Longwalls 201 to 204

Coal Resource Recovery Plan

November 2016

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1 INTRODUCTION

This coal resource recovery plan has been prepared as part of the Ashton Coal Extraction Plan for Longwalls LW201 to LW204.

1.1 SCOPE & OBJECTIVE

The Coal Resource Recovery Plan (CRRP) has been prepared to demonstrate the effective recovery of the available resource within the Upper Lower Liddell (ULLD) Seam at Ashton Coal Mine using conventional Longwall mining techniques. See **Figure 1**.

This CRRP has been prepared in accordance with Condition 32(g) of Schedule 3 of DA 309-11-2001-i (MOD 5) as a component of the Ashton Coal Mine Extraction Plan LW201-LW204.

Therefore, this report provides a description of the:

- Coal resources available within the ULLD seam;
- 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 Ashton Coal by the Department of Planning and Environment in 2016.

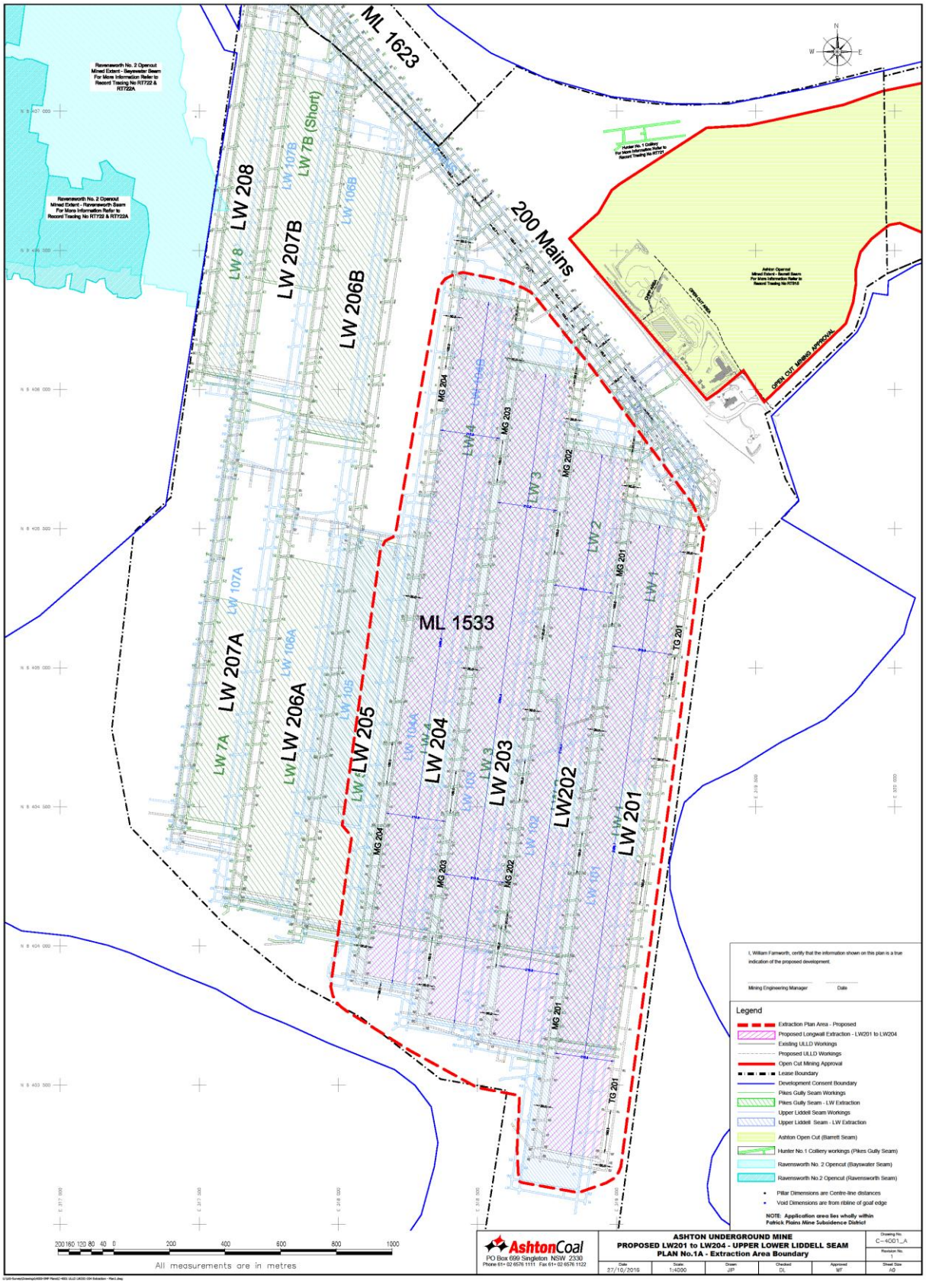


Figure 1 – Longwalls 201 – 204

2 RESOURCE DESCRIPTION

2.1 SITE CONDITIONS

The Ashton Underground Coal Mine is located in the Hunter Coalfield, within the Northern Sydney Basin. The coal seams and surrounding strata form the very basal part of the Burnamwood Formation of the Jerrys Plains Subgroup (which only occurs in the far south-west of the underground mining area), and the underlying, thinner Bulga Formation and much thicker Foybrook Formation of the underlying Vane Subgroup. The stratigraphy of the Ashton Underground Coal Mine is dominated by the seams and strata of the Foybrook Formation. The above formations are stratigraphic units of the Late Permian Singleton Supergroup. The Foybrook Formation is the basal coal bearing sequence of the Wittingham Coal Measures and the Singleton Supergroup.

The current study area is located on the western limb of the Camberwell Anticline (see **Figure 2**) which is the principal structural feature of the Development Consent area. The axis of this structure trends along the eastern boundary of EL4918 which coincides with a sub crop of the coal seams of principal interest. These sub crops define the westerly dipping limb of the Camberwell Anticline. The stratum consists of a mix of sandstone, shale, and interbedded to finely laminated sandstone/shale with a number of coal seam splits between.

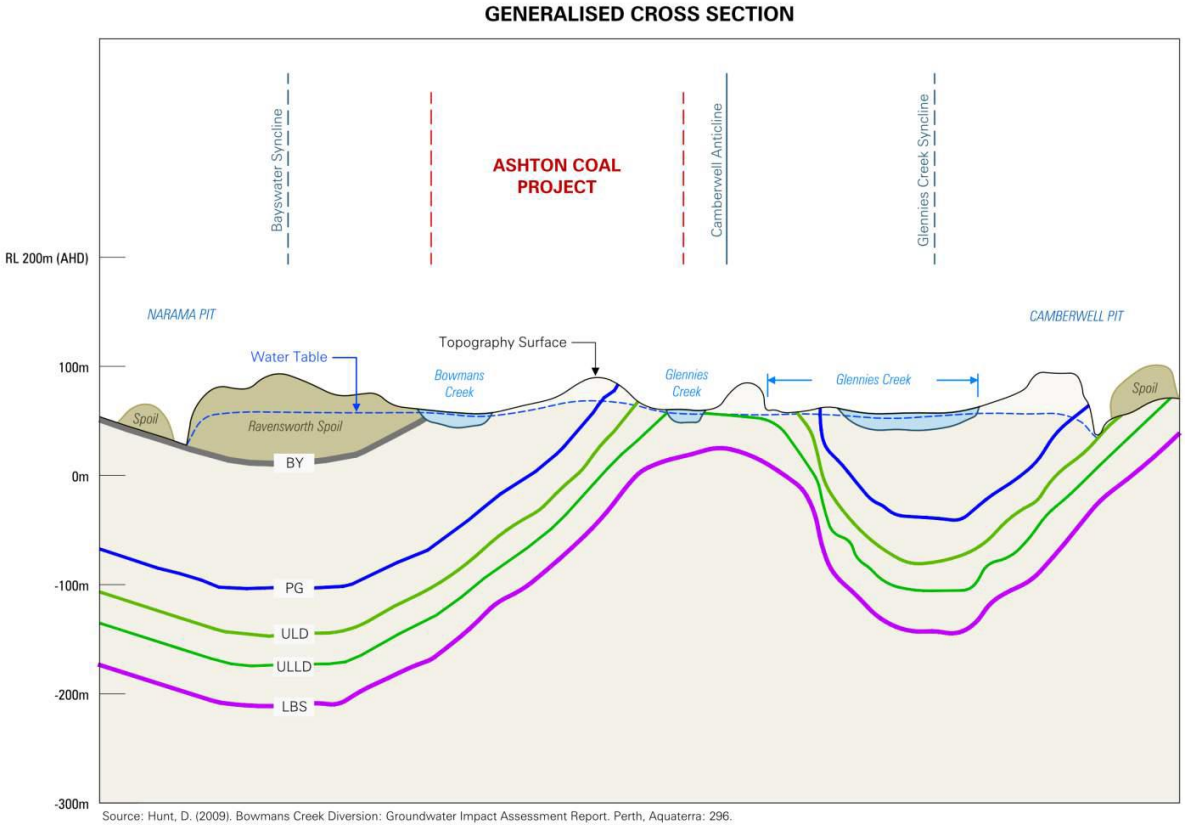


Figure 2 – Generalised Cross Section

Ashton Coal Mine is proposing to extract LW201 – 204 within the ULLD Seam using conventional longwall mining methods. The Extraction Plan Area is bounded by the mining lease to the east and south, interburden thickness to the south for LW201 and the 200 Main Headings to the north.

Ashton Mine primarily produces a semi-soft coking coal at 9.5% ash for the export market. The coal seams of the Foybrook Formation at the Ashton Mine are bituminous, high-volatile, low sulphur, vitrinite-rich and low in other elements such as chlorine and phosphorous. The ash content of ROM (run of mine) coal at Ashton is variable due to a variable seam cross-dip, seam thickness, splitting and convergence and stone bands. ROM coal ash at Ashton Mine ranges from 30.7% and 57.3% with an average of 42.9% (ROM Moisture 8.65%), (Kaltschmidt T., LOM 2016 XPAC model). Raw coal is processed in the Ashton Coal Handling and Preparation Plant (CHPP) and a low ash product (9.5% average) with strong coking CSN (swell) properties is recovered. This places the coal resources at the Ashton Mine at the upper end of the coal rank profile for the Hunter Valley.

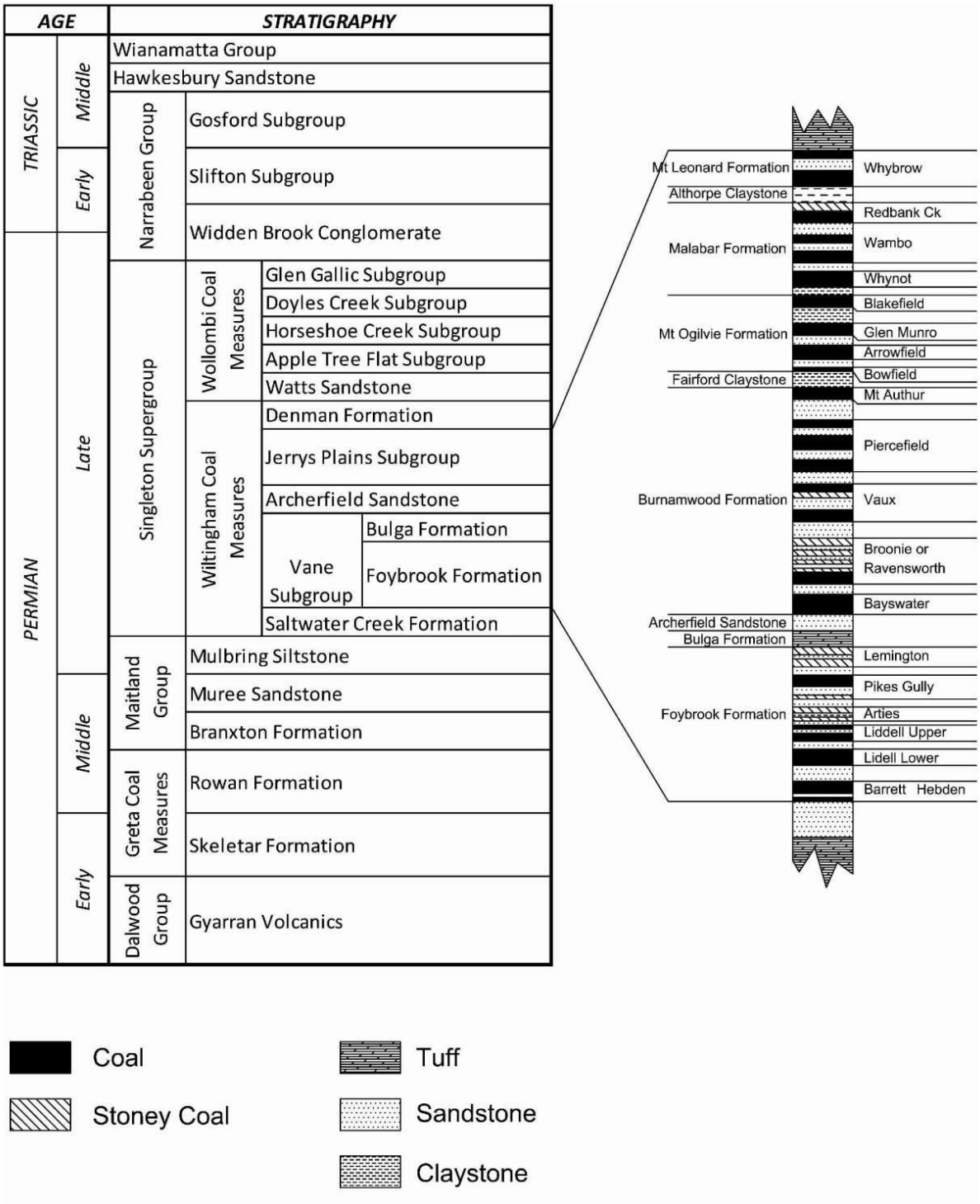
The ULLD Seam varies from 3.41m in surface borehole YAC-011 in the TG201 4ct-5ct chain pillar where the ULLD1-2 plies split is 0.51m of mudstone and siltstone 25-36MPa strength and the normal split ULLD2-3 plies of 0.25m of mudstone 24MPa strength and 1.19m in ULD-ULLD interseam borehole ISLL04 which has a very high strength sandstone roof and high strength sandstone and siltstone floor. Away from these areas the ULLD Seam varies in thickness from 1.70m-2.8m but is generally 2.0m-2.6m thick with some variations.

2.2 OVERBURDEN STRATIGRAPHY

The stratum within the Foybrook Formation is deltaic in origin and comprises, in order of predominance: fine to coarse grained sandstone, siltstone, conglomerate, mudstone, shale and coal. The top of this formation corresponds with the base of the overlying Bulga Formation which is in turn overlain by the Archerfield Sandstone and Jerrys Plains Subgroup respectively. The Bulga Formation and Archerfield Sandstone are marine sandstones or laminates.

The Jerrys Plains Subgroup includes the basal Bayswater Seam which has been mined by open cut methods in the adjacent Ravensworth Mine. A remnant portion of the Bayswater Seam exists in the far south-western part of the Ashton Coal Project (ACP). The Bayswater Seam does not form part of the target seams of the ACP. Conglomerates outcrop at several locations along the natural channel of Bowmans Creek (i.e. near the New England Highway Bridge and the NSW Office of Water NoW) stream gauging station) and in the prominent north-south trending ridge in the eastern part of the surface area of the underground mining area.

A typical stratigraphic section of the Hunter Coalfield is shown in **Figure 3**.



Ref : Ashton Coal A-9410 (10/02/2010)

Figure 3 – Stratigraphy of the Hunter Coalfields

2.3 LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS (IMMEDIATE ROOF STRATA)

The immediate roof of the ULLD Seam consists of dominantly mudstone and siltstone units with sandstone comprising the seam roof in several, defined, palaeo-channel areas, which were predicted prior to development commencing from surface and interseam borehole logs. The ULD-ULLD interburden above the ULLD Seam consists of fine to coarse grained, fine-medium bedded and massive sandstone units, siltstone, mudstone and the MLD1 and 2 Seams (Middle Liddell 1 and 2). The sandstone units contain zones of sub-vertical jointing and may exhibit slow-moderate (steady but reducing over time) roof water egress from them by drippers as routinely mapped in the underground roadways and panels.

Medium-coarse grain-sized sandstone units lying directly on the ULLD Seam roof often show erosive basal contacts during development to date eroding up to 0.30m of the top ULLD1 ply where mapped to date. Several areas of steep and tight seam roof and floor rolls have also been mapped during main headings and longwall gateroad panel development, similar to roll zones intersected and mapped during development and longwall extraction of the overlying ULD Seam.

The typical Unconfined Compressive Strength (UCS) values for the roof strata ranges from 40-120MPa for sandstone units, 15-45MPa for siltstone and 10-30MPa for mudstone. Mining experience in the ULLD Seam on development in the 200 Mains, TG201 and MG201 panels has shown that away from geologically disturbed strata, the ULLD Seam roof is very competent.

2.4 LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS (IMMEDIATE FLOOR STRATA)

The ULLD Seam floor is strong-very strong and competent. It comprises predominantly siltstone with minor mudstone and an underlying very strong sandstone which forms a very competent and very strong floor. The siltstone generally ranges from 0.10m-0.25m thick and the underlying sandstone is exposed when development cuts below the immediate ULLD floor due to the seam rolling and the variable left to right cross-dip.

2.5 LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS (ULLD1-2 AND ULLD2-3 PLY SPLITS)

The ULLD Seam consists of 3 named, correlated and modelled plies known as ULLD1, ULLD2 and ULLD3. These plies comprise the working section ULLDWS. The plies of the ULLD Seam, as is common with all seams of the Foybrook Formation, split and converge rapidly over relatively short distances. Therefore, during development and longwall extraction within the LW201-204 Extraction Plan area, stone bands of varying lithology, thickness and strength between the ULLD1-2 plies and ULLD2-3 plies are modelled in Minex and scheduled in XPAC to be cut as part of the ULLDWS working section. A cutability assessment for the ULLD roof, floor and seam stone splits has been completed.

The ULLD1-2 interburden ranges from 0.05m-0.90m thick as logged in surface and interseam exploration boreholes and mapped during development to date but is generally only an issue during development to cut when it exceeds 0.30m thick. The ULLD1-2 split is composed of dominantly medium-high strength mudstone or siltstone of 8-50MPa but occurs as mudstone or siltstone interbedded with sandstone in the thicker areas with the sandstone units being high-very high strength as logged and 45-75MPa UCS where tested. To date the continuous miners in TG and MG 201 panels have been able to cut the thicker and stronger split areas albeit slower at slower rates

than scheduled and with wear of the cutter drums, increased cutter pick changes and vibration contributing to machinery down-time for repairs.

The ULLD1-2 stone split is modelled as thickest in LW202 where in MG201 it extends from 10ct-17ct and ranges from 0.30m to 0.85m of dominantly mudstone with a basal sandstone unit 0.25m thicker and 75MPa strength in ULD-ULLD interseam borehole ISLL07. A thicker zone of ULLD1-2 stone split also occurs in bore WML191 centered on 18ct in MG202 (but extending into LW202 and 203) where the split reaches 0.57m thickness and comprises mudstone of un-determined strength. In the far outbye part of LW201 and in TG201 the stone split is 0.52m thick, 26-36MPa strength and composed of mudstone and siltstone as mapped during development and as in surface borehole YAC-011.

The ULLD2-3 split thickness is variable and ranges from 0.10m-0.80m thick but is generally 0.30m-0.50m in the LW201-LW204 area as logged in surface and interseam exploration boreholes and mapped during development to date. However, the stone split does increase in thickness rapidly towards the far southern, inbye end of LW202-LW204 near the installation faces where the split is 0.70m-0.87m thick. The ULLD1-2 split is composed of dominantly of medium-high strength mudstone or siltstone of 12-30MPa but has a maximum tested UCS strength of 24-106MPa in an interbedded mudstone/siltstone/sandstone unit in borehole ISLL25B. Generally the stone split occurs as mudstone or siltstone but is interbedded with sandstone in the thicker areas with the sandstone units being high-very high strength as logged and from 45-106MPa UCS where tested. To date the continuous miners in TG and MG 201 panels have been able to cut the split areas up to 0.55m thick and composed of mudstone and sandstone beds generally 50:50 in thickness.

Cutting of the ULLD1-2 stone splits is made more difficult by the variable seam cross dip (0m-1.30m) and other seam roll grade changes which means much more roof stone is cut in a wedge at the development face than if the seam roof was relatively flat and maximum dip was inbye in the direction of development.

2.6 LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS (ULLD-LLLD1/2 INTERBURDEN)

The ULLD Seam working section comprises plies ULLD1-3 and below the seam floor lies the LLLD (Lower Lower Liddell Seam) composed of 2 modelled plies being LLLD1 and LLLD2. The interburden between these 2 seams varies from 5m in LW201, 5m-2m in LW202, 4.8m-1m in LW203 and reduces to the west and south to 0.5m in the far inbye and outbye parts of LW204 but increases to 1m-2.5m in the central part of the panel. The interburden contours follow a curving, approximately north-south trend which thins generally east-west from the 200 Mains to the far inbye parts of the LW201-208. Where the interburden thins and the ULLD working section thickness is around 2.30m, the weaker and thinner mudstone/siltstone floor may break up during development and longwall extraction leaving a coal or partly coal floor.

Where thick, the ULLD3-LLLD1 interburden is generally 0.20m-0.30m of mod-high strength siltstone underlain by high-very strength sandstone units. Where the interburden thins to the west and south, the interburden is characterized by weaker siltstone and mudstone units of 20MPa-40MPa strength.

The LLLD1 Seam is generally 0.30m-0.50m thick and the LLLD2 ply is generally 0.40m-0.60m thick with a weak tuffaceous claystone interburden generally 0.15m-0.20m thick.

2.7 GEOLOGICAL STRUCTURES

Ashton Coal Mine is dominated by geological structures emplaced within a dominantly extensional tectonic regime. The LW201-204 area contains several significant geological structures as a result of this extensional regime including an igneous Teschenite dyke (a Titanium-rich Dolerite related to crustal extension and thinning during the opening of the Tasman Sea) and 2 normal separate fault zones.

The igneous dyke was intersected within PG LW2, ULD LW102 and has been intersected in a pre-extraction development drive into ULLD LW202 to the west off MG201 13ct. The dyke ranges in thickness from <1m-3.5m with associated silling and cinder zones 0.50m-1.0m thick on the dyke edges. The dyke is planned to be pre-mined before LW202 extraction as was done in the overlying PG and ULD Seams. In-seam drilling by VLI from drilling stubs already driven is scheduled to be undertaken off MG201 at 11ct, 12ct, 13ct drive and 14ct to define the extent of the dyke in the ULLD Seam. This drilling will determine whether the dyke has a similar location, extent and thickness to the same dyke in the 2 overlying seams. Cores of NMLC size will be taken of the dyke, silling and cinder for logging and Point Load Tests for the calculation of UCS values for mine planning.

The first normal fault zone within the extraction plan area will be intersected in the back road, installation face and within the block of LW201 Panel. This fault zone trends approximately north-south, is about 30m wide and was mined in the overlying PG and ULD Seams. This fault zone is a graben or trough structure composed of several smaller fault planes dipping 70-80 degrees to the west and of about 1.70m total down-throw to the west and; a similar group of smaller faults with a total 1.60m vertical displacement upthrow to the west but dipping east as mapped during development and longwall extraction. This fault zone will be intersected about 50m from MG202 to MG203 across the installation and back road faces. The fault zone maintains similar dimensions initially within the LW203 block before steadily diminishing in width and vertical displacement to <0.10m about 780m outbye within LW203 Panel.

The second normal fault zone within the extraction plan area also trends approximately north-south and will be intersected in LW204 Panel between 30ct and 29ct in the MG204 chain pillar between A Hdg and B Hdg, and is also predicted to be intersected in the MG204 water pumping sump off 29ct. This fault zone is about 60m wide and was mined in the overlying PG and ULD Seams. The fault zone is composed of several smaller fault planes of 0.05m-0.35m vertical displacement that dip 50-80 degrees to the west and; 1 larger fault of 2.85m-2.45m vertical displacement at its furthest inbye mapped extent and dipping 70-80 degrees to the west. This fault zone will probably not be intersected in LW204 block and will be confined to the LW105 back road, installation face and LW205 block. Outbye of the LW205 installation face, the fault zone will reduce quickly in vertical displacement and width in LW205 to <0.10m about 710m outbye within the block.

2.8 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 LW201 – LW204 within the ULLD 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 LW201, LW202, LW203 and then LW204.

Table 2 Geometry of the Proposed Panels LW201 to LW204

Panel	Overall Void Length Including Installation Heading (m)	Overall Void Width Including First Workings (m)	Overall Tailgate Chain Pillar Width (m)
LW201	2,290	215.8	24.6
LW202	2,137	215.8	24.6
LW203	2,355	215.8	24.6
LW204	2,470	215.8	24.6

3.2 DEPTH OF COVER

The depth of cover to the ULLD Seam directly above the proposed longwalls varies between a minimum of 100 metres above the tailgate of Longwall 201 and a maximum of 230 metres above the south-western corner of Longwall 204. The seam floor within the proposed mining area dips from the north-east to the south-west, having an average gradient of around 11 %, or 1 in 9.

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

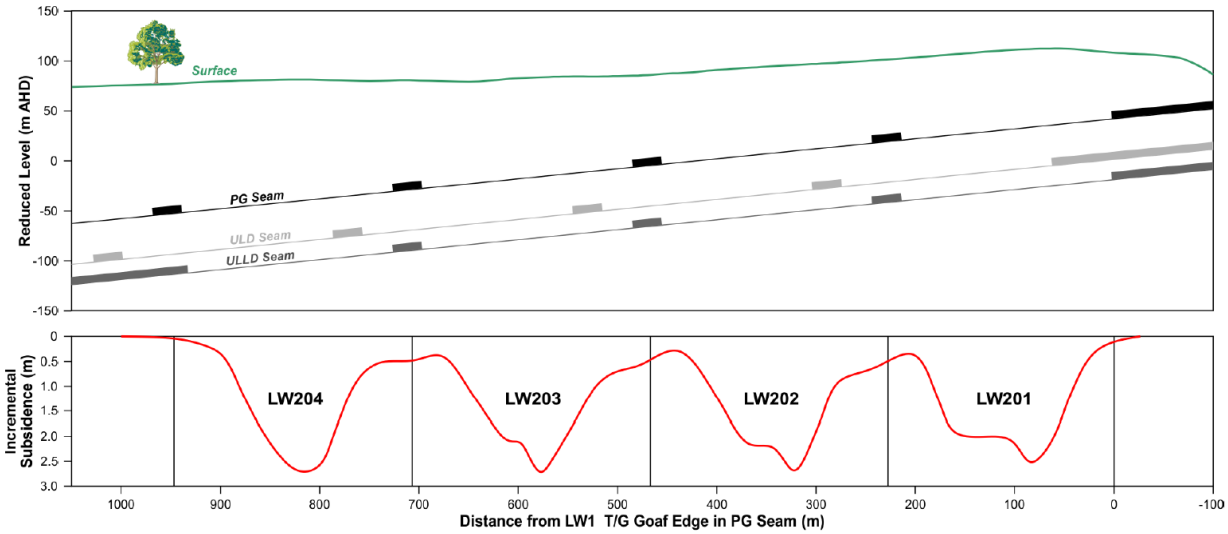


Figure 2 Surface and Seam levels along XL5 (ASH4552_REV3)

3.3 MINING METHOD

Ashton will use the conventional longwall method of mining the ULLD Seam within the application area.

The thickness of the ULLD Seam within the proposed mining area varies between 2.2 metres and 2.6 metres. It is proposed that an average longwall mining height of 2.5 metres will be achieved using conventional longwall mining techniques with variations of about ± 0.3 metres to accommodate the practical operational requirements of the mining equipment.

Extraction will take place generally in a south to north direction towards the 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 Mains Headings in each Panel commencing with LW201. 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, continuous miner, longwall and 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)
LW201	April 2017	Dec 2017	240
LW202	Jan 2018	Sept 2018	240
LW203	Oct 2018	June 2019	255
LW204	July 2019	March 2020	255

3.5 FUTURE MINING

Extraction of LW201 – 204 in the ULLD Seam will commence the proposed extraction of coal in the ULLD Seam within the current mining lease. To the west of LW204, Ashton proposes further longwall mining in the ULLD Seam subsequent to an approved Extraction Plan.

The Ashton Coal Project is approved as a multi-seam longwall operation. Therefore following mining in the ULLD seam, mining will progressively access the reserves within the Lower Barrett (LB) Seam as approved under the Development Consent. Ashton Coal Operation Limited (ACOL) intends to extract the remainder of the ULD Seam prior to completing mining of the ULLD Seam.

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 DA 309-11-2001-i conditions.

It should be noted that there remains some uncertainty regarding the interburden thickness between the ULD and ULLD seams at the southernmost end of LW201. A minimum interburden of 15m is required to ensure geotechnical integrity. Further drilling is planned to define the interburden between the two seams in this area. As a result LW201 may be shortened to accommodate the minimum interburden requirement.

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 Plan area)	11.27Mt
Total tonnes extracted through development	1.01Mt
Tonnes extracted by Longwall	8.83Mt
Percentage recovery	87%

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 Extraction Height (m)	Panel Extraction Tonnes (Mt)
LW201	2,290	215.8	2.5	1.97
LW202	2,137	215.8	2.5	2.07
LW203	2,355	215.8	2.5	2.38
LW204	2,470	215.8	2.5	2.41

3.7 JUSTIFICATION

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

The vertical alignment of LW201 – 204 is horizontally offset from the immediately overlying Upper Liddell (ULD) Seam mine workings and directly beneath the overlying Pikes Gully (PG) Seam mine workings. The layout and method also provides an extraction layout which maximises the efficient use and management of resources through maximising resource utilisation 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.

4 REFERENCES

Strata Control Technology (ASH4552_REV3, 2016). Ashton Coal Operations Pty Ltd: S*ubsidence Assessment for the Extraction Plan for Longwalls 201 – 204 in the Upper Lower Liddell Seam*, Report Number ASH4552.