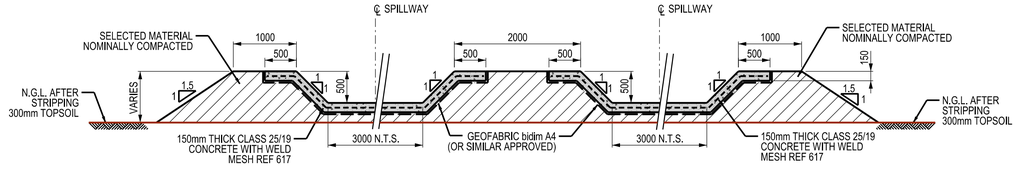
1. SETTING OUT TO BE CONFIRMED BY THE ENGINEER PRIOR TO COMMENCEMENT OF EXCAVATION.
2. EARTH ADJACENT TO CONCRETE TO BE COMPACTED.
3. ALL CONCRETE TO HAVE A SMOOTH FINISH.
4. ALL CONSTRUCTION JOINTS TO BE AS PER DETAIL 2. PANEL SIZES TO BE APPROVED BY THE ENGINEER.



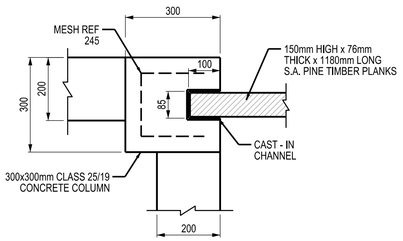
SECTION C - C
SCALE 1:50



SECTION D - D
SCALE 1:50



SECTION E - E
SCALE 1:50



DETAIL 1
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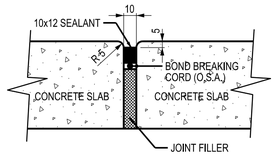
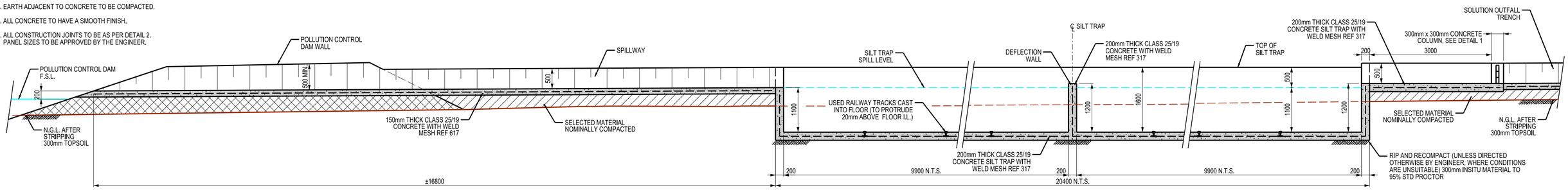


DETAIL 2
CONSTRUCTION JOINT
N.T.S.



SECTION F - F
SCALE 1:50

ISSUED FOR INFORMATION

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000-176-002	PHASE 2 - GENERAL ARRANGEMENT		
000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
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000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
000-176-013	SILT TRAP DETAILS		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

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02					
01					
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0C	3D	2013-11-20			- SILT TRAP ALTERED
OB	3D	2013-02-19			- SPILLWAYS UPDATED
0A	3D	2012-10-08			- ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION
NAME:
PR.ENG.No.
DATE:
SIGNED:

ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☐
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DATE	DEC 2012
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APPROVED (ENG)	
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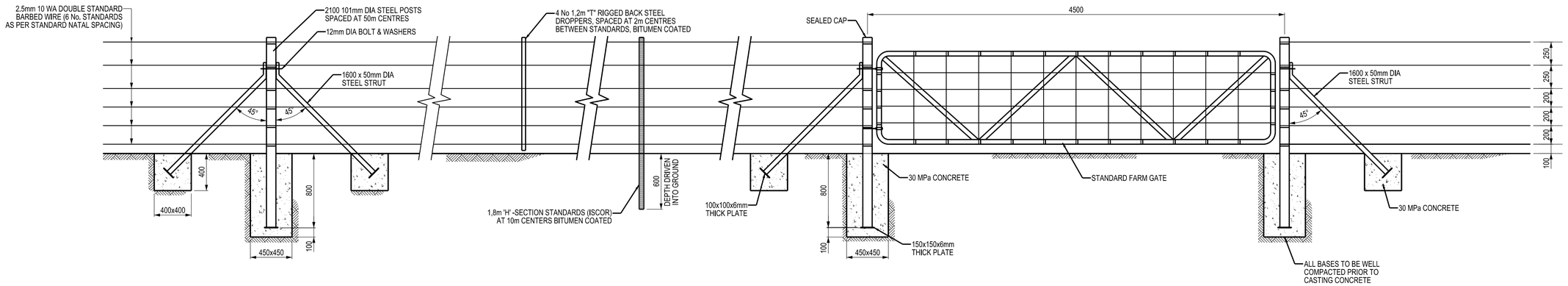
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
CAPE DATUM Lo.29	A1 1:250 / A3 1:500

epoch resources (pty) ltd
mine residue and environmental engineering consultants

TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
SILT TRAP SPILLWAY DETAILS

DRG No. 000-176-014
REV. C



TYPICAL FENCING AND GATE DETAIL

SCALE 1:25

ISSUED FOR INFORMATION

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000-176-004	PHASE 4 - GENERAL ARRANGEMENT		
000-176-005	PHASE 5 - GENERAL ARRANGEMENT		
000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

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03	APPD	DATE
02	MADE / APPD	DATE
01	MADE / APPD	DATE
00	MADE / APPD	DATE
0C	MADE / APPD	DATE
OB	MADE / APPD	DATE
0A	MADE 3D / APPD	DATE 2012-10-08 / DATE

- ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION
NAME:
PR.ENG.No.
DATE:
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ISSUED FOR:
MANUFACTURE ☐
CONSTRUCTION ☐
APPROVAL ☐
COMMENT ☐
PRICING ☐
INFORMATION ☐
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DATE	DEC 2012
CHECKED BY	
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APPROVED (ENG)	
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APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
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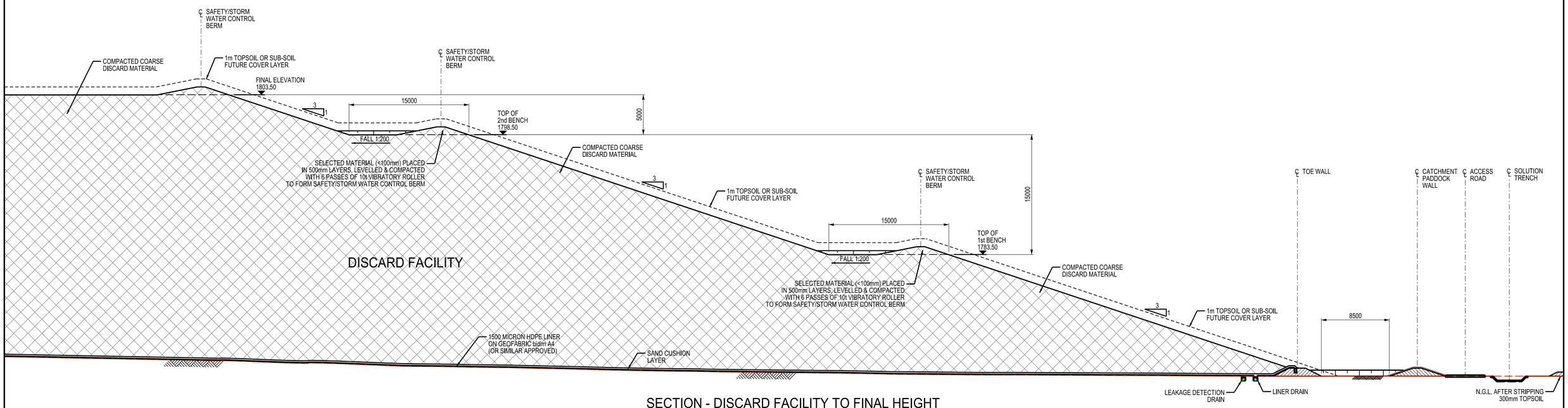
	A3 1:50

epoch resources (pty) ltd
mine residue and environmental engineering consultants

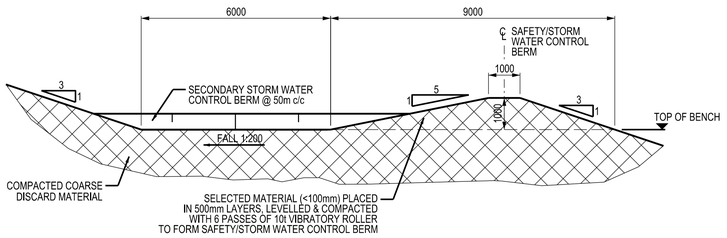
TITLE
BELFAST COAL PROJECT
DISCARD FACILITY
PERIMETER FENCE AND GATE DETAILS

DRG No. 000-176-015
REV. A



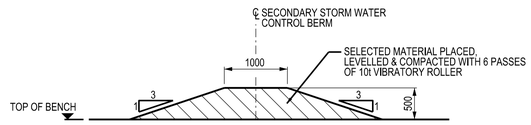
SECTION - DISCARD FACILITY TO FINAL HEIGHT

SCALE 1:250



SAFETY/STORM WATER CONTROL BERM

SCALE 1:100



SECONDARY STORM WATER CONTROL BERM - 50m c/c

SCALE 1:50

ISSUED FOR INFORMATION

DRAWING No.	DRAWING TITLE	DRAWING No.	DRAWING TITLE
000-176-001	PHASE 1 - GENERAL ARRANGEMENT		
000-176-002	PHASE 2 - GENERAL ARRANGEMENT		
000-176-003	PHASE 3 - GENERAL ARRANGEMENT		
000-176-004	PHASE 4 - GENERAL ARRANGEMENT		
000-176-005	PHASE 5 - GENERAL ARRANGEMENT		
000-176-006	PHASE 6 - GENERAL ARRANGEMENT		
000-176-007	PHASE 7 - GENERAL ARRANGEMENT		
REFERENCE DRAWINGS		REFERENCE DRAWINGS	

	MADE	DATE	
03	APPD	DATE	
02	APPD	DATE	
01	APPD	DATE	
00	APPD	DATE	
0C	3D	2013-11-18	- GENERAL UPDATES
0B	3D	2013-10-03	- LINER DETAILS ADDED - TOE WALL WIDENED
0A	3D	2012-12-02	- ISSUED FOR INFORMATION

PROFESSIONAL REGISTRATION

NAME:

PR.ENG.No.

DATE:

SIGNED:

ISSUED FOR:
- MANUFACTURE ☐
- CONSTRUCTION ☐
- APPROVAL ☐
- COMMENT ☐
- PRICING ☐
- INFORMATION ☐

DATE:

SIGNED:

DRAWN	3D
DATE	DEC 2012
CHECKED BY	
DATE	
APPROVED (ENG)	
DATE	
APPROVED (CLIENT)	
DATE	
CO-ORD SYSTEM	SCALE
	A1 1:250
	A3 1:500

epoch resources (pty) ltd

mine residue and environmental engineering consultants

TITLE

BELFAST COAL PROJECT
DISCARD FACILITY
TO FINAL HEIGHT
SECTION AND DETAILS

DRG No. 000-176-016

REV. C