YANCOAL
兖煤澳大利亚有限公司

AUSTAR COAL MINE
PART OF THE YANCOAL AUSTRALIA GROUP

LWB1 to LWB3

Coal Resource Recovery Plan

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DOCUMENT CONTROL

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1 INTRODUCTION

This coal resource recovery plan has been prepared as part of the Extraction Plan for Longwall LWB1 to LWB3.

1.1 SCOPE & OBJECTIVE

The objective of this Coal Resource Recovery Plan (CRRP) has been prepared to demonstrate the effective recovery of the available resource in the Bellbird South Area within the Greta Seam at Austar Coal Mine using conventional Longwall mining techniques. See **Figure 1**.

This Coal Resource Recovery Plan has been prepared in accordance with Condition 3A(d) of Schedule 3 of DA29/95 (MOD 6) as a component of the Austar Coal Mine Extraction Plan LWB1-LWB3.

Therefore, this report provided a description of the:

- Coal resources available within the Bellbird South Area;
- Proposed Mining Method, Schedule and Mine plan;
- Resource recovery and effects on future mining; and
- Justification for the Mine plan.

Graphical Plans (included with the main Extraction Plan) provide supporting information and provide details of the coal resource, existing and proposed workings, and impacted surface features. The plans have been prepared in accordance with the *Guidelines for the Preparation of Extraction Plans (Draft V5)* (Extraction Plan Guidelines) provided to Austar Coal by the Department of Planning and Environment in 2016.

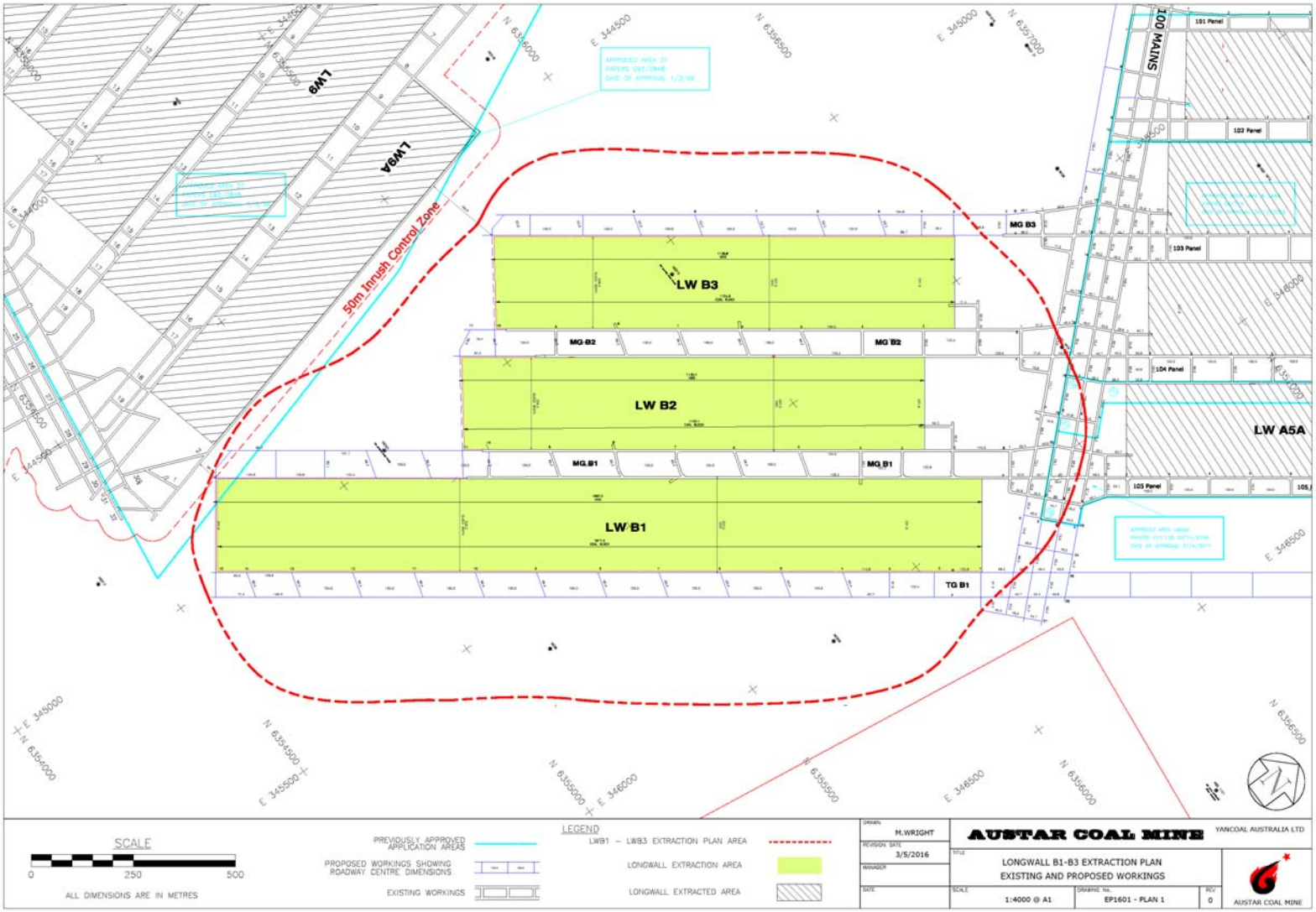

Figure 1 – Longwalls B1 – B3

2 RESOURCE DESCRIPTION

2.1 SITE CONDITIONS

The Austar Underground Mine lies in the Newcastle Coalfield, within the Northern Sydney Basin. Austar Coal Mine is proposing to extract LWB1 – B3 using conventional longwall mining methods within the Greta Seam. The Extraction Plan Area is bounded by the depth of cover to the south and the previously extracted Ellalong workings to the west.

2.2 OVER BURDEN STRATIGRAPHY

The Extraction Plan Area lies in the Newcastle Coalfield, within the Northern Sydney Basin. A typical stratigraphic section of the Newcastle Coalfield (after Ives et al, 1999, Moelle and Dean-Jones, 1995, Loehe and Dean-Jones, 1995, Loehe and Allan, 1995) is shown in **Table 1**. The strata shown in this table were laid down between the Early Permian and the Middle Triassic Periods.

Longwalls B1 to B3 are proposed to be extracted within the Greta Seam, which is located within the Kitchener Formation of the Greta Coal Measures. The overlying strata comprise the Paxton Formation, which consists of interbedded sandstone and siltstone layers up to 20 metres thick. The uppermost layer in the Greta Coal Measures is the Pelton Seam, which is less than 1.0 metre thick. The underlying strata comprise the Kurri Kurri Conglomerate and the Neath Sandstone. Strong and thick strata consisting of conglomerate and sandstone are typically observed within these formations.

The main sequence overlying the Greta Coal Measures is the Branxton Formation, which is part of the Maitland Group sediments from the mid Permian period. The Maitland Group comprises, in order of deposition, the Branxton Formation, Muree Sandstone and Mulbring Siltstone. The Branxton Formation immediately overlies the Greta Coal Measures and is made up of a substantial thickness of sedimentary rocks. The lithology of the Branxton Formation generally consists of the coarser sandstone and conglomerate rocks at the base of the formation, grading to finer deposits of silty sandstone and siltstone at the top of the formation. The upper part of the formation contains a unit known as Fenestella Shale that contains numerous fossils of marine invertebrate fauna.

The Newcastle region is characterised by a complex geological setting, with a great variety of rock types occurring over short lateral and vertical distances (Moelle and Dean-Jones, 1995). Folds, normal faults and dykes dominate the region and generally trend north-west to north-north-west (Lohe and Dean-Jones, 1995).

Table 1 Stratigraphy of the Newcastle Coalfield

Stratigraphy			Lithology
Group	Formation	Coal Seams	
Narrabeen Group	Clifton		Sandstone, siltstone, mudstone, claystone
Newcastle Coal Measures	Moon Island Beach	Vales Point Wallarah Great Northern	Sandstone, shale, conglomerate, claystone, coal
	Awaba Tuff		Tuff, tuffaceous sandstone, tuffaceous siltstone, claystone, chert
	Boolaroo	Fassifern Upper Pilot Lower Pilot Hartley Hill	Conglomerate, sandstone, shale, claystone, coal
	Warners Bay Tuff		Tuff, tuffaceous sandstone, tuffaceous siltstone, claystone, chert
	Adamstown	Australasian Montrose Wave Hill Fern Valley Victoria Tunnel	Conglomerate, sandstone, shale, claystone, coal
	Nobbys Tuff		Tuff, tuffaceous sandstone, tuffaceous siltstone, claystone chert
	Lambton	Nobbys Dudley Yard Borehole	Sandstone, shale, minor conglomerate, claystone, coal
	Waratah Sandstone		Sandstone
Tomago Coal Measures	Dempsey		Shale, siltstone, fine sandstone, coal, and minor tuffaceous claystone
	Four Mile Creek	Upper Donaldson Lower Donaldson	
	Wallis Creek		
Maitland Group	Mulbring Siltstone		Siltstone
	Muree Sandstone		Sandstone
	Branxton		Sandstone, and siltstone
Greta Coal Measures	Paxton	Pelton	Sandstone, conglomerate, and coal
	Kitchener	**Greta**	
	Kurri Kurri	Homeville	
	Neath Sandstone		Sandstone
Dalwood Group	Farley		Shale, siltstone, lithic sandstone, conglomerate, minor marl and coal, and interbedded basalts, volcanic breccia, and tuffs
	Rutherford		
	Allandale		
	Lochinvar		
Seaham Formation			

2.3 LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS (IMMEDIATE ROOF STRATA)

The immediate roof of the Greta Seam consists of thickly bedded and massive sandstone and conglomerate units which are in turn overlain by the Pelton Seam.

In the outbye areas of LWB1-B3, the immediate roof is dominated by 14 to 14.5 m of sandstone and conglomerate, overlain by the Pelton Seam, which in this area consists of thin, muddy carbonaceous and coal bands. Towards the central portion of the mining area, the immediate sandstone and conglomerate roof units thin to approximately 13 m. The inbye end of the mining area sees the sandstone and conglomerate thickness further reduce to approximately 7m as the overlying Pelton Seam comes closer to the Greta Seam. In this area the Pelton Seam is less than 1.0 metre thick.

Typical Unconfined Compressive Strength (UCS) values for the roof strata are; 53 MPa for sandstone units, 46 MPa for conglomerate units and 12MPa for coal. Mining experience on development in the Bellbird South area has shown that distal to geologically disturbed ground, the roof tends to be competent.

2.4 LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS (IMMEDIATE FLOOR STRATA)

The Greta Seam floor comprises predominantly sandstone and conglomerate, however two drill holes in the central and inbye areas of LWB2 and LWB3 also contain between 0.5 m and 1.0 m of mudstone immediately underlying the coal seam. Floor condition could potentially be poor in these areas.

2.5 GEOLOGICAL STRUCTURES

Uncommon or anomalous geological structure has been encountered between 2 and 3 c/t in the mining area (known as the Swamp Fault). The Swamp Fault system consists of a number of closely spaced normal faults with a typical orientation of NNW-SSE and displacements down to the ENE. Total displacement was mapped to be between 0.6 m and 1.0 m in MGB1, and between 1.2 m and 1.5 m in MGB2. Also associated with the Swamp Fault system is a seam roll that impacts the general area from 1 c/t to 4 c/t.

An additional geological structure zone is also predicted more than 50 metres inbye end of the mining area. The geological feature is referred to as the Barraba Fault Zone and is believed to consist of a number of faults orientated NNW-SSE. The fault zone has been projected to rotate from intersections in the Ellalong LW9 gateroads where measured fault displacements ranged from 0.1 m to 7.2 m. Longhole drilling has indicated displacements of greater than 10 metres inbye of LWB2.

2.6 STABILITY OF UNDERGROUND WORKINGS

The proposed pillars in the application area are designed to provide stable underground workings for the period of development and subsequent extraction. As such, pillars are designed with an appropriate Factor of Safety and width to height ratio for their purpose.

Detail on predicted subsidence impacts, the associated method of prediction and relevant subsidence parameters can be found in the Extraction Plan main report.

Accompanying the designed mining layout is a monitoring program whose objective is to monitor roadways, pillars and panel performance, to ensure the adequacy of the design. The monitoring program comprises a combination of tell-tales, gel extensometers, borescopes, and visual inspections. Monitoring is conducted during both development and secondary extraction.

3 MINING SYSTEMS AND RESOURCE RECOVERY

3.1 MINING GEOMETRY

The layouts of the proposed longwall panels LWB1 – LWB3 within the Greta Seam are shown in **Figure 1**. A summary of the proposed dimensions of these panels is provided in **Table 2**. It is proposed that the longwalls would be extracted in order of LWB2, LWB3 and then LWB1.

Table 2 Geometry of the Proposed Panels LWB1 to LWB3

Panel	Overall Void Length Including Installation Heading (m)	Overall Void Width Including First Workings (m)	Overall Tailgate Chain Pillar Width (m)
LWB2	1,141	237	60
LWB3	1,137	237	60
LWB1	1,882	237	60

3.2 DEPTH OF COVER

The depth of cover to the Greta Seam directly above the proposed longwalls varies between a minimum of 480 metres above the maingate of Longwall B3 and a maximum of 555 metres above the north-eastern corner of Longwall B1. The seam floor within the proposed mining area dips from the north-west to the south-east, having an average gradient of around 6 %, or 1 in 17.

The variations in the surface and seam levels across the mining area are illustrated along Cross-sections 1 in **Figure 2**.

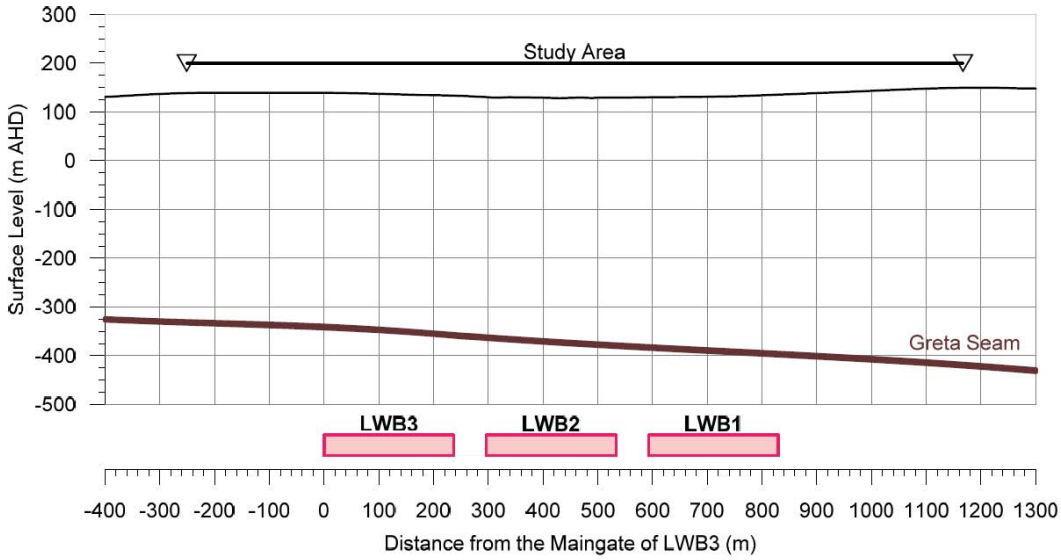

Figure 2 Surface and Seam levels along Cross-section 1 (MSEC833)

3.3 MINING METHOD

Austar will use the conventional longwall method of mining the Greta Seam within the application area.

The thickness of the Great Sefam within the proposed mining area varies between 3.3 metres and 4.6 metres. It is proposed that a constant thickness of 3.4 metres will be extracted using conventional longwall mining techniques.

Extraction will take place generally in a southwest to northeast direction towards the 100 Mains Headings.

Long term mains development pillars are designed to be long term stable and hence not cause subsidence, thus rendering the roads serviceable for the life of the mine.

Development roads will nominally be driven at a width of up to 5.4 metres using single pass continuous miners.

3.4 SCHEDULE

The mining schedule for the Extraction Plan Area is shown in **Table 3**. Extraction will progress in a direction towards the 100 Mains Headings in each Panel commencing with LWB2. Development rates are budgeted from 8 to 10 metres per continuous miner shift dependent on geological conditions and support regime. Longwall extraction will typically produce in the order of 3,000 to 4,000 tonnes per shift.

Normally operations are carried out 24 hours per day seven days per week. Generally maintenance operations (e.g. stonedusting, roadway maintenance etc) are undertaken on Wednesdays.

The anticipated start and completion dates are summarised in **Table 3**.

Table 3 Panel Extraction Rate and Sequence

Panel	Start Date	End Date	Estimate Duration (Days)
LWB2	July 2016	Dec 2017	150
LWB3	Feb 2017	July 2017	150
LWB1	Feb 2018	Aug 2018	195

3.5 FUTURE MINING

There are no other seams considered economically mineable within the Extraction Plan Area.

3.6 RESOURCE RECOVERY

The method of extraction selected allows for maximum resource recovery whilst providing safety for the workforce. There are no significant environmental impacts that preclude longwall extraction within the Extraction Plan Area.

In the initial planning of the area an option study was conducted whereby a number of alternative mine plans were considered having regard to the lease boundaries, exploration geological data and initial environmental assessment details. The plan and layout have been continually reassessed and reviewed as additional exploration, geological, and environmental data have become available.

The resultant mine plan provides for optimum resource recovery within the bounds created by geological and previous mining constraints. It is considered to be a layout which will result in subsidence being completed in accordance with DA29/95 conditions.

The estimated recovery of the resource for the Extraction Plan Area is provided in **Table 4**.

Table 4 Extraction Plan Area Estimated Resource Recovery

Total tonnes of coal (Resource within extraction area)	12.3Mt
Total tonnes extracted through development	0.35Mt
Tonnes extracted by Longwall	3.7Mt
Percentage recovery	33%

Particulars relating to each Panel is given in **Table 5**.

Table 5 Estimated Individual Panel Tonnages

Panel	Panel Length (m)	Panel Width (void m)	Average Extrcation Height (m)	Panel Extraction Tonnes (Mt)
LWB1	1,882	237	3.4	1.03
LWB2	1,141	237	3.4	1.00
LWB3	1,137	237	3.4	1.44

3.7 JUSTIFICATION

The layout, as indicated on **Figure 1**, has been developed based on extensive drilling, environmental investigation and assessment and consultation with relevant authorities.

The layout and method also provide an extraction layout which maximises the efficient use and management of resources through maximising resource utilisation within an area of historical underground workings and using well established surface facilities. There are no significant environmental impacts that preclude longwall mining within the Extraction Plan Area.

The subsidence monitoring program contained within the Extraction Plan summarises the overall monitoring of mining impacts on the natural and built environments, with management actions detailed in the relevant environmental management plan(s) or Built features Management Plan.