TAHMOOR COLLIERY
LONGWALL 24B

END OF PANEL

SUBSIDENCE MONITORING REPORT

FOR LONGWALL 24B

AT TAHMOOR COLLIERY

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- Mine Subsidence Board
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- Sydney Water
- Tahmoor Colliery

References

Mine Subsidence Engineering Consultants, (2004). *Tahmoor Colliery Longwalls 24 to 26 Report on the Prediction of Subsidence Parameters and the Assessment of Subsidence Impacts on Surface and sub-Surface Features due to Mining Longwalls 24 to 26 at Tahmoor Colliery in support of an SMP Application. Volume 1.* Report No. MSEC157, Revision C, March 2006.

Geoterra, (2007). *Xstrata Coal – Tahmoor Colliery End of Longwall 24B Surface Water, Dams & Groundwater Monitoring Report, Tahmoor NSW*. GeoTerra Report No. TA5-R2A, January 2008.

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CHAPTER 1. INTRODUCTION

This report has been prepared by Mine Subsidence Engineering Consultants Pty Ltd (MSEC) for Xstrata Coal Tahmoor Colliery to comply with conditions of the SMP Approval by the Department of Primary Industries, particularly portions of Clause 13.

This report compares the observed and predicted subsidence, tilt and strain profiles along all available monitoring lines, and the observed and predicted impacts on surface features, following the completion of Longwall 24B. The location of Longwall 24B is shown in Drawing No. MSEC272-01, which together with all other drawings, is attached in Appendix A at the back of this report.

This report also includes many of the movements and impacts observed during the extraction of Longwalls 22 to 24B. The dates of extraction for all longwalls are provided in Table 1.1.

Table 1.1 Start and Finish Dates for Longwalls 22 to 24B

Longwall	Start Date	Completion Date
Longwall 22	31 May 2004	27 July 2005
Longwall 23A	13 September 2005	21 February 06
Longwall 23B	22 March 2006	26 August 2006
Longwall 24B	14 October 2006	02 October 2007
Longwall 24A	15 November 2007	Current longwall

The predicted movements and impacts resulting from the extraction of Longwalls 24 to 26 were provided in Report No. MSEC157 (Revision C), which was issued in March 2006.

Longwall 24B was approximately 2260 metres long and 283 metres wide, rib to rib. The pillar width was approximately 34.5 metres wide, rib to rib. The depth of cover was relatively consistent over the panel, varying between 430 and 440 metres. While the seam thickness varied between 1.75 metres at the finishing end and 2.05 metres at the commencing end, Tahmoor Colliery advised that the design cut for Longwall 24B was 2.15 metres and the shearer would never cut below 2.05 metres.

Chapter 2 of this report describes the monitoring lines and monitoring points at Tahmoor Colliery, and provides comparisons between the observed and predicted movements resulting from the extraction of Longwall 24B.

Chapter 3 of this report summarises the surveys and inspections undertaken during the mining of Longwall 24B.

Chapter 4 of this report describes the reported impacts on surface features resulting from the extraction of Longwall 24B, and compares these with the predicted impacts. The reported impacts on surface water and ecology are provided in other reports.

Appendix A includes all drawings and figures associated with this report.

CHAPTER 2. COMPARISON BETWEEN OBSERVED AND PREDICTED SUBSIDENCE MOVEMENTS

As set out in the Surface Safety and Serviceability Management Plan, for Tahmoor Colliery Longwalls 24 to 26, regular subsidence surveys have been conducted along monitoring lines that have been established in selected streets. The monitoring is being undertaken to compare observed movements against predicted movements, and to identify any anomalous movements that might potentially have an adverse effect on surface features. The locations of all of the monitoring lines near Longwall 24B are shown in Drawing No. MSEC272-01.

In addition to the monitoring lines, subsidence monitoring was conducted at survey stations located at and around the Tahmoor Town Centre, road bridges and culverts, and selected power poles in accordance with the Surface Safety and Serviceability Management Plan. Surveys were also undertaken at houses that form part of a research project that was developed between the Department of Primary Industries and Tahmoor Colliery during the mining of Longwalls 22 and 23.

Surveys were undertaken at regular intervals during the extraction of Longwall 24B and the End of Panel surveys were conducted during October to December 2007. The observed total and incremental subsidence profiles along the monitoring lines are provided in Figs. MSEC272-01 to MSEC272-30.

2.1. Comparison between Predicted and Observed Systematic Subsidence Movements

2.1.1. Subsidence

Review of the magnitude of the observed subsidence

A comparison of maximum observed and predicted subsidence due to and after the mining of Longwall 24B is provided in Table 2.1.

Table 2.1 Summary of Maximum Predicted and Observed Subsidence

	Predicted (SMP Report MSEC157)	Nearest Street Location	Observed	Monitoring Line
Maximum Incremental Subsidence due to LW 24B (mm)	605	Patterson Street	629	Huen Place extension north of Myrtle Creek
Maximum Total Subsidence after LW 24B (mm)	866	Thirlmere Way	819	A house on Thirlmere Way (not identified for privacy reasons)

It can be seen from Table 2.1 that observed maximum incremental subsidence was slightly greater than predicted maximum subsidence. The difference is 24 mm, which is very small and represents an under-prediction of approximately 4 %. As noted in the SMP Report No. MSEC157, empirical methods of subsidence prediction are generally accepted as providing predictions of maximum subsidence to an accuracy of ± 10% to ± 15% (please refer to Section 3.25 of Report No. MSEC157). It can also be seen from Table 2.1 that observed maximum total subsidence is less than predicted maximum subsidence. The difference is approximately 47 mm, which is very small and represents an over-prediction of approximately 5 %.

One reason for this slight under-prediction follows from using a seam thickness range of 1.75 to 2.05 metres for the prediction calculations for Longwall 24B, as per the seam thickness drawing in the SMP Report (Drawing No. MSEC157-08), whilst Tahmoor Colliery has since advised that the shearer never cuts below 2.05 metres and the design cut height is 2.15 metres. This represents a 17 to 23% increase in cutting height at the north-eastern end of Longwall 24B and this would have resulted in an increase in predicted subsidence and over-predictions rather than under-predictions.

While the predictions of maximum subsidence are within the stated accuracy of the Incremental Profile Method, it is recognised that subsidence is not measured across the whole subsided area. It is therefore

likely that there are areas that have experienced subsidence that is slightly greater than the maximum measured. However, given the density of the monitoring grid, it is likely that any difference from the maxima reported in this report will be small.

The following detailed comparisons between the observed and predicted subsidence are presented without adjusting for this increase in extracted seam thickness. A summary of maximum observed and predicted subsidence along each monitoring line is provided in Table 2.2.

Table 2.2 Summary of Maximum Subsidence along Monitoring Lines

MONITORING LINE	MAXIMUM INCREMENTAL SUBSIDENCE DUE TO EACH LONGWALL				MAXIMUM TOTAL SUBSIDENCE AFTER EACH LONGWALL			
	OBSERVED			PREDICTED	OBSERVED			PREDICTED
	LW22 (mm)	LW23A & LW23B (mm)	LW24B (@ 1100m) (mm)	LW24B (mm)	LW22 (mm)	LW23A & LW23B (mm)	LW24B (@ 1100m) (mm)	LW24B (mm)
Main Southern Railway	12	45	88	60	12	52	89	75
Thirlmere Way	471	534	357	355	471	593	775	865
Chapman Street	-	-	560	550	-	-	560	-
Castlereagh Street	136	577	521	470	136	570	645	490
Park Street	46	56	569	510	46	103	603	520
Fraser Street	452	548	384	350	452	728	759	850
Milne Street	496	331	109	95	496	723	771	795
Elphin Street	-	42	575	495	-	42	603	500
Elphin-Myrtle Creek	-	-	144	125	-	-	144	-
Pimelia Street	-	28	483	465	-	28	536	470
Winpara Close	-	35	508	490	-	35	536	495
Huen Place	-	50	629	515	-	50	629	520
Macquarie Place	498	91	83	60	498	588	632	510
Turner-Denmead	493	307	63	50	493	740	798	745
Brundah Road	-	49	533	470	-	49	546	475
Marion Street	-	45	173	165	-	45	212	165
All Monitoring Lines	**498**	**577**	**629**	**550**	**498**	**740**	**775**	**865**

Testing of the Incremental Profile Method against Tahmoor Colliery surveys was undertaken prior to the SMP submission and the results were provided in the SMP Report No. MSEC157. Based on observations from previous Tahmoor panels including Longwalls 22 and 23A, predicted maximum incremental subsidence was set to approximately 90 % of the standard Incremental Profile Method. The results from Longwalls 22 and 23A were graphically presented in Fig. 3.10 of the SMP Report. This graph has been reproduced in Fig. 2.1, with the results for Longwalls 23B and 24B included.

It can be seen from Fig. 2.1 and Table 2.2 that observed maximum incremental subsidence is greater than predicted maximum incremental subsidence for all monitoring lines. Where subsidence is predicted at points beyond the goaf edge, which are likely to experience very low values of subsidence, the predictions should generally be accurate to within 50 mm of subsidence, which has been observed here. When compared to the experience from previous longwalls, observed subsidence has been comparatively greater, though the difference is still within ± 15% in the majority of cases. Considering that the extracted height was up to 23% greater than the seam thickness adopted for the predictions in the SMP Report, this comparison indicates that the predicted subsidence values are generally reasonable.

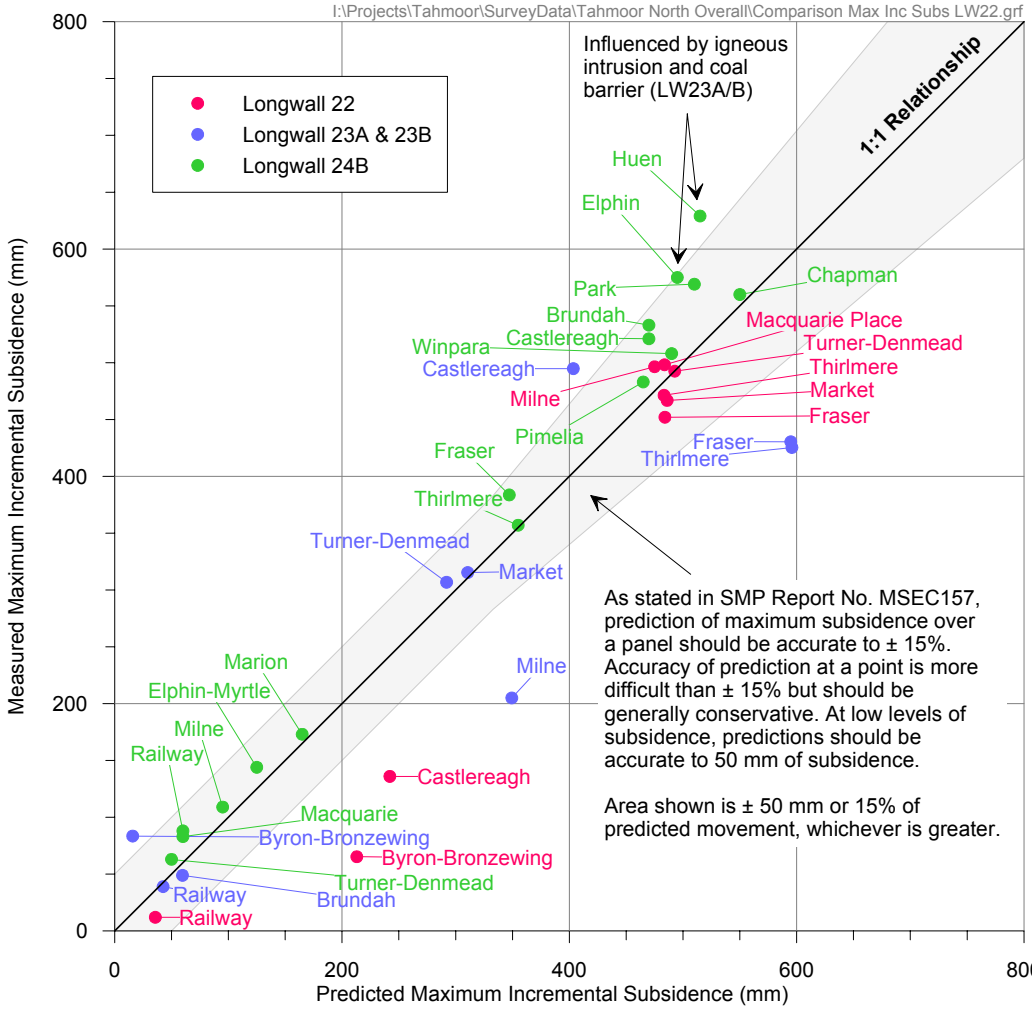


Fig. 2.1 Comparison between Measured and Predicted Maximum Incremental Subsidence above Longwalls 22 to 24B at Tahmoor Colliery

As shown in Fig. 2.1 and Figs. MSEC272-01 to MSEC272-30, a very good correlation between observed and predicted incremental subsidence was observed on many monitoring lines. These include Thirlmere Way, Chapman Street, Fraser Street, Pimelia Street, Winpara Close and Turner-Denmead and Marion Street. While the correlation between observed and predicted subsidence was exceptional for these monitoring lines, we would prefer, in principle, to provide predictions that are more conservative than observed subsidence.

The locations of greatest exceedence of subsidence predictions are in the vicinity of the coal barrier between Longwalls 23A and 23B, such as Macquarie Place, Huen Place, Milne Street, Fraser Street and a section along Thirlmere Way above Longwall 22. The results are most evident along the Elphin Street and the Huen Place extension line, which crossed Myrtle Creek. The amount of exceedence at the Huen Place extension was approximately 115 mm, which represents an under-prediction of approximately 22 %. The amount of exceedence along Elphin Street was approximately 80 mm, which represents an

under-prediction of approximately 16 %. The potential for less favourable correlation between observed and predicted subsidence was anticipated at the time of writing the SMP Report No. MSEC157 (please refer Section 3.27) as irregular, non-systematic subsidence movements were observed in the vicinity of the igneous intrusion during the mining of Longwalls 22 and 23A. There is also limited empirical information available on subsidence movements around coal barriers.

These exceedences would have been reduced if the minimum extraction heights of 2.05 metres or the design cutting height of 2.15 metres had been adopted for the SMP predictions. For example, observed maximum subsidence along Brundah Road exceeded predictions by approximately 13.4% and the seam thickness directly below this monitoring line was approximately 1.8 metres. If the actual extracted height was 2.05m, we would add 13.9% additional subsidence to the predictions. If the actual extracted height was the design cut of 2.15m, we would add 19.4% to the predictions.

However, even if some predictions were adjusted for increased extraction heights, observed incremental subsidence due to the mining of Longwall 24B would nevertheless have been greater than predicted subsidence in some areas, such as along Park Street. The amount of exceedence was almost uniform along the whole length of this monitoring line, as shown in Fig. MSEC272-09. Maximum observed subsidence was greater than predicted maximum subsidence by approximately 59 mm, which represents an under-prediction of approximately 12 %. The seam thickness directly beneath Park Street is approximately 2.0 metres. If the actual extracted height was 2.05m, we would add 2.5% additional subsidence to the predictions. If the actual extracted height was the design cut of 2.15m, we would add 7.5% to the predictions.

Review of Subsidence Profile Shapes

There was generally a reasonable correlation between the shapes of the predicted and observed subsidence profiles, as shown by Figs. MSEC272-01 to MSEC272-30. Some observed profiles compare vey well with predicted profiles, such as Thirlmere Way, Chapman Street, Park Street, Elphin Street, Elphin-Myrtle Creek, Pimelia Street and Winpara Close.

The correlation between observed and predicted profile shapes were less favourable for all sections of monitoring lines near the coal barrier between Longwalls 23A and 23B, which was anticipated for the reasons discussed already.

The correlation between observed and predicted profile shapes was also less favourable where the monitoring lines traverse the sides of the longwall panel where the subsidence profiles are steepest. This was observed, for example along Castlereagh Street above the commencing end of Longwall 23A and increased subsidence was again observed at this location during the mining of Longwall 24B.

Summary

Observed subsidence was comparatively greater than predictions in the SMP Report, unlike previous observations during the mining of Longwalls 22 and 23. The difference between observed and predicted subsidence was, however, generally within the stated accuracy of the prediction method. Observed and predicted subsidence was very close for many monitoring lines. However, we would prefer, in principle, to provide predictions that are more conservative. The extraction heights have been greater than adopted in the SMP Report and the predictions would have been increased in some cases. The greatest departures between observed and predicted subsidence were located in the vicinity of the igneous intrusion and coal barrier between Longwalls 23A and 23B, which was anticipated at the time of writing the SMP Report.

Finally, it was found that there was generally a reasonable correlation between observed and predicted systematic subsidence profiles. This means that there has been a good correlation between predicted and observed differential movements (particularly tilt and curvature). This is an important observation as subsidence impacts generally occur as a result of differential movements rather than absolute vertical subsidence. Further details in differential subsidence movements are provided in the following section.

2.1.2. Systematic Tilt, Curvature and Strain

Observed maximum tilts, curvature and strain have generally been less than predicted systematic tilts, curvature and strain throughout Longwall 24B. In a small number of isolated locations, observed tilt, curvature and strain have exceeded the systematic predictions but it is clear that non-systematic movement has occurred in each of these instances. Predictions and discussion on non-systematic movement were provided separately in the SMP Report and discussion on observed non-systematic movements are provided in the Section 2.2 of this report.

Maximum predicted incremental systematic tilt for Longwall 24B was predicted to be 4.7 mm/m. As shown in Figs. MSEC272-01 to MSEC272-30, observed tilt was less than predicted maximum tilt along all of the monitoring lines where systematic subsidence has occurred. Maximum observed incremental systematic tilt was approximately 4.3 mm/m, which occurred along Chapman Street. Maximum observed tilt exceeded the prediction maximum systematic tilt in one instance along the monitoring lines, and this occurred along Brundah Road (5.7 mm/m), where non-systematic movement had clearly occurred.

It is not surprising that observed tilts have been consistently less than the predicted maximum tilt as the monitoring lines are generally orientated at 45 degrees to the longwalls. The predicted maximum tilt is oriented transverse to the longwalls. The main exception is Chapman Street, which though orientated at an angle of 45 degrees to the longwalls, is located directly above the corner of Longwall 24B. It is therefore not surprising that maximum observed tilt was measured on this monitoring line.

A more accurate method of comparing observed and predicted tilts can be achieved by comparing observed and predicted tilt profiles, which are shown in Figs. MSEC272-01 to MSEC272-30. It can be seen from these results that there is a reasonable correlation between observed and predicted systematic tilt, especially when the increased extraction height is considered. At most locations, the difference between observed and predicted tilt is comfortably less than 1 mm/m.

Maximum predicted incremental systematic radii of curvature for Longwall 24B were predicted to be 0.1 km^{-1} sagging and 0.05 km^{-1} hogging. While not shown graphically in this report, observed curvature was equal to or less than predicted maximum curvature along all of the monitoring lines where systematic subsidence has occurred. Maximum observed incremental systematic curvature was approximately 0.08 km^{-1} sagging and 0.05 km^{-1} hogging, which occurred along Chapman Street. In all instances where maximum observed strain exceeded the predicted maxima, non-systematic movement had occurred. Maximum observed non-systematic incremental curvature of 0.18 km^{-1} sagging and 0.19 km^{-1} hogging occurred on Brundah Road.

Maximum predicted incremental systematic strain for Longwall 24B was predicted to be 0.8 mm/m tensile and 1.5 mm/m compressive. As shown in Figs. MSEC272-01 to MSEC272-30, observed strains were equal to or less than predicted maximum strains along all of the monitoring lines where systematic subsidence has occurred. Maximum observed incremental systematic tensile strain was approximately 0.8 mm/m on Brundah Road. Maximum observed incremental systematic compressive strain was approximately 1.1 mm/m on Park Street. In all instances where maximum observed strain exceeded the predicted maxima, non-systematic movement had occurred. Maximum observed non-systematic incremental compressive strain of 4.2 mm/m occurred on Brundah Road. Interestingly, a previously identified site of non-systematic movement on Milne Street experienced a relaxation of compressive strain of 0.9 mm/m during the mining of Longwall 24B. Further details on non-systematic movement are provided in Section 2.2.

2.1.3. Summary of Predictions of Systematic Subsidence

In summary, there is generally a good correlation between observed and predicted systematic subsidence, tilt, curvature and strain due to the mining of Longwall 24B. We recommend that predictions of systematic subsidence remain unchanged from those provided in the SMP Report No. MSEC157 for Longwalls 25 and 26 for the following reasons:

- Observed maximum incremental subsidence is within 4% of predicted maximum incremental subsidence, which is within the stated accuracy of ± 10% to ± 15%.
- Observed maximum total subsidence after Longwall 24B is less than predicted maximum total subsidence by approximately 5%.
- There is a reasonable correlation between observed and predicted shapes of subsidence and tilt profiles.
- Observed tilt, curvature and strain is less than predicted maxima where systematic subsidence has occurred.
- Subsidence due to Longwall 24B is significantly influenced by the presence of the large igneous intrusion and coal barrier located between Longwalls 23A and 23B, where most notable departures from predicted subsidence were observed.
- Actual extraction heights are slightly greater than assumed in the SMP Report, particularly at the finishing end of the longwalls.
- Other notable departures between observed and predicted tilt, curvature and strain occurred where non-systematic movements have occurred. While non-systematic movements were anticipated, predictions and discussion of these types of movements were treated separately in the SMP Report and do not form part of this review of predicted systematic subsidence.
- There is a reasonable correlation between observed and predicted impacts, which is discussed in CHAPTER 4.
- The methods adopted by Tahmoor Colliery to manage potential subsidence impacts would not change as a result of any slight adjustment to predicted subsidence.
- While slight adjustments could be made to subsidence predictions in the interests of providing more conservative predictions, such changes would potentially generate unnecessary and unwarranted confusion within the community. However, based on this experience we intend to adjust the prediction method for future SMP applications to be more conservative.

2.2. Identification of Non-Systematic Subsidence Movements

Irregular subsidence movements can be found in observed subsidence, tilt and strain profiles. The most common causes of irregular movements in subsidence profiles are listed below.

- Valley closure and upsidence,
- Geological structures,
- Change in direction of monitoring line,
- Bumped or damaged pegs,
- Survey line discontinuities, where survey lines are extended after the subsidence has already occurred,
- Survey inaccuracies, and
- Anomalous movements

Irregularities that have occurred as a result of the surveying process are not considered to be non-systematic subsidence movements.

Anomalous movements have been identified by a process of elimination. If a cause behind an irregularity in a subsidence, tilt or strain profile cannot be explained, the irregularity is described as an anomaly.

There are twelve new locations where it is considered that non-systematic movement has occurred in the period during the mining of Longwall 24B. Other non-systematic movements were identified during the extraction of Longwalls 22 to 23, however there has been little change to these movements during the mining of Longwall 24B.

A summary of new non-systematic movements for the monitoring lines within the active subsidence zone is provided below in Table 2.3.

Table 2.3 Location of New Identified Non-Systematic Movements during Longwall 24B

Monitoring Line or Location	Maximum Upsidence (mm)	Maximum Strain (mm/m)	Maximum Tilt (mm/m)	Type	Impacts to Surface
Brundah Road (Pegs BH19-21)	45	-4.2	2.3	Anomaly	Pavement and one house
Brundah Road (Pegs BH25-26)	40	-3.0	5.7	Anomaly	Pavement
Brundah Road (no survey line)	Not measured	Not measured	Not measured	Anomaly	Impact to pavement and one house beyond goaf edge
Elphin Street (Pegs E8-10)	25	-0.6	2.9	Anomaly	Possibly minor impacts to house
Elphin-Myrtle (Pegs EM3-6)	15	-1.5 (14 m bay) -4.6 (4 m bay)	0.9	Valley	None
Huen Place (Pegs H8-14)	20	-2.3 (18 m bay) -3.5 (9 m bay)	4.5	Valley	None
Glenanne Place	Not measured	Not measured	Not measured	Anomaly	Localised impacts to pavement, fence, water main and house
Mahonga Street	Not measured	Not measured	Not measured	Anomaly	Impacts at two houses at low levels of subsidence and early longwall progress.
Pimelia Street (Pegs PM2-4)	10	-1.7	1.0	Anomaly	Kerb and gutter
Reserve between Stuart and Huen Place	Not measured	Not measured	Not measured	Valley or Anomaly	Impacts to all houses backing onto Reserve
House at Turner Street	Nil on Turner-Denmead Line	-0.1 to +0.4	0.9	Anomaly	Impact to one house only well beyond goaf edge
Winpara Close (Pegs W2-5)	25	-1.9	2.6	Anomaly	Impacts to road surface and irregular impacts to kerb and gutter.

In this table, "upsidence" is defined as the height of the local subsidence bump at the anomaly, as calculated or determined from an otherwise smooth systematic subsidence profile. The maximum upsidence at these anomalies is 45 mm, which is small relative to the observed total subsidence of 819 mm.

Further details are provided below with regards to some of the newly identified locations of non-systematic movement.

- Anomalous movements have been observed in two locations along Brundah Road. The movements were first apparent following the 1900 metre survey. The movements have resulted in impacts to the road pavement, which are shown in Fig. 4.1. Relative level surveys around a nearby house indicate a lifting of the walls and slab in one corner. The slab feels uneven and slippage has occurred to the damp proof course in this same corner. One sewer pipe has also experienced reverse gradient and had to be re-laid. It is therefore considered that this house has also experienced anomalous non-systematic movements.
- Four impacts were observed in close proximity on Glenanne Place. Longwalls 22 to 24B have directly mined beneath over 2 kilometres of water main pipework and this is the only site to have experienced impacts. In addition to this, the road pavement cracked and buckled at the same localised location, as did some timber rails on a fence, and minor impacts were experienced in a nearby house. While no ground surveys have been conducted along this street, the nature of the impacts suggest significant anomalous movements. A photograph of impacts to the pavement is shown in Fig. 4.1.
- The Mine Subsidence Board has received claims from almost every property that backs onto Stuart Reserve. The properties are located on Stuart and Huen Place. Some of the impacts to the houses are categorised as Category 3 and one house, which backs onto Myrtle Creek has experienced Category 4 impacts. Given that all of these houses are located above the igneous intrusion and coal barrier between Longwalls 23A and 23B, it is considered that the impacts are related to non-systematic movement. The cause or causes of the impacts are not known but there are a number of possibilities. Stuart Reserve is located within a natural drainage line that flows into Myrtle Creek and it is possible that the structures have experienced valley related movement. It is also not known whether part of the drainage line had been backfilled as part of sub-division work and whether this may have influenced movements at the structures. These impacts could also have been affected by the presence of the igneous intrusion.
  Unfortunately, there is no monitoring line available to measure the ground movements that occurred. A number of monitoring lines are located above the igneous intrusion and very little differential movement was observed. No non-systematic movement has observed along these lines, which include a short monitoring line across the top of the drainage line at Stuart Place.
- Valley closure and upsidence movements have been observed along Myrtle Creek, as expected. Monitoring lines were placed across the creek near Huen Place and Elphin Street for research purposes. Valley closure movements were first observed following the 900 metre survey. The observed peak compressive strains are aligned with the base of Myrtle Creek. Upsidence movements are less evident than the valley closure related compressive strains. In the case of the Huen Place extension line, upsidence is difficult to distinguish due to the timing of the extension of the ground survey across Myrtle Creek.
- Non-systematic movement along the Winpara Close monitoring line was first observed following the 900 metre survey. The profiles for Winpara Close show some minor upsidence which has developed slightly since the 1100 metre survey. The movements have results in irregular surface impacts to the pavement and kerb and gutter and a photograph is shown in Fig. 4.1.
- Two houses on Mahonga Street experienced impacts on 17 and 30 November 2006. Longwall 24B had progressed distances of approximately 240 metres and 320 metres respectively at this time. The impacts to one house are significant and include cracking to brickwork, cracking and delamination of floor tiles and jamming of doors. The impacts are considered to be a result of anomalous non-systematic movement due to the early timing of the impacts.

- A house on Turner Street has reported impacts during the mining of Longwall 24B. The house is located a minimum distance of 170 metres from the nearest goaf edge. A claim at this distance is unusual, as evidenced by the impacts map, which is provided in Drawing No. MSEC272-02. A recent inspection of the house indicates movement along the damp proof course, cracking and spalling of brick mortar, cracking of external concrete pavement and cracking of linings to internal walls and ceiling. The house is located directly above an area identified as "geologically disturbed" at seam level and it is not known whether these conditions extend to the surface. The impact is perplexing in that neither the road, kerb nor any other neighbouring houses have experienced impacts. However, in the absence of any other cause, it is assumed that the impact is related to mine subsidence given the timing of the impact.

In addition to the above locations, it is possible that there are other sites are experiencing non-systematic movement. These include the noticeable hump in the pavement on Leiha Place and small strain concentrations and upsidence along the Main Southern Railway.

The locations of all sites where it is considered that observed non-systematic movements have occurred are shown in Drawing No. MSEC272-02.

2.3. Main Southern Railway

The Main Southern Railway was surveyed 22 times on a weekly, twice weekly and thrice weekly basis during the extraction of Longwall 24B. The Main Southern Railway experienced 88 mm of subsidence during the mining of Longwall 24B, which is also the maximum total subsidence experienced due to the mining of Longwalls 22 to 24B. While observed subsidence was slightly greater than predicted, the difference was well within the accuracy of the prediction method. Observed maximum incremental and total tilts were less 1 mm/m. Observed maximum incremental strain was approximately 0.4 mm/m compressive and observed maximum total strain was 0.6 mm/m compressive.

No anomalous movements were observed during mining though a number of small bumps and localised compressive strains have occurred at some isolated locations, which will be closely watched in case they develop into significant anomalous movement during the extraction of Longwall 25.

Observed changes in stress free temperature in the rails was 7 degrees, which is less than the predicted change of 8 degrees. It was found that continuous monitoring of rail strain gauges and rail temperature provided a valuable tool for monitoring welded track stability during mining. A very good correlation was found between observed ground strain, subsidence and changes in stress free temperature throughout the mining period.

Platform clearances at Tahmoor Railway Station were measured in accordance with the agreed management plan with Australian Rail Track Corporation (ARTC) and measured changes in clearances were within survey tolerance. Since the completion of mining Longwall 24B, ARTC has subsequently upgraded both the Up and Down Tracks from timber to concrete sleepers and the track and platform has subsequently been adjusted.

2.4. Thirlmere Way Overbridge

A total of 12 surveys and 14 visual inspections were undertaken of the Thirlmere Way Overbridge on a weekly basis in accordance with the agreed management plans with ARTC and Wollondilly Council. No impacts were observed to the Bridge, as expected following extensive strengthening works undertaken by Tahmoor Colliery prior to commencement of Longwall 24B.

Maximum subsidence of 73 mm was measured at the Bridge. Maximum tilt of 0.8 mm/m was measured across the deck, falling towards Longwall 24B on the Thirlmere side of the bridge. Measured strains were within survey accuracy. The expansion joint was measured on 14 occasions and the results were always within 2 mm of the initial survey.

A survey of the bridge opening above the Main Southern Railway track was conducted and the results show that the bridge opening satisfies Structure Gauge requirements.

2.5. Castlereagh Street Bridge over Myrtle Creek

A total of 4 surveys were undertaken of the Castlereagh Street Bridge over Myrtle Creek in accordance with the agreed management plan with Wollondilly Council. No impacts were observed to the Bridge, as expected.

Maximum subsidence of 58 mm has been measured at the bridge. The bridge has subsided in a relatively uniform fashion with negligible tilts and strains.

2.6. Sewer Surveys

A total of 28 surveys along two sewer pipes that cross Myrtle Creek were conducted on a weekly and twice weekly basis in accordance with the agreed management plan with Sydney Water. No impacts were observed to any sewer infrastructure during the mining of Longwall 24B.

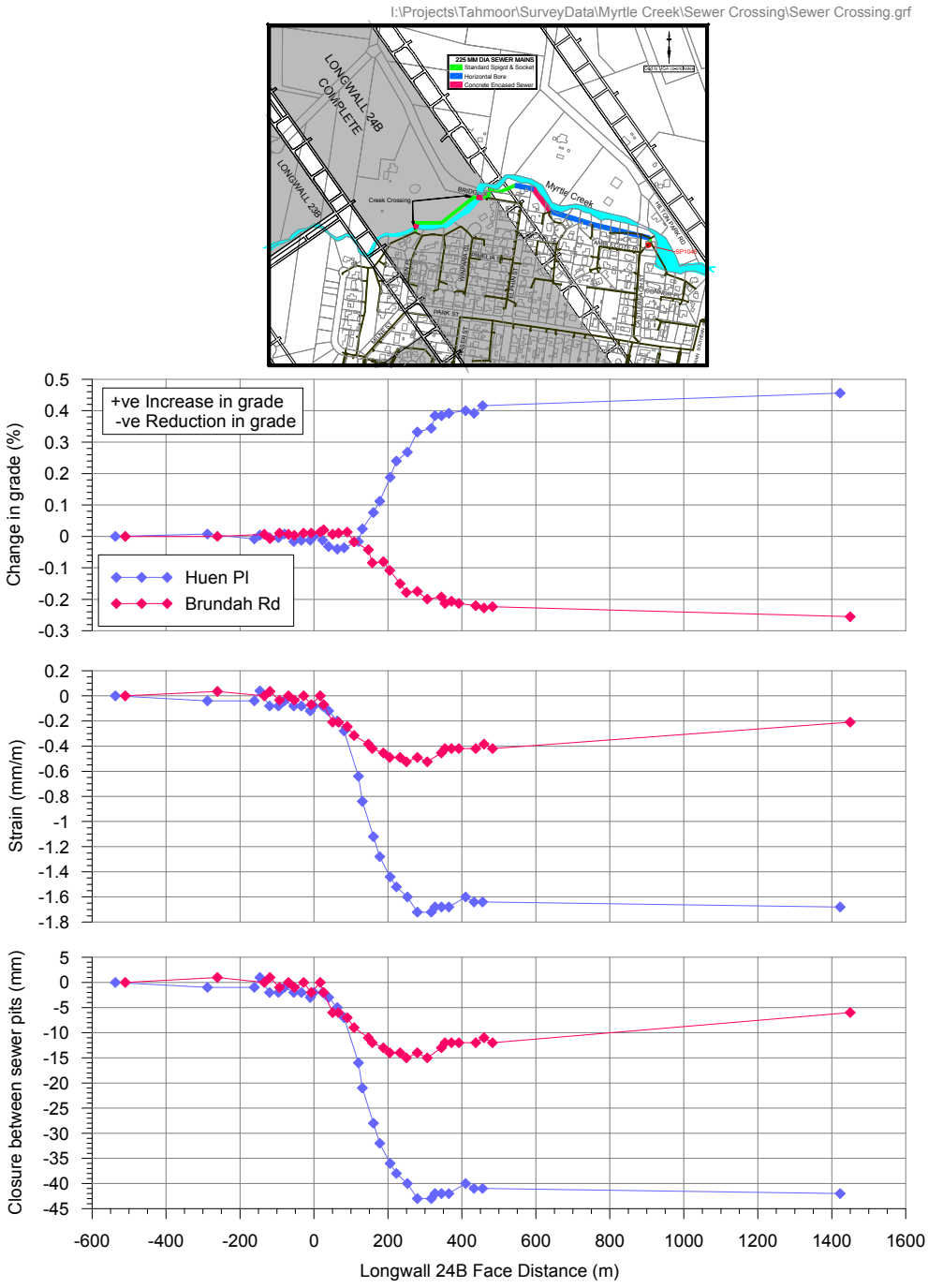


Fig. 2.2 Observed Strain and Closure along Sewer Pipes that cross Myrtle Creek

In accordance with the management plan, daily visual inspections were conducted once observed closures exceeded 20 mm. A total of 128 visual inspections were made during mining. While no impacts were recorded during mining, the observed amount of closure in the pipes is significant and it is possible that impacts may be experienced during the mining of Longwall 25. It is recommended that Tahmoor Colliery consider implementing measures to prevent this potential impact.

2.7. Power Pole Surveys

A total of 46 surveys of selected power poles were conducted in accordance with the agreed management plan with Integral Energy. No impacts were observed to any power pole during the mining of Longwall 24B as expected.

Of the poles that were surveyed, maximum subsidence of 623 mm was observed at Pole 271 on Glenanne Place. A maximum horizontal movement of 40 mm was measured at the top of the same pole in May 2007. The amount of movement reduced to 23 mm at the completion of Longwall 24B.

2.8. Tahmoor Town Centre

Four detailed surveys of the Tahmoor Town Centre and basement carpark were undertaken in accordance with the conditions of SMP Approval by the Department of Primary Industries. No impacts were observed to Tahmoor Town Centre during the mining of Longwall 24B as expected. Maximum observed subsidence was 11 mm, which is within prediction, which was less than 20 mm of subsidence.

CHAPTER 3. SUMMARY OF SURVEYS AND INSPECTIONS

Many surveys and inspections were required to be conducted to meet the requirements of the Surface, Safety and Serviceability Management Plan. Due to the complexities involved, surveys and inspections were managed using a computer database on a weekly basis. A register was also kept, detailing when each survey and inspection had been completed. A timeline showing when each type of survey and inspection was conducted is shown in Fig. 3.1 and Fig. 3.2.

Fig. 3.1 Timeline and Surveys and Inspections during Longwall 24B (Part 1 of 2)

Fig. 3.2 Timeline and Surveys and Inspections during Longwall 24B (Part 2 of 2)

A count of surveys and inspections is provided in Table 3.1.

Table 3.1 Number of Surveys and Inspections conducted during Longwall 24B

Inspection / Survey	Responsibility	Number of Inspections / Surveys
Ground Monitoring Surveys		
Main Southern Railway Corridor	Meadows Consulting	22
Thirlmere Way	Lean & Hayward	17
Chapman Street	Lean & Hayward	13
Castlereagh Street	Lean & Hayward	14
Park Street	Lean & Hayward	6
Milne Street	Lean & Hayward	6
Elphin Street	Lean & Hayward	9
Elphin-Myrtle Creek	Lean & Hayward	5
Pimelia Street	Lean & Hayward	5
Winpara Close	Lean & Hayward	5
Huen Place	Lean & Hayward	6
Macquarie Place	Lean & Hayward	3
Turner-Denmead	Lean & Hayward	3
Brundah Road	Lean & Hayward	2
Marion Street	Lean & Hayward	3
Sub-Total		**150**
Natural Features		
Bargo River flow gauging	HCS	13
Bargo River data logger downloads	HCS	13
Bargo River water level surveys	HCS	13
Bargo River water quality sampling - field & lab	Geoterra	12
Myrtle Creek - Monthly Visual Monitoring in ASZ + End of LW	Sunrise	5
Myrtle Creek - Download Level Data Loggers (bi-monthly)	Geoterra	7
Myrtle Creek - Water Quality sampling - Field (bi-monthly)	Geoterra	7
Myrtle Creek - Water Quality Sampling - Lab (quarterly)	Geoterra	4
Redbank Creek - Download Level Data Loggers (bi-monthly)	Geoterra	5
Redbank Creek - Water Quality sampling - Field (bi-monthly)	Geoterra	7
Redbank Creek - Water Quality Sampling - Lab (quarterly)	Geoterra	7
Steep Slopes - Weekly Visual	Geoterra	16

Inspection / Survey	Responsibility	Number of Inspections / Surveys
Kerbside Inspection in ASZ		
Groundwater - Water levels in piezometers (bi-monthly)	Geoterra	7
Groundwater - Water Quality sampling - Field (bi-monthly)	Geoterra	7
Groundwater - Water Quality Sampling - Lab (quarterly)	Geoterra	4
Bargo River data logger downloads	Geoterra	13
Sub-Total		**127**
Main Southern Railway (note Corridor survey above)		
Reports for continuous discrete rail stress transducers monitoring results	Pidgeon Civil Engineering	13
Subsidence monitoring reports	MSEC	11
Enhanced track patrol	ARTC	25
Thirlmere Way Overbridge surveys	Meadows Consulting	13
Thirlmere Way Overbridge inspections	Sunrise	14
Bridges & Culverts		
Castlereagh St Bridge - survey	Lean & Hayward	2
Bridge St (Tahmoor) Culvert - visual inspection	Sunrise	76
Bridge St (Tahmoor) Culvert - survey	Lean & Hayward	3
Sydney Water - Sewer		
Myrtle Creek - daily visual inspections	Sunrise	128
Myrtle Creek - twice weekly survey of sewer crossings at Bridge St (Tahmoor)	Lean & Hayward	28
Myrtle Creek - twice weekly survey of sewer crossings at Huen Place	Lean & Hayward	28
Choke report from Sydney Water	Sydney Water	2
Integral Energy - Electrical		
Power Pole surveys	Lean & Hayward	46
Telstra - Telecommunications		
Visual inspections	Lutibo (Colin Dove)	24
Tahmoor Town Centre		
Building surveys	Lean & Hayward	4
Structure Inspections		
Public amenities / commercial district	Sunrise	1303

Inspection / Survey	Responsibility	Number of Inspections / Surveys
Houses, Units and Aged Care Villages	Sunrise	1248
Pools and pool gates	Sunrise	160
Dams	Geoterra	11
Sub-Total		**2722**

CHAPTER 4. IMPACTS TO SURFACE FEATURES

4.1. Summary of Impacts to Surface Features

A comparison between predicted and observed impacts to surface features is summarised in Table 4.1 below. It can be seen from that the impacts to surface features have been relatively minor. The predicted and observed impacts to surface features compare reasonably well, with the exception of locations where non-systematic movements have occurred.

Table 4.1 Summary of Predicted and Observed Impacts during Longwall 24B

SURFACE FEATURE	PREDICTED IMPACTS	OBSERVED IMPACTS
NATURAL FEATURES		
Myrtle Creek	Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.	No impacts observed during Longwall 24B. Please refer report by Geoterra.
Aquifers or Known Groundwater Resources	Please refer report by Geoterra.	Water depressurisation observed in water bores. Please refer report by Geoterra.
Steep slopes	Potential soil slippage and cracking to slopes. Large-scale slope failures unlikely.	No impacts observed during Longwall 24B.
Natural Vegetation	No impacts anticipated.	No impacts observed during Longwall 24B.
PUBLIC UTILITIES		
Railways	8 degree loss of rail stress free temperature. No impact to track geometry likely if systematic movements occur.	Observed loss of rail stress free temperature of 7^{o}C. Rail restressed. No impact to track geometry.
Roads (All Types)	Minor cracking and buckling may occur in isolated locations.	Cracks and buckling in pavements observed in 7 isolated locations (Glenanne Pl, Brundah Road (3 locations), Winpara Cl, Elphin St, and Leiha Pl). Cracks and buckling observed in concrete kerbs in isolated locations (Castlereagh St, Chapman St, Patterson St, Park St, Elphin St, Pimelia St, Winpara Cl, Huen Pl and Leiha Pl).
Bridges	Impacts unlikely due to mining of Longwall 24B.	No impacts observed during Longwall 24B.
Water Pipelines	Minor impacts possible to pipelines, particularly older cast iron pipes with lead joints.	Leak at cast iron water main on Glenanne Pl, most likely as a result of non-systematic movement.
Gas Pipelines	Ground movements unlikely to adversely impact pipelines if systematic movement occurs.	No impacts observed during Longwall 24B.

Table 4.1 Summary of Predicted and Observed Impacts during Longwall 23B (continued)

SURFACE FEATURE	PREDICTED IMPACTS	OBSERVED IMPACTS
PUBLIC UTILITIES (continued)		
Sewerage Pipelines	Mining induced tilt may reduce gradient of some pipes to less than that required for self-cleansing. Cracking to pipes and joints are unlikely if systematic movement occurs. Potential impacts at creek crossings where non-systematic movement is expected.	No impacts observed during Longwall 24B.
Electricity Transmission Lines or Associated Plants	Ground movements unlikely to adversely impact electrical infrastructure if systematic movement occurs.	No impacts observed during Longwall 24B.
Telecommunication Lines or Associated Plants	Ground movements unlikely to adversely impact telecommunications infrastructure if systematic movement occurs. Most vulnerable cables are older cables such as air pressurised lead sheathed cables. Strains may be higher where they connect to support structures or where affected by tree roots.	Retensioned consumer lines on Huen Pl, Pimelia St, Winpara Cl and Leiha Pl as precautionary measure.
PUBLIC AMENITIES	Potential impacts to public amenities, but unlikely due to the mining of Longwall 24B.	No impacts observed during Longwall 24B.
FARMLAND AND FACILITIES		
Farm Buildings or Sheds	Negligible to slight impacts predicted for all farm buildings and sheds if systematic movement occurs.	No impacts observed during Longwall 24B.
Fences	Potential for impacts to fences and gates. Gates are most vulnerable.	One impact in a semi-rural property. No impact on fences securing livestock.
Farm Dams	Potential cracking and leakage. Ground movements unlikely to result in overflowing or reduction in dam capacity. Please refer report by Geoterra.	No impacts observed during Longwall 24B. Please refer report by Geoterra.
Wells or Bores	No registered usage within SMP Area. Please refer report by Geoterra.	Water depressurisation observed in water bores. Please refer report by Geoterra.
INDUSTRIAL, COMMERCIAL & BUSINESS ESTABLISHMENTS	Negligible to slight impacts predicted for all business and commercial establishments.	No impacts observed during Longwall 24B, including Tahmoor Commercial District.
AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE	Negligible to very impacts predicted for items of heritage significance.	No impacts observed during Longwall 24B.

Table 4.1 Summary of Predicted and Observed Impacts during Longwall 24B (continued)

SURFACE FEATURE	PREDICTED IMPACTS	OBSERVED IMPACTS
PERMANENT SURVEY CONTROL MARKS	Ground movement predicted at identified survey marks.	Ground movement occurred.
RESIDENTIAL ESTABLISHMENTS		
Houses, flats or units *Status as at 11 November 2007 (prior to start of Longwall 24A).*	Predictions and impact assessments provided for individual structures based on systematic subsidence movements. Of the 799 houses and public amenities within zone of influence of LWs 22 to 24B, 263 structures assessed to have Strain Category 1 or 2. Potential for impacts to occur as a result of non-systematic movement. Potential for some structures to experience minor impacts that may only be classified as Tilt Category A or Strain Category 1. All houses expected to remain safe, serviceable and repairable provided that they are in sound condition prior to mining.	No. of properties that have reported impacts after LW 24B = 136 (72 claims during LW 24B). No. of properties with impacts that relate to a residential structure = 120 (65 claims during LW 24B). No. of properties with impacts that only relate to associated structures = 16 (7 claims during LW 24B). No. of impacts to structures that are considered to be a result of non-systematic movements = 30. No. of impacts to structures that are considered to be a result of systematic movements = 90. No structures have been identified as being either unsafe or unserviceable at this time. However, MSB have decided that cost of repair is greater than cost of replacement for two houses. Please refer details in this report.
Retirement or Aged Care Villages	Negligible to very slight impacts at Macquarie Grove Retirement Village.	Very slight to slight impacts observed at 3 residential structures. (These residences included in statistics for houses above).
Swimming Pools	While predicted tilts are not expected to cause a loss in capacity, tilts are more readily noticeable in pools as the height of the freeboard will vary along the length of the pool. While predicted strains impacts are low, many of the pools are in-ground, which are more susceptible.	Impacts to 9 swimming pools. 6 pools have noticeable tilt. 3 in-ground pools cracked and one could not retain water.
Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks or Tennis Courts	Potential impact to pipes connected to in-ground septic tanks. Negligible impacts predicted for non-residential domestic structures, including sheds and tanks.	Minor impacts to 6 structures, including sheds, garages, a carport, a retaining wall and pool decking during the mining of Longwall 24B.
External Residential Pavements	Cracking and buckling likely to occur, though majority minor.	Impacts to pavements observed on 24 properties during mining of Longwall 24B.
Fences in Urban Area	Some fences and gates could be slightly damaged. Most vulnerable are colorbond fences.	Impacts to fences or gates observed on 14 properties.

4.2. Main Southern Railway

As discussed in Section 2.3, a 7 degree loss in stress free temperature was observed during the mining of Longwall 24B. In accordance with the agreed management plan with ARTC, the rail was re-stressed and restored to pre-mining condition following cessation of subsidence from Longwall 24B.

4.3. Roads

Cracks and buckling were observed in 7 isolated locations during the mining of Longwall 24B. The impacts were minor and did not present a public safety risk. It is considered that the largest impacts were related to non-systematic movements. The impacts were repaired by the Mine Subsidence Board. A selection of photographs is provided in Fig. 4.1. It is noted Longwalls 22 to 24B have directly mined beneath approximately 9.2 kilometres of public road with impacts to pavements at 11 locations.

Impact to pavement on Glenanne Place. Repaired fence and water main beneath bare patch in grass beyond. Only water main damage above longwalls to date. (Impact possibly due to anomalous non-systematic movement)

Gap formed between behind kerb on Winpara Close. Size of gap not seen above longwalls in other locations (Impact possibly due to anomalous non-systematic movement)

Typical impact to kerb (Patterson Street)

Impact to pavement on Brundah Road (Impact possibly due to anomalous non-systematic movement)

Fig. 4.1 Photographs of impacts to road pavements and kerbs during Longwall 24B

4.4. Potable Water Infrastructure

An impact occurred to a cast iron concrete lined pipe (CICL) on Glenanne Place on 6 June 2007. The impact followed observed impacts to the road pavement and timber fence railings at the same location. Ground surveys were not undertaken along Glenanne Place. However, due to the concentration of impacts at this one location, it is considered that the impacts occurred as a result of anomalous non-systematic movement. A photograph following repairs to the water main is shown in Fig. 4.1.

It was noted in the SMP Report that minor impacts could possibly occur as a result of mine subsidence and that the most vulnerable pipes were the older CICL pipes, which has occurred in this case.

Longwalls 22 to 24B have directly mined beneath approximately 350 metres of DICL pipe and 1970 metres of CICL pipe. This is the first impact to have occurred to the water main network, though a very small number of minor leaks have been observed to consumer connection pipes on private properties.

4.5. Gas Infrastructure

Longwalls 22 to 24B have directly mined beneath approximately 4.8 kilometres of gas pipe and no impacts have been recorded so far.

4.6. Sewer Infrastructure

Longwalls 22 to 24B have directly mined beneath approximately 6.2 kilometres of sewer pipes and no noticeable impacts have been recorded so far. The observed frequency of incidences is similar to those in areas not affected by mine subsidence.

As stated previously in this report, while no impacts were recorded during mining, the observed amount of closure in the pipes across Myrtle Creek is significant and it is possible that impacts may be experienced during the mining of Longwall 25. It is recommended that Tahmoor Colliery consider implementing measures to prevent this potential impact.

4.7. Electrical Infrastructure

Longwalls 22 to 24B have directly mined beneath approximately 15.0 kilometres of electrical cables and approximately 340 power poles and no noticeable impacts have been recorded so far. However, one local feed line to a house was loosened on Market Street during the mining of Longwall 22.

4.8. Telecommunication Infrastructure

While no impacts were observed to telecommunications infrastructure during the mining of Longwall 24B, some aerial consumer lines were retensioned as a precautionary measure.

Longwalls 22 to 24B have directly mined beneath approximately 17.4 kilometres of copper cable and 1.2 kilometres of optical fibre cable. The only impact recorded so far has been air leakage on an old lead cable at two locations on Thirlmere Way during the mining of Longwall 22.

4.9. Structures

4.9.1. Residential Structures and Public Amenities

A register of observed impacts is based on claims received from the Mine Subsidence Board (MSB). Information on the nature of the impacts was provided by the MSB and Sunrise Property Building Services, who inspect impacted structures on behalf Tahmoor Colliery. The register was updated on a weekly basis and the statistics provided in this report are based on impacts recorded up to the week starting 11 November 2007, just prior to the commencement of Longwall 24A.

Site inspections of impacted structures were conducted by MSEC at a number of properties in August 2007. A small number of amendments were made following this review and the information in this report is an update from the weekly updates that were provided during mining.

A summary of reported impacts following the completion of Longwall 24B is provided in Table 4.2. The count of residential structures and public amenities includes only those structures that were predicted to experience more than 20 mm of subsidence due to the extraction of Longwalls 22 to 24B.

Table 4.2 Summary of Observed Impacts to Residential Structures

	Total after LWs 22 to 24B	Increment during LW 24B
Number of Residential Structures within zone of influence (predicted subsidence > 20 mm)	799	678
Number of properties with reported impacts (not including refused claims)	136	72
Number of properties with reported impacts that relate to residential structures	120	65
Number of properties with reported impacts that only relate to associated structures	16	7

Observed impacts have been classified in accordance with the impact classification tables provided in the SMP Report. Strain impacts are classified generally in accordance with Table C.1 of the Australian Standard AS2870 – 1996, although the classification was extended to include a Category 5, which corresponds to the Very Severe Damage Category of the UK National Coal Board Classification.

Australian Standards AS2870 advises that crack width is the main factor by which damage to walls is categorized. Predicted crack width was also the method by which impact assessments were conducted. Crack width has therefore been used for the purposes of classifying strain impacts to residential structures.

Predictions and impact assessments for residential structures and public amenities were provided in the SMP Report No. MSEC157. Predictions and assessments focussed on two separate types of subsidence movements: normal systematic subsidence movements and non-systematic movements. Detailed impact assessments were provided for each individual house on the basis that normal systematic movements would occur. The potential for impacts from non-systematic subsidence movements were discussed separately and no specific predictions were provided.

For the purposes of properly comparing predicted and observed impacts, it is important to separate impacts to structures that relate to normal systematic movements from impacts that relate to non-systematic movements. It is recognised that this task is difficult to achieve, particularly where ground movements have not been measured but division by subsidence movement is necessary to provide an “apples for apples” comparison.

Areas that are considered to have experienced non-systematic movements were identified in Section 2.2 and are shown in Drawing No. MSEC272-02. A total of 30 residential structures are located within these areas.

A summary of structures, classified according type and level of impact is provided in Table 4.3.

Table 4.3 Summary of Impacts classified according to impact type and level

	Total number of observed impacts after LWs 22 to 24B	Total number within Observed impact categories considered to be due to Non-Systematic Movement	Total number within Observed impact categories considered to be due to Systematic Movement	Total number within Predicted impact categories considered to be due to Systematic Movement
Tilt Impacts				
Tilt Impact Category A	115	27	88	792*
Tilt Impact Category B	5	3	2	7
Total	**120**	**30**	**90**	**799***
Strain Impacts				
Strain Impact Category 0	90	14	76	536*
Strain Impact Category 1	10	3	7	257
Strain Impact Category 2	14	7	7	6
Strain Impact Category 3	3	3	0	0
Strain Impact Category 4	1	1	0	0
Strain Impact Category 5	2	2	0	0
Total	**120**	**30**	**90**	**799**

* Note: Please note that while impact assessments for Tilt Category A or Strain Category 0 impacts were provided in the SMP Report, it was not envisaged that an impact would be experienced at every structure. As noted in the SMP Report, it was envisaged that a percentage of structures would experience minor impacts (e.g. door jams, door swings and minor cracks to internal linings or floor finishes) that may only be classified as Tilt Category A or Strain Category 0. At the time of writing the SMP Report, 4.2% of structures within the zone of influence had experienced these minor impacts. It can be seen from Table 4.3 above that this percentage has increased to approximately 10%.

It is noted that one (1) house, which has experienced Category B tilt impacts, has also experienced a Category 2 crack.

Based on the statistics in Table 4.3 above, it can be seen that the overall frequency of impacts is 120 out of 799 structures, or approximately 15%. It can also be seen from Table 4.3 that the majority of the houses that have experienced higher observed impacts are considered to have experienced non-systematic subsidence movement, as expected. To place the results into perspective, six houses have experienced moderate or greater impacts, which represent a proportion of less than 1% of the total number of residential structures and public amenities within the zone of influence. This is less than the total equivalent percentage of houses with moderate or greater impacts as stated in the Conditions of Development Consent, as amended in December 2006.

When the predicted and observed impacts due to systematic movements are compared, it can be seen that the method of assessing impacts is very conservative for Strain Category 1 but slightly less than observed for Strain Category 2. While it is expected that further claims will be received from the Mine Subsidence Board after subsidence movements have ceased, it is not expected that this number of delayed claims will exceed the predictions.

The locations of the affected houses and public amenities are shown in Drawing No. MSEC235-02. It can be seen from this drawing that the great majority of impacts have occurred directly above the

extracted longwall panels and the greatest concentration of impacts are located above the centre of the longwall panels, where subsidence, compressive strain and sagging curvature are generally the greatest.

While it is considered that the current method for assessing impacts to structures is reasonable, it has long been recognised by this company and others that the method can be improved. It is also considered that the method for classifying observed impacts could be improved. The observations over Tahmoor are currently being used to improve the method of impact classification and assessment for residential structures, which is being conducted as part of an ACARP Research Project by this company and as part of a review by Tahmoor Colliery and the Department of Primary Industries.

4.9.2. Swimming Pools

A total of 9 swimming pools have experienced mine subsidence impacts during the mining of Longwall 24B. Six pools have noticeable tilt. Three in-ground pools have cracked and one could not retain water.

Predictions and impacts assessments were provided for the SMP Report, using the same method that has been used for residential structures. It was recognised at the time of writing the SMP Report that the overall predicted level of impact is generally quite low. While predicted tilts were not expected to cause a loss in capacity, tilts are more readily noticeable in pools as the height of the freeboard will vary along the length of the pool. While predicted strains impacts were low, many of the pools are in-ground pools, which are more susceptible to impacts than above-ground pools.

It is considered that a separate method for assessing impacts to pools should be developed. A review is currently being conducted as part of the ACARP Research Project to develop a method for assessing impacts to pools.

4.9.3. Associated Structures

Minor impacts have been observed for six structures, including sheds, garages, a carport, a retaining wall and pool decking during the mining of Longwall 24B.

4.9.4. Fences

The potential for impacts to fences was raised in the SMP Report and a total of 14 properties have claimed impacts to fences or gates within the urban area of Tahmoor and one property has claimed an impact to a fence within a semi-rural area.

CHAPTER 5. SUMMARY OF RESULTS

There is generally a good correlation between observed and predicted systematic subsidence, tilt, curvature and strain ground movements due to the mining of Longwall 24B. Observed maximum incremental subsidence is within 4% of predicted maximum incremental subsidence, which is within the stated accuracy of ± 10% to ± 15%. Observed maximum total subsidence after Longwall 24B is less than predicted maximum total subsidence by approximately 5%.

Subsidence at a point is, however, generally greater than predicted. This is partly due to actual extraction heights that are slightly greater than heights that were adopted in the SMP Report and the influence of the large igneous intrusion and coal barrier that is located between Longwalls 23A and 23B, where most notable departures from predicted subsidence were observed. Tilts, strains and curvatures were generally less than the maximum predicted, though some higher values were observed where non-systematic movements developed, as expected.

While movements have exceeded predictions in some locations, there remains a reasonable correlation between observed and predicted impacts, particularly in relation to public infrastructure such as the Main Southern Railway, roads, bridges and services infrastructure.

There have generally been fewer impacts to houses than predicted. However, in less than 1% of 799 residential structures affected by Longwalls 22 to 24B, impacts have been classified as moderate or greater and it is considered that these houses experienced such impacts as a result of non-systematic movement. In two cases, the cost of repair has exceeded the cost of replacement, though the houses remained safe serviceable at all times. The potential for greater impacts from non-systematic movement was anticipated in the SMP report and the Colliery is preparing to undertake further investigations into the occurrence, frequency and possible causes of these anomalous ground movements.

Importantly, all structures have remained safe and serviceable throughout the mining period.

APPENDIX A. FIGURES AND DRAWINGS

I:\Projects\Tahmoor\MSEC272-Monitoring LW24B\ACADdata\MSEC272-01 Monitoring Lines_Rev G.dwg

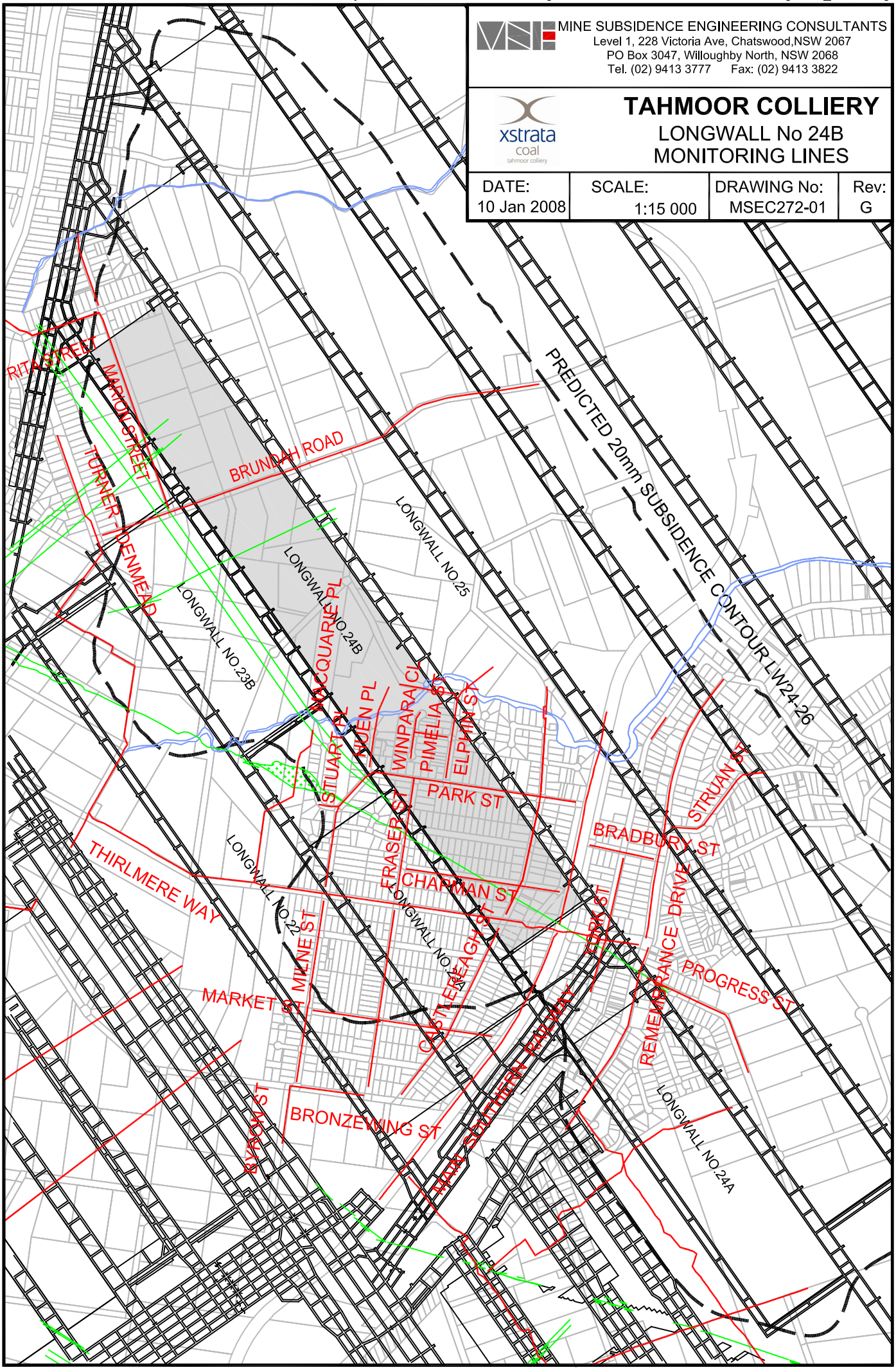
MINE SUBSIDENCE ENGINEERING CONSULTANTS
Level 1, 228 Victoria Ave, Chatswood,NSW 2067
PO Box 3047, Willoughby North, NSW 2068
Tel. (02) 9413 3777 Fax: (02) 9413 3822

xstrata coal
tahmoor colliery

TAHMOOR COLLIERY

LONGWALL No 24B
MONITORING LINES

DATE:	SCALE:	DRAWING No:	Rev:
10 Jan 2008	1:15 000	MSEC272-01	G



I:\Projects\Tahmoor\MSEC272-Monitoring LW24B\ACADdata\MSEC272-02 Impacts LW24B .dwg

MINE SUBSIDENCE ENGINEERING CONSULTANTS
Level 1, 228 Victoria Ave, Chatswood,NSW 2067
PO Box 3047, Willoughby North, NSW 2068
Tel. (02) 9413 3777 Fax: (02) 9413 3822

TAHMOOR COLLIERY

LONGWALL No 24B IMPACTS END OF PANEL

DATE:	SCALE:	DRAWING No:	Rev
05 Feb 2008	1:15 000	MSEC272-02	BE

PREDICTED 20mm SUBSIDENCE CONTOUR LW22-23 & 24B

LONGWALL NO.24B

LONGWALL NO.23B

LONGWALL NO.22

LONGWALL NO.23A

Water main leak

Crack in paddock

Crack in creekbed

Crack in creekbed

LEGEND:

TILT IMPACT CATEGORY

STRAIN IMPACT CATEGORY

TILT Cat A
STRAIN Cat 0

TILT Cat B
STRAIN Cat 1

STRAIN Cat 2

STRAIN Cat 3

STRAIN Cat 4

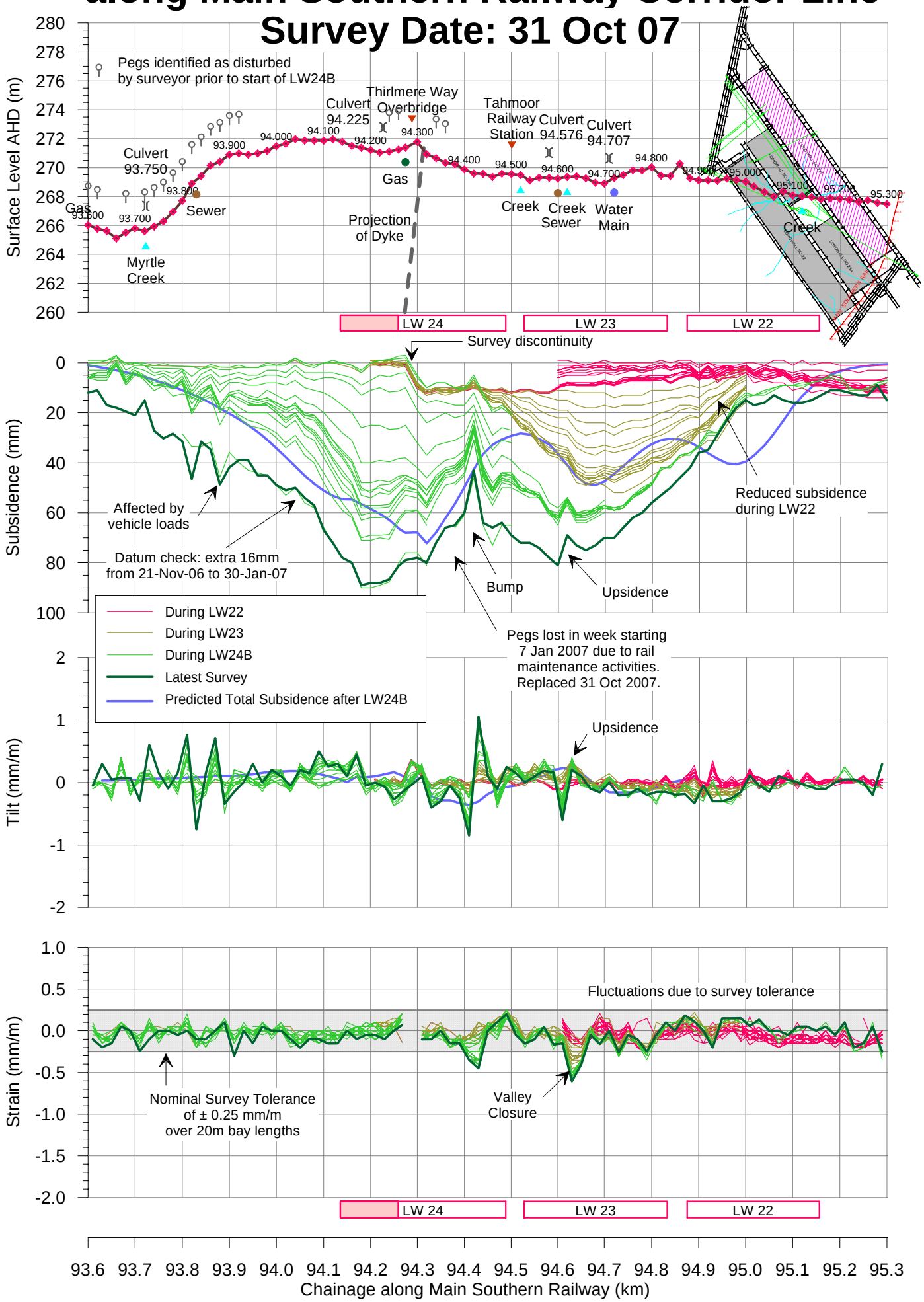
STRAIN Cat 5

POSSIBLE NON-SYSTEMATIC MOVEMENT OBSERVED

ROAD IMPACT

Tahmoor Colliery - Total Subsidence Profiles along Main Southern Railway Corridor Line

Survey Date: 31 Oct 07

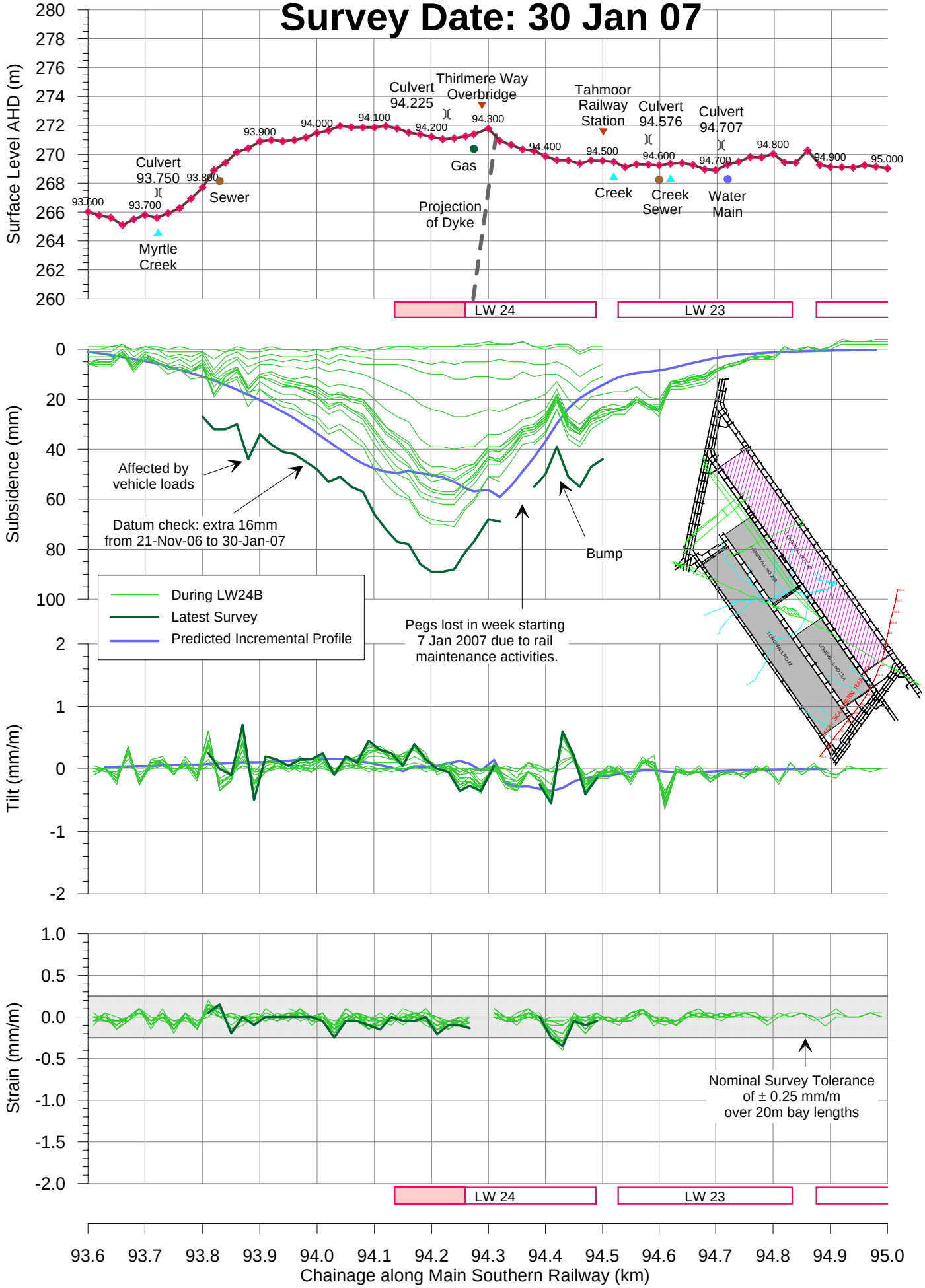


Mine Subsidence Engineering Consultants

Fig. MSEC272-01 Rev L

Tahmoor Colliery - Incremental Subsidence Profiles Main Southern Railway Corridor Line during LW24B

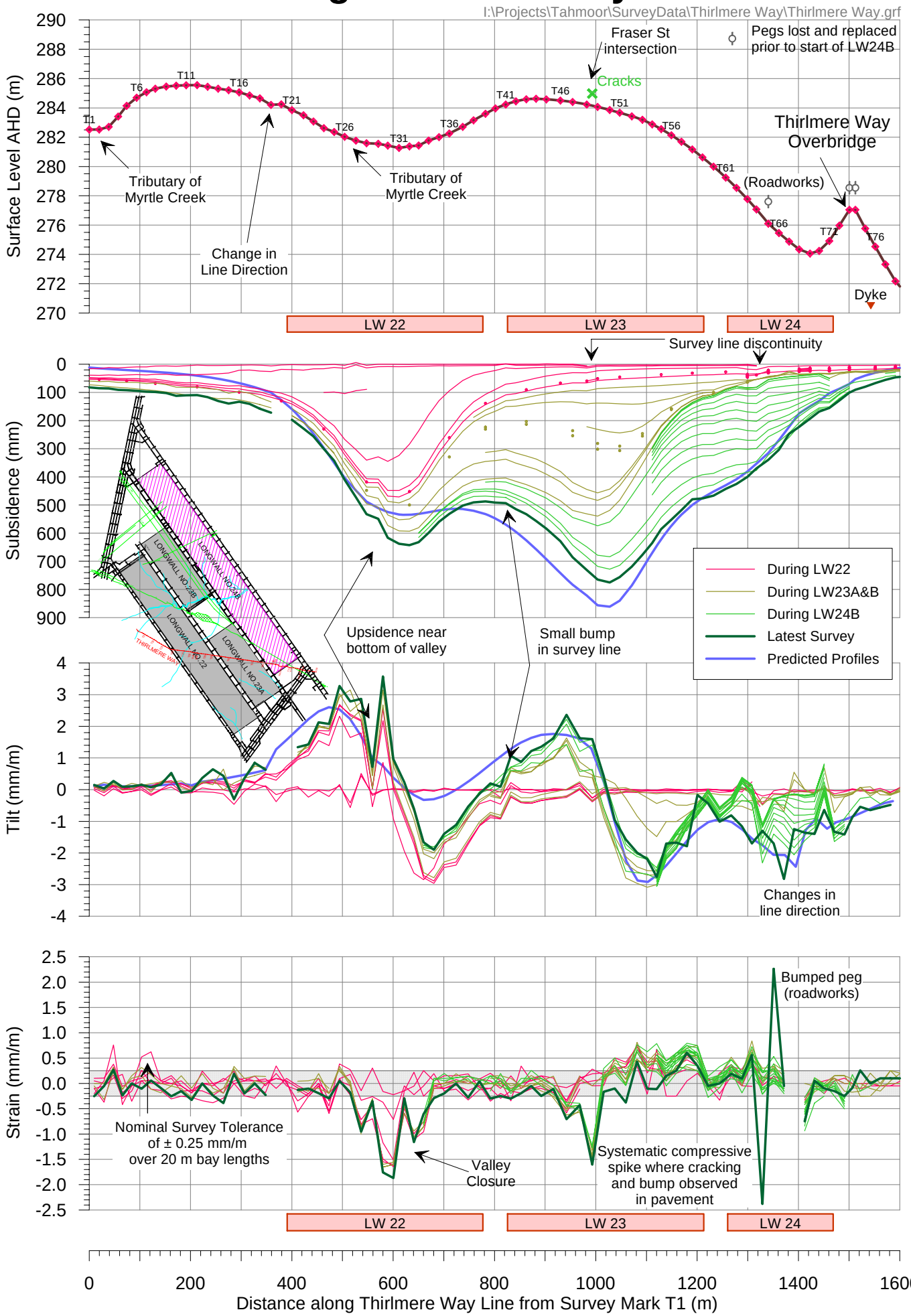
Survey Date: 30 Jan 07



Mine Subsidence Engineering Consultants

Fig. MSEC272-02 Rev L

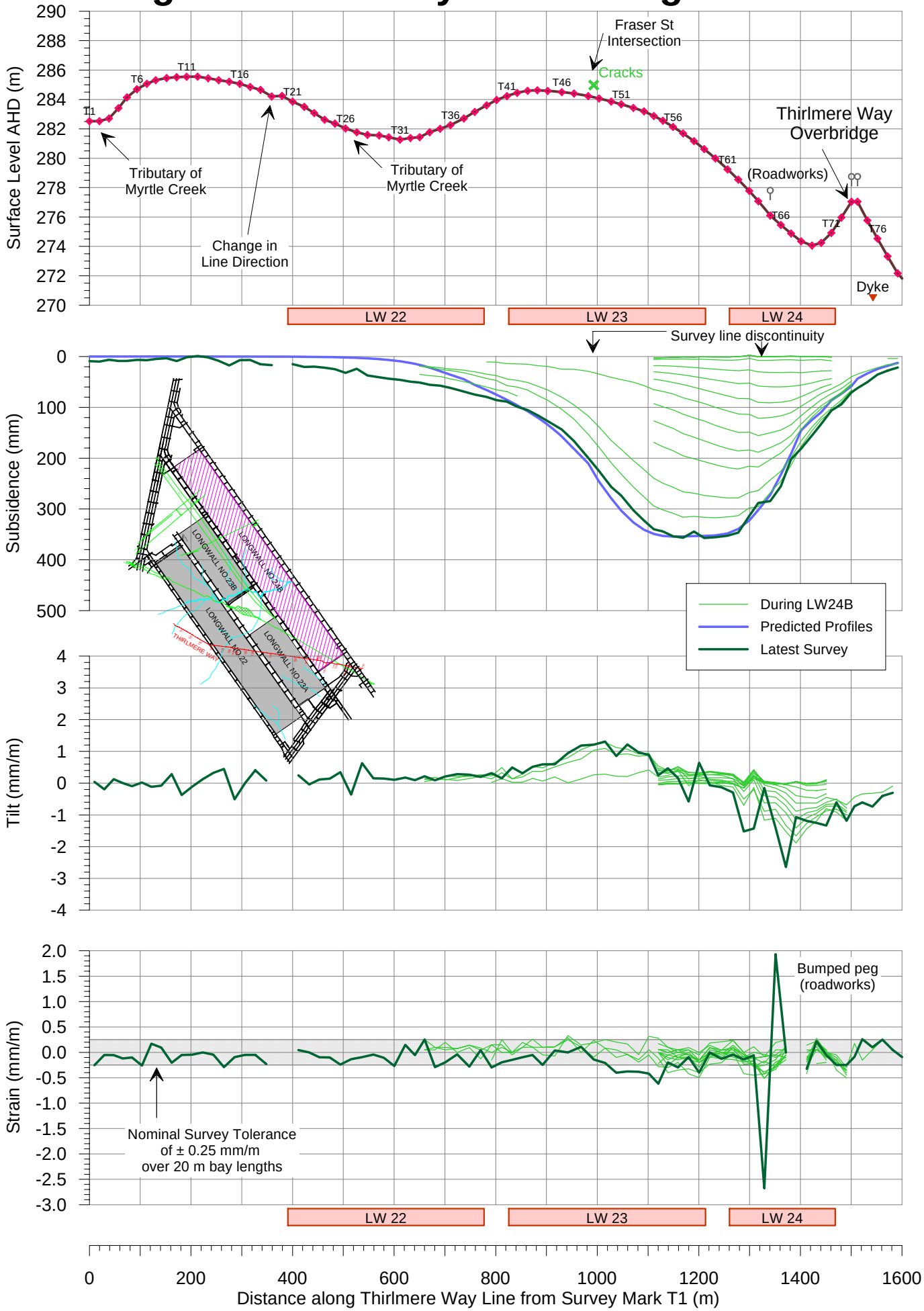
Tahmoor Colliery - Total Subsidence Profiles along Thirlmere Way Line



Mine Subsidence Engineering Consultants

Fig. MSEC272-03 Rev E

Tahmoor Colliery - Incremental Subsidence Profiles along Thirlmere Way Line during LW 24B



Mine Subsidence Engineering Consultants

Fig. MSEC272-04 Rev E

Tahmoor Colliery - Total Subsidence Profiles along Chapman Street Line

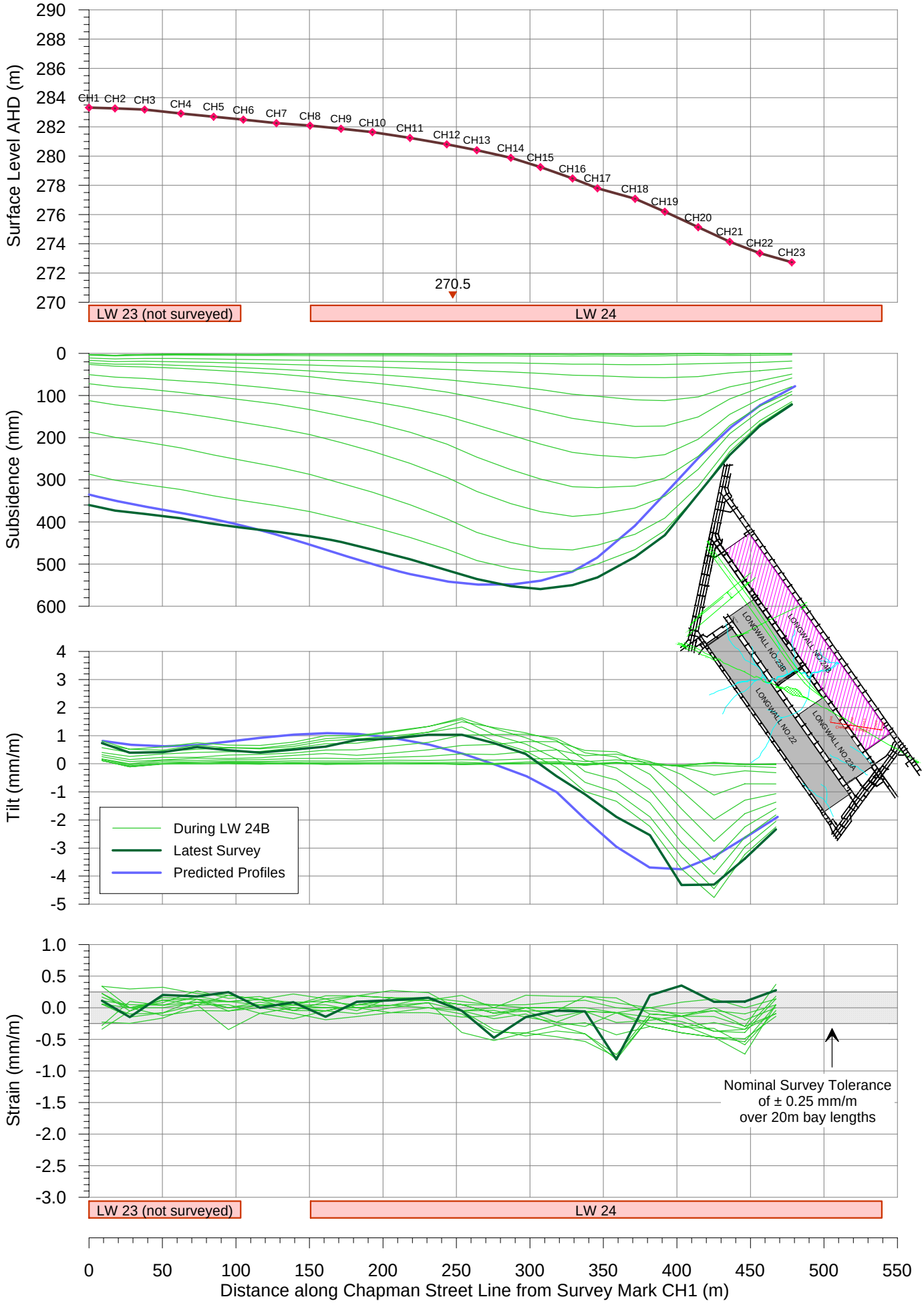


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Fig. MSEC272-05 Rev D

Tahmoor Colliery - Total Subsidence Profiles along Castlereagh Street Line

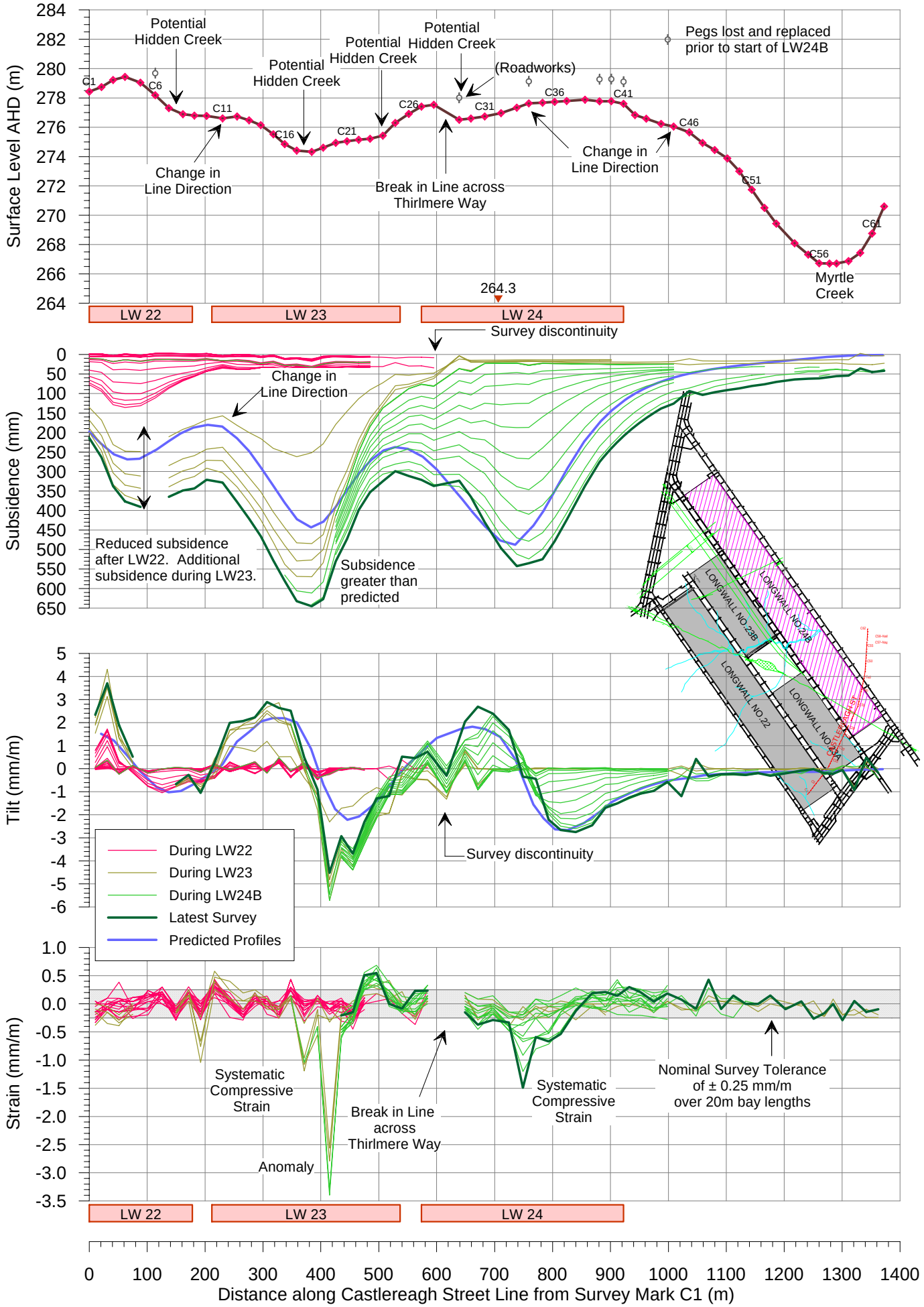

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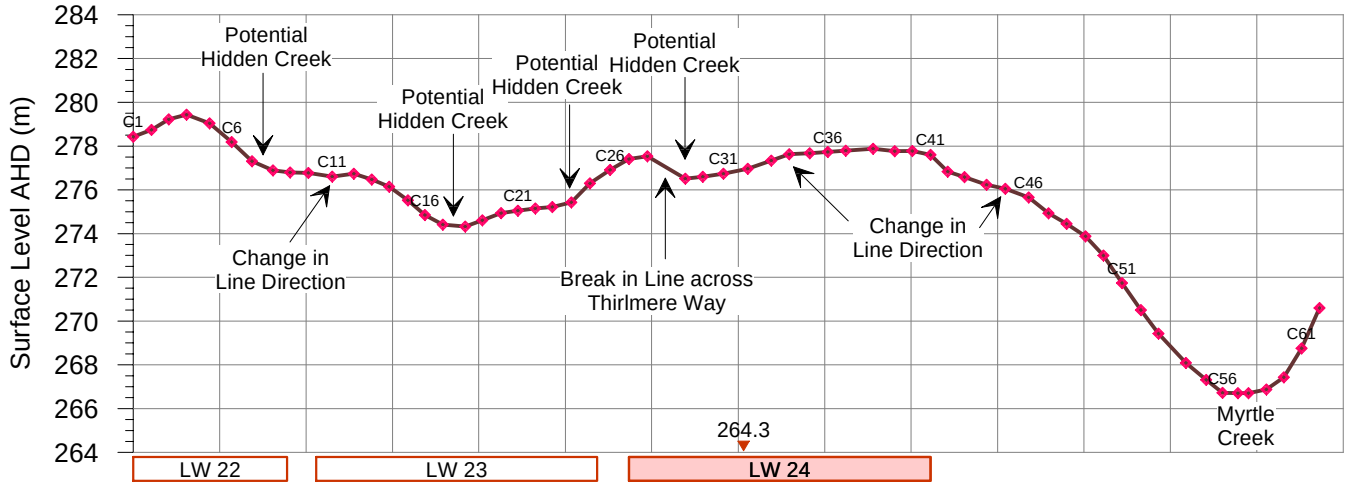
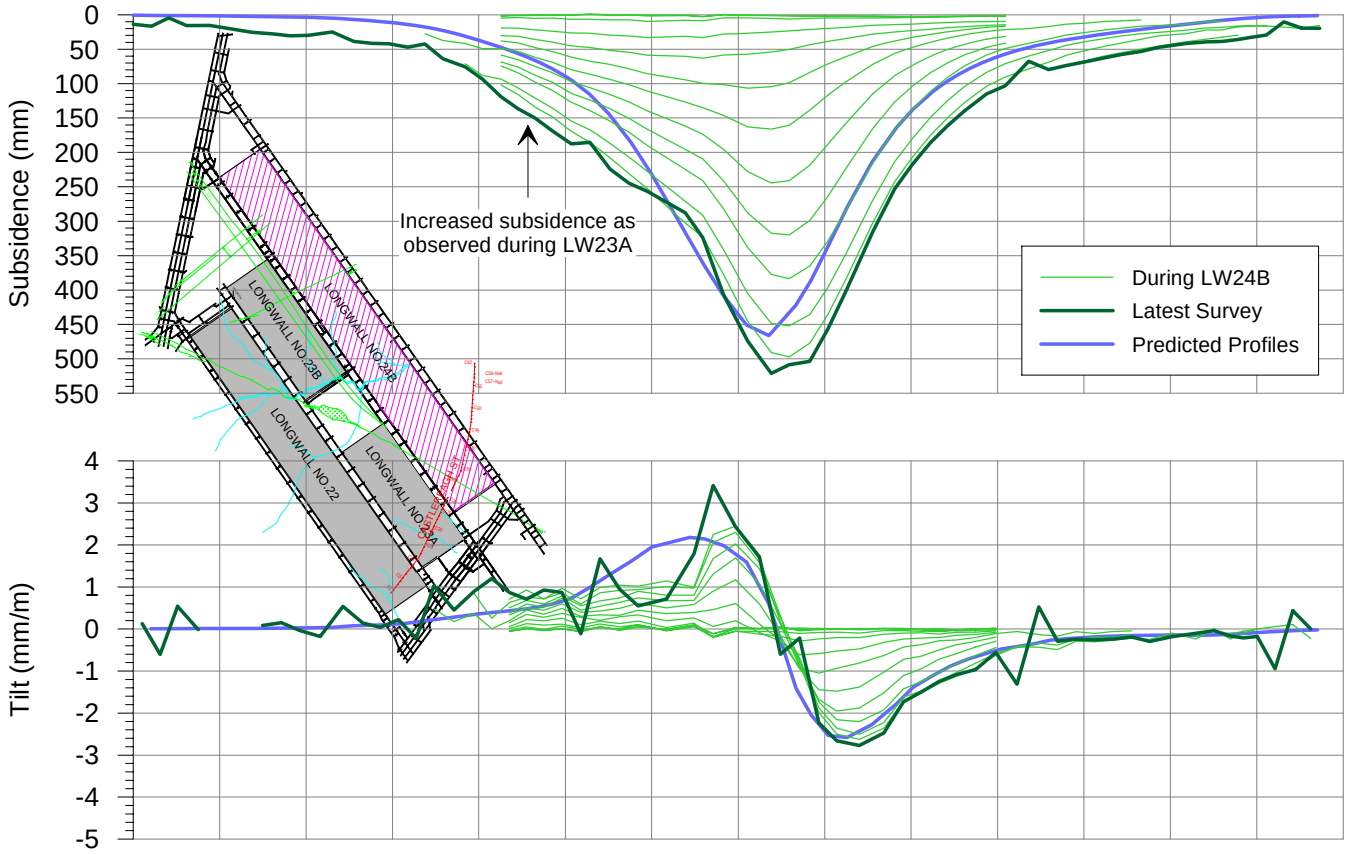
Fig. MSEC272-06 Rev D

Tahmoor Colliery - Incremental Subsidence Profiles along Castlereagh Street Line during LW 24B





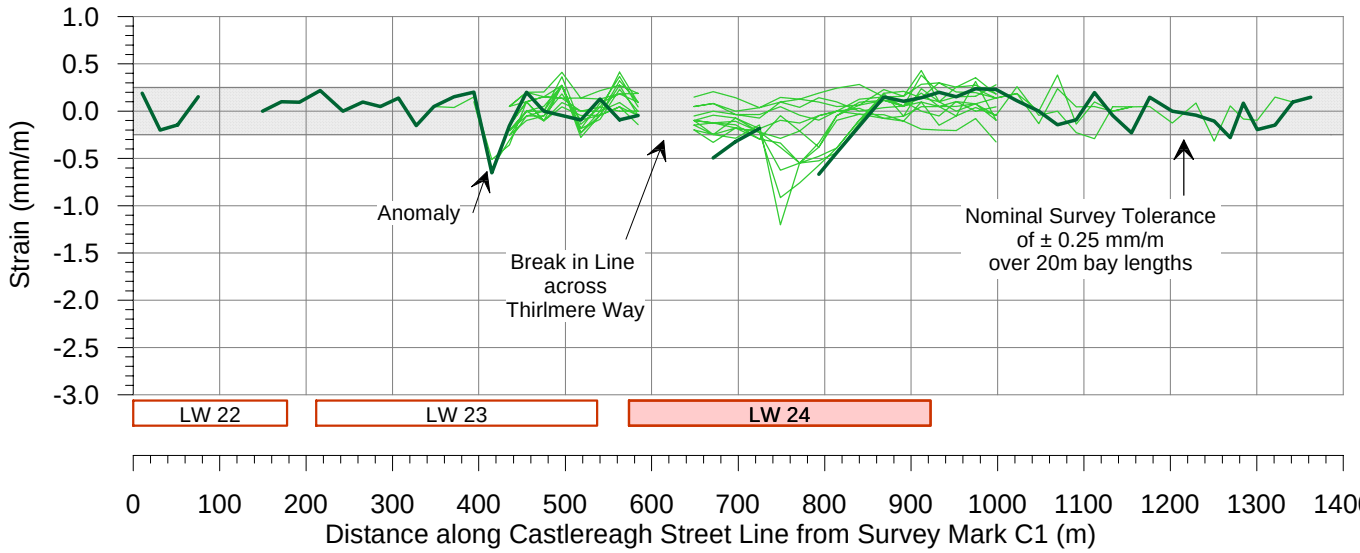


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Fig. MSEC272-07 Rev D

Tahmoor Colliery - Total Subsidence Profiles along Park Street Line

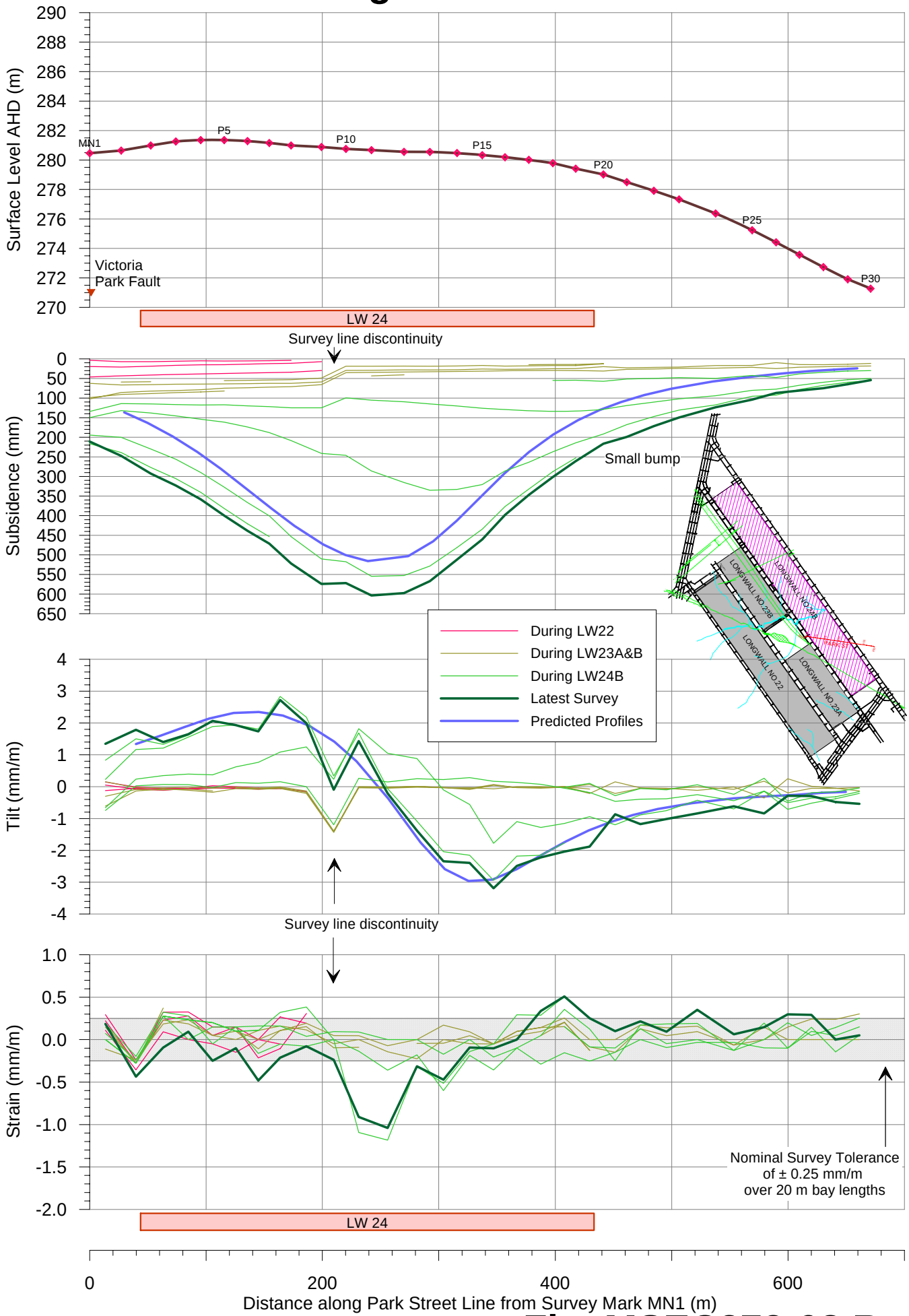

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Fig. MSEC272-08 Rev F

Tahmoor Colliery - Incremental Subsidence Profiles along Park Street during LW 24B

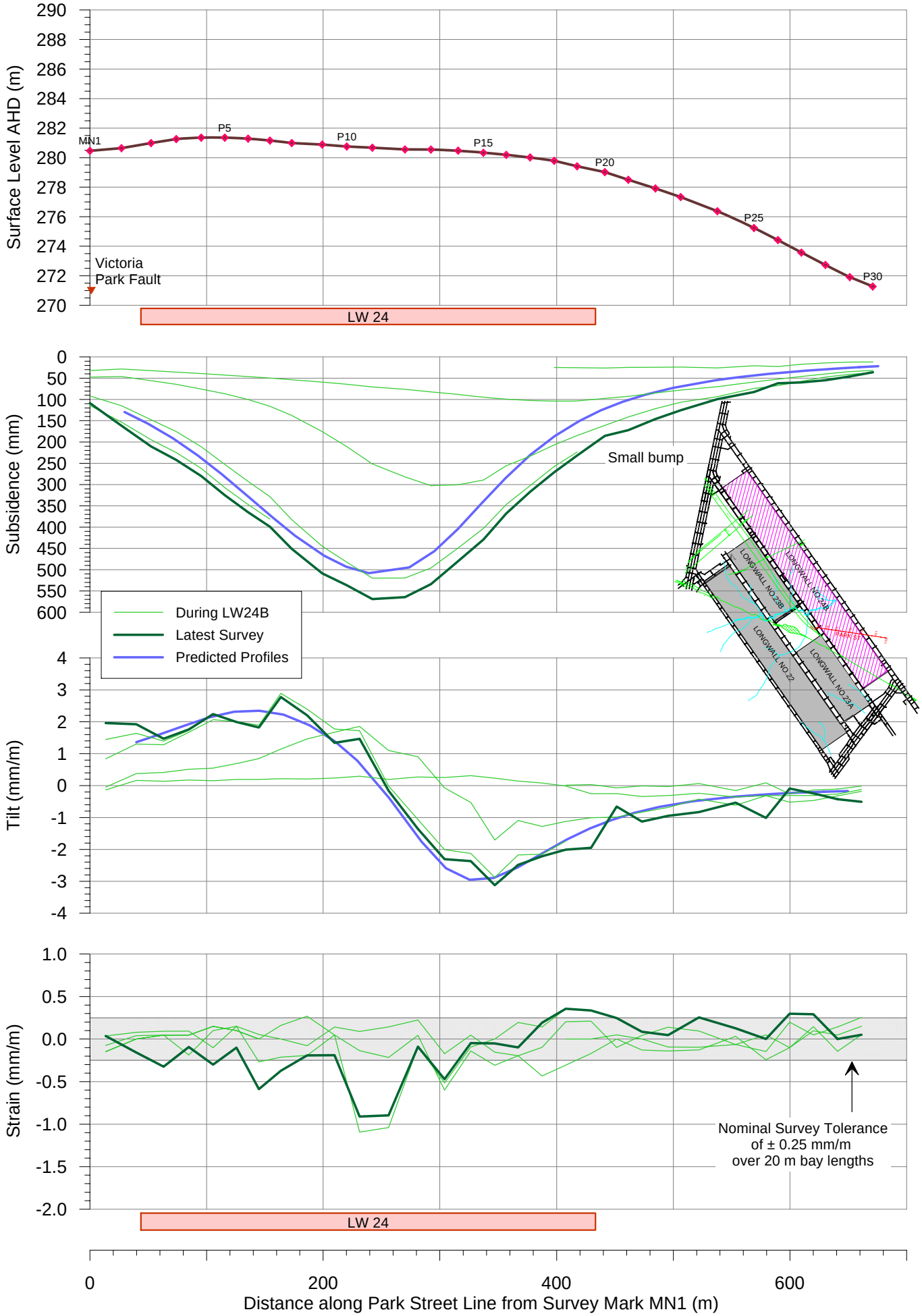

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Fig. MSEC272-09 Rev F

Tahmoor Colliery - Total Subsidence Profiles along Fraser Street Line

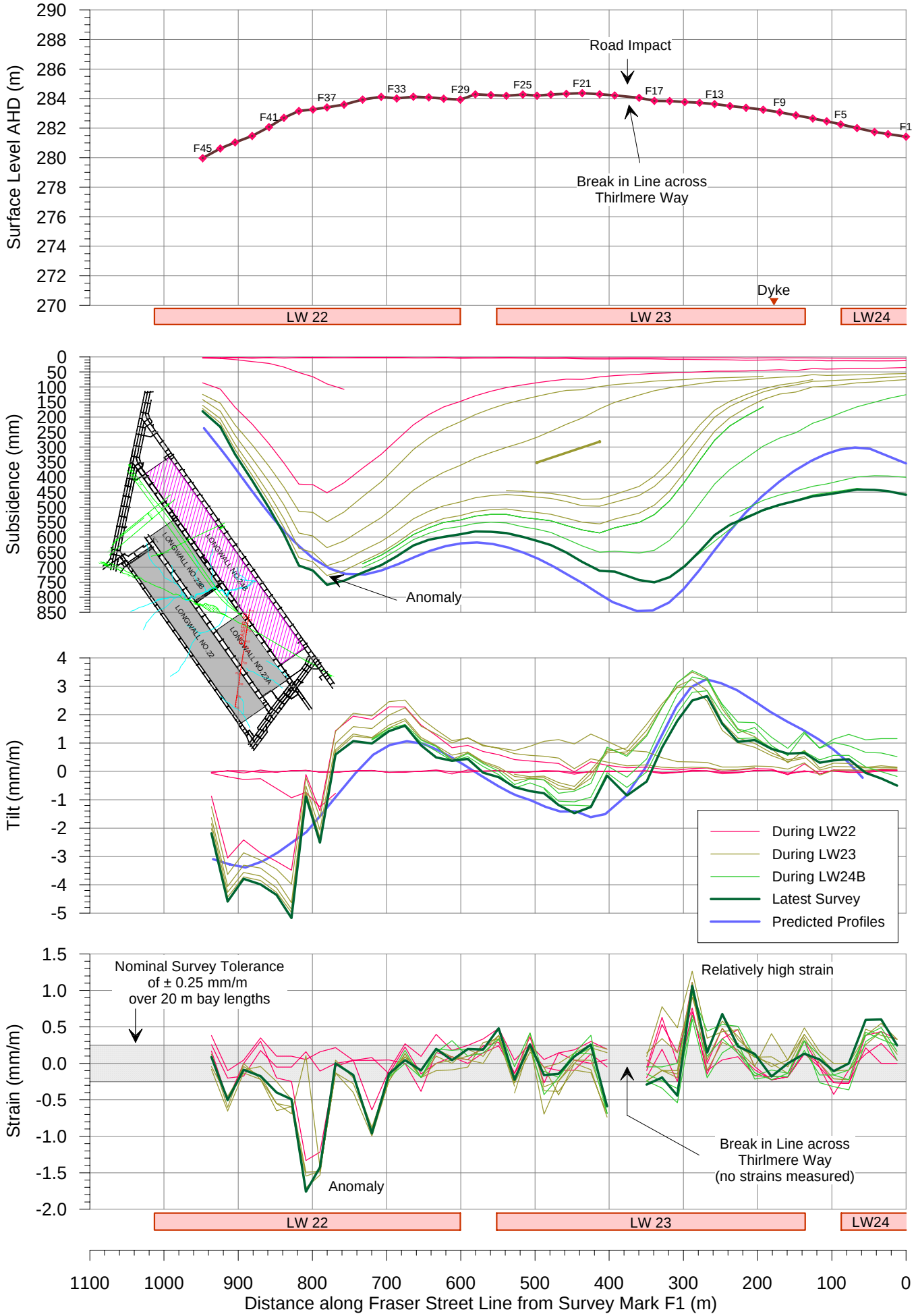

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Fig. MSEC272-10 Rev E

Tahmoor Colliery - Incremental Subsidence Profiles along Fraser Street during LW 24B

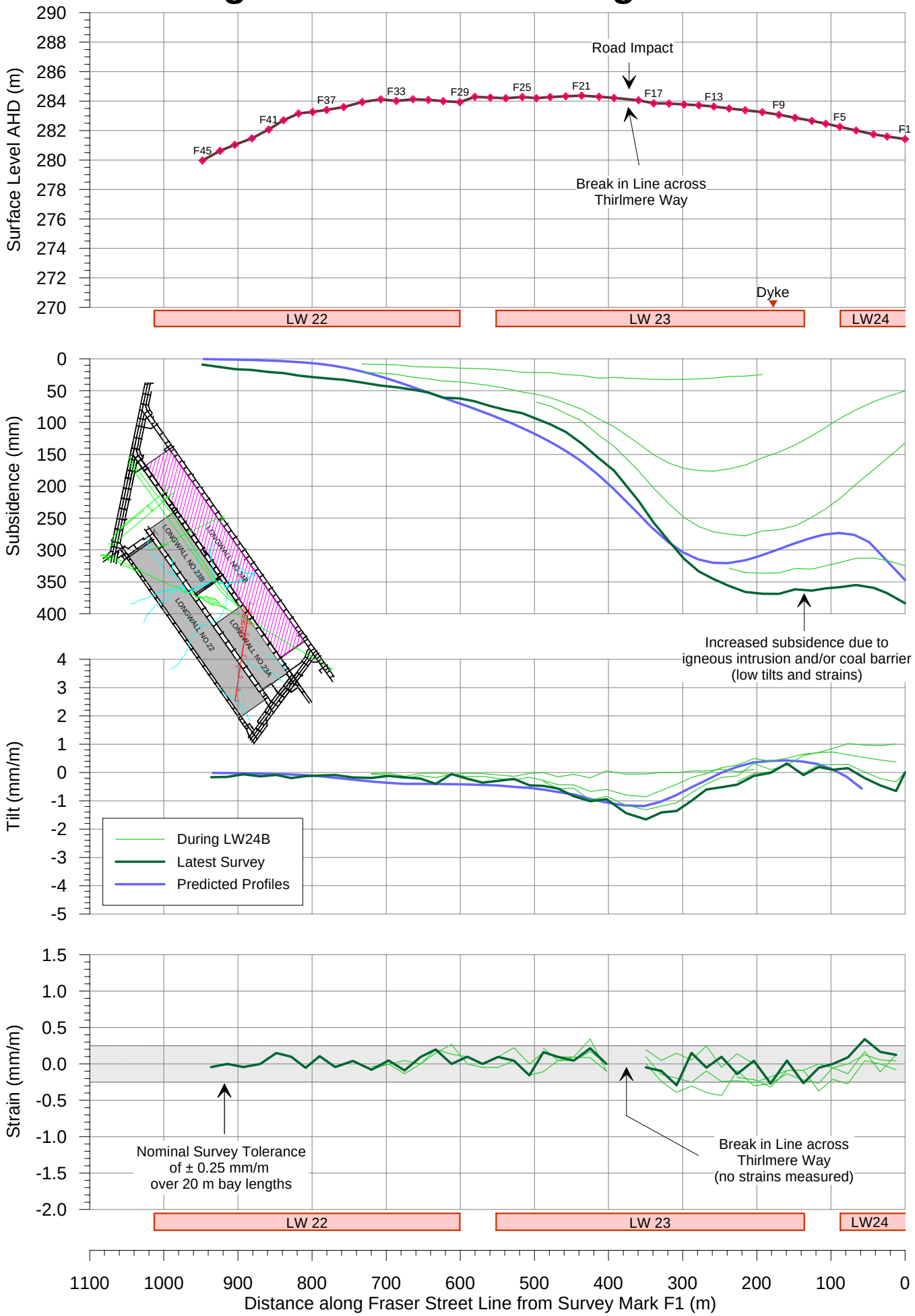

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Fig. MSEC272-11 Rev E

Tahmoor Colliery - Total Subsidence Profiles along Milne Street Line

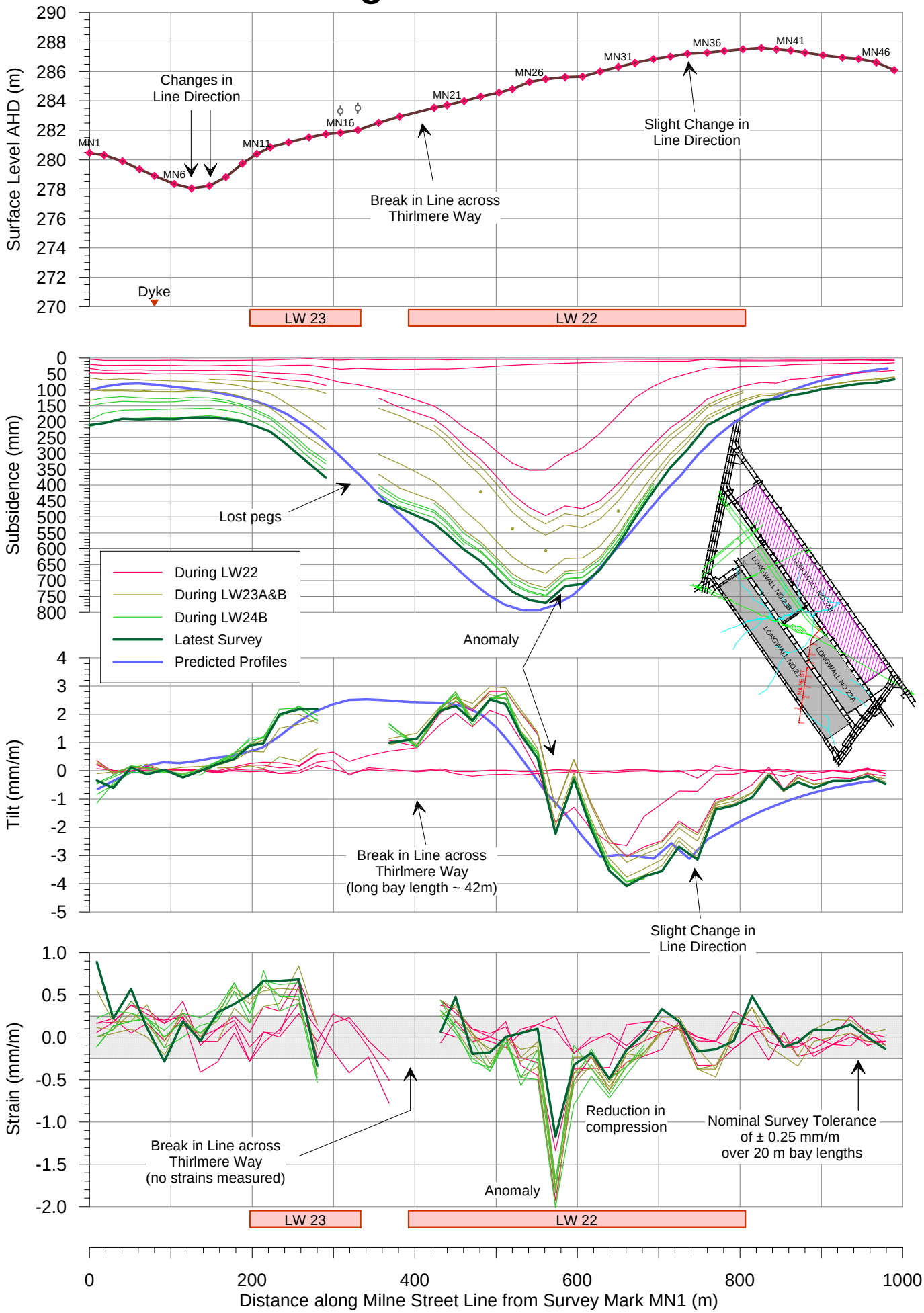

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Fig. MSEC272-12 Rev F

Tahmoor Colliery - Incremental Subsidence Profiles along Milne Street Line during LW 24B

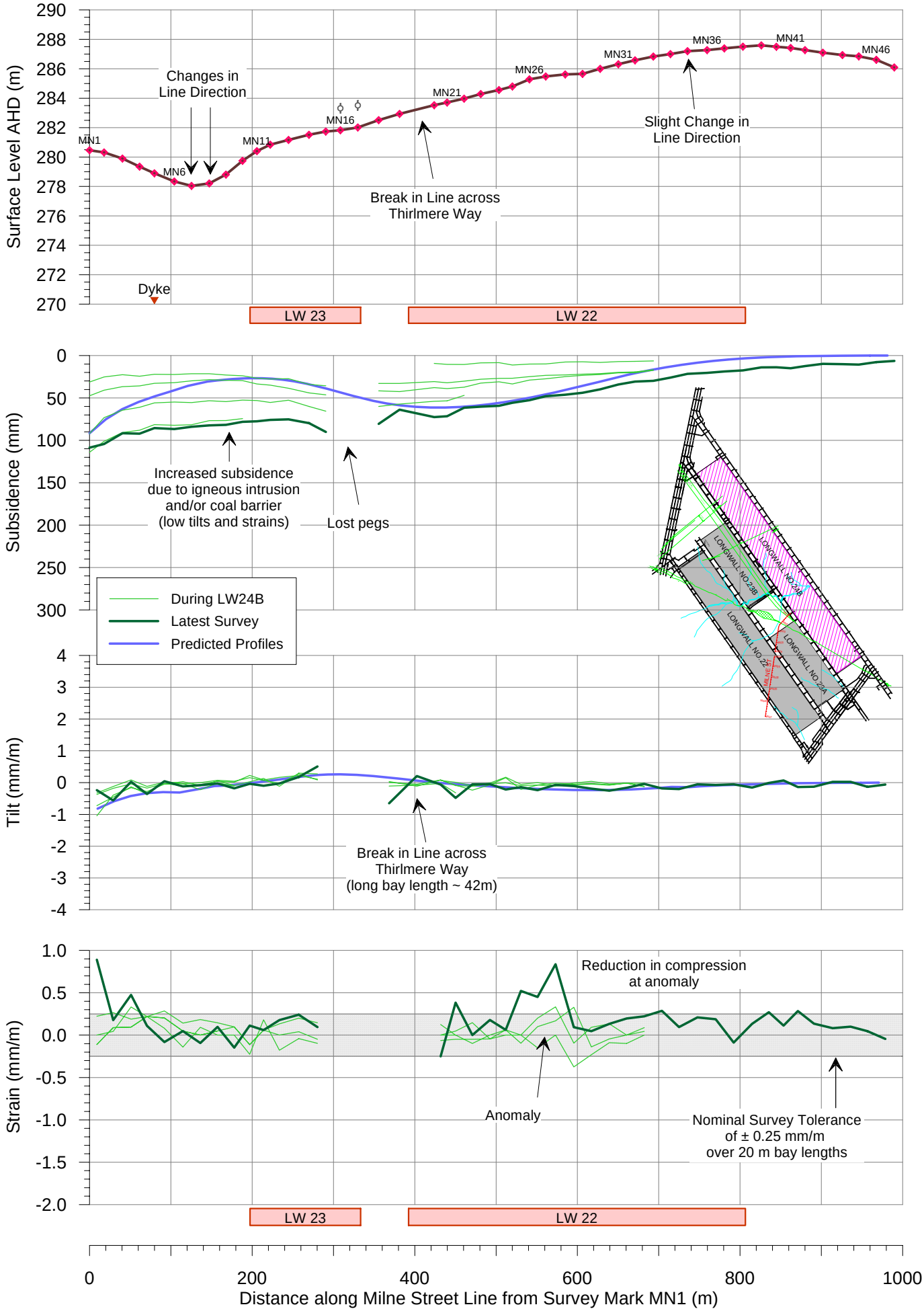

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Fig. MSEC272-13 Rev F

Tahmoor Colliery - Total Subsidence Profiles along Elphin Street Line

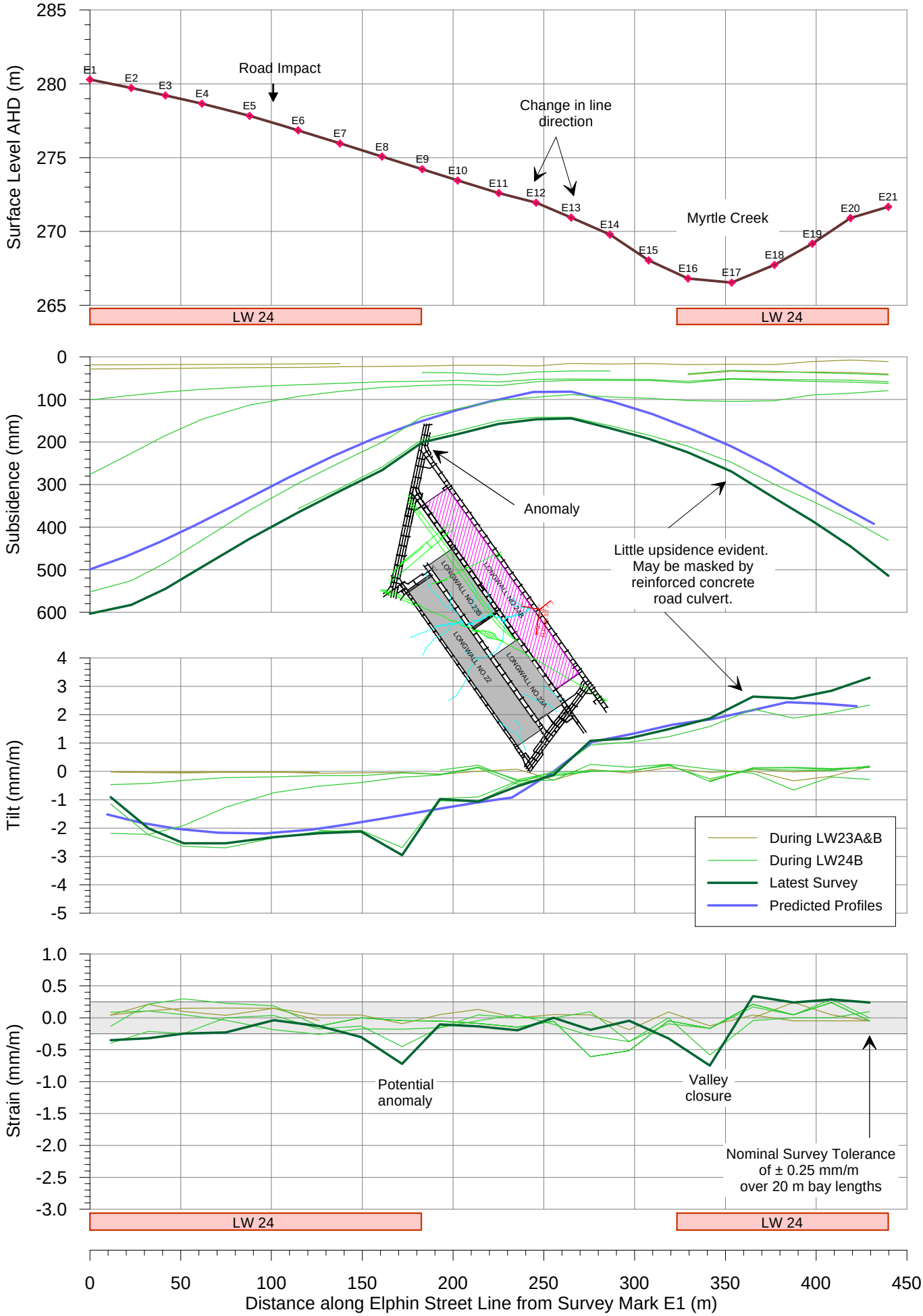

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Fig. MSEC272-14 Rev E

Tahmoor Colliery - Incremental Subsidence Profiles along Elphin Street Line during LW 24B

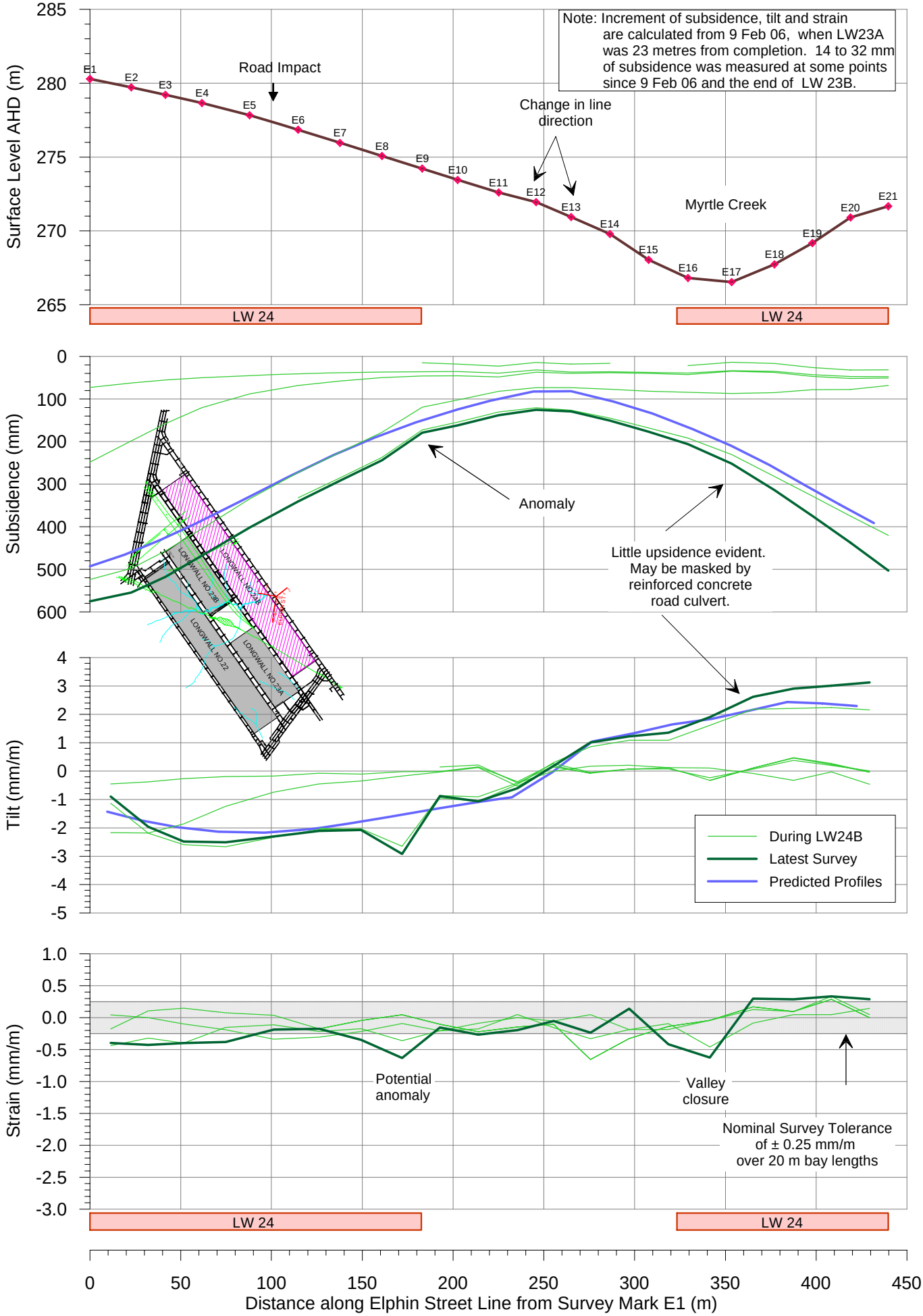

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Fig. MSEC272-15 Rev E

Tahmoor Colliery - Total Subsidence Profiles along the Elphin-Myrtle Creek Line

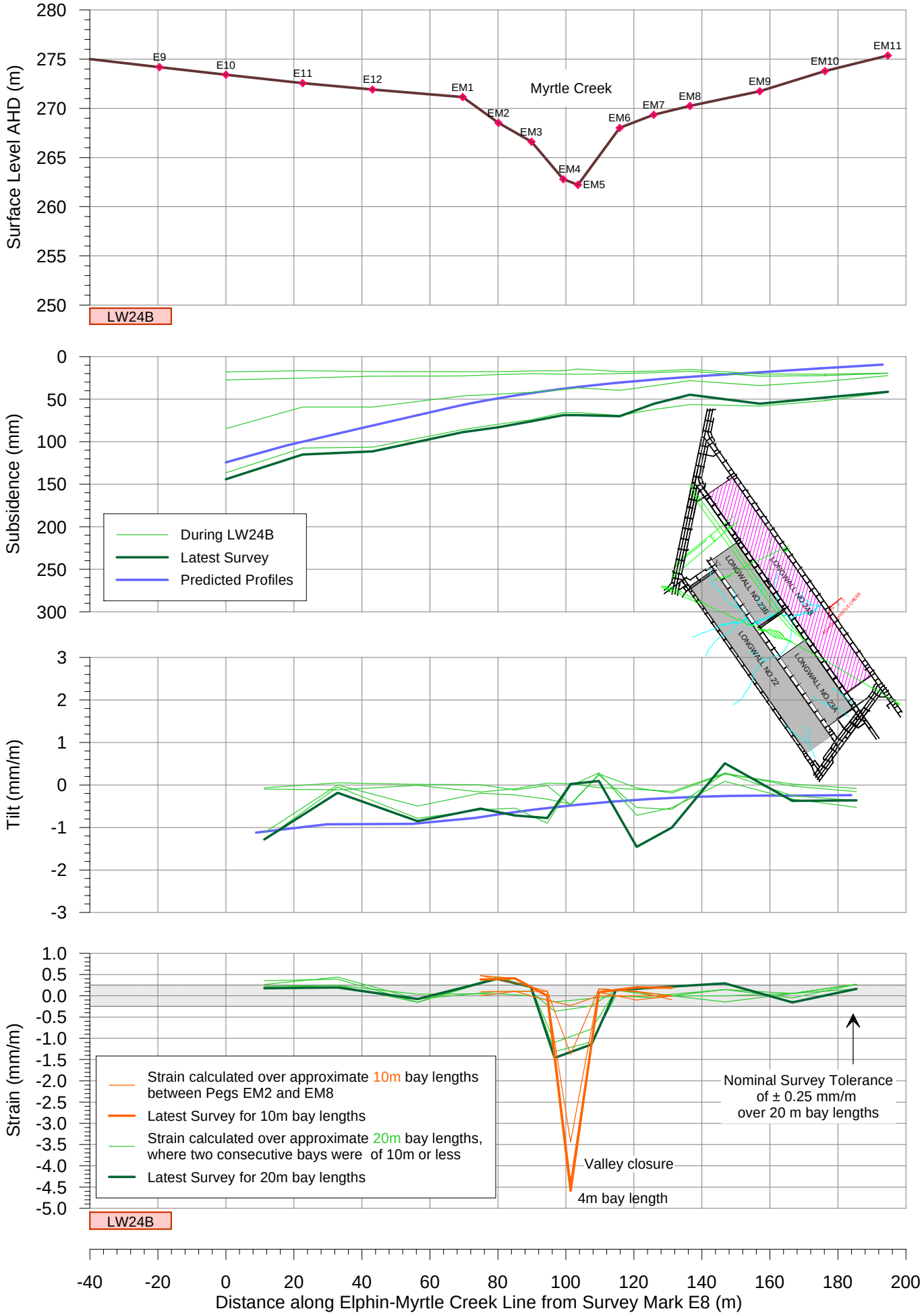

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Fig. MSEC272-16 Rev E

Tahmoor Colliery - Total Subsidence Profiles along Pimelia Street Line

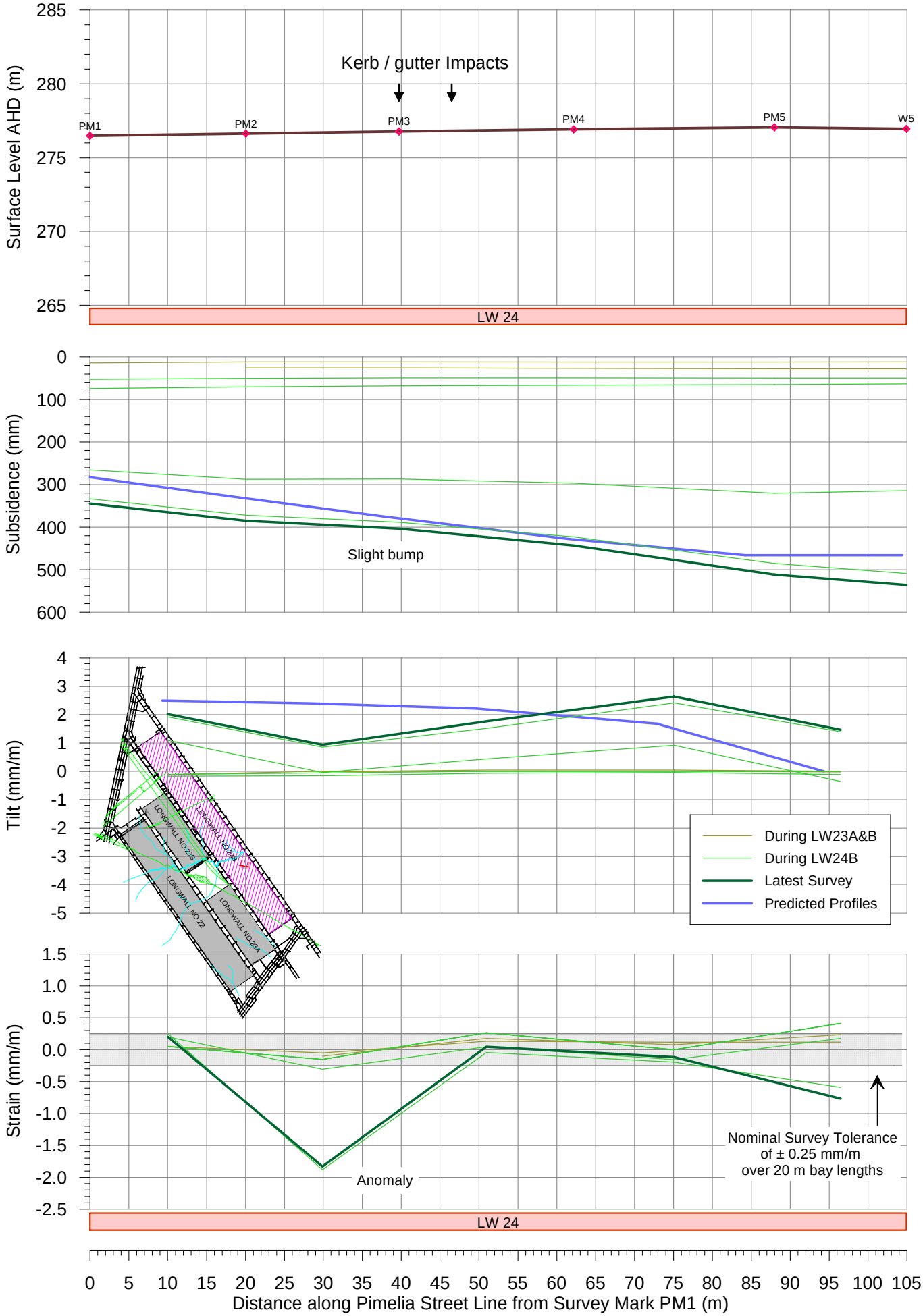

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Fig. MSEC272-17 Rev E

Tahmoor Colliery - Incremental Subsidence Profiles along Pimelia Street Line during LW 24B

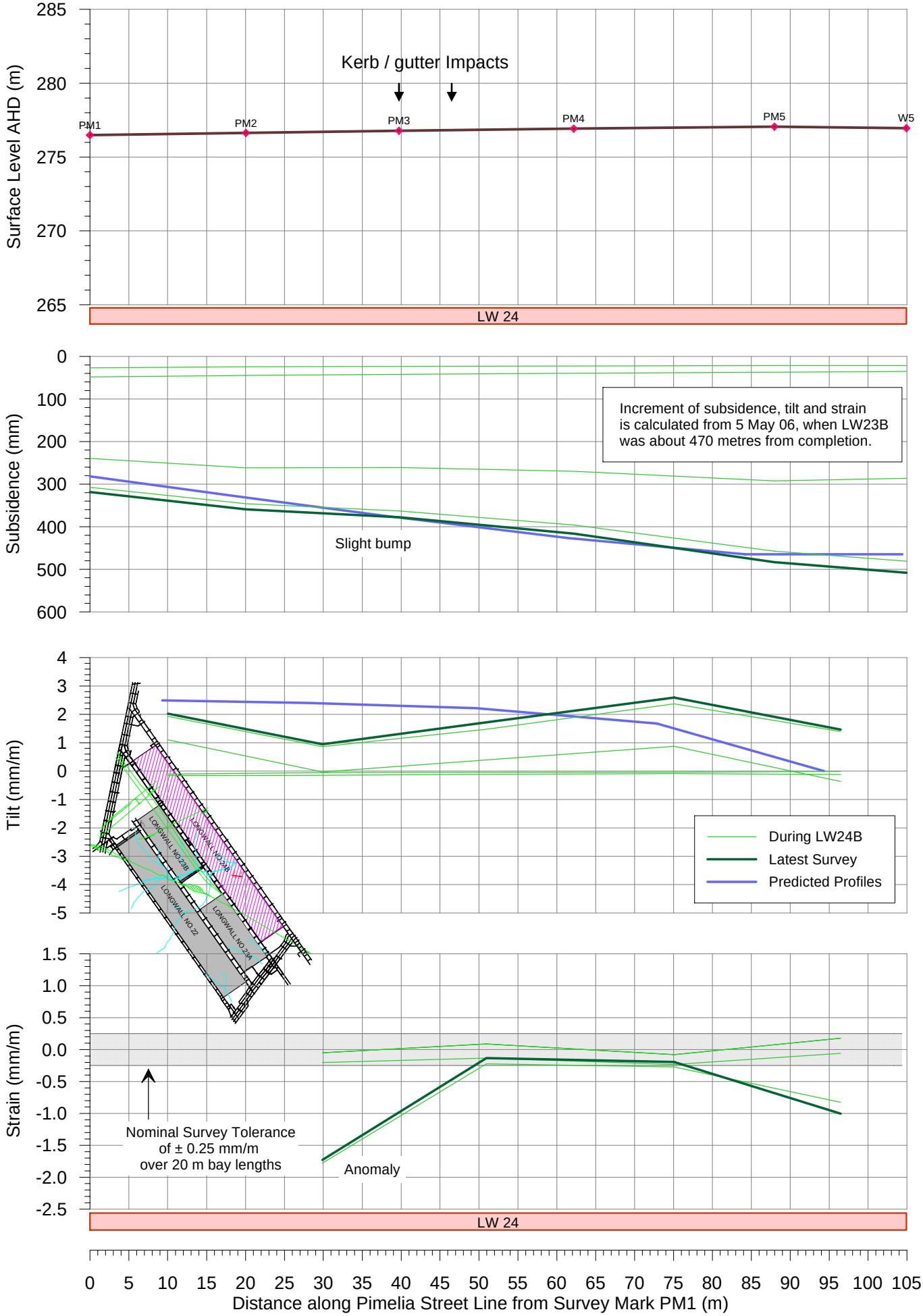

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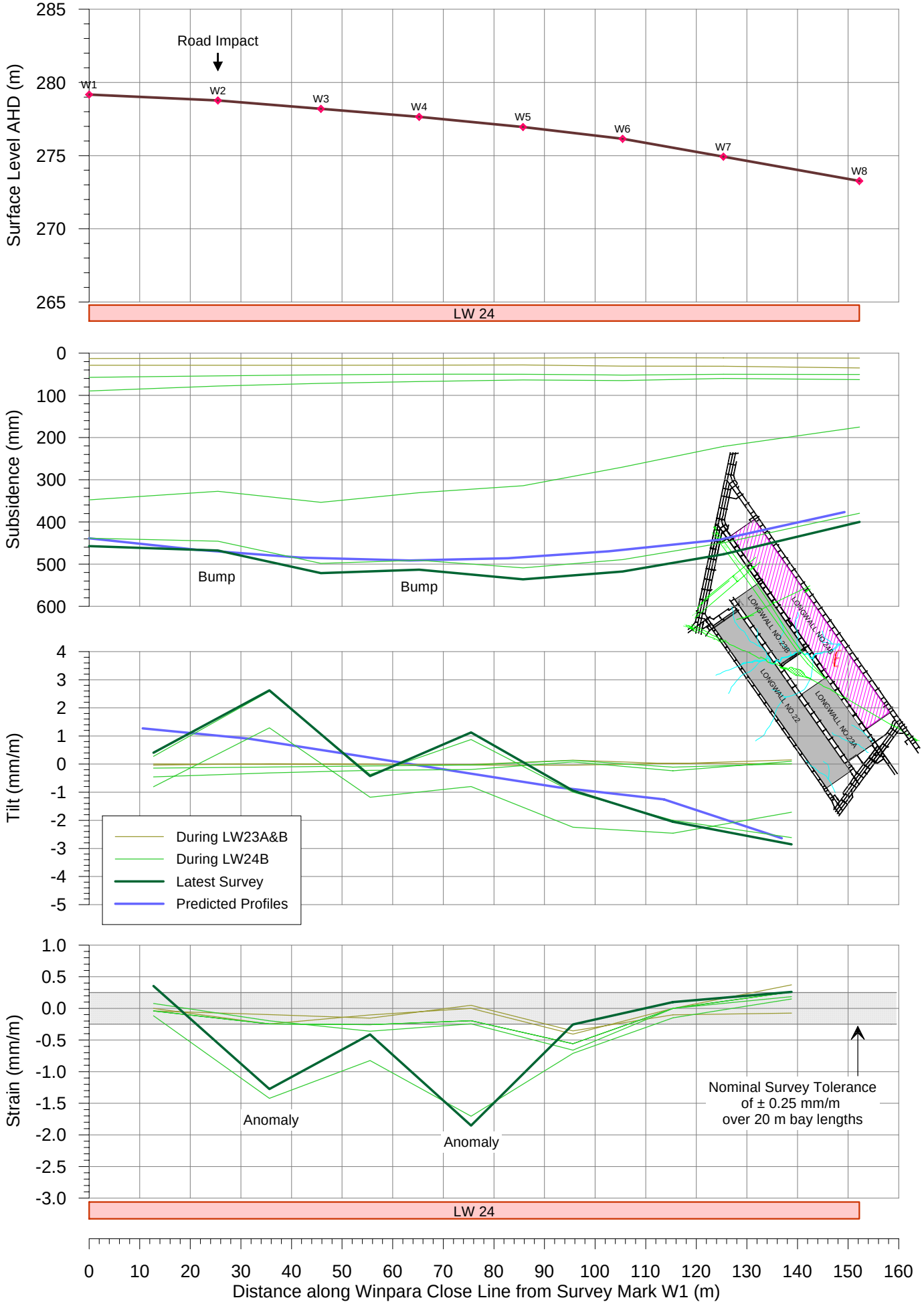
Fig. MSEC272-18 Rev E

Tahmoor Colliery - Total Subsidence Profiles along Winpara Close Line



Tahmoor Colliery - Incremental Subsidence Profiles along Winpara Close Line during LW 24B

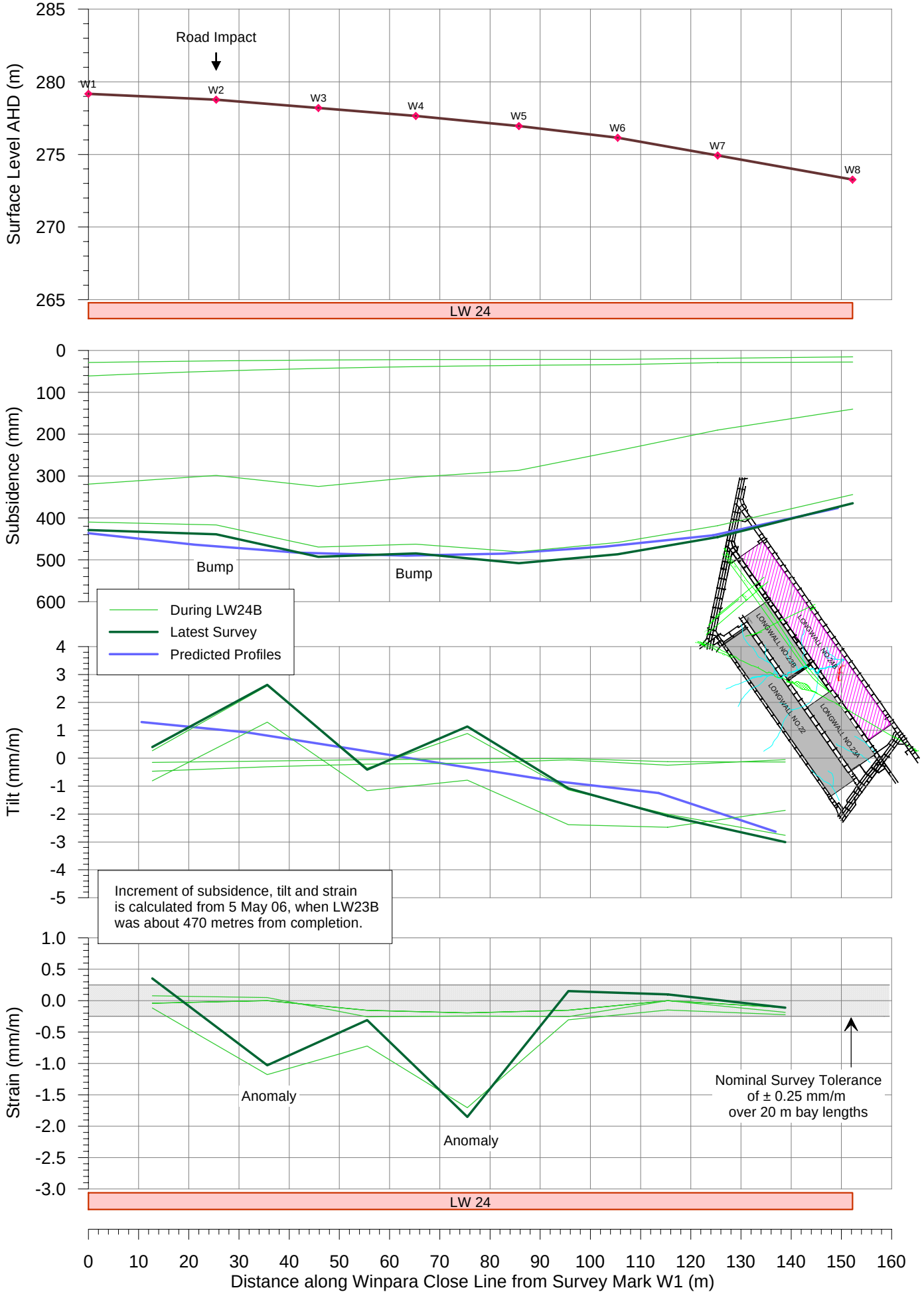


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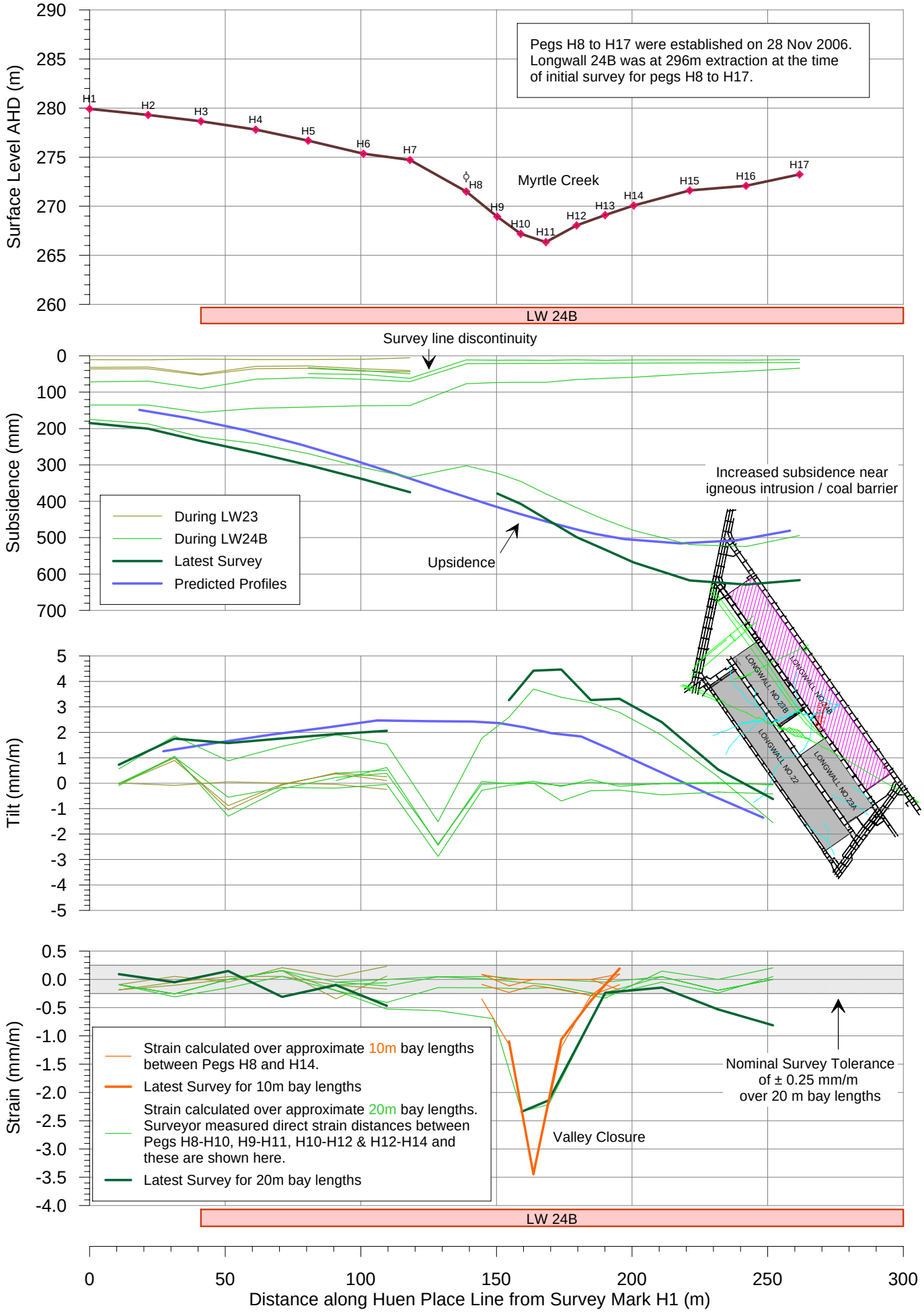
Fig. MSEC272-20 Rev E

Tahmoor Colliery - Total Subsidence Profiles along Huen Place Line



Tahmoor Colliery - Incremental Subsidence Profiles along Huen Place Line during LW 24B

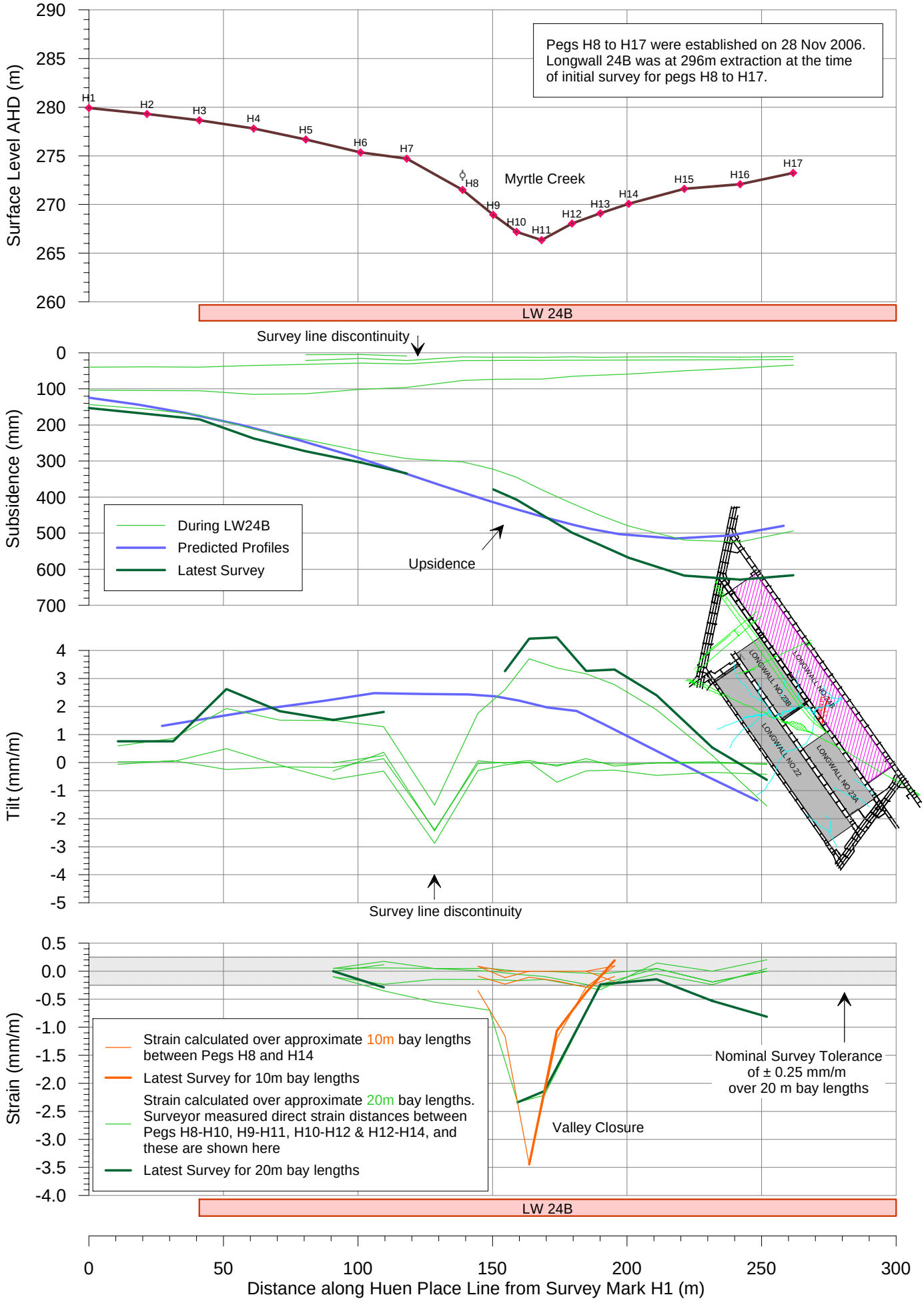


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Fig. MSEC272-22 Rev E

Tahmoor Colliery - Total Subsidence Profiles along Macquarie Place Line

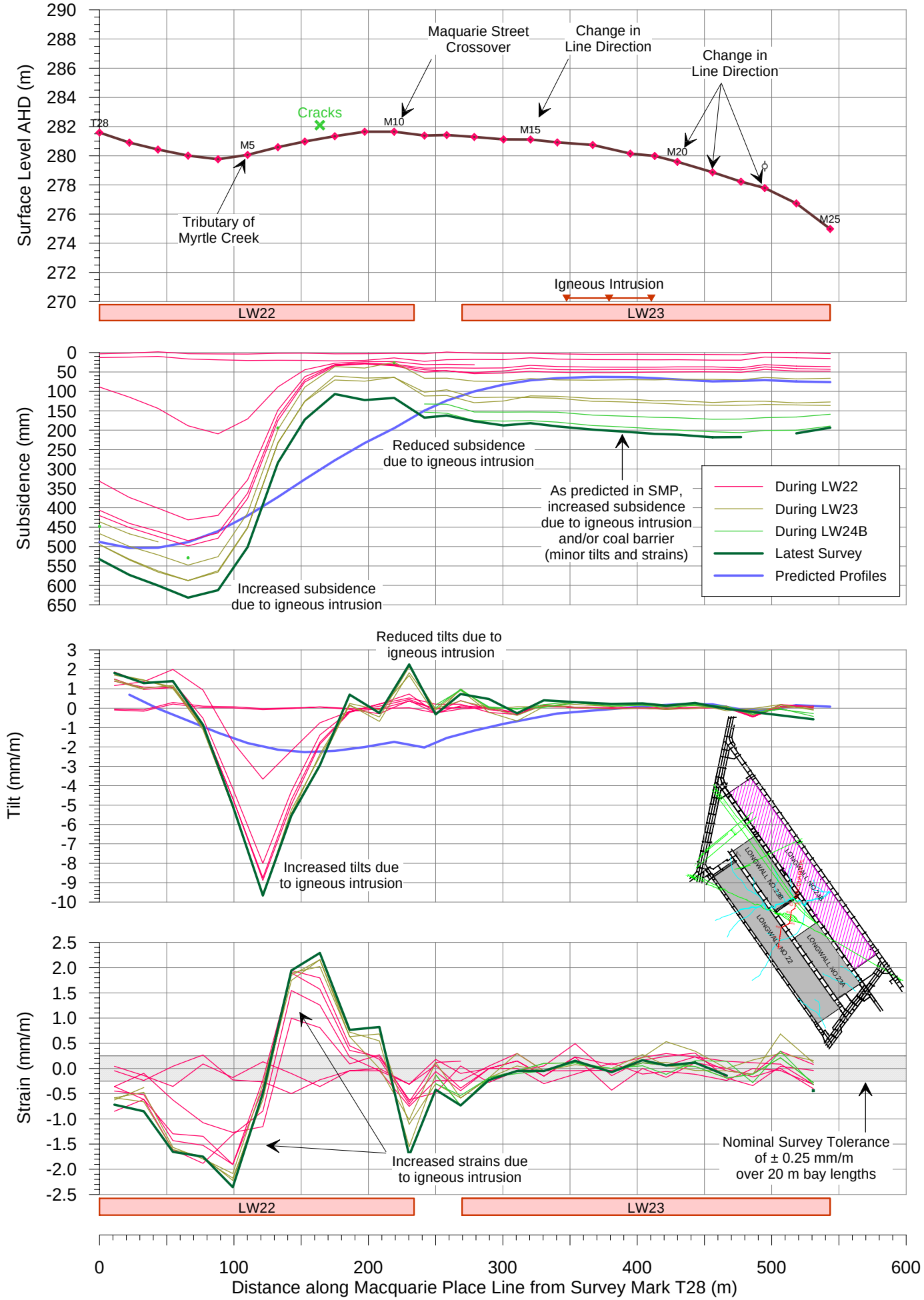

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Fig. MSEC272-23 Rev C

Tahmoor Colliery - Incremental Subsidence Profiles along Macquarie Place Line during LW24B

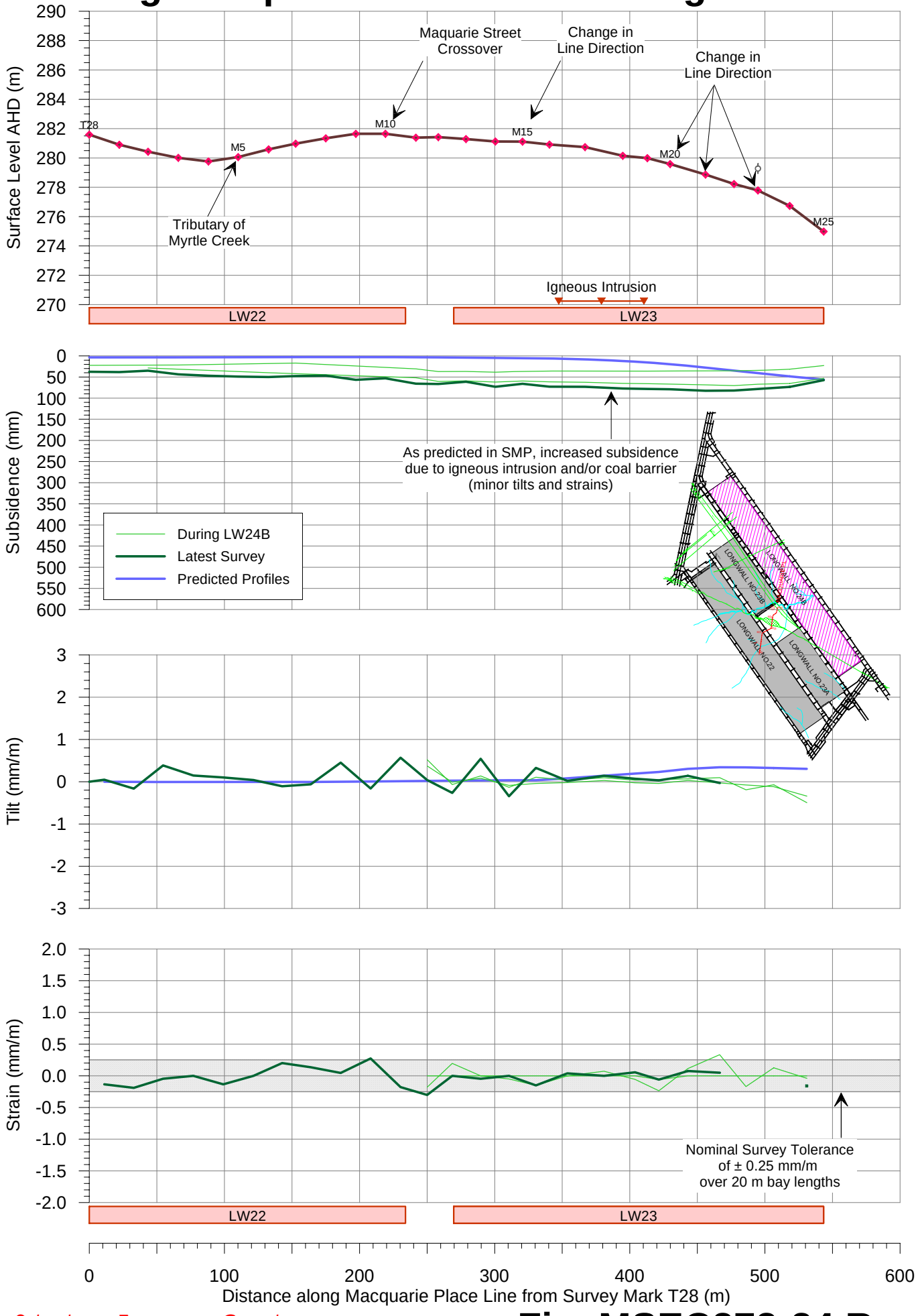

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Fig. MSEC272-24 Rev C

Tahmoor Colliery - Total Subsidence Profiles along Turner-Denmead Line

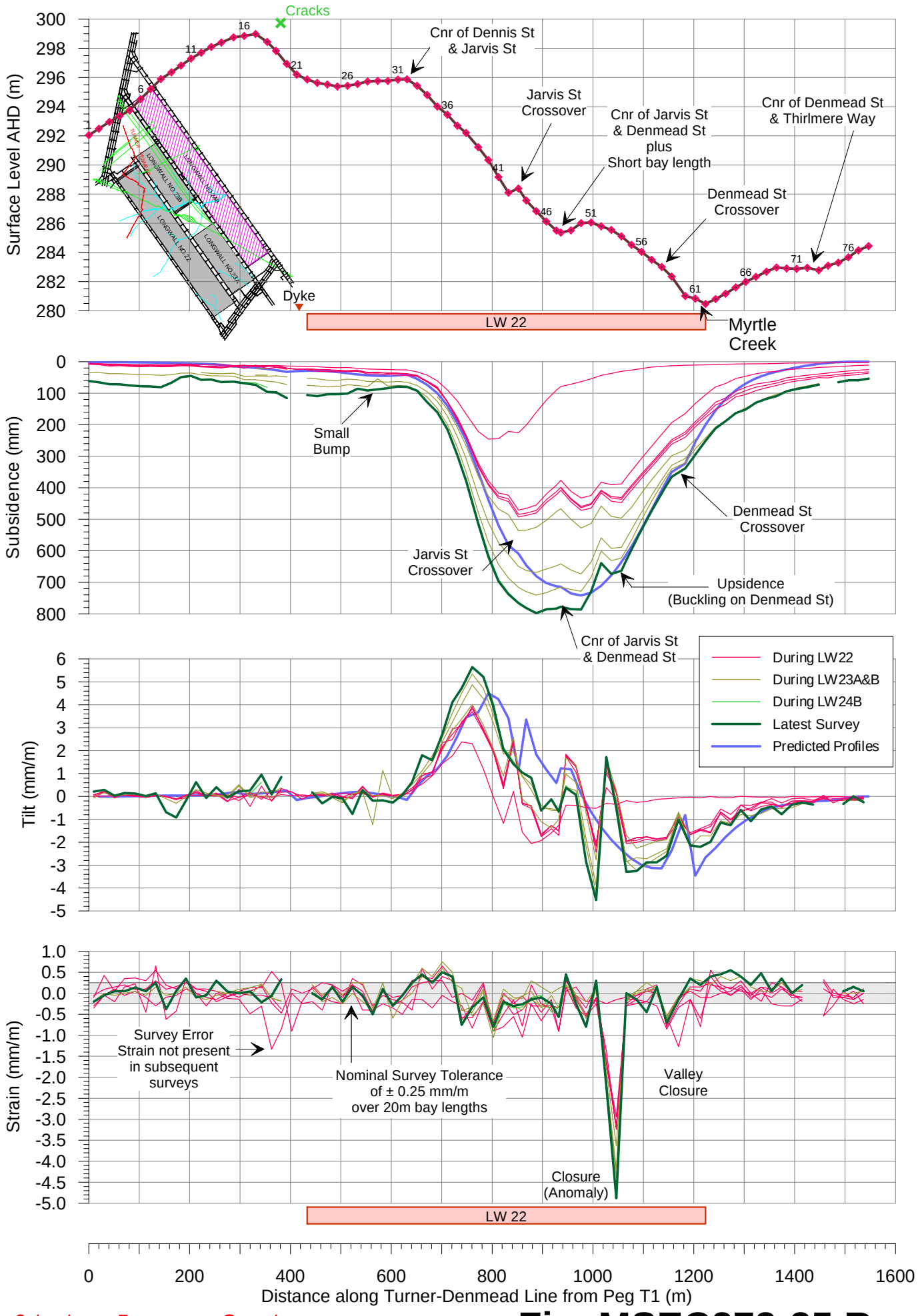

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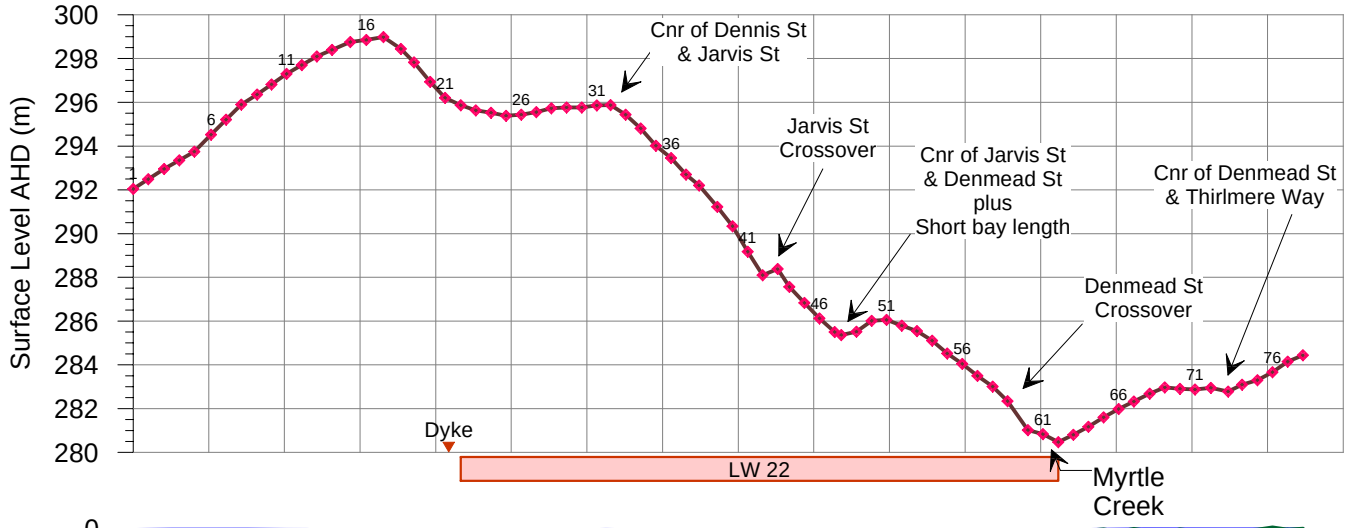
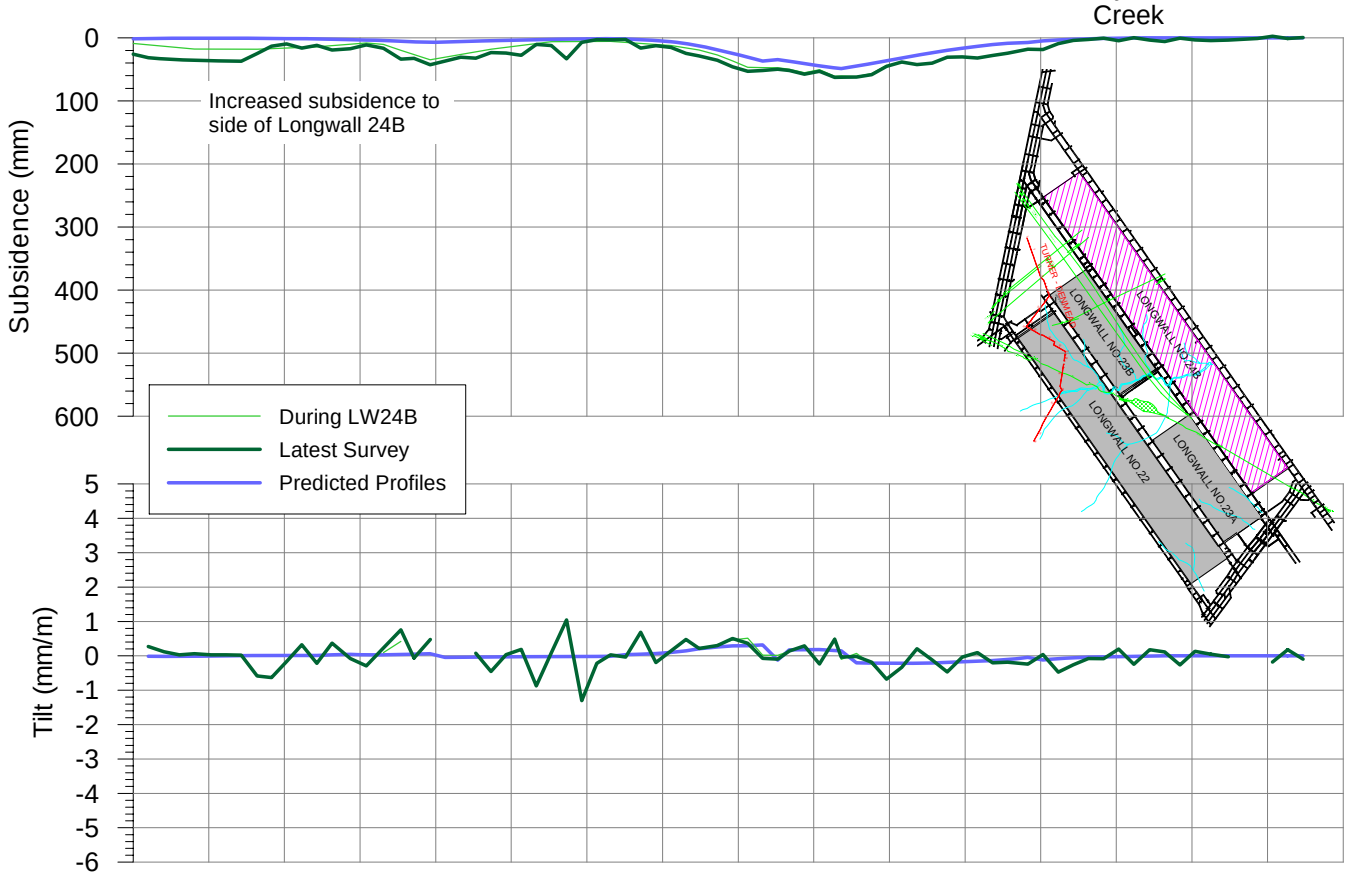
Fig. MSEC272-25 Rev A

Tahmoor Colliery - Incremental Subsidence Profiles along Turner-Denmead Line during LW24B





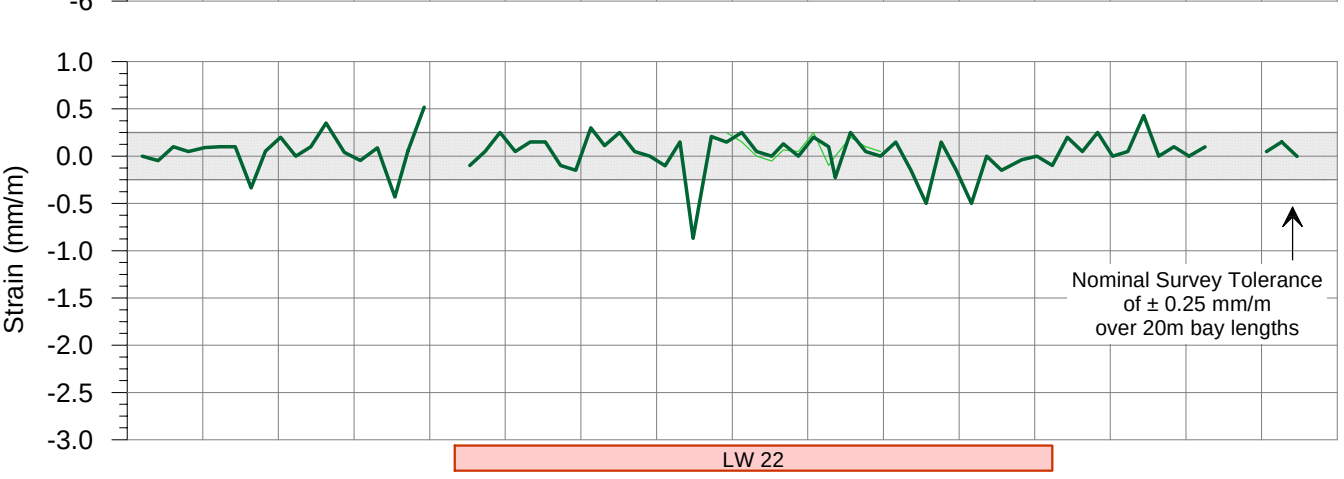


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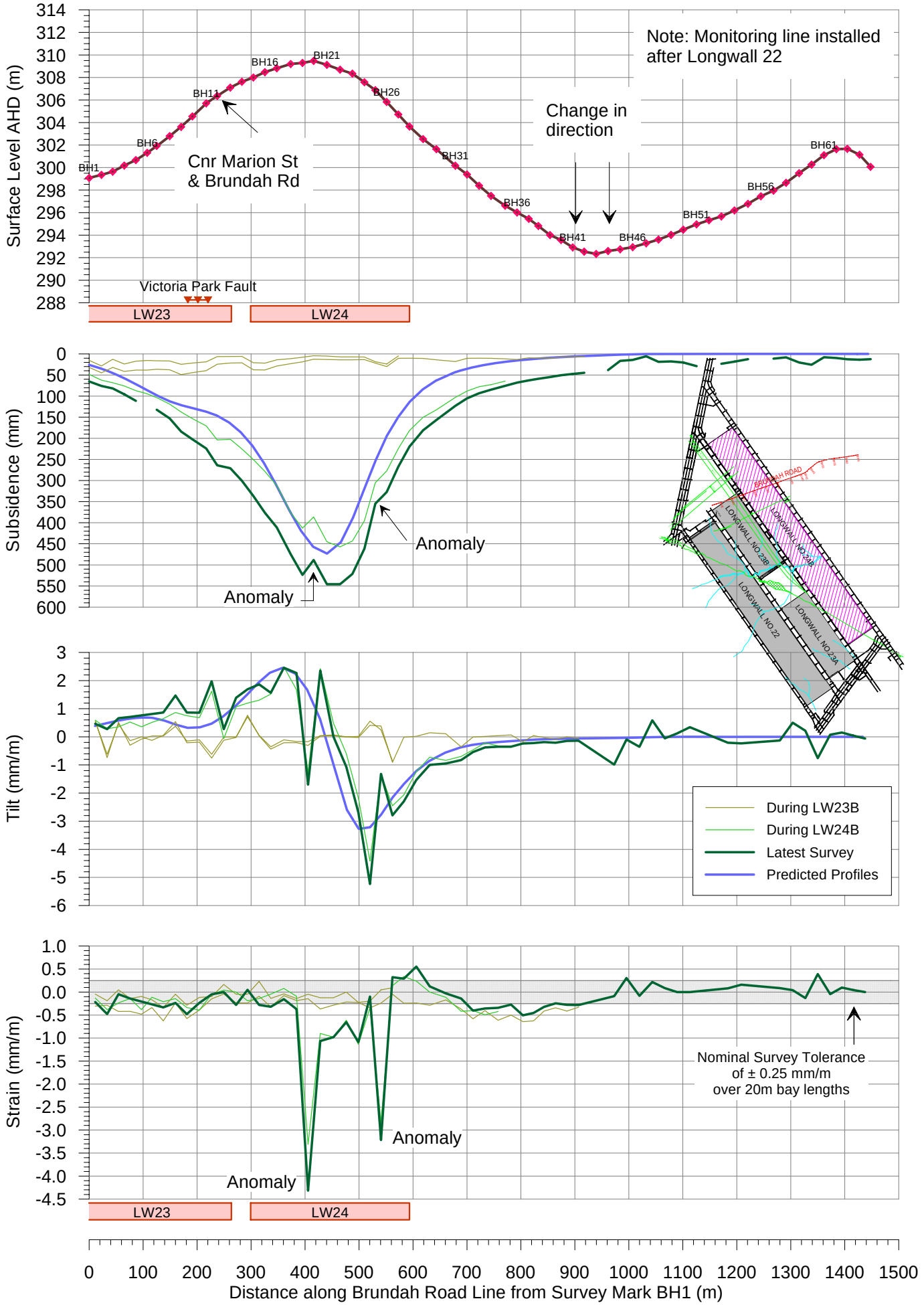
Fig. MSEC272-26 Rev A

Tahmoor Colliery - Total Subsidence Profiles along Brundah Road Line



Tahmoor Colliery - Incremental Subsidence Profiles along Brundah Road Line during LW24B

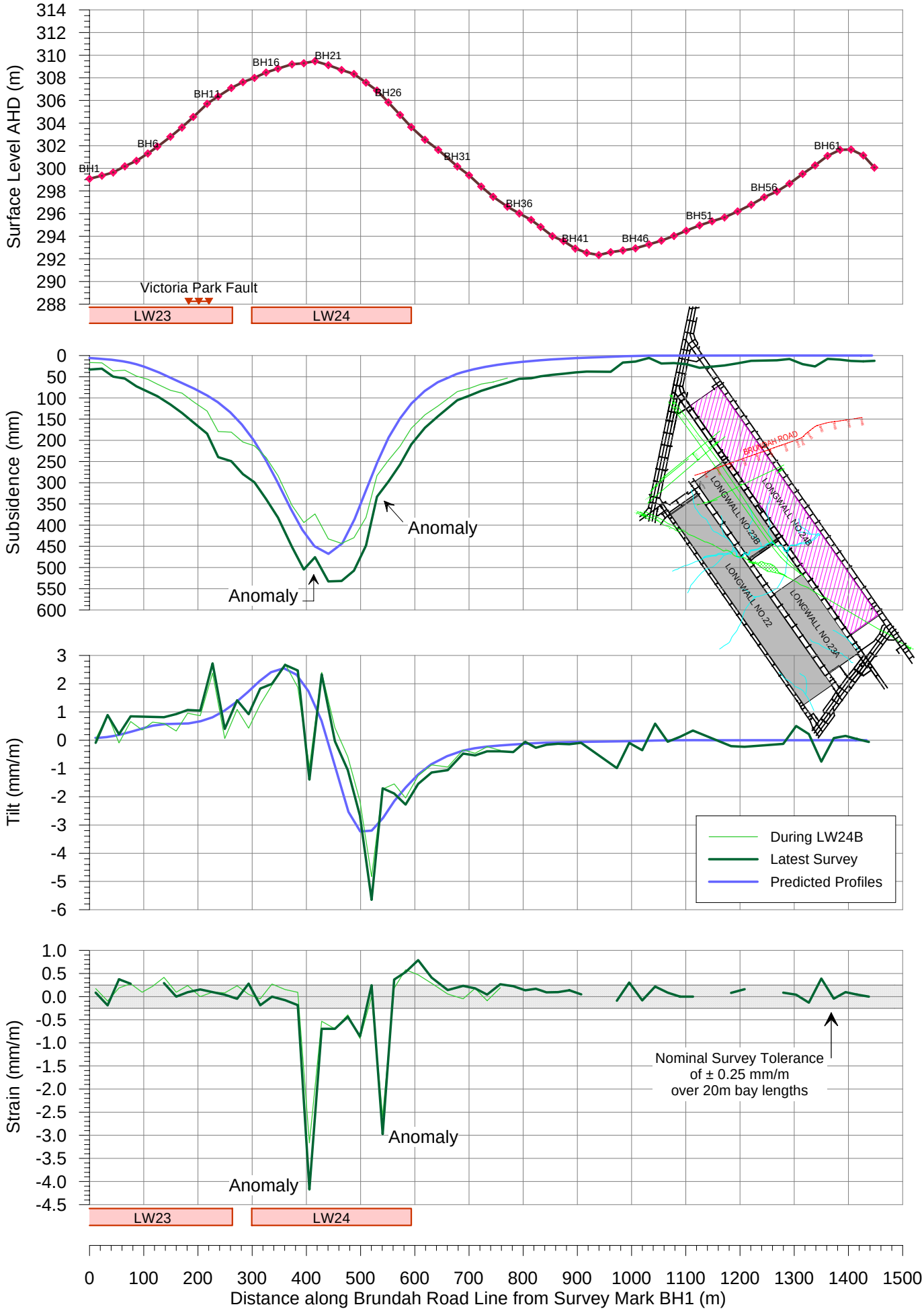


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Fig. MSEC272-28 Rev A

Tahmoor Colliery - Total Subsidence Profiles along Marion Street Line

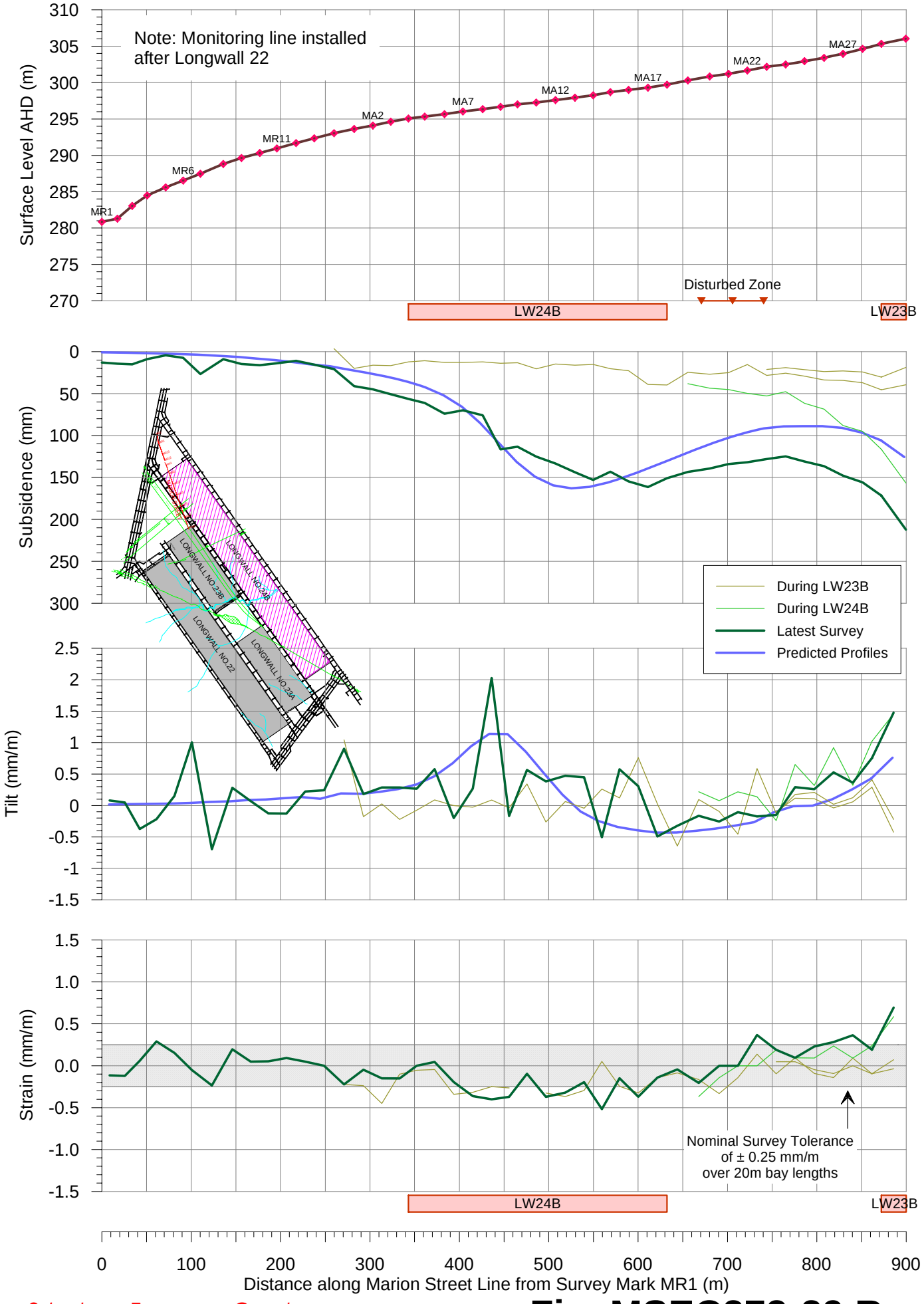

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Fig. MSEC272-29 Rev A

Tahmoor Colliery - Incremental Subsidence Profiles along Marion Street Line during LW24B