Centennial Coal Airly

Centennial Coal Airly - Reject Emplacement Area Concept Design - Rev 2

August 2014

Table of contents

Table index

Figure index

Appendices

1. Introduction

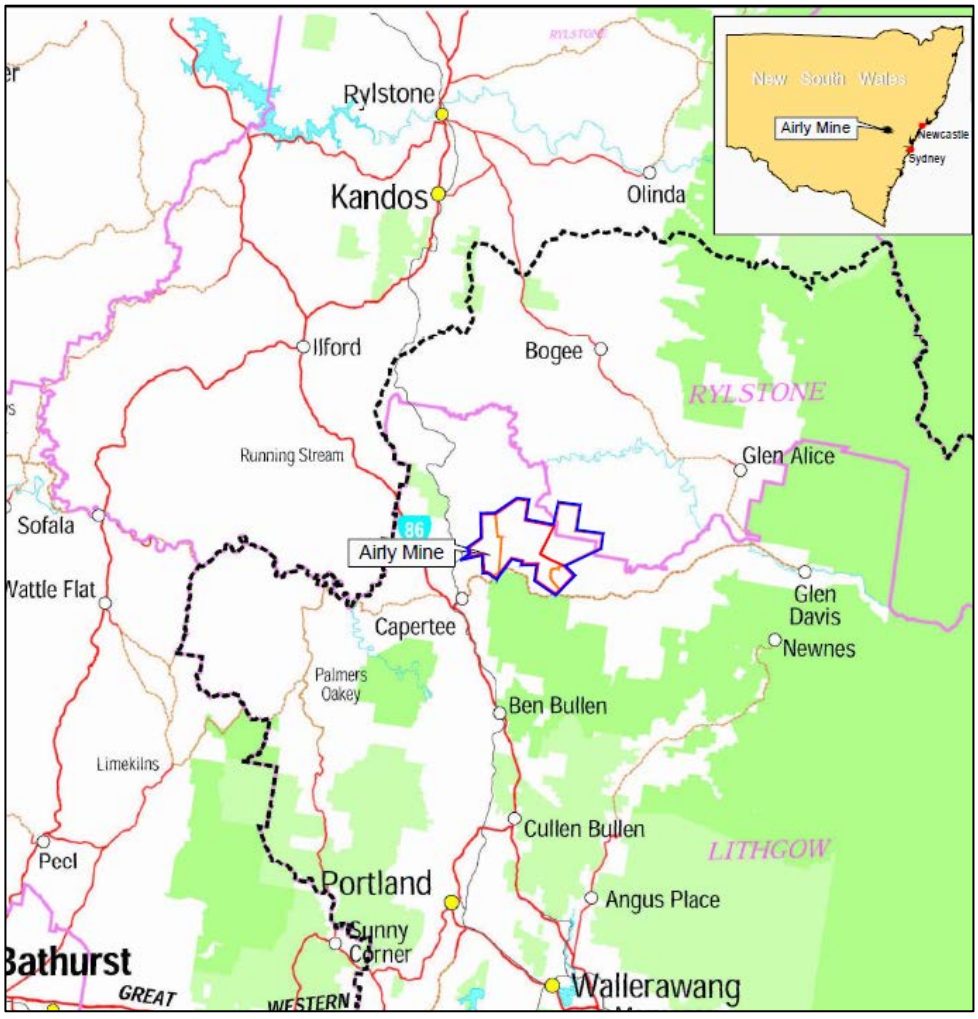
This report has been prepared by GHD Pty Ltd (GHD) for Centennial Airly Coal Pty Ltd (Centennial), to present and describe the Concept Design options for a proposed Reject Emplacement Area (REA) at their Airly coal mine, located near Capertee in New South Wales.

Since this report was originally prepared (i.e. as Revision 0), Centennial have submitted their Environmental Impact Statement (EIS) for an adequacy review, focussing on REA Option 2 (see Section 4.2). Additional design information was subsequently requested for the proposed REA, and hence this up-revised version of the report (Revision 1) has been updated to include:

- Refinements to the western edge of the proposed REA to suit the topographic survey;
- Details of the REA drainage plan, including sizing and gradients;
- The REA water management structure, including spillway sizing and location.

The above items have been addressed in Section 5 of this report.

Figure 1 Site Location



Base Map Source: City of Lithgow LGA Dept. of Lands

1.1 Project Background

The Airly underground coal mine was first granted a Development Consent in 1993 (DA 162/91) to mine within the mine lease ML 1331; DA 162/91 is set to expire in October 2014. In 1997,

Centennial acquired the mine, with production commencing in December 2009. In December 2012, the mine went into 'Care and Maintenance'.

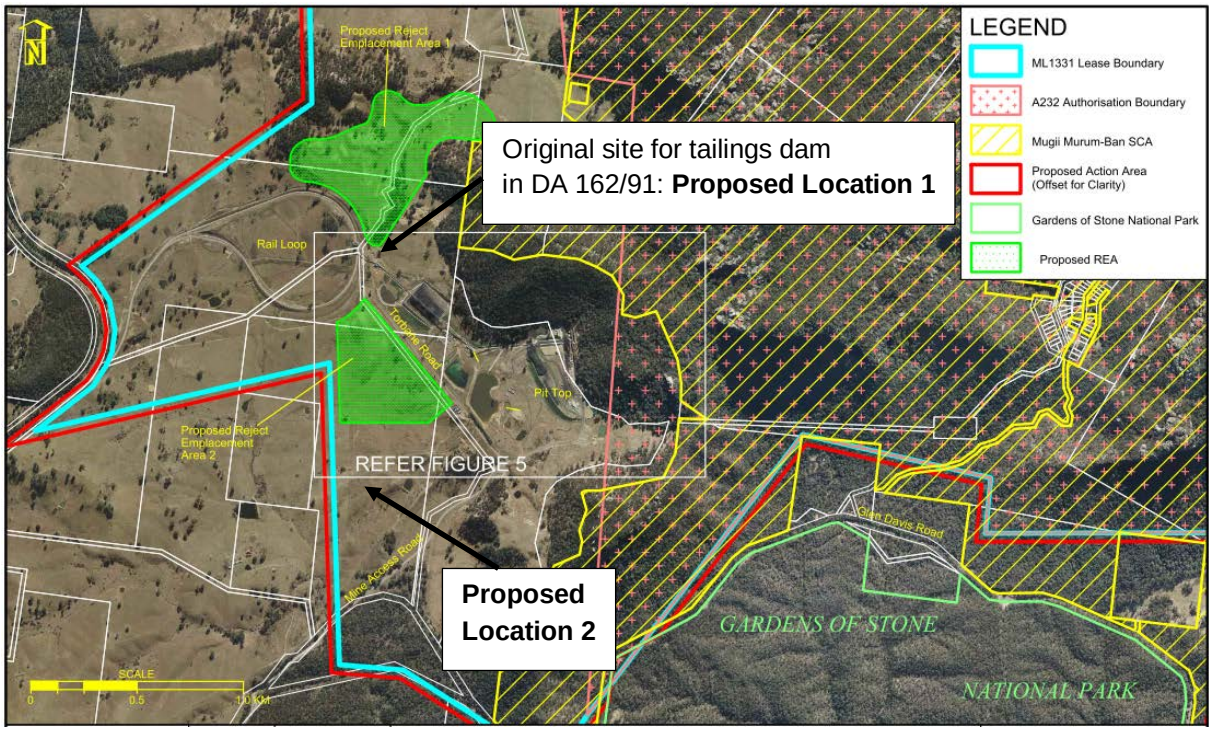
Centennial is currently in the process of applying for an extension of their mining operations, into the eastern section of the existing mine lease ML 1331, and additionally into Authorisation Area A232. The proposed project seeks a new Development Consent, and increase the Run-of-Mine (ROM) production limit from 1.8 Mtpa to 3.0 Mtpa.

DA 162/91 allows for the construction of a Reject Emplacement Area (REA) as well as a tailings dam, along with associated settling ponds. The initial plan was for the coarse reject to be dumped in the REA, and the tailings stream to be placed in a dam. Consent conditions included co-disposal to be reviewed.

It is now planned to combine the coarse and fine reject and co-dispose the waste at the REA. This will allow a reduction in the footprint of the waste management facilities; reduce the required infrastructure for water management as well as providing additional environmental benefits with regards to closure of the facility.

Two options have been identified as potential sites for the proposed REA site, as presented in Figure 2.

Figure 2 Airly Mine Site



2. Emplacement Methodology

The proposed emplacement methodology for the Concept Design is to co-dispose the coarse and fine waste reject streams. At this stage, no data is available for the physical or geochemical properties of the reject, or any geotechnical information of the proposed site options. Thus the methodology is conceptual, without engineering design but is considered to be realistic based on past experience of similar projects.

2.1 Waste Co-Disposal

The processing of coal won from mining is (conservatively) expected to produce approximately 15% waste reject; the reject will consist of coarse waste rock and fine, saturated tailings. These two waste streams will be mixed in proportions and by methods to be developed. Transport may be by conveyor, truck or slurry pumping, depending on which option is selected and other factors to be developed as details of the Coal Preparation Plant (CPP) are confirmed.

2.1.1 Advantages of Co-Disposal

Co-disposal of the waste streams presents the following potential advantages:

- Coarse waste rock placed in a dump would normally have a porosity in the order of ~30%, presenting ideal conditions for Acid Metalliferous Drainage (AMD) formation where Potentially Acid Forming (PAF) waste materials exist. It has been anecdotally noted that this may by the case at Airly Mine. Mixing the fine tailings with the coarse waste would reduce the porosity of the resultant soil matrix, reducing permeability and increasing the moisture holding properties of the mixed waste thus limiting oxygen access and reducing the risk of AMD.
- The overall volume of waste is reduced and the required footprint of a combined waste storage would be less than separate waste streams.
- No containing embankment is required for either waste stream.
- The combined material is expected to have superior engineering properties to the separate materials and will be suitable to construct an easily trafficable, low dust generating, stable landform with likely good properties for drainage and revegetation.

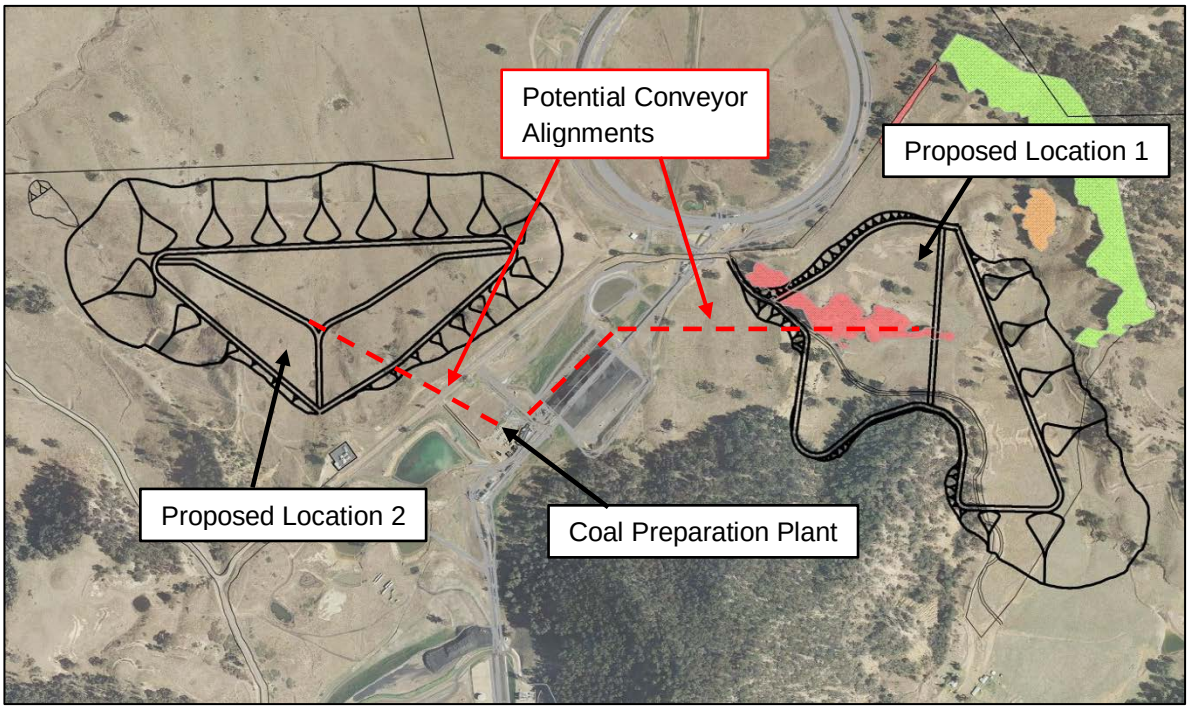
2.2 Proposed Construction/Emplacement Methodology

The first stage of the co-disposal process would consist of dewatering of the tailings stream, producing a filter cake. This would likely be achieved through a belt filtration process.

The filter cake would then be mixed with the coarse waste rock at the Coal Preparation Site (CPS). The resultant material would then be ideally transported to the REA using a conveyor system, bringing a greater level of Quality Assurance (QA) to the mixing process and subsequent emplacement.

At this stage, this is the proposed transport method; however, this may not prove to be feasible and transport by trucking may be the only option.

Figure 3 Potential REA Site Overview



Material would be placed, dozed and compacted at the proposed site. It is unknown at this stage whether any of the material would not require compaction; this will depend on the final design and properties of the waste material (i.e. potential for AMD generation and required level of saturation).

External batters would be laid back to between 3H:1V and 4H:1V, to be confirmed upon completion of geochemical/geophysical investigations. This slope would be targeted at requirements for revegetation and erosion reduction. Internal batters may vary, but would have a minimum slope of 100H:1V from drainage considerations.

The construction would likely be staged by emplacing over the lower levels of the footprint area and bringing the embankment height up through a series of layers sloping to collector drains for stormwater management. The active emplacement area would be drained back into the natural slope with external batters being progressively trimmed and revegetated to limit erosion and create visual screening of ongoing works.

2.3 Potential Issues

A number of potential issues exist with the proposed methodology, which will need to be addressed during the Development and Detailed Design phases.

According to literature, the ideal ratio for mixing the coarse waste to dewatered tailings is 4:1 (coarse to fine). If the percentage of tailings becomes greater than this, it may result in reduced strength and increased erosion potential[1]. Therefore, the dump may need to be zoned to provide a strong, erosion resistant outer zone and a weaker internal zone.

To provide maximum resistance to AMD generation the combined material should be placed and maintain a saturation level of approximately 85% minimum. Moisture levels may need to be adjusted during placing if the combined material is too dry. Alternatively the level of dewatering of tailings may be adjusted.

[1] Gowan, M Lee, M Williams, D 2010, '*Co-Disposal techniques that may mitigate risks associated with storage and management of potentially acid generating wastes'* Australian Centre for Geomechanics

3. Surface Water Management

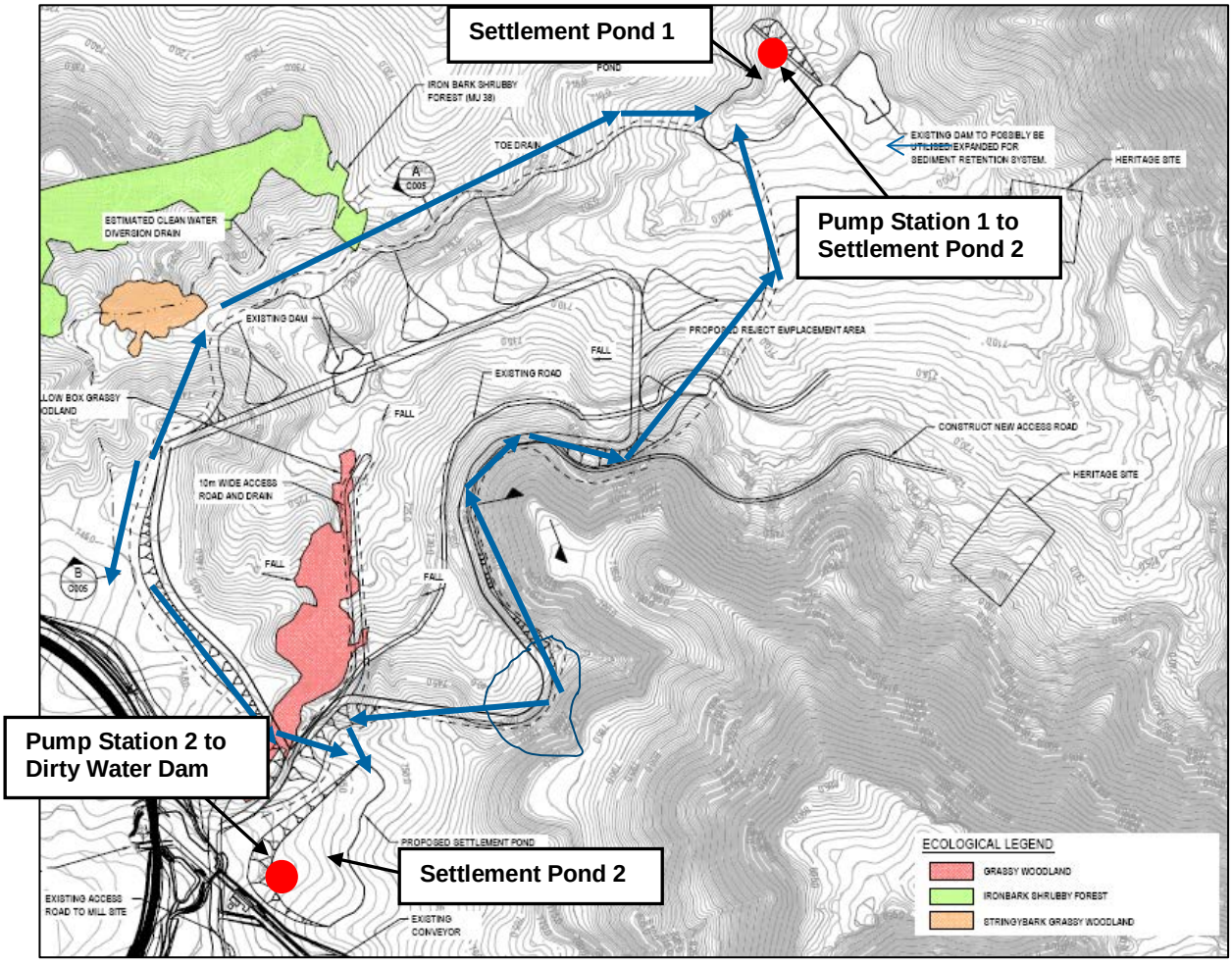
This section describes the design concepts for surface water management at the proposed REA locations.

3.1 Dirty Water

Surface runoff from the REA would be controlled primarily by designing the emplacements to limit external batters and direct the maximum runoff to the internal areas, where runoff would be collected in silt traps and then collected by internal rock-lined drains running adjacent to construction access roads. This runoff would then be transported along external toe drains, before reporting to a settlement pond.

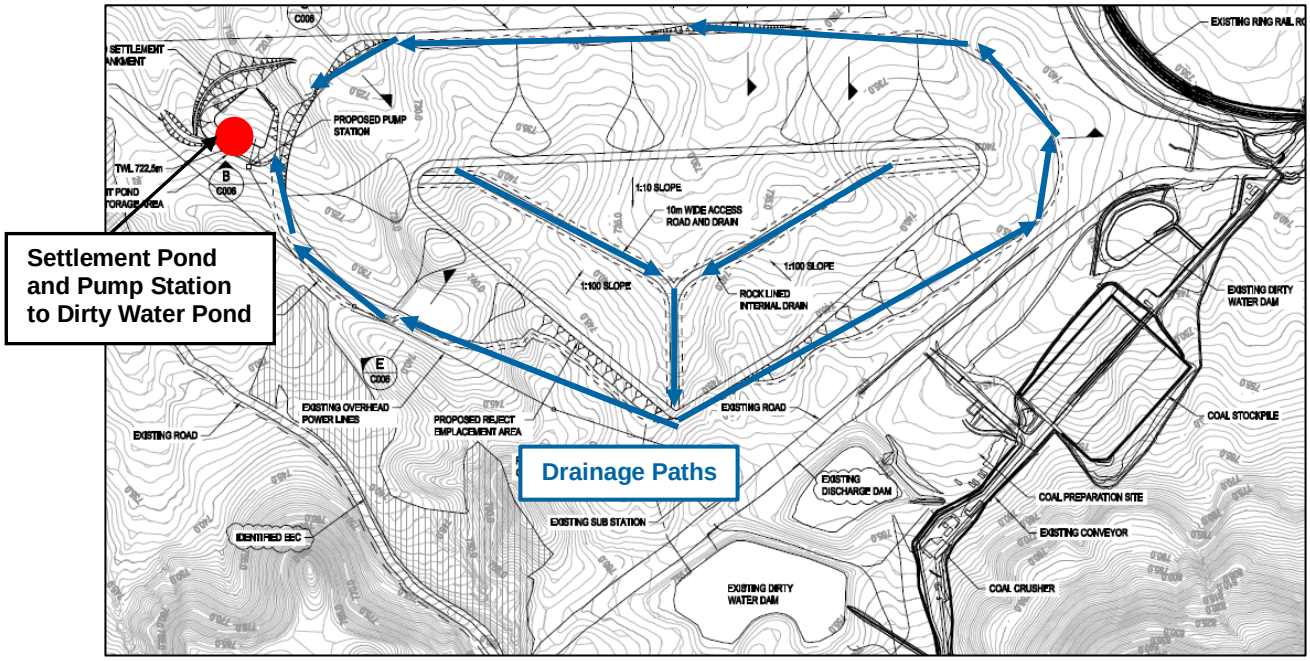
The proposed drainage system for Location 1 is shown on Figure 4. This shows that internal drainage would be directed to a new settlement pond that would be located to the south of the REA, east of the rail loop. Water would be pumped to this pond from temporary water collection silt traps within the active placement area. These would be progressively relocated as the waste level was raised and advanced up the contours. The major external batters would drain to a second pond to the north-east. Water from this pond would be pumped up to the new pond and from there to the existing dirty water dam.

Figure 4 Proposed Location 1



The layout for location 2 is shown in Figure 5. This shows the central active emplacement area as an elevated plateau draining to internal drains directed to a Settlement Pond to the south-east of the facility. External batter drains also gravitate to the pond where a pump station would direct settled water to the existing dirty water pond.

Figure 5 Proposed Location 2



3.1.1 Operational Arrangement

During operations, dirty water from active emplacement areas would be collected in local silt traps then pumped or directed by gravity to larger settlement ponds. For Location 1, several pumps would be required but for Location 2 all drainage should be able to be directed to a single pond by gravity flow. Settled water would be pumped from the settlement pond to the existing Dirty Water Dam for reuse on site. Therefore, the proposed settlement pond should not release any water during regular operations. The pump would nominally be triggered to begin operation when the settlement pond is at a low level, say 10% full.

3.2 Clean Water

It is anticipated that management of clean water will be relatively straightforward due to the small catchments that would be affected by either of the two REA options.

Clean water diversions would consist of a combination of rockfill-lined cut-off drains and homogenous earthfill bunds.

4. REA Options Analysis

Two locations have been identified as potential options for the proposed REA site. These sites have been compared, under the following conditions as discussed with Centennial:

- Storage volume of 5 Mm^3. This initial estimate has been based on remaining reserves, ~15% reject production and a density of 1.5 t/m^3. This is considered a conservative estimate, and densities in excess of 1.5 are considered likely to be achieved.
- Footprint of the REA was to remain within the mining lease, and to avoid existing infrastructure.
- Impacts to be taken into consideration included: environmental factors – in particular areas identified as being of ecological significance; visual and noise impacts; water management; operational practicality and safety; potential for expansion and overall feasibility of the proposed sites.

The two REA site options and associated features are presented in the Concept Design Drawings attached as Appendix A, as well as the 3D rendered sketches attached as Appendix B.

4.1 Proposed Location 1 Overview

Table 1 Proposed Location 1 Features

REA Component	Value
Footprint Area	30.4 Ha
Crest Level	RL 752.4m
Height (max)	49m
Storage Volume	5.0 Mm^3
External Batter Slope	3H:1V to 4H:1V

The proposed Location 1 site is located approximately 850m north of the CPP, and is the tailings dam site identified in the existing DA. The site is positioned within a natural valley within the mine lease; the land is owned by Centennial and is currently leased out for grazing purposes.

Figure 6 Proposed Location 1 Site Looking Northwest

Given the distance from the CPP to the proposed site, a conveyor system for material transport may not be feasible, and the waste may need to be transported by truck (most likely scenario under the current plan).

4.1.1 Ecology

An ecological survey conducted by RPS Australia East Pty Ltd (RPS)[2] found that the proposed Location 1 site will involve the removal of native vegetation to accommodate the emplacement of reject materials. Location 1 will have direct impacts upon one endangered Ecological Community and one threatened flora species. Clearing of vegetation will have the following impacts:

- The removal of approximately 2.131 ha of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native Grassland (Critically Endangered Ecological Community).
- The removal of 1 ha of non-listed vegetation, which may constitute potential habitat for Eucalyptus macrorhyncha subsp. cannonii (Capertee Stringybark) (Vulnerable) and threatened fauna species.
- The removal of a small number (approximately five) of E. macrorhyncha subsp. cannonii (Vulnerable threatened flora).

These ecological impacts have been red-flagged in the Biodiversity Banking & Offset Scheme, and would require a significant potential offset.

4.1.2 Heritage

In addition to the ecologically significant areas, the proposed area is constrained in the eastern valley area due to the presence of historical heritage sites associated with oil shale mining activities at Mount Airly.

[2]Hillier, P 2012, *'Re: Due Diligence Inspection for a Proposed Reject Emplacement Area, Airly Mine, Capertee, NSW',* RPS Australia East Pty Ltd

The proposed site is located over a section of the now-demolished Torbane village. Remnants of the Torbane Processing Site are still visible. The proposed REA would be partially located over the Torbane tramway route, which was opened in 1900. The tramway was dismantled in 1930.[3]

Figure 7 Heritage Sites in Eastern Valley

4.2 Proposed Location 2 Overview

Table 2 Proposed Location 2 Features

REA Component	Value
Footprint Area	33.6 Ha
Crest Level	RL 765m
Height (max)	40m
Storage Volume	5.2 Mm^3
External Batter Slope	3H:1V to 4H:1V

The proposed Location 2 site is located approximately 400m to the southwest of the CPP, on gently sloping, open reclaimed farmland. The proposed REA emplacement area will be able to be seen from various points along the Castlereagh Highway, west of the mine site, as well as some properties. However the design allows for progressive revegetation of the outer visible batter which over a period of time would allow the REA to provide a visual and noise screen to the CPP.

[3] RPS 2012, '*Historic Heritage Assessment: Airly Coal Mine, Capertee, NSW*', RPS Australia East Pty Ltd

Figure 8 Proposed Location 2 Site Looking Southwest

This location has been identified as a potential site due to environmental and operational advantages when compared to the proposed Location 1. Due to the relatively close proximity to the CPP, transport of the reject material by conveyor system would be less costly in terms of infrastructure required, operational costs as well as maintenance. In addition the proposed Location 2 site avoids interference with any areas of ecological or historical significance.

An ecological survey has been completed by RPS over the proposed Location 2 area. In the letter provided, it was concluded that direct ecological impacts of construction would be of low significance.[4]

4.3 Options Comparison

Table 3 presents a comparison of the two REA site options from a number of perspectives.

[4] Hillier, P 2012, '*Re: Ecological Inspection for the Proposed Reject Emplacement Area 2, Airly Mine, Capertee, NSW'* RPS Australia East Pty Ltd

Table 3 REA Options Comparison

Component	Location 1	Location 2	Comments
Safety	No significant issues	No significant issues	Either design should be able to be constructed and operated safely provided an appropriate risk register is completed, and suitable precautions are taken.
Operations	Average transport distance would be ~1000m. This location would be comparatively more expensive from a capex perspective if transported by conveyor. This location would be comparatively more expensive from an opex perspective if transported by truck.	Average transport distance would be ~400m. This location would be comparatively cheaper from a capex perspective if transported by conveyor. This location would be comparatively cheaper from an opex perspective if transported by truck.	REA 2 is clearly the preferred site operationally as it is in closer proximity to the CPS, presenting savings in capex and opex. **This is further discussed in Section 4.3.**
Water Management	Clean water diversion would be relatively straightforward. Two settlement ponds required, one of which would be in a different catchment to the existing site water runoff. Pumping back to the existing dirty water dam would require a ~2400m pipeline pumping up ~55m head. The proposed two settlement dams would require approximately 39,000 m^3 of above-ground earthworks.	Very little construction required for clean water diversion. Only one settlement pond required and located in the same catchment as the existing site water runoff system. Pumping back to the dirty water dam would require a ~900m pipeline pumping up ~25m head. The proposed settlement dam would require approximately 21,500 m^3 of above-ground earthworks.	Location 2 is preferred from an operational perspective due to the closer proximity resulting in lower capital and operating costs for pumps and pipelines. Location 2 settlement pond arrangement is preferred as simpler system with single pump compared to multiple pumps
Visual Impact	Hidden by natural landforms from public roads and private property.	Very open site that will be visible from the nearby highway and some properties. Once initial construction developed the REA may be advantageous in reducing the overall mine site visual impact.	Location 1 is preferred from a visual perspective in the short term but Location 2 has advantage once past initial construction.

Component	Location 1	Location 2	Comments
Noise Impact	The noise impact from construction would be constrained to some degree due to the surrounding land forming a natural barrier; however there would be a noise impact due to haulage from the CPP to site.	The noise impact from construction would be relatively high due to the site being very open; however this is offset to some degree due to the shorter comparative haulage distance from the CPP. The noise impact would also reduce with time once an outside embankment is formed and vegetation screen developed.	Location 1 is preferred at start-up due to a lower noise impact from construction; however Location 2 would have a lesser impact from a material transport perspective and in longer term provides visual and noise screen for the CPP.
Environmental Impact	Significant ecological areas identified that will require Bio Banking offsets.	Area has been identified as having no significant ecological issues.	Location 2 is preferred from an ecological perspective, as there is relatively no impact compared to Location 1.
Heritage Impact	Footprint constrained to the east by heritage Mount Airly mining sites. The proposed location will be partially over the old Torbane village tram line.	Area has been identified as having no significant heritage impacts.	Location 2 is preferred from a heritage perspective, as Location 1 is in closer proximity to significant sites.
Potential for Expansion	Potential for expansion to the northeast.	The site is constrained by the current mine lease, giving little room for expansion without altering the lease or moving existing infrastructure.	Under the current mine lease constraints; Location 1 has more potential for expansion. At this stage under the projected mine life, it is considered unlikely that the REA would require expansion. Location 2 potential capacity can be increased by steepening the external batter to 3:1.

4.4 High Level Cost Comparison

An Order of Magnitude cost comparison has been completed of the two proposed sites. At this Concept Level stage these are only considered indicative budget costs, and **only include costs that are expected to differ for the two proposed sites.** An accurate indicative cost estimate for the entire project is considered outside this scope of work, and may include items excluded from this comparison, including:

- Capex and mobilisation of plant;
- Capex for additional infrastructure required for either site, including process and mixing plant requirements, buildings and structures;
- Maintenance of plant and infrastructure.

The viability of the material transport method (i.e. conveyor system or trucking) has also not been analysed at this stage from a cost perspective. This would be done as part of the development phase once a preferred site has been chosen by Centennial.

4.4.1 Capital Expenditure Comparison

Table 4 and Table 5 give a comparison of the estimated costs for capex that would differ for the two sites, given transport of the waste material by conveyor. Prices have been nominally assumed based on previous experience.

The conveyor has been rated at 60 tph to give a capacity of 0.525 Mtpa. The design allows for a 6m high stockpile on the REA at the end of the conveyor which would contain 700 t of material, to allow for dozing on day shift only assuming 12 hour shifts.

Table 4 Location 1 Capex Budget Estimate

Item	Quantity	Unit	Rate	Total
Preliminaries				
Clear and grub footprint area	30.4	Ha	$2,500	$76,000
Strip and stockpile topsoil material	91,200	m^3	$3	$273,600
Conveyor system for material transport				
Conveyor	875	m	$3,500	$3,062,500
Steel for trestles (10 off)	5	t	$10,000	$50,000
Footings	20	m^3	$1,000	$20,000
Steel for trusses 300 m long (9 off)	18	t	$10,000	$180,000
Transfer tower	4	t	$10,000	$40,000
Water management				
Construct 2 x Settlement Ponds	39,000	m^3	$10	$390,000
Construct dirty water drainage system	4,440	m	$15	$66,600
Construct clean water cutoff/diversion system	1,610	m	$25	$40,250
Supply 2x Warman Pump	2	Item	$12,000	$24,000
Return pipeline	2,400	m	$50	$120,000
			Total	**$4,342,950**

Table 5 Location 2 Capex Budget Estimate

Item	Quantity	Unit	Rate	Total
Preliminaries				
Clear and grub footprint area	33.6	Ha	$2,500	$84,000
Strip and stockpile topsoil material	100,800	m^3	$3	$302,400
Conveyor system for material transport				
Conveyor	400	m	$3,500	$1,400,000
Steel for trestles (4 off)	2	t	$10,000	$20,000
Footings	8	m^3	$1,000	$8,000
Steel for truss 100 m long (3 off)	6	t	$10,000	$60,000
Water management				
Construct Settlement Pond	21,500	m^3	$10	$215,000
Construct dirty water drainage system	4,150	m	$15	$62,250
Construct clean water cutoff/diversion system	1,700	m	$25	$42,500
Supply 1x Warman Pump	1	Item	$12,000	$12,000
Return pipeline	950	m	$50	$47,500
			Total	**$2,253,650**

It can be seen that the estimated cost saving for Location 2 is in the order of $2 Million.

4.4.2 Operational Expenditure Comparison

If the reject material is to be transported by conveyor, neither option presents any significant differential in cost saving, as the primary operating costs are the same and would include:

- Dewatering of tailings;
- Mixing of the waste streams;
- Dozing and compacting material at the site.

If the reject material is to be transported by truck, the haulage cost would vary depending on the REA location. A basic cost analysis has been undertaken, under the following assumptions:

- 450,000 tpa of reject material to be transported, equating to 51.5 tph at 24 hours per day, or 1,233 tonnes per day.
- 1 truck operating at 80% efficiency.
- Truck capacity of 15 m^3 or 22.5 tonnes at 1.5 t/m^3.
- 60 sec loading time, 45 sec unloading time, truck travels at an average of 30 km/hr.

Under these assumptions, it is estimated that the cycle time for Location 1 would be 5 min 45 sec, and for Location 2 would be 2 min 40 sec. Therefore for Location 1, the truck would need to be operating for 6.6 hours/day, and for Location 2 would need to be operating for 3 hours/day.

Assuming a nominal rate of $150/hr (inc. operator), this equates to a saving for Location 2 in the order of $200,000 per annum, or $0.44/tonne of reject material (or $0.08/tonne saleable coal).

Other costs associated with hauling, including capex and maintenance, are considered equivalent for both options and have therefore not been considered.

4.4.3 Discussion

If a conveyor system is to be used for reject material transport, it can clearly be seen that Location 2 is more cost effective when comparing potential capex. This is obviously due to the longer distance of the proposed site to the CPP.

Additionally, the ecological impacts of Location 1 (as discussed in Section 4.1.1) and associated Bio Banking offsets may have a significant cost impact.

From an operational perspective, Location 2 is more cost effective due to the closer proximity resulting in a shorter haulage, only one settlement dam required, a shorter water return pipeline and lesser pumping requirements.

GHD would like to emphasise that these costs are a high level, order of magnitude estimate at this stage, and further analysis is required.

4.5 Discussion & Recommendations

It is the opinion of GHD that both sites analysed, proposed Location 1 and Location 2, present viable options for placement of five million cubic metres of reject material at the Airly Mine site.

It is recommended that Centennial concentrate on further development of the Location 2 site in preference to Location 1, for the following reasons:

- Location 2 should prove a more cost effective solution in terms of capital and operational expenditure.
- Location 1 has significant ecological constraints as discussed in Section 4.1, requiring significant Bio Banking offsets. No significant issues exist at the REA 2 site.
- Location 1 would require lower operational costs from a water management perspective, and is located within the same catchment as the existing site water runoff system.

The most significant factor counting against Location 2 when compared to Location 1 is the potential visual/noise impact. It is recommended that staged rehabilitation of the external batter slopes be undertaken to minimise the visual impact during operations. The proposed facility should eventually provide a partial visual/noise barrier to the mine operations.

The required storage of 5 Mm^3 has been calculated from reserves estimates as of March 2012. Conservatism has been built into this estimate, however future potential increases in reserves (for example if price of coal increases) may require expansion of the REA. The current Concept Design for Location 2 has limited potential for expansion within the existing mine lease, without having to relocate existing power lines and realign the mine access road; however, these are realistic options for expansion if required. The capacity could be increased significantly by extending outside the lease towards the north. The Concept Design for Location 1 would not require any major realigning/replacing of existing infrastructure for expansion within the current mine lease.

5. Proposed REA Option 2 Design Details

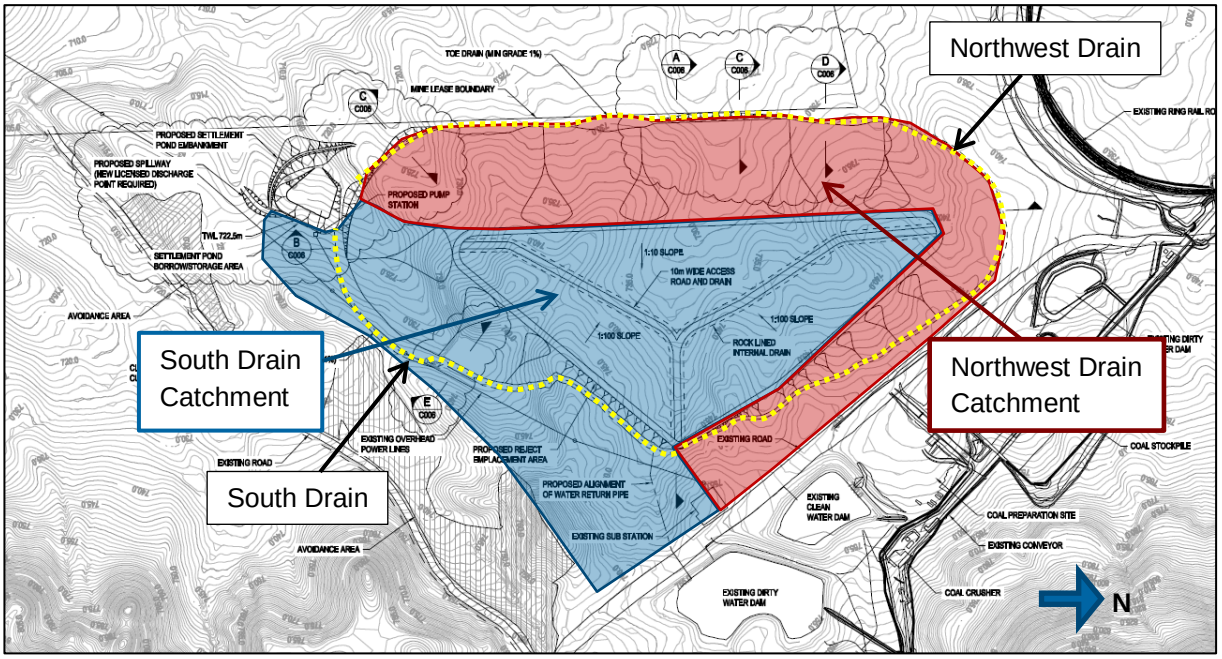
As recommended in Section 4.5, Location 2 is preferred over Location 1. Therefore, this section documents hydrology, water management and staging designs for the proposed REA at Location 2.

5.1 Hydrology

5.1.1 Catchment Area

The total catchment for the REA and water management dam has been split into two catchments 18.1 Ha and 26.9 Ha in size, with runoff respectively reporting to the Northwest and South drains as illustrated in Figure 9 below.

Figure 9 Drain Alignments and Catchments



5.1.2 Design Events

The following table presents the design criteria for the water management structures:

Table 6 Design Criteria

Item	Design Criterion
Perimeter Stormwater Drains	Capacity for a 1:100 AEP flood event (peak flow)
Stormwater Management Dam	• Storage of a 1:100 AEP 72 hour flood • Type D sediment basin as per EPA requirements
Spillway	1:1,000 AEP peak flood flow
Pump & Pipeline	Average and wet year flows (water balance)

The Australian National Committee on Large Dams (ANCOLD) guidelines have been used to determine the design criteria, along with the NSW Department of Environment and Climate Change's publication *'Managing Urban Stormwater: Soils and Construction"* (DECC, 2008).

The design parameters for the water management structures are summarised in

Table 7. The runoff flow rates were calculated using the rational method as defined in *Australian Rainfall and Runoff Vol. 1 Book IV* (EA, 1998). The time of concentration for each of the catchments was calculated using the Bransby Williams Formula.

Table 7 Water Management Design Parameters

Parameter	Value	
Natural surface runoff coefficient	1:100 AEP	0.54
	1:1,000 AEP	1.0
Reject material runoff coefficient	1:100 AEP	0.9
	1:1,000 AEP	1.0
Northwest Drain Required Capacity	1.69 m^3/s	
Southern Drain Required Capacity	5.97 m^3/s	
Water Management Dam Required Storage	45.1 ML	
Spillway Required Capacity	9.7 m^3/s	

5.1.3 Water Balance

A high level water balance has been undertaken in order to provide a concept design for the Settlement Dam pump and pipeline, with the design requirement being to keep the water level in the Settlement Dam low.

The design parameter chosen was a 90th percentile wet year, based on the rainfall model developed by GHD and reported in *'Airly Mine Extension Project: Surface Water Impact Assessment'* (GHD, 2014).

Evaporation records were taken from the Bathurst agricultural station, ~50 km from site (records from 1966 to 2014 taken from Bureau of Meteorology (BOM) website).

In addition, the following design parameters were applied:

- Runoff coefficient of 0.8 for the REA;
- Runoff coefficient of 0.6 for open ground;
- Pan evaporation factor of 0.7;
- No seepage through the embankment or foundations;
- Evaporation only applied to Settlement Dam surface area.

The monthly water balance inputs are summarised in Table 8:

Table 8 Summary of Water Balance Inputs

Month	Rainfall (mm)		Evaporation (mm)
	Average	90th Percentile	Average
January	67.4	123.2	210.8
February	65.0	131.4	159.6
March	51.2	119.7	136.4
April	44.8	97.2	87
May	44.5	92.9	52.7
June	52.1	103.0	33
July	53.4	111.3	37.2
August	58.0	105.0	55.8
September	52.4	87.6	84
October	58.9	109.5	124
November	64.4	124.6	159
December	61.5	117.4	201.5
Annual	**673.6**	**1,323.0**	**1,341**

It can be seen that average evaporation exceeds average rainfall even for a wet year; however as the catchment area for the Settlement Dam (~46 Ha) far exceeds the surface area of the dam (~1.1 Ha), the inflows exceed the outflows and a pump and pipeline system is required to keep water levels low in the dam.

The monthly water balance for the Settlement Dam is summarised in Table 9.

Table 9 Summary of Settlement Dam Water Balance

Month	Rainfall Inflow (m^3/month)		Evaporation Outflow (m^3/month)	Pump Ouflow (L/s)	
	Average	90th Percentile		Average	90th Percentile
January	22,940	41,950	1,620	8.0	15.1
February	22,100	44,690	1,230	8.6	**18.0**
March	17,420	40,710	1,050	6.1	14.8
April	15,240	33,080	670	5.6	12.5
May	15,130	31,600	410	5.5	11.6
June	17,710	35,030	250	6.7	13.4
July	18,160	37,860	290	6.7	14.0
August	19,740	35,730	430	7.2	13.2
September	17,830	29,790	650	6.6	11.2
October	20,020	37,260	950	7.1	13.6
November	21,920	42,380	1,220	8.0	15.9
December	20,900	39,930	1,550	7.2	14.3
Annual	**229,100**	**450,010**	**10,330**	**6.9**	**14.0**

5.2 Water Management

The REA has been designed to limit external batters and direct the maximum runoff to the internal areas, where runoff will be collected by internal drains running adjacent to construction access roads, then directed to silt traps. This runoff would then be transported along external toe drains, before reporting to a water management dam.

5.2.1 External Drainage Design

The Northwest and South drains have been designed as trapezoidal open channels with capacity for the 1:100 AEP flood event. The drains will run by gravity with a minimum 1% slope, reporting to the REA Settlement Pond.

In order to remain within the mining lease, two bunds will be required to allow the drains to remain on grade. These bunds may require a clay cut-off trench, to prevent leachate seepage under the bund.

Concept design parameters of the drains are presented in Table 10, with cross-sections presented in Figure 10 and Figure 11.

Table 10 External Drain Concept Design Parameters

Parameter	Northwest Drain	South Drain
Base Width (m)	0.5	0.5
Depth (m)	0.85	1.3
Batters	1H:1V	1H:1V
Average Slope	1.0%	2.2%
Manning's Roughness Coefficient	0.035	0.035
Maximum Flow Rate	1.77	6.74

Figure 10 Northwest External Drain Cross-Section – Bunded Area

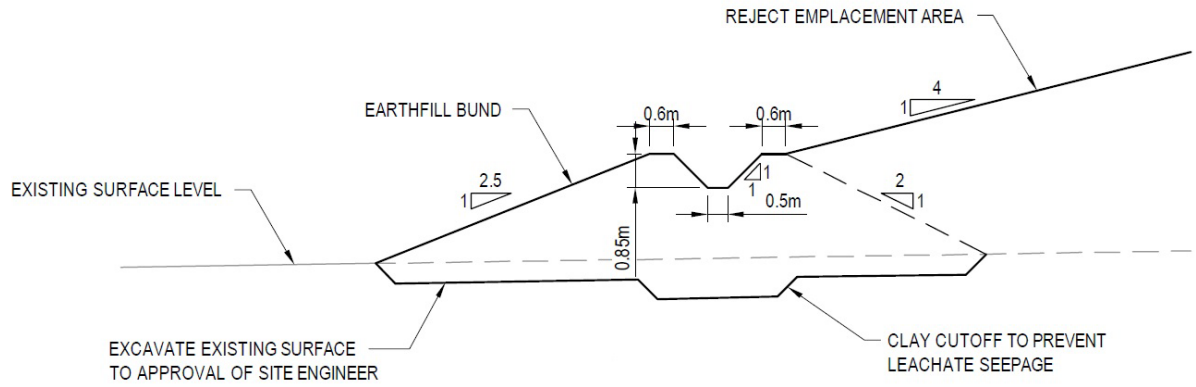
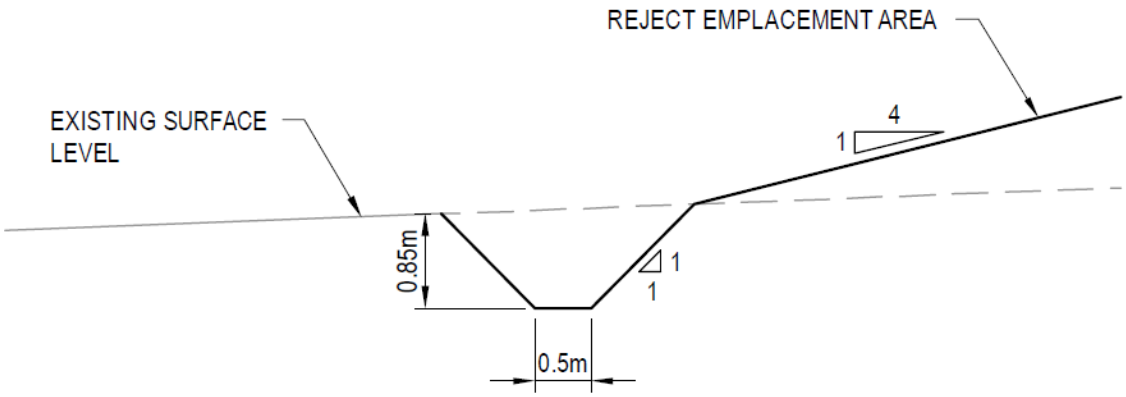


Figure 11 Northwest Drain Cross-Section – Natural Ground



5.2.2 REA Settlement Pond

ANCOLD Guidelines

The aforementioned ANCOLD guidelines have been used to provide a high level assessment on the required Extreme Storm Storage Allowance (ESSA) of the proposed REA Settlement Pond. Note that this will need to be reviewed when more information is known on the reject material and associated environmental impacts.

At this stage a Dam Spill Consequence Category (DSCC) of 'Significant' has been assigned, based on a dam spill having 'significant effects on rural land and local flora & flora'[5]. In accordance with Table 4 of the guidelines, the minimum ESSA would be a 1:100 Annual Exceedence Probability (AEP) 72 hour flood event. As previously reported, this equates to a storage requirement of approximately 45.1 ML. With a nominal 15% allowance for water and sediment in the pond, this results in a required storage of 51.8 ML.

Environment Protection Licence

As stated in CA's Environment Protection Licence issued by the Environment Protection Agency – NSW (EPA), the sediment basin must be able to retain "a total of 44 millimetres of rainfall over any consecutive 5 day period". This is as defined in the publication *'Managing Urban Stormwater: Soils and Construction"* (DECC, 2008).

44 mm of rainfall over the catchment, with a conservative runoff coefficient of 1.0 and allowing an additional 50% for water / sediment in the storage, equates to approximately 37.6 ML.

Design Details

The Settlement Pond has been modelled as a cut / fill balance, with embankment material taken from within the storage area. The additional cut material (~7,250 m^3) will be used in the construction of the drainage bunds described in Section 5.2.1. The design has a storage volume of approximately 52.4 ML, accommodating the required storage of 51.8 ML.

Concept design parameters of the Settlement Pond are summarised in Table 11, with plans and typical sections found in the drawings in Appendix A.

Table 11 REA Settlement Pond Concept Design Parameters

Parameter	Value
Crest Level	RL 723.5m
Embankment Height	11 m
Batter Slopes	1:2.5 (vertical to horizontal – nominal)
Crest width	3 m
Top Water Level	RL 722.5 m
Storage Volume	52.4 ML
Embankment Fill Volume	14,500 m^3
Storage Borrow Cut Volume	21,750 m^3

[5] ANCOLD 2012, '*Guidelines on Tailings Dams: Planning, Design, Construction, Operation and Closure'* ANCOLD Inc.

5.2.3 Emergency Spillway

The emergency spillway for the Settlement Pond has been designed to have the capacity to pass a 1:1,000 AEP flood event. This is as per ANCOLD guidelines for a 'Significant' Hazard Category dam. The design flow for this event was calculated to be approximately 9.7 m^3/s.

Concept design parameters of the spillway design are provided in Table 12.

Table 12 Emergency Spillway Concept Design Parameters

Parameter	Value
Type	Broad-Crested Weir
Width	6 m
Depth	1 m
Capacity	10.2 m^3/s

5.2.4 Pump and Pipeline

A pump and pipeline system is required at the Settlement Dam in order to keep the pond level low, so that there is sufficient storage for flood events.

The pump and pipeline have been sized with a capacity that exceeds the maximum monthly required outflow during a wet year (February, 18 L/s – see Section 5.1.3).

Concept design parameters for the system are provided in Table 13.

Table 13 Pump & Pipeline Concept Design Parameters

Parameter	Value
Minimum Static Head	40 m
Pipeline Length	850 m
Duty Pressure	50.5 m at 20 L/s (72 m^3/hr)
Pump Type	Warman 3/2 AH, or equivalent, direct coupled to 2 pole motor Automatic start based on level sensor (pump will switch off when water level is too low)
Pump Max Capacity	37 L/s (133.2 m^3/hr)
Intake	Floating intake with screen
Pipeline Type	DN 160 Polypipe, PE 100, PN 10

5.3 Staging and Rehabilitation

Table 14 presents nominal staging heights and volumes for the proposed REA. It is planned to progressively rehabilitate the external batters, with estimated surface areas for each stage shown below.

The final stage for rehabilitation would be the internal surface area (13.7 Ha). As the REA has been designed with a relatively flat internal area sloping into the REA, there may be an opportunity to construct a wetlands area as part of the rehabilitation scheme.

Table 14 Staging Volumes and Rehabilitation Areas

Stage	Crest Height	Rejects Volume (m^3)		Surface Area for Rehabilitation (Ha)	
		Stage	Cumulative	Stage	Cumulative
1	RL 745m	2,357,000	2,357,000	9.0	9.0
2	RL 750m	1,198,000	3,555,000	2.9	11.9
3	RL 755m	886,000	4,441,000	3.1	15.0
4	RL 765m	765,000	5,206,000	6.3	21.3
Final	**RL 765m**	**-**	**5,206,000**	**13.7**	**35.0**

6. Recommended Future Work for Development Phase

In order to progress the Location 2 REA design to a Feasibility Study level, the following work is proposed for the Development Phase (Pre-Feasibility Stage):

- Undertake geotechnical/geochemical investigations and assessment, including the site conditions and properties of the reject materials;
- Carry out workshop with key personnel from Centennial (including plant designers) and GHD, including discussion/confirmation on the proposed design, preparation and delivery processes, and Safety in Design, including methodologies for blending and transporting the waste streams;
- Undertake engineering design to Preliminary Design level, including hydrology, stability analysis and drainage;
- Refine 3D model of the REA and associated water management infrastructure (i.e. exclusive of process and delivery design at this stage);
- Develop a detailed Emplacement & Construction Methodology;
- Prepare staged development plans;
- Prepare a Preliminary Design Report.

7. Limitations

This report: 'Centennial Coal Airly – Reject Emplacement Area (REA) Concept Design 'has been prepared by GHD for Centennial Coal Airly and may only be used and relied on by Centennial Coal Airly for the purpose of a Concept Level design for the proposed REA. Specifically, this report and associated drawings should not be used for construction purposes.

GHD otherwise disclaims responsibility to any person other than Centennial Coal Airly arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

GHD has prepared this report including opinions, conclusions and recommendations based on conditions encountered and information provided by Centennial Coal Airly, which GHD has not independently verified or checked beyond the agreed scope of work, including: topographic survey data, ecological survey and associated conclusions/recommendations, heritage survey and associated conclusions/recommendations and mine production data. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared, or due to errors in information provided.

GHD has prepared the high level order of magnitude cost estimate set out in section 4.4 of this report ("High Level Cost Comparison") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD as set out in the aforementioned section 4.4.

The Cost Estimate has been prepared for the purpose of a comparative indicative estimate of the two REA locations and must not be used for any other purpose, specifically for project budgeting purposes, without further analysis.

The Cost Estimate is a high level estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

8. References

Australian National Committee on Large Dams 2012, *Guidelines on Tailings Dams: Planning, Design, Construction, Operation and Closure.* May 2012.

Gowan, M Lee, M Williams, D 2010, '*Co-Disposal techniques that may mitigate risks associated with storage and management of potentially acid generating wastes'* Australian Centre for Geomechanics

Hillier, P 2012, *'Re: Due Diligence Inspection for a Proposed Reject Emplacement Area, Airly Mine, Capertee, NSW',* RPS Australia East Pty Ltd

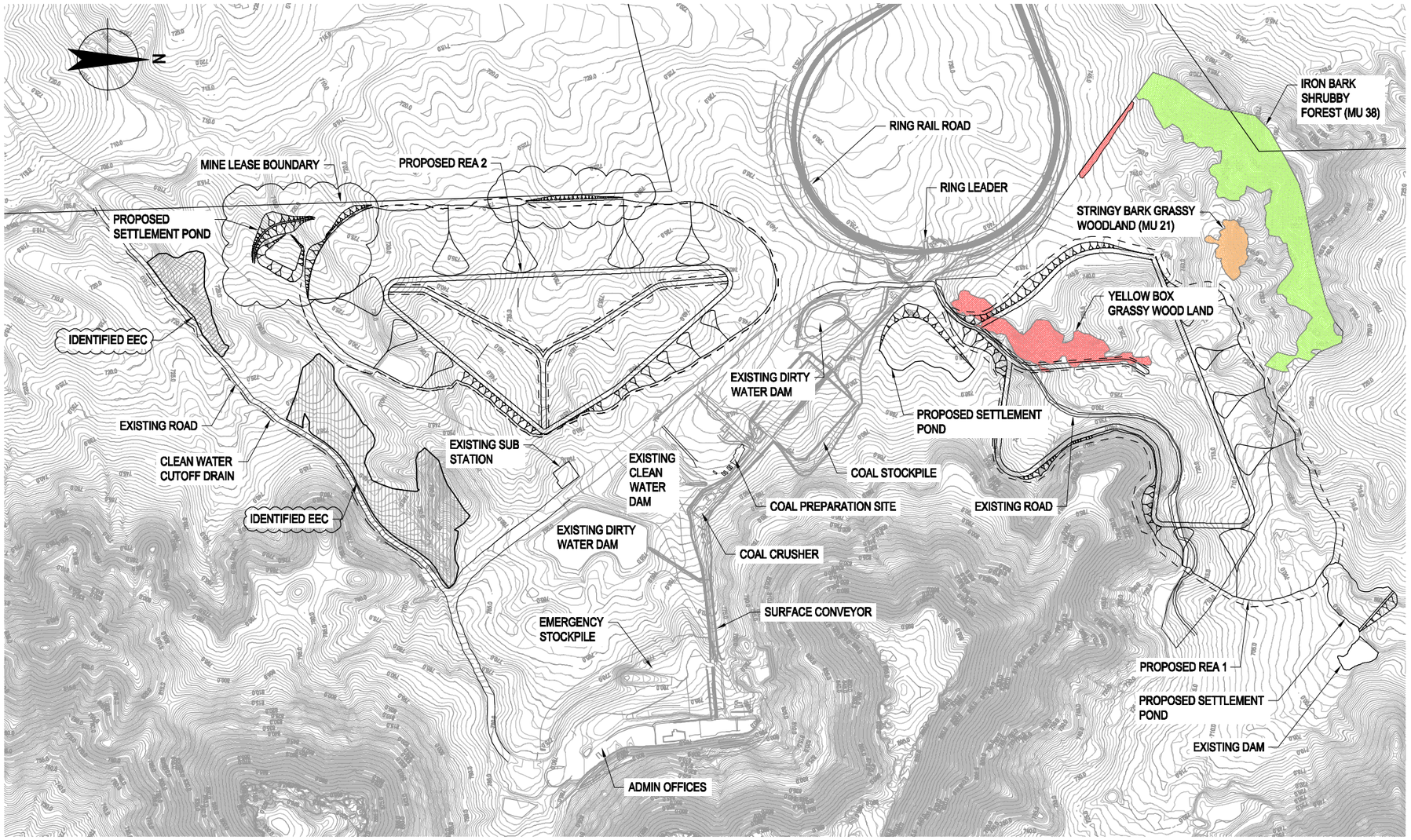
NSW Department of Environment and Climate Change (DECC) 2008, *Managing Urban Stormwater: Soils and Construction.* June 2008.

RPS 2012, '*Historic Heritage Assessment: Airly Coal Mine, Capertee, NSW*', RPS Australia East Pty Ltd

The Institution of Engineers Australia 1998, *Australian Rainfall and Runoff Vol. 1 Book IV*. 1998.

Appendices

Appendix A – Concept Design Drawings



PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
E	RE-ISSUED FOR CLIENT COMMENT	DRB	MD*	MD*	30.07.14
D	RE-ISSUED FOR CLIENT COMMENT	DRB	MD*	MD*	10/7/14
C	RE-ISSUED FOR COMMENT	TS	DBL*	MD*	5/6/13
B	RE-ISSUED FOR CLIENT COMMENT	VGJ	DBL*	MD*	31/5/13
A	ISSUED FOR CLIENT COMMENT	TS	DBL*	MD*	23/5/13

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 100 200 300m
SCALE 1:10,000 AT ORIGINAL SIZE

LEGEND

EEC - ENDANGERED ECOLOGICAL COMMUNITY

GHD
2 Salamanca Square Hobart TAS 7000 Australia
GPO Box 667 Hobart TAS 7001
T 61 3 6210 0600 F 61 3 6210 0601
E hbamail@ghd.com W www.ghd.com

DO NOT SCALE

Drawn T.SWANN | Designer A.SIMMONS
Drafting Check | Design Check
Approved (Project Director)
Date
Scale 1:10000
This Drawing must not be used for Construction unless signed as Approved

Client CENTENNIAL COAL COMPANY LTD
Project AIRLY MINE - REJECT MANAGEMENT 2013
Title GENERAL ARRANGEMENT PLAN

Original Size A3
Drawing No: 32-16831-C002
Rev: E

Plot Date: 30 July 2014 - 3:40 PM Plotted By: Daniel Booker Cad File No: G:\32\16831\CADD\Drawings\32-16831-C002.dwg

N

IRON BARK SHRUBBY FOREST (MU 38)

PROPOSED SETTLEMENT POND

TOE DRAIN

EXISTING DAM TO POSSIBLY BE UTILISED/EXPANDED FOR SEDIMENT RETENTION SYSTEM.

HERITAGE SITE

A
C005

ESTIMATED CLEAN WATER DIVERSION DRAIN

TOE DRAIN

MINE LEASE BOUNDARY

EXISTING DAM

PROPOSED REJECT EMPLACEMENT AREA

FALL

EXISTING ROAD

YELLOW BOX GRASSY WOODLAND

FALL

CONSTRUCT NEW ACCESS ROAD

10m WIDE ACCESS ROAD AND DRAIN

HERITAGE SITE

FALL

FALL

B
C005

EXISTING RING RAIL LOOP

PROPOSED SETTLEMENT POND

EXISTING RAIL LOADER

EXISTING ACCESS ROAD TO MILL SITE

EXISTING CONVEYOR

ECOLOGICAL LEGEND

- GRASSY WOODLAND
- IRONBARK SHRUBBY FOREST
- STRINGYBARK GRASSY WOODLAND

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
C	RE-ISSUES FOR COMMENT	TS	DBL*	MD*	5/6/13
B	RE-ISSUED FOR CLIENT COMMENT	VGJ	DBL*	MD*	30/5/13
A	ISSUED FOR CLIENT COMMENT	TS	DBL*	MD*	23/5/13

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 50 100 150m

SCALE 1:5000 AT ORIGINAL SIZE

GHD
2 Salamanca Square Hobart TAS 7000 Australia
GPO Box 667 Hobart TAS 7001
T 61 3 6210 0600 F 61 3 6210 0601
E hbamail@ghd.com W www.ghd.com

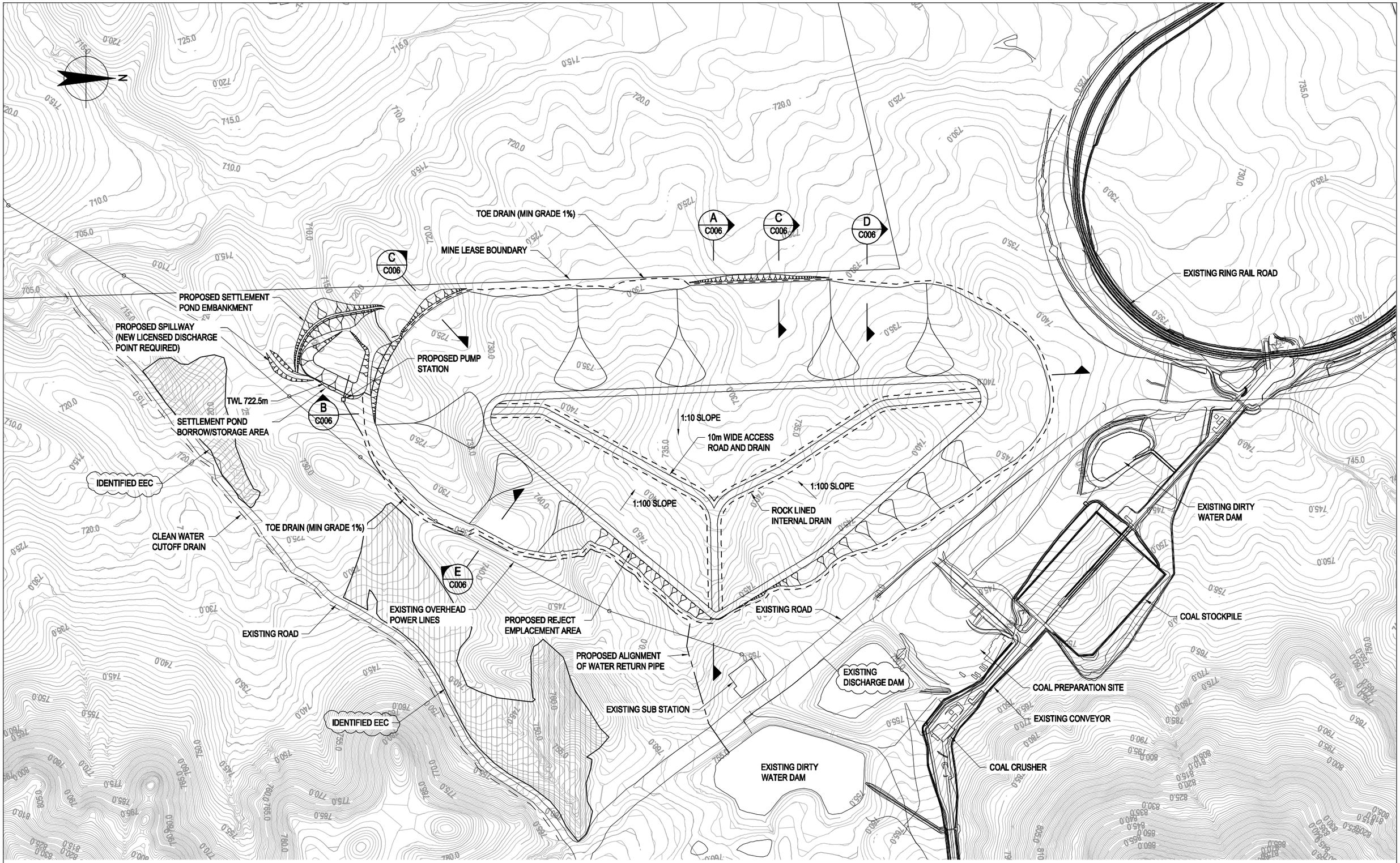
DO NOT SCALE

Drawn	V. JENKINS	Designer	A.SIMMONS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	1:5000	This Drawing must not be used for Construction unless signed as Approved	

Client: CENTENNIAL COAL COMPANY LTD
Project: AIRLY MINE - REJECT MANAGEMENT 2013
Title: REA 1 PLAN

Original Size: A3
Drawing No: 32-16831-C003
Rev: C

Plot Date: 5 June 2013 - 1:04 PM Plotted By: David Buxton Cad File No: G:\32\16831\CADD\Drawings\32-16831-C003.dwg



PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
F	RE-ISSUED FOR CLIENT COMMENT	DRB	MD*	MD*	30.07.14
E	RE-ISSUED FOR CLIENT COMMENT	DRB	MD*	MD*	10.07.14

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

LEGEND

EEC - ENDANGERED ECOLOGICAL COMMUNITY

GHD
2 Salamanca Square Hobart TAS 7000 Australia
GPO Box 667 Hobart TAS 7001
T 61 3 6210 0600 F 61 3 6210 0601
E hbamail@ghd.com W www.ghd.com

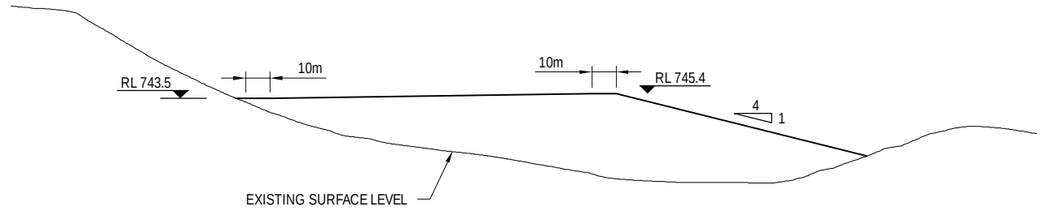
DO NOT SCALE

Drawn	T.SWANN	Designer	A.SIMMONS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	1:5000	This Drawing must not be used for Construction unless signed as Approved	

Client: **CENTENNIAL COAL COMPANY LTD**
Project: **AIRLY MINE - REJECT MANAGEMENT 2013**
Title: **REA 2 PLAN**

Original Size: **A3**
Drawing No: 32-16831-C004
Rev: F

Plot Date: 30 July 2014 - 3:40 PM Plotted By: Daniel Booker Cad File No: G:\32\16831\CADD\Drawings\32-16831-C004.dwg



A SECTION
C003 SCALE 1 : 2500

B SECTION
C003 SCALE 1 : 2500

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR CLIENT COMMENT	TS	DBL*	MD*	23/5/13

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

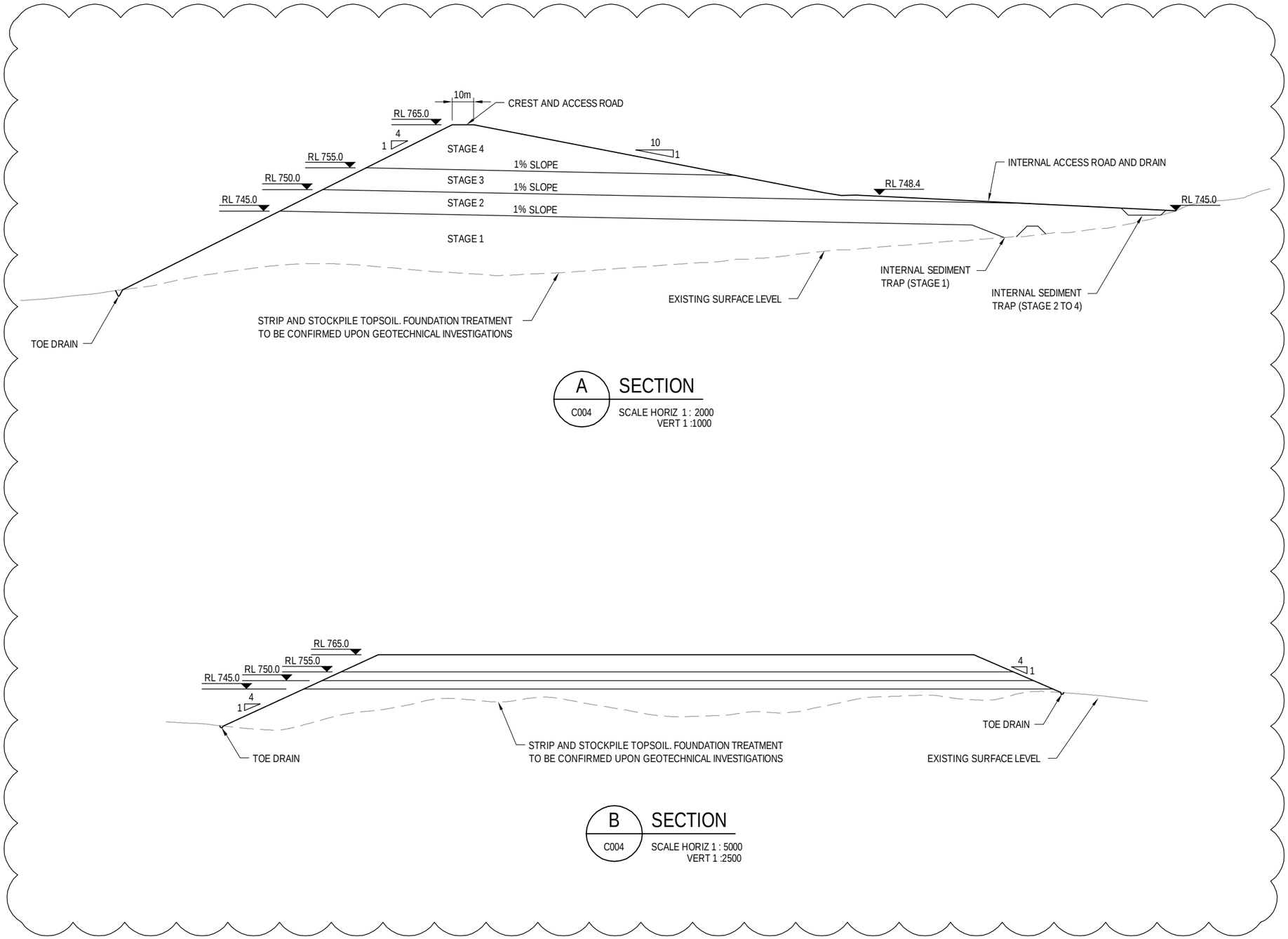
GHD
2 Salamanca Square Hobart TAS 7000 Australia
GPO Box 667 Hobart TAS 7001
T 61 3 6210 0600 F 61 3 6210 0601
E hbamail@ghd.com W www.ghd.com

Drawn	T.SWANN	Designer	A.SIMMONS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	1:2500	This Drawing must not be used for Construction unless signed as Approved	

Client CENTENNIAL COAL COMPANY LTD
Project AIRLY MINE - REJECT MANAGEMENT 2013
Title REA 1
TYPICAL SECTIONS

Original Size A3
Drawing No: 32-16831-C005
Rev: A

Plot Date: 23 May 2013 - 4:50 PM Plotted By: Tim Swann Cad File No: G:\32\16831\CADD\Drawings\32-16831-C005.dwg



A SECTION
C004
SCALE HORIZ 1 : 2000
VERT 1 :1000

B SECTION
C004
SCALE HORIZ 1 : 5000
VERT 1 :2500

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
C	RE-ISSUED FOR CLIENT COMMENT	DRB	MD*	MD*	22/7/14
B	RE-ISSUED FOR CLIENT COMMENT	DRB	MD*	MD*	10/7/14
A	ISSUED FOR CLIENT COMMENT	TS	DBL*	MD*	23/5/13

Note: * indicates signatures on original issue of drawing or last revision of drawing

VERTICAL SCALE 1:1000 AT ORIGINAL SIZE
HORIZONTAL SCALE 1:2000 AT ORIGINAL SIZE
0 10 20 30m
0 20 40 60m
VERTICAL SCALE 1:2500 AT ORIGINAL SIZE
HORIZONTAL SCALE 1:5000 AT ORIGINAL SIZE
0 25 50 75m
0 50 100 150m

GHD
2 Salamanca Square Hobart TAS 7000 Australia
GPO Box 667 Hobart TAS 7001
T 61 3 6210 0600 F 61 3 6210 0601
E hbamail@ghd.com W www.ghd.com

DO NOT SCALE

Drawn T.SWANN | Designer A.SIMMONS
Drafting Check | Design Check
Approved (Project Director)
Date
Scale AS SHOWN
This Drawing must not be used for Construction unless signed as Approved

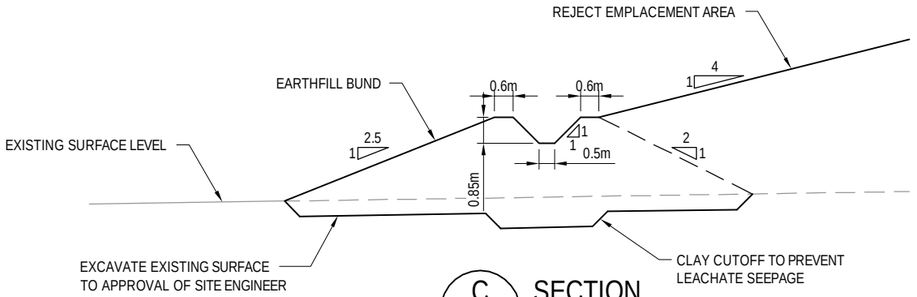
Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - REJECT MANAGEMENT 2013**
Title **REA 2**
TYPICAL SECTIONS - SHEET 1 OF 2

Original Size **A3**
Drawing No: **32-16831-C006**
Rev: **C**

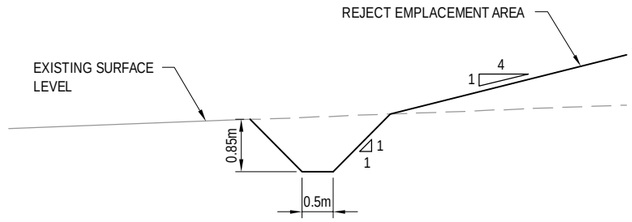
Plot Date: 22 July 2014 - 8:57 AM Plotted By: David Buxton Cad File No: G:\32\16831\CADD\Drawings\32-16831-C006_C007.dwg

NOTE:

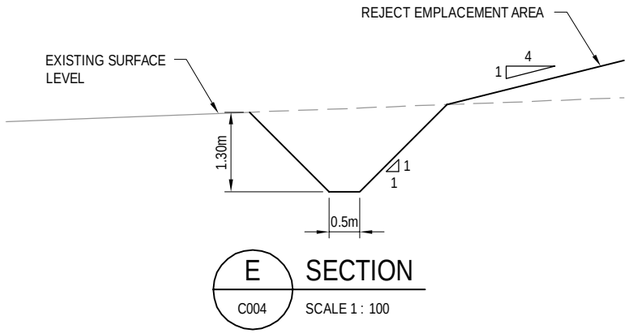
EROSION PROTECTION ON DRAINS AND SETTLEMENT POND SPILLWAY TO BE DESIGNED DURING DETAIL DESIGN



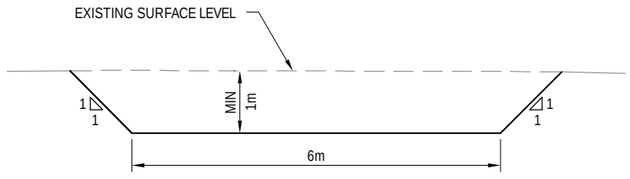
C SECTION
C004 SCALE 1 : 200



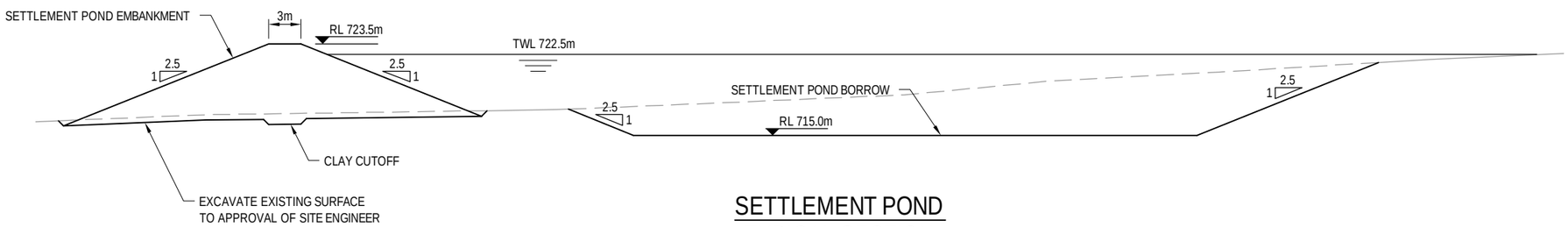
D SECTION
C004 SCALE 1 : 100



E SECTION
C004 SCALE 1 : 100



SETTLEMENT POND SPILLWAY
TYPICAL SECTION
SCALE 1:100



SETTLEMENT POND
TYPICAL SECTION
SCALE 1:500

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR CLIENT COMMENT		DRB	MD*	MD*	22/7/14

0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE

2 Salamanca Square Hobart TAS 7000 Australia
GPO Box 667 Hobart TAS 7001
T 61 3 6210 0600 **F** 61 3 6210 0601
E hbamail@ghd.com **W** www.ghd.com

DO NOT SCALE

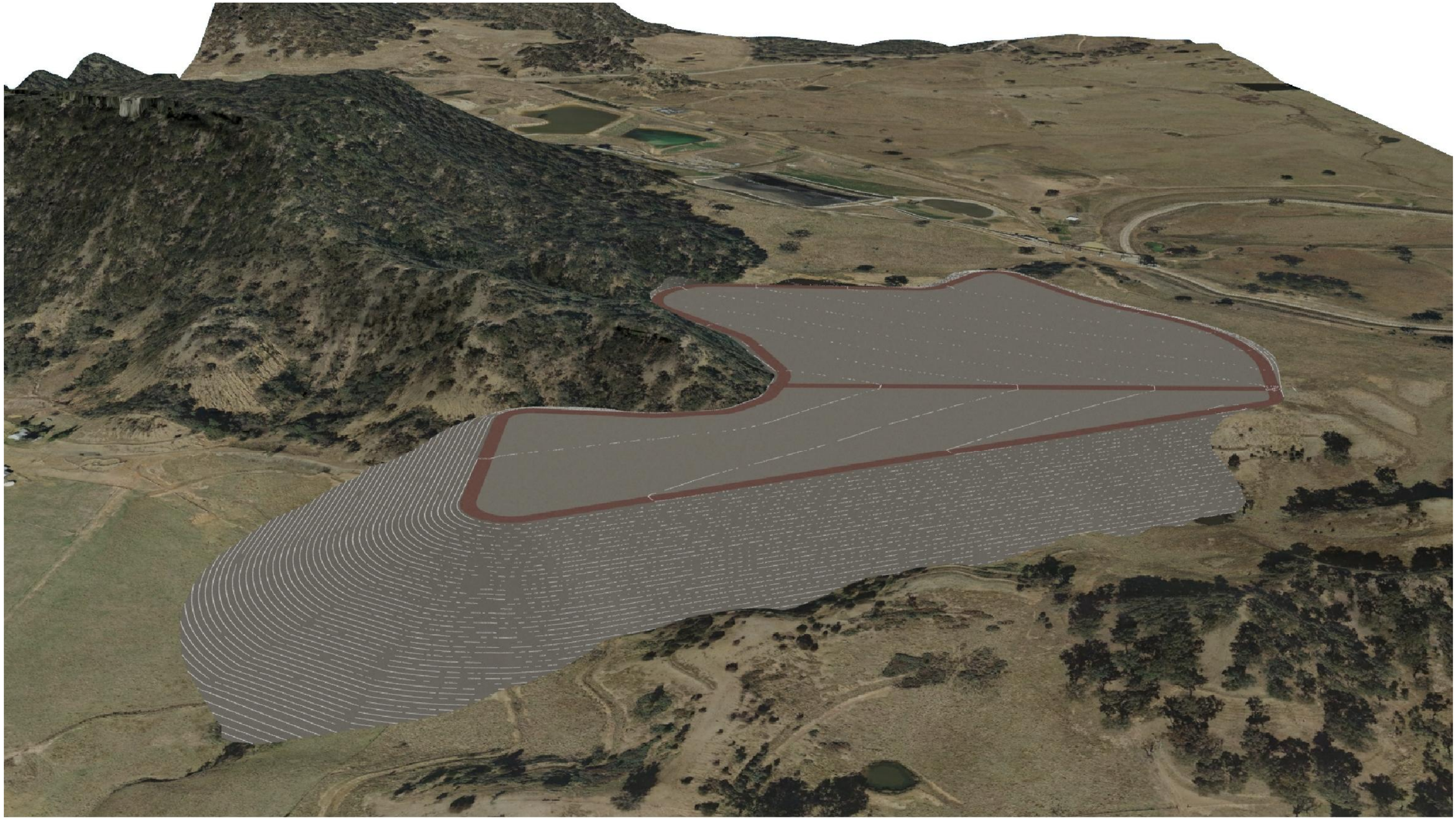
Drawn	D.BUXTON	Designer	A.SIMMONS
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client **CENTENNIAL COAL COMPANY LTD**
Project **AIRLY MINE - REJECT MANAGEMENT 2013**
Title **REA 2**
TYPICAL SECTIONS - SHEET 2 OF 2

Original Size **A3** Drawing No: **32-16831-C007** Rev: **A**

Plot Date: 22 July 2014 - 8:56 AM Plotted By: David Buxton Cad File No: G:\32\16831\CADD\Drawings\32-16831-C006_C007.dwg

Appendix B – 3D Rendered Model



CENTENNIAL COAL COMPANY LTD
AIRLY MINE - REJECT MANAGEMENT 2013

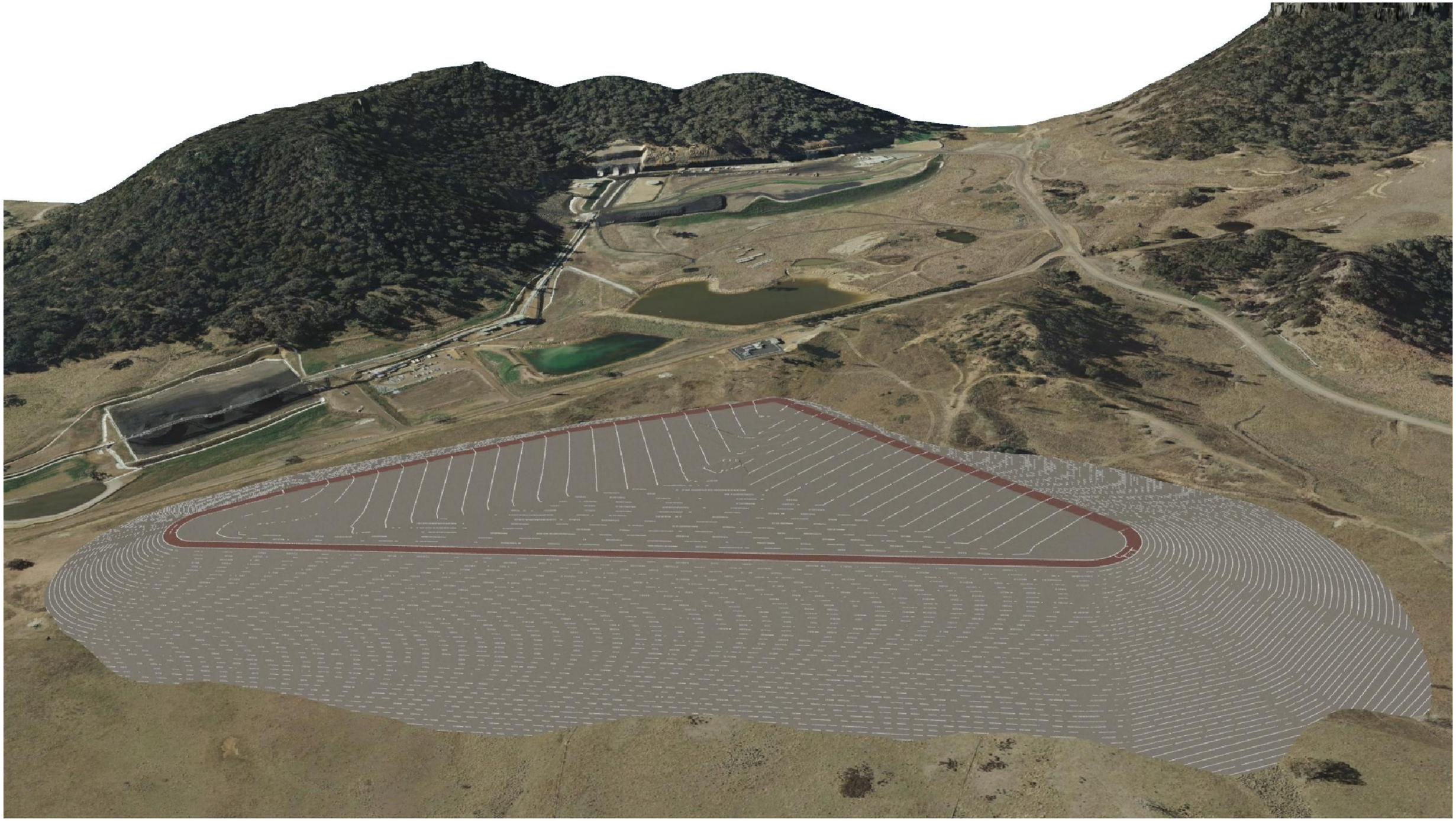
REA 1
PLAN

Job Number 32-16831
Revision A
Date MAY 2013

Figure 101

2 Salamanca Square Hobart TAS 7000 Australia **T** 61 3 6210 0600 **F** 61 3 6210 0601 **E** hbamail@ghd.com **W** www.ghd.com

Plot Date: 31 May 2013 - 4:08 PM Plotted by: Tim Swann Cad File No: G:\32\16831\CADD\Drawings\32-16831-FIG101.dwg



CENTENNIAL COAL COMPANY LTD
AIRLY MINE - REJECT MANAGEMENT 2013

REA 2
PLAN

Job Number 32-16831
Revision A
Date MAY 2013

Figure 102

2 Salamanca Square Hobart TAS 7000 Australia **T** 61 3 6210 0600 **F** 61 3 6210 0601 **E** hbamail@ghd.com **W** www.ghd.com

Plot Date: 31 May 2013 - 4:08 PM Plotted by: Tim Swann Cad File No: G:\32\16831\CADD\Drawings\32-16831-FIG102.dwg

GHD

2 Salamanca Square Hobart 7000
GPO Box 667 Hobart 7001
T: 03 6210 0600 F: 03 6210 0601 E: hbamail@ghd.com

\\ghdnet\ghd\AU\Hobart\Projects\32\16831\WP\59414.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A Simmons	D Brett	On File	D Brett	On File	05/06/14
1	A Simmons	M Daley	On File	M Daley	On File	01/08/14
2	CC Jong	M Daley	On File	M Daley	On File	19/08/14

www.ghd.com