



LWA7 to LWA10 Subsidence Monitoring Program



DOCUMENT CONTROL

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11/4/2013	0	Original document	A Moodie G Mulhearn	A Moodie
	1	After comment from DP&I and DRE, & modification of Crossline to take advantage of existing tracks in Werakata SCA.	A Moodie G Mulhearn	A Moodie
27/5/13	2	Update Line A10 Monitoring Frequency	A Moodie	A Moodie
31/10/13	3	Update for LWA7 to A10 Modifications (proposed MOD3)	A Moodie	A Moodie
4/12/13	4	Update Quorrobolong Rd visual monitoring details	A Moodie	A Moodie

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APPENDICES

Appendix A Subsidence Monitoring Survey Program

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1 INTRODUCTION

This Subsidence Monitoring Program (the **SM Program**) has been prepared as part of the Extraction Plan for Longwall LWA7 to LWA10.

1.1 SCOPE & OBJECTIVE

The scope of the SM Program includes the Extraction Plan Area for LWA7 to LWA10 (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.

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 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, 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 comprises area the Werakata State Conservation Area and privately owned rural properties. Placement and monitoring of subsidence marks and general condition monitoring can only be conducted with agreement with the relevant landowner (National Parks and Wildlife Services or private landholders).

Austar has secured access for monitoring purposes over several of the private landholdings and the Werakata State Conservation Area in the Extraction Plan Area and will continue to seek access for monitoring.

2.2 SUBSIDENCE PARAMETERS OVER LONGWALLS – SURVEY PROGRAM

The proposed layout and monitoring details of the grid are outlined in **Appendix A** (including a drawing of the monitoring lines and culvert monitoring locations and general arrangements).

The proposed subsidence monitoring strategy consists of:

1. Longitudinal Subsidence monitoring lines to be established along the central part of each of the four longwalls as well as LWA11, with survey mark spacing at nominal 25m intervals. (Lines A7 to A10 on attached plan). Final line positioning to cause minimum disturbance to land owners.
2. A Cross line (Cross line 1), with survey marks at 25m centres, located as centrally as possible over the combined area of Longwalls but positioned to cause minimum disturbance to land owners, and taking advantage of tracks in the Werakata SCA.
3. Quorrobolong Road monitoring line, with survey marks at 25m centres positioned adjacent to the road. Additional monitoring points around culverts or cuttings to measure potential changes in drainage patterns or cutting stability will also be included (See **Appendix A**).
4. The installation of monitoring will be progressively installed or in filled. Prior to the commencement of extraction (Longwall A7) the following will be established:
 - A7 centreline from 20mm subsidence limit to mid panel (past cross line) at nominated 25m spacing
 - A8 centreline from 20mm subsidence limit to mid panel (past cross line) at nominated 25m spacing
 - A9 centreline to mid panel (past cross line) at maximum 100m spacing
 - Cross line 1 from 20mm subsidence limit to A9 centreline at 25m spacing then to A10 centreline at 100m maximum spacing
5. A7 ,A8 and A9 centrelines will be completed or in filled prior to subsidence impact from A7 reaching the cross line.

6. Quorrobolong road monitoring line will be progressively installed. Prior to longwall A7 retreating to within 100m of the road monitoring will be installed for 250m either side of A7 void. An additional panel width (250m) will be progressively installed with each longwall panel prior subsidence impact.
7. Cross line 1 (south of A10 centreline) will be completed prior to the commencement of A8
8. A10 centreline will be installed prior the commencement of A8
9. A11 centreline will be installed prior the commencement of A9

Survey particulars include:

- The grids will be established using “Feno” survey marks at nominal 25m intervals.
- Grids will be progressively installed prior to the influence of subsidence. The grids will be monitored using Total Station techniques to measure full three dimensional movements.
- Survey accuracy will be within:
 - i. ± 20 mm for horizontal movements
 - ii. ± 10 mm 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 PSE in the form of an excel spreadsheet within 1 week of completing data acquisition.
- Longwall extraction heights will be estimated with regard to LTCC extraction reports.
- 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 during routine subsidence surveys as outlined in Table A1. Regular inspections will be conducted in the zone defined as being 500 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 tracks
- Slope, boulder and tree instability
- General vegetation condition observations
- Quorrobolong Road and culvert observations

Additional visual monitoring of Quorrobolong Road will occur as per the following protocols:

Action	Timing	Person Responsible
Routine visual inspection of road condition to inspect for possible subsidence damage	As per Survey Subsidence Monitoring program (Table A.1)-ie Fortnightly within 100m of the road	Austar Mine Surveyor or delegate
Increased visual inspections of the road and cuttings condition monitoring for cracking and humps or drainage issues.	Every 35m ($\pm 5m$) of retreat when the Longwall is within 30m of the nearest point of the road	Austar Technical Services Manager or delegate
Daily visual inspection of the road and cuttings condition monitoring for cracking and humps or drainage issues.	Once subsidence monitoring indicates subsidence parameters have exceeded: <ul style="list-style-type: none"> • Strain $>2mm/m$ • Or irregularity observed in routine visual inspections Until stable or remediation undertaken.	Austar Technical Services Manager or delegate

The proposed surface condition monitoring form to be completed during each inspection is included in **Appendix B**. Natural landform features within the Stage 3 Project 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 Subsidence Monitoring and Management TARP indicates scenarios where the frequency of monitoring may be increased to more frequent intervals than that presented in **Appendix B**. 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 (refer to the Extraction Plan Subsidence Monitoring and Management TARP for trigger levels), if any 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 with the approval of the Division or Resources and Energy (DRE).

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)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Ensure that all subsidence monitoring is completed to the requirements of the Subsidence Monitoring Program and provided to the TSM for review. • Ensure appropriate road controls are in place for monitoring along Quorrobolong Road. This will require s138 approval from Council.

Appendix A

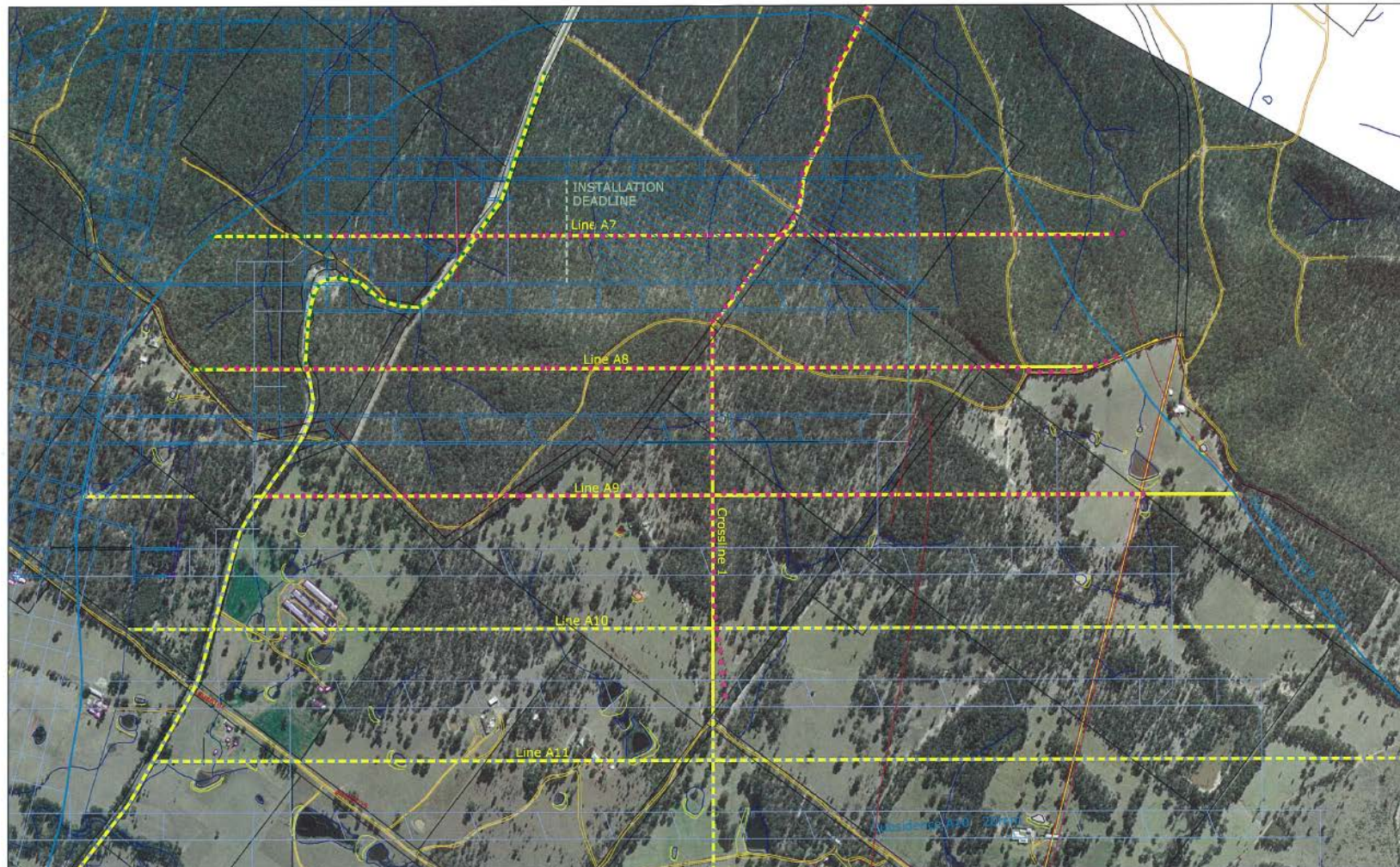
Subsidence Monitoring Survey Program

Table A1: Subsidence Monitoring Survey Program

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Line A7	Longitudinal line located as centrally over A7 Longwall as the surface features will allow.	Measure the development of the A7 subsidence then capture the combined subsidence effect of the adjacent longwall blocks.	Feno marks with 600mm spike if no rock.	25 metres	Every 100m of retreat for the first 400m retreat of Longwall A7 and A8. Reduction to Quarterly for the remainder of extraction. At the completion of each longwall. Additional monitoring as requested by DRE Principal Subsidence Engineer (PSE).
Line A8	Longitudinal line located as centrally over A8 Longwall as the surface features will allow.	Measure the development of the A8 subsidence then capture the combined subsidence effect of the adjacent longwall blocks.	Feno marks with 600mm spike if no rock.	25 metres	Every 100m of retreat for the first 400m retreat of Longwalls A8 and A9.Reduction to quarterly for the remainder of extraction At the completion of each longwall Additional monitoring as requested by PSE
Line A9	Longitudinal line located as centrally over A9 Longwall as the surface features will allow.	Measure the development of the A9 subsidence & capture the combined subsidence effect of the adjacent longwall blocks.	Feno marks with 600mm spike if no rock.	25 metres	Every 100m of retreat for the first 400m retreat of Longwalls A9 and A10 Reduction to quarterly for the remainder of extraction At the completion of each longwall Additional monitoring as requested by PSE

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
Line A10	Longitudinal line located as centrally over A10 Longwall as the surface improvements will allow.	Measure the development of the A10 subsidence & capture the combined subsidence effect of the adjacent longwall blocks.	Feno marks with 600mm spike if no rock.	25 metres	Every 100m of retreat for the first 400m retreat of Longwall A10 Reduction to quarterly for the remainder of extraction At the completion of each longwall A8 to A10 Additional monitoring as requested by PSE
Line A11	Longitudinal line located as centrally over A11 Longwall as the surface improvements will allow.	Measure the influence of the A10 subsidence & capture the combined subsidence effect of the adjacent longwall blocks.	Feno marks with 600mm spike if no rock.	25 metres	At the completion of each longwall A9 to A10 Quarterly monitoring during extraction of A10 Additional monitoring as requested by PSE
Cross Line 1	With due regard to minimum disturbance to surface features. A Cross line for longwalls A7 to A10	To capture the subsidence profile across the combined extraction area including Max Subsidence.	Feno marks with 600mm spike if no rock.	25 metres	Pre mining and when LW is at -200m, -100m, 0m, +100m, +200m, +300m from the cross line (-ve = inbye of, +ve = outbye of) Otherwise quarterly monitoring in subsidence affected areas of the cross line or at the end of each longwall
Quorrobolong Road	Monitoring line	To measure the	Feno marks with	25m and	Fortnightly when the Longwall has

Subsidence Line	Location	Purpose	Survey Marks	Mark Spacing	Monitoring Frequency
	running parallel to the road within the area affected by A7 to A10	onset of movement on the road and trigger requirements as per the Cessnock City Council Built Features and Public Safety Management Plans.	600mm spike in ground adjacent to road and positioned to minimise chance of disturbance	additional adjacent to culverts or cuttings	approached within 100m of the road for a distance of 350m either side of the current longwall centreline Continued fortnightly monitoring for a month after the completion of the longwall panel (visual inspections to continue with each routine subsidence monitoring occurrence)



- LEGEND:**
- Marks Installed & Surveyed.
 - Marks to be Installed & Surveyed Before LWA7 "Installation Deadline".
 - Future Marks post LW A7

** Marks are approximate 25m spacing where conditions allow.

DRAWN M. Campbell		AUSTAR COAL MINE	
DATE 16/12/2013	TITLE LW A7 to LW A10 Proposed Subsidence Marks		
CHECKED	SCALE NOT TO SCALE		
APPROVED	DRAWING No. SUB 1303C REV 2.dwg	A3	



Appendix B

Subsidence Inspection Checklist

FORM: Subsidence Inspection Checklist

SUBSIDENCE INSPECTION CHECKLIST		
Date		
Name of Inspection		
Longwall Number		
Face Position (chainage)		
Inspection Zone Start (Face chainage -500m)		
Inspection Zone End (Face chainage +100m)		
INSPECTION ITEM	CHECKED	COMMENTS
Surface cracking		
Surface humps (compression)		
Step change in land surface		
Unstable slopes, boulders or trees		
Surface slumping, erosion		
Changes to streams, ponding, sediment load		
General vegetation condition (in particular, dieback of vegetation)		
Quorrobolong road and surrounding road verges for cracking and humps. Also inspection of the culverts for headwall or pipe join alignment and drainage issues. Road cuttings for signs of cracking, toe movement or general instability.		

SUBSIDENCE INSPECTION CHECKLIST

Where to Inspect

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

Cover the full subsidence bowl out to the 30° 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 streams, ponding, sediment load; and
- General vegetation condition (in particular dieback of vegetation)
- Change in conditions of Quorrobolong road or surrounding verges including drainage culverts and water flows as well as road cutting stability.

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);
- 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.

