South32

Illawarra Metallurgical Coal

SOUTH32 ILLAWARRA METALLURGICAL COAL:

Dendrobium – Area 3B – Longwall 18

End of Panel Subsidence Monitoring Review Report for Dendrobium Longwall 18

DOCUMENT REGISTER

Revision	Description	Author	Checker	Date
01	Draft issue	JB	-	9 Aug 22
A	Final issue	JB	KK	25 Aug 22

Report produced for: Compliance with conditions attached to the SMP Approval set by Industry and Investment NSW (now DPE).

Associated reports:

WKA77 (January 2001) – Dendrobium Mine Project – Report on the prediction of mining subsidence parameters and the assessment of impacts on surface infrastructure – Longwalls 1 to 18 (in support of the EIS).

MSEC311 (October 2007) – The prediction of subsidence parameters and the assessment of mine subsidence impacts on natural features and surface infrastructure resulting from the extraction of proposed Longwalls 6 to 10 in Area 3A and future longwalls in Areas 3B and 3C at Dendrobium Mine (in support of the SMP Application and the Modification to the Development Consent).

MSEC459 (September 2012) – Dendrobium Area 3B – Longwalls 9 to 18 – subsidence predictions and impact assessments for natural features and surface infrastructure in support of the SMP Application.

MSEC792 (December 2015) – Dendrobium Area 3B – Longwalls 12 to 18 – Review of the subsidence predictions and impact assessments for natural and built features in Dendrobium Area 3B based on observed movements and impacts during Longwalls 9 and 10.

MSEC865 (November 2016) – The effects of the proposed modifications to the ends of Longwalls 12 to 18 in Area 3B at Dendrobium Mine on the subsidence predictions and impact assessments.

MSEC914 (August 2017) – The effects of the proposed modified commencing ends of Longwalls 15 to 18 in Area 3B at Dendrobium Mine on the subsidence predictions and impact assessments.

MSEC1103 (June 2020) – Subsidence Predictions and Impact Assessments for the Natural and Built Features due to the Extraction of the Proposed Longwall 18 in Area 3B at Dendrobium Mine.

Background reports available at *www.minesubsidence.com*:

Introduction to Longwall Mining and Subsidence (Revision A)

General Discussion of Mine Subsidence Ground Movements (Revision A)

Mine Subsidence Damage to Building Structures (Revision A)

CONTENTS

Tables

Tables are prefixed by the number of the section in which they are presented.

Figures

Figures are prefixed by the number of the section in which they are presented.

Drawings

Drawings referred to in this report are included in Appendix A at the end of this report.

1.1. Introduction

Illawarra Metallurgical Coal (IMC) has completed the mining of Longwall 18 (LW18) at Dendrobium Mine, which is in the Southern Coalfield of New South Wales. The locations of the longwalls in Area 3B at Dendrobium Mine are shown in Drawing No. MSEC1267-01, in Appendix A. The extraction of LW18 commenced on 2 December 2021 and it was completed on 17 May 2022.

Mine Subsidence Engineering Consultants (MSEC) was previously commissioned by IMC to prepare subsidence predictions and impact assessments for Dendrobium Longwalls 9 to 18 (LW9 to LW18) in Area 3B. Report No. MSEC459 (Revision B) was issued in September 2012 in support of the SMP Application for these longwalls.

The subsidence prediction model was reviewed and re-calibrated, based on the updated monitoring data from LW7 and LW8 in Area 3A and LW9 and LW10 in Area 3B. The subsidence predictions and impact assessments for the natural and built features were reviewed and updated based on the re-calibrated subsidence model and are provided in Report No. MSEC792 (Rev. C). The predictions provided in this End of Panel subsidence review report are based on the re-calibrated subsidence prediction model.

IMC initially shortened the finishing (i.e. eastern) end of LW18 by 64 m from the extent that was indicated in the SMP Application. The maximum height of extraction in the Wongawilli Seam for LW15 to LW18 was also reduced from 4.6 m to 3.9 m. Reports Nos. MSEC865 (Rev. A) and MSEC914 (Rev. A) were issued in support of the applications for these modifications.

The finishing end of LW18 was further shortened by 910 m giving an overall void length (including first workings) of approximately 1018 m. IMC submitted a Subsidence Management Plan (SMP) Application for LW18 based on the modified length. MSEC prepared Report No. MSEC1103 (Rev. C) in support of that application. The SMP Application for LW18 was approved by the Department of Planning, Industry and Environment (now DPE) on 8 December 2020.

In accordance with Condition 9 End of Panel Reporting of the Development Consent (Schedule 3) for the Area 3B longwalls, this report provides:

- comparisons between the measured and predicted subsidence effects at the monitoring lines and points in Dendrobium Area 3B due to the mining of LW18; and
- comparisons between the observed and predicted effects and impacts on the natural and built features within the SMP Area due to the mining of LW18.

Further details on the observed and assessed impacts for natural features, due to the mining of LW18, are provided in the reports by other consultants. The discussions provided in this report should be read in conjunction with those and all other relevant reports.

Chapter 2 of this report describes the locations of the ground monitoring lines and points which were surveyed during the mining of LW18. This section provides comparisons between the measured and predicted effects due to the mining of this longwall.

Chapter 3 of this report describes the natural and built features near LW18. This section provides comparisons between the observed and assessed impacts for these features due to the mining of this longwall.

Chapter 4 of this report provides a summary of the comparisons between the measured and predicted ground movements and the observed and assessed surface impacts due to the mining of LW18.

Appendix A includes all drawings associated with this report.

1.2. Mining geometry

The layout of the longwalls in Area 3B at Dendrobium Mine is shown in Drawing No. MSEC1267-01, in Appendix A. A summary of the as-extracted dimensions for LW9 to LW18 is provided in Table 1.1.

Table 1.1 Mining geometry of the as-extracted longwalls

Location	Longwall	Overall void length including installation heading (m)	Overall void width including first workings (m)	Overall tailgate chain pillar width (m)
Area 3B	LW9	2162	305	-
	LW10	2219	305	45
	LW11	2204	305	45
	LW12	2602	305	45
	LW13	2223	305	45
	LW14	1980	305	45
	LW15	1963	305	45
	LW16	1874	305	45
	LW17	1910	305	45
	LW18	1018	305	45

The mined lengths of the longwalls excluding the installation headings are approximately 9 m shorter than the overall void lengths provided in Table 1.1. The length of extraction for LW18, therefore, is approximately 1009 m. The longwall face widths excluding the first workings are approximately 294 m.

The longwalls in Area 3B have been extracted from the Wongawilli Seam, from the west towards the east, i.e. towards Wongawilli Creek. The natural surface and the seam levels along the centreline of LW18 are illustrated in Fig. 1.1.

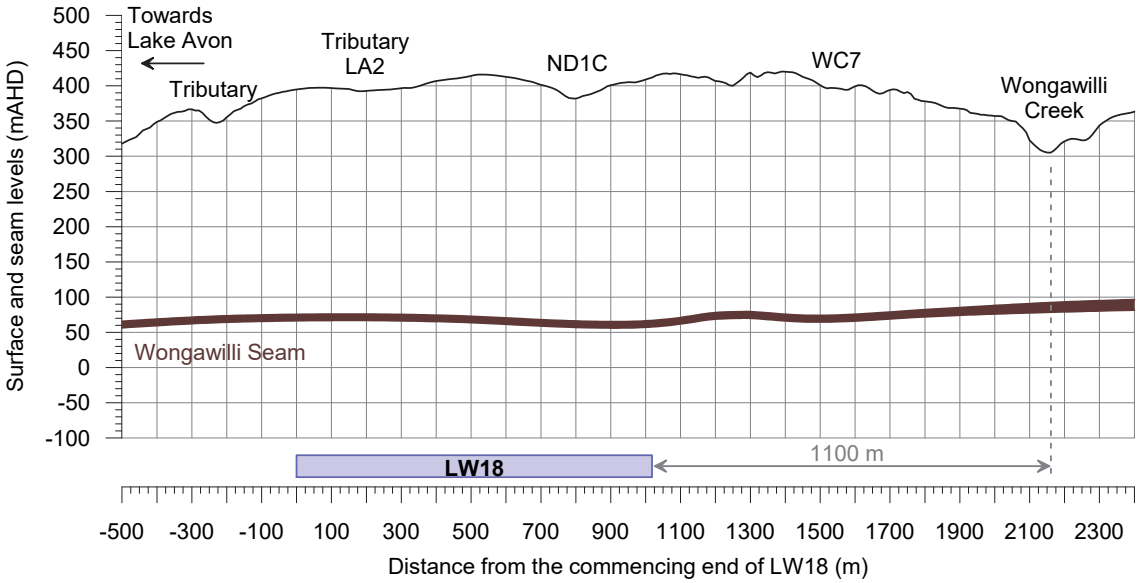


Fig. 1.1 Surface and seam levels along the centreline of LW18

The depths of cover to the Wongawilli Seam directly above LW18 vary between 300 m and 370 m. The minimum depth of cover occurs along Drainage Line ND1C above the maingate of LW18. The maximum depth of cover occurs along the ridgeline above the north-eastern corner of the longwall. The average depth of cover directly above LW18 is 335 m.

The seam generally dips from the south towards the north with an average grade across the mining area of approximately 2 %, or 1 in 50. A syncline crosses LW18 with a north-northeast to south-southwest orientation. The degree of folding increases from the north towards the south of this feature. The maximum seam dip within the mining area is approximately 6 % at the maingate of LW18.

The extraction height varies along the length of LW18, depending on the local roof conditions, with a maximum mining height of 3.9 m. The predictions provided in this report have been based on the maximum proposed extraction height of 3.9 m, as adopted in Report No. MSEC1103.

2.1. Introduction

The mine subsidence effects due to the mining of Dendrobium LW18 were monitored along several monitoring lines and monitoring points including the following:

- Wongawilli Creek closure lines;
- Avon Dam closure lines;
- Area 3B and Avon Dam 3D monitoring points;
- Tributary cross lines;
- Swamp cross line;
- Waterfall 54; and
- Airborne laser scans of the area.

The locations of these survey lines and survey points are shown in Drawing No. MSEC1267-01, in Appendix A. Comparisons between the measured and predicted subsidence effects at these monitoring lines and points are provided in the following sections. The predicted subsidence effects have been obtained using the re-calibrated subsidence model presented in Reports Nos. MSEC792, MSEC865 and MSEC914 and MSEC1103.

2.2. Wongawilli Creek closure lines

The closure movements across Wongawilli Creek have been measured by IMC using 2D survey techniques at the Wong X D-Line and Wong X E-Line. The Wong X A-Line, Wong X B-Line and Wong X C-Line were not measured at the completion of LW18 due to their distances from that longwall.

The locations of the Wongawilli Creek closure lines are shown in Drawing No. MSEC1267-01. The survey dates for these monitoring lines are provided in Table 2.1.

Table 2.1 Survey dates for the Wongawilli Creek closure lines for LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Completion of LW18	13 February 2013 (base survey) 4 March 2016 (end of LW11) 28 April 2017 (end of LW12) 14 June 2018 (end of LW13) 28 March 2019 (end of LW14) 28 March 2020 (end of LW15) 10 December 2020 (end of LW16) 11 December 2021 (end of LW17) 23 June 2022 (end of LW18)	No ongoing commitments

The monitoring lines each comprise two survey marks, with the marks located on either side of Wongawilli Creek and, therefore, they measure closure between the valley sides. Survey marks could not be installed near the base of the valley due to the difficult terrain and safety concerns with access. The upsidence in the base of the valley, therefore, could not be measured.

The development of total closure for the Wongawilli Creek closure lines, due to the mining of LW6 to LW18, is illustrated in Fig. 2.1. The base survey for the Wong X D-Line was carried out after the completion of LW12 and, therefore, this line measured the additional movements due to LW13 to LW18 only. The base survey for the Wong X E-Line was carried out after the completion of LW14 and, therefore, this line measured the additional movements due to LW15 to LW18 only.

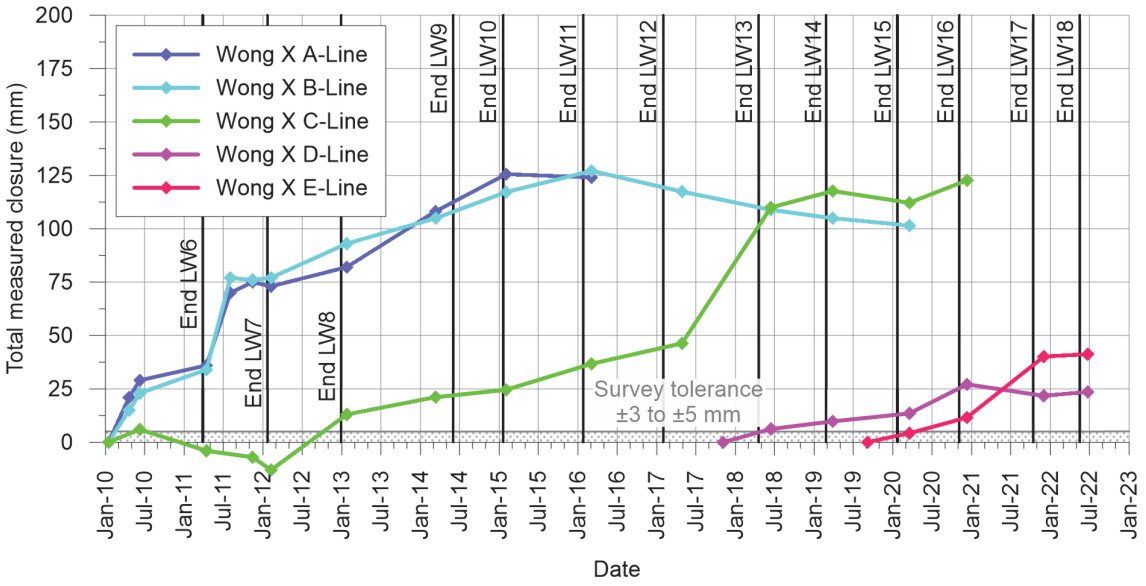


Fig. 2.1 Development of total closure for the Wongawilli Creek closure lines

The predictions of vertical subsidence, upsidence and closure for Wongawilli Creek, due to the mining of Dendrobium LW6 to LW18, are provided in Report No. MSEC1103. The measured and predicted total closures along Wongawilli Creek after the completion of LW18 are illustrated in Fig. 2.2.

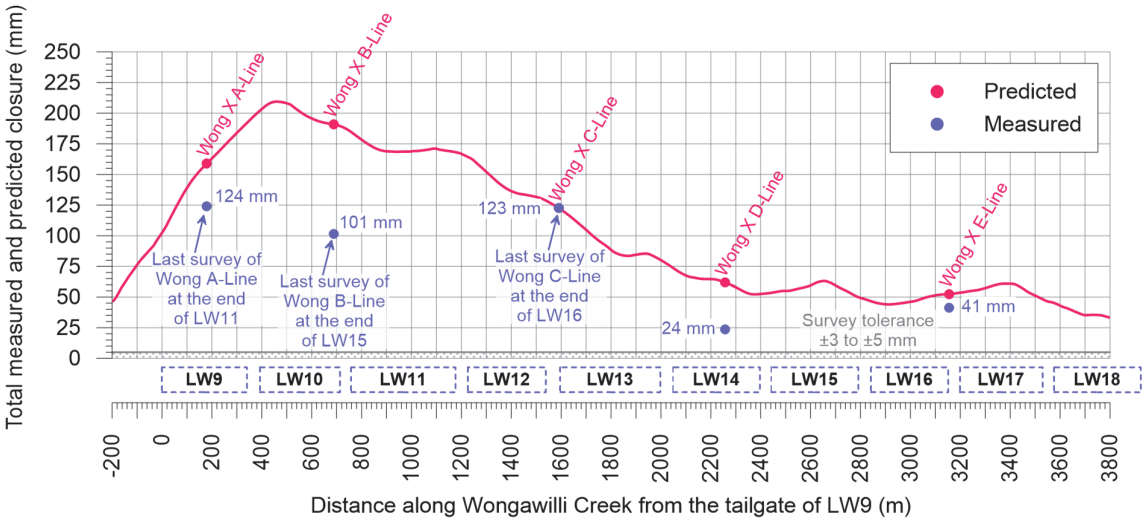


Fig. 2.2 Measured and predicted total closure along Wongawilli Creek after LW18

A summary of the maximum measured and maximum predicted total closure movements for each of the Wongawilli Creek closure lines, due to the mining of LW6 to LW18, is provided in Table 2.2. The predicted total closures are based on the as-extracted finishing ends of LW11, LW12 and LW14 to LW18.

Table 2.2 Measured and predicted total closure at the Wongawilli Creek closure lines due to the mining of LW6 to LW18

Location	Longwalls	Measured total closure (mm)	Predicted total closure (mm)
Wong X A-Line	LW6 to LW11	124	160
Wong X B-Line	LW6 to LW15	101	190
Wong X C-Line	LW6 to LW16	123	120
Wong X D-Line	LW13 to LW18	24	60
Wong X E-Line	LW15 and LW18	41	50

The accuracies of the measured closure movements are in the order of ±5 mm.

The measured total closure at the Wong X C-Line of 123 mm is similar to but slightly greater than the predicted total closure of 120 mm. The exceedance of 3 mm represents less than 3 % of the predicted value and it is in the order of survey tolerance. The maximum measured total closures at the remaining Wongawilli Creek closure lines are less than the predicted values at the completion of LW18.

It is considered that the movements measured using the Wongawilli Creek closure lines are reasonably consistent with the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

2.3. Avon Dam closure lines

The closure across the Avon Dam has been measured by IMC using the Avon Dam A-Line to E-Line. The locations of these monitoring lines are shown in Drawing No. MSEC1267-01. The discussions on the Avon Dam 3D monitoring points are included in Section 2.4.

The survey dates for the Avon Dam closure lines are provided in Table 2.3. The base surveys were carried out just prior to the commencement of LW12 and, therefore, the closure lines have measured the accumulated movements due to the mining of LW12 to LW18.

Table 2.3 Survey dates for the Avon Dam closure lines during LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Completion of LW18	12 February 2016 (base survey) 30 August 2016 (end of LW12) 23 May 2018 (end of LW13) 2 April 2019 (end of LW14) 5 February 2020 (end of LW15) 9 December 2020 (end of LW16) 21 October 2021 (end of LW17) 30 June 2022 (end of LW18)	No ongoing commitments

The monitoring lines each comprise two survey marks, with the marks located on either side of the Avon Dam and, therefore, they measure closure or opening between the valley sides. Survey marks could not be installed near the base of the valley due to the stored water in the dam and high water levels impeding access. The upsidence in the base of the valley, therefore, could not be measured.

The development of the measured accumulated movements across the Avon Dam closure lines during the mining of LW12 to LW18 are illustrated in Fig. 2.3. The mining of LW18 has resulted in a 1 mm increase in the closure measured at the A-Line, 3 mm decreases in the opening movements measured at the B-Line and C-Line, and 2 mm and 5 mm increases in the opening movements measured at the D-Line and E-Line, respectively.

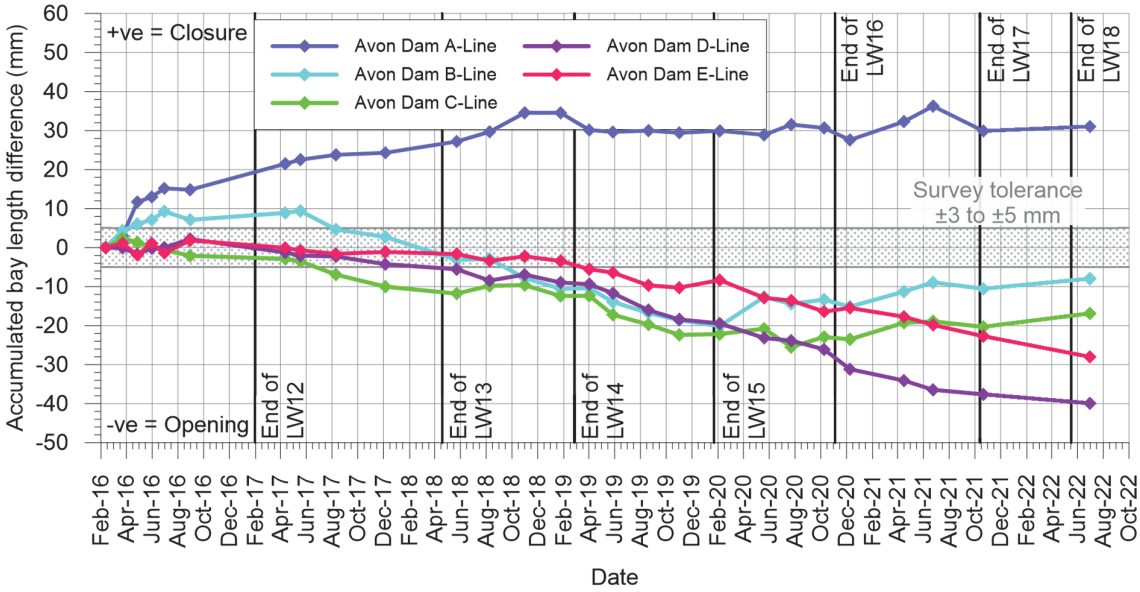


Fig. 2.3 Measured accumulated closure for the Avon Dam closure lines

A summary of the maximum measured and maximum predicted accumulated movements for each of the Avon Dam closure lines, due to the mining of LW12 to LW18, is provided in Table 2.4. The predicted closures due to the earlier extracted LW9 to LW11 are negligible, i.e. less than 20 mm. The measured values are based on the latest survey dated 30 June 2022. The vertical subsidence was not measured along these monitoring lines.

Table 2.4 Maximum measured and maximum predicted accumulated movements for the Avon Dam closure lines due to the mining of LW12 to LW18

Location	Measured accumulated closure (mm)	Predicted accumulated closure (mm)
Avon Dam A-Line	31	70
Avon Dam B-Line	-8 (opening)	90
Avon Dam C-Line	-17 (opening)	90
Avon Dam D-Line	-40 (opening)	60
Avon Dam E-Line	-28 (opening)	60

The accuracies of the measured closure movements are in the order of ±5 mm.

The measured total closure at the Avon Dam A-Line is less than the predicted value at the completion of LW18. Net opening movements have been measured at the Avon Dam B-Line to E-Line due to the conventional subsidence effects (i.e. horizontal movements towards the mining area) being greater that the valley-related effects (i.e. closure). The absolute magnitudes of the measured opening movements are less than the absolute magnitudes of the predicted closure movements.

The movements across Avon Dam and two tributaries to the dam (Refs. LA4A and LA4B) have also been measured by IMC using the Avon Dam GPS (Marks DA3B-05A, DA3B-06 and DA3B-07). The base survey was carried out on the 26 February 2013, i.e. prior to the commencement of LW9. Subsequent surveys were carried out on the same dates as the Avon Dam closure lines, as summarised in Table 2.3.

The development of the measured accumulated movements across LA4A (DA3B-06 to DA3B-07), LA4B (DA3B-05A to DA3B-06) and the Avon Dam (DA3B-05A to DA3B-07) during the mining of LW12 to LW18 are illustrated in Fig. 2.4. The extraction of LW18 has resulted in a 14 mm decrease in the closure measured at the LA4A monitoring line, and 7 mm and 8 mm increases in the opening movements measured at the LA4B and Avon Dam monitoring lines, respectively.

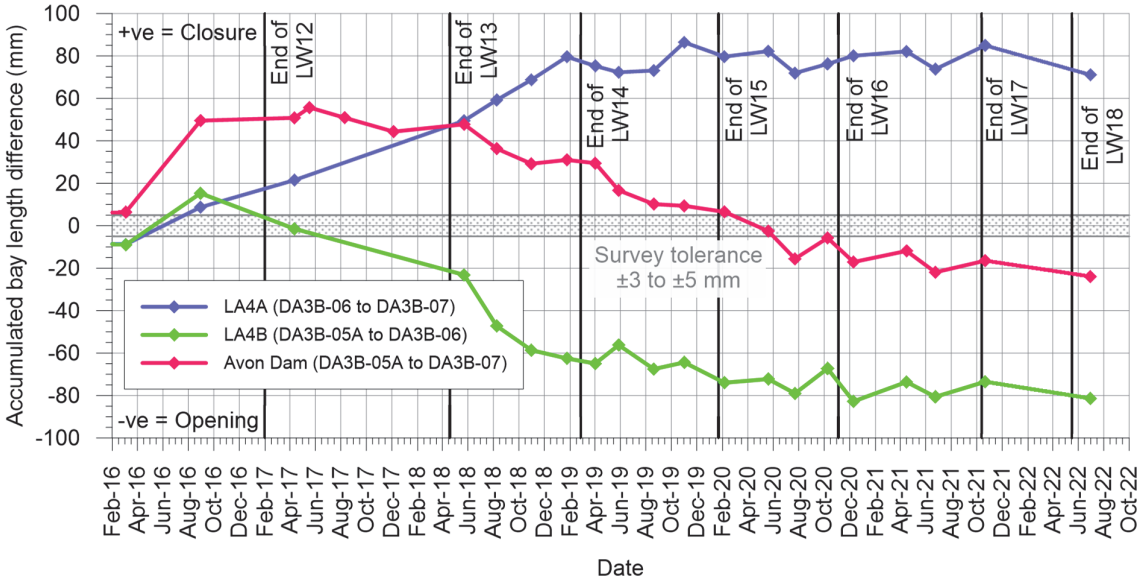


Fig. 2.4 Measured accumulated closure for Tributaries LA4A and LA4B and Avon Dam

A summary of the total measured and total predicted closures across LA4A, LA4B and Avon Dam, due to the mining of LW9 to LW18, is provided in Table 2.5. The measured values are based on the latest survey dated 30 June 2022. The vertical subsidence was not measured along these monitoring lines.

Table 2.5 Maximum measured and predicted total closure across LA4A, LA4B and Avon Dam due to the mining of LW9 to LW18

Location	Measured accumulated closure (mm)	Predicted accumulated closure (mm)
LA4A (DA3B-06 to DA3B-07)	71	170
LA4B (DA3B-05A to DA3B-06)	-81 (opening)	170
Avon (DA3B-05A to DA3B-07)	-24 (opening)	80

The accuracies of the measured closure movements are in the order of ±5 mm.

The measured total closure at the LA4A monitoring line is less than the predicted value at the completion of LW18. Net opening movements have been measured at the LA4B and Avon monitoring lines due to the conventional subsidence effects (i.e. horizontal movements towards the mining area) being greater that the valley-related effects (i.e. closure). The absolute magnitudes of the measured opening movements are less than the absolute magnitudes of the predicted closure movements.

The maximum measured total closure across Lake Avon is less than the maximum predicted value at the completion of LW18. It is considered that the ground movements measured using these monitoring lines are consistent with the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

2.4. Dendrobium Area 3B and the Avon Dam three-dimensional monitoring points

The far-field horizontal movements near LW18 have been measured by IMC using the Dendrobium Area 3B 3D monitoring points (DA3B 3D) and the Avon Dam 3D monitoring points. The locations of these monitoring points are shown in Drawing No. MSEC1267-01.

The survey dates for the DA3B 3D monitoring points are provided in Table 2.6. The survey dates and monitoring commitments for the Avon Dam 3D monitoring points (not shown in the table below) are the same as the Avon Dam closure lines provided in Table 2.3.

Table 2.6 Survey dates for the DA3B 3D monitoring points for LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Completion of LW18	26 February 2013 (base survey) 4 March 2016 (end of LW11) 9 March 2017 (end of LW12) 15 May 2018 (end of LW13) 23 April 2019 (end of LW14) 24 April 2020 (end of LW15) 10 December 2020 (end of LW16) 4 November 2021 (end of LW17) 1 July 2022 (end of LW18)	No ongoing commitments

The measured incremental horizontal movement vectors for DA3B 3D and the Avon Dam 3D monitoring points, due to the mining of LW18, are shown in Drawing No. MSEC1267-04. The accuracies of the measured absolute positions (i.e. eastings and northings) are in the order of ±20 mm.

The greatest incremental horizontal movements occur directly above LW18. The maximum measured incremental value due to the mining of LW18 is 316 mm at Mark DA3B-62 which is located at the top of a ridgeline directly above that longwall. The vector of incremental horizontal movement at Mark DA3B-62 is orientated towards the south, with a slight skew towards the east, generally in a downslope direction with a skew towards the mining direction.

The vectors located above the previously mined longwalls are also orientated towards the south, i.e. towards LW18. The incremental horizontal movements outside of LW18 are greatest above the adjacent LW17 with a maximum value of 119 mm at Mark DA3B-50. Only low level incremental horizontal movements have been measured outside the extents of the mining area.

The comparison between the maximum measured incremental horizontal movements at the DA3B 3D and Avon Dam 3D monitoring points with those previously measured in Dendrobium Area 1 (DA1 3D) and Dendrobium Area 2 (DA2 3D) and Dendrobium Area 3A (DA3A 3D), as well as other collieries in the Southern Coalfield, is provided in Fig. 2.5. The mean and the 95 % confidence level for the 3D monitoring data at Dendrobium Mine are also shown in this figure.

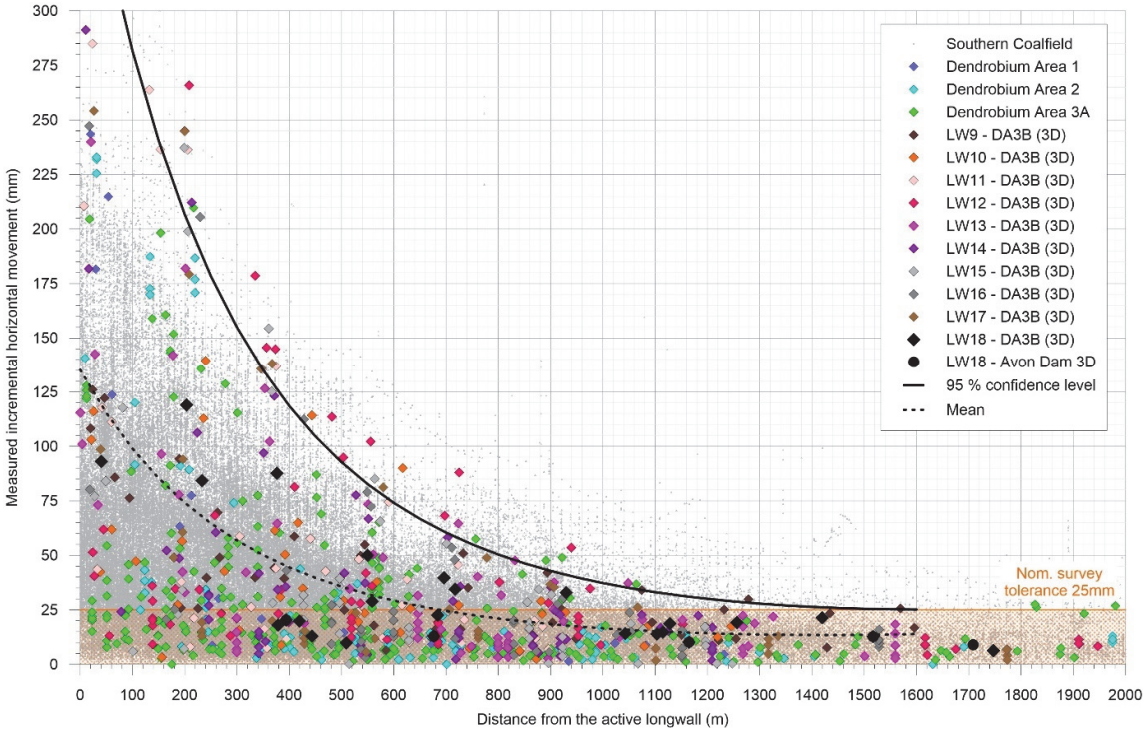


Fig. 2.5 Measured incremental horizontal movements at Dendrobium Mine

The measured incremental horizontal movements due to the mining of LW18 (i.e. black diamonds and circles) are within the range of those measured at similar distances from previously extracted longwalls at Dendrobium Mine (i.e. blue, cyan, green, brown, orange, red, magenta, purple, grey and brown diamonds) and elsewhere in the Southern Coalfield (i.e. grey triangles).

2.5. LA2 cross lines

The mine subsidence effects for LA2 (a tributary to Lake Avon) have been measured by IMC using 2D survey techniques using the LA2 RB2-Line and LA2 RB13-Line. The locations of these monitoring lines are shown in Drawing No. MSEC1267-01. The survey dates for the LA2 cross lines for LW18 are provided in Table 2.7.

Table 2.7 Survey dates for the LA2 cross lines for LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
First survey 100 m before lines final survey when mining 400 m past lines	6 September 2019 (base survey) 10 December 2020 (end of LW16) 1 December 2021 (end of LW17) 25 January 2022 15 February 2022 23 June 2022 (end of LW18)	No ongoing commitments

The development of the measured total closures at the LA2 cross lines are illustrated in Fig. 2.6. These two monitoring lines were established during the mining of LW15 and, therefore, they do not include the effects of LW9 to LW14 and part of LW15. These monitoring lines have short lengths and are located near the valley base and, therefore, they may not measure the maximum closure within the valley.

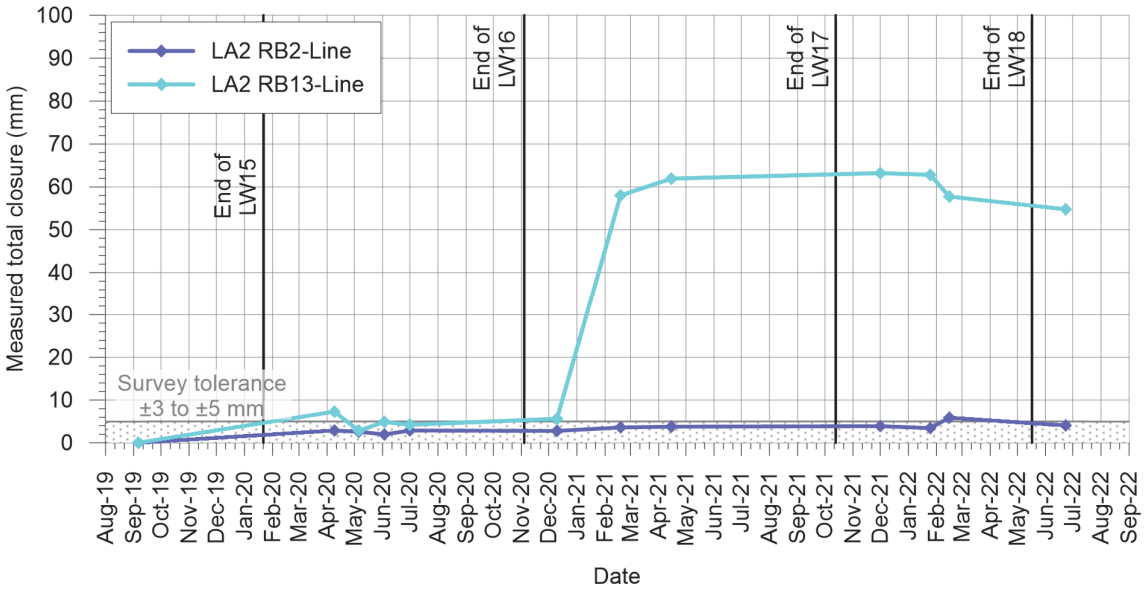


Fig. 2.6 Measured total closure for the LA2 cross lines due part LW15 to LW18

Only low-level closure has been measured at the LA2 RB2-Line due to the mining of part LW15 to LW18. This movement is similar to the order of survey tolerance. There was a reduction in the closure measured at the LA2 RB13-Line during the mining of LW18.

Summaries of the maximum measured and predicted total subsidence and closure at the LA2 cross lines, after the completion of LW18, are provided in Table 2.8 and Table 2.9. The predicted subsidence values have been derived from the predicted subsidence contours illustrated in Report No. MSEC1103. The predicted closures are based on a combination of the conventional horizontal movements and valley related movements, taking the equivalent heights of the valleys within half-depths of cover from the valley bases.

Table 2.8 Maximum measured and predicted total subsidence and closure at the LA2 RB2-Line due to the mining of part LW15 to LW18

Type	Maximum total subsidence (mm)	Maximum total closure (mm)
Measured	9	4
Predicted	< 20	50

Table 2.9 Maximum measured and predicted total subsidence and closure at the LA2 RB13-Line due to the mining of part LW15 to LW18

Type	Maximum total subsidence (mm)	Maximum total closure (mm)
Measured	1458	55
Predicted	1750	350

The accuracies of the measured absolute levels of the survey marks are in the order of ±30 mm. The accuracies of the measured closures are in the order of ±5 mm.

Only low-level vertical subsidence and closure have been measured at the LA2 RB2-Line which are similar to the order of survey tolerance. The ground movements measured using LA2 RB13-Line are less than the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

2.6. WC7 and WC12 cross lines

The mine subsidence effects for WC7 and WC12 (tributaries to Wongawilli Creek) have been measured by IMC using 2D survey techniques at the WC7 RB7-Line and WC12 RB18-Line, respectively. The locations of these monitoring lines are shown in Drawing No. MSEC1267-01. The survey dates for the WC7 and WC12 cross lines for LW18 are provided in Table 2.10.

Table 2.10 Survey dates for the WC7 and WC12 cross lines for LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Monthly once the longwall face is nominally 100 m before the cross line until it is 400 m past	6 September 2019 (base survey) 10 December 2020 (end of LW16) 1 December 2021 (end of LW17) 22 December 2021 23 June 2022 (end of LW18)	No ongoing commitments

The development of the measured accumulated closure at the WC7 RB7-Line and WC12 RB18-Line cross lines are illustrated in Fig. 2.7. The WC7 cross line was established during the mining of LW17 and, therefore, it does not include the effects of LW9 to LW16. The WC12 cross line was established during the mining of LW15 and, therefore, it does not include the effects of LW9 to LW14 and part of LW15. These two monitoring lines have short lengths and they are located near the valley base and, therefore, they may not measure the maximum closure within the valley.

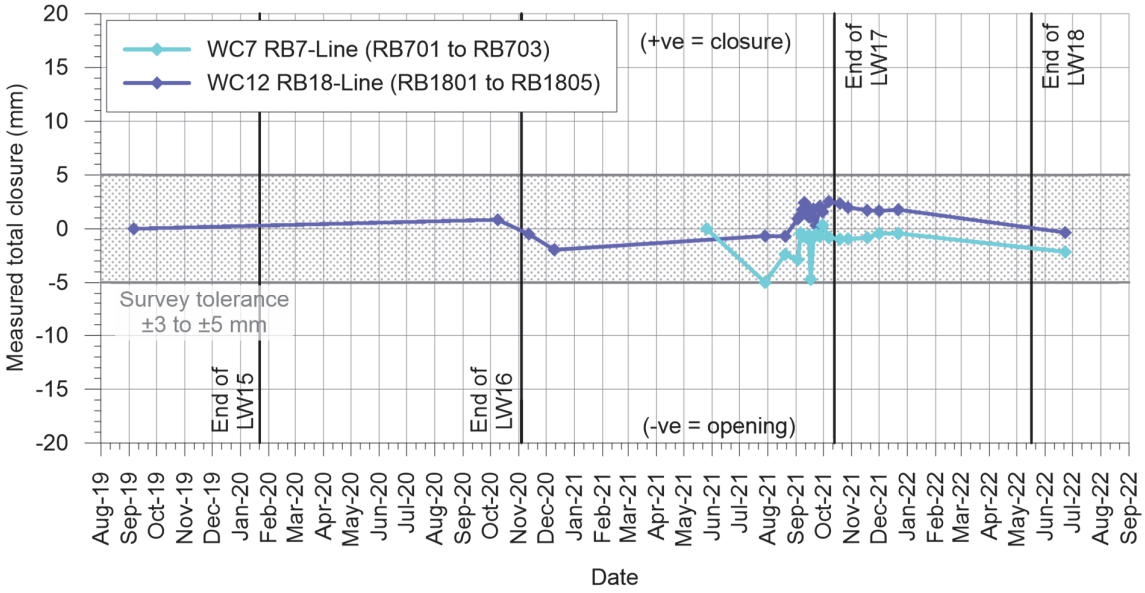


Fig. 2.7 Measured accumulated closure for the WC7 and WC12 cross lines

The mining of LW18 has resulted in negligible change (i.e. less than 2 mm) in the closure measured at the WC7 RB7-Line and WC12 RB18-Line. The measured incremental movements are in the order of survey tolerance.

Summaries of the maximum measured and predicted subsidence and closure at the WC7 and WC12 cross lines, after the completion of LW18, are provided in Table 2.11 and Table 2.12, respectively. The predicted subsidence value has been derived from the predicted subsidence contours illustrated in Report No. MSEC1103. The predicted closure is based on a combination of the conventional horizontal movements and valley related movements, taking the equivalent height of the valley within half-depth of cover from the valley base.

Table 2.11 Maximum measured and predicted incremental subsidence and closure at the WC7 RB7-Line due to the mining of LW17 and LW18

Type	Maximum accumulated subsidence (mm)	Maximum accumulated closure (mm)
Measured	11	-2 (opening)
Predicted	< ±20	80

Table 2.12 Maximum measured and predicted accumulated subsidence and closure at the WC12 RB18-Line due to the mining of part LW15, LW16 to LW18

Type	Maximum accumulated subsidence (mm)	Maximum accumulated closure (mm)
Measured	27	0
Predicted	80	270

The accuracies of the measured absolute levels of the survey marks are in the order of ±30 mm. The accuracies of the measured closures are in the order of ±5 mm.

Only low-level vertical subsidence and opening have been measured at the WC7 RB7-Line which are similar to the order of survey tolerance. The ground movements measured at the WC12 RB18-Line are less than the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

2.7. WC15 cross lines

The mine subsidence effects for WC15 (a tributary to Wongawilli Creek) have been measured by IMC using 2D survey techniques at the WC15 RB34-Line. The location of the WC15 cross line is shown in Drawing No. MSEC1267-01. The survey dates for this monitoring line for LW18 are provided in Table 2.13.

Table 2.13 Survey dates for the WC15 RB34-Line for LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Monthly once the longwall face is nominally 100 m before the cross line until it is 400 m past	13 December 2018 (base survey) 28 March 2019 (end of LW14) 18 March 2020 (end of LW15) 10 December 2020 (end of LW16) 1 December 2021 (end of LW17) 23 June 2022 (end of LW18)	No ongoing commitments

The development of the measured accumulated closure at the WC15 RB34-Line is illustrated in Fig. 2.8. The monitoring line was established during the mining of LW14 and, therefore, it does not include the effects of LW9 to LW13 and part of LW14. The monitoring line has a short length and it is located near the valley base and, therefore, it may not measure the maximum closure within the valley.

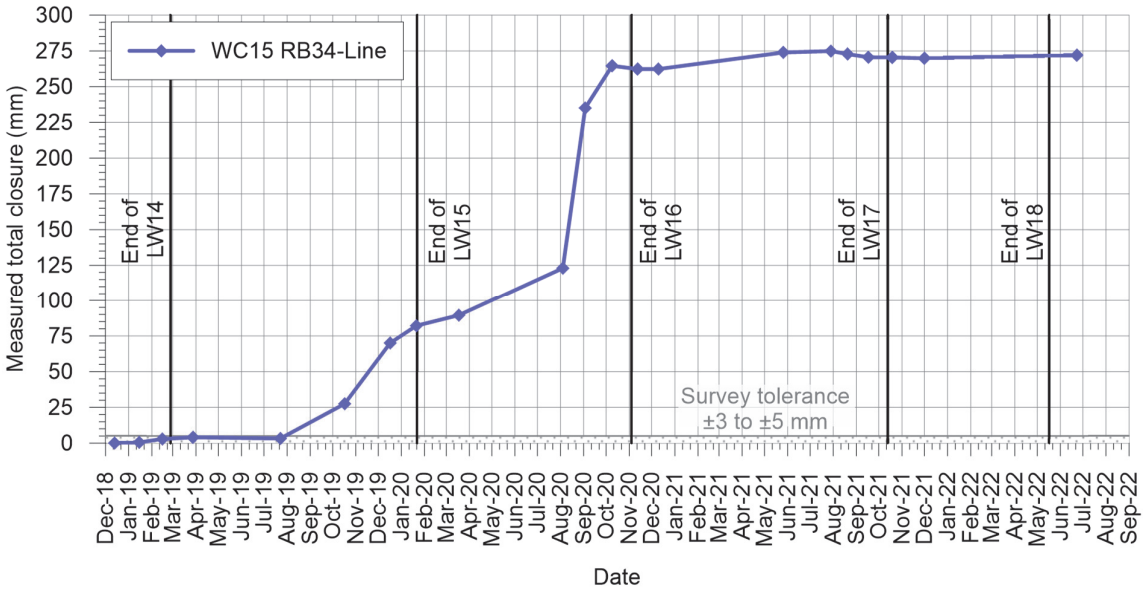


Fig. 2.8 Measured accumulated closure for the WC15 RB34-Line due to LW14 to LW18

The mining of LW18 has resulted in negligible change (i.e. 2 mm) in the closure measured at the WC15 RB34-Line -Line. The measured incremental movement is in the order of survey tolerance.

A summary of the maximum measured and predicted accumulated subsidence and closure at the WC15 RB34-Line, due to the mining of LW14 to LW18, is provided in Table 2.14. The predicted subsidence value has been derived from the predicted subsidence contours illustrated in Report No. MSEC1103. The predicted closure is based on a combination of the conventional horizontal movement and valley related movement, taking the equivalent height of the valley within half-depths of cover from the valley base.

Table 2.14 Maximum measured and predicted incremental subsidence and closure at the WC15 RB34-Line due to the mining of LW14 to LW18

Type	Maximum accumulated subsidence (mm)	Maximum accumulated closure (mm)
Measured	713	272
Predicted	1250	510

The accuracies of the measured absolute levels of the survey marks are in the order of ±30 mm. The accuracies of the measured closures are in the order of ±5 mm.

The ground movements measured using the WC15 RB34-Line are less than the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

2.8. Swamp cross line

The mine subsidence effects at the swamps and their associated drainage lines have been measured by IMC using 2D survey techniques. Only the SW35A-Line across Swamp 35A was measured during the mining of LW18. Other swamp monitoring lines are located outside the zone of influence for this longwall.

The locations of the swamp cross lines are shown in Drawing No. MSEC1267-01. The survey dates for the SW35A-Line are provided in Table 2.15.

Table 2.15 Survey dates for the SW35A-Line during LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Completion of LW18	21 October 2021 (base survey) 25 July 2022 (end of LW18)	No ongoing commitments

A summary of the maximum measured and predicted total subsidence and closure for the SW35A-Line is provided in Table 2.16. The base survey was carried out nearing the completion of LW17 and, therefore, the results for this monitoring line are due to LW18 only.

The predicted subsidence values have been derived from the predicted subsidence contours illustrated in Report No. MSEC1103. The predicted closures are based on a combination of the conventional horizontal movements and valley related movements, taking the equivalent heights within half-depths of cover from the valley bases.

Table 2.16 Maximum measured and predicted incremental subsidence and closure at the SW35A-Line due to the mining of LW18 only

Type	Maximum incremental subsidence (mm)	Maximum incremental closure (mm)
Measured	39	3
Predicted	40	200

The accuracies of the measured absolute levels of the survey marks are in the order of ±30 mm. The accuracies of the measured closures are in the order of ±5 mm.

The ground movements measured using the SW35A-Line are less than the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

2.9. Waterfall 54 monitoring

The mine subsidence effects for Waterfall 54 (WF54) along Wongawilli Creek have been measured by IMC using 2D survey techniques using the WF54 A-Line, B-Line and C-Line. The locations of these monitoring lines are shown in Drawing No. MSEC1267-01. The survey dates for the WF54 cross lines for LW18 are provided in Table 2.17.

Table 2.17 Survey dates for the WF54 cross lines for LW18

Mining phase commitments	Mining phase survey dates	Post-mining phase commitments
Monthly for last 200 m of extraction and completion of longwall	26 September 2019 (base survey) 12 November 2020 (end of LW16) 1 December 2021 (end of LW17) 22 December 2021 25 January 2022 17 February 2022 30 May 2022 27 June 2022 28 July 2022 (end of LW18)	No ongoing commitments

The development of the measured accumulated closure at the WF54 A-Line to C-Line are illustrated in Fig. 2.9. These cross lines were established before the commencement of mining of LW16 and, therefore, they include the effects of LW16 to LW18. These monitoring lines have short lengths and they are located near the valley base and, therefore, they may not measure the maximum closure within the valley.

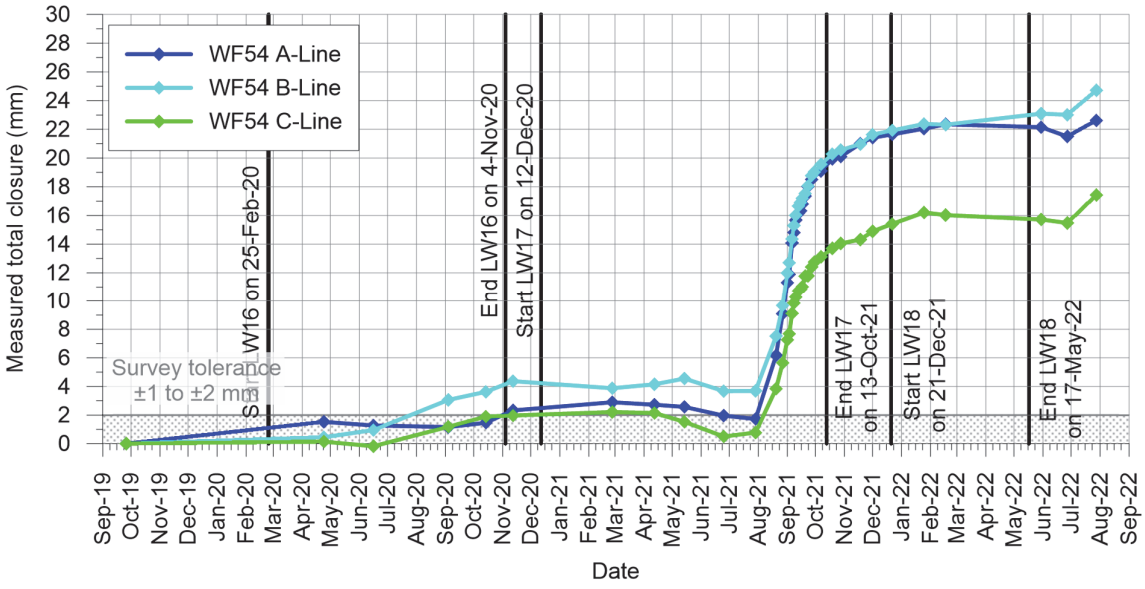


Fig. 2.9 Measured accumulated closure for the WF54 A-Line to C-Line

The measured incremental closures for the WF54 A-Line to C-Line varied between 1.2 mm and 3.1 mm. These movements predominately occurred in the latest survey carried out on 28 July 2022, more than two months after the completion of the longwall. Only low-level movements were measured beforehand including during the mining of LW18.

Heavy rainfall occurred between the previous survey carried out on 27 June 2022 and the latest survey carried out on 28 July 2022.The cumulative rainfall between these two surveys is 749 mm. The maximum daily rainfall during this period is 276 mm recorded on 3 July 2022. The heavy rainfall between could have allowed slip-stick movement at Waterfall 54. This measured movement could therefore include both mining-related and seasonal movements. However, natural valley closure tends to occur during and after the summer period rather than during the winter period.

A summary of the maximum measured and predicted total closure at the WF54 A-Line to C-Line, after the completion of LW18, is provided in Table 2.18. The predicted closure is based on the equivalent height of the valley within half-depth of cover from the valley base.

Table 2.18 Maximum measured and predicted total closure at the WF54 cross lines due to the mining of LW16 to LW18

Type	Location	Maximum total closure (mm)
Measured	WF54 A-Line	23
	WF54 B-Line	25
	WF54 C-Line	17
Predicted	WF54 A-Line	27
	WF54 B-Line	
	WF54 C-Line	

The accuracies of the measured closures are in the order of ±1 mm.

The ground movements measured using these monitoring lines are less than the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

The changes in distance on the western valley side of Wongawilli Creek, adjacent to Waterfall 54, have been measured using Global Navigation Satellite System (GNSS) units. The distances have been measured between the GNSS unit located near the waterfall (DA3B-66) and three GNSS units near the top of the western valley side (DA3B-65, DA3B-52, DA3B-53 and DA3B-54, from northernmost to southernmost).

The locations of the GNSS are shown in Drawing No. MSEC1267-01. The measured incremental changes in distances between the GNSS units due to the mining of LW18 are illustrated in Fig. 2.10.

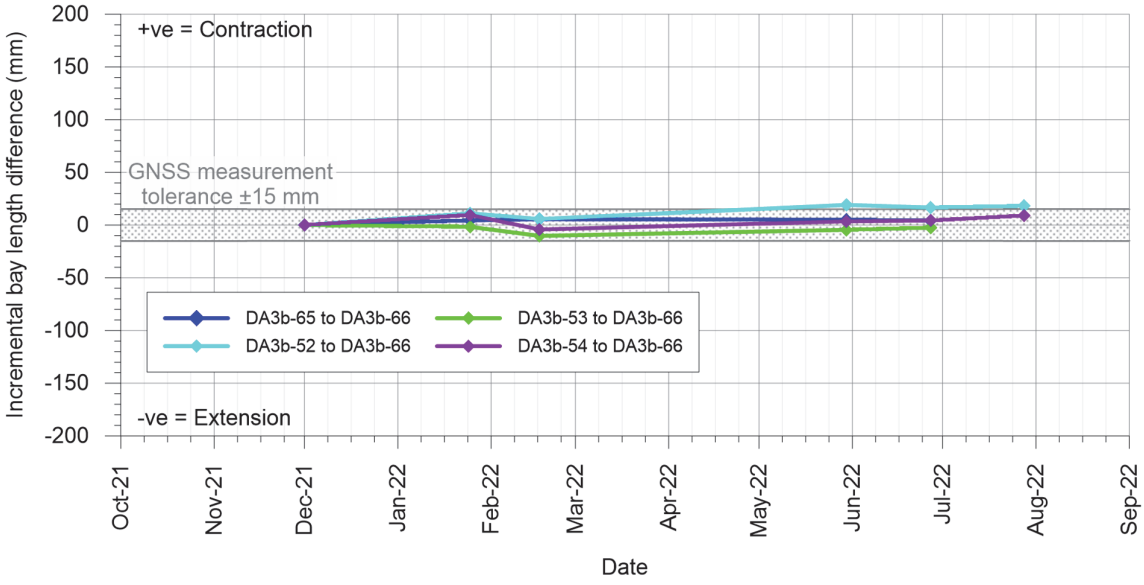


Fig. 2.10 Measured incremental changes in distance between the GNSS units due to LW18

There has been no measurable change in the distances between the GNSS units due to the mining of LW18.

Time Domain Reflectometry (TDR) monitoring was carried out in borehole S2478 near the waterfall (refer to Drawing No. MSEC1267-01). The latest TDR data was downloaded on 30 June 2022.

The results and interpretation of the TDR data are in the report by HGEO ("*Time Domain Reflectometry monitoring at S2478 (Waterfall 54) as of 30/6/2022*", Report Ref. D22186, dated 25 July 2022) which states that there was:

> "*… a very subtle reflectance anomaly at channel 510, equating to a depth of 64.34 m and approximately 2.4 m above the base of the Newport Formation. The anomaly is first apparent after 18/8/2021 when Longwall 17 was 665 m west of Waterfall 54 and 470 m west of S2478. The anomaly reaches a maximum at ~1/10/2021 and remains unchanged thereafter*";

"*Intermittent fluctuations in reflectance are apparent from early to mid-2022" and "The fluctuations affect the entire cable length and appear to correlate with heavy rainfall events in 2022. These effects do not represent movement of geological strata*"; and

"*No further anomalies are apparent during or following Longwall 18 extraction*".

The TDR data indicate a localised movement occurred below the Hawkesbury Sandstone (i.e. below the overhang of the waterfall) during the mining of LW17. This localised movement is consistent with the period when closure was developing during the latter stages of LW17. There were no localised movements identified in the TDR data during the mining of LW18.

2.10. ALS / LiDAR surveys

The changes in surface level due to the mining in Area 3B have been measured using Airborne Laser Scan (ALS) / Light Detection and Ranging (LiDAR) surveys.

The original survey carried out in January 2013 (i.e. prior to the extraction of LW9) does not cover the full extent of LW18. Hence, the survey carried out in January 2016 (i.e. prior to the mining of LW12) has been adopted as the base survey. The post-mining surface level contours have been determined from the subsequent surveys carried out in March 2017 after LW12, May 2018 after LW13, March 2019 after LW14, February 2020 after LW15, November 2020 after LW16, November 2021 after LW17 and June 2022 after LW18.

The measured incremental changes in surface level due to the mining of LW18 only are shown in Fig. 2.11. These contours have been determined by taking the differences between the surface levels measured before and after the extraction of this longwall. The data located outside the predicted limit of vertical subsidence (i.e. incremental 20 mm subsidence contour) have been removed for clarity.

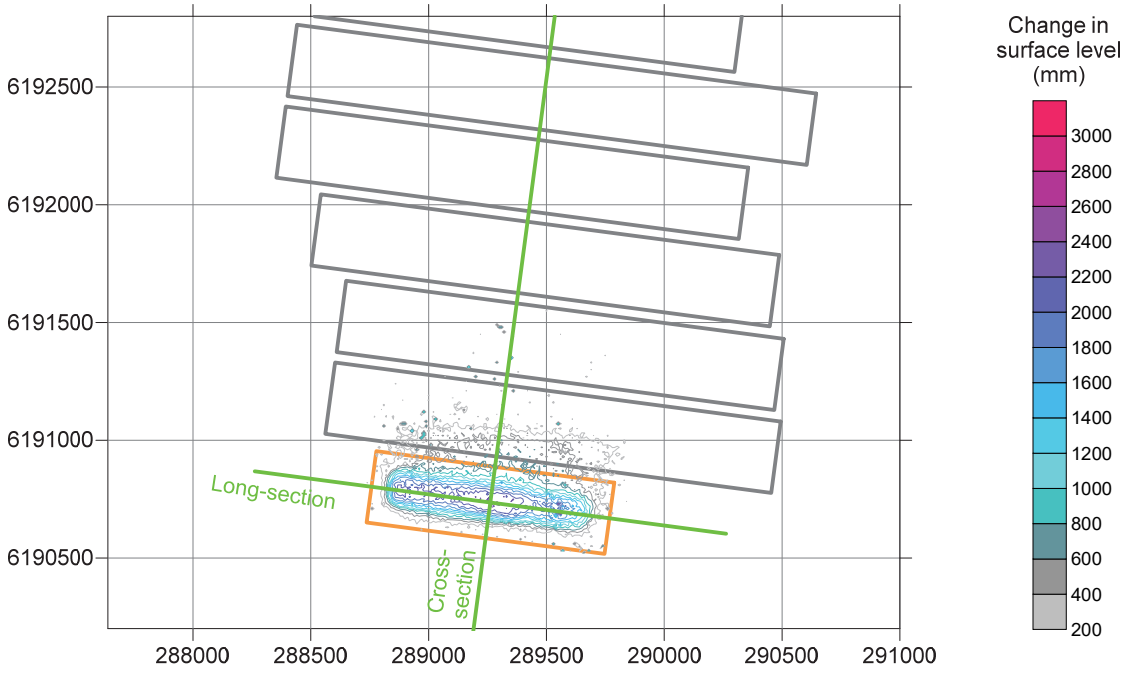


Fig. 2.11 Measured incremental changes in surface level due to the mining LW18

The measured total changes in surface level due to the mining of LW12 to LW18 are shown in Fig. 2.12. These contours have been determined by taking the differences between the surface levels measured after the completion of LW11 and after the completion of LW18. The data located outside the predicted limit of vertical subsidence (i.e. total 20 mm subsidence contour) have been removed for clarity. The extent of the latest ALS survey covers the area above LW13 to LW18 and, therefore, the contours are not shown above the earlier longwalls.

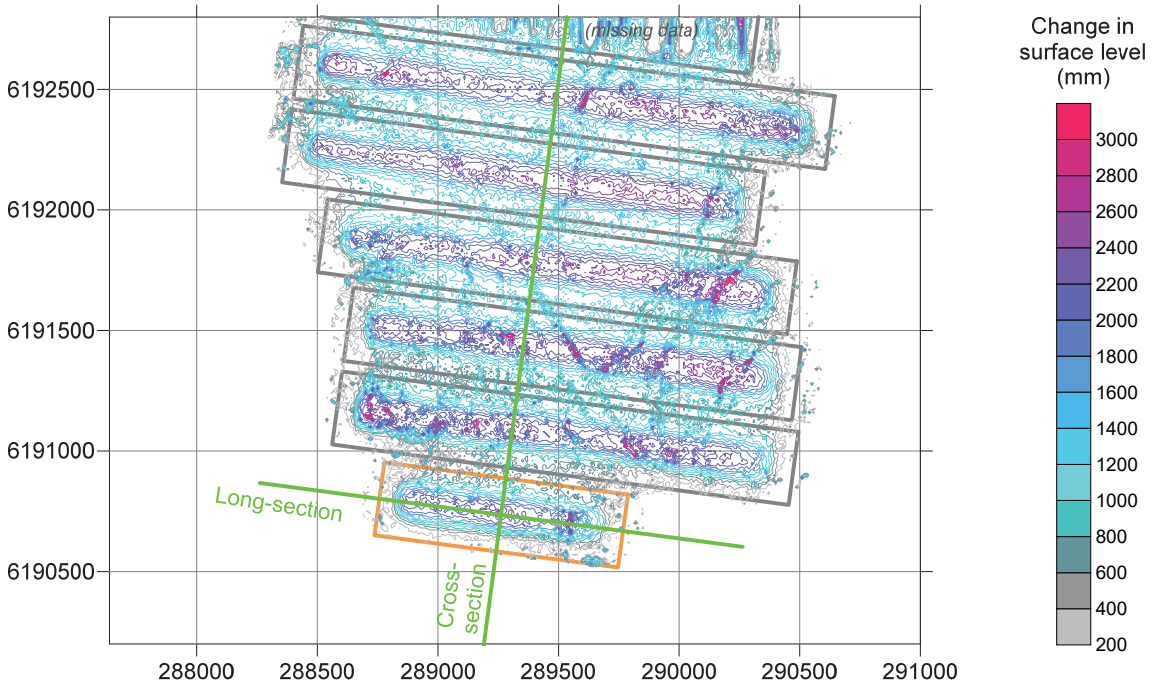


Fig. 2.12 Measured total changes in surface level due to the mining of LW12 to LW18

The LiDAR surveys have an accuracy for absolute level in the order of ±100 mm. The accuracy of the measured changes in surface level (i.e. the difference between two surveys), therefore, is in the order of ±200 mm.

The contours of the measured changes in surface level, developed from the LiDAR surveys, show the changes in the heights of points at fixed positions in space (i.e. eastings and northings). This differs from traditional subsidence contours that include both the vertical and horizontal components of the movements of points fixed to the surface. Horizontal movements are usually included in the subsidence profiles, as traditional ground monitoring data is based on the movements of survey marks that are fixed to the ground.

The contours can contain artefacts (i.e. locally increased or decreased movements), particularly in the locations of steeply incised terrain, such as at the cliffs and steep slopes. These artefacts can be seen in Fig. 2.11 and Fig. 2.12 as the localised areas of dark purple to red contours above the longwalls and the lower level subsidence outside the extents of the longwalls.

The change in surface level at a fixed position in space (i.e. easting and northing), therefore, can be large in the locations of cliffs and steep slopes and does not provide a true indication of the actual vertical subsidence at a point on the ground. However, where the ground is reasonably flat, the contours of the measured changes in surface level should provide a good indication of the actual vertical subsidence.

The comparisons of the measured changes in surface level and the predicted vertical subsidence along the cross-section and long-section are provided in Fig. 2.13 and Fig. 2.14. The locations of these sections are indicated in Fig. 2.11 and Fig. 2.12. The extent of the latest ALS survey covers the area above LW13 to LW18 and, therefore, the profiles are not shown above the earlier longwalls. The predicted profiles of vertical subsidence have been derived from the predicted subsidence contours illustrated in Report No. MSEC865.

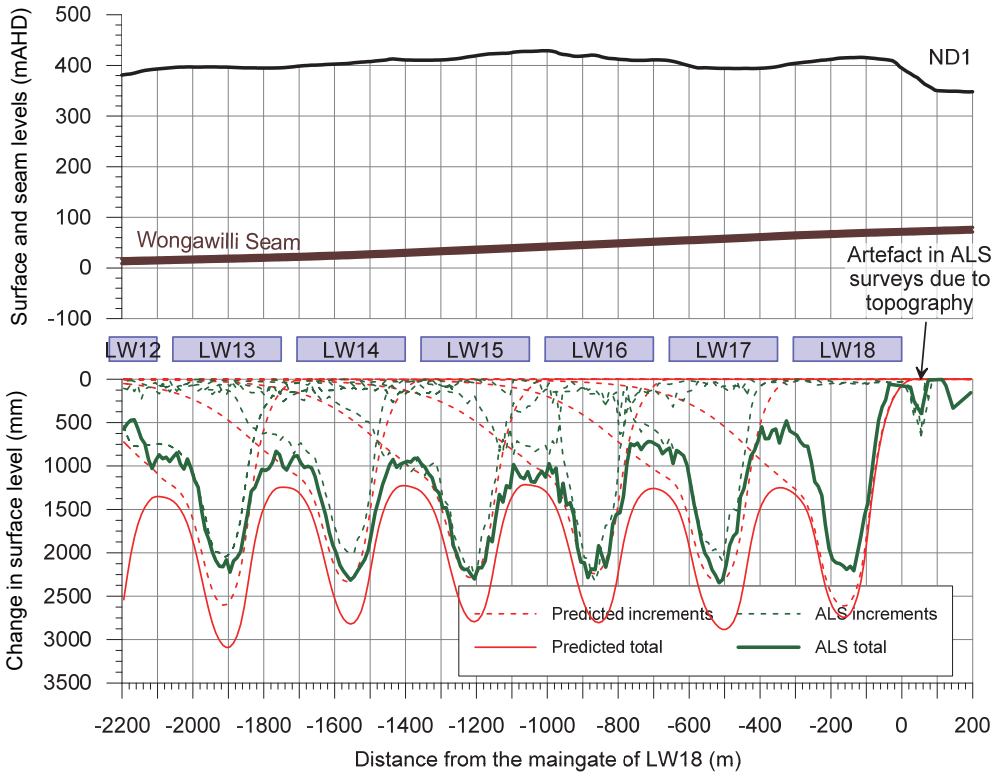


Fig. 2.13 Measured changes in surface level and predicted vertical subsidence along the cross-section

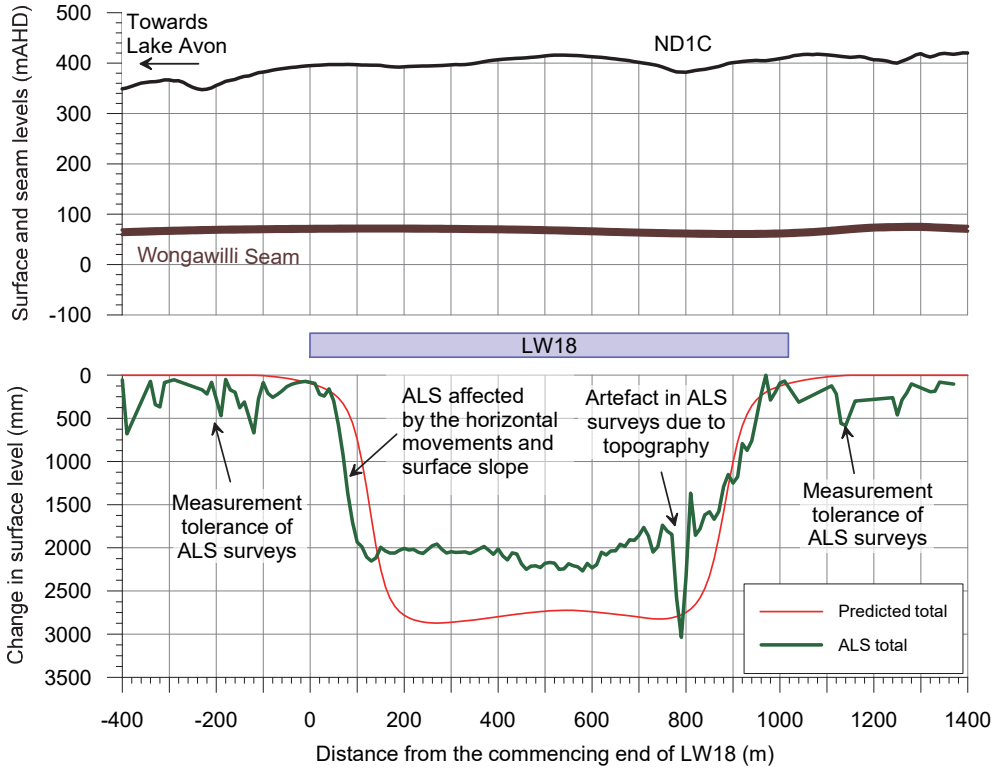


Fig. 2.14 Measured changes in surface level and predicted vertical subsidence along the long-section

The profiles of the measured changes in surface level reasonably match the predicted profiles of vertical subsidence along the cross-section and long-section. The maximum measured changes in surface level above each of the longwalls less than the maximum predicted values. Also, the measured changes in surface level above each of the chain pillars are similar to or less than the predicted values in these locations.

The measured change in surface level along the long-section 1 (refer to Fig. 2.14) is greater than the predicted vertical subsidence above the commencing end of LW18 (i.e. left-hand side of the figure). However, this is partly due to the surveying tolerance and the effects of the horizontal movements and sloping terrain on the LiDAR surveys. The ground directly above the commencing end of LW18 has moved towards the longwall (i.e. following the extraction face). The natural surface dips towards the west in this location (i.e. towards Lake Avon). The mining-induced horizontal movement, therefore, results in the apparent measured change in level at a fixed position being greater than the true vertical subsidence above the commencing end of LW18.

The measured change in surface level along the long-section (refer to Fig. 2.14) is also greater than the predicted vertical subsidence towards the eastern end of LW18 (i.e. right-hand side of the figure). There are areas with localised increased measured movements and other areas with localised reduced measured movements which appear to be affected by the surface topography at drainage line ND1C. Elsewhere, the difference between the measured and predicted movements are typically in the order of accuracy of the measurement method.

There are localised areas outside of the longwalls where the measured changes in surface level exceed the predicted vertical subsidence. However, these are artefacts of the LiDAR surveys and are not real movements. Elsewhere, the low-level movements are in the order of accuracy of the measurement method.

It can be inferred from the slopes of the profiles, that the measured changes in grade are similar to the predicted tilts along the cross-section and long-section. It is not possible to derive the curvature nor the horizontal movements from the LiDAR surveys.

It is considered that the ground movements measured using the LiDAR surveys are consistent with the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

3.1. Surface deformations

The surface deformations due to the mining of LW18 have been identified by the IMC Environmental Field Team and are described in the accompanying IMC landscape report. The locations of the surface deformations identified during the mining of LW18 are illustrated in Fig. 3.1.

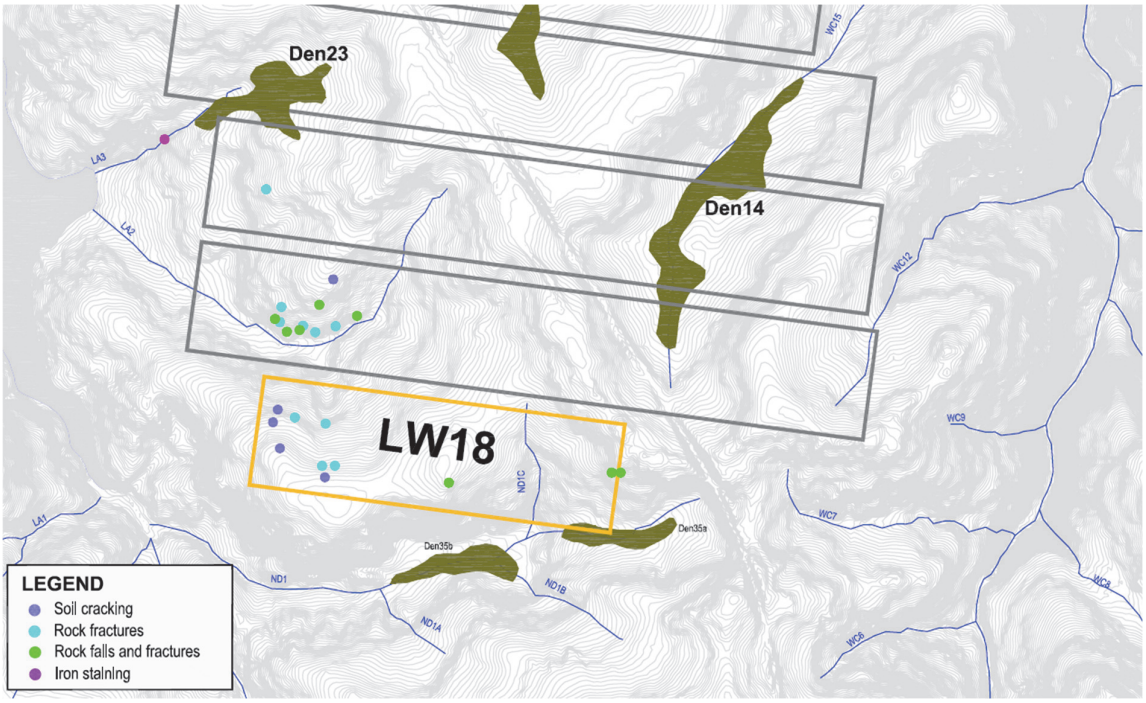


Fig. 3.1 Surface deformations due to the mining of LW18

Soil cracking (i.e. blue circles) was identified in four locations above LW18 and one location above LW17. Rock fracturing (i.e. cyan circles) was also identified in 13 locations and rockfalls (i.e. green circles) in eight locations at the rock outcrops and minor cliffs on the sides of the ridgelines located above the mining area.

The soil crack and rock fracture widths were typically less than 100 mm in 12 locations (i.e. 67 % of cases), ranged between 100 mm and 200 mm in four locations (i.e. 22 % of cases) and greater than 200 mm in two locations (i.e. 11 % of cases). The maximum crack width was 280 mm.

Rockfalls (i.e. green circles) were identified in eight locations above LW17 and LW18 at the rock outcrops and minor cliffs on the sides of the ridgelines. The largest rockfall occurred on the northern valley side of LA2 above LW17 and it had an estimated volume of approximately 26 m^3 (7.3 m x 3.9 m x 0.9 m).

There was no fracturing or diversion of surface water flows identified along the streams. However, iron staining was identified in one location along LA3 to the west of LW16.

A rockfall was identified at Waterfall 54 along Wongawilli Creek after the completion of LW18. A review of historical photographs found that the rockfall occurred between 6 and 28 October 2021 during the mining of LW17. The impact therefore is not associated with the current LW18. The rockfall was not identified earlier as it occurred behind a densely vegetated area. The site visits were also restricted due to safety with observations being conducted at a distance away from the overhang.

Further details of these surface deformations are provided in the accompanying IMC landscape report.

3.2. Natural features

The natural features near LW18 are shown in Drawing No. MSEC1267-02, in Appendix A, and include:

- Wongawilli Creek;
- tributaries;
- cliffs;
- rock outcrops;
- steep slopes;
- swamps; and
- Aboriginal heritage sites.

The MSEC assessed impacts for the natural features due to the mining of LW9 to LW18 are provided in Report No. MSEC459 which supported the original SMP Application. These assessments have been reviewed and updated based on the re-calibrated subsidence model and are provided in Report No. MSEC1103 which supported the SMP Application for LW18. More detailed assessments for the natural features are also provided in other consultants' reports supporting the SMP Application.

Comparisons between the MSEC assessments and the reported impacts for the natural features listed above due to the mining of LW18 are provided in Table 3.1. The reported impacts are based on those recorded by IMC Environmental Field Team, that are described in the accompanying landscape report.

Table 3.1 Assessed and reported impacts for the natural features due to LW18

Natural feature	MSEC assessed impacts	Reported impacts
Wongawilli Creek	Very localised additional **ponding** or **flooding** developing in the locations of existing pools, steps or cascades due to vertical subsidence or tilt.	No reported impacts due to the mining-induced vertical subsidence or tilt.
	Minor **fracturing** of the bedrock within 400 m of the longwalls due to strain.	No new fracturing or iron stating identified along the creek due to the mining of LW18. A rockfall was identified but a review of historical photographs found that it occurred during LW17 and therefore it is not associated with the current longwall.
	Low-likelihood that **surface water flow diversions** would occur due to fracturing of the bedrock.	No new surface water flow diversions (i.e. Type 3 impacts) identified along the creek due to the mining of LW18. One Type 3 impact was previously observed between LW6 and LW9, where fracturing was first observed during the mining of LW9.
Drainage lines (tributaries)	Localised additional **ponding**, **flooding** or **scouring** along sections of the drainage lines located directly above the longwall.	No reported impacts.
	Buckling and **fracturing** of the bedrock along the drainage lines above or within 400 m of the longwalls.	No new fracturing identified along the drainage lines due to the mining of LW18. Fracturing and cracking occurred along the steep slopes on the sides of the ridgelines.
	Surface water flow diversions into the dilated strata beneath the drainage lines which are directly mined beneath.	No new surface water diversions identified along the drainage lines due to the mining of LW18.
	Water quality – refer to the accompanying water quality report.	
	Terrestrial ecology – refer to the accompanying terrestrial ecology report.	
	Aquatic ecology – refer to the accompanying aquatic ecology report.	

Natural feature	MSEC assessed impacts	Reported impacts
Cliffs	Fracturing resulting in isolated **rockfalls** for the cliffs that are located within and just outside the mining area. Large-scale cliff instabilities are not expected.	No reported impacts to cliffs within the valley of Wongawilli Creek.
Rock outcrops	Fracturing of bedrock which could result in **rockfalls** along the exposed rockfaces. Fracture widths up to approximately 300 mm previously observed at the Mine.	Fracturing causing localised rock falls identified in eight locations at the rock outcrops and minor cliffs on the sides of the ridgelines above LW17 and LW18. Refer to the IMC landscape report for further details.
Steep slopes	**Soil slippage** resulting in tension cracks and compression ridges. Soil cracks between approximately 100 mm and 400 mm previously observed at the Mine.	Soil cracking and rock fracturing observed in 18 locations above LW17 and LW18. Crack widths were typically up to 200 mm; however, in one case the crack width was 280 mm. Refer to the IMC landscape report for further details.
Swamps	**Fracturing** of the underlying strata which could result in the **diversion of surface water**.	No reported physical impacts or triggers. Refer to the IMC landscape report for further details.
Aboriginal heritage sites	Impacts on overhang sites including fracturing of sandstone, rock falls, or water seepage through joints which may affect artwork.	No reported physical impacts. Refer to the accompanying cultural heritage report.

It is considered that the observed impacts on the natural features due to the mining of LW18 are consistent with the MSEC assessments provided in Report No. MSEC1103 which supported the SMP Application for LW18. Further assessments of natural features have been provided by other specialist consultants on the project, which are described in the relevant reports accompanying the *End of Panel* report.

3.3. Built features

The built features near LW18 are shown in Drawing No. MSEC1267-03, in Appendix A, and include:

- Fire trails and four-wheel drive tracks;
- Disused Maldon Dombarton Railway Corridor;
- Avon Dam; and
- Survey control marks.

Cordeaux Dam Wall is located more than 5 km north of LW18, at its closest point. The Upper Cordeaux No. 2 Dam Wall is located more than 6 km south-east of LW18, at its closest point. It is unlikely that these dam walls would experience measurable far-field horizontal movements due to the mining of LW18 and, therefore, they have not been assessed further.

The MSEC assessed impacts for the built features due to the mining of Dendrobium LW9 to LW18 are provided in Report No. MSEC459 which supported the original SMP Application. These assessments were reviewed and updated based on the re-calibrated subsidence model and are provided in Report No. MSEC1103 which supported the SMP Application for LW18.

Comparisons between the MSEC assessments and the reported impacts for the built features due to the mining of LW18 are provided in Table 3.2. The reported impacts are based on those recorded by IMC Environmental Field Team, that are described in the accompanying landscape report.

Table 3.2 Assessed and reported impacts for the built features due to LW18

Built feature	MSEC assessed impacts	Reported impacts
Fire trails and four-wheel drive tracks	Cracking of unsealed road surfaces.	No cracking observed along the fire trails and four-wheel drive tracks due to the mining of LW18. However, cracking observed in bushland near the trails and tracks, with widths typically ranging between 10 mm and 200 mm. Refer to the IMC landscape report for further details.
Disused Maldon-Dombarton Railway	Possible fracturing of rock cuttings, spalling, and/or mobilisation of rock joints.	No reported impacts to the railway corridor due to the mining of LW18.
Avon Dam	Adverse impacts not anticipated.	No reported impacts on the dam walls. Refer to associated groundwater report for further details on impacts to the stored water.
Survey control marks	Vertical and horizontal movements which could require re-establishment.	No reported damage to the survey control marks. The marks to be re-established after completion of mining, as required.

It is considered that the observed impacts on the built features due to the mining of LW18 are similar to or less than the MSEC assessments provided in Report No. MSEC1103 which supported the SMP Application for LW18.

4.0 SUMMARY

The mine subsidence effects due to the mining of LW18 were measured using the Wongawilli Creek closure lines, Avon Dam closure lines, Area 3B and Avon Dam 3D monitoring points, tributary cross lines, swamp cross lines, Waterfall 54 monitoring lines and airborne laser scans of the area.

The measured ground movements after the mining of LW18 are generally similar to or less than the predicted values based on the re-calibrated subsidence model outlined in Report No. MSEC1103 which supported the SMP Application for LW18. The measured closure at the Wong X C-Line is slightly greater than the predicted value; however, the exceedance is in the order of survey tolerance. The changes in surface level measured using the LiDAR surveys locally exceeded the predicted values in some locations; however, this was largely due to the measurement tolerance and the influence of the surface topography on the surveys.

It is considered, therefore, that the ground movements measured due to the mining of LW18 are consistent with the predictions provided in Report No. MSEC1103 which supported the SMP Application for LW18.

Soil cracking and rock fracturing were observed directly above LW17 and LW18. The crack and fracture widths were typically up to 200 mm; however, in one case the crack width was 280 mm. It was assessed that soil and fracture widths between approximately 100 mm and 400 mm could occur directly above the extracted longwalls and that more isolated surface impacts could occur outside of the longwalls.

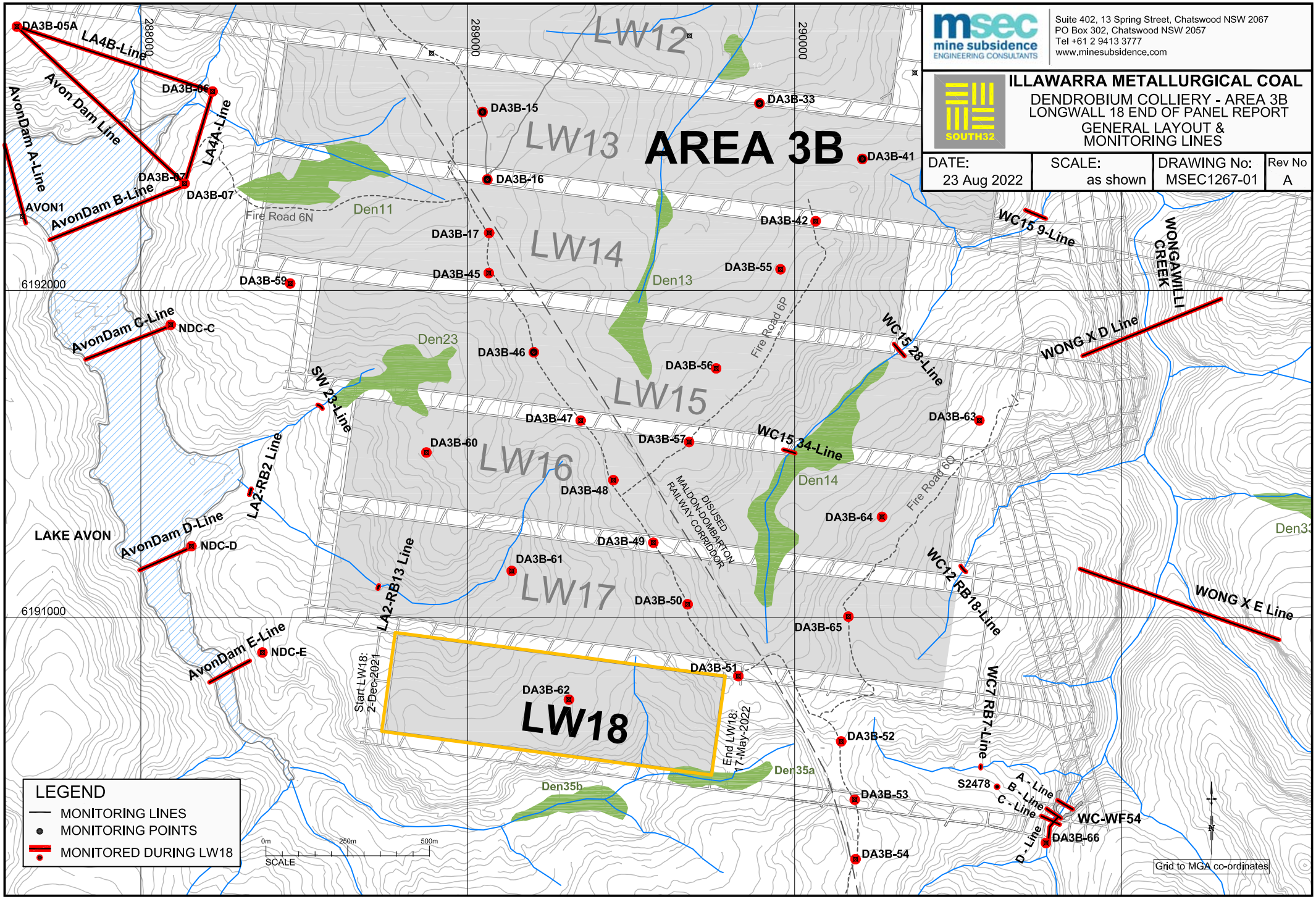
There were no new surface water diversions (i.e. Type 3 impact) observed along the streams during the mining of LW18. However, iron staining was identified in one location along LA3 to the west of LW16.

A rockfall was identified at Waterfall 54 along Wongawilli Creek after the completion of LW18; however, a review of historical photographs found that the rockfall occurred between 6 and 28 October 2021 during the mining of LW17. The impact therefore is not associated with the current LW18.

It is considered, therefore, that the observed surface impacts on the natural and built features, due to the mining of LW18, are consistent with the MSEC assessments provided in Report No. MSEC1103 which supported the SMP Application for LW18. Further assessments for the natural features have been provided by the specialist consultants on the project and the findings in this report should be read in conjunction with the findings provided in the accompanying specialist reports.

APPENDIX A. DRAWINGS

I:\Projects\Dendrobium\Area 3\MSEC1267 - Area 3B - Longwall 18 End of Panel Report\AcadData\MSEC1267-01 General Layout.dwg



msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SOUTH32

ILLAWARRA METALLURGICAL COAL

DENDROBIUM COLLIERY - AREA 3B
LONGWALL 18 END OF PANEL REPORT
GENERAL LAYOUT & MONITORING LINES

DATE:	SCALE:	DRAWING No:	Rev No
23 Aug 2022	as shown	MSEC1267-01	A

I:\Projects\Dendrobium\Area 3\MSEC1267 - Area 3B - Longwall 18 End of Panel Report\AcadData\MSEC1267-02 Natural Features.dwg

msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SOUTH32

ILLAWARRA METALLURGICAL COAL

DENDROBIUM MINE - AREA 3B
LONGWALL 18 END OF PANEL REPORT
NATURAL FEATURES

DATE:	SCALE:	DRAWING No:	Rev No
23 Aug 2022	as shown	MSEC1267-02	A

AREA 3B

LW12 LW13 LW14 LW15 LW16 LW17 **LW18**

LAKE AVON

Fire Road 6N

Fire Road 6P

Fire Road 6Q

DISUSED MALDON-DOMBARTON RAILWAY CORRIDOR

WONGAWILLI CREEK

Start LW18: 2-Dec-2021

End LW18: 17-May-2022

Den11 Den13 Den14 Den23 Den33 Den35a Den35b

LA1 LA1A LA2 LA3 LA4A LA4A1 LA4B

ND1 ND1A ND1B ND1C ND2 ND2A

WC21A WC21 WC15A WC13 WC12 WC11 WC9 WC10 WC7 WC8 WC6 WC-WF54

LEGEND

- WATERCOURSE
- SWAMPS

STREAM FEATURES
- POOLS
- ROCKBARS
- RIFFLES
- BOULDERFIELD
- CHANNEL
- ISLAND
- ROCKSHELF

SURFACE LEVEL CONTOURS

Grid to MGA co-ordinates

0m 250m 500m
SCALE

I:\Projects\Dendrobium\Area 3\MSEC1267 - Area 3B - Longwall 18 End of Panel Report\AcadData\MSEC1267-03 Built Features.dwg

msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SOUTH32

ILLAWARRA METALLURGICAL COAL

DENDROBIUM MINE - AREA 3B
LONGWALL 18 END OF PANEL REPORT
BUILT FEATURES

DATE:	SCALE:	DRAWING No:	Rev No
23 Aug 2022	as shown	MSEC1267-03	A

AREA 3B

LW12 LW13 LW14 LW15 LW16 LW17 **LW18**

LAKE AVON

Fire Road 6N Fire Road 6P Fire Road 6Q

MALDON-DOMBARTON DISUSED RAILWAY CORRIDOR

WONGAWILLI CREEK

288000 289000 290000 291000

6192000 6191000

MDB-F4 MDB-F5 MDB-F6 MDB-F7 MDB-F8 MDB-F9 MDB-F10 MDB-F11 MDB-F12 MDB-F13

S2314 S2314A S2078 S2376 S2376A S2306 S1633 S2307 S1634 S1635 S1911 S1914 S0710 S0710 PM 6168 S1927 SS 40781 S1579 S2001a S2001 S1739 S2378 S1932 SS 40782 SS 40783 S2354 S1755 SS 40784 PM 6167 SS 40785 S0712 S0712 S1879

DM22 DM16 DM21

52-2-1773 52-2-1774 52-2-1771 52-2-1626 52-2-2229 52-2-1646 52-2-1623 52-2-2246 52-2-3088 52-2-2248 52-2-1772

Start LW18: 2-Dec-2021

End LW18: 17-May-2022

LEGEND

- FIRE ROADS
- DISUSED RAILWAY CORRIDOR
- CUTTINGS
- EMBANKMENT
- DRILLHOLES
- SURVEY MARKS
- ABORIGINAL HERITAGE SITES

0m 250m 500m
SCALE

Grid to MGA co-ordinates

I:\Projects\Dendrobium\Area 3\MSEC1267 - Area 3B - Longwall 18 End of Panel Report\AcadData\MSEC1267-04 Observed Hzl Vectors.dwg

msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SOUTH32

ILLAWARRA METALLURGICAL COAL
DENDROBIUM MINE - AREA 3B
LONGWALL 18 END OF PANEL REPORT
MEASURED INCREMENTAL HORIZONTAL MOVEMENT VECTORS DUE TO LW18

DATE:	SCALE:	DRAWING No:	Rev No
23 Aug 2022	as shown	MSEC1267-04	A

AREA 3B

LW12
LW13
LW14
LW15
LW16
LW17
LW18

LW18 Started 2-Dec-2021
LW18 Complete 17-May-2022

LAKE AVON

DA3B-05A 2
DA3B-06 6
DA3B-07 13
AVON1 9
DA3B-17
DA3B-42 21
DA3B-45 19
DA3B-55 19
DA3B-59 15
NDC-C 10
DA3B-46
DA3B-56 33
DA3B-47 35
DA3B-63 14
DA3B-60 29
DA3B-57 40
DA3B-48 50
DA3B-64 23
NDC-D 13
DA3B-49 88
DA3B-61 84
DA3B-50 119
DA3B-65 20
NDC-E 20
DA3B-62 316
DA3B-51 93
DA3B-52 18
DA3B-53 13
DA3B-54 10
WC-WF54
DA3B-66 14

Fire Road 6AA
Fire Road 6N
Fire Road 6P
Fire Road 6A
Fire Road 6Q
Disused Maldon-Dombarton Rail Corridor
Wongawilli Creek

VECTOR & MAGNITUDE OF MEASURED HORIZONTAL MOVEMENT (mm)

0m 250m 500m
SCALE