Longwalls 201 to 204

Subsidence Monitoring Program

May 2017

DOCUMENT CONTROL

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7/11/2016	0	Original document	D Lee J Barben	Tony Sutherland
05/05/2017	1	Modified Monitoring frequencies on subsidence lines (Table 1A) Updated "Subsidence Impacts Monitoring" Table A2 to reflect approved Asset Management Plans (Ausgrid and Telstra) Revised plans to reflect shortening of LW201 block	J Peck	Tony Sutherland

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1 INTRODUCTION

Ashton Coal Operations Pty Ltd (ACOL) was granted approval for underground mining of Longwalls in the Camberwell area by the Minister for Planning on 11 October 2002 (DA309-11-2001). ACOL has subsequently prepared an Extraction Plan for longwall mining of LW201 to 204 in the Upper Lower Liddell (ULLD) Seam of the Ashton Underground Coal Mine, varying between 105 metres and 230 metres below the surface. Proposed longwall mining in the Extraction Plan area of 201 to 204 (the Extraction Plan Area – refer **Figure 1**) is due to commence in July 2017, and is planned to take place over a three-year period.

This Subsidence Monitoring Program (the **SM Program**) has been prepared as part of the Extraction Plan for Longwalls LW201 to LW204 and in accordance with condition 32(g) of the development consent DA309-11-2001-i.

1.1 SCOPE & OBJECTIVE

The scope of the SM Program includes the Extraction Plan Area for LW201 to LW204 (the **Extraction Plan Area**).

The objective of the SM 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 those risks associated with subsidence;
- Validate the 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 SM 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.

The monitoring results from the SM Program will allow review against subsidence predictions, and to allow a trigger for any required remediation and/or review management measures based on measurements of observations.

The process for collecting subsidence monitoring data, review against the relevant TARP, and trigger of actions from relevant Extraction Plan sub-plans is 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) will be detailed in individual Built Features Management Plans prepared in consultation with the relevant owner.

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 other than a small part in the far southeast known as Property 130. Property 130 is a privately owned dairy farm and is serviced on a daily basis across ACOL land located above the underground mine provided via a 'right of way' agreement. Placement and monitoring of subsidence marks and general condition monitoring can only be conducted with agreement with the relevant landowners.

Ashton is in the process of securing access for monitoring purposes over Property 130 in 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 longwall as well as any adjacent longwall/s.

The proposed subsidence monitoring strategy consists of:

1. Existing longitudinal subsidence monitoring lines over Longwalls 201 – 204 (LW1-CL1, LW1-CL2, LW101-CL1, LW101-CL2, LW2-CL1, LW2-CL2, LW102-CL1, LW102-CL2, LW3-CL1, LW3-CL2, LW103-CL1, LW103-CL2, LW4-CL1, LW4-CL2, LW104-CL1, and LW104-CL2);

2. An existing subsidence monitoring cross line over Longwalls 201 – 204 (XL5);

3. Existing subsidence monitoring cross lines over Longwall 201 (XL22, XL1, XL2, XL3, XL4, XL6, XL7, and XL8); and

4. An existing subsidence monitoring cross line over Longwall 204 (XL10).

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
  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 DRE 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 surface inspections of the area as outlined in **Appendix A: Table A1**. Regular inspections will be conducted in the zone defined as being 200 metres behind and 100 metres in front of the current face position will include inspection of:

- Surface cracking particularly around edges of extraction void, travelling abutments and steep slopes
- Surface humps near centre of extracted panels, travelling abutments and topographic lows of adjacent steep slopes
- Step changes in land surface
- Serviceability of access tacks
- Slope, boulder and tree instability
- General vegetation condition observations
- Condition of creeks, tributaries/drainage lines observations

Additional visual monitoring of the 'right of way' access track will occur as per the following protocols:

Action	Timing	Person Responsible
Routine visual inspection of track condition to inspect for possible subsidence damage.	Fortnightly within 100m of the track	Ashton Mine Surveyor or delegate
Increased visual inspections of the track for cracking and humps or drainage issues.	Weekly within 50m of the track	Ashton Mine Surveyor or delegate
Visual inspection every 3 days of the track for cracking and humps or drainage issues.	Every 3 days as a minimum when undermining. Increased frequency if required.	Ashton Mine Surveyor or delegate

The 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 SM Program shall be reviewed after the completion of each longwall. The plan will also be reviewed as a result of an incident, if subsidence levels are significantly higher than predicted, if any significant changes to the mine plan occur, or after submission of an Annual Review or Independent Environmental Audit.

Significant changes to the SM Program (such as alteration of proposed monitoring lines, or a reduction in monitoring frequency based on monitoring results) will be undertaken in consultation with relevant government agencies.

4 SM PROGRAM ROLES AND ACCOUNTABILITIES

Detailed below are key personnel involved with implementing this SM Program, their roles and responsibilities.

Role	Responsibilities
Technical Services Manager (TSM)	• Owner of the SM Program • Coordinate Mine Surveyor to ensure subsidence monitoring is undertaken in accordance with the SM Program • Review subsidence monitoring data against predictions and TARPs in order to trigger any actions required on the basis of subsidence results • Review and update the SM Program as required • Ensure visual monitoring requirements are completed by a trained and competent person
Environment and Community Manager (ECM)	• Liaise with Landholders in relation to gaining access for monitoring of the SM Program • Notify and liaise with neighbours and community in relation to mining timing and monitoring performance;
Mine Surveyor	• Ensure that all subsidence monitoring is completed to the requirements of the Subsidence Monitoring Program and provided to the TSM for review.

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 201-205	Measure the development of the subsidence then capture the combined subsidence effect of the adjacent longwall blocks.	Star Pickets	5-10m	Pre subsidence impacts on multi-goaf and PG centrelines for previous adjacent longwall, if applicable. Pre subsidence impacts for current longwall. Active Subsidence monitoring. Survey the multi-goaf centreline every 100m of retreat as the longwall passes beneath the subsidence line until the longwall is ~200m past the end of the subsidence line. Post subsidence impacts on Multi-goaf and PG centrelines for current longwall when longwall face is ~500m past the end of the subsidence line. Post subsidence impacts when subsequent adjacent longwall face is ~500m past the end of the subsidence line, if applicable.
Longitudinal (Northern)	Longitudinal lines located over the northern ends of Longwalls 201-205	Measure the development of the subsidence then capture the combined subsidence effect of the adjacent longwall	Star Pickets	5-10m	Pre subsidence impacts on multi-goaf and PG centrelines for previous adjacent longwall, if applicable. Pre subsidence impacts for current longwall. Active Subsidence monitoring. Survey the

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Longitudinal (Northern) (Continued)		blocks.			multi-goaf centreline every 100m of retreat as the longwall passes beneath the subsidence line until the longwall has finished. Post subsidence impacts ~3 months after completion of extraction of current longwall. Post subsidence impacts ~3 months after completion of extraction of the subsequent adjacent longwall.
XL5	Perpendicular line located over LW201-204	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 to be surveyed. A full XL5 survey from Glennies Creek to Bowmans Creek to be done after the completion of LW204
XL1, XL2, XL3, XL4, XL6 & XL7	Starting at eastern base of steep slopes associated with Glennies Creek and extending west up to	Monitor effects of first longwall of each seam on steep slopes adjacent to Glennies	Star Pickets	Generally 5m	Pre and post subsidence impacts associated with the extraction of LW201.

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
XL1, XL2, XL3, XL4, XL6 & XL7 (continued)	the approximate mid-point of LW201 Perpendicular to Longwall Centrelines.	creek.			
XL22	Sub parallel line located on fence and adjacent to access track on Property 130	To capture the subsidence profile across the multi goaf zone adjacent to the access track.	Marks placed in base of fence posts	Approx. 8m	Pre and post subsidence impacts using GNSS surveying techniques – if required by property owner (refer to Property 130 Management Plan)
XL8	Starting at top of New England Highway cutting and running diagonally (SW direction) over LW201	Monitor effects of adjacent longwall on Highway cutting.	Star Pickets	5m	When LW201 is ~150m from take-off position and then for every 100m of retreat (+/- 20m), then after completion of LW201. A final survey ~3 months after completion of LW201 and then after completion of LW202
XL10	Perpendicular line located over LW204	Monitor effects of adjacent longwall on steep slopes adjacent to creek.	Star Pickets	10m	Prior to retreating face of LW203 being within 200m of cross line. When LW204 is within 100m of cross line, then when LW204 is approximately adjacent to cross line, then some 200m past cross-line (+/- 20m).

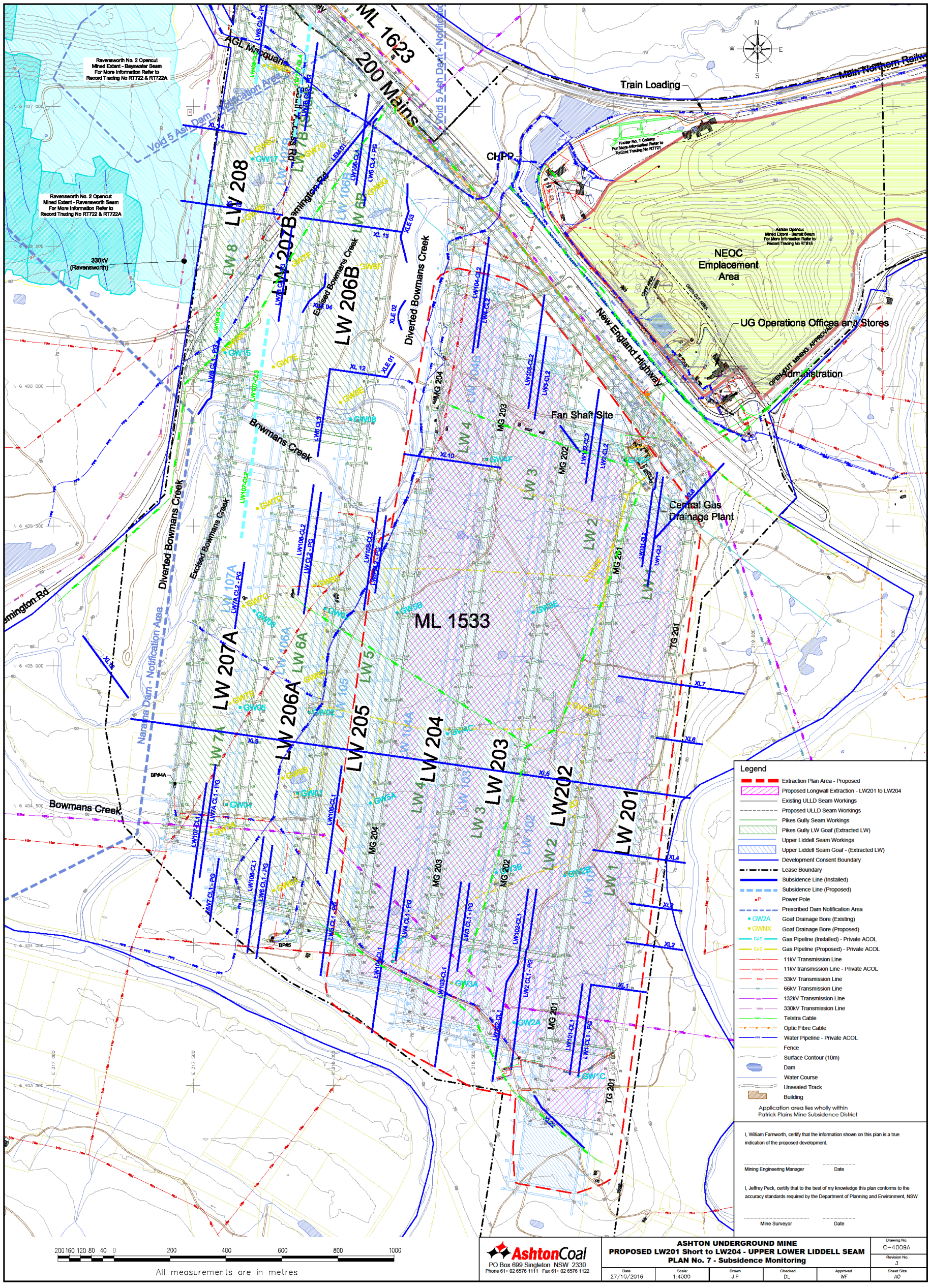
Table A2: Subsidence Impacts Monitoring

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
Public Safety Management Plan (summary of monitoring actions only – full details provided in relevant management plans)	Surface Cracking including steep slopes	Weekly around active mining area	Visual inspection of the area immediately behind the longwall faces passage to identify/map subsidence cracking. Documented inspection of steep slopes along the Hunter River and Glennies Creek to identify cracking requiring remediation.
	Dams	Weekly whilst in active mining area	Monitoring of dams within the Application Area to detect any subsidence impacts that may require management. Monitor water level using markers.
	Access Track (Right of Way)	Every 3 days as a minimum whilst in active subsidence area. Increased frequency if required	Visual inspection of tracks to identify any subsidence impacts that could affect the safety of vehicles. Alternate right of way to be in place during undermining where applicable.
	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 actual management plan)			
Ausgrid 132kV BFMP	Power Poles	As a minimum pre and post mining surveys will be carried out as well every 50 metres of retreat when the longwall is 50m from the poles to 150 metres past on affected power poles	Monitoring will be by total station survey to provide x, y and z values to establish movement of poles. Also, radiations measured to top of each pole to measure for any possible tilt

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
	Power poles and Transmission Lines inspections	pre-mining and every 3 days when the Longwall has approached within 50m of the poles, till the completion of subsidence	Visual inspections will be carried out to assess impact on the ground surface adjacent to the poles, pole footings, wires and conductors. Observed impacts on the ground surface may indicate an impact on the powerlines.
Ausgrid 11kV BFMP Northern end of LW204 Only	Power Poles	TBD	Management plan under construction in conjunction with asset owner
	Transmission Lines	TBD	Management plan under construction in conjunction with asset owner
Telstra BFMP	Telstra Copper Cables	Ground subsidence survey data to be provided progressively to Telstra & Consultant at critical times for cable line as each longwall progresses	ACOL to carry out Subsidence Survey along agreed subsidence lines, provide results within 48 hours to Telstra members of Plan Review Meeting as each longwall approaches the cable line
RMS New England Highway BFMP	New England Highway	TBD	Management plan under construction in conjunction with asset owner
Property 130 MP	Access Track (Right of Way)	Every 3 days as a minimum whilst in active subsidence area. Increased frequency if required	Visual inspection of tracks to identify any subsidence impacts that could affect the safety of vehicles. Alternate right of way to be in place during undermining where applicable.
	Fences & Gates	Pre and Post subsidence impacts and weekly whilst in	Visual inspection of fences and gates to identify any subsidence impacts that could affect the integrity of the fences and gates.

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
		active mining area	
	Farm Dam	Pre and Post subsidence impacts and weekly whilst in active mining area	Monitoring of farm dam to detect any subsidence impacts that may require management. Monitor water level using markers.
	General Landform	Pre and Post subsidence impacts and weekly whilst in active mining area	Visual inspection of the area immediately behind the longwall faces to identify/map subsidence cracking that may require remediation.
Environmental Management Plans (Summary of monitoring action only – full details provided in actual management plan. Monitoring programs are subject to changes should the approved management plan be varied during the course of the Extraction Plan)			
Land Management Plan (Mining Operations Plan)	General Land Surface	During and post mining	Visual inspection of cracking and subsidence to manage erosion, impacts to flora and fauna and drainage.
	Farmland Monitoring	Biannually (twice yearly)	Monitoring to ensure farmland is maintained to the same or higher land capability and agricultural suitability than prior to mining
Flora and Fauna (Biodiversity Management Plan)	Conservation Area	Biannually (twice yearly)	Monitoring flora and fauna for any possible mining related impacts
	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

Management Plan	Aspect/Feature	Frequency	Monitoring Measures
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


ML 1623
200 Mains
Void 5 Ash Dam - Notification Area
Ravensworth No. 2 Opencut Mined Extent - Bayswater Seam For More Information Refer to Record Tracing No RT722 & RT722A
Ravensworth No. 2 Opencut Mined Extent - Ravensworth Seam For More Information Refer to Record Tracing No RT722 & RT722A
330kV (Ravensworth)
AGL Macquarie
Train Loading
Main Northern Railway
CHPP
Hunter No. 1 Colliery For More Information Refer to Record Tracing No RT721
Ashton Opencut Mined Extent - Barrett Seam For More Information Refer to Record Tracing No RT815
NEOC Emplacement Area
UG Operations Offices and Stores
Open Cut Administration
Fan Shaft Site
Central Gas Drainage Plant
New England Highway
Diverted Bowmans Creek
Excised Bowmans Creek
Bowmans Creek
Narama Dam - Notification Area
LW 208
LW 207B
LW 206B
LW 8
LW 7
LW 6B
LW 4
LW 3
LW 2
LW 1
LW 207A
LW 206A
LW 6A
LW 7A
LW 107A
LW 106A
LW 105A
LW 5
LW 205
LW 204
LW 203
LW202
LW 201
ML 1533
MG 204
MG 203
MG 202
MG 201
TG 201
Legend
Extraction Plan Area - Proposed
Proposed Longwall Extraction - LW201 to LW204
Existing ULLD Seam Workings
Proposed ULLD Seam Workings
Pikes Gully Seam Workings
Pikes Gully LW Goaf (Extracted LW)
Upper Liddell Seam Workings
Upper Liddell Seam Goaf - (Extracted LW)
Development Consent Boundary
Lease Boundary
Subsidence Line (Installed)
Subsidence Line (Proposed)
Power Pole
Prescribed Dam Notification Area
Goaf Drainage Bore (Existing)
Goaf Drainage Bore (Proposed)
Gas Pipeline (Installed) - Private ACOL
Gas Pipeline (Proposed) - Private ACOL
11kV Transmission Line
11kV transmission Line - Private ACOL
33kV Transmission Line
66kV Transmission Line
132kV Transmission Line
330kV Transmission Line
Telstra Cable
Optic Fibre Cable
Water Pipeline - Private ACOL
Fence
Surface Contour (10m)
Dam
Water Course
Unsealed Track
Building
Application area lies wholly within Patrick Plains Mine Subsidence District
I, William Farnworth, certify that the information shown on this plan is a true indication of the proposed development.
Mining Engineering Manager
Date
I, Jeffrey Peck, certify that to the best of my knowledge this plan conforms to the accuracy standards required by the Department of Planning and Environment, NSW
Mine Surveyor
Date
200 160 120 80 40 0 200 400 600 800 1000
All measurements are in metres
AshtonCoal
PO Box 699 Singleton NSW 2330
Phone 61+ 02 6576 1111 Fax 61+ 02 6576 1122
ASHTON UNDERGROUND MINE
PROPOSED LW201 Short to LW204 - UPPER LOWER LIDDELL SEAM
PLAN No. 7 - Subsidence Monitoring
Drawing No. C-4009A
Revision No. 3
Date 27/10/2016
Scale: 1:4000
Drawn JP
Checked DL
Approved WF
Sheet Size A0
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Appendix B

Subsidence Inspection Checklist

SUBSIDENCE INSPECTION CHECKLIST		
LW 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, Waste Water and Gas drainage pipelines		
Access roads and tracks		
Fences, gates, cattle grids		
Damage to Power-poles, Cross-arms, Insulators and Conductors (Ausgrid) e.g. leaning poles, increased sag in conductors, reduced ground clearance		
Dams		
Structures (houses, outbuildings)		
Other (den and/or nest trees)		

****Any Impacts observed are to be photographed, located and marked on a plan.**

SUBSIDENCE INSPECTION CHECKLIST

Where to Inspect

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

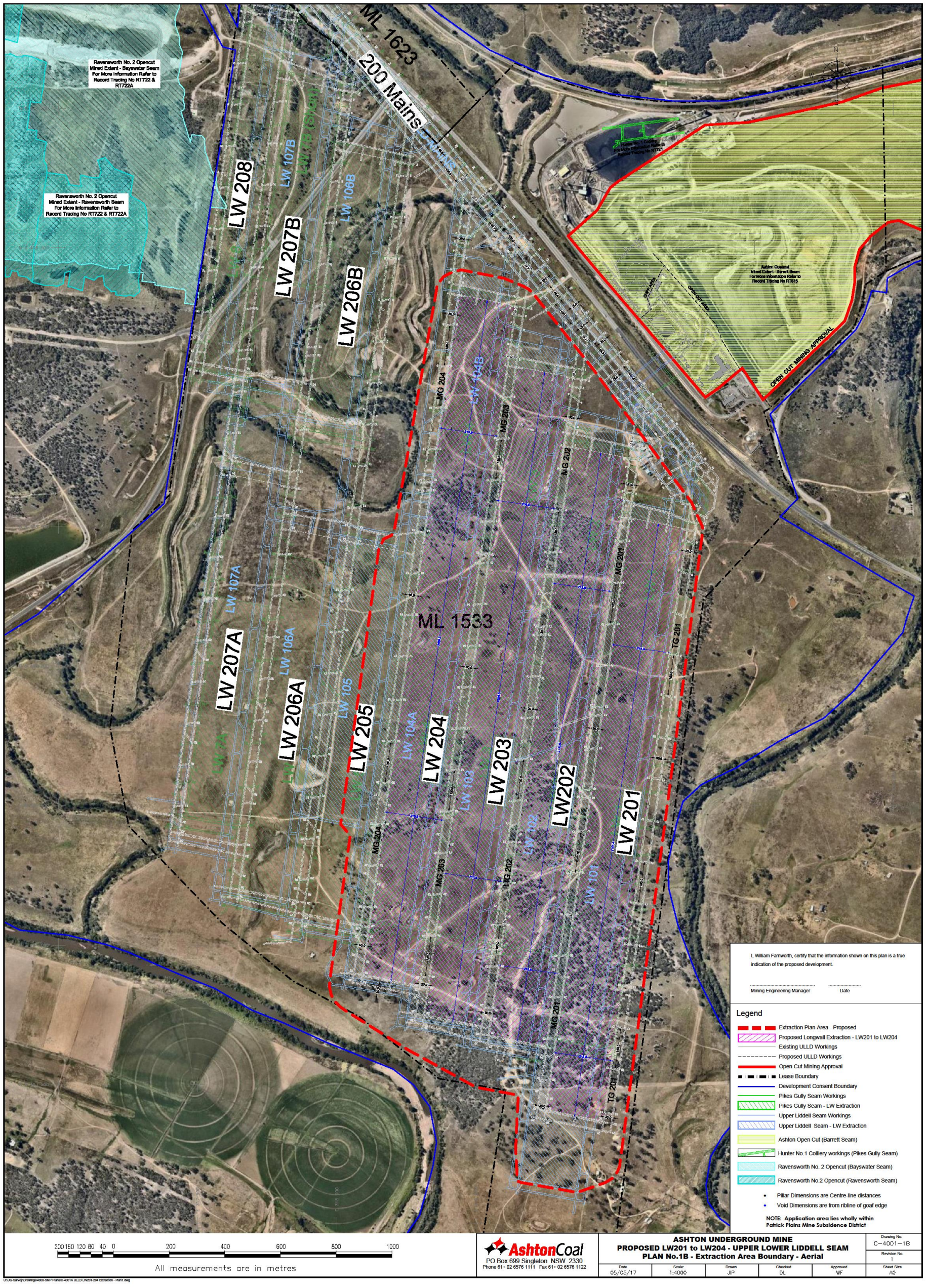
Cover the full subsidence bowl out to the 45° angle of draw.

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; and
- 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.
- Power Poles and wires – adverse tilts on poles and ground clearances for wires, especially when crossing access tracks.

Actions if there is a public safety risk

- Implement the **Public Safety Management Plan**; including
- Immediately notify the Landholder or Stakeholder (or responsible person) of the issue (Stakeholder list contained in Appendix A of the Public Safety Management Plan);
- take actions to remediate the issue (if possible);
- erect 'NO ACCESS' tape and warning signs (e.g. traffic control signs, traffic controllers as appropriate) if remediation is not possible; and
- Notify the Environment & Community Manager to coordinate actions.


ML 1623
200 Mains
LW 208
LW 207B
LW 206B
LW 107B
LW 106B
LW 7B (Split)
LW 8
Ravensworth No. 2 Opencut
Mined Extent - Bayswater Seam
For More Information Refer to
Record Tracing No RT722 &
RT722A
Ravensworth No. 2 Opencut
Mined Extent - Ravensworth Seam
For More Information Refer to
Record Tracing No RT722 & RT722A
Ashton Opencut
Mined Extent - Barrett Seam
For More Information Refer to
Record Tracing No RT815
OPEN CUT MINING APPROVAL
ML 1533
LW 207A
LW 206A
LW 205
LW 204
LW 203
LW202
LW 201
LW 107A
LW 106A
LW 105
LW 104A
LW 103
LW 102
LW 101
LW 7A
MG 204
MG 203
MG 202
MG 201
TG 201
I, William Farnworth, certify that the information shown on this plan is a true indication of the proposed development.
Mining Engineering Manager
Date
Legend
Extraction Plan Area - Proposed
Proposed Longwall Extraction - LW201 to LW204
Existing ULLD Workings
Proposed ULLD Workings
Open Cut Mining Approval
Lease Boundary
Development Consent Boundary
Pikes Gully Seam Workings
Pikes Gully Seam - LW Extraction
Upper Liddell Seam Workings
Upper Liddell Seam - LW Extraction
Ashton Open Cut (Barrett Seam)
Hunter No.1 Colliery workings (Pikes Gully Seam)
Ravensworth No. 2 Opencut (Bayswater Seam)
Ravensworth No.2 Opencut (Ravensworth Seam)
Pillar Dimensions are Centre-line distances
Void Dimensions are from ribline of goaf edge
NOTE: Application area lies wholly within Patrick Plains Mine Subsidence District
200 160 120 80 40 0 200 400 600 800 1000
All measurements are in metres
AshtonCoal
PO Box 699 Singleton NSW 2330
Phone 61+ 02 6576 1111 Fax 61+ 02 6576 1122
ASHTON UNDERGROUND MINE
PROPOSED LW201 to LW204 - UPPER LOWER LIDDELL SEAM
PLAN No.1B - Extraction Area Boundary - Aerial
Drawing No. C–4001–1B
Revision No. 1
Date 05/05/17
Scale: 1:4000
Drawn JIP
Checked DL
Approved WF
Sheet Size A0