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Draft Report

Estimation of Rehabilitation Costs

AUSTRALIA

AGL Loy Yang Mine

19 August 2015
43283845/002_LYM/3

Prepared for:
Department of Economic Development, Job, Transport and Resources

Prepared by URS Australia Pty Ltd

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DOCUMENT PRODUCTION / APPROVAL RECORD				
Issue No.	**Name**	**Signature**	**Date**	**Position Title**
Prepared by	Bryan Chadwick		19 Aug 2015	Senior Principal
Checked by	Geoff Byrne		19 Aug 2015	Principal
Approved by	Adrian Bowden		19 Aug 2015	Senior Principal

Draft Report Name:
Estimation of Rehabilitation Costs

Sub Title:
AGL Loy Yang Mine

Draft Report No.
43283845/002_LYM/3

Status:
Draft

DOCUMENT REVISION RECORD		
Issue No.	**Date**	**Details of Revisions**
01	09/06/15	Draft
02	09/07/15	Second Draft
03	18/08/15	Third draft

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ABBREVIATIONS

Abbreviation	Description
AMD	Acid Mine Drainage
BPEM	Best Practice Environmental Management
BWE	Bulk Water Entitlement
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DPI	Department of Primary Industries
EOD	External Overburden Dump
ERR	Earth Resources Regulation
ET	Evapotranspiration
Ha	Hectare
LYM	AGL Loy Yang Mine
mAHD	Metres above Australian Height Datum
MRSDA	Mineral Resources (Sustainable Development) Act 1990
MT	Metric Tonnes
NPV	Net Present Value
PS	Power Station
RCB	Raw Coal Bunker
RL	Reduced Level
SECV	State Electricity Commission Victoria
URS	URS Australia Pty Ltd

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1 INTRODUCTION

Earth Resources Regulation (**ERR**), from the Department of Economic Development, Jobs, Transport and Resources (**DEDJTR**), engaged URS Australia Pty Ltd (**URS**) in March 2015 to provide an estimate of the rehabilitation (closure) costs for ALG Loy Yang Mine (**LYM**).

1.1 Aims and Objectives

The aim and objectives of the URS scope of works are:

- provide an independent estimate of cost for closure based on the approved and pending work plan and assumptions provided by ERR;
- provide general advice to ERR to determine whether the existing Rehabilitation Bond lodged by the licence holder is appropriate to cover the cost of rehabilitation in accordance with the approved mine rehabilitation plan; and
- support ERR in any negotiation for a change in the Rehabilitation Bond.

1.2 Exclusions

The work undertaken in generating closure costs does not include an assessment as to whether the closure strategy provided is viable or that it provides the best outcome to any of the various stakeholders.

The cost estimates generated herein uses the information contained within the various documents provided and assumes the conclusions and assessments made are valid and will be achieved. Furthermore, the URS brief for this work was a desk top study of the rehabilitation costs and therefore did not include the following:

- Site inspections;
- Discussions with the operator;
- Development of detailed closure data such as designs for final slopes, water quality modelling or closure criteria; and
- Collection of contractor quotations.

The estimate costs have been largely based on URS experience and judgement, as well as rates included in the ERR rehabilitation bond calculator. In some instances individual cost estimates have been provided to URS by ERR for specific closure related activities.

This estimate of closure costs is limited to areas within the current MIN and therefore excludes any power station or other operations or activities located outside the MIN.

It is also important to note that for the closure concepts costed URS has not considered the cumulative impacts or risks of the other Latrobe Valley coal mines closing at the same time and how this might impact concept and thus costs.

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2 METHODOLOGY

2.1 Data Acquisition

2.1.1 Initial ERR Briefing

ERR provided a briefing (20 April 2015) to URS to confirm the scope and outline the data sources that would be made available. The core URS team and representatives from the ERR group attended the meeting.

The objective of the briefing was to present the draft project management plan which set out the key deliverables and milestones of the project. The output from the meeting was a project management plan document, which was issued as a final to ERR on 21 April 2015.

A subsequent held with DEDJTR on 20 July 2015 further clarified assumptions to be used in the closure cost estimates and the scope of the deliverable.

2.1.2 Information Sources

ERR provided the following documents and/or information:

- MIN5189 Work Plan 1997 Gazettal.pdf;
  - Part 1 – Mine Overview;
  - Part 2 – Rehabilitation Plan
  - Part 3 – Environmental Monitoring Plan
- GHD, AGL Loy Yang, Mine Hydrogeological and Geotechnical Performance Report, 6 monthly Report, July to December 2014, March 2015;
- Loy Yang 2013_14 annual expenditure return.pdf;
- MIN5189 Bond calculator_na07_concept.xls;
- Selected portions from AGL Loy Yang Mining Licence Work Plan Variation (V05) May 2015:
  - Section 6 – Rehabilitation Plan
  - Figures 1 – 28

In addition, the following URS reports were reviewed as part of the data acquisition task:

- Mine and Power Station Closure under Contract for Closure, Implications and Costs (June 2012); and
- Water Resource Options for a Sustainable Coal Industry (August 2007)

The latest version of the ERR bond calculator[1], which was developed to address the need for a consistent methodology for estimating rehabilitation costs for the extractive, exploration and mining operations, was used as a key reference document.

[1] Last updated – 24 February 2014.
http://www.energyandresources.vic.gov.au/earth-resources/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/establishment-and-management-of-rehabilitation-bonds-for-the-mining-and-extractives-industries/bond-calculator

In addition to the reports, URS was allowed access to ERR personnel in order to clarify key assumptions in relation to the proposed closure concepts.

LIDAR data was provided to URS, however as it only covered a small portion of the mine licence area for LYM it was not used in the estimates for areas, slopes, and void volumes.

2.2 Work Plan Review

The data received from ERR was reviewed and a draft letter report entitled "Latrobe Valley Work Plan Review", dated 1 May 2015 was issued to ERR.

The review identified a number of data gaps in the work plans received and requested clarification on a number of queries in relation to various aspects of the data received.

Two members of the URS project team visited ERR representatives in Traralgon on 8 May 2015 and conducted an "outside the fence" site visit to verify some of the information provided in the mine work plans.

2.3 Progressive Rehabilitation

Based on the various sources of information obtained URS facilitated a workshop on 15 May 2015, in order to allow the URS and ERR technical teams to reach agreement on the status of progressive rehabilitation which has occurred to date and assumed details for the closure of LYM.

URS conveyed to ERR at the meeting that the scope and currency of the rehabilitation plan for LYM has gaps compared to international practice for mine closure plans. Additionally there is limited progressive rehabilitation carried out on site, mainly due to fact that it is a single pit operation, with pit batter slopes and in-pit overburden dumps being integral to ongoing operations.

2.4 Closure Cost Estimates

Cost estimates have been developed for the following scenarios:

- Current approved Work Plan (1997):
  - End of Mine Life Closure – closure based on the predicted footprint for the current mine plan with mining finishing in 2037.
  - Early Closure with current footprint – a "close tomorrow" scenario
- Submitted Work Plan Variation (V05, dated May 2015):
  - End of Mine Life – closure based on the predicted footprint for the 2015 mine plan with mining finishing in 2037.
  - Early Closure with current footprint – a "close tomorrow" scenario

The cost estimates are based on the closure domains outlined in Table 2-1 (below) and generally consistent with the format of the ERR bond calculator. Where there are items, which are not considered in the bond calculator, a new domain has been developed: such as Domains 5, 6 and 7.

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Table 2-1 Domain Descriptions

DOMAIN	DESCRIPTION	INCLUSIONS/EXCLUSIONS
1	Infrastructure areas – includes the removal and demolition of conveyors, buildings, power lines	Includes: Mine Workshops, Administration buildings, Sediment dams, Fire reservoir, Conveyors, Fire services equipment and pipework, Access roads, Raw coal bunker.
2	Tailings and coarse rejects – includes capping, reshaping and landscaping of ash ponds	LYM has no ash ponds or coarse rejects in mining licence area.
3	Overburden and waste dumps – includes overburden dumps	Includes external overburden dump (EOD)
4	Active Mines and Voids – includes the backfilling of mine voids, slope reshaping, fencing and landscaping	Includes: North East Batters, North West Batters, Western Batters, Southwestern Batters, Southeastern Batters, Mine Floor/East, Haul roads.
5	Execution management costs - including mobilisation and demobilisation	-
6	Fill pit with water - including all aspects of filling the pit with water	Includes: maintenance of extraction bores, water licence acquisition (if necessary) and annual fees
7	Post execution maintenance and monitoring – including all costs to conduct monitoring and maintenance post closure	-

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3 MINE STATUS

3.1 Current Mine Status

Mining began at LYM in 1982 and is scheduled to continue until the mining licence expires in 2037 with the extension of the pit to the east and south east.

The current approved Work Plan is that outlined in the May 1997 Gazettal.

The LYM Mining Licence boundary (MIN 5189) is shown in Appendix A and is approximately 4,561 ha in area. The Loy Yang A and B Power Stations are excluded from the mining licence and are not considered in this costing.

LYM submitted a Work Plan Variation (**WPV**) in May 2015, which is currently being assessed by ERR. The assumed limit of mining is similar to that outlined in 1997, and is shown in Figure 14 of the AGL Loy Yang Mining Licence Work Plan Variation (reference: 31-2072315, rev 1, dated 08 March 2015).

Mining is currently conducted using four bucket wheel excavators and overburden is conveyed to the External Overburden Dump (**EOD**) by two conveyors.

The overburden dump strategy for the current Work Plan (1997) assumes the EOD is constructed to 7 levels, with no material going to an internal dump. 1997 Work Plan states that 570 Mm^3 of waste (plus leached ash) will ultimately have to be placed into the EOD based on mining a reserve volume of 2,000 Mt of coal.

Runoff from the EOD is monitored, treated and discharged to Traralgon Creek under EPA licence.

MIN5189 expiry date is 6 May 2037.

3.2 Approved Rehabilitation Master Plan

The approved closure and rehabilitation commitments are contained in the 1997 Work Plan (Part 2- Rehabilitation Master Plan). The key statement in the 1997 Work Plan is:

…mine be gradually flooded at the end of operations to form a lake for community purposes.

The overburden dump would be reverted to grazing land and recreational areas.

No further details are provided in the 1997 Work Plan on the time taken to flood the void, the source of the water supply or the final water level or water quality.

3.3 Pending Closure Plan

It is understood that ERR are currently assessing the LYM's 2015 WPV (VO5, dated May 2015) and it is uncertain whether the details provided therein will be that in the finalised document. However, the costed 2015 WPV closure strategy outlined herein is based on the all the statements made in V05 (dated May 2015) and that they are assumed to be valid and correct.

The 2015 WPV provides a suite of technical studies and reports on the closure methodology for end of mine life. There is no commentary around the applicability or validity of the closure strategy for early closure (i.e. closure today), however, it is assumed for the purposes of this costing that they broadly hold true.

The overall closure strategy is:

…partially flood the final open cut to form a lake and return the remaining disturbed land to agricultural use.

The other key elements in the 2015 WPV to closure are:

- Cover placed across exposed coal with overburden and water;
- EOD is reduced from 7 to 4 levels with internal dumping of overburden to commence in 2018 (one stacker) with second stacking going internal approximately 5 years later;
- Pit void to be partially filled with water to -21 mAHD;
- Source water to flood void is to come from:
  - Existing power station entitlements;
  - Groundwater licences, and
  - Local catchment during flood events.

For cost comparison purposes, closure cost estimates are presented for both the 1997 and 2015 strategies (refer to Section 4.3).

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4 CLOSURE STRATEGY

4.1 Background

1997 Work Plan

The 1997 WP closure concept for LYM is a fully flooded pit lake, with the assumption that it spills into the local catchment (Traralgon Creek or Sheepwash Creek). However, the strategy to achieve this 'fully flooding' concept is lacking in detail in relation to:

- water source(s)
- filling time;
- final land use; and
- final water quality (need for treatment).

2015 Work Plan Variation (pending)

The 2015 WPV (pending) closure concept is to partially flood the pit to form a lake and return the remaining disturbed land to agricultural use. It is also noted that prior to lake filling the in-pit overburden dump will be used to profile the void and cover areas of exposed coal.

The 2015 WPV closure strategy does provide estimates on the assumed water sources, potential filling time and end land use[2].

Summary

In generating the closure cost estimates for the 1997 WP and 2015 WPV strategies it was necessary to develop a broad closure strategy in terms of the various domains. These are outlined below in Section 4.2.

4.2 Closure Activities Used as Basis for Closure Cost Development

4.2.1 General Land Use

The final land uses are the same for both the 1997 and 2015 closure strategies and are assumed to be:

- restricted access (pit lake); and
- grazing (remainder of lease).

[2] Appendix C of Work Plan Variation (V05, May 2015).

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4.2.2 Domain 1 – Infrastructure Areas

The assumptions with Domain 1 are the same for both the 1997 and 2015 closure strategies, and are summarised as follows:

- All major mining infrastructure including buildings, conveyors and dredgers will be decommissioned, decontaminated and demolished for sale as scrap. No salvage has been incorporated into the costs to off-set some or all of this task.
  - Also included as part of the infrastructure decommissioning is the RCB, and associated Bunker Driver Tower, both of which are assumed to be within the MIN licence.
- All mobile plant and equipment will be decommissioned and decontaminated.
- Concrete structures will be decommissioned, decontaminated and demolished to a maximum depth of 1 m below ground. Cost for this task incorporates demolition, crushing and/or placement in an on-site location.
- Allowance for clean-up of localised zones of soil contamination of 500 m^3. Cost includes excavation and transport to local off-site facility.
- All haul and access roads that will not be subject to lake inundation will be ripped and seeded, unless the road is deemed necessary for post closure land uses;
- Some access roads will be retained for the duration of the maintenance and monitoring phase, after which they will be ripped and seeded;
- Firefighting services will be decommissioned after attainment of target lake level or until approved by relevant authority;
- All exploration bores will be decommissioned and capped prior to void filling. It is assumed this is done prior to closure and no additional cost has been incorporated into the closure cost estimates.

4.2.3 Domain 2 – Ash Ponds

No ash ponds and/or tailings dams existing within MIN5189.

4.2.4 Domain 3 – Overburden Dumps

1997 Work Plan

The 1997 WP states that the all overburden, throughout the mine life, will be placed outside the pit in the External Overburden Dump (EOD). Thus the closure strategy for Domain 3 is as follows:

- Major reshaping of EOD to enhance drainage;
- Placement of vegetation medium
- Planting of overburden slopes with low maintenance, shallow rooted, native vegetation endemic to the region

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2015 Work Plan Variation (pending)

The 2015 WPV states that progressively from 2018 overburden will be placed in-pit. Thus the closure is:

- Minor reshaping of former EOD footprint to enhance drainage;
- Planting of EOD footprint with low maintenance, shallow rooted, native vegetation endemic to the region; and
- Major Earth Works of in-pit overburden dump to level and cover exposed coal faces.

4.2.5 Domain 4 – Pit

There are a number of closure assumptions that are the same for the 1997 and 2015 strategies, these are:

- Final overall pit slopes of 1:3 (V:H) provide acceptable long term stability.
- It is necessary for individual batter slopes to be re-shaped to approximately conform to the overall final slope.
- Installation of a track rolled cover layer over pit slopes above final lake level of inert material with nominal 0.75 m and minimum 0.5 m thickness to enable slope to be fully water shedding and reduce fire risk;
- Installation of 0.1 m thick topsoil or equivalent growing medium;
- Planting of slopes with low maintenance native vegetation endemic to the region;
- Intermediate surface drainage works will be installed at 50 m vertical heights in the exposed final batters;
- A 0.75 m thick rip rap zone will be installed in the final slope as a rim around the lake within a range of 2 m above and 2 m below final lake level to control wave erosion.

The closure strategies that differ for the 1997 and 2015 are:

CLOSURE STRATEGY	1997 WORK PLAN	2015 WORK PLAN VARIATION (PENDING)
Pit Void	Fully flooded pit void. No placement of overburden within pit void.	From 2018 overburden will be placed within pit void. Remaining weight balance required achieved with water.
Final Lake Level	Actively fill pit void with water to spill level (+50m AHD) using available water licences (Assumed to be 50 GL/y)	Actively fill pit void with water to target weight balance level (-21m AHD) using available water licences (Assumed to be 50 GL/y), then allow natural catchment to slow fill to 0m AHD.

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4.2.6 Domain 5 – Management

Domain 5 includes all the costs for the third party implementation of closure, such as:

- All necessary investigations, studies and detail design for closure
- Mobilisation and demobilisations of contractors
- Project management all on-site works
- Necessary audits at closure

Cost for Domain 5 has been generated from a combination of the following:

- Mobilisation – 5% of total execution costs
- Engineering, procurement and construction management – 15% of total execution costs

4.2.7 Domain 6 – Pit Lake Filling

Integral to the closure of LYM for both the 1997 WP and 2015 WPV is filling the pit to a target level:

1997 Work Plan

The 1997 WP does not provide a target lake level, with the statement made assuming to mean that the pit is fully flood to a level with spills into the local catchment. Therefore, the following assumptions, based on the 1997 WP, have been used in the costs for filling the pit void with water:

- Water needs to fill to +50m AHD to achieve spill into local catchment
- All water used to fill pit void to +50m AHD will be from LYM's Bulk Water Entitlement (BWE) of 40 GL/year and Groundwater Extraction Licence (GEL) of 10 GL/year. Further:
  - There will be no cost to transfer the BWE and GEL for use in closure;
  - The annual fees for use of the BWE and GEL will be the same as currently paid;
- End of Mine (EoM) and Early Closure (EC1) time taken to fill the pit void to spill is estimated to be 43 years and 22 years respectively.

2015 Work Plan Variation (pending)

The 2015 WPV states that the pit will partially filled with water to -21m AHD and then allow natural inundation to slowly fill to 0 mAHD to achieve a 'hydrological equilibrium'.

The following assumptions, based on the 2015 WPV, have been used in the costs for filling the pit void with water:

- Water needs to fill to -21m AHD to achieve floor stability
- All water used to fill pit void to -21m AHD will be from LYM's Bulk Water Entitlement (BWE) of 40 GL/year and Groundwater Extraction Licence (GEL) of 10 GL/year. Further:
  - There will be no cost to transfer the BWE and GEL for use in closure;
  - The annual fees for use of the BWE and GEL will be the same as currently paid;

- End of Mine (EoM) and Early Closure (EC1) time taken to fill the pit void to -21m AHD is estimated to be 15 years and 8 years respectively.

The following sections outline a number of issues in sourcing the water and how they have been incorporated into the various LYM closure cost estimates.

Closure based on both the 1997 WP and 2015 WPV is to fill the mine void with water to a level which achieves floor and batter stability. This effectively creates a lake for which the long term water balance will be dominated by incident rainfall and evaporation as well as any local inflows. For maintenance of water levels a balance of rainfall and inflows over evaporation is required.

Direct rainfall and evaporation

The mode of closure is to fill the mine void with water to a target level. This effectively creates a lake for which the long term water balance will be dominated by incident rainfall and evaporation as well as any local inflows. For maintenance of water levels a positive/neutral balance of rainfall and inflows over evaporation is required.

The water balance study in the 2015 WPV appears to have considered the differential between rainfall and evaporation on a long term annual basis and concluded there is a slight positive balance, or an equivalence, in rainfall falling to the ground and evaporation leaving the ground. An annual comparison is problematic since it does not take account of the seasonal changes between rainfall and evaporation, or the effects of prolonged wet or dry periods. For this reason a closer examination of the rainfall – evaporation differential is necessary based on the use of daily SILO climate data for Morwell.

The appropriate measure of evaporation for this purpose is Morton's Lake Evaporation as other forms of evaporation reported in the SILO data set are for standard grasslands and crops, and required appropriate factors to be applied. Morton's Lake Evaporation does not require a 'pan factor' and is considered to be within +/- 15% of true evaporation from a lake surface depending on the volume in storage, depth of water body, turbidity and exposure to solar radiation and wind.

In this case - where deep, relatively clear water storages are likely - it is expected that Morton's Lake Evaporation should provide a good estimate of true evaporation from the lake surface.

Daily SILO point rainfall and evaporation data was differenced then aggregated to a monthly time step before averaging. The data shows a clear seasonal deficit in summer months with a smaller excess of rainfall over evaporation during the winter months.

The costs estimates generated herein have therefore assumed that annually, the sum of the monthly average point rainfall-evaporation deficit is -278 mm. The inter-annual range of this deficit is -652 mm to +202 mm. For example a lake with 20,000,000 m^2 surface area this is equivalent to an average deficit of ~5.5 GL/year.

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Local Catchment Inflows

Various methods have been used to assess local catchment inflows over time. Two main areas of uncertainty exist:

- Definition of catchment which will flow into any nominated pit; and
- Use of constant runoff coefficients instead of using local data.

For the purposes of generating a preliminary water balance URS has estimated catchment areas under current and future rehabilitation conditions using Nearmap. These catchments have largely been restricted to the mine boundary, although in some areas allowance has been made for limited urban runoff.

Most of the methods used to date have adopted a runoff coefficient approach. This is not preferred as it is difficult to defend both the magnitude of the runoff coefficient(s) chosen and the application of a constant runoff coefficient that does not reflect antecedent rainfall and soil wetness.

For the purposes of the current analysis a water yield per unit area from local stream gauging records and used these rates to estimate local catchment inflows to the mine based on the estimated catchment areas.

Where urban areas may contribute to pit water these have been identified separately and their yields have been assumed to be 80% higher than natural runoff based on observations of low flow changes due to urbanisation in Melbourne's eastern catchments.

The results of the preliminary water balance is that the net effect of direct rainfall/evaporation and local catchment inflows will be a small annual deficit of inflows during and following filling of voids. Even though there will be considerable variability in these numbers due to the climatic conditions in a given year, it is clear that the relative size of these annual deficits is small when compared with the annual rate of water delivery required to fill the void in 15 years (i.e. typically less than 2%).

A daily water balance model was run for 110 years incorporating delivery of water volumes equivalent to 10% of current licenced water requirements and daily rainfall and evaporation. The variability of rainfall-evaporation deficit was not found to significantly affect predicted water levels or the rate of void filling.

Based on this analysis, a post-closure provision should be made to make up the relevant annual deficit in local rainfall, evaporation and inflows so that the long term maintenance of void water levels can be secured.

It should also be noted that for the purpose of the water accounting, it was assumed that there is no seepage or other groundwater loss from the void as it fills.

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4.2.8 *Domain 7 – Monitoring and Maintenance*

Domain 7 includes all the costs associated with maintaining the necessary infrastructure during closure and the various monitoring to assess the success of implementation.

- Maintenance. Cost to maintain the following for period of closure:
  - rehabilitation areas, based on an assumed 15% vegetation fail over 5 years
  - fire services until exposed coal is covered
  - site security
  - erosion repair
  - council rates
  - site services (buildings, power water etc)
- Monitoring. The scope of monitoring is assumed to includes the following: surface water (flow and quality), groundwater (level & quality), geotechnical stability, ecological (including rehabilitation) fire, dust, and odour.
- Management. To cover the costs for managing and procuring the contracts a sum has been generated based on 3% of total maintenance and monitoring cost.

4.3 Timing of Closure

A costing for 1997 WP and 2015 WPV has been generated for two closure timeframes:

- End of mine life – within the model this is referred to as EoM
- Early closure (closure based on current footprint) – within the model this is referred to as EC1

The main difference between the current and end of mine closure costings is the mine's footprint.

Based on available information regarding progressive rehabilitation on site, costings assume little or no additional rehabilitation will have been carried out by end of mine life.

4.3.1 *Execution Phase*

The closure execution phase is assumed to run for 5 years and commences in the year after production shutdown. It comprises the period of intense closure activity, including rehabilitation, slope shaping, slope soil cover, decommissioning, decontamination and demolition of infrastructure and general site clean-up.

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4.3.2 *Void Filling Phase*

The void filling phase is the period over which the mine pit will fill with water based on the assumed water balance:

- 1997 Work Plan
  - EoM - a void filling phase of 43 years has been adopted
  - EC1 – a void filling phase of 22 years has been adopted
- 2015 Work Plan Variation (pending):
  - EoM - a void filling phase of 15 years has been adopted
  - EC1 – a void filling phase of 8 years has been adopted

4.3.3 *Post Execution Maintenance and Monitoring Phase*

This phase begins after the closure execution phase (Year 6), with the activities during this phase comprising the following:

- Ongoing water level, surface water quality, groundwater quality, ecological, slope stability, fire risk and rehabilitation monitoring;
- Ongoing maintenance including erosion repair, replacement of failed rehabilitation areas, sediment dam and fire reservoirs maintenance, security, Council rates and upkeep of monitoring/maintenance infrastructure and equipment.

In the various closure scenarios, the pit void may take 8 to 48 years to reach target and maintenance and monitoring will be required for all this time period.

4.4 Summary of Assumptions

In preparing this costing for the Loy Yang Mine the following has been assumed:

- End of mine life of 2037, based on no extension to the current mining licence expiry date;
- None of the batters have yet been reshaped;
- 15% of the planned vegetation will fail within the first 5 years of the maintenance and monitoring phase and require replacement;
- Final pit slopes of 1V:3H will have long-term geotechnical and erosional stability;
- No major cut-backs of slopes are required (apart from the northern batters at Loy Yang which are less than 1V:3H);
- Final pit water is suitable for required beneficial use;
- There is no groundwater contamination present which would present a human/ecological risk;
- No seepage or groundwater loss from the voids on filling;
- Little or no additional rehabilitation will have been carried out by end of mine life;
- There is a low fire risk during the first five years of the maintenance and monitoring phase;

- Current Loy Yang A power station bulk water entitlements can be transferred and used for void filling at zero cost;
- Current groundwater pumping water limits can be used for void filling;
- Monitoring will confirm compliance with the closure criteria and performance assumptions.

4.5 Exclusions

The following items have been excluded from the closure cost estimates:

- Community cost associated with managing the closure transition
- Asset recovery amounts from sale of scrap, recoverable metals, oils etc
- Reimbursement/sale of water allocation rights

4.6 Key Risks

If the assumptions indicated above are not correct then they represent risks within the closure costing and have been incorporated into our closure costing as risk events with estimates of degrees of likelihood of occurrence and consequence.

In addition, the following key risks have been identified for HM for each closure concept:

- Seepage of acid mine drainage (AMD):
  - AMD and/or other contaminants impact on groundwater to the extent that clean-up and treatment are required under audit.
- Batter failure in an area where infrastructure is affected;
  - A slope failure occurs on a batter where there is major public/private infrastructure that requires stabilisation. The consequence includes both stabilisation of batter for long term and rehabilitation/compensation items.
- Batter failure in an area where no infrastructure is affected;
  - A slope failure occurs on a batter where there is no major public/private infrastructure. The consequence is stabilisation of batter for long term and rehabilitation of slope.
- Coal fire;
  - A coal fire during the full closure period that requires management and land requires subsequence rehabilitation.
- Pit water quality is unsuitable;
  - The water quality of pit lake does not meet standard for its target beneficial use and requires treatment.
- Inability to secure existing water licences;
  - The existing BWE and GEL are not able to be used in filling the pit void and all water sources need to be purchased on open market at commercial rates.

- Requirement for water sources to maintain lake level:
  - The 2015 WPV water balance conclusion is inaccurate and that there is significant periods post closure where there is a net water deficit, and thus purchase of water is needed to maintain the lake level.

It is considered that the risks for the early and end of mine life closure scenarios are similar in terms of likelihood and consequence.

Each closure concept has been costed and the concept of "risk cost" has been factored into the total closure costs.

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5 COST ESTIMATES FOR CLOSURE

5.1 Methodology

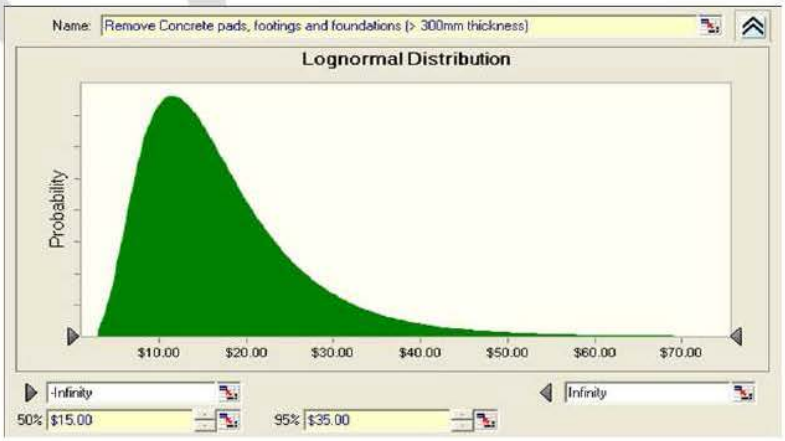
A probabilistic costing model was developed in Excel using URS' previous experience of mine closure costings and the information from the documents provided by ERR. The costing model built upon the costing work, which was conducted in 2012 for the former Department of Primary Industries (DPI). The costing model incorporated Monte Carlo simulation, which is a statistical technique that uses random numbers to account for uncertainty in a mathematical model. URS uses the spread sheet add-in, Crystal Ball™, to run the Monte Carlo simulation.

The basis of Monte Carlo simulation is that it recognises variables (in this case the cost of individual mine closure items) as probability distributions rather than single numbers. The probability distribution chosen for cost estimates is lognormal as this assumes the following conditions in relation to costs and other variables such as length, area and volume:

- Costs are strongly skewed towards high values;
- Variable (cost) can increase without bound but is confined to a finite value at the lower limit i.e. the costs cannot be less than $0; and
- the distribution can be defined by two cost estimates (the P50, or 50% confidence level estimate and a P95, or 95% confidence level estimate) provided by a relevant specialist; the P50 estimate is a best estimate (50% chance that the given cost would not be exceeded) and the P95 is a very conservative estimate (95% chance that the indicated cost would not be exceeded, or conversely, a 5% chance that the cost would be exceeded).

Chart 5-1 shows an example cost distribution where the specialist judged that a best estimate of the cost to remove relatively thick concrete pads etc. would be $15/m^2, and a very high estimate that would have around a 5% chance of being exceeded would be $35/m^2. The relatively large difference between the P50 and P95 shows that the specialist considered that there is a high degree of uncertainty in the potential cost outcome. The spread of potential costs across the chart also shows that although there is no theoretical upper limit to the cost, the specialist also considered that a practical upper limit to the cost could be $60 to $70/m^2.

Chart 5-1 Example Probability Distribution for Infrastructure Cost Item



For each closure concept and for both of the closure scenarios (close tomorrow and end of mine life) expert judgement was used to derive cost estimates at a 50% probability (best estimate) and 95% probability (very conservative, high estimate), for each cost component. The decisions were informed by discussions with ERR technical staff at the site visit and the workshop on the 15 May 2015. The inputs for each of the mine closure concepts are provided in **Appendix C**.

The Monte Carlo simulation was run 2,000 times and a curve of total project costs was obtained for each closure option.

The time value of money was factored into the model using net present value (NPV) calculations. NPV is the net present value of an investment over a period of time, calculated using a discount rate and a series of future payments and incomes. The discount rate adopted is a real NPV discount rate of 3% as instructed by ERR.

5.2 Model Results

5.2.1 Overall Costs

The results of the Monte Carlo simulation for total project costs for end of mine and early closure concept at a range of confidence levels are provided in **Chart 5-2** to **Chart 5-5**. A summary of the 50%, 80% and 95% Confidence Level outputs for each closure concept are provided in **Table 5-1** and **Table 5-2**.

Chart 5-2 End of Mine Closure Liability and Risk Costs – 1997 Work Plan

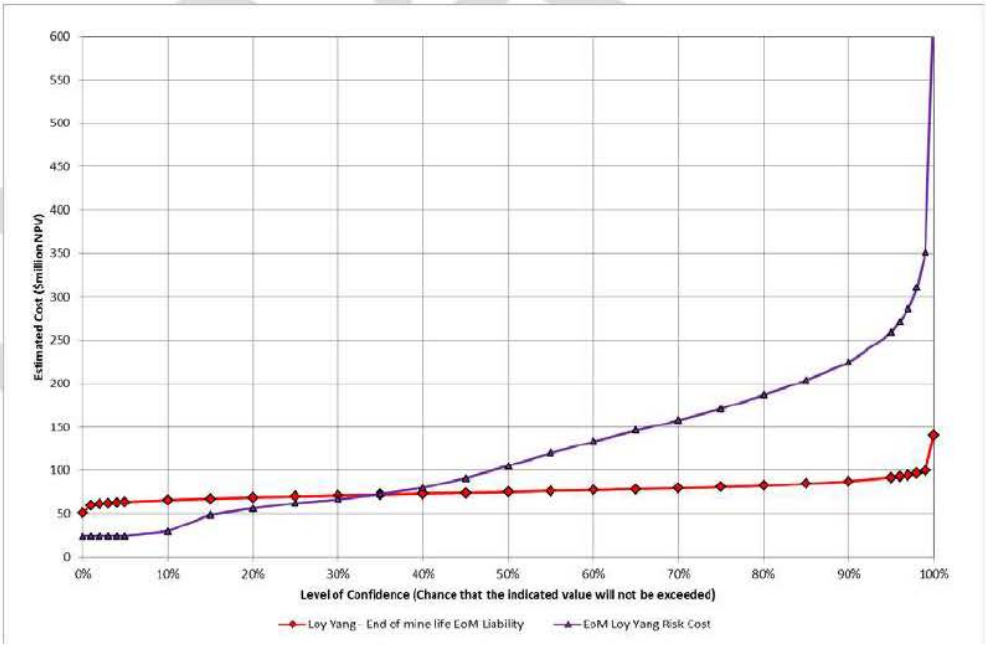


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Chart 5-3 End of Mine Closure Liability and Risk Costs – 2015 Work Plan Variation

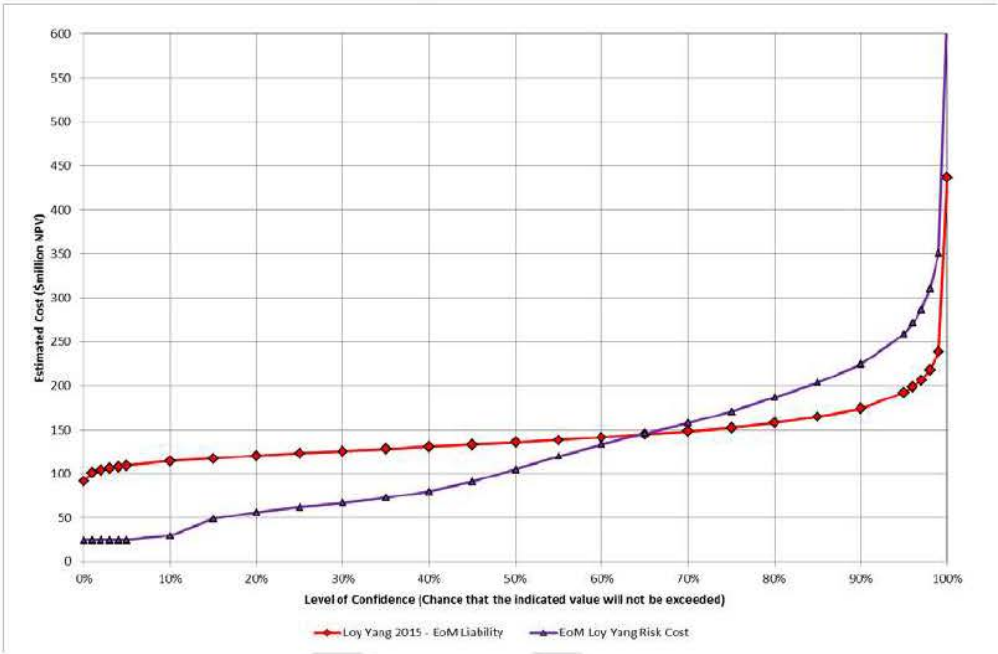

Chart 5-4 Early Closure Liability and Risk Costs – 1997 Work Plan

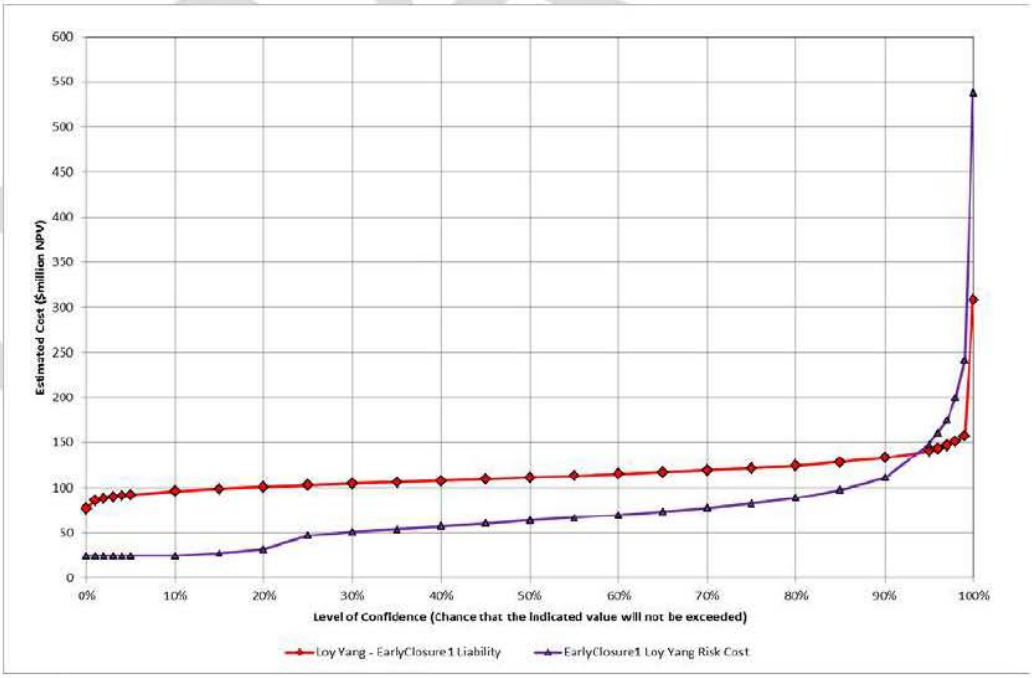

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Chart 5-5 Early Closure Liability and Risk Costs – 2015 WPV

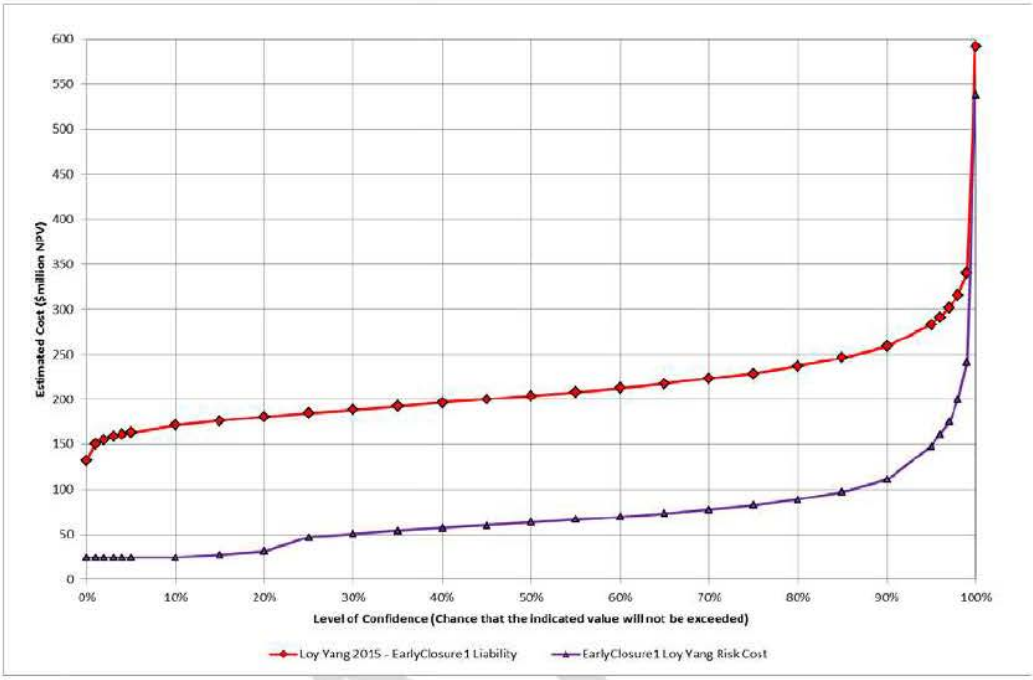


Table 5-1 Summary of Closure Costs – 1997 Work Plan

Confidence Level	P50	P80	P95
EoM - Liability Costs ($million NPV) *(EoM - Risk Costs)*	75.1 *(105.1)*	82.6 *(186.7)*	91.6 *(258.6)*
EC1 - Liability Costs ($million NPV) *(EC1 - Risk Costs)*	111.3 *(63.7)*	124.4 *(88.7)*	140.6 *(147.8)*

Table 5-2 Summary of Closure Costs – 2015 Work Plan Variation

Confidence Level	P50	P80	P95
EoM - Liability Costs ($million NPV) *(EoM - Risk Costs)*	135.8 *(105.1)*	157.9 *(186.7)*	192.2 *(258.6)*
EC1 - Liability Costs ($million NPV) *(EC1 - Risk Costs)*	203.9 *(63.7)*	236.8 *(88.7)*	283.0 *(147.8)*

It should be noted that the end of mine life cost estimates are significantly lower due to the fact that all estimates are discounted costs. That is the cost is based on expenditure in the future at a present value discounted by 3%[3].

In regards the 2015 WPV, in 80% of the 2,000 trials for early closure concept the estimated cost was less than $236.8 million. That can be interpreted as there being an 80% chance that the rapidly filling closure cost will be less than $236.8 million. Alternatively, the same result shows that according to the simulated results, there is a 20% chance that the cost will be more than $236.8 million.

This way of interpreting the results makes it possible for decision-makers to link any of the estimated cost outcomes with its associated confidence level, and to select cost estimates that reflect their level of conservatism. For example, a decision-maker might feel that a 20% chance that an allocated cost would be exceeded is too high, and that a 5% chance would be more appropriate. In that case, the decision-maker would select the 95% confidence level estimate, which for the 2015 early closure (current footprint) is $283.0 million. On the other hand, a much less risk-averse decision-maker might select the cost ($203.9 million) that has a 50-50 chance of being exceeded.

In essence, the simulation results allow ERR (and any other stakeholder) to assess the full range of potential cost outcomes and to choose allocated costs at the confidence level that most suits their position.

The wide range of cost estimates for each option is indicative of the degree of uncertainty inherent in the risk model. This is a function of the lack of precise data available to URS which meant that the inputs at a probability of 50% and 95% were often wide ranging.

5.2.2 Early Closure Contributor Costs - 2015 WPV

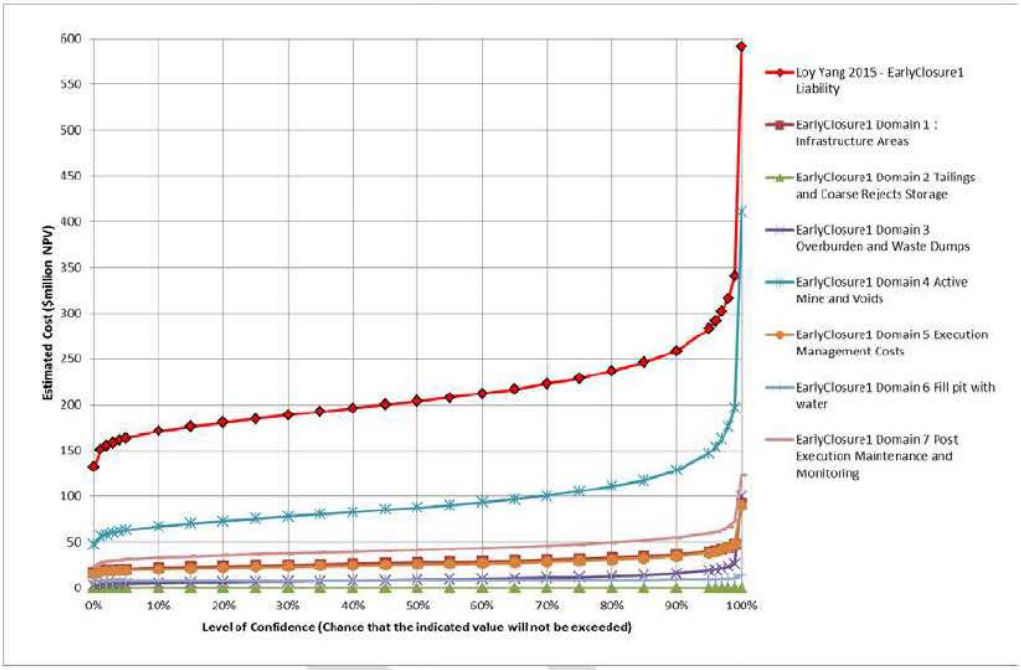
The following provides additional detail in terms of the where the majority of the liability costs for early closure (2015 WPV) are, in terms of the domains and specific items:

Domains

The domain liability costs with regards early closure (2015 WPV) is presented in **Chart 5-6**.

[3] Based on published wage discount rate: http://www.dtf.vic.gov.au/Publications/Government-Financial-Management-publications/Financial-reporting-policy/Wage-inflation-and-discount-rates

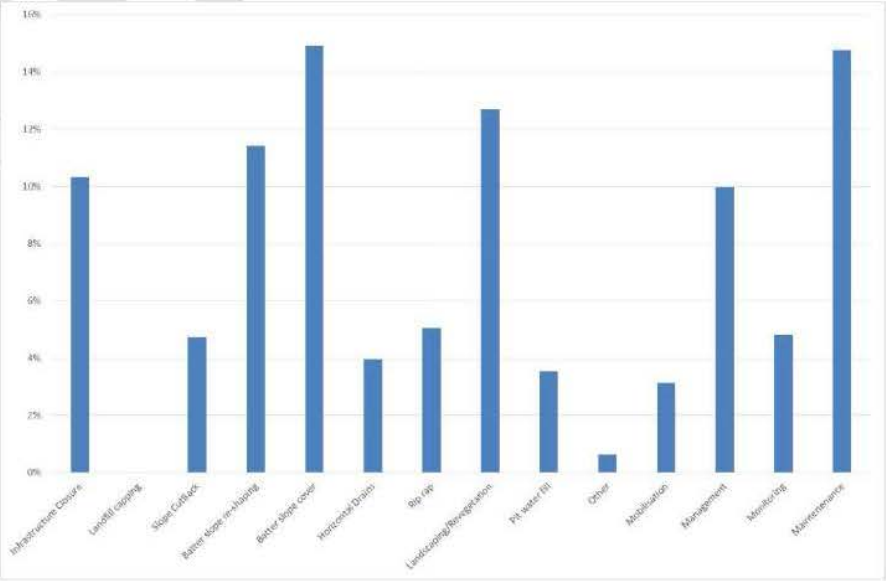
Chart 5-6 Domain Early Closure Liability Costs – 2015 WPV



Key Contributors to Costs

The key contributor to early closure liability costs (2015 WPV) is summarised in **Chart 5-7**. This shows that the major contributors to the overall discounted closure cost are the covering and closure management. Other major cost activities include landscaping/revegetation, reshaping of batter slopes, installation of rip rap, the stabilising buttress, and infrastructure decommissioning/decontamination/demolition

Chart 5-7 Contributors to Early Closure Liability Costs – 2015 WPV



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5.2.3 *Early Closure Uncertainty – 2015 WPV*

Sensitivity analysis of probabilistic models is calculated as part of the Crystal Ball Monte Carlo simulation process where the outputs show which assumptions most affect the uncertainty in the result for a given forecast (in this case the estimated early closure liability).

Chart 5-8 shows the proportion that each of the identified assumptions contributes to the total variance of the given forecast result.

In order to have an impact on the forecast result the assumption usually has to have an impact on both the quantum of the result and the spread (uncertainty) of the result. This analysis only considers the uncertainty (not magnitude) caused by assumptions. For example, an assumption that has a big impact on the quantum of the answer, but is very well known (input as a single value, or close to that) would not feature in this sensitivity analysis.

The sensitivity analysis identifies which assumptions in the model would reduce the overall uncertainty of the result, if the issue (represented by the assumption) was better understood by further investigation.

Chart 5-8 Key Contributors to the Variance - Early Closure 2015 WPV

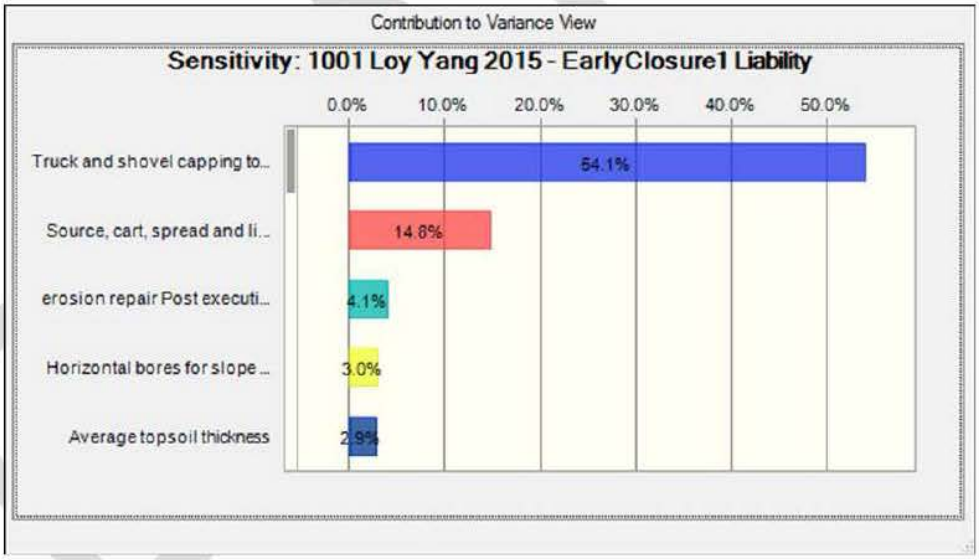

Chart 5-8 shows that the rate for truck and shovel capping of the pit batters and floor is highly uncertain (P50=$10 and P95=$30) and has a very large influence (responsible for 54% of the variance) on the total uncertainty of the estimated early closure liability.

In summary, the key contributors to the variance associated with early closure liability (2015 WPV) are the following.

- Active Mining Pit or other Voids (including the voids and any internal benches or mine strips):
  - Truck and shovel cover to batters and floor.

- Landscaping, minor earthworks and revegetation throughout domain area:
  - Source, cart, spread and lightly rip topsoil (>5km).
  - Average topsoil thickness.
- Post execution maintenance - initial phase:
  - Erosion repair
- Horizontal bores for slope stabilisation:
  - Installation cost

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6 REFERENCES

GHD, AGL Loy Yang, Mine Hydrogeological and Geotechnical Performance Report, 6 monthly Report, July to December 2014, March 2015;

http://www.dpi.vic.gov.au/earth-resources/minerals/environmental-guidelines/bond-calculator

MIN5189 Work Plan 1997 Gazettal

MIN5189 Work Plan Variation 2015 (draft pending ERR acceptance)

MIN5189 Bond calculator_na07_concept.xls (Loy Yang);

Rawlinsons, Australian Construction Handbook 2015 Edition 33.

URS, Mine and Power Station Closure under Contract for Closure, Implications and Costs, 27 June 2012;

URS, Water Resource Options for a Sustainable Coal Industry, August 2007

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7 LIMITATIONS

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Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

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APPENDIX A MINE PLANS

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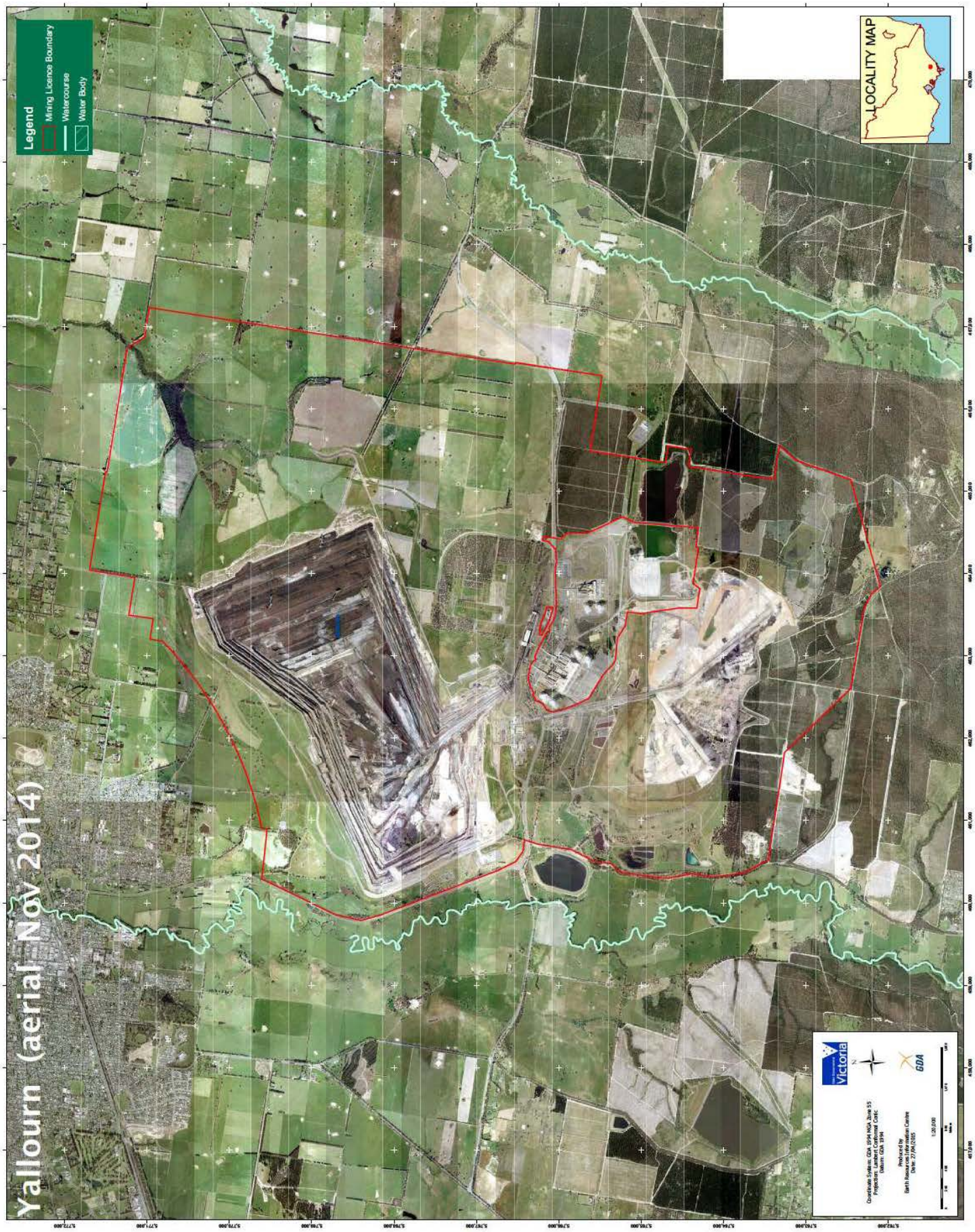
A.1 Mine Licence Area


Yallourn (aerial Nov 2014)
Legend
Mining Licence Boundary
Watercourse
Water Body
LOCALITY MAP
Victoria
GDA
Coordinate System: GDA 1994 MGA Zone 55
Projection: Lambert Conformal Conic
Datum: GDA 1994
Produced by
Earth Resources Information Centre
Date: 27/04/2015
1:20,000

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APPENDIX B MODEL INPUTS

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B.1 Early Closure (Current Footprint) - 1997 WP

EarlyClosure1 Cost Components

LOY YANG Early Closure 1 Footprint	Total Costs
EarlyClosure1 Domain 1 : Infrastructure Areas	**26,586,600**
Disconnect and terminate services	20,000
Demolish and remove buildings	952,000
Remove concrete pads & footings (of buildings)	2,265,000
Decommission access and haul roads	180,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sumps	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	240,000
Demolish and remove conveyors	3,010,000
Decommission, decontaminate and demolish crusher and RCB	5,890,000
Decommission, decontaminate and demolish dredgers	6,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	6,049,600
Removal of power lines	800,000
EarlyClosure1 Domain 2 Tailings and Coarse Rejects Storage	**0**
None in Loy Yang	0
EarlyClosure1 Domain 3 Overburden and Waste Dumps	**9,112,000**
Landscaping, minor earthworks and revegetation throughout domain area	9,112,000
EarlyClosure1 Domain 4 Active Mine and Voids	**30,610,464**
Northeast Batters	5,050,509
Northwest Batters	7,841,137
Western Batters	742,302
Southwestern	1,445,743
Southeastern	1,798,697
Mine Floor/East	1,060,090
Horizontal Drains	1,054,620
Rip Rap	9,562,728
Erect a security fence around site	1,190,000
Landscaping, minor earthworks and revegetation throughout domain area	864,638
EarlyClosure1 Domain 5 Execution Management Costs	**13,261,813**
Mobilisation/Demobilisation	3,315,453
Engineering Procurement & Construction Management	9,946,360
EarlyClosure1 Domain 6 Fill pit with water	**8,807,000**
O&M of dewatering facilities	640,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	5,992,000
EarlyClosure1 Domain 7 Post Execution Maintenance and Monitoring	**31,371,740**
Post execution monitoring	7,520,000
Post execution maintenance	22,938,000
Management	913,740
EarlyClosure1 Liability	**119,749,616**

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B.2 Early Closure (Current Footprint) - 2015 WPV

EarlyClosure1 Cost Components

LOY YANG 2015 Early Closure 1 Footprint	Total Costs
EarlyClosure1 Domain 1 : Infrastructure Areas	**26,586,600**
Disconnect and terminate services	20,000
Demolish and remove buildings	952,000
Remove concrete pads & footings (of buildings)	2,265,000
Decommission access and haul roads	180,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sumps	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	240,000
Demolish and remove conveyors	3,010,000
Decommission, decontaminate and demolish crusher and RCB	5,890,000
Decommission, decontaminate and demolish dredgers	6,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	6,049,600
Removal of power lines	800,000
EarlyClosure1 Domain 2 Tailings and Coarse Rejects Storage	**0**
None in Loy Yang	0
EarlyClosure1 Domain 3 Overburden and Waste Dumps	**9,112,000**
Landscaping, minor earthworks and revegetation throughout domain area	9,112,000
EarlyClosure1 Domain 4 Active Mine and Voids	**85,415,397**
Northeast Batters	11,212,405
Northwest Batters	12,163,576
Western Batters	6,023,928
Southwestern	7,783,693
Southeastern	12,538,002
Mine Floor/East	8,982,529
Horizontal Drains	7,509,461
Rip Rap	9,562,728
Erect a security fence around site	1,190,000
Landscaping, minor earthworks and revegetation throughout domain area	8,449,076
EarlyClosure1 Domain 5 Execution Management Costs	**24,222,799**
Mobilisation/Demobilisation	6,055,700
Engineering Procurement & Construction Management	18,167,100
EarlyClosure1 Domain 6 Fill pit with water	**8,807,000**
O&M of dewatering facilities	640,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	5,992,000
EarlyClosure1 Domain 7 Post Execution Maintenance and Monitoring	**99,086,000**
Post execution monitoring	23,675,000
Post execution maintenance	72,525,000
Management	2,886,000
EarlyClosure1 Liability	**253,229,797**

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B.3 End of Mine Life – 1997 WP

EoM Closure Cost Components

LOY YANG EoM FOOTPRINT	Total Costs
EoM Domain 1 : Infrastructure Areas	**20,537,000**
Disconnect and terminate services	20,000
Demolish and remove buildings	952,000
Remove concrete pads & footings (of buildings)	2,265,000
Decommission access and haul roads	180,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sumps	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	240,000
Demolish and remove conveyors	3,010,000
Decommission, decontaminate and demolish crusher and RCB	5,890,000
Decommission, decontaminate and demolish dredgers	6,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	0
Removal of power lines	800,000
EoM Domain 2 Tailings and Coarse Rejects Storage	**0**
None in Loy Yang	0
EoM Domain 3 Overburden and Waste Dumps	**9,112,000**
Landscaping, minor earthworks and revegetation throughout domain area	9,112,000
EoM Domain 4 Active Mine and Voids	**34,305,486**
Northeast Batters	4,754,718
Northwest Batters	3,400,903
Western Batters	742,302
Southwestern	1,445,743
Southeastern	2,358,947
Mine Floor/East	2,261,526
Horizontal Drains	1,606,437
Rip Rap	15,254,827
Erect a security fence around site	1,190,000
Landscaping, minor earthworks and revegetation throughout domain area	1,290,083
EoM Domain 5 Execution Management Costs	**23,938,173**
Mobilisation/Demobilisation	14,345,000
Engineering Procurement & Construction Management	9,593,173
EoM Domain 6 Fill pit with water	**14,610,000**
O&M of dewatering facilities	1,200,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	11,235,000
EoM Domain 7 Post Execution Maintenance and Monitoring	**60,291,050**
Post execution monitoring	14,345,000
Post execution maintenance	44,190,000
Management	1,756,050
EoM Liability	**162,793,709**

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B.4 End of Mine Life – 2015 WPV

EoM Closure Cost Components

LOY YANG EoM FOOTPRINT	Total Costs
EoM Domain 1 : Infrastructure Areas	**20,537,000**
Disconnect and terminate services	20,000
Demolish and remove buildings	952,000
Remove concrete pads & footings (of buildings)	2,265,000
Decommission access and haul roads	180,000
Waste disposal	235,000
Removal and disposal of contaminated water from bunded areas and sumps	250,000
Removal and disposal of contaminated soils	195,000
Removal of USTs	240,000
Demolish and remove conveyors	3,010,000
Decommission, decontaminate and demolish crusher and RCB	5,890,000
Decommission, decontaminate and demolish dredgers	6,000,000
Remove fire services equipment and pipework	300,000
Remove fire services reservoir	200,000
Landscaping, minor earthworks and revegetation	0
Removal of power lines	800,000
EoM Domain 2 Tailings and Coarse Rejects Storage	**0**
None in Loy Yang	0
EoM Domain 3 Overburden and Waste Dumps	**9,112,000**
Landscaping, minor earthworks and revegetation throughout domain area	9,112,000
EoM Domain 4 Active Mine and Voids	**127,475,262**
Northeast Batters	25,000,949
Northwest Batters	11,323,341
Western Batters	6,023,928
Southwestern	7,783,693
Southeastern	16,443,281
Mine Floor/East	19,162,728
Horizontal Drains	11,903,446
Rip Rap	15,254,827
Erect a security fence around site	1,190,000
Landscaping, minor earthworks and revegetation throughout domain area	13,389,068
EoM Domain 5 Execution Management Costs	**47,243,639**
Mobilisation/Demobilisation	23,675,000
Engineering Procurement & Construction Management	23,568,639
EoM Domain 6 Fill pit with water	**14,610,000**
O&M of dewatering facilities	1,200,000
Re-install dewatering bores, then decommission existing bores	2,175,000
Supplementary & other water charges	11,235,000
EoM Domain 7 Post Execution Maintenance and Monitoring	**99,086,000**
Post execution monitoring	23,675,000
Post execution maintenance	72,525,000
Management	2,886,000
EoM Liability	**318,063,901**

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APPENDIX C UNIT RATES AND PARAMETERS

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C.1 General – 1997 WP

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GENERAL PARAMETERS USED IN COSTING				
	NPV Discount Rate	3.0%	As per Vic gov wage inflation and discounts file	
Final Void			**EoM**	**Early Closure 1**
Overall Pit Slope Angle (V:H)				
Angle	degrees		18.4	18.4
Vertical	ratio		1	1
Horizontal	ratio		3	3
Final lake level	RL m		60	60
Northeast Batters				
Ground Surface	RL m		78	78
Batter Lengths	m		5,750	1,750
Northwest Batters				
Ground Surface	RL m		90	90
Batter Lengths	m		2,250	2,250
Western Batters				
Ground Surface	RL m		64	64
Batter Lengths	m		1,500	1,500
Southwestern				
Ground Surface	RL m		77	77
Batter Lengths	m		1,800	1,800
Southeastern				
Ground Surface	RL m		68	68
Batter Lengths	m		4,000	3,050
Mine Floor/East				
Ground Surface	RL m		63	63
Batter Lengths	m		4,800	2,250
Average Batter Height	m		20	20
Pit Floor	RL m		-110	-85
Execution Phase General Rates				
Mobilisation/Demobilisation	% of total execution costs		5%	
Engineering Procurement & Construction Management	% of total execution costs		15.00%	
Monitoring & Maintenance Phase Rates			**P50**	**P95**
Post execution monitoring - initial phase				
surface water	$/yr		$ 50,000	$ 75,000
groundwater	$/yr		$ 100,000	$ 125,000
geotechnical	$/yr		$ 75,000	$ 150,000
ecological (inc. rehabilitation)	$/yr		$ 50,000	$ 75,000

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fire	$/yr		$ 50,000	$ 100,000
Total monitring - initial	$/yr		$ 325,000	
Post execution monitoring - subsequent				
surface water	$/yr		$ 25,000	$ 40,000
groundwater	$/yr		$ 50,000	$ 60,000
geotechnical	$/yr		$ 35,000	$ 75,000
ecological (inc. rehabilitation)	$/yr		$ 25,000	$ 40,000
fire	$/yr		$ 50,000	$ 100,000
Total monitring - subsequent	$/yr		$ 185,000	
Post execution maintenance - initial phase				
fire	$/yr		$ 200,000	$ 400,000
rehabilitation	ha		400	500
rehabilitation fail rate	% / yr		3%	
rehabilitation rate	$/ha		$ 3,500	
rehabilitation	$/yr		$ 42,000	
erosion repair	$/yr		$ 400,000	$ 900,000
lease costs	$/yr		$ 100,000	$ 200,000
security services	$/yr		$ 100,000	$ 200,000
securit maintenance	$/yr		$ 20,000	$ 50,000
Council rates	$/yr		$ 100,000	$ 500,000
site services (demountables, power, water)	$/yr		$ 50,000	$ 80,000
Total maintenance - initial	$/yr		$ 1,012,000	
Post execution maintenance - subsequent				
fire	$/yr		$ -	$ -
rehabilitation	ha		400	500
rehabilitation fail rate	% / yr		3%	
rehabilitation rate	$/ha		$ 3,500	
rehabilitation	$/yr		$ 42,000	
erosion repair	$/yr		$ 50,000	$ 100,000
lease costs	$/yr		$ 100,000	$ 200,000
security services	$/yr		$ 50,000	$ 100,000
securit maintenance	$/yr		$ 20,000	$ 50,000
Council rates	$/yr		$ 75,000	$ 300,000
site services (demountables, power, water)	$/yr		$ -	$ -
Total maintenance - subsequent	$/yr		$ 337,000	
Management	% of total monitoring/maintenance costs		3%	3%
Timelines			**EoM**	**Early Closure 1**
Year of current assessment			2015	2015
Year number			1	1
Mine Shutdown			2037	2015
Year closure execution to commence			2038	2015
Year number			24	1
Duration of Closure Execution phase	years		3	3

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Duration of post execution maintenance/monitoring - initial phase	years		43	22
Duration of post execution maintenance/monitoring - subsequent phase	years		2	2
Effective duration of post execution maintenance/monitoring - subsequent phase	years		2	2
Duration of lake fill to achieve floor stability (RL-21m)	years		15	8
Duration of full lake fill to final level	years		43	22
Other Costs and Parameters (not in Bond Calculator)			**P50**	**P95**
Bulking factor for earthworks			1.15	1.2
Summary adopted earthworks rates				
Externally sourced topsoil	$/m^3		$20.00	
Externally sourced cover & cap material	$/m^3		$10.00	
Internally sourced buttress / fill material	$/m^3		$5.00	
Reshaping	$/m^3		$4.00	
Lime dosiing	$/year		$200,000	$500,000
Horizontal bores for slope stabilisation				
No required	#/ha slope		1	1.5
Installation cost	$/bore		$20,000	$50,000
Dewatering bores				
Connection pipeworks	$/m		$50.00	$70.00
Rip Rap				
thickness	m		0.75	
vertical height	m		4	
Annual dewatering costs				
Loy Yang	$/annum		80,000	120,000
Bulk Water Entitlement				
Current Loy Yang BWE	GL/yr		40	
Supplementary Water Costs				
Allocation Purchase	$/ML		$ 2,000	$ 5,000
Allocation Purchase	$/GL		$ 2,000,000	
Annual groundwater fee	$/ML/yr		$ 20	
Annual groundwater fee	$/GL/yr		$ 20,000	
Annual Bulk Water Entitlement	$		$ 729,000	
Total annual fees	$/yr		$ 749,000	

Management Precinct	Activity	Unit	FROM BOND CALCULATOR	Adopted Rates- green/yellow highlight means value used in model		Distribution	Comment on Changes to Bond Calculator Rate
				P50	P95		
Main Work Shop and	Disconnect and terminate services	item	$5,000.00	$5,000	$6,000	Lognormal Distribution applied	
	Demolish and remove industrial buildings such as workshops and large sheds	m2	$160.00	$160	$200	Lognormal Distribution applied	
	Remove Concrete pads, footings and foundations (> 300mm thickness)	m2	$15.00	$15	$35	Lognormal Distribution applied	
	Demolish and remove overland conveyors, transfer stations & gantries (scrapping only - does not include dismantling for re-use at another site).	m	$100.00	$100	$250	Lognormal Distribution applied	Used the same rate for all conveyors
	Decomission, decontaminate and demolish dredgers	ea		$1,000,000	$2,500,000	Lognormal Distribution applied	URS Estimate-Loy Yang BC had $50,000 - considered too low
	Pipework removal	m		$5	$10	Lognormal Distribution applied	Estimate taken from Loy Yang Bond Calc Sheet
Access & Haul Roads							
	Reshape, deep rip and ameliorate sealed unsealed roads	ha	$2,500.00	$2,500	$3,500	Lognormal Distribution applied	
Removal and disposal of							
	Removal and disposal of oil contaminated water from bunded areas and sumps.	L	$0.25	$0.25	$0.40	Lognormal Distribution applied	
	Load, cart and dispose of low-level contaminated soil off site to a licensed landfill. Assumes cartage to a local landfill. Add $50/m3 for cartage to regional landfill.	m3	$390.00	$390	$700	Lognormal Distribution applied	
	Removal of underground fuel storage tank (UST) above 5,000L and below 15,000L capacity (include all site facilities and is to include pipes, bunds, etc)	@	$48,000.00	$48,000	$50,000	Lognormal Distribution applied	
Landscaping, minor earthworks and revegetation throughout domain area.							
	Source, cart, spread and lightly rip topsoil (>5km)	$/m3	$3.60	$20	$45	Lognormal Distribution applied	based on commercial rates as no topsoil stockpiled at any site; $7.50/m3 excavate, deposit & spread - double for commerical rates - $15/m3; haulage at $0.57/m3/km - @10km $5.70/m3, 23km $17.10/m3
	Average topsoil thickness	m		0.1	0.15	Lognormal Distribution applied	URS Estimate of topsoil thickness - loose cubic metres
	Direct seeding (native tree species OR using native grasses), with single application of fertiliser	$/ha	$3,500.00	$3,500	$4,000	Lognormal Distribution applied	
	Overall topsoil and revegetation rate	$/ha		$23,500			Combined vegetation rate - no distribution applied
Landscaping, minor earthworks and revegetation throughout domain area.	Shaping or levelling of minor excavations, batters and stockpiles, final trim, rock rake and deep rip	$/ha	$1,300.00	$1,300	$1,700	Lognormal Distribution applied	
	Structural water management works, banks, drains, rock lined waterways, sediment dams	$/ha	$2,000.00	$2,000	$2,500	Lognormal Distribution applied	
Active Mining Pit or other Voids (including the voids and any internal benches or mine strips)	Truck and shovel capping to batters and floor	m3	$1.35	$10	$30	Lognormal Distribution applied	Hazelwood had $6.67/m3, but there are no sources on site, other than re-excavating any ex-pit overburden dumps which would require segregation of materials
	Buttress material	m3		$5	$10	Lognormal Distribution applied	Assume on-site source (East Field Overburden Dump)and rate includes rehab of source area
	Major bulk pushing (Sand Batter) to achieve grades nominated in the approval/permit (i.e. < 18o) >50 - 100m	m3	$1.15	$1.55	$3.00	Lognormal Distribution applied	Estimated range from range of BC rates
	Major bulk pushing (Stiff Clay or Soft Rock with ripping) to achieve grades nominated in the approval/permit (i.e. < 18o) 50-100m	m3	$1.95	$4	$5	Lognormal Distribution applied	Range based on Project Support report of 2014 which had ($2.58/m3 cut & push down batters plus $1.62/m3 spread/compact)
	Erect a 6' chain mesh security fence around the top face where the final pit will include steep faces	m	$50.00	$50	$55	Lognormal Distribution applied	consistent with rawlinsons given project scale
	Reshaping volume per m exposed batter height per lineal m of batter slope	m3/m/m		100	110	Lognormal Distribution applied	URS Estimate - based on assumed average 1:1 batter slopes and balance of cut to fill - see "Batter Slopes" tab
	Final cover material over pit slope to control fire and minmise surface water infiltration	m		0.75	1	Lognormal Distribution applied	URS Estimate - based on discussion with DEDJTR
	Rip rap at final lake level	$/m2		$60	$90	Lognormal Distribution applied	Rawlinsons has $121/m2 for revetment walls 450mm thick dry place embedded in mortar - take 25% of this rate but for 0.75m thick
Ash Dams	Cap material - load, haul place	$/m3		$10	$30	Lognormal Distribution applied	As per Truck and Shovel rate above
	Cap material - compact	$/m3		$3	$4	Lognormal Distribution applied	Based on Rawlinsons of $3.60/m3 to compact
Other Management Issues	Removal of powerlines (this includes disconnection, rolling up the wires and removing the poles). It does not inlcude the removal of substations.	km	$12,000.00	$20,000	$40,000	Lognormal Distribution applied	URS estimate

URS

C.2 General – 2015 WPV

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GENERAL PARAMETERS USED IN COSTING					
	NPV Discount Rate	3.0%		As per Vic gov wage inflation and discounts file	
Final Void				**EoM**	**Early Closure 1**
Overall Pit Slope Angle (V:H)					
Angle	degrees			18.4	18.4
Vertical	ratio			1	1
Horizontal	ratio			3	3
Final lake level	RL m			0	0
Stabilised floor water level	RLm			-21	-21
Northeast Batters					
Ground Surface	RL m			78	78
Batter Lengths	m			5,750	1,750
Northwest Batters					
Ground Surface	RL m			90	90
Batter Lengths	m			2,250	2,250
Western Batters					
Ground Surface	RL m			64	64
Batter Lengths	m			1,500	1,500
Southwestern					
Ground Surface	RL m			77	77
Batter Lengths	m			1,800	1,800
Southeastern					
Ground Surface	RL m			68	68
Batter Lengths	m			4,000	3,050
Mine Floor/East					
Ground Surface	RL m			63	63
Batter Lengths	m			4,800	2,250
Average Batter Height	m			20	20
Pit Floor	RL m			-110	-85
Execution Phase General Rates					
Mobilisation/Demobilisation	% of total execution costs			5%	
Engineering Procurement & Construction Management	% of total execution costs			15.00%	
Monitoring & Maintenance Phase Rates				**P50**	**P95**
Post execution monitoring - initial phase					
surface water	$/yr			$ 50,000	$ 75,000
groundwater	$/yr			$ 100,000	$ 125,000
geotechnical	$/yr			$ 75,000	$ 150,000
ecological (inc. rehabilitation)	$/yr			$ 50,000	$ 75,000
fire	$/yr			$ 50,000	$ 100,000
Total monitring - initial	$/yr			$ 325,000	
Post execution monitoring - subsequent					
surface water	$/yr			$ 25,000	$ 40,000
groundwater	$/yr			$ 50,000	$ 60,000
geotechnical	$/yr			$ 35,000	$ 75,000
ecological (inc. rehabilitation)	$/yr			$ 25,000	$ 40,000
fire	$/yr			$ 50,000	$ 100,000
Total monitring - subsequent	$/yr			$ 185,000	
Post execution maintenance - initial phase					
fire	$/yr			$ 200,000	$ 400,000
rehabilitation	ha			400	500
rehabilitation fail rate	% / yr			3%	
rehabilitation rate	$/ha			$ 3,500	
rehabilitation	$/yr			$ 42,000	
erosion repair	$/yr			$ 400,000	$ 900,000
lease costs	$/yr			$ 100,000	$ 200,000
security services	$/yr			$ 100,000	$ 200,000
securit maintenance	$/yr			$ 20,000	$ 50,000
Council rates	$/yr			$ 100,000	$ 500,000
site services (demountables, power, water)	$/yr			$ 50,000	$ 80,000
Total maintenance - initial	$/yr			$ 1,012,000	
Post execution maintenance - subsequent					
fire	$/yr			$ -	$ -
rehabilitation	ha			400	500
rehabilitation fail rate	% / yr			3%	
rehabilitation rate	$/ha			$ 3,500	
rehabilitation	$/yr			$ 42,000	
erosion repair	$/yr			$ 50,000	$ 100,000
lease costs	$/yr			$ 100,000	$ 200,000
security services	$/yr			$ 50,000	$ 100,000
securit maintenance	$/yr			$ 20,000	$ 50,000
Council rates	$/yr			$ 75,000	$ 300,000
site services (demountables, power, water)	$/yr			$ -	$ -
Total maintenance - subsequent	$/yr			$ 337,000	
Management	% of total monitoring/maintenance costs			3%	3%
Timelines				**EoM**	**Early Closure 1**
Year of current assessment				2015	2015
Year number				1	1
Mine Shutdown				2037	2015
Year closure execution to commence				2038	2015
Year number				24	1
Duration of Closure Execution phase	years			3	3
Duration of post execution maintenance/monitoring - initial phase	years			70	70
Duration of post execution maintenance/monitoring - subsequent phase	years			5	5
Effective duration of post execution maintenance/monitoring - subsequent phase	years			5	5
Duration of lake fill to achieve floor stability (RL-21m)	years			15	8
Duration of lake fill to final level	years			20	13

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