Longwalls 205 to 208

Subsidence Monitoring Program

April 2021

DOCUMENT CONTROL

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	Document Status	FINAL

APPROVAL DATE	Revision	Revision Details	Prepared	Date
-	1	Original document	ACOL	August 2020
	2	Minor updates to address comments from Transport for NSW	ACOL	September 2020
	3	Revised for increase monitoring of Ausgrid's 132kV assets	ACOL	April 2021

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1 INTRODUCTION AND SCOPE

Ashton Coal Operations Pty Ltd (ACOL), a subsidiary of Yancoal Australia Limited (Yancoal), owns the Ashton Coal Project (ACP), an underground coal mine located approximately 14 kilometres north-west of Singleton in the Hunter Valley in New South Wales (NSW) (**Figure 1**).

The ACP was granted consent on 11 October 2002 by the Minister of Planning pursuant to the provisions of the *Environmental Planning and Assessment Act 1979* (DA 309-11-2001-i). The Mine is approved to produce up to 5.45 million tonnes per annum (Mtpa) of run of mine (ROM) coal and operate until 2024. The consolidated Development Consent has been modified on ten occasions, with the most recent amendment approved on 20 June 2016.

The underground mine is approved for multi-seam longwall extraction, targeting four coal seams in descending order (Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB)) (**Figure 2**). Development of the underground mine commenced in December 2005 and is accessed through the southern wall of the Arties Pit under the New England Highway.

ACOL has subsequently prepared an Extraction Plan for mining of Longwalls 205 to 208 in the ULLD Seam of the Ashton Underground Coal Mine, varying between 185 metres and 255 metres below the surface. Proposed mining of Longwalls 205 to 208 (the **Extraction Plan Area** – refer **Figure 3**) is due to commence in March 2021 and is planned to take place over a three-year period.

1.1 SCOPE AND OBJECTIVE

The scope of the Subsidence Monitoring program includes the Longwalls 205-208 Extraction Plan area. The objective of the Subsidence Monitoring Program is to provide:

- a formal program for monitoring of subsidence parameters and subsidence effect observations on land within the Extraction Plan area.
- provide data to assist in the management of potential risks associated with subsidence.
- validate subsidence predictions; and
- analyse the relationship between the subsidence effects and impacts under the Extraction Plan and any ensuing environmental consequences.

To achieve the objective the Subsidence Monitoring Program will:

- describe subsidence monitoring procedures to measure actual subsidence parameters for the Extraction Plan area; and
- describe observations/inspections of the general landform and environmental condition in the Extraction Plan area.

Figure 1

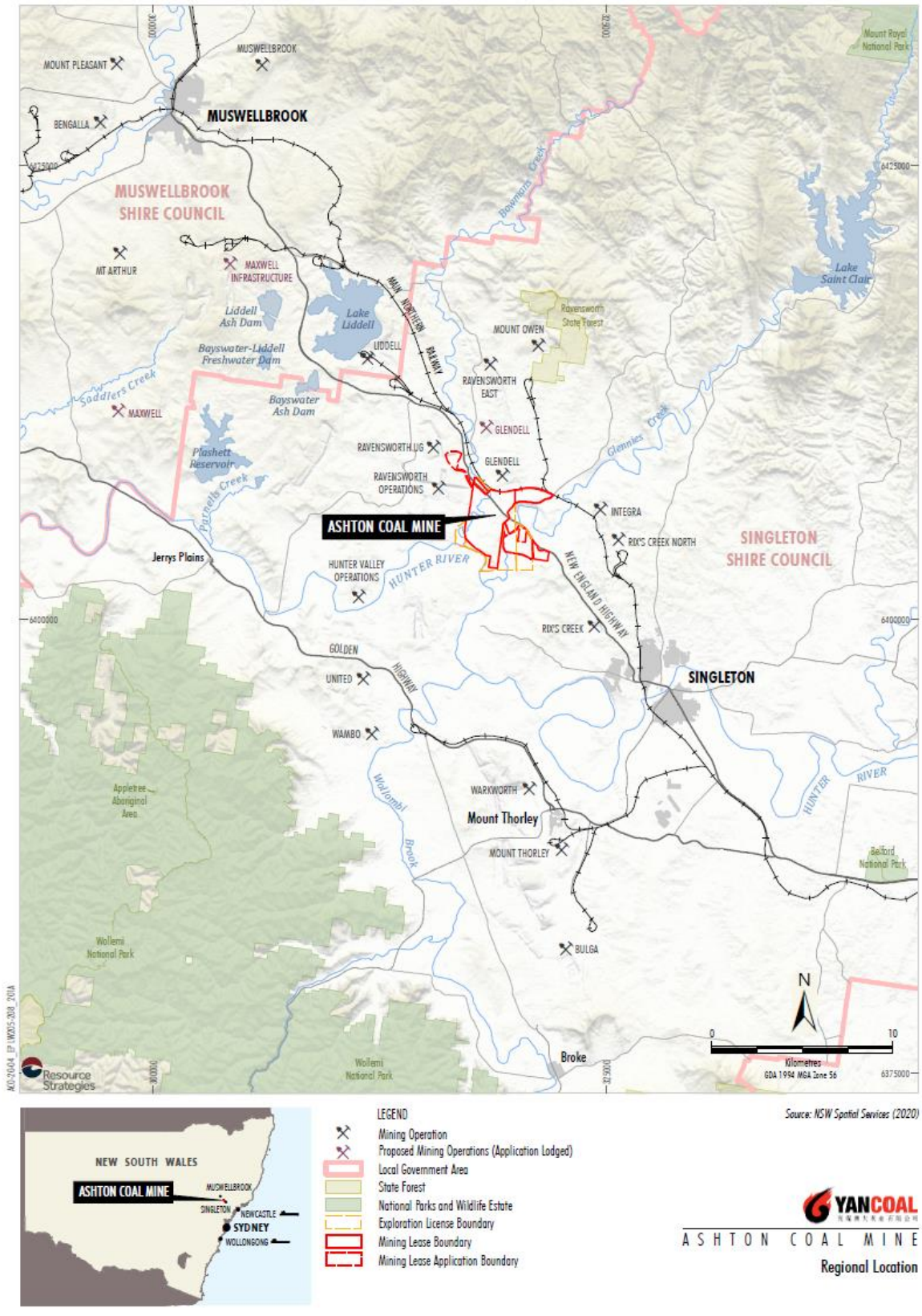
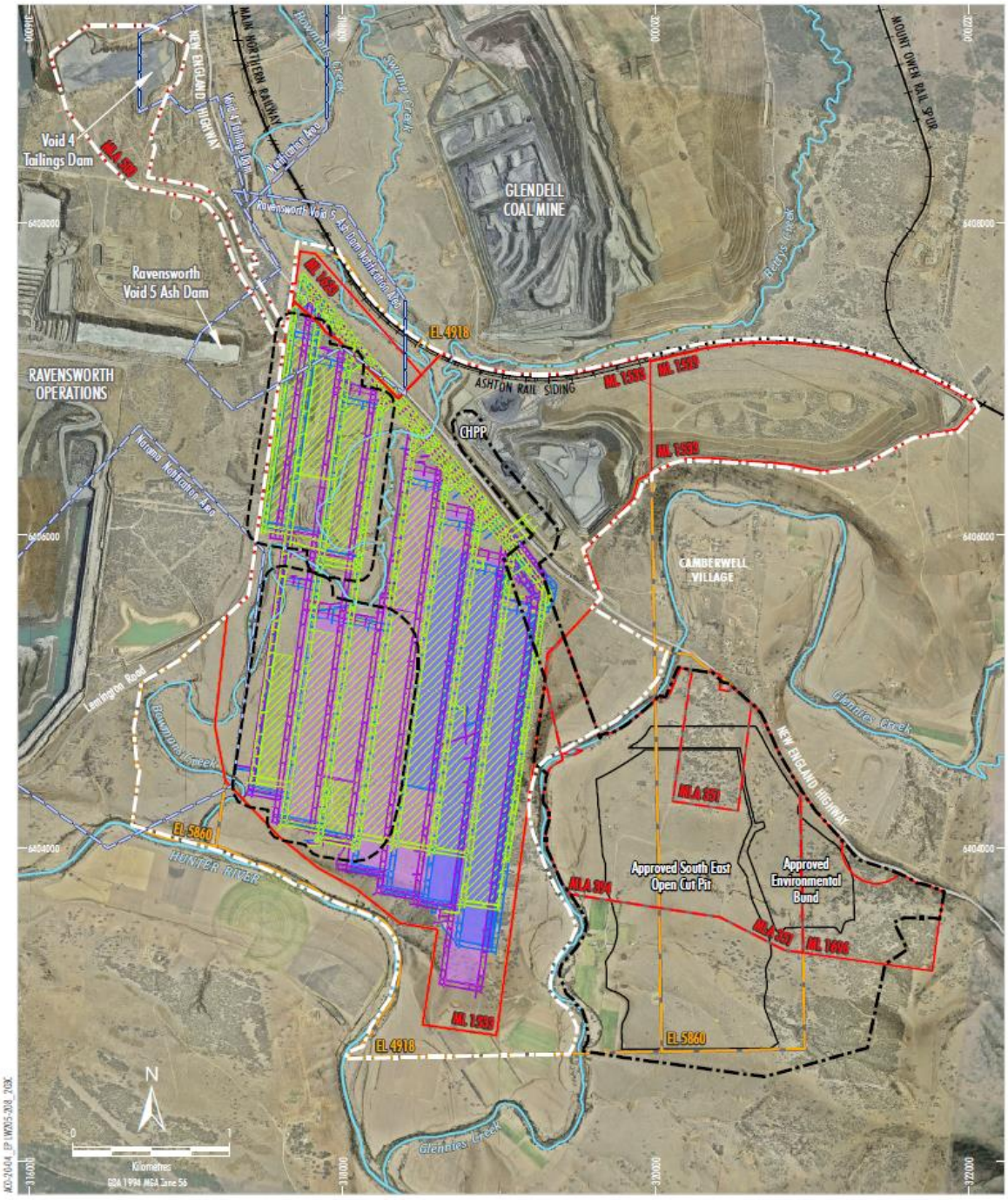


Figure 1

Figure 2



LEGEND
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Lease Application Boundary
- Prescribed Dam Notification Area
- Project Approval Boundary
- South East Open Cut Approval Boundary
- Pike's Gully Seam Longwall
- Upper Liddell Seam Longwall
- Upper Lower Liddell Seam Longwall
- Extraction Plan Application Area

Source: NSW Spatial Services (2020)
Orthophoto: Ashton Coal (Dec 2019); NSW Spatial Services (2019)

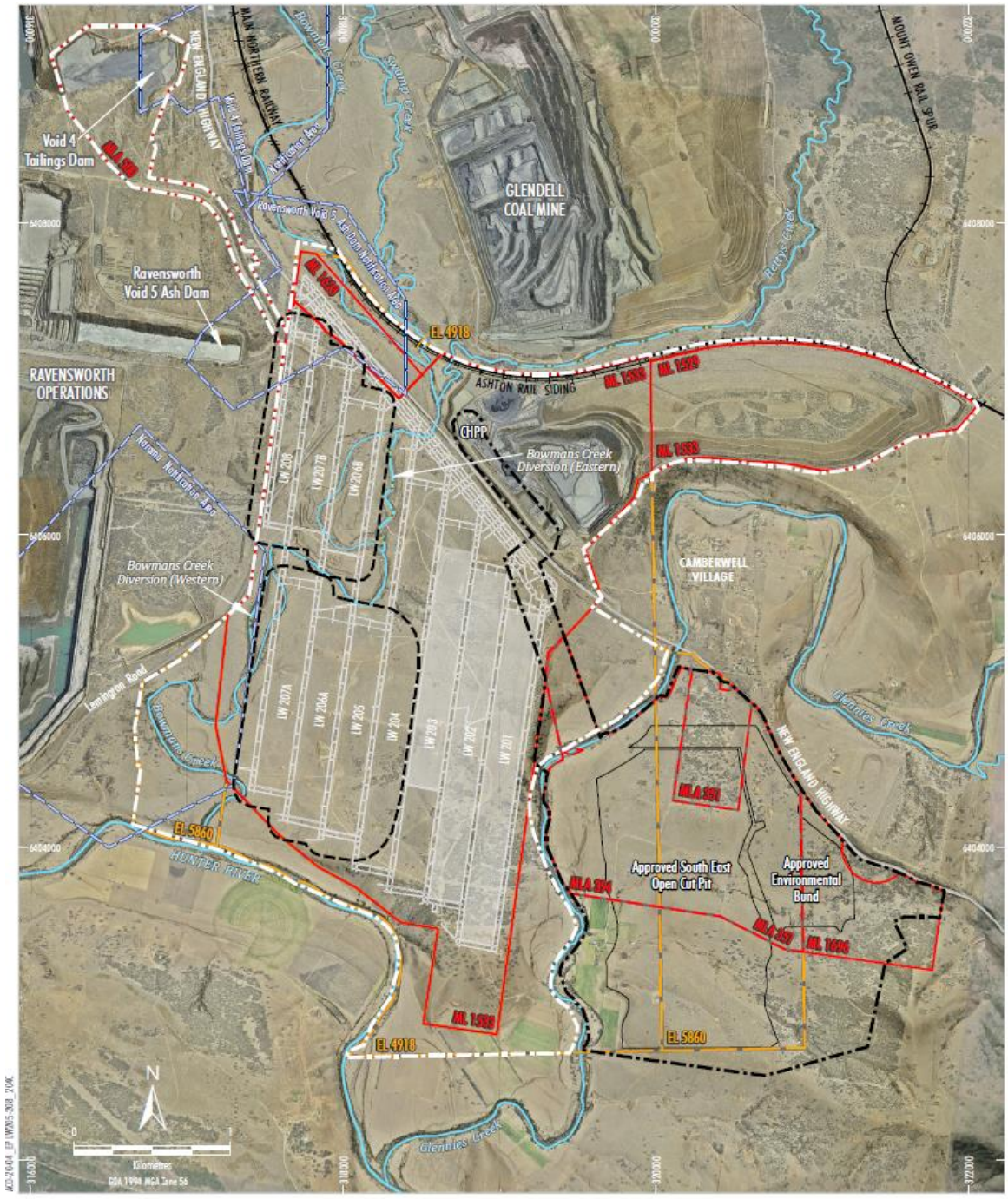
YANCOAL

ASHTON COAL MINE

General Arrangement

Figure 2

Figure 3



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Source: NSW Spatial Services (2020)
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YANCOAL

ASHTON COAL MINE

Upper Lower Liddell Seam Longwall Layout

Figure 3

The monitoring results from the Subsidence Monitoring Program will allow for:

- review against predicted subsidence impacts.
- implementation of the Trigger Action Response Plan; and/or
- review of remediation and/or management measures based on observation measurements.

The process for collecting subsidence monitoring data, reviewing data against the relevant TARP, and triggers of any required actions are detailed in the Extraction Plan sub-plans provided in the main Extraction Plan document.

1.2 BUILT FEATURES SUBSIDENCE MONITORING

Monitoring specific to individual built features (e.g. powerlines, telecommunications, and private property improvements) are detailed in individual Asset Management Plans prepared in consultation with the relevant infrastructure and asset owner(s).

2 SUBSIDENCE MONITORING PROGRAM

2.1 LAND OWNERSHIP AND LAND ACCESS

Surface land in the Extraction Plan Area is predominately cattle grazing land owned by ACOL.

A private property (Property 130) resides to the southeast of Longwall 201 outside of the Extraction Plan area. There are no predicted subsidence impacts to Property 130 as a result of mining in Longwalls 205-208 (SCT, 2020). An alternative access road to Property 130 lies directly above Longwall 205. Impacts will be monitored accordingly and access to Property 130 is expected to be maintained via the primary access road throughout mining.

Lemington Road is a public road maintained and owned by the Singleton Council that overlies Longwalls 206B, 207B and 208. Placement and monitoring of subsidence marks and the general condition of this road will be conducted in consultation with the Singleton Council. Details of the monitoring proposed for this built feature are provided in Table A2 and in the Singleton Council Asset Management Plan.

AGL Macquarie owns a portion of land in the north-western area of the Extraction Plan area (on the north-western side of Lemington Road). AGL Macquarie land is accessed via the South Access Road which connects to Lemington Road. Details of the monitoring proposed for this built feature are provided in Table A2 and the AGL Macquarie Asset Management Plan.

ACOL has obtained secured access for monitoring purposes over monitoring sites within the Extraction Plan area. Survey monitoring points were established for prior mining and are proposed to be utilised again.

2.2 SUBSIDENCE PARAMETERS OVER LONGWALLS – SURVEY PROGRAM

The proposed layout and monitoring details of the subsidence lines are outlined in **Appendix A**. In essence, all subsidence lines will be monitored to capture the effects of subsidence from the associated longwalls. Where relevant, existing subsidence monitoring lines have been extended and additional lines installed to capture the subsidence effects of the planned Longwalls 205-208.

The proposed subsidence monitoring strategy consists of:

1. Longitudinal subsidence monitoring lines over Longwalls 205-208 (LW5-CL1, LW105-CL1, LW5-CL2, LW105-CL2, LW6-CL1, LW106-CL1, LW6-CL2, LW106-CL2, LW6-CL3, LW6-CL4, LW106-CL4, LW107-CL1, LW7A-CL1, LW7A-CL2, LW207A-CL3, LW7B-CL1, LW7B-CL2, LW207B-CL3, LW8-CL1, LW8-CL2).
2. Subsidence monitoring crossline over Longwalls 205 – 208 (XL5).
3. Subsidence monitoring crosslines over Longwalls 208, 207B and 206B (XL12, XL13 and XL14).
4. Subsidence monitoring lines adjacent to Bowmans Creek and the Bowmans Creek Diversion (XLE01, XLE02, XLE03 and XLE04).
5. Subsidence monitoring line along Lemington Road (LEM01).
6. Subsidence monitoring of the nearest point on the road reserve boundary to the ends of LW206B, LW207B and LW208

Survey particulars include:

- The subsidence lines generally consist of star pickets at nominal 5m and 10m intervals depending on depth of cover.
- Expected survey accuracy will be within:
  i). ± 10mm for horizontal movements; and
  ii). ± 10mm for vertical movements.
- Data will be kept in an excel spreadsheet and will be accompanied by an updated subsidence plan (which will show the longwall face positions at the time of each survey).
- Survey data will be provided to the RR via the Subsidence Data Portal within 1 week of completing data acquisition.
- Monitoring frequency as per attached table in Appendix A.

2.3 GENERAL LANDFORM CONDITION INSPECTIONS

Mine personnel will also conduct regular surface inspections of the area as outlined in **Appendix A: Table A1**. Regular inspections will be conducted in the zone defined as being 200m behind and 100m in front of the current face position. The inspections will cover the full subsidence bowl out to the 45-degree angle of draw. Inspections will be carried out by trained persons and will follow the inspection checklist. Inspections will identify the following subsidence impacts:

- surface cracking particularly around edges of extraction void, travelling abutment and steep slopes.
- surface humps near centre of extracted panels, travelling abutment and topographic lows of adjacent steep slopes.
- step changes in land surface.
- serviceability of access tracks.
- slope, boulder and tree instability.
- general vegetation condition observations; and
- condition of creeks, tributaries/drainage lines observations.

Additional visual monitoring of Lemington Road will occur as per the following protocols described in **Table 1**.

Table 1. Lemington Road Visual Monitoring

Action	Timing	Person Responsible
Routine visual inspection of Lemington Road to inspect for possible subsidence damage.	Fortnightly when mining within 100m of the Lemington Road.	Ashton Mine Surveyor or delegate.
Increased visual inspections of Lemington Road for cracking and humps or drainage issues.	Weekly when mining within 50m of Lemington Road.	Ashton Mine Surveyor or delegate.
Visual inspection every three days of Lemington Road for cracking and humps or drainage issues.	Every three days as a minimum when undermining. Increased frequency if required.	Ashton Mine Surveyor or delegate.

A proposed surface condition monitoring form to be completed during each inspection is included in **Appendix B.** Natural landform features within the Extraction Plan Area (including steep slopes and drainage lines) are included with the monitoring form in **Appendix B.**

3 ADAPTIVE MANAGEMENT

3.1 INCREASE IN MONITORING FREQUENCY

The Extraction Plan TARP indicates scenarios where the frequency of subsidence monitoring may be increased to more frequent intervals than that presented in **Appendix A**. This may occur where greater than predicted subsidence parameters are measured, or abnormal surface conditions are observed.

3.2 REVIEW

This Subsidence Monitoring Program shall be reviewed after the completion of each longwall. The plan will also be reviewed in the event:

- of any incident.
- subsidence parameters/impacts are measured/observed that are significantly higher than predicted.
- significant changes to the mine plan occur.
- after submission of an Annual Review or Independent Environmental Audit.

Should any significant changes to the Subsidence Monitoring Program be deemed necessary (such as alteration of proposed monitoring lines, or a reduction in monitoring frequency based on monitoring results) these changes will be undertaken in consultation with relevant stakeholders.

4 SUBSIDENCE MONITORING PROGRAM ROLES AND ACCOUNTABILITIES

Key ACOL personnel involved with implementing this Subsidence Monitoring Program, including their roles and responsibilities as described are described **Table 2 below**.

Table 2. Roles and Responsibilities

Roles	Responsibilities
Operations Manager	• Ensure sufficient resources are available to implement the requirements of this plan.
Technical Services Manager	• Facilitate the Subsidence Monitoring Program. • Coordinate with the Mining Surveyor to ensure subsidence monitoring is undertaken in accordance with the Subsidence Monitoring Program. • Review subsidence monitoring data against predictions and TARPs in order to trigger any actions required on the basis of subsidence results. • Ensure visual monitoring requirements are completed by a trained and competent person.
Environment and Community Superintendent	• Liaise with Landholders in relation to gaining access for monitoring of the Subsidence Monitoring Program. • Notify and liaise with neighbours and community in relation to mining timing and monitoring performance.
Registered Mining Surveyor	• Ensure that all subsidence monitoring is completed to the requirements of the Subsidence Monitoring Program and provided to the NSW Resources Regulator (via subsidence data portal - SSIMS) and Technical Services Manager for review.

5 REFERENCES

Strata Control Technology (2020) S*ubsidence Assessment for the Extraction Plan for Longwalls 205 – 208 in the Upper Lower Liddell Seam*, Report Number ASH4927.

Appendix A

Subsidence Monitoring Survey and Inspection Program

Table A1. Subsidence Monitoring Survey Program

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Longitudinal (Southern)	Longitudinal lines located over the southern ends of Longwalls 205-208.	Measure the development of the subsidence on the current longwall.	Star Pickets.	5-10m.	Pre-subsidence impacts for current longwall on both centrelines (if applicable). Active subsidence monitoring. Survey the most relevant centreline every 100m of retreat as the longwall passes beneath the subsidence line until the longwall is ~100m past the end of the subsidence line. Post subsidence impacts on both centrelines for current longwall when longwall face is >400m past the end of the subsidence line/s.
Longitudinal (Northern)	Longitudinal lines located over the northern ends of Longwalls 205-208.	Measure the development of the subsidence on the current longwall.	Star Pickets.	5-10m.	Pre-subsidence impacts for current longwall on both centrelines (if applicable). Active subsidence monitoring. Survey the most appropriate centreline every 100m of retreat as the longwall passes beneath the subsidence line until the longwall has finished (i.e. after shields removed). Final survey to include both centrelines (if applicable).
Crossline across the entire underground mine (XL5)	Perpendicular line located over Longwalls 205-208.	To capture the cross-line subsidence profile across the multi-goaf zone.	Star Pickets.	5m when depth of cover is < 100m to the Pikes Gully Seam, otherwise 10m.	Pre-subsidence impacts for the current longwall. Active subsidence impacts as the longwall passes beneath XL5 at -50m, 0m, 80m and 400m (+/- 20m) past XL5. Only the section of XL5 associated with the current longwall needs to be surveyed (extending into the adjacent longwall panels to observe the full subsidence profile).

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Crosslines associated with Longwalls 206B, 207B and 208 (XL12, XL13 and XL14)	At the eastern base and mid points of Longwall 206B. Along the approximate mid-point of Longwall 207B and 208 and at the north west edge of Longwall 208.	Monitor effects of longwalls for nearby surrounding infrastructure (i.e. nearby dams, water, roads and transmission towers/poles/lines).	Star Pickets.	5-10m.	Pre-subsidence impacts for the current longwall. Active subsidence impacts as the longwall passes beneath XL12, XL13 and XL14 at -100m, 0m and 200m (+/-20m) past the relevant crossline or as needed from visual inspections of Lemington Road (XL13 only).
Bowmans Creek monitoring lines (XLE01, XLE02, XLE03 and XLE04)	Adjacent to Bowmans Creek Eastern Diversion along sections of Longwall 206B.	Monitor effects of Longwall 206B on Bowmans Creek Eastern Diversion.	Star Pickets.	~20m.	Pre- and post-mining of Longwall 206B. Use GNSS or total station survey methods or a combination of both to determine subsidence impacts.
Lemington Road (LEM01)	Adjacent to Lemington Road in left hand road shoulder of south-west bound lane.	Monitor effects of longwall mining on Lemington Road.	Road Spikes or Roofing Nail (galvanised spike or nail).	5-10m.	Pre-mining of appropriate section of subsidence line for Longwalls 206B, 207B and 208. Active subsidence monitoring as the longwall passes beneath the road depending on visual inspections of Lemington Road. Only the section of Lemington road being affected needs to be monitored. Then after the current longwall is >200m past the northern most section of Lemington Road being affected by that longwall. Note: active subsidence profiles may need to be done using other survey methods if survey marks have been destroyed by reparatory earthworks.
New England Highway Road Reserve Boundary marks	On edge of Road Reserve Boundary Fence adjacent to the ends of LW206B, LW207B and LW208	Monitor effects of longwall mining on Road Reserve	Start Picket or substantial survey mark	Survey mark adjacent to Tailgate end of each of these longwalls	To be monitored prior to respective longwall being within 200m of the road reserve and then after completion of that longwall. Marks are also to be monitored if the northern centreline measures consistent subsidence induced movement of >40mm.

Table A2: Subsidence Impacts Monitoring

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
Public Safety Management Plan (summary of monitoring actions only – full details provided in actual management plan)			
Public Safety Management Plan	Surface cracking including steep slopes and unstable ground/structures	Weekly proximal to the active mining area.	Visual inspection of the area immediately behind the longwall faces passage to identify/map subsidence cracking or unstable ground/structures.
	Dams	Weekly whilst in active mining area.	Monitoring of dams within the Extraction Plan Area to detect any subsidence impacts that may require management. Monitor water level using markers.
	Public roads and tracks (e.g. Lemington Road)	At least every three days when undermining. Increased frequency if required.	Visual inspection of roads/tracks to identify any subsidence impacts that could affect the safety of vehicles.
	Flooding and access	After and during significant rain events.	Visual inspection of tracks to identify any ponding impacts that could affect the safety and access of vehicles.
Built Features Management Plan (summary of monitoring actions only – full details provided in relevant Asset Management Plan)			
Ausgrid Asset Management Plan (AMP)	Power poles	Pre and post mining surveys to be carried out as well as at every 50m of retreat (+/-20m) when the longwall is in the active subsidence zone of 50m on the approach side of the structure to 200m past the structure.	Monitoring will be of the top and base of the poles by total station survey to provide x, y and z values to establish movement and tilt of poles. Visual inspections to be a minimum every 3 days whilst structure is being undermined (~50m before to ~200m past)
	Transmission lines	Pre and post mining visual surveys will be carried out on lines to determine ground clearance.	Visual inspections will be carried out to assess impacts on the ground clearance for wires and conductors.
TransGrid AMP 330kV transmission line	Towers	Pre and post mining surveys on tower footings to be carried out.	Surveys to provide x, y and z values of footing corners to establish movement of footings.
	Transmission lines	Pre and post mining visual surveys will be carried out on lines to determine ground clearance.	Visual inspections will be carried out to assess impacts on the ground clearance for wires and conductors.
Telstra AMP	Telstra Copper and Fibre Optic Cables	Ground subsidence survey data to be provided progressively to Telstra at critical times for cable line as each longwall progresses.	Ground subsidence survey data to be provided progressively to Telstra at critical times for cable line as each longwall progresses.

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
Glencore AMP	33kV transmission line	Prior to mining Longwall 207B. During active subsidence and upon completion of mining.	Structural assessment of the transmission line including visual inspections with observations of the transmission line condition, line clearance and tilt.
	Bayswater Pit (No.2) and No. 5 Ventilation Shaft	Prior to mining Longwall 208. During active subsidence and following completion of mining.	Visual inspections and survey making note of any potential impacts as a result of subsidence from nearby longwall mining.
	Void 5 Ash Dam	Prior to mining Longwall 208 and following completion of Longwall 208.	Survey of subsidence monitoring marks.
	Water Supply Pipeline	Prior to mining Longwall 207B and daily during active subsidence whilst the longwall is within 50m of the water supply pipeline, until the completion of subsidence.	Visual inspection/monitoring of exposed section of the pipeline. With specific attention to the pipeline condition (i.e. tilting). Glencore is to continue monitor the pipeline flows.
Transport for NSW AMP	New England Highway	Pre-mining, during mining whilst proximal survey markers indicate subsidence greater than 20mm and post active subsidence.	Visual survey (photo monitoring) of the road reserve which is within the Extraction Plan area.
Singleton Council	Lemington Road	Prior to subsidence effects from Longwalls 206B, 207B and 208. Daily, during active subsidence over areas of road being affected by subsidence. Once active subsidence has ceased.	Pre-mining condition assessment to document pre-subsidence condition of the road, including photographic records of any existing pavement fatigue in accordance with the Lemington Road Subsidence Deed. Visual inspections of subsidence affected section of the road daily to identify subsidence impacts which may affect the safety of vehicles. Post-mining condition assessment of the road to confirm that any perceptible subsidence impacts have ceased and document the post-subsidence status of the road.
	Lemington Road Culvert	Pre-mining, during and post subsidence.	Regular visual inspections.
AGL Macquarie	South Access Road	Prior to mining Longwall 207B. Daily during timing of active subsidence and following undermining.	Pre-mining condition assessment. During and post subsidence monitoring inspections.

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
	Sediment Dams	Monthly inspection during active subsidence to dams and post-longwall extraction.	Visual inspections of dams which includes photos noting any potential impacts as a result of subsidence.
	Other Minor Infrastructure	During active subsidence and following completion of mining.	Pre-mining condition assessment. During and post subsidence monitoring inspections.
Other	Property 130 Alternative Access Road	Prior to mining, every three days as a minimum whilst in an active subsidence area and following completion of undermining.	Visual inspection of the alternative access road to identify any subsidence impacts that could affect the safety of vehicles.
Environmental Management Plans (summary of monitoring action only – full details provided in actual management plans)			
Land Management Plan Addendum	Conservation Area	Biannually (twice yearly).	Monitoring to ensure farmland is maintained to the same or higher land capability and agricultural suitability than prior to mining.
	General Land Surface	During and post mining.	Visual inspection of cracking and subsidence to manage erosion, with monitoring of flora and fauna in accordance with the Flora and Fauna Management Plan and Mining Operations Plan.
Flora and Fauna Management Plan Addendum	Bowmans Creek	Biannually (twice yearly).	Aquatic fauna and habitat, stream health and water quality will be monitored at established locations to detect any possible mining or diversion related impacts.
	Glennies Creek	Biannually (twice yearly).	Aquatic fauna and habitat, stream health and water quality will be monitored at established locations to detect any possible mining related impacts.
Water Management Plan	Hunter River	Monthly.	Routine monitoring for pH, electrical conductivity (EC), total dissolved solids (TDS) and total suspended solids (TSS) to detect any possible mining related impacts.
	Bowmans Creek	Monthly.	Routine monitoring for pH, electrical conductivity (EC), total dissolved solids (TDS) and total suspended solids (TSS) to detect any possible mining related impacts.
	Glennies Creek	Monthly.	Routine monitoring for pH, electrical conductivity (EC), total dissolved solids (TDS) and total suspended solids (TSS) to detect any possible mining related impacts.

Appendix B
Subsidence Inspection Checklist

SUBSIDENCE INSPECTION CHECKLIST		
Longwall Panel		
Date		
Face Position		
Subsided Inspection Zone		
Pre-Subsidence Inspection Zone		
Area Inspected by (Print Name and sign)		
INSPECTION ITEM	**CHECKED**	**COMMENTS**
Surface cracking		
Surface humps (compression)		
Hunter River, Mine Water and Gas drainage pipelines		
Access roads and tracks		
Fences, gates, cattle grids		
Damage to Power-poles, Cross-arms, Insulators and Conductors e.g. leaning poles, increased sag in conductors, reduced ground clearance		
Dams		
Structures (houses, outbuildings)		
Other (den and/or nest trees)		

SUBSIDENCE INSPECTION CHECKLIST

Where to Inspect

200 metres behind and 100 metres in front of the current face position.

Cover the full subsidence bowl out to the 45-degree angle of draw.

What to look for

- surface cracking - edges of extraction void and start and travelling abutments particularly in rock outcrop areas and topographic high.
- surface humps (compression) - near centre of extracted panels, the travelling abutment and topographic lows if adjacent to steep terrain.
- step change in land surface - associated with cracking.
- slope, boulder and tree instability.
- surface slumping, erosion.
- serviceability of access tracks.
- changes to creeks, ponding, sediment load.
- general vegetation condition (in particular dieback of vegetation).
- change in conditions of 'right-of-way' access track or surrounding verges including drainage culverts and water flows as well as road cutting stability; and
- power poles and wires – adverse tilts on poles and ground clearances for wires, especially when crossing access tracks.

Actions if there is damage to non ACOL infrastructure:

Immediately notify the:

- Operations Manager.
- Technical Services Manager and/or Environment & Community Superintendent; and
- relevant infrastructure owner/operator.

If repairs or remediation work are required these will be undertaken by the relevant infrastructure owner/operator.