Austar Coal Mine

End of Panel Report

Stage 3 – Longwall A8

DOCUMENT CONTROL

DOCUMENT DETAILS	**Title**	Austar Coal Mine Stage 3 Longwall A8 End of Panel Report		
	Reference			
	Document Status	Final		
APPROVAL DATE	**Revision**	**Prepared**	**Reviewed**	**Approved**
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1 INTRODUCTION

Austar Coal Mine Pty Ltd (Austar), a subsidiary of Yancoal Australia Pty Limited (Yancoal), operates Austar Coal Mine, an underground coal mine located approximately 10 kilometres south of Cessnock in the Lower Hunter Valley in NSW.

Project Approval 08_0111 (PA 08_0111) was granted by the Minister for Planning in September 2009, enabling longwall mining using Longwall Top Coal Caving (LTCC) technology in the Stage 3 area. PA08_0111 was modified under delegated authority of the Minister for Planning and Infrastructure on 13 March 2012 and 17 December 2013 to allow realignment of the Stage 3 longwall panels and extension of finishing lines for Longwalls A7 to A10.

An updated Extraction Plan for Longwalls A7 to A10 (Austar, December 2013) was approved under delegation of the Director General of the Department of Planning and Infrastructure (DP&I) on 6 January 2014. Austar subsequently received Subsidence Management Plan Approval (SMP Approval) under delegation for the Director General of the Department of Trade and Investment – Division of Resources and Energy (DRE) on 19 February 2014 (File No. 13/1876).

The extraction of Longwall A8 commenced on 13 June 2014 and was completed on 20 June 2015. This longwall is the second in the series in Stage 3 of the Austar Coal Mine, and is also second in the series described in SMP approval for LWA7 to LWA10. The location of Longwall A8 with reference to adjoining Stage 3 longwall panels is shown in **Figure 1.1**.

In accordance with the approved Extraction Plan for Longwalls A7 to A10, subsidence surveys and visual inspections were conducted over Longwall A8 in accordance with the approved Subsidence Monitoring Program, with environmental monitoring conducted in accordance with the relevant approved Environmental Management Plans.

1.1 PURPOSE AND SCOPE

This End of Panel Report for Longwall A8 has been prepared to fulfil the requirements of Condition 18 of the Austar Coal Mine Subsidence Management Plan Approval for Longwalls A7 to A10, which states:

"Within 4 months of the completion of each longwall panel, an end of panel report must be submitted to the Director General. The end of panel report must:

- *a) include a summary of the subsidence and environmental monitoring results for the applicable longwall panel;*
- *b) include an analysis of these monitoring results against the relevant;*
  - *impact assessment criteria;*
  - *monitoring results from previous panels; and*
  - *predictions in the SMP;*
- *c) identify any trends in the monitoring results over the life of the activity; and*
- *d) describe what actions were taken to ensure adequate management of any potential subsidence impacts due to longwall mining."*

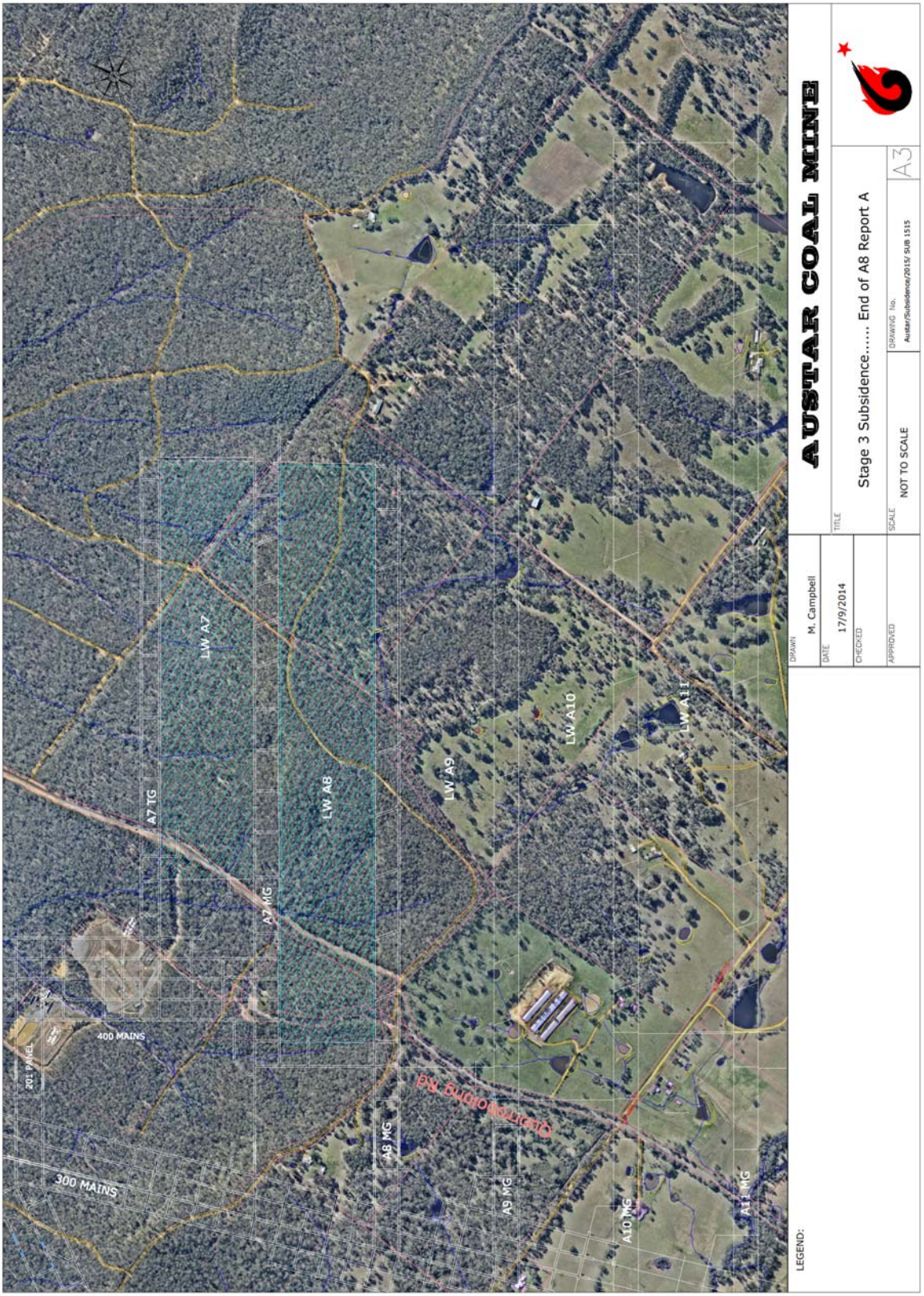

Figure 1.1 - Layout of Longwalls A7 - A10 in Stage 3 at Austar Coal Mine

2 MINE SUBSIDENCE

2.1 LONGWALL A8 EXTRACTION

The extraction of Longwall A8 commenced on 13 June 2014 and was completed on 20 June 2015. Longwall A8 is the second panel to be extracted from Stage 3, after longwall mining commenced on 14 June 2013 with Longwall A7.

The Greta Seam was mined along the length of Longwall A8 at Austar. The overall length of Longwall A8 is 1,406.5 metres and the overall void width, including first workings, is 237 metres.

The depth of cover to the Greta Seam, directly above Longwall A8, varies between a minimum of 500 metres towards each end of the longwall and a maximum of 560 metres above the maingate towards the middle of the longwall.

The thickness of the Greta Seam within the extent of Longwall A8 varies between 6.0 metres and 6.5 metres. The Longwall Top Coal Caving equipment extracted the bottom 3.3 metres of the seam and partially recovered (approximately 60%) of the remaining top coal up to chainage 300 metres, and then recovered no top coal (rear AFC removed) through to the longwall finishing end.

2.2 SUBSIDENCE SURVEYS

Subsidence monitoring has been undertaken in accordance with the approved LWA7 to LWA10 Subsidence Monitoring Program. The mine subsidence movements resulting from the extraction of Longwall A8 were monitored using the following:

- Line A8;
- Line XL3;
- Quorrobolong Road Line; and
- Line A7.

The locations of these monitoring lines are shown in Figure 2.1.

The following sections provide comparisons between the observed and predicted subsidence movements for the monitoring lines which were measured during and after the extraction of Longwall A8.

The predicted subsidence parameters are based on extracting 3.0 metres of bottom coal and achieving an 85 % recovery of the top coal. It is noted, that the as-extracted seam thickness (bottom plus top coal) is around 20 % less than that assumed for the subsidence predictions.

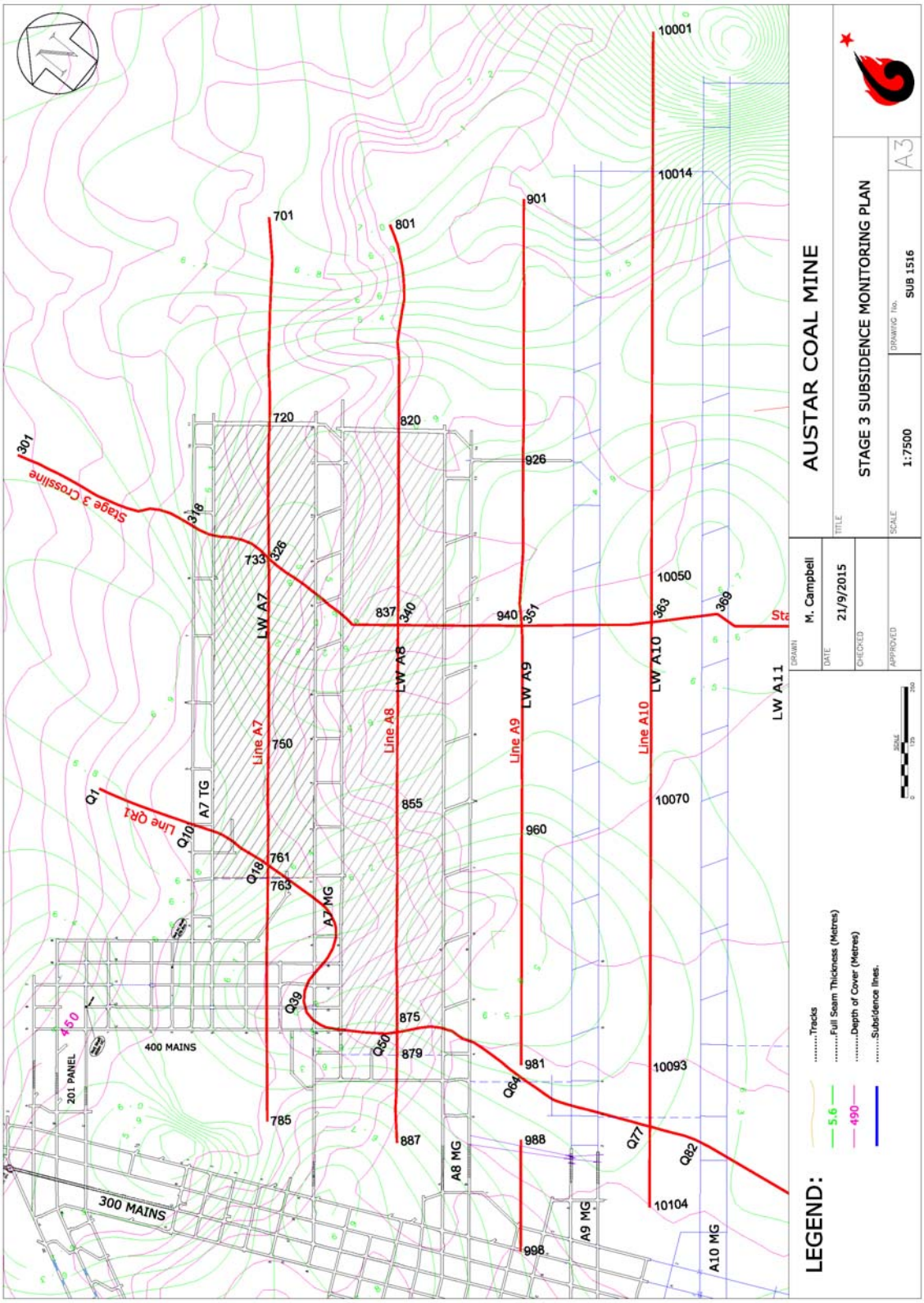

Figure 2.1 - Monitoring Lines over Longwalls A7 – A10 at Austar Coal Mine

2.2.1 Line A8

Line A8 is a longitudinal monitoring line which follows the centreline of Longwall A8. The monitoring line was measured seven times during and one time after the extraction of Longwall A8. The latest survey was carried out on 27 August 2015, around two months after the completion of the longwall. The base survey was carried out on 23 May 2013, around three weeks prior to the commencement of Longwall A7.

The observed profiles of incremental subsidence, tilt and strain along Line A8, resulting from the extraction of Longwall A8 area shown in **Figure 2.2** to **Figure 2.4**. The predicted profile of incremental subsidence along this monitoring line after the completion of the longwall is also shown in Figure 2.2 for comparison.

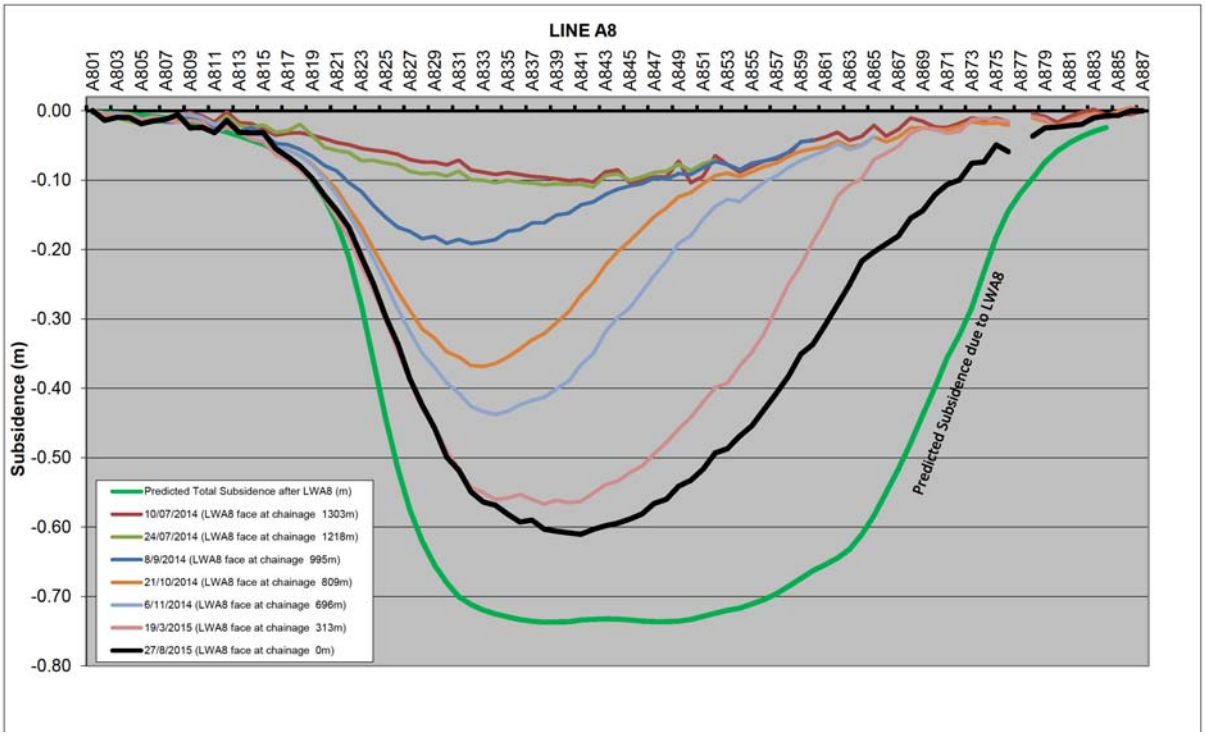

Figure 2.2 - Observed and Predicted Profile of Incremental Subsidence along Line A8

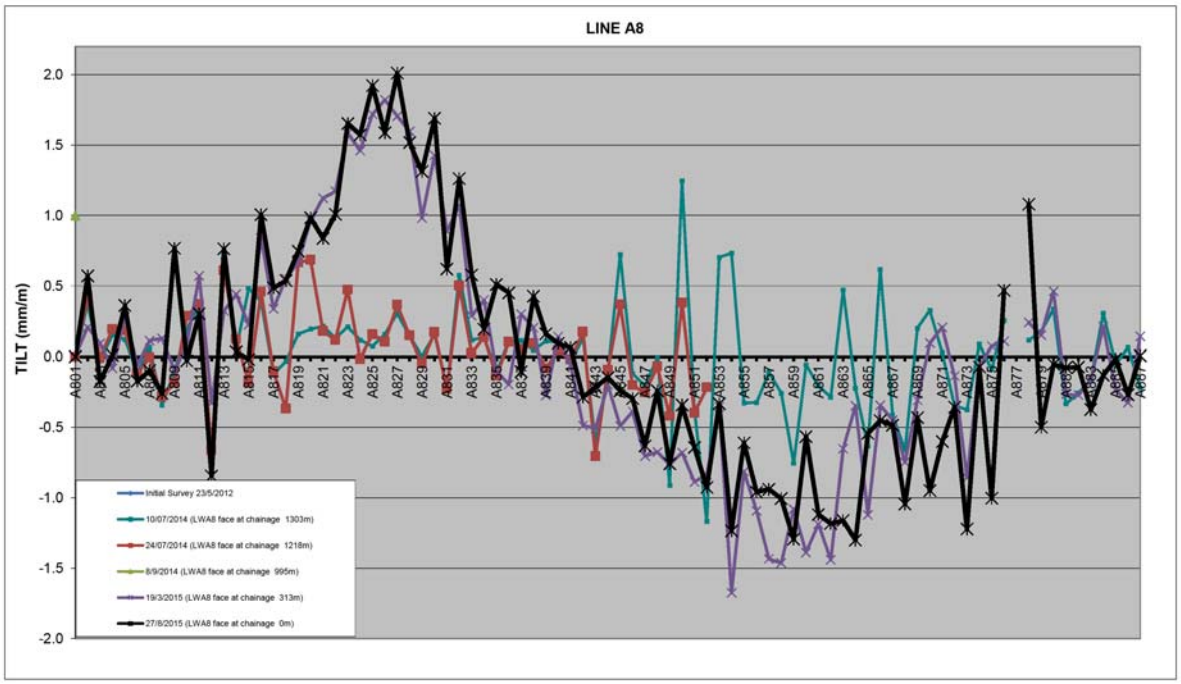

Figure 2.3 - Observed Profile of Incremental Tilt along Line A8

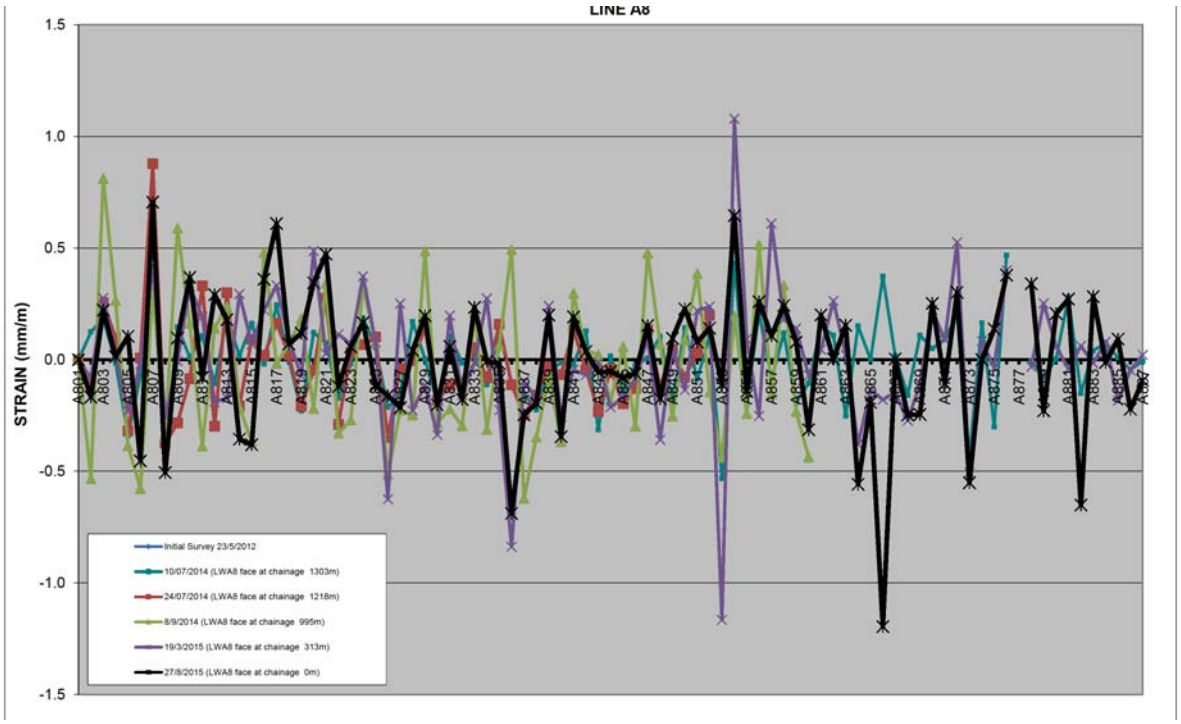

Figure 2.4 - Observed Profile of Incremental Strain along Line A8

A summary of the maximum observed and maximum predicted incremental subsidence parameters along Line A8, resulting from the extraction of Longwall A8, is provided in **Table 2.1**. The observed values are the maxima after the completion of Longwall A8.

Table 2.1 - Maximum Observed and Predicted Incremental Subsidence Parameters along Line A8 Resulting from the Extraction of Longwall A8

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Compressive Strain (mm/m)
Observed	610	2.0	0.7	1.2
Predicted	750	4.0	Refer to discussion below	

The maximum observed incremental subsidence along Line A8 was 610 mm, which represents 81 % of the maximum predicted subsidence of 750 mm. The maximum observed tilt of 2.0 mm/m represented 50 % of the maximum predicted tilt of 4.0 mm/m.

The observed subsidence and tilt profiles were reasonably symmetrical, but the subsidence profile was slightly flatter (i.e. lower tilt) at the longwall finishing end. Mark A877 was not surveyed due to the dangers involved in occupying the mark so close to the carriageway of Quorrobolong Road.

The maximum observed incremental strains along Line A8 were 0.7 mm/m tensile and 1.2 mm/m compressive. The maximum predicted conventional strains, based on applying a factor of 15 to the maximum predicted conventional curvatures anywhere above Longwall A8, are 0.8 mm/m tensile and 1.4 mm/m compressive.

The maximum observed tensile strain occurs between marks A807 and A808 which are located on the edge of a local access road and could be the results of disturbed survey marks. The maximum observed compressive strain occurs between marks A866 and A867 which are located on the change of grade at the bottom of a gully and therefore which could be the result of the natural surface slope. Elsewhere, the observed strains were typically in the order of survey tolerance, with some localised strains up to around 0.6 mm/m.

There were no strains greater than predicted identified along the Line A8.

2.2.2 Line XL3

Line XL3 is a cross-line located between the middle and commencing end Longwall A8. The monitoring line was measured seven times during and one time after the extraction of Longwall A8. The latest survey was carried out on 20 August 2015, two months after the completion of the longwall. The base survey was carried out on 4 June 2013, which was 10 days prior to the commencement of Longwall A7.

The observed profiles of incremental subsidence, tilt and strain along Line XL3, resulting from the extraction of Longwall A8 are shown in **Figure 2.5** to **Figure 2.7**. The predicted profile of incremental

subsidence along this monitoring line after the completion of longwall A8 is also shown in **Figure 2.5** for comparison.

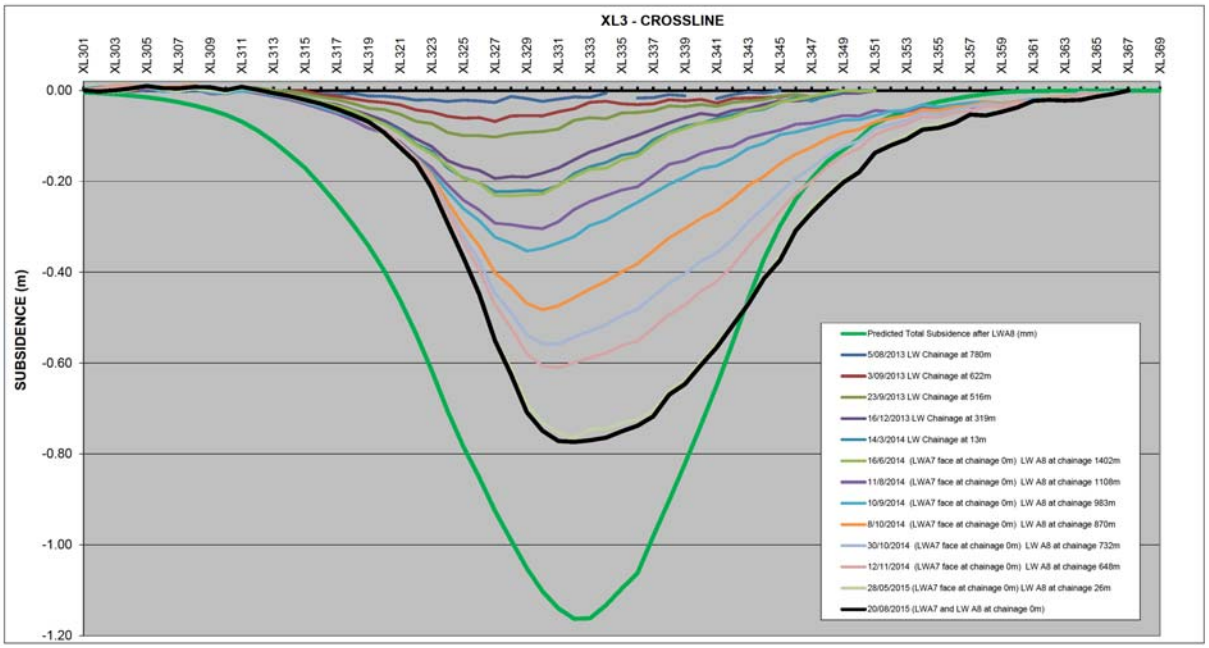

Figure 2.5 - Observed and Predicted Profile of Incremental Subsidence along Line XL3

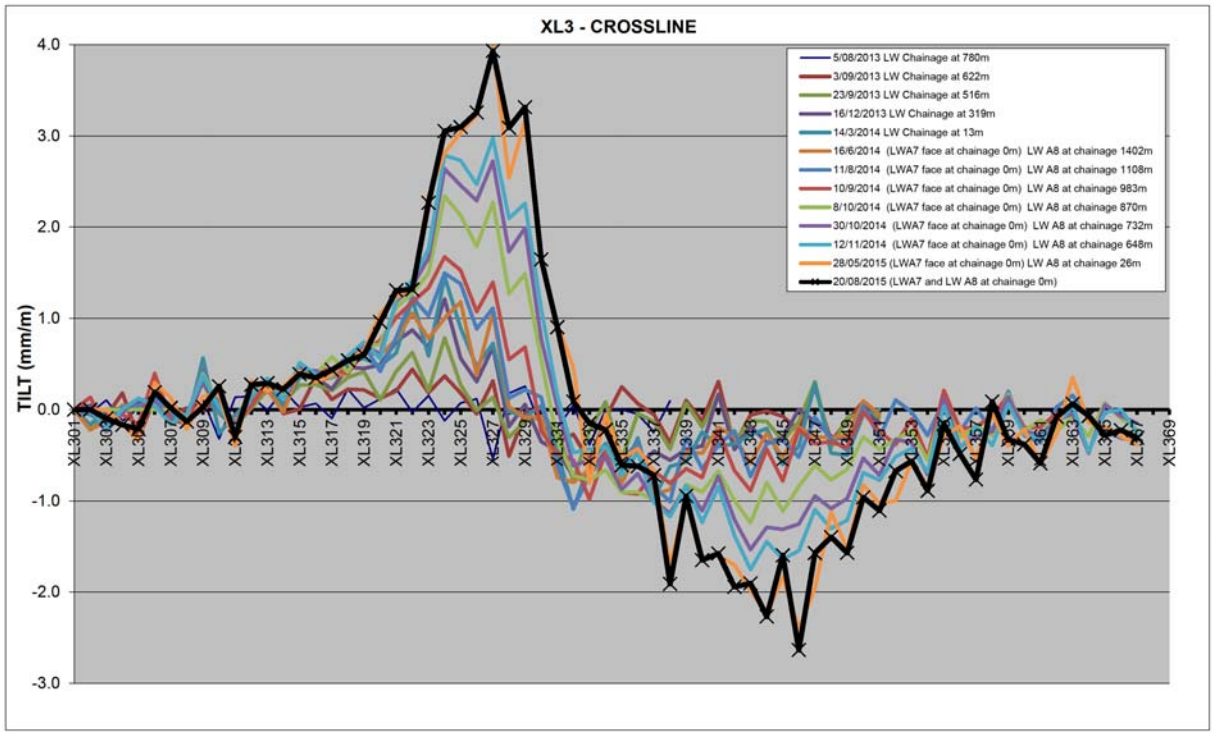

Figure 2.6 - Observed Profile of Incremental Tilt along Line XL3

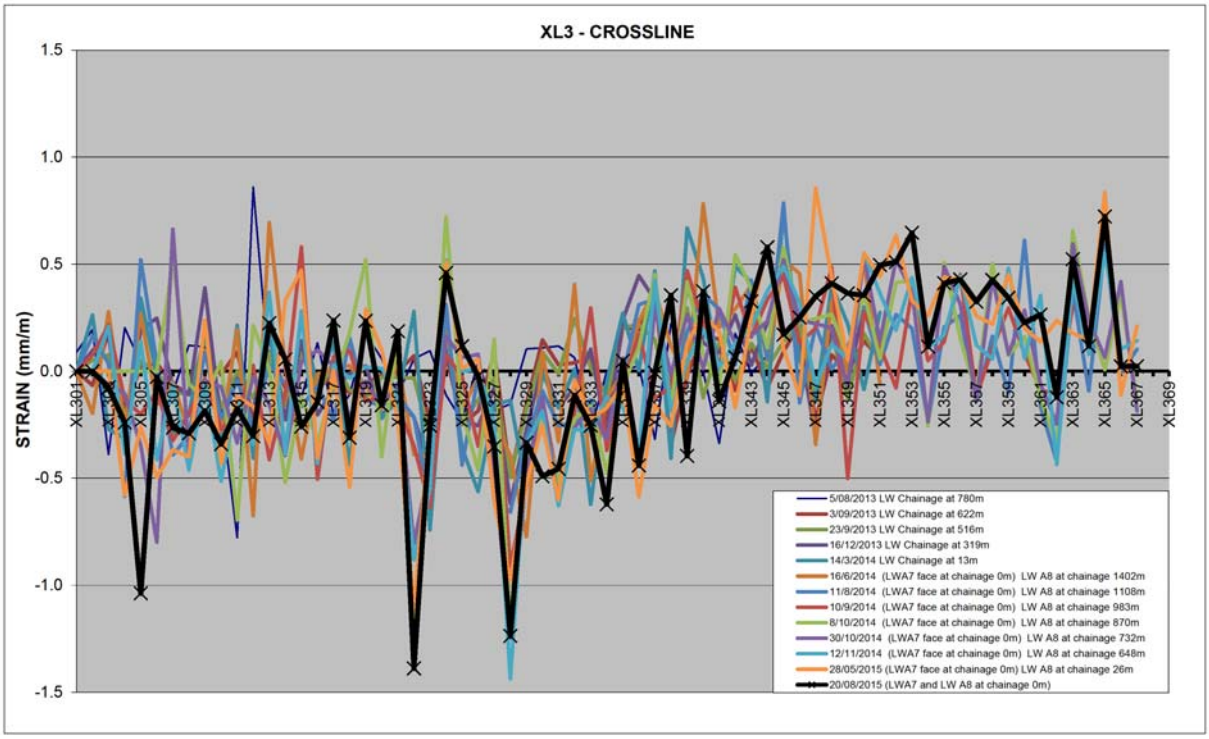

Figure 2.7 - Observed Profile of Incremental Strain along Line XL3

A summary of the maximum observed and maximum predicted incremental subsidence parameters along Line XL3, resulting from the extraction of Longwall A8, are provided in **Table 2.2**. The observed values are the maxima after the completion of Longwall A8.

Table 2.2 - Maximum Observed and Predicted Incremental Subsidence Parameters along Line XL3 Resulting from the Extraction of Longwall A8

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Compressive Strain (mm/m)
Observed	773	3.9	0.7	1.4
Predicted	1150	4.0	Refer to discussion below	

The maximum observed incremental subsidence along Line XL3 was 773 mm, which represents 67 % of the maximum predicted subsidence of 1150 mm. The shape of the observed subsidence profile reasonably matched the predicted subsidence profile, but with a reduced magnitude. There is a slight lateral shift in the observed subsidence profile, towards the longwall maingate (i.e. right side in Figure 2.5), which could be the result of the natural surface slope and/or cantilevering of the overburden further over the longwall void than what was anticipated. The observed vertical subsidence slightly exceeds the predicted subsidence outside the extents of the extracted longwalls adjacent to the maingate, however this low level vertical subsidence is not associated with any significant observed tilts or strains and impacts are not anticipated at this distance from the

extracted longwall. This lateral shift is similar to what was observed over Line A3X on the previously extracted A3, A4, A5 and A5a longwalls.

The maximum observed incremental tilt was 3.9 mm/m which was very close to the maximum predicted tilt of 4.0mm/m.

The maximum observed incremental strains were 0.7 mm/m tensile and 1.4 mm/m compressive. The maximum predicted conventional strains, based on applying a factor of 15 to the maximum predicted conventional curvatures anywhere above Longwall A8, are 0.8 mm/m tensile and 1.4 mm/m compressive.

The maximum observed tensile strain occurs between Marks XL364 and XL365, which are located away from the mining area above the centre of the proposed longwall A10 where subsidence was observed at less than 20mm. Therefore it is likely that this localised strain is the result of disturbed survey marks. The maximum observed compressive strain occurs between Marks XL321 and XL322, which were located directly above longwall A7 at the base of a hill and could have been influenced by the surface topography. Elsewhere, the observed strains were typically in the order of survey tolerance, with some localised strains up to around 1.0 mm/m.

There were no strains greater than predicted identified along the Line XL3.

2.2.3 Quorrobolong Road

The Quorrobolong Road monitoring line follows the alignment of Quorrobolong Road which crosses the western end of Longwall A8. The monitoring line was measured eight times during and three times after the extraction of Longwall A8. The latest survey was carried out on 22 July 2015, around one month after the completion of the longwall. The base survey was carried out on 28 January 2014, when the longwall chainage for Longwall A7 was 230 metres and the Longwall A7 extraction face was around 100 metres from the road.

The observed profiles of incremental subsidence, tilt and strain along the Quorrobolong Road Line, resulting from the extraction of Longwall A8 are shown in **Figure 2.8** to **Figure 2.10**.

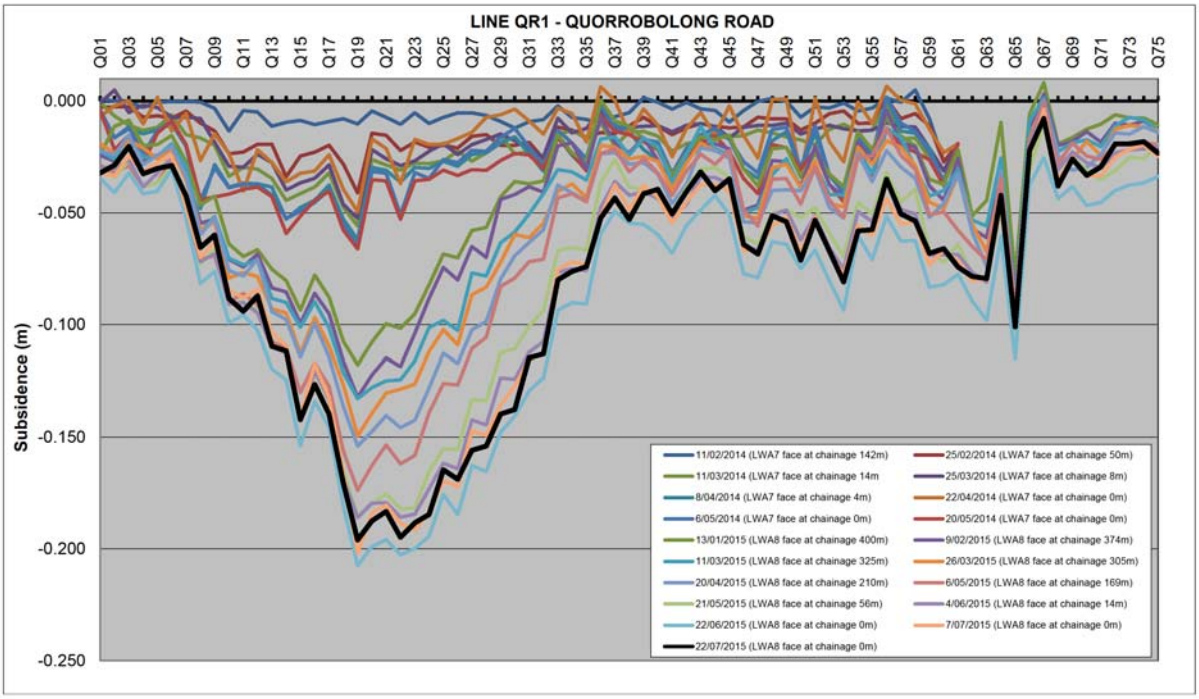

Figure 2.8 - Observed Profile of Incremental Subsidence along Line QR1

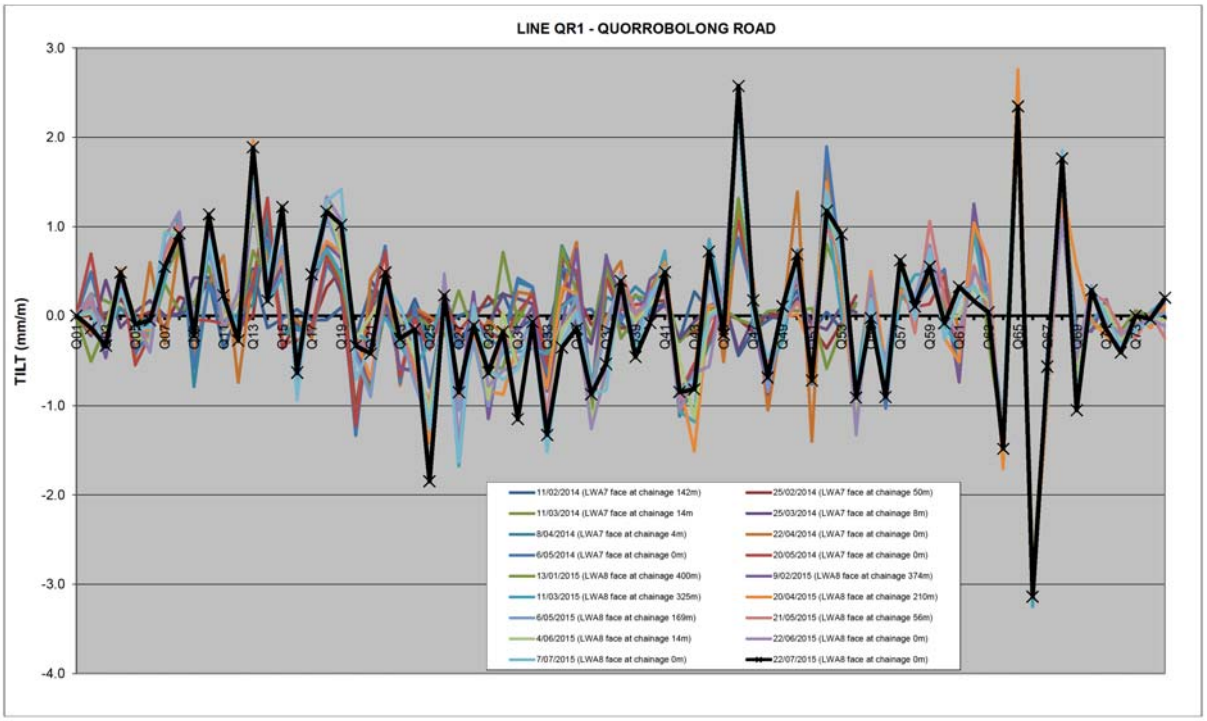

Figure 2.9 - Observed Profile of Incremental Tilt along Line QR1

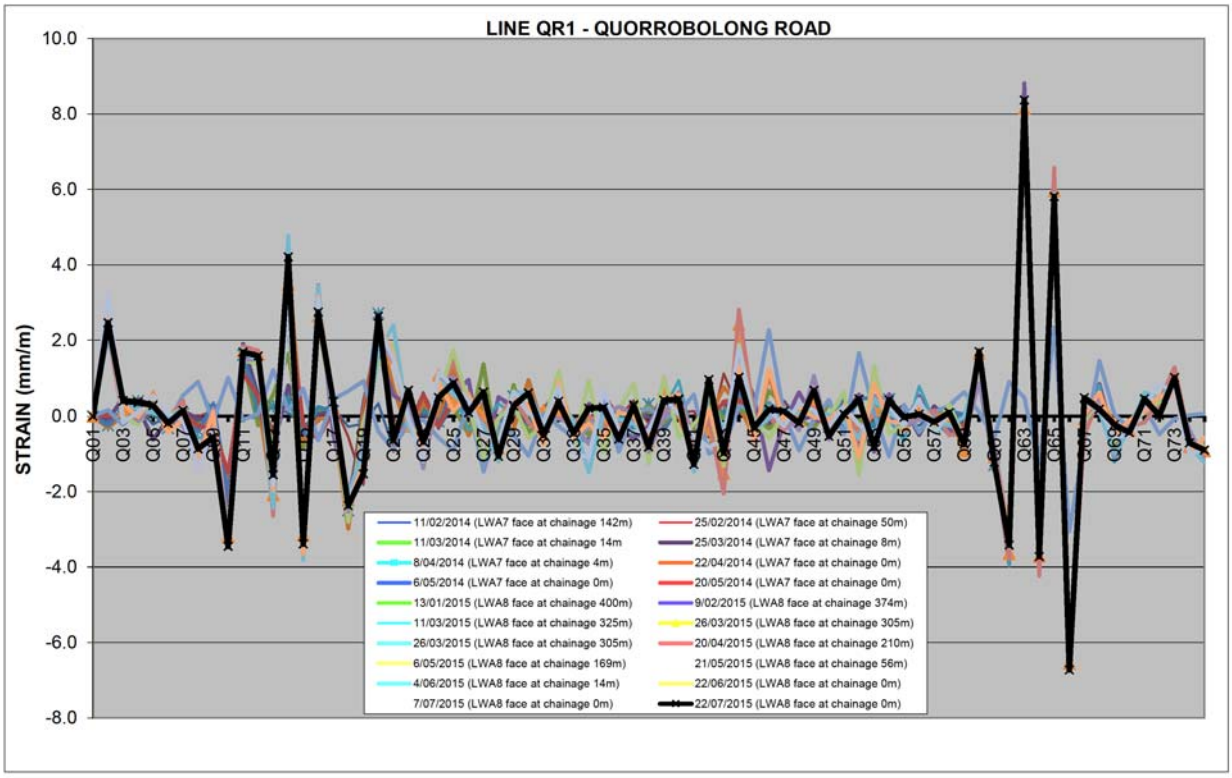

Figure 2.10 - Observed Profile of Incremental Strain along Line QR1

A summary of the maximum observed and maximum predicted incremental subsidence parameters along the Quorrobolong Road Line, resulting from the extraction of Longwall A8, are provided in **Table 2.3**. The observed values are the maxima after the completion of Longwall A8.

Table 2.3 – Maximum Observed and Predicted Incremental Subsidence Parameters along Quorrobolong Road Line Resulting from the Extraction of Longwall A8

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Compressive Strain (mm/m)
Observed	196	3.1	8.3	6.7
Predicted	500	1.5	0.3	0.6

The maximum observed incremental subsidence along the Quorrobolong Road Line was 196 mm, which is less than half of the maximum predicted subsidence of 500 mm.

It can be seen from **Figure 2.9** and **Figure 2.10** that the profiles of observed tilt and strain were very irregular. The localised tilts and strains along the monitoring line exceed those predicted based on conventional movements and are greater than those which would be expected based on the low level of vertical subsidence.

The survey marks have been established in the verge adjacent to Quorrobolong Road and therefore it is likely that these localised tilts and strains were the result of disturbed survey marks. This is supported by the fact that the visual monitoring did not identify any visual impacts in road pavement as a result of mining.

It is expected, based on the low levels of vertical subsidence that the actual tilts and strains (i.e. excluding the disturbed marks) would be in the order of survey tolerance.

2.2.4 Line A7

Line A7 is a longitudinal monitoring line which follows the centreline of Longwall A7. The monitoring line was measured five times during and one time after the extraction of Longwall A8. The latest survey was carried out on 11 August 2015, around two months after the completion of the longwall. The base survey was carried out on 25 May 2013, around three weeks prior to the commencement of Longwall A7.

The observed profiles of incremental subsidence, tilt and strain along Line A7 resulting from the extraction of Longwall A8 are shown in **Figure 2.11** to **Figure 2.13**. The predicted profiles of incremental subsidence along this monitoring line after the completion of longwall A8 is also shown in this **Figure 2.11** for comparison.

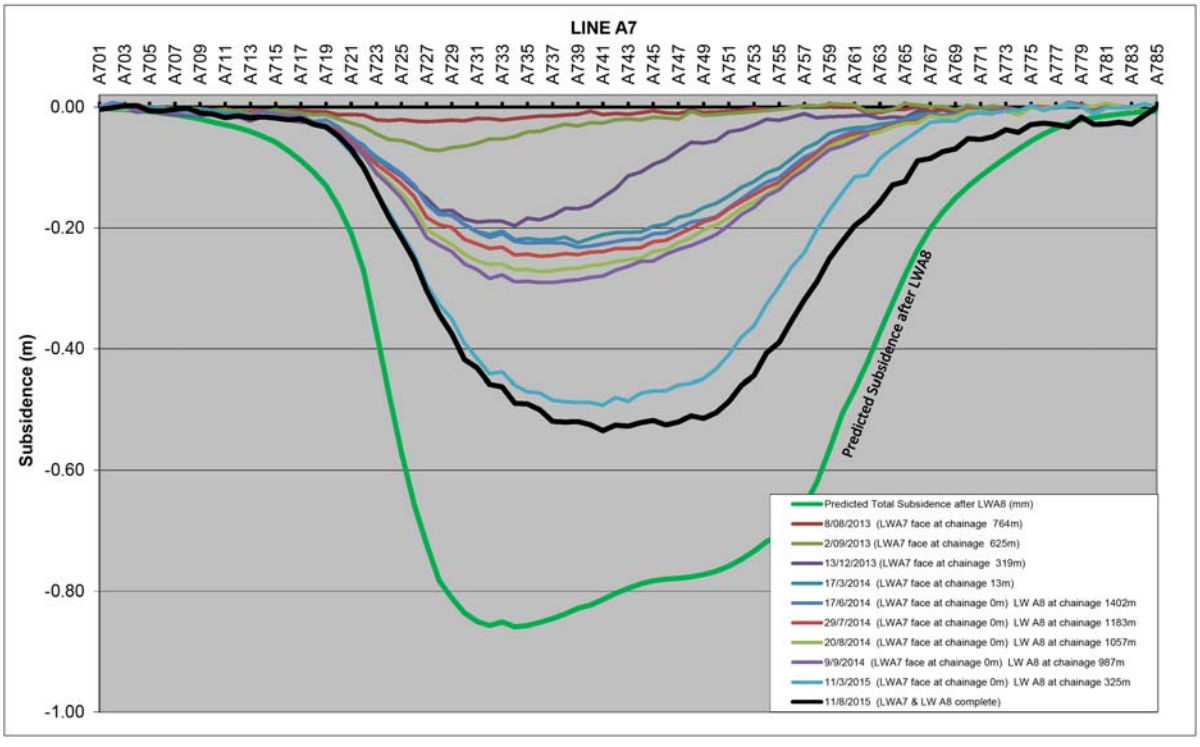

Figure 2.11 - Observed and Predicted Profile of Incremental Subsidence along Line A7

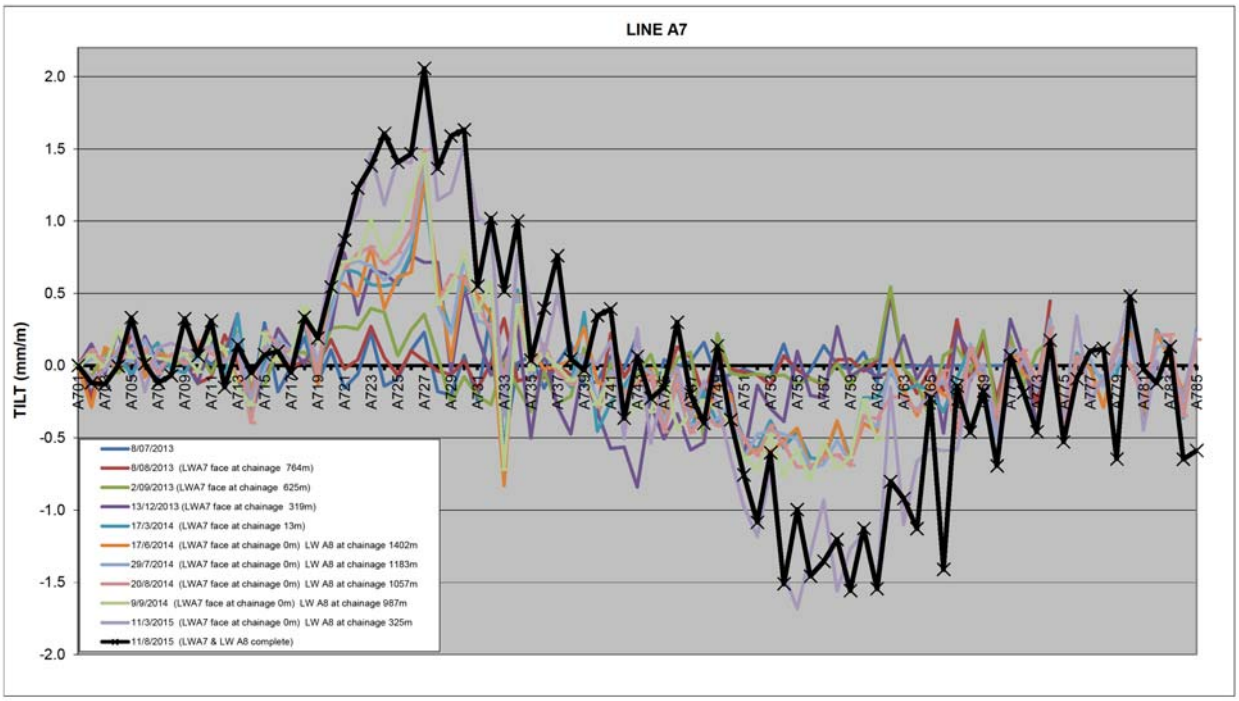

Figure 2.12 - Observed Profile of Incremental Tilt along Line A7

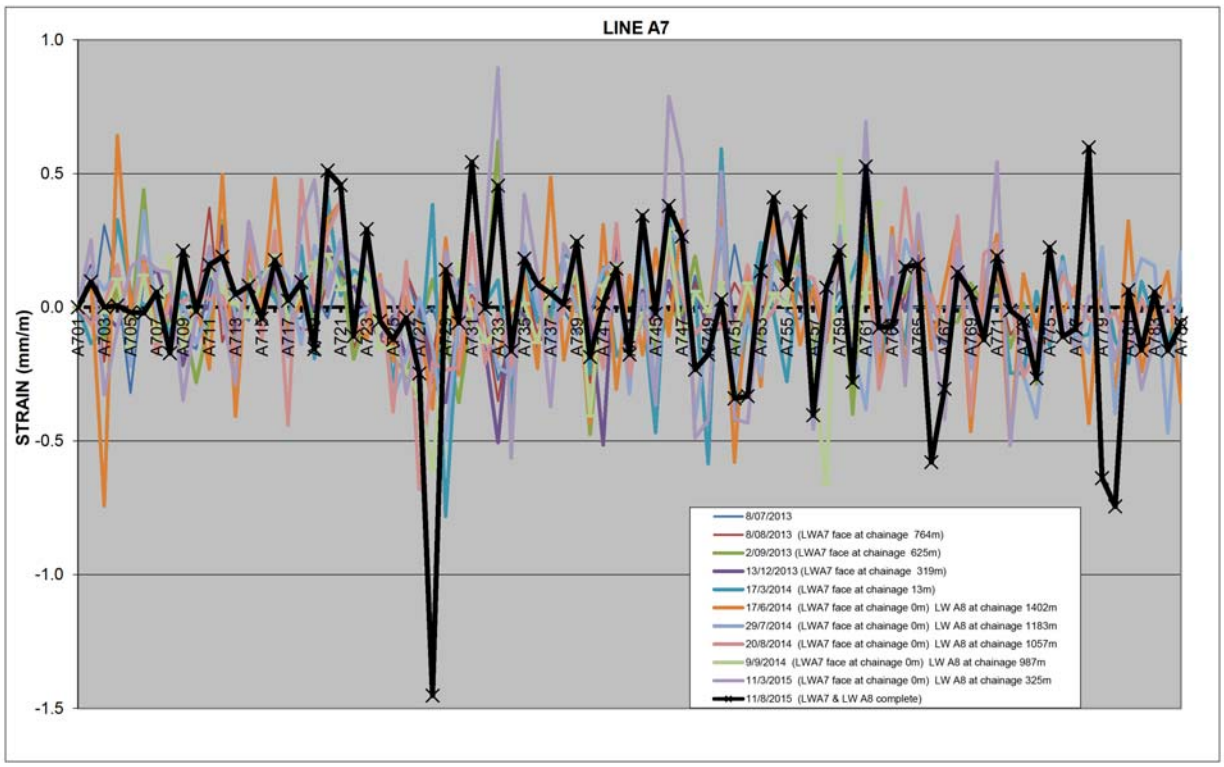

Figure 2.13 - Observed Profile of Incremental Strain along Line A7

A summary of the maximum observed and maximum predicted incremental subsidence parameters along Line A7, resulting from the extraction of Longwall A8, is provided in **Table 2.4**. The observed values are the maxima after the completion of Longwall A8.

Table 2.4 - Maximum Observed and Predicted Incremental Subsidence Parameters along Line A7 Resulting from the Extraction of Longwall A8

Type	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Tensile Strain (mm/m)	Maximum Total Compressive Strain (mm/m)
Observed	534	2.0	0.6	1.4
Predicted	850	4.0	Refer to discussion below	

The maximum observed incremental subsidence along Line A7 was 534 mm, which represents 63 % of the maximum predicted subsidence of 850 mm. Similarly, the maximum observed tilt of 2.0 mm/m represented 50 % of the maximum predicted tilt.

The observed subsidence profile is reasonably symmetrical, but the subsidence profile was slightly flatter (i.e. lower tilt) at the longwall finishing end (i.e. left side of Figure 2.11).

The maximum observed incremental strains along Line A7 were 0.6 mm/m tensile and 1.4 mm/m compressive. The maximum predicted conventional strains, based on applying a factor of 15 to the maximum predicted conventional curvatures anywhere above Longwall A7, are 0.8 mm/m tensile and 1.4 mm/m compressive.

The maximum observed tensile strain occurred in adjacent survey bays (i.e. as a tensile-compressive pair) and were located outside of the extents of the longwall and, therefore, could be the result of a disturbed survey mark. The maximum observed compressive strain occurs between Marks A728 and A729, which are at the bottom of a gully and could have been influenced by the surface topography. Elsewhere the observed strains were typically in the order of survey tolerance.

2.3 COMPARISON TO PREVIOUS PANEL

The previous panel extracted was Longwall A7 which lies adjacent to Longwall A8. A comparison of the two panels is shown below in **Table 2.5**.

Table 2.5 - Subsidence Parameters after Extraction of Longwall A7 and Longwall A8

LW	Maximum Predicted Incremental Subsidence (mm)	Actual Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Actual Incremental Tilt (mm/m)	Maximum Predicted Incremental Tensile Strain (mm/m)	Actual Incremental Tensile Strain (mm/m)	Maximum Predicted Incremental Compressive Strain (mm/m)	Actual Incremental Compressive Strain (mm/m)
A7	450	232	2.5	1.5	0.6	0.9	0.9	0.8
A8	1150	773	4.0	3.9	0.8	0.7	1.4	1.4

2.4 IMPACT ASSESSMENT

Chapter 3 of the subsidence prediction report (MSEC650) details the anticipated impacts on natural features and surface infrastructure. **Table 2.6** summarises these impacts and makes comment as to the level of impact created by A8 subsidence as compared to maximum predicted subsidence parameters.

Table 2.6 - Impact Assessment Criteria Post Longwall A8 Mining

Item	Subsidence Impact Assessment	Actual Observation / Occurrence	Action
Cracking of alluvial creek beds	None within SMP area	N/A	Nil
Drainage lines	Potential for minor shallow isolated cracking around tensile zones of perimeter of longwalls	None observed	Nil
Steep slopes (northern side A8 near start, northern side of A8 and southern side of A7 along chain pillar mid panel and perpendicular across last part of panel)	Tilts 5.5 mm/m, Strains <1.4 mm/m after LWA10. Potential for minor cracking and unlikely to cause any long term impact	Tilt of 1.3 mm/m and compressive strain of 1.2 mm/m potentially as a result of downward slope movement at the bottom of gully	Continue to monitor
Quorrobolong Rd	500mm after LWA8 and 1.5 mm/m Tilt. After LWA10 1250mm, Tilt 5.0 mm/m, Strains 0.3-1.1 mm/m. Minor surface cracking to 25mm	Subsidence 196mm. Tilt 3.1 mm/m Strains to 8.3 mm/m. Tilts and strains higher but appear to be from disturbed subsidence marks. No visual sings of impact	Nil
Electrical Infrastructure	Unlikely for any adverse impact	No impact observed	Re-contact Ausgrid regarding line roller installation as per M.Plan
Telecommunications Cables	After LWA10 1600mm, Tilt <4 mm/m, Strains 0.3-0.45 mm/m. Moderate likelihood of damage.	OTDR testing completed. No loss of transmission	Continue to monitor as per M.Plan
Rural building structures	No expected impacts	None reported	Nil
Other structures/dams	Minimal impact	None reported	Nil
Archaeological Sites	Minor cracking with no adverse impact	None reported	Nil

2.5 SUBSIDENCE SUMMARY

The ground movements measured along Lines A7, A8 and XL3 indicate that the observed subsidence and tilt, resulting from the extraction of Longwall A8, were generally similar to or less than the maxima predicted. The profiles of observed subsidence also reasonably matched those predicted, but with reduced magnitudes with the exception of Line XL3 which showed a slight lateral shift in the observed subsidence profile towards the longwall maingate.

Only low level subsidence was measured along the Quorrobolong Road Line (<200mm) as this monitoring line crosses the back end of the longwall. The observed tilt and strain profiles along this monitoring line were very irregular and the localised movements appear to be the result of disturbed survey marks.

The observed strains along Lines A7, A8 and XL3 were typically less than the predicted conventional strains. The maximum observed compressive strain for Line A8 occurred between marks A866 and A867 which are located on the change of grade at the bottom of a gully and therefore which could be the result of the natural surface slope. Tensile-compressive strain pairs also occurred along each of the Lines A7, A8 and XL3, at locations outside of the longwall and, therefore, could have resulted from disturbed survey marks. Otherwise, the strains were similar to the order of survey tolerance.

It has been considered, therefore, that the Incremental Profile Method has provided adequate predictions of the mine subsidence movements for Austar Stage 3 Longwall A7 & A8.

3 PUBLIC SAFETY MONITORING AND MANAGEMENT PLAN

During routine subsidence monitoring and on occasions the area was being accessed for other purposes the following items were inspected as per the Public Safety Management Plan:

- Surface cracking;
- Surface humps;
- Step changes in landform;
- Serviceability of roads and access tracks;
- Slope or boulder instability; and
- Other sign of subsidence.

Of all the inspection occasions no evidence of any of the above could be observed (Also refer to **Table 2.6**). Inspections also confirmed that no safety issues manifested and no physical signs of subsidence were observed.

4 VIBRATION MONITORING

4.1 MONITORING RESULTS SUMMARY

Vibration monitoring has been undertaken in accordance with the Noise and Vibration Management Plan. Monitoring was undertaken at locations V7 and V8 during extraction of LWA8 (refer to **Figure 4.1**).

Monitors were set to monitor vibration continuously, and also to record a waveform when vibration exceeded 1mm/sec in any axis. Results of vibration monitoring greater than 1mm/sec are shown in **Figure 4.2** and **Figure 4.3.** Periods which recorded vibration less than 1mm/sec are not shown on the graphs.

Guideline values for annoyance (*Assessing Vibration: a technical guideline, DECC February 2006*), and for minimal risk of cosmetic damage (*BS7385:1993*) are included with the graphed results.

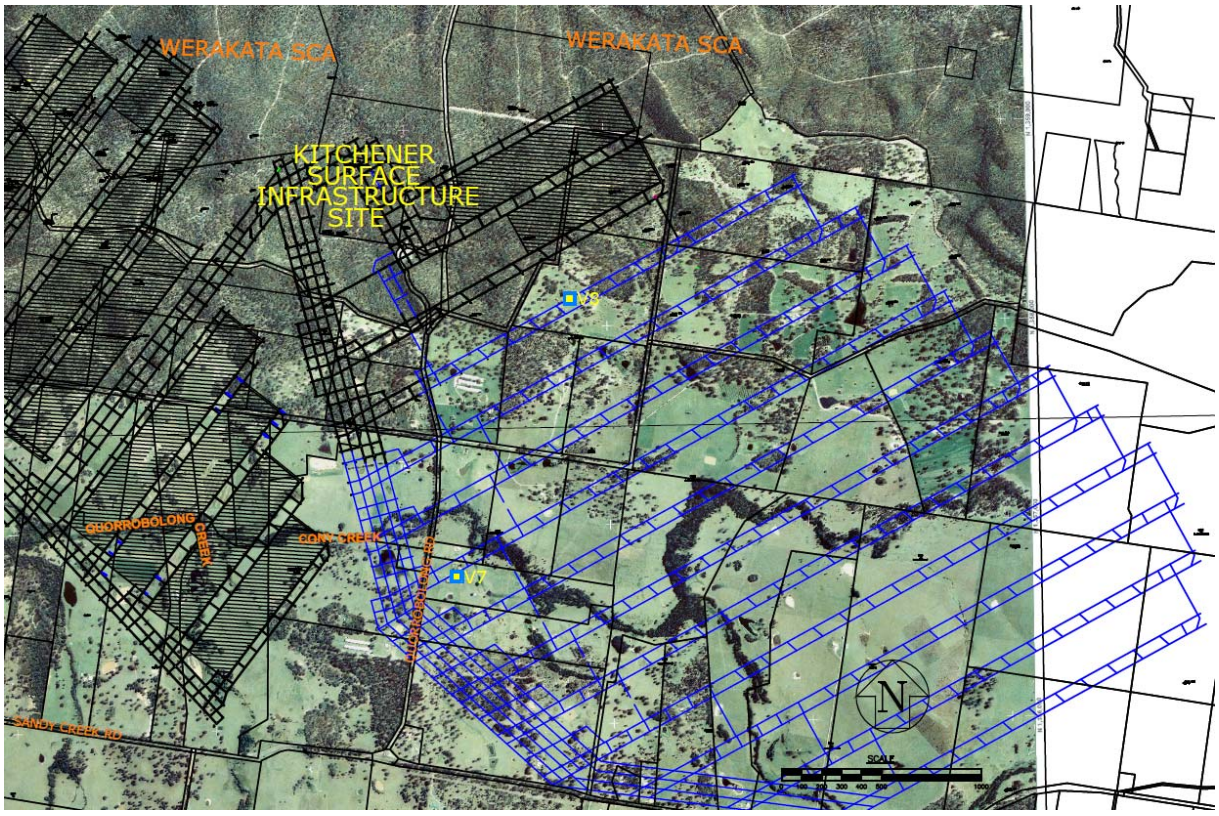

Figure 4.1 - Austar Vibration Monitoring Locations (V7 and V8)

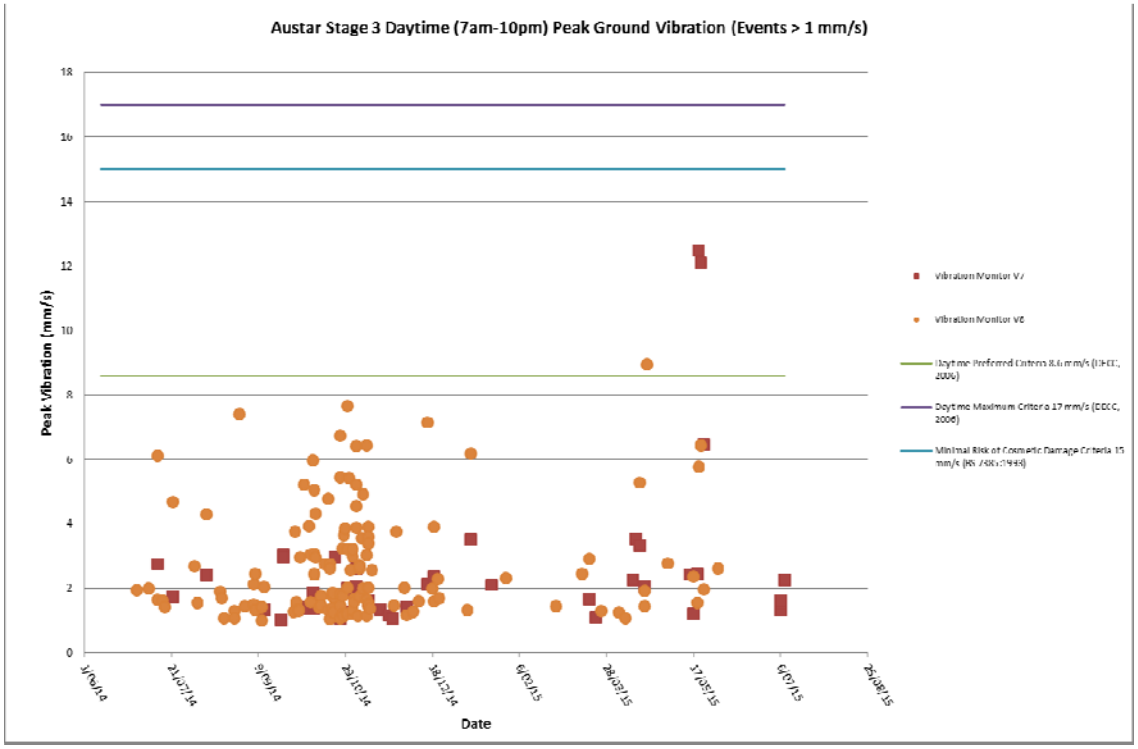

Figure 4.2 - Vibration Monitoring Results – Daytime

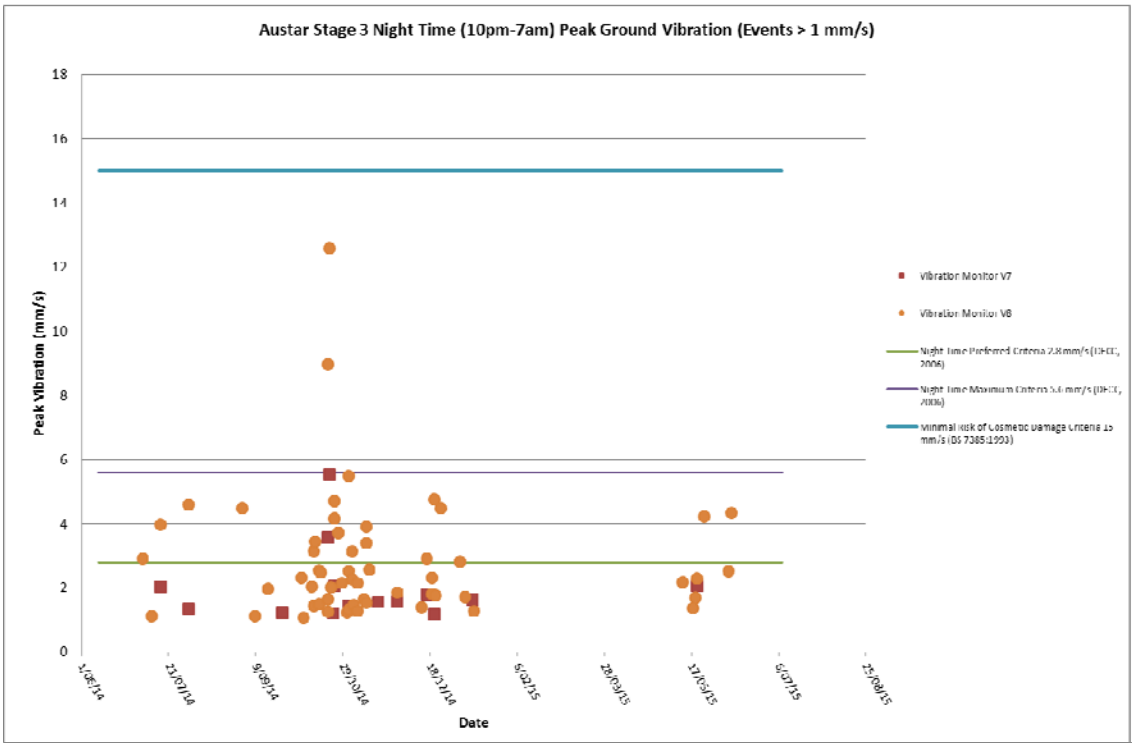

Figure 4.3 - Vibration Monitoring Results – Night

4.2 ANALYSIS OF MONITORING RESULTS

Results indicate that vibration from the extraction of Longwall A8 has been event based in nature. It is considered that vibration events are typically generated from the caving zone behind the longwall, or from tensile fractures in the overlying strata immediately above the longwall area. The majority of vibration events are less than 4 mm/sec, with only 14 events greater than 6 mm/sec over the period of extraction of A8. There were no events greater than 12.6 mm/sec.

Over the period of monitoring (1st June 2014 to 6th July 2015), two events exceeded the maximum criteria for human response to vibration during the night period. It is important to note that the vibration criteria are non-mandatory (DECC 2006) so are used as a monitoring tool to assess possible annoyance. Also, due to the vibration being strata generated, the timing of vibration events cannot be controlled, as would be the case in say pile driving, so operational controls are not feasible in this case. In that context, two exceedances of the maximum criteria over the extraction of Longwall A8 is not considered to be significant.

No events exceeded the guideline value where a minimal risk of cosmetic damage to building structures may occur (15mm/sec).

Community complaints in relation to vibration have been quite low. Only three community complaints were received in relation to vibration during the extraction of Longwall A8.

4.3 TRENDS IN MONITORING RESULTS

This is the second longwall panel in the Stage 3 mining area. There were significantly more vibration events during the extraction of Longwall A8 (216 events) than Longwall A7 (48 events). The observation of an increased number of vibration events for the second longwall panel in a series is consistent with the trend observed in the Stage 2 mining area. However, despite the increased number of vibration events when compared with the extraction of Longwall A7, the majority of events were within relevant criteria.

4.4 MANAGEMENT ACTIONS

No management actions relating to vibration have been necessary. Vibration monitoring should continue for Stage 3 as per the Austar Noise and Vibration Management Plan.

5 BIODIVERSITY MONITORING

5.1 MONITORING RESULTS SUMMARY

A Biodiversity Management Plan (BMP) is being implemented as part of the Extraction Plan for LWA7 to LWA10. The purpose of the BMP is to describe the ecological management strategies, procedures, controls and monitoring programs that are to be implemented for the management of flora and fauna as a result of subsidence related biodiversity impacts described in the Austar Stage 3 Modification Environmental Assessment (Umwelt 2011) and within the Austar Coal Mine LWA7-A10 Modification - Stage 3 Area Environmental Assessment (Umwelt 2013).

Secondary workings undertaken as part of Stage 3 mining are not anticipated to have a significant impact on biodiversity. However, in order to assess any potential impacts, a detailed monitoring program has been developed for the LWA7-A10 Extraction Plan area. The monitoring specifically focuses on the Lower Hunter Spotted Gum – Ironbark Forest EEC and River Flat Eucalypt Forest EEC which occur on the drier slopes and ridges of the Extraction Plan area and on the drainage flats/lower slopes respectively, and threatened species identified within the subsidence zone of LWA7 to LWA10.

Monitoring is undertaken using a mixture of bi-annual monitoring (one survey in autumn and one in spring), and annual monitoring (for threatened species monitoring to coincide with flowering events). Monitoring locations are shown in **Figure 5.1**.

There are seven routine monitoring locations above the mining area and two reference sites. The program is arranged so that monitoring sites will be added to and removed from the program progressively as mining proceeds. For example, sites influenced by mining of LWA8 will be monitored for baseline data 12 months prior to the mining of that longwall, and will continue after the mining of that longwall. Additional sites for future longwall panels (i.e. LW A11 onwards) will be commenced prior to mining of these panels.

For the current stage of the Stage 3 program the following key methods are utilised:

- permanent vegetation sampling quadrats;
- ecological condition assessment;
- photographic monitoring; and
- targeted threatened species monitoring.

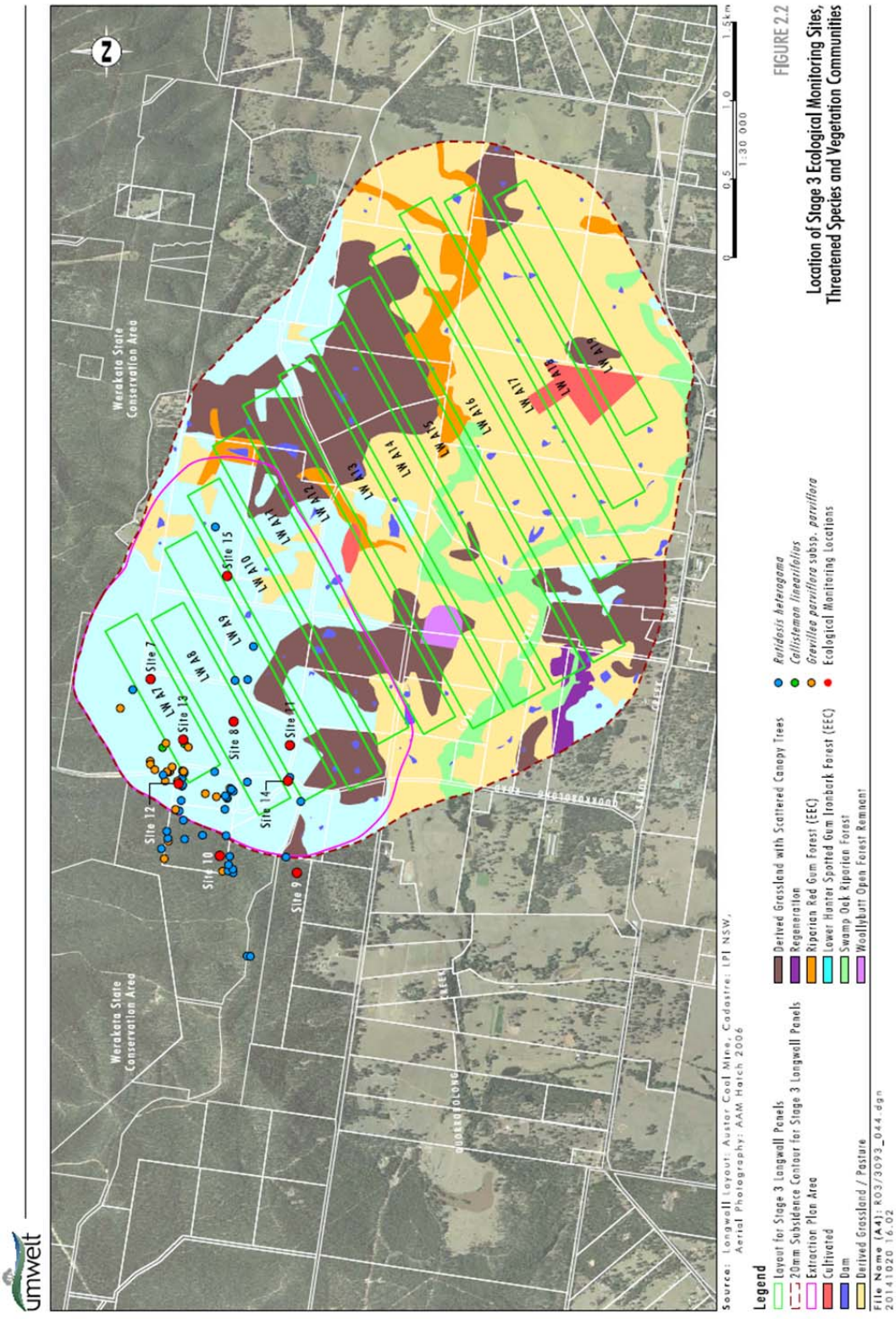

Figure 5.1 - Ecological Monitoring Locations

5.2 ANALYSIS OF MONITORING RESULTS

Monitoring undertaken prior to and up to the completion of LWA8 has included baseline monitoring in 2012, and monitoring in 2013, 2014 and Autumn 2015. The results arising from the data obtained from the monitoring surveys undertaken to date are detailed below.

- Longwall mining has now passed under monitoring Site 7, 8 and 13, and in close proximity to Site 12. Ongoing monitoring will consequently be tracking potential impacts resulting from longwall mining.
- No discernible change was observed in the vegetation or condition of the Stage 3 monitoring sites during the Autumn 2015 monitoring from the Spring 2014 monitoring event.
- No changes have been observed at any of the monitoring sites occurring over longwalls that would be attributable to the impacts of longwall mining.
- As the vegetation of these sites is currently considered stable and there are no impacts as a result of longwall mining, no management recommendations are considered necessary at this point in time.
- The targeted threatened species monitoring locations revealed these species are in a good state of health.
- There was no myrtle rust identified at any of the locations.
- No weed infestation was identified at any of the sites with only seven introduced species recorded across four sites. Lantana was observed at site 11 at a low density.
- One of the Stage 3 reference sites (Site 10) has been subject to bushfire between the Spring 2013 and Autumn 2014 monitoring events. Shrubs and groundcover were largely absent in the Autumn 2014 monitoring event, however the canopy was largely un-impacted. A replacement for reference Site 10 is not considered necessary, as monitoring the site will provide useful data on the how a healthy vegetation community responds to a burning event. Results from monitoring in Autumn 2015 suggested that Site 10 was recovering well from the burning event.

5.3 TRENDS IN MONITORING RESULTS

To date there is no evidence of any impacts on ecological features as a result of longwall mining.

5.4 MANAGEMENT ACTIONS

Nil management actions required to date in relation to biodiversity.

6 SUMMARY

Longwall A8 has been successfully extracted and monitoring of subsidence and environmental aspects has been completed in accordance with relevant Extraction Plan and environmental management plans.

It is considered that the Incremental Profile Method has provided adequate predictions of the mine subsidence movements for Austar Stage 3 Longwall A7 & A8.

There have been no management actions for subsidence impacts based on the monitoring program results.

Nil adverse impacts due to subsidence impacts have been observed during monitoring that would require modification to monitoring programs or management strategies.