



# **TAHMOOR COLLIERY LONGWALL 24A**

**END OF PANEL  
SUBSIDENCE MONITORING REPORT  
FOR LONGWALL 24A  
AT TAHMOOR COLLIERY**



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Compliance with conditions attached to the SMP Approval by the Department of Primary Industries for Longwall 24A – 0m to 250m and Longwall 24A – 250m to End.

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- Meadows Consulting
- Mine Subsidence Board
- Pidgeon Civil Engineering
- Sunrise Building and Property Services
- 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.

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John Matheson & Associates Pty Ltd, August 2008. *Tahmoor Town Centre - Report on column cracking at base of concrete columns in basement car park.*

Pells Sullivan Meynink Pty Ltd, May 2008. Letter report entitled *Assessment of Recent Rockfalls in the Bargo Gorge.*

# TABLE OF CONTENTS

<b>DOCUMENT REGISTER</b>	<b>i</b>
<b>LIST OF DRAWINGS AND ILLUSTRATIONS</b>	<b>iv</b>
<b>CHAPTER 1. INTRODUCTION</b>	<b>6</b>
<b>CHAPTER 2. COMPARISON BETWEEN OBSERVED AND PREDICTED SUBSIDENCE MOVEMENTS</b>	<b>7</b>
2.1. Comparison between Predicted and Observed Systematic Subsidence Movements	8
2.2. Identification of Non-Systematic Subsidence Movements	11
2.3. Bargo River	13
2.3.1. Angle of Draw Surveys	15
2.4. Main Southern Railway	15
2.4.1. Strain Gauge and Switch Displacement Monitoring	15
2.4.2. Thirlmere Way Overbridge	16
2.4.3. Platform Clearance Surveys	16
2.5. Sewer Infrastructure	16
2.6. Power Pole Surveys	19
2.7. Tahmoor Town Centre	19
2.8. Inghams	19
2.8.1. Ground and Building Monitoring Results	19
2.8.2. Ammonia Pipes	19
2.8.3. Pipe Stress Transducers (PSTs)	20
2.8.4. Discussion	20
<b>CHAPTER 3. SUMMARY OF SURVEYS AND INSPECTIONS</b>	<b>21</b>
<b>CHAPTER 4. IMPACTS TO SURFACE FEATURES</b>	<b>26</b>
4.1. Summary of Impacts to Surface Features	26
4.2. Bargo River Gorge	29
4.2.1. Water Quality and Flow Impacts	29
4.2.2. Rockfalls	29
4.2.3. Exceedence of Defined Triggers	29
4.3. Main Southern Railway	29
4.3.1. Thirlmere Way Overbridge	30
4.3.2. Exceedence of Defined Triggers	30
4.4. Roads	30
4.4.1. Exceedence of Defined Triggers	30
4.5. Potable Water Infrastructure	32
4.5.1. Exceedence of Defined Triggers	32
4.6. Gas Infrastructure	32

4.6.1.	Exceedence of Defined Triggers	32
4.7.	Sewer Infrastructure	32
4.7.1.	Exceedence of Defined Triggers	32
4.8.	Electrical Infrastructure	33
4.8.1.	Exceedence of Defined Triggers	33
4.9.	Telecommunication Infrastructure	33
4.9.1.	Exceedence of Defined Triggers	33
4.10.	Inghams Infrastructure	33
4.10.1.	Processing Plant	33
4.10.2.	Inghams Dams	34
4.10.3.	Exceedence of Defined Triggers	34
4.11.	Residential Structures and Public Amenities	34
4.11.1.	Comparison in General	36
4.11.2.	Comparison based on Predicted Impact Categories	37
4.11.3.	Discussion of Results	37
4.11.4.	Swimming Pools	42
4.11.5.	Associated Structures	42
4.11.6.	Fences	42
4.11.7.	Exceedence of Defined Triggers	42
4.12.	Public Amenities	42
4.12.1.	Exceedence of Defined Triggers	42
4.13.	Tahmoor Town Centre	42
4.13.1.	Observations of Cracking	42
4.13.2.	Possible Causes of Cracking	39
4.13.3.	Conclusions	39
4.13.4.	Exceedence of Defined Triggers	39
<b>CHAPTER 5. SUMMARY OF RESULTS</b>		<b>44</b>

## LIST OF DRAWINGS AND ILLUSTRATIONS

### Drawings

<i>Drawing No.</i>	<i>Description</i>
MSEC335-01	Longwall 24A Monitoring Lines
MSEC335-02	Longwall 24A Impacts

### Figures

<i>Figure No.</i>	<i>Description</i>
MSEC335-01	Total Subsidence Profiles along Bradbury Street Line
MSEC335-02	Total Subsidence Profiles along BC Line
MSEC335-03	Total Subsidence Profiles along Castlereagh Street Line
MSEC335-04	Total Subsidence Profiles along Chapman Street Line
MSEC335-05	Total Subsidence Profiles along Courtland Avenue Line
MSEC335-06	Total Subsidence Profiles along Emmett Street Line
MSEC335-07	Total Subsidence Profiles along Larkin Street Line
MSEC335-08	Total Subsidence Profiles along Lintina Street Line
MSEC335-09	Total Subsidence Profiles along LW24A Draw Line
MSEC335-10	Total Subsidence Profiles along LW25 Draw Line
MSEC335-11	Total Subsidence Profiles along LW26 Draw Line
MSEC335-12	Total Subsidence Profiles along the Main Southern Railway Corridor Line
MSEC335-13	Incremental Subsidence Profiles the Main Southern Railway Corridor Line
MSEC335-14	Total Subsidence Profiles along Mitchell Close Line
MSEC335-15	Total Subsidence Profiles along Pandora Place Line
MSEC335-16	Total Subsidence Profiles along Progress Street Line
MSEC335-17	Incremental Subsidence Profiles along Progress Street Line
MSEC335-18	Total Subsidence Profiles along Ralfe Street Line
MSEC335-19	Total Subsidence Profiles along Remembrance Drive Line
MSEC335-20	Incremental Subsidence Profiles along Remembrance Drive Line
MSEC335-21	Total Subsidence Profiles along Remembrance Drive Shopfronts Line
MSEC335-22	Total Subsidence Profiles along Tanya Place Line
MSEC335-23	Total Subsidence Profiles along Thirlmere Way Line
MSEC335-24	Incremental Subsidence Profiles along Thirlmere Way Line
MSEC335-25	Total Subsidence Profiles along Inghams Dam Line
MSEC335-26	Total Subsidence Profiles along Inghams East-West Line
MSEC335-27	Total Subsidence Profiles along Inghams High-Rise Freezer Line
MSEC335-28	Total Subsidence Profiles along Inghams North-South Line
MSEC335-29	Total Subsidence Profiles along Inghams Pipe Support Line (PS1-PS15)
MSEC335-30	Total Subsidence Profiles along Inghams Pipe Support Line (PS16-PS23)

MSEC335-31	Total Subsidence Profiles along Inghams Plant Line
MSEC335-32	Total Subsidence Profiles along Mermaid Pool Line
MSEC335-33	Total Subsidence Profiles along Bargo River X1 Line
MSEC335-34	Total Subsidence Profiles along Bargo River X2 Line
MSEC335-35	Total Subsidence Profiles along Bargo River X3 Line
MSEC335-36	Total Subsidence Profiles along Bargo River X3a Line
MSEC335-37	Total Subsidence Profiles along Bargo River X4 Line
MSEC335-38	Total Subsidence Profiles along Bargo River X5a Line
MSEC335-39	Total Subsidence Profiles along Bargo River X5b Line
MSEC335-40	Total Subsidence Profiles along Bargo River X5c Line
MSEC335-41	Total Subsidence Profiles along Bargo River X6 Line

## 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 Clause 23.

This report includes:

- A summary of the subsidence and environmental monitoring results for Longwall 24A;
- An analysis of these results against the relevant impact assessment criteria, monitoring results from previous panels and predictions provided in the SMP;
- The identification of any trends in the monitoring results;
- A description of actions that were taken to ensure adequate management of any potential subsidence impacts

The location of Longwall 24A is shown in Drawing No. MSEC335-01, 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 24A. Note that Longwall 24B was extracted prior to Longwall 24A. The dates of extraction for all longwalls are provided in Table 1-1.

**Table 1-1 Start and Finish Dates for Longwalls 22 to 24A**

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	19 July 2008

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 24A was approximately 991 metres long and 283 metres wide, rib to rib. The pillar width was approximately 34.5 metres wide, rib to rib. However, there is a coal barrier between Longwall 24A and the previously extracted 200 Panels of approximately 160 metres width. The depth of cover was relatively consistent over the panel, varying between 430 and 440 metres. While the seam thickness was approximately 2.1 metres, Tahmoor Colliery advised that the design cut 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 24A.

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

Chapter 4 of this report describes the reported impacts on surface features resulting from the extraction of Longwall 24A, 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 24A are shown in Drawing No. MSEC335-01.

A number of these monitoring lines were installed prior to the commencement of Longwall 24A to measure subsidence movement at key surface features such as the Inghams Plant, Remembrance Drive and Main Southern Railway.

Additional monitoring lines were installed as mining progressed when it became apparent that the urban area may experience increased subsidence. Some subsidence had already developed at each of these additional survey marks prior to the initial survey. A summary of all monitoring lines, dates of initial survey and estimated subsidence prior to initial survey are provided in Table 2-1.

**Table 2-1 Summary of Monitoring Lines directly above Longwall 24A**

Monitoring Line	Date of Initial Survey	Estimated subsidence due to LW 24A prior to initial survey (mm)
LW24A Draw Line	15 November 2007	0
Dam Line	14 November 2007	0
East-West Line	14 November 2007	0
North-South Line	14 November 2007	0
High-Rise Freezer Line (HRF1 to HRF5)	14 November 2007	0
High-Rise Freezer Line (HRF6 to HRF18)	14 March 2008	30 to 130
Plant and Pipe Support Lines	04 December 2007	5
BC Line	22 April 2008	70 to 245
Ralfe Street Line	10 April 2008	20 to 25
Lintina Street Line	02 May 2008	25 to 70
Courtland Avenue Line	02 May 2008	15 to 55
Tanya Place Line	02 May 2008	30 to 50
Mitchell Close Line	02 May 2008	30 to 35
Pandora Place Line	02 May 2008	20 to 30
Progress Street Line	03 October 2006	0
Remembrance Drive Line	13 May 2005	0
Larkin Street Line	20 May 2008	10 to 30
York Street Line	20 May 2008	15 to 25
Emmett Street Line	20 May 2008	20 to 35

In addition to the monitoring lines, subsidence monitoring was conducted at survey stations located at and around the Tahmoor Town Centre, selected power poles and at the Bargo Gorge in accordance with the Surface Safety and Serviceability Management Plan.

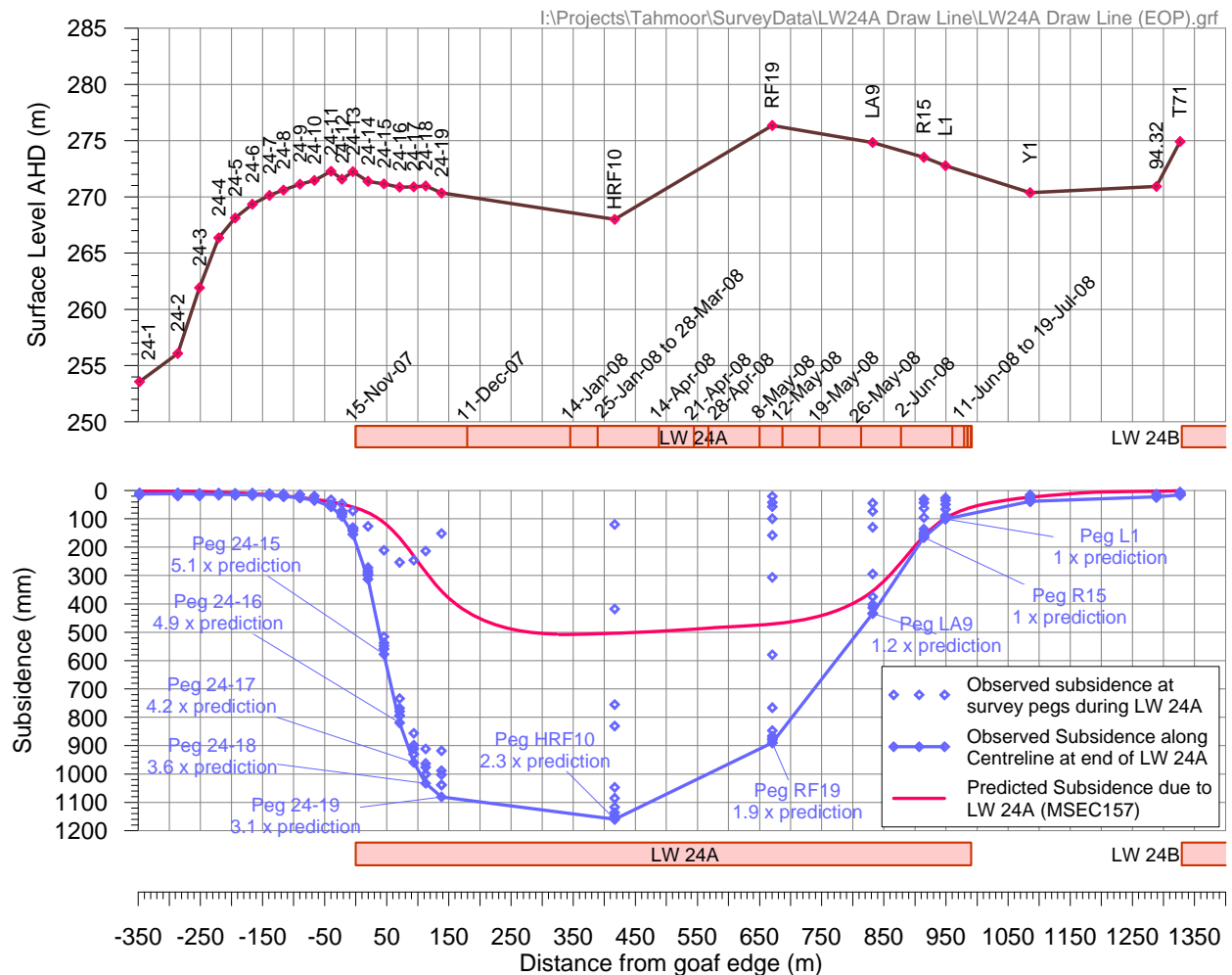
Surveys were undertaken at regular intervals during the extraction of Longwall 24A and the End of Panel surveys were conducted during July and August 2008. The observed total and incremental subsidence profiles along the monitoring lines are provided in Figs. MSEC335-01 to MSEC335-41.

### 2.1. Comparison between Predicted and Observed Systematic Subsidence Movements

Observed subsidence, tilt and curvature due to the mining of Longwall 24A have substantially exceeded predictions. Maximum observed subsidence was 1169 mm, which was more than double the maximum predicted subsidence of 509 mm. While observed tilts and curvature were also substantially greater than predicted, observed ground strains were within the normal range.

The observation of increased subsidence was not observed at other nearby longwalls at Tahmoor Colliery, where there was a reasonable correlation between predicted and observed profiles over Longwalls 22, 23 and 24B.

Observed subsidence was greatest above the southern half of Longwall 24A, and gradually reduced in magnitude towards the northern half of the longwall, which was directly beneath the urban area of Tahmoor. These observations are shown graphically in Figure 2.1, which shows observed subsidence at survey pegs located along the centreline of Longwall 24A.



**Figure 2.1 Observed Subsidence along Centreline of Longwall 24A**

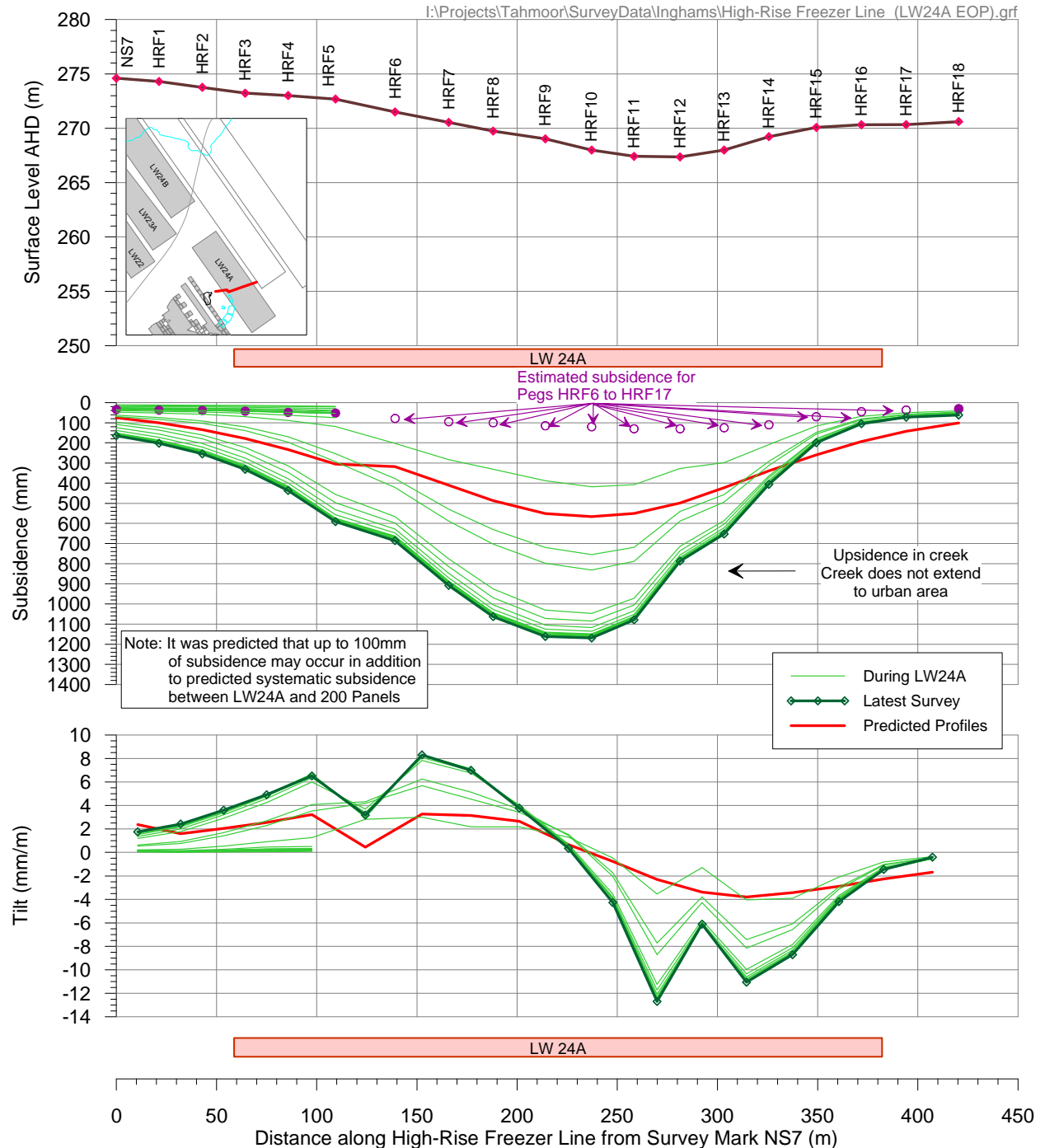
It can be seen from Figure 2.1 that while observed subsidence was substantially greater than predicted above the commencing end of the longwall, observed subsidence compared reasonably well with predictions towards the finishing end of Longwall 24A.

Maximum observed incremental and total subsidence parameters for all monitoring lines surveyed during Longwall 24A are summarised in Table 2-2. The maximum value for each parameter is highlighted.

**Table 2-2 Summary of Maximum Subsidence along Monitoring Lines**

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Hogging Curvature (km <sup>-1</sup> )	Maximum Observed Sagging Curvature (km <sup>-1</sup> )	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Compressive Strain (mm/m)
Bradbury Street	47	0.8	0.05	-0.05	0.4	-0.3
BC Line	779	5.1	0.11	-0.18	0.1	-0.3
Castlereagh Street	17	0.2	0.01	-0.01	0.4	-0.2
Chapman Street	15	0.2	0.01	-0.01	0.2	-0.5
Courtland Avenue	730	6.0	0.14	-0.03	0.4	-0.6
Emmett Street	84	0.5	0.02	-0.01	0.1	-0.1
Larkin Street	110	1.2	0.03	-0.01	0.4	-0.2
Lintina Street	630	3.6	0.09	-0.13	0.1	-1.1
LW24A Draw Line	1091	10.2	0.15	-0.14	1.3	-0.4
LW25 Draw Line	12	0.3	0.01	-0.01	0.3	-0.3
LW26 Draw Line	20	0.4	0.02	-0.02	0.5	-0.5
Main Southern Railway	40	0.6	0.03	-0.06	0.3	-0.5
Mitchell Close	471	4.3	0.06	-0.23	0.3	-4.8
Pandora Place	120	1.1	0.02	-0.02	0.1	-0.1
Progress Street	26	0.3	0.08	-0.05	-	-
Ralfe Street	937	8.4	0.1	-0.13	1.2	-3.2
Remembrance Drive	199	3.0	0.12	-0.11	0.8	-0.4
Remembrance Drive Shopfronts	127	1.4	0.10	-0.03	-	-
Tanya Place	462	6.8	0.10	0.00	0.9	0.0
Thirlmere Way	36	1.5	0.12	-0.08	0.2	-0.2
<b>Inghams</b>						
Dam Line	762	4.7	0.06	-0.14	0.5	-0.3
East-West Line	602	6.4	0.08	-0.03	1.0	-0.2
High-Rise Freezer Line	1169	12.7	0.29	-0.38	1.0	-2.5
North-South Line	174	0.5	0.01	-0.03	0.1	-0.2
Pipe Support Line	108	0.7	0.14	-0.10	0.7	-0.7
Plant Line	118	0.7	0.12	-0.08	2.8	-0.4

The distribution of subsidence transverse to the longwalls is illustrated by the results along the High-Rise Freezer Line (Figure 2.2). This shows that subsidence on the tailgate side (Inghams side) was greater than the subsidence on the maingate side (Progress Street side). The potential for increased subsidence on the tailgate side was anticipated as the tailgate side is located above mostly solid, unmined coal reserves that lie between a previously mined area (200 Panels) and the currently mined Longwall 24A. Observations of increased subsidence have been experienced in similar previous mining situations.



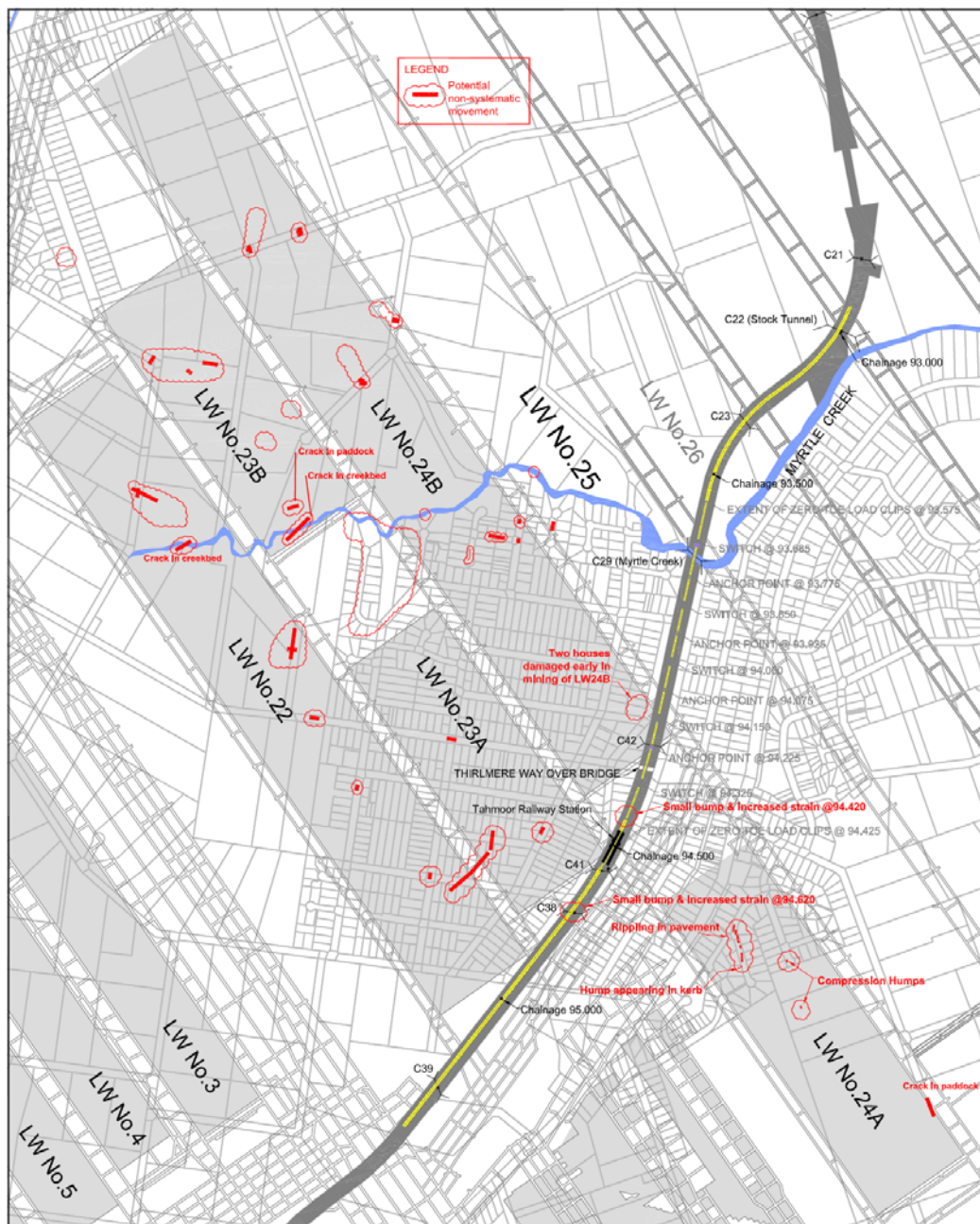
**Figure 2.2 Observed Subsidence along the High-Rise Freezer Line during Longwall 24A**

While subsidence is greater on the tailgate side, tilts and curvatures on the tailgate side are comparatively less than on the maingate side as the shape of the subsidence profile is flatter. For example, maximum tilts on the tailgate side are approximately 8 mm/m, compared to over 10 mm/m on the maingate side along the High-Rise Freezer line.

The nature and magnitude of the increased subsidence is rare and the cause of the increased subsidence is currently not known. Tahmoor Colliery has commissioned a geotechnical study by Dr Winton Gale of Strata Control Technology to try to identify the cause or causes of the increased subsidence. Results of this study are not yet available as research is continuing. Once it became apparent that increased subsidence had developed, Tahmoor Colliery revised its management plans during extraction of LW24A to manage potential increased impacts to surface infrastructure before the longwall extracted beneath the urban area of Tahmoor.

## 2.2. Identification of Non-Systematic Subsidence Movements

A plan showing the locations of potential non-systematic movements observed at Tahmoor is shown in Figure 2.3. The locations were selected based on ground monitoring results or observed impacts that appear to have been caused by non-systematic movement. A total of approximately 30 locations (not including valleys) have been identified over the four extracted Longwalls 22 to 24, of which 3 locations are located above Longwall 24A.



**Figure 2.3 Map of locations of potential non-systematic movement**

Monitoring lines crossed the locations of non-systematic movement along two monitoring lines. A summary of non-systematic movements at these locations is provided below in Table 2-3.

**Table 2-3 Location of New Identified Non-Systematic Movements during Longwall 24A**

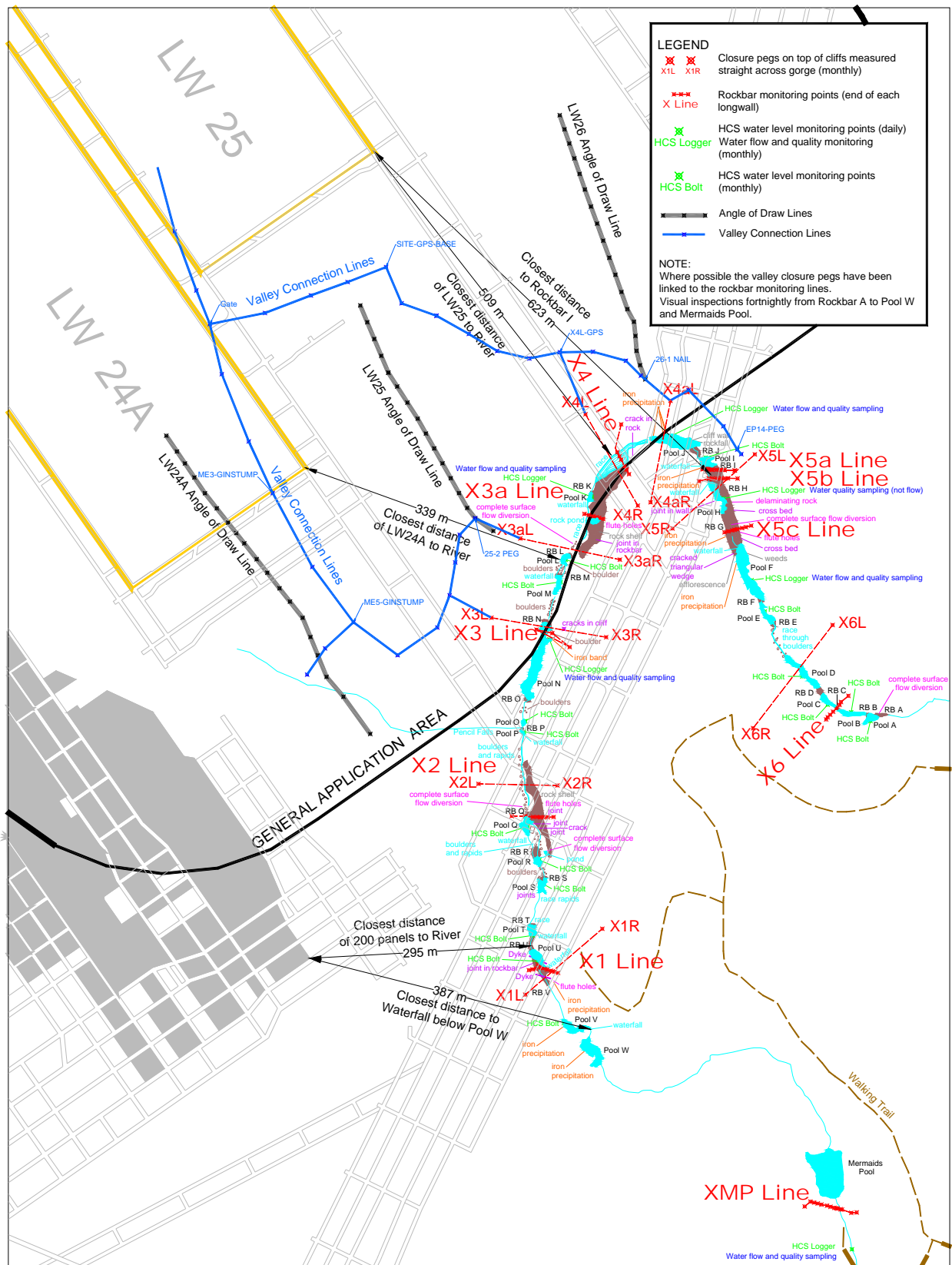
Monitoring Line or Location	Maximum Upsidence (mm)	Maximum Strain (mm/m)	Maximum Tilt (mm/m)	Type	Impacts to Surface
Mitchell Close / Lintina Street (Pegs ML1-LA8)	Not measured as end of monitoring line	-4.8	4.3	Anomaly	Road pavement cracking, adjustment to tension of aerial phone lines
Ralfe Street /Courtland Ave (Pegs RF19-20 and CL1-CL3)	35 (CL1 to CL3)	-3.2 (RF19-20)	5.9 (CL1 to CL3)	Anomaly	5 houses (3xCat 0, 1xCat 1 & 1xCat 4) and compression hump in pavement and kerbs
High-Rise Freezer (Pegs HRF11-13)	82	-2.5	12.7	Valley upsidence & closure	None (in paddock)

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 most severe non-systematic movement observed during the mining of Longwall 24A occurred along Lintina Street. The road pavement experienced severe cracking. The movements developed gradually over time and the pavement was repaired on a number of occasions as mining progressed. Photographs of the impacts are shown in Figure 4.1.

### 2.3. Bargo River

The location of Longwall 24A relative to the Bargo River is shown in Figure 2.4.



**Figure 2.4 Location of Longwall 24A in relation to the Bargo River**

A summary of observed subsidence parameters is provided in Table 2-4.

**Table 2-4 Summary of Observed Subsidence, Upsidence and Closure along Bargo Gorge Cross Lines**

Monitoring Line	Maximum Observed Subsidence at top of Gorge (mm)	Maximum Observed Subsidence at base of Gorge (mm)	Upsidence (mm)	Closure (mm)
Survey Tolerance	± 5 mm	± 10 mm between top and bottom of gorge	± 3 mm differential vertical subsidence	± 3 mm for horizontal distance across tops of Gorge
Mermaids Pool	No pegs	Not connected to datum	0	0
X1 Cross Line	Not connected to datum	Not connected to datum	0	-2 (closure)
X2 Cross Line	Not connected to datum	Not connected to datum	0	-2 (closure)
X3 Cross Line	9	15	0	0
X3a Cross Line	8	11	0	-2 (closure)
X4 Cross Line	8	12	0	-3 (closure)
X4a Cross Line	9	No pegs	No pegs	-2 (closure)
X5a Cross Line	11	12	0	0
X5b Cross Line	11	12	0	0
X5c Cross Line	11	11	0	0
X6 Cross Line	Not connected to datum	Not connected to datum	0	0

The monitoring results indicate that no measureable upsidence or closure has occurred across any of the monitoring lines across the Bargo Gorge during the mining of Longwall 24A. All differential movements have been very small and close to or within stated survey tolerance.

The observed subsidence is less than 20 mm as predicted. The results indicate that the Gorge may be experiencing a small amount of vertical subsidence of approximately 11 mm or less, based on the more accurate surveys at the tops of the Gorge.

The current observed movements during the mining of Longwall 24A are less than the predicted Longwall 24A maximum incremental upsidence of 20 mm and maximum incremental closure of 50 mm. Given the incised nature of the Gorge and its significant valley height, it was considered possible that actual upsidence and closure movements might exceed predictions but this does not appear to have occurred.

The reason for the lack of valley bulging movement is not known. It is possible that the strata above Longwall 24A had already been stress-relieved by past geological activity. An unusually large amount of vertical subsidence has been observed directly above Longwall 24A. The combination of increased subsidence, tilt and curvature without increased ground strain directly above the goaf suggests that horizontal movements into the goaf have not been substantial, with the predominant direction of ground movement being vertical. The lack of significant differential horizontal movement suggests that mining, therefore, may not have significantly changed the stress environment in the overlying strata in the base of the valley.

The above comments only represent our considered opinion, which is based on limited facts. Tahmoor Colliery is currently undertaking a geotechnical investigation into the cause of the increased subsidence observed directly above Longwall 24A and the findings of the investigation may shed light on why no measureable upsidence or closure has occurred in the Bargo Gorge.

### 2.3.1. Angle of Draw Surveys

As shown in Drawing No. MSEC335-01, monitoring lines were installed off the commencing ends of Longwalls 24A, 25 and 26 to measure the extent of vertical subsidence that occurs between the extracted longwalls and the Bargo Gorge. The results of the survey in relation to Longwall 24A are attached to this report.

A summary of observed subsidence parameters along these three monitoring lines is shown in Table 2-5.

**Table 2-5 Summary of Observed Subsidence Parameters along Angle of Draw Monitoring Lines**

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Compressive Strain (mm/m)
LW 24A Draw Line	1090	10.2	1.3	-0.4
LW 25 Draw Line	12	0.3	0.3	-0.3
LW 26 Draw Line	20	0.4	0.5	-0.5

### 2.4. Main Southern Railway

The Main Southern Railway was surveyed 17 times on a weekly, twice weekly and thrice weekly basis during the extraction of Longwall 24A. Details of the monitoring undertaken are provided in the monitoring reports prepared by MSEC on behalf of Tahmoor Colliery and these reports have been provided to ARTC throughout the mining period.

The Main Southern Railway experienced a maximum of 40 mm of subsidence during the mining of Longwall 24A. While observed subsidence was greater than predicted (less than 20 mm), the amount of subsidence is very small. Observed maximum incremental tilt was 0.6 mm/m. Observed maximum incremental strain was approximately 0.3 mm/m tensile and 0.5 mm/m compressive (excluding survey marks that have been obviously damaged).

Differential vertical and horizontal movements are relatively small and changes between each survey within survey tolerance. However, elevated ground strain of 0.45 mm/m was measured between 94.600 and 94.620 km. The ground strains represent a closure of 9 mm over a 20 metre bay. Increased ground strain was observed at this site during the mining of Longwall 23A but not during the mining of Longwall 24A. The movements are consistent with valley upsidence and closure movements, as their location coincides with a small watercourse. This watercourse continues beneath the Main Southern Railway through a ballast top bridge culvert at Ch. 94.576 km.

There are a number of locations where irregular subsidence has been observed including 94.260 km, 94.700 km and 95.160 km. These are considered to be due to disturbance of survey marks in the rail corridor in the period between October 2007 and May 2008. All of these bumps have been first observed at the time of first survey since the commencement of Longwall 24A, with nil or minimal change in differential movement for subsequent surveys.

#### 2.4.1. Strain Gauge and Switch Displacement Monitoring

Monitoring in excess of the requirements of the Management Plan for Longwall 24A was conducted as part of the Trial Switch Management Plan. It included continuous rail stress gauge and switch displacement monitoring between 93.900 and 94.400 km.

Small reductions of between 4 and 5 degrees in Stress Free Temperatures (SFT) were observed on the Up and Down Tracks at 94.350 km and 94.400 km from the beginning of May 2008. It is considered that

these changes are related to mine subsidence. Some dissipation of tensile stress from fixed Continuously Welded Rail (CWR) track into the free rail on the Up Main was observed. Very little change in SFT was observed during the mining of the end of Longwall 24A, which correlates well with measured ground movements.

It is noted that no stress gauges are located near 94.600 km where maximum increases in compressive ground strains have been measured, though it is considered likely that some change in SFT has occurred. This section of track has since been re-stressed.

#### **2.4.2. Thirlmere Way Overbridge**

A total of 16 surveys and 38 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.

Measured tilts and strain at the abutments are very small. The results indicate a fall of up to 1.0 mm/m between the bridge abutments from east to west, towards Longwall 24B. Changes in measurements between surveys have been within survey tolerance during the mining of Longwall 24A.

No impacts were observed to the Bridge during the mining of Longwall 24A, as expected following extensive strengthening works undertaken by Tahmoor Colliery prior to commencement of Longwall 24B.

#### **2.4.3. Platform Clearance Surveys**

A total of 14 platform clearance surveys were undertaken during the mining of Longwall 24A. All platform clearances are currently greater than minimum design clearances. Measured changes in clearances were within survey tolerance.

### **2.5. Sewer Infrastructure**

One of the key items of infrastructure that had potential to experience impacts as a result of increased subsidence were the self-cleansing sewer pipes within the urban area. Subsidence monitoring was undertaken along the streets and at key sewer pit lids during mining.

Prior to Longwall 24A mining beneath the urban area, the potential changes in sewer grades were re-assessed based on observations along the High-Rise Freezer Line (refer Peg HRF10 in Figure 2.2) for all sewer pipes within the urban area. The reassessment indicated that the grades on the majority of the pipes were expected to remain greater than the minimum grades required for self-cleansing following the mining of Longwall 24A. However, the analysis identified three pipe sections where the projected grades were assessed to be only just greater than the minimum grade required for self-cleansing. The pipes identified were:

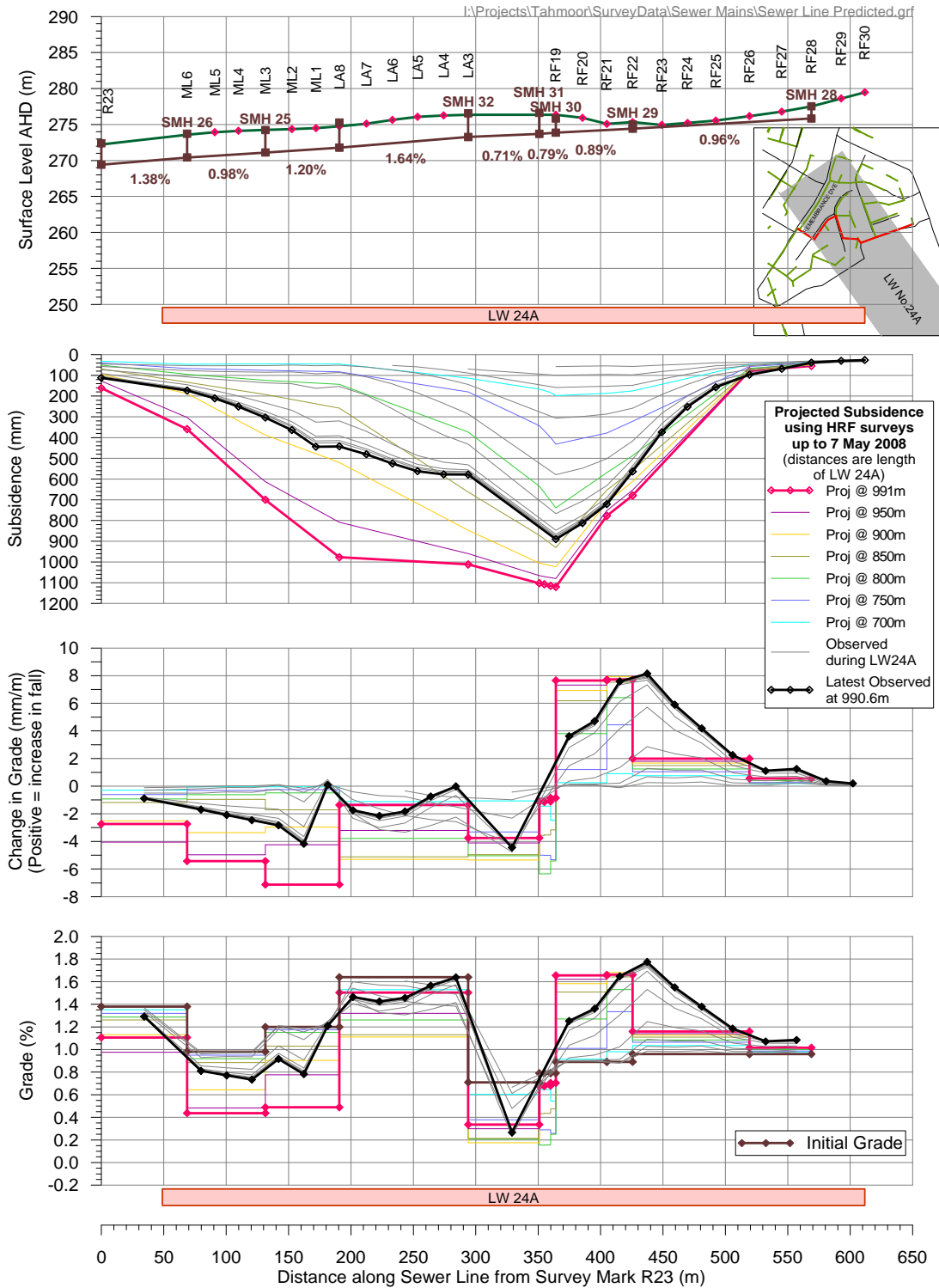
- SMH30 to SMH31: A 17 metre long section of pipe with a pre-mining grade of 0.79%
- SMH31 to SMH32: A 55 metre long section of pipe with a pre-mining grade of 0.71%
- SMH25 to SMH26: A 68 metre long section of pipe with a pre-mining grade of 0.98%

A plot of projected changes in grade and projected grades during and after the mining of Longwall 24A is provided in Figure 2.5. The projected changes in grade are primarily based on observed monitoring results along the High-Rise Freezer Line. The projected values were compared with observations based on subsidence measured at nearby survey marks, which are also shown in Figure 2.5.

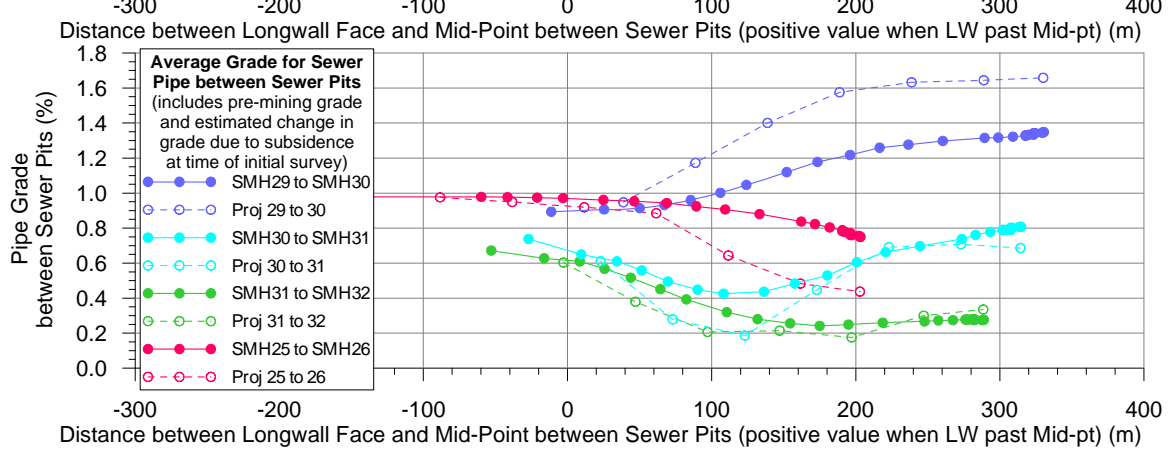
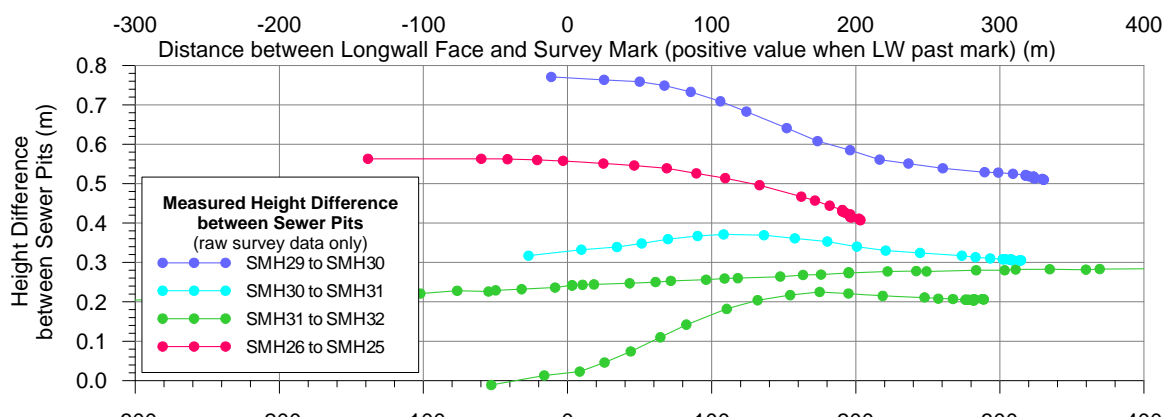
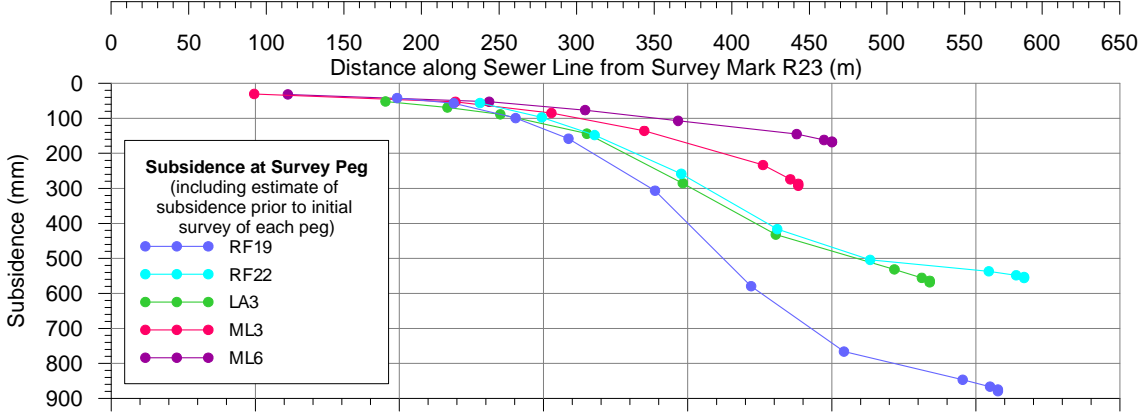
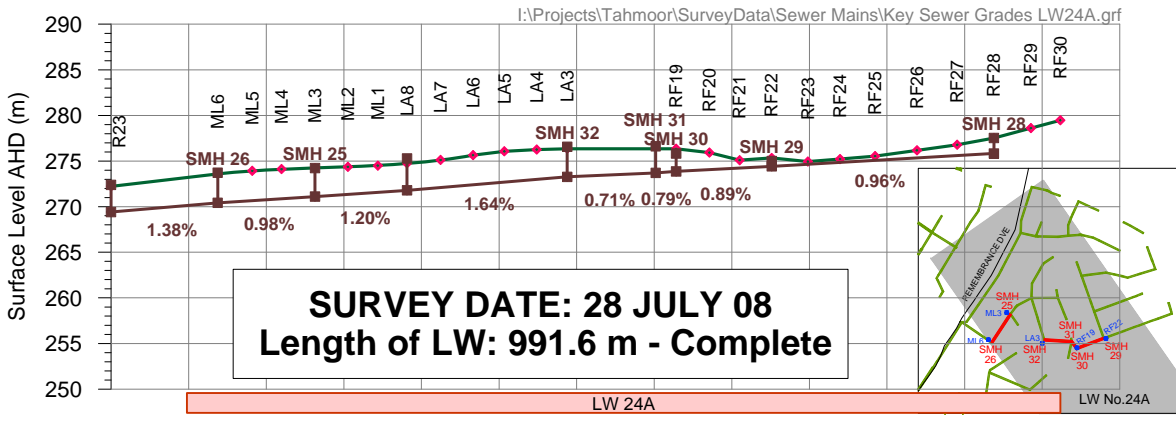
Relative height differences between the sewer pit lids for four identified pipe sections were measured three times a week in accordance with an agreed management plan with Sydney Water. A total of 29 surveys were conducted along the above pipe sections during the mining of Longwall 24A. A plot of observed height differences and changes in grade is provided in Figure 2.6. The results are compared with projected sewer grades, which were based on observations along the High-Rise Freezer line.

It can be seen from Figure 2.6 that changes in sewer grade have occurred and the changes in grade appear to be less than the grades that have been projected to develop based on observed monitoring results along the High-Rise Freezer Line.

It can be seen that the pipes between SMH30 and SMH31, and SMH31 to SMH32 had initially reduced as the longwall passed directly beneath it, but the grade has gradually improved as the longwall progressed away from the pipe. The pipe section is located near the centre of the longwall and is oriented almost parallel to the longitudinal direction of the longwall. The observed grades were expected as the pipe section was largely influenced by travelling tilts as the subsidence wave approached and passed the pipes. All grades remained positive and self-cleansing.



**Figure 2.5 Projected & Observed Subsidence Profiles along selected Sewer Line during LW 24A**



**Figure 2.6 Projected and Observed Changes in Grade between selected Sewer Pits**

## 2.6. Power Pole Surveys

A total of 21 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 24A as expected.

Of the poles that were surveyed, maximum subsidence of 489 mm was observed at Pole 240 on Lintina Street. A maximum horizontal movement of 109 mm was measured at the top of the same pole.

## 2.7. Tahmoor Town Centre

A total of 3 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. Maximum observed subsidence was 41 mm at the south-east corner of the complex.

## 2.8. Inghams

### 2.8.1. Ground and Building Monitoring Results

Ground and building surveys have been conducted in accordance with the Management Plan. The locations of monitoring lines relative to Longwall 24A and the Inghams infrastructure are shown in Drawing No. MSEC341-01 and a summary of maximum observed subsidence parameters for each monitoring line is provided in Table 2-6.

**Table 2-6 Summary of Maximum Observed Subsidence Parameters**

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Compressive Strain (mm/m)
Dam Line	762	4.7	0.5	-0.3
East-West Line	602	6.4	1.0	-0.2
North-South Line	174	0.5	0.1	-0.2
High-Rise Freezer Line	1169 <sup>2</sup>	12.7	1.0 <sup>3</sup>	-2.5 <sup>3</sup>
Plant Perimeter Line	118 <sup>1</sup>	Please refer Table 2-7 for differential vertical and horizontal movements.		
Pipe Support Line	108 <sup>1</sup>	Please refer Table 2-7 for differential vertical and horizontal movements.		

<sup>1</sup> Observed subsidence along the Plant Perimeter Line and Pipe Support Line are less than other monitoring lines because they were installed just after the commencement of Longwall 24A. Based on surveys from the survey origin, it is estimated that 5 mm of subsidence occurred prior to the installation of these monitoring lines and it is recommended that this amount be added to the monitoring results. Pipe Support Marks 16 to 23 were installed as part of the Stage 2 Management Plan. Approximately 23 mm of subsidence had been measured near these pegs at this time.

<sup>2</sup> High-Rise Freezer line was extended from HRF5 to HRF18 while Longwall 24A had stopped at 389 metres of extraction.

### 2.8.2. Ammonia Pipes

The Management Plan includes planned procedures that are triggered from results of monitoring in relation to ammonia pipes. The triggers for the blue trigger level are:

- *Ground survey:* Differential vertical or horizontal movement of 10 mm between adjacent survey marks on the Plant Perimeter and Pipe Support Monitoring Lines
- *Displacement transducers:* 10 mm movement since re-commencement of Longwall 24A

- *Pipe Stress Transducers*: 82.8 MPa for low temp pipes and 112.5 MPa for high temp pipes

#### *Ground survey*

A summary of maximum observed differential vertical and horizontal movements along these monitoring lines are shown in Table 2-7.

**Table 2-7 Summary of Maximum Observed Differential Movements along Plant Perimeter and Pipe Support Monitoring Lines**

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Differential Vertical Movement (mm)	Maximum Observed Differential Horizontal Movement (mm)	Is BLUE trigger exceeded?
Plant Perimeter Line	124 <sup>1</sup>	-10.7 to +9.4	-3.0 to +3.0	YES
Pipe Support Line	113 <sup>1</sup>	-5.2 to +2.9	-1.0 to +6.0	NO

<sup>1</sup> Please refer Note 1 for Table 2-6.

Differential vertical movements exceeded the blue trigger between survey marks Plant 11 and Plant 12, which are located on the southern side of the Carton Tunnel. The pegs are spaced approximately 21 metres apart and the corresponding ground tilt is therefore 0.5 mm/m. The measured differential horizontal movements were within survey tolerance.

#### *Displacement transducers*

The measured displacements for Sensors 2 and 3 exceeded the BLUE trigger on a number of occasions. However, the sensors were later found to be faulty. It is considered that the actual displacements did not exceed the trigger levels.

### **2.8.3. Pipe Stress Transducers (PSTs)**

While some pipe stress transducers showed slight changes in stress, the majority of stress gauges did not reach the trigger level, except for intermittent spikes that were considered to be due to either electrical interference or influence of compressor operation. Only one gauge was observed to experience an increase in pipe stress. The pipe supports were adjusted during mining and the stresses were subsequently reduced.

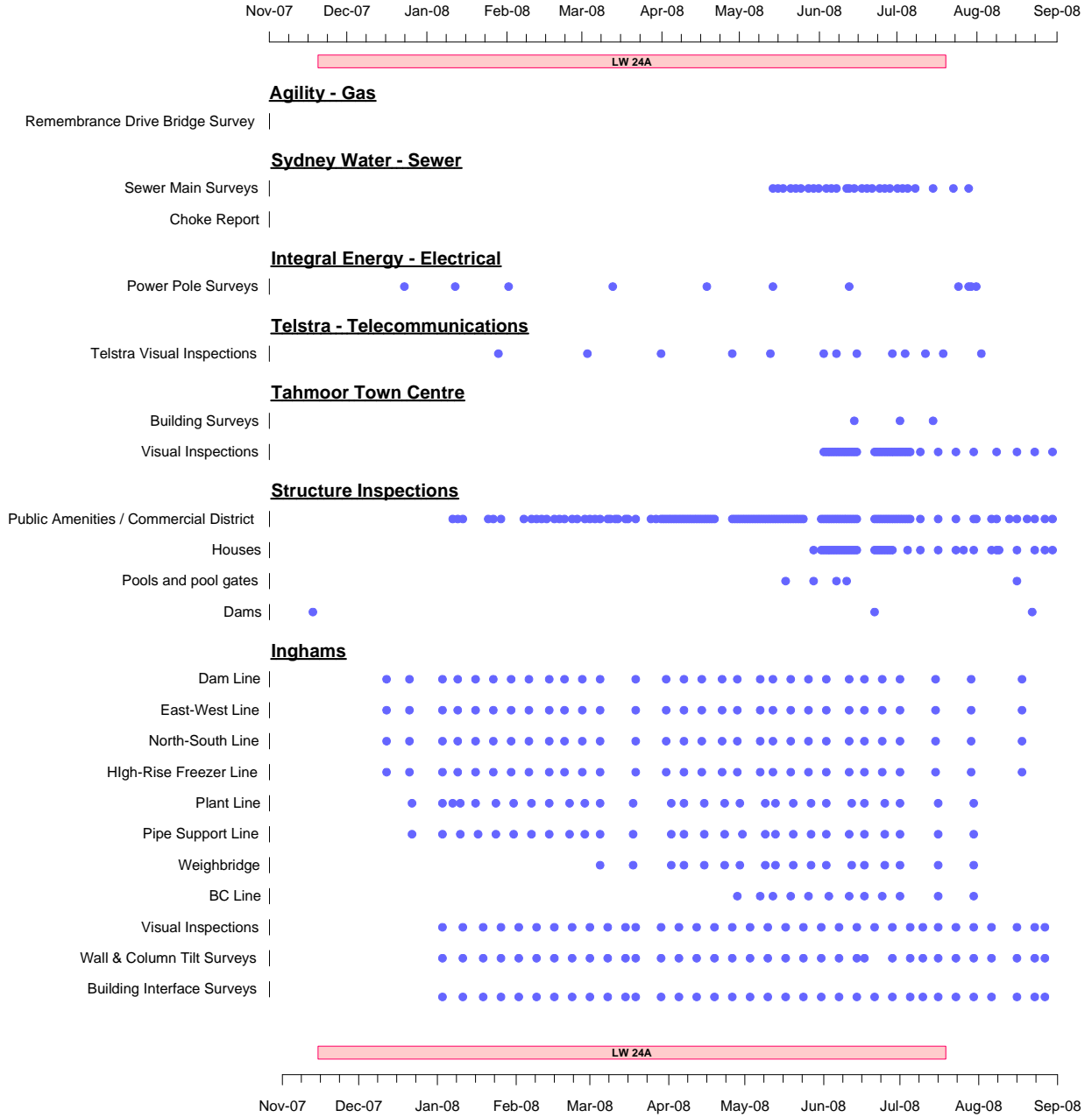
### **2.8.4. Discussion**

The subsidence associated with the Inghams Plant occurred in accordance with predictions. Increased subsidence above predictions obtained by the Incremental Profile Model was observed at the Plant during the mining of Longwall24A. However, this was predicted as the Plant was located above mostly solid, unmined coal reserves that lay between a previously mined area (200 Panels) and the currently mined Longwall 24A. Observations of increased subsidence had been experienced in similar previous mining situations and these are believed to be due to a regional relaxation of the insitu stresses in the overlying strata.

As discussed in the Management Plan, it was expected that this increased subsidence would be accompanied by low tilts and strains, and this was observed during the mining of Longwall 24A. It can be seen from the monitoring results that observed tilts and strains similar to or less than survey tolerance in the vicinity of the Inghams Plant and along nearby monitoring lines (North-South, High-Rise Freezer). A total variation of approximately 38 mm of subsidence was observed among all survey pegs along the Plant Perimeter and Pipe Support Monitoring Lines.

While subsidence developed as expected at the Plant, increased subsidence was observed at the dams. This was not predicted.





**Fig. 3.2** Timeline and Surveys and Inspections during Longwall 24A (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 24A**

<b>Inspection / Survey</b>	<b>Responsibility</b>	<b>Number of Inspections / Surveys</b>
<b>Ground Monitoring Surveys</b>		
Main Southern Railway Corridor	Meadows Consulting	17
Bradbury Street	Lean & Hayward	1
BC Line	Lean & Hayward	12
Castlereagh Street	Lean & Hayward	1
Chapman Street	Lean & Hayward	1
Courtland Avenue	Lean & Hayward	11
Emmett Street	Lean & Hayward	9
Larkin Street	Lean & Hayward	9
Lintina Street	Lean & Hayward	11
LW24A Draw Line	Lean & Hayward	7
LW25 Draw Line	Lean & Hayward	7
LW26 Draw Line	Lean & Hayward	7
Mitchell Close	Lean & Hayward	9
Pandora Place	Lean & Hayward	9
Progress Street	Lean & Hayward	8
Ralfe Street	Lean & Hayward	14
Remembrance Drive	Lean & Hayward	20
Remembrance Drive Shopfronts	Lean & Hayward	1
Tanya Place	Lean & Hayward	10
Thirlmere Way	Lean & Hayward	12
<b>Sub-Total</b>		<b>176</b>
<b>Natural Features</b>		
Bargo River flow gauging	HCS	8
Bargo River data logger downloads	HCS	8
Bargo River water level surveys	HCS	9
Bargo River water quality sampling - field & lab	Geoterra	6
Bargo River visual inspections	Tahmoor Colliery, Geoterra, HCS	32
Bargo River Angle of Draw Surveys	Lean & Hayward	7
Bargo River Valley Closure Surveys	Lean & Hayward	7
Bargo River Rockbar Monitoring Surveys	Lean & Hayward	4
Myrtle Creek - Download Level Data Loggers (bi-monthly)	Geoterra	3
Myrtle Creek - Water Quality	Geoterra	3

<b>Inspection / Survey</b>	<b>Responsibility</b>	<b>Number of Inspections / Surveys</b>
sampling - Field (bi-monthly)		
Myrtle Creek - Water Quality Sampling - Lab (quarterly)	Geoterra	3
Redbank Creek - Download Level Data Loggers (bi-monthly)	Geoterra	3
Redbank Creek - Water Quality sampling - Field (bi-monthly)	Geoterra	3
Redbank Creek - Water Quality Sampling - Lab (quarterly)	Geoterra	3
Groundwater - Water levels in piezometers (bi-monthly)	Geoterra	3
Groundwater - Water Quality sampling - Field (bi-monthly)	Geoterra	3
Groundwater - Water Quality Sampling - Lab (quarterly)	Geoterra	3
<b>Sub-Total</b>		<b>109</b>
<b>Main Southern Railway (note Corridor survey above)</b>		
Reports for continuous discrete rail stress transducers monitoring results	Pidgeon Civil Engineering	13
Subsidence monitoring reports	MSEC	6
Tahmoor Station Platform Clearance Surveys	Meadows Consulting	14
Thirlmere Way Overbridge surveys	Meadows Consulting	16
Thirlmere Way Overbridge visual inspections	Sunrise	38
<b>Sydney Water - Sewer</b>		
Sewer Main Surveys	Lean & Hayward	28
<b>Integral Energy - Electrical</b>		
Power Pole surveys	Lean & Hayward	21
<b>Telstra - Telecommunications</b>		
Visual inspections	Lutibo (Colin Dove)	13
<b>Tahmoor Town Centre</b>		
Building surveys	Lean & Hayward	3
<b>Structure Inspections</b>		
Public amenities / commercial district	Sunrise	3630
Houses, Units and Aged Care Villages	Sunrise	196
Pools and pool gates	Sunrise	13
Dams	Geoterra	18
<b>Sub-Total</b>		<b>3856</b>

<b>Inspection / Survey</b>	<b>Responsibility</b>	<b>Number of Inspections / Surveys</b>
<b>Inghams</b>		
Dam Line	Lean & Hayward	30
East-West Line	Lean & Hayward	30
North-South Line	Lean & Hayward	30
High-Rise Freezer Line	Lean & Hayward	30
Plant Line	Lean & Hayward	29
Pipe Support Line	Lean & Hayward	28
Weighbridge	Lean & Hayward	18
Wall & Column Tilt Surveys	Sunrise	58
Building Interface Surveys	Sunrise	105
Visual Inspections	Sunrise	145
<b>Sub-Total</b>		<b>503</b>

## 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. 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 24A**

SURFACE FEATURE	PREDICTED IMPACTS	OBSERVED IMPACTS
<b>NATURAL FEATURES</b>		
Bargo River	Potential cracking and uplift of river bed. Potential for observable loss of flow and pool level reduction Potential reduction in water quality Potential for transfer of water to shallow groundwater system Please refer report by Geoterra.	No cracks or uplift observed.  No loss of stream flow or pool level reductions observed No observable reduction in quality No transfer of water to shallow groundwater observed Please refer report by Geoterra.
Aquifers or Known Groundwater Resources	Potential for enhanced groundwater seepage from the cliffs Temporary lowering of piezometric surface by up to 10m which may stay at that level until maximum subsidence develops Groundwater levels should recover with no permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops No permanent reduction in groundwater levels under the Bargo River Please refer report by Geoterra.	No change in cliff seepage flow or water quality observed Lowering of piezometric surface by up to 8.9m in piezometer P2 has been observed  Groundwater levels in P2 have recovered by approximately 8.6m from their lowest point over approximately the last 12 months  No reduction in groundwater levels under the Bargo River have been observed Please refer report by Geoterra.
Steep slopes and cliffs	Potential soil slippage and cracking to slopes. Large-scale slope failures or cliff instabilities unlikely.	No impacts observed during Longwall 24A though 4 small natural rock falls occurred.
Natural Vegetation	No impacts anticipated.	No impacts observed during Longwall 24A.
<b>PUBLIC UTILITIES</b>		
Railways	No impact to track geometry likely if systematic movements occur.	Observed loss of rail stress free temperature of 4 to 5°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 on Lintina Street and Courtland Avenue. Cracks and buckling in kerbs and gutters along Remembrance Drive.
Water Pipelines	Minor impacts possible to pipelines, particularly older cast iron pipes with lead joints.	No impacts observed during Longwall 24A.
Gas Pipelines	Ground movements unlikely to adversely impact pipelines if	No impacts observed during Longwall 24A.

**Table 4-1 Summary of Predicted and Observed Impacts during Longwall 24A**

<b>SURFACE FEATURE</b>	<b>PREDICTED IMPACTS</b>	<b>OBSERVED IMPACTS</b>
	systematic movement occurs.	
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 24A. While grades for some pipes were reduced, none experienced a reversal of grade. Sydney Water advises that no pipes require re-levelling.
Electricity Transmission Lines or Associated Plants	Ground movements unlikely to adversely impact electrical infrastructure if systematic movement occurs.	No impacts observed during Longwall 24A.
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.
<b>PUBLIC AMENITIES</b>	Potential impacts to public amenities, particularly shops along Remembrance Drive. All public amenities expected to remain safe and serviceable due to the mining of Longwall 24A.	Separation of construction joint in one shop on Remembrance Drive. All structures remained safe and serviceable during mining.
<b>FARMLAND AND FACILITIES</b>		
Farm Buildings or Sheds	Negligible to slight impacts predicted for all farm buildings and sheds if systematic movement occurs.	No impacts observed during Longwall 24A.
Fences	Potential for impacts to fences and gates. Gates are most vulnerable.	No impact on fences on farmland.
Farm Dams	Potential adverse effects on dam walls and storage capacity. Please refer report by Geoterra.	No impacts observed to farm dams during Longwall 24A. 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.
<b>INDUSTRIAL, COMMERCIAL &amp; BUSINESS ESTABLISHMENTS</b>	Negligible to slight impacts predicted for all business and commercial establishments.	Separation of construction joint in one shop on Remembrance Drive. Separation of floor slab joint and reversal of grade to connecting pipe between dams at Inghams Plant.
<b>AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE</b>	Negligible to very impacts predicted for items of heritage significance.	No impacts observed during Longwall 24A.
<b>PERMANENT SURVEY</b>	Ground movement predicted at	Ground movement occurred.

**Table 4-1 Summary of Predicted and Observed Impacts during Longwall 24A**

SURFACE FEATURE	PREDICTED IMPACTS	OBSERVED IMPACTS
<b>CONTROL MARKS</b>	identified survey marks.	
<b>RESIDENTIAL ESTABLISHMENTS</b>		
<p>Houses, flats or units</p> <p><i>Status as at 24 August 2008 (two days after the start of Longwall 25).</i></p>	<p>Predictions and impact assessments provided for individual structures based on systematic subsidence movements. Of the 1,016 houses and public amenities within zone of influence of LWs 22 to 24A, 492 structures assessed to have Strain Category 1 or 2.</p> <p>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.</p> <p>All houses expected to remain safe, serviceable and repairable provided that they are in sound condition prior to mining.</p>	<p>No. of properties that have reported impacts after LW 24A = 160 (32 claims during LW 24A).</p> <p>No. of properties with impacts that relate to a residential structure = 147 (31 claims during LW 24A).</p> <p>No. of properties with impacts that only relate to associated structures = 13 (1 claim during LW 24A).</p> <p>Some structures are considered to have experienced impacts due to non-systematic movements.</p> <p>No structures have been identified as being either unsafe or unserviceable at this time.</p> <p>However, MSB have decided that cost of repair is greater than cost of replacement for four houses, one of which is located above LW 24A. Please refer details in this report.</p>
Retirement or Aged Care Villages	Longwall 24A will not Macquarie Grove Retirement Village	No impacts during mining of Longwall 24A.
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.	<p>Impacts to 12 swimming pools during mining of LWs 22 to 24A.</p> <p>No impacts to pools due to mining of LW 24 A.</p>
Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks or Tennis Courts	<p>Potential impact to pipes connected to in-ground septic tanks.</p> <p>Negligible impacts predicted for non-residential domestic structures, including sheds and tanks.</p>	<p>Minor impacts to 23 structures during mining of LWs 22 to 24A.</p> <p>Impacts to 3 structures above Longwall 24A.</p>
External Residential Pavements	Cracking and buckling likely to occur, though majority minor.	<p>Impacts to pavements observed on 61 properties during mining of Longwalls 22 to 24A.</p> <p>Impacts to 3 pavements above Longwall 24A.</p>
Fences in Urban Area	Some fences and gates could be slightly damaged. Most vulnerable are colorbond fences.	<p>Impacts to gates and fences observed on 44 properties during mining of Longwalls 22 to 24A.</p> <p>Impacts to 3 properties above Longwall 24A.</p>

## **4.2. Bargo River Gorge**

### **4.2.1. Water Quality and Flow Impacts**

Geoterra undertook an investigation into the effects of Longwall 24A on surface and ground waters in the area (Geoterra, 2008). Geoterra reported no cracks or riverbed uplift observed during mining and no observed impacts to pool levels, water flow or quality.

No adverse effect on stream water quality due to subsidence effects following extraction of Longwall 24A have been observed in the Bargo River for the monitored salinity, metals and nutrients. This is supported by the observation that the sulfate, as well as lithium, barium and strontium concentrations within the SMP Area also do not show any increase or decrease from changes in groundwater flow into or out of the river following extraction of Longwall 24A.

Field inspections, monitoring and laboratory analyses conducted to date have shown no increase the seepage volume, iron hydroxide precipitation or changes in other monitored water quality parameters within any pool containing a ferruginous groundwater seep within or outside the SMP area, either before or since Longwall 24A was extracted.

### **4.2.2. Rockfalls**

Four very minor rockfalls have been observed during mining, though each of these has been observed following significant rainfall or wind events. The rock falls are referred to as RF-1, RF-A, B and C. Similar minor rockfalls were observed prior to mining.

A geotechnical inspection of the rockfalls was completed by Pells Sullivan Meynink (May 2008) and information below has been drawn from this report. No single factor can be identified as the cause of all the rock falls.

RF-1 lies below a relatively unstable portion of gorge wall and the morphology and condition of debris in the fall zone indicate that this has been and will continue to be an area of high rock fall potential. There is a strong correlation between rainfall intensity and RF-1.

RF-A, B and C represent single events that occurred in relatively stable regions of the gorge (plateau with thick vegetation). The presence of a water flow path down the cliff line in the location of RF-A suggests that a small rainfall event may have contributed to this rock fall.

The triggers of the four rock falls were assessed by PSM to be:

- Increased rainfall and wind; and/or
- Rapid changes in temperature and humidity.

There is no evidence to show that mining activity is directly responsible for any of the four rock falls and hence a mining associated trigger is considered unlikely. Given the unstable nature of cliffs, it is very difficult to know whether mine subsidence has contributed to these very minor rockfalls. However, given that no upsidence or closure is apparent across any of the monitoring lines, it is considered that any contribution from mining would be very small.

### **4.2.3. Exceedence of Defined Triggers**

During the mining of Longwall 24A no triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Natural Features, Surface Safety Serviceability and Management Plan (Rev G, November 2007)* have been reached or exceeded.

No remediation works have been required.

## **4.3. Main Southern Railway**

No impacts were observed during the daily visual inspections.

As discussed in Section 2.34, small reductions in SFT between 4 and 5 degrees were observed during the mining of Longwall 24A. 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 24A.

#### **4.3.1. Thirlmere Way Overbridge**

No impacts were observed to the Bridge, as expected following extensive strengthening works undertaken by Tahmoor Colliery prior to commencement of Longwall 24B.

#### **4.3.2. Exceedence of Defined Triggers**

During the mining of Longwall 24A one of the triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Main Southern Railway Surface Safety Serviceability and Management Plan (Rev D, September 2006)* was exceeded. The trigger was an observed incremental subsidence exceeding 10 mm, which is above predictions of systematic movement.

No remediation action was required in relation to this trigger exceedence. The extent of monitoring along the rail corridor was increased, in accordance with the Management Plan.

#### **4.4. Roads**

Approximately 10.3 kilometres of asphaltic pavement lie directly above the extracted longwalls and a total of 12 impacts have been observed. The observed rate of impact equates to an average of one impact for every 860 metres of pavement. The impacts were minor and did not present a public safety risk.

One of these impact sites, located on Lintina Street above Longwall 24A, was substantially greater than the other 11 impact sites. A selection of photographs is provided in Figure 4.1. The impacts on Lintina Street were repaired twice as the longwall progressed.

Cracks to kerbs and gutters were also observed in isolated locations on Courtland Avenue and Remembrance Drive.

#### **4.4.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A one of the triggers associated with the *Tahmoor Colliery Longwalls 24 to 26, Wollondilly Shire Council Roads, Bridges and Culverts, Surface Safety Serviceability and Management Plan (Rev B)* was exceeded. The trigger exceeded was impacts to road pavements. The impacts have been recorded by the MSB and will be repaired. Temporary repairs have been conducted along Lintina Street.



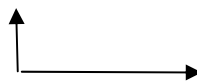
Lintina Street



Lintina Street



Remembrance Drive



*Photographs courtesy of Tahmoor Colliery and Colin Dove*

**Figure 4.1 Photographs of impacts to road pavements and kerbs during Longwall 24A**

#### **4.5. Potable Water Infrastructure**

Longwalls 22 to 24A have directly mined beneath approximately 960 metres of DICL pipe and 2.7 kilometres of CICL pipe, with only one noticeable impact recorded. This was a leak in a cast iron water main on Glenanne Place in June 2007. A very small number of minor leaks have been observed to consumer connection pipes on private properties

During the mining of Longwall 24A no impacts were observed to water mains above the longwall. No remediation was required.

##### **4.5.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A no triggers associated with the *Sydney Water Potable Water Infrastructure Surface Safety Serviceability and Management Plan (Rev E)* were exceeded and no remediation was required.

#### **4.6. Gas Infrastructure**

It is noted that Longwalls 22 to 24A have directly mined beneath approximately 6.0 kilometres of gas pipes and no impacts have been recorded so far.

Subsidence monitoring and enhanced gas patrols were undertaken along the streets during mining. Increased subsidence has been observed above Longwall 24A with no impacts to gas infrastructure.

##### **4.6.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A no triggers associated with the *Tahmoor Colliery Longwalls 24 to 26 Alinta (now Jemena) Asset Management Surface Safety Serviceability and Management Plan (Rev E)* were exceeded and no remediation was required.

#### **4.7. Sewer Infrastructure**

Longwalls 22 to 24A have directly mined beneath approximately 8.1 kilometres of sewer pipes. While changes in sewer grade have occurred as a result of mine subsidence, no noticeable impacts have been recorded so far. The observed frequency of incidences is similar to those in areas not affected by subsidence.

Subsidence monitoring was undertaken along the streets and at key sewer pit lids during mining as outlined in Section 2.5. Increased subsidence has been observed above Longwall 24A with no reported leakage, blockage or reversal of grade of the sewers.

##### **4.7.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A one of the triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Sydney Water Sewer Infrastructure, Surface Safety Serviceability and Management Plan (Rev E, August 2008)* was exceeded. The trigger exceeded was the minimum grade required for self cleansing of the sewer (i.e. less than 4 mm/m or 0.4%), and this occurred at SMH31-32.

On 23 May, the grade for SMH31 to SMH32 was measured to be 0.39%, which was less than the first trigger level of 0.4 % in the agreed management plan with Sydney Water. This trigger level was set as an early warning of potential impacts, where consideration would be given to tanker flush the affected sewer pipes. A teleconference was convened on 23 May, where Sydney Water recommended that tanker flushing not commence and to continue monitoring. It was agreed to re-set the trigger level to 0.3 % based on the observed gradual change in grade. On 27 May, it was apparent from the monitoring results that the grade would soon reduce below 0.3 % and it was agreed at a scheduled teleconference to re-set the trigger level to 0.2 % based on the observed gradual change in grade. The minimum grade at the end of Longwall 24A was 0.28 %.

## **4.8. Electrical Infrastructure**

Longwalls 22 to 24A have directly mined beneath approximately 16.7 kilometres of electrical cables and 380 power poles and no noticeable impacts have been recorded so far.

Subsidence monitoring and daily visual inspections were undertaken along the streets during mining of Longwall 24A. While increased subsidence has been observed above Longwall 24A there were no reported impacts to electrical infrastructure.

### **4.8.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A no triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Integral Energy Surface Safety Serviceability and Management Plan (Rev C, August 2006)* were exceeded and no remediation was required.

## **4.9. Telecommunication Infrastructure**

Longwalls 22 to 24A have directly mined beneath approximately 19.1 kilometres of buried copper cable and 1.2 kilometres of buried optical fibre cable and 2.5 kilometres of aerial cable.

During the mining of Longwall 24A there was tilting of Telstra poles supporting the aerial cable network in the residential area of Tahmoor, around Courtland Avenue, Pandora Place, Tanya Place, Lintina Street and Mitchell Close. The movement of the poles created excess sag and tension within the aerial distribution network. Telstra, in consultation with the MSB, adjusted the cable tensions where necessary, to prevent loss of service, and where aerial cables crossed streets, hazard to traffic.

The areas requiring adjustment of the aerial cables were:

- 10 Pair second span east into Pandora Place, which were tight relative to other spans.
- Lead-in to Nos 4 & 6 Tanya: No 4 was tight and required checking and No 6 ran through a tree in front yard.
- Lead-in to No 9 Lintina was tight and required checking and adjustment.
- 2 x 10 Pair in Lintina, 3rd & 4th spans west from Courtland, 3rd span were loose and into two trees and 4th span cables were into one tree.
- Lead-ins to No 8 & 10 Mitchell were tight and required checking and adjustment.

The major Inter Exchange Network optical fibre and main copper cables were not impacted by LW24A.

### **4.9.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A no triggers associated with the *Management Plan for Longwall Mining (LW24 to LW25) Beneath Telstra Plant at Tahmoor and Thirlmere NSW* were exceeded. Adjustments to aerial cables were carried out as required.

## **4.10. Inghams Infrastructure**

### **4.10.1. Processing Plant**

A joint between ground slabs within the Plant was observed to open up. The joint was sealed during mining and no further impacts were observed.

The Management Plan required a structural inspection and action plan to be developed if measured tilts of the High-Rise Freezer exceeded 2 mm/m tilt. This trigger level was not exceeded and no remediation work was necessary.

The most accurate measure of tilt is ground tilt between Plant Perimeter Marks 2 to 7. The survey results indicated a maximum tilt of approximately 0.69 mm/m after Longwall 24A, falling in an easterly direction towards the longwall face. This tilt contributed to correcting a tilt of approximately 0.5 mm/m which occurred in relation to previous mining in the area. This tilt is very small and is oriented in the expected direction.

#### 4.10.2. Inghams Dams

Due to the increased subsidence at the Inghams dams, the grade on an overflow pipe between two treatment plants was reversed. This pipe has been re-laid and no further remediation work is required.

#### 4.10.3. Exceedence of Defined Triggers

During the mining of Longwall 24A triggers associated with the *Tahmoor Colliery Inghams Enterprises Pty Ltd Surface Safety Serviceability and Management Plan (Rev K, March 2008)* were exceeded.

Differential vertical movements exceeded the Blue trigger between survey marks Plant 11 and Plant 12, which are located on the southern side of the Carton Tunnel. The pegs are spaced approximately 21 metres apart and the corresponding ground tilt is therefore 0.5 mm/m. No impacts were observed.

The displacement sensor 2 exceeded the Blue trigger on numerous occasions but was found to be faulty and in need of adjustment or replacement. These exceedences are therefore not related to mining.

#### 4.11. 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 24 August 2008, two days after the commencement of Longwall 24A.

Information on the nature of impacts to each structure has been collected in the following manner:

1. Initial details of claim as supplied by the MSB on a weekly basis
2. Photographs taken during claim inspections by the MSB
3. Site visits to selected properties in company with MSB representatives
4. Inspection contained in claim files held by the MSB

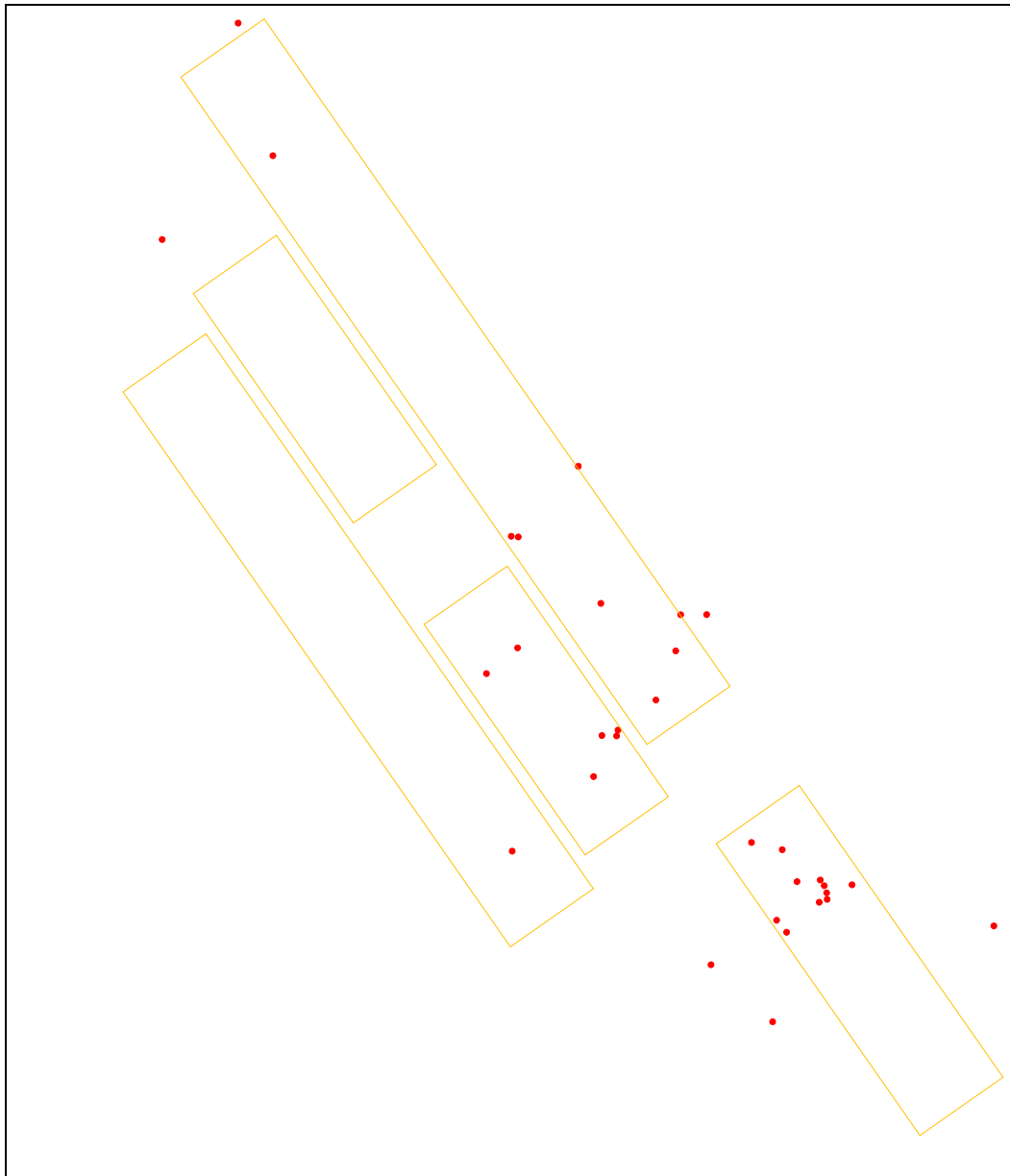
A summary of reported impacts following the completion of Longwall 24A is provided in Table 4-2. The count of residential structures and public amenities includes only those structures that were predicted to experience more than 20 mm of subsidence due to the extraction of Longwalls 22 to 24A.

**Table 4-2 Summary of Observed Impacts to Structures**

	<b>Total after LWs 22 to 24A</b>	<b>Increment during LW 24A</b>
Number of Structures within zone of influence (predicted subsidence > 20 mm)	1016	183
Number of properties with reported impacts (not including refused claims)	160	32
Number of properties with reported impacts that relate to main structures (e.g. house or shop)	147	31
Number of properties with reported impacts that only relate to associated structures	13	1

The above information can be misleading as the majority of claims received during the mining of Longwall 24A were associated with the previous mining of Longwalls 22 to 24B. This is due to time lag between the actual impact and the claim of an impact by residents to the Mine Subsidence Board.

This is illustrated by a spatial plot of locations of impacts reported during the mining of Longwall 24A in Figure 4.2. A total of 18 of 32 claims related to the mining of Longwalls 22 to 24B, rather than the active Longwall 24A.



**Figure 4.2 Locations of Impacts during the mining of Longwall 24A**

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. Areas that are considered to have experienced non-systematic movements were identified in Section 2.2.

#### 4.11.1. Comparison in General

A comparison between observed and predicted impacts is provided in Table 4-3.

**Table 4-3 Comparison between Observed and Predicted Impacts in General**

	<b>Predicted Total No. of Structures</b>	<b>Observed Total No. of Structures</b>
<b>Tilt Impacts</b>		
No impact to house or civil structure	0	869
Tilt Impact Category A	1008 systematic +/- unspecified non-systematic	142
Tilt Impact Category B	8 systematic +/- unspecified non-systematic	4
Tilt Impact Category C	0 systematic +/- unspecified non-systematic	0
Tilt Impact Category D	0 systematic +/- unspecified non-systematic	1
<b>Total</b>	<b>1016</b>	<b>1016</b>
<b>Strain Impacts</b>		
No impact to house or civil structure	0	869
Strain Impact Category 0	524 systematic +/- unspecified non-systematic	101
Strain Impact Category 1	465 systematic +/- unspecified non-systematic	16
Strain Impact Category 2	27 systematic +/- unspecified non-systematic	17
Strain Impact Category 3	0 systematic +/- unspecified non-systematic	4
Strain Impact Category 4	0 systematic +/- unspecified non-systematic	5
Strain Impact Category 5	0 systematic +/- unspecified non-systematic	4
<b>Total</b>	<b>1016</b>	<b>1016</b>

Notes:

“Systematic” refers to impacts assessed based on predictions of systematic subsidence movements, as described in Section 3.17.1.1 of SMP Report No. MSEC157.

“non-systematic” refers to the predicted potential for impacts to structures from non-systematic subsidence movements, as described in Section 3.17.1.4 of SMP Report No. MSEC157.

A discussion of the above comparison is provided in Section 4.11.3.

#### 4.11.2. Comparison based on Predicted Impact Categories

A comparison has been made between observed and predicted impacts on a structure by structure basis for Strain Impacts only. The comparison is based on information up to 24 August 2008. A summary is provided in Table 4-4 below.

**Table 4-4 Summary of Comparison between Observed and Predicted Impacts for each Structure**

Strain Impact Category	Total No. of Observed Impacts for Structures predicted to be Strain Impact Category 0	Total No. of Observed Impacts for Structures predicted to be Strain Impact Category 1	Total No. of Observed Impacts for Structures predicted to be Strain Impact Category 2	Total
No impact	476	373	20	<b>869</b>
Cat 0	28	68	5	<b>101</b>
Cat 1	7	8	1	<b>16</b>
Cat 2	6	10	1	<b>17</b>
Cat 3	2	2	0	<b>4</b>
Cat 4	3	2	0	<b>5</b>
Cat 5	2	2	0	<b>4</b>
<b>Total</b>	<b>524</b>	<b>465</b>	<b>27</b>	<b>1016</b>
<b>% claim</b>	<b>9 %</b>	<b>20 %</b>	<b>26 %</b>	<b>14 %</b>
<b>% Obs &gt; Pred</b>	<b>4 %</b>	<b>3 %</b>	<b>0 %</b>	-
<b>% Obs &lt;= Pred</b>	<b>96 %</b>	<b>97 %</b>	<b>100 %</b>	-

Note:

Predicted impacts due to systematic subsidence only, as per Section 3.17.1.1 of SMP Report No. MSEC157.

#### 4.11.3. Discussion of Results

Given that observed impacts are less than or equal to predicted impacts in 96 % of cases, it is considered that the current methods are generally conservative even though non-systematic movements were not taken into account in the predictions and assessments. However, when compared on a house by house basis, the predictions have been substantially exceeded in a small proportion of cases.

The majority, if not all, of the houses that have experienced Category 3, 4 or 5 impacts are considered to have experienced substantial non-systematic subsidence movements. The consideration is based on nearby ground survey results, where upsidence bumps are observed in subsidence profiles and high localised strain is observed. The potential for impact from non-systematic movements were discussed generally and not included in the specific impact assessments for each structure.

The inability to specify the number or probability of impacts due to the potential for non-systematic movements is a shortcoming of the current method. It is considered that there is significant room for improvement in this area and recommendations have been provided in a report following a review of predicted impacts on dwellings (Report No. MSEC361).

The comparison shows a favourable observation that the overall proportion of claims increased for increasing predicted impact categories. This suggests that the main parameters currently used to make impact assessments (namely predicted systematic curvature and maximum plan dimension of each structure) are credible.

The overall claim rate for main structures during the mining of Longwalls 22 to 24A was 14%. The claim rate for main structures affected by subsidence due to the mining of Longwall 24A was 8%. The result is surprising given that observed subsidence substantially exceeded predictions.

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

#### **4.11.4. Swimming Pools**

No impacts have been observed to swimming pools due to the mining of Longwall 24A.

#### **4.11.5. Associated Structures**

Minor impacts have been observed for 3 structures due to the mining of Longwall 24A.

#### **4.11.6. Fences**

The potential for impacts to fences was raised in the SMP Report and a total of 3 properties have claimed impacts to gates and properties above Longwall 24A.

#### **4.11.7. Exceedence of Defined Triggers**

During the mining of Longwall 24A one of the triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Residential Establishments Surface Safety Serviceability and Management Plan (Rev C, May 2008)* was exceeded. The trigger exceeded was a ground tilt which exceeded 7 mm/m along Ralfe St between Pegs RF21 and RF23.

In response to the identification of the exceedence of the above trigger, visual inspections of nearby houses on Tanya Place were undertaken and no structural issues were found.

Impacts to one house were observed to be Category 4. A structural inspection was undertaken and the house was found to be safe and serviceable.

### **4.12. Public Amenities**

A number of public amenity structures experienced mine subsidence movements due to the mining of Longwall 24A. All of the structures were located along Remembrance Drive. The majority of the structures comprise of relatively small shopfronts. The large shopping centre, Tahmoor Town Centre, also experienced subsidence movements and discussion is provided separately in Section 4.13.

Only one structure experienced impacts during mining. A construction joint in one shop on Remembrance Drive was observed to open to Category 3 width during the mining of Longwall 24A. A structural inspection was undertaken and the house was found to be safe and serviceable.

#### **4.12.1. Exceedence of Defined Triggers**

During the mining of Longwall 24A one of the triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Public Amenities, Surface Safety Serviceability and Management Plan (Rev C, May 2008)* was exceeded. One shop experienced an opening of a construction joint. A structural inspection was undertaken and the house was found to be safe and serviceable.

### **4.13. Tahmoor Town Centre**

During the mining of Longwall 24A cracking at the base of some columns within the basement car park at the Tahmoor Town Centre development was reported. John Matheson & Associates Pty Ltd undertook an investigation of these, to observe the cracks and to report on the history of the observed cracks and the likely causes.

#### **4.13.1. Observations of Cracking**

Cracking was evident in the columns before the commencement of active subsidence as outlined in the pre-mining inspection report prepared by Mr John Schwarz.

Following mining, a number of columns were observed to have cracking around the column base, where the concrete has been poured so that it bears directly upon the ground floor slab. The report found that it was evident that the concrete ground slab was cast before the concrete column and that the ovoid recess

had been incorrectly located so that when casting the column, the cover concrete was cast directly onto the ground slab rather than wholly upon the underlying footing without any provision for differential movement between the ground slab and overlying column concrete. The intimate bearing of the column cover concrete on the ground slab has meant that restraint forces have been developed sufficient to cause slab cracking and surface spalling cracks at the base of the columns.

The connections between the concrete columns and the suspended concrete slab above were inspected and these connections appeared to be unchanged from earlier inspections and there was no discernable change in the condition of the structure in these locations.

#### **4.13.2. Possible Causes of Cracking**

The observed cracking appears to have been caused by restraint forces developed between the concrete column and the basement slab on ground. The restraint forces develop where the slab moves away from the column due to concrete shrinkage, significant slab shortening during extended periods of low temperature and tensile ground strains caused by mine subsidence.

From an analysis of crack size versus time overlaid with ambient temperature conditions and the progress of LW24A/B, the following was observed:

- Prior to mining LW24B, 16 columns had pre-existing category 0 or 1 cracking.
- During or after mining LW24B and prior to mining LW24A, 2 additional columns developed category 0/1 cracking and one column developed category 2 cracking.
- During or after mining LW24A and prior to the extended cold period during winter 2008, 2 additional columns developed category 0/1 cracking and one column developed category 2 cracking.
- Additional cracking appears not to have developed during the recent very cold period of weather.

#### **4.13.3. Conclusions**

It has been concluded that subsidence is the most likely cause of the additional 4 cracked columns and the growth in 2 columns from category 0/1 to category 2 although pre-existing ground slab shrinkage strains and poor column/ground slab construction detail may be contributing to the additional observed cracking.

The observed cracking appears to be localised within the column concrete cover zone and does not appear to propagate into the core of the column within the confinement of the column ties and longitudinal reinforcement. The columns were effectively designed as pinned at the base and therefore minor spalling cracking, whilst it is undesirable, is not considered to be seriously detrimental to the overall strength of the structure and that repairs may be carried out to control further cracking of category 1 cracking and epoxy concrete repairs to the small number of category 2 cracks observed.

Tahmoor Colliery has recently patched 20 columns within the TTC basement. The majority of the columns are located along Grid E. The patching works were undertaken to remove the existing spalling cracks from the reporting program so that the management plan can focus on the development of new structural cracking caused by subsidence. JMA reports that a number of construction defects were observed whilst making the repairs, which will improve concrete confinement, ductility and column shear strength.

#### **4.13.4. Exceedence of Defined Triggers**

During the mining of Longwall 24A no triggers associated with the *Tahmoor Colliery Longwall 24 to 26, Tahmoor Town Centre, Surface Safety Serviceability and Management Plan (Rev D, August 2006)* were exceeded.

No remediation works are required.

## CHAPTER 5. SUMMARY OF RESULTS

Observed subsidence, tilt and curvature due to the mining of Longwall 24A have substantially exceeded predictions. Maximum observed subsidence was 1169 mm, which was more than double the maximum predicted subsidence of 509 mm. While observed tilts and curvature were also substantially greater than predicted, observed ground strains were within the normal range.

The observation of increased subsidence was not observed at other nearby longwalls at Tahmoor Colliery, where there was a reasonable correlation between predicted and observed profiles over Longwalls 22, 23 and 24B.

Observed subsidence was greatest above the southern half of Longwall 24A, and gradually reduced in magnitude towards the northern half of the longwall, which was directly beneath the urban area of Tahmoor.

The nature and magnitude of the increased subsidence is rare and the cause of the increased subsidence is currently not known. Tahmoor Colliery has commissioned a geotechnical study by Dr Winton Gale of Strata Control Technology to try to identify the cause or causes of the increased subsidence. Results of this study are not yet available as research is continuing. Once it became apparent that increased subsidence had developed, Tahmoor Colliery revised its management plans during extraction of LW24A to manage potential increased impacts to surface infrastructure before the longwall extracted beneath the urban area of Tahmoor.

While subsidence was substantially exceeded predictions in most locations, there remains a reasonable correlation between observed and predicted impacts, particularly in relation to public infrastructure such as sewer mains, water mains, gas mains, and electrical and telecommunications infrastructure. Impacts to road pavements were similar in frequency compared to those observed during the mining of previous longwalls. The impacts to the road pavement on Lintina Street were, however, more severe than had been observed previously.

In relation to structures, the overall claim rate for main structures during the mining of Longwalls 22 to 24A was 14%. The claim rate for main structures affected by subsidence due to the mining of Longwall 24A was 8%. The result is surprising given that observed subsidence substantially exceeded predictions.

Given that observed impacts to structures are less than or equal to predicted impacts in 96 % of cases, it is considered that the current methods are generally conservative even though non-systematic movements were not taken into account in the predictions and assessments. However, when compared on a house by house basis, the predictions have been substantially exceeded in a small proportion of cases.

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

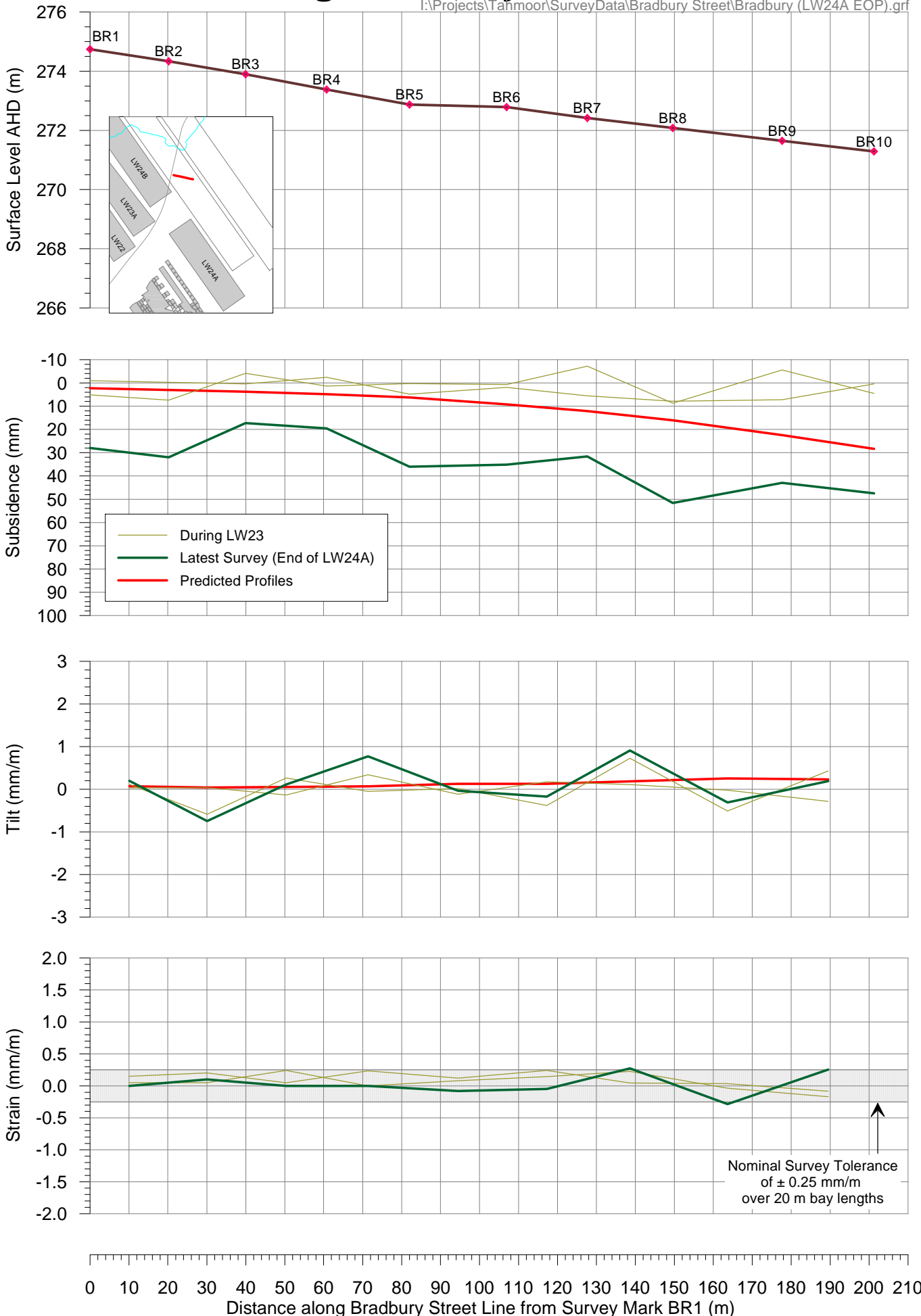
In relation to the Bargo Gorge, the monitoring results indicate that no measureable upsidence or closure has occurred across any of the monitoring lines across the Bargo Gorge during the mining of Longwall 24A. All differential movements have been very small and close to or within stated survey tolerance. The current observed movements during the mining of Longwall 24A are less than the predicted Longwall 24A maximum incremental upsidence of 20 mm and maximum incremental closure of 50 mm. Given the incised nature of the Gorge and its significant valley height, it was considered possible that actual upsidence and closure movements might exceed predictions but this does not appear to have occurred.

No physical, hydrological or water quality impacts were observed to the Bargo River. Four very minor rockfalls have been observed during mining, though each of these has been observed following significant rainfall or wind events. A geotechnical inspection of the rockfalls found no evidence to show that mining activity is directly responsible for any of the four rock falls and hence a mining associated trigger is considered unlikely. Given the unstable nature of cliffs, it is very difficult to know whether mine subsidence has contributed to these very minor rockfalls. However, given that no upsidence or closure is apparent across any of the monitoring lines, it is considered that any contribution from mining would be very small.

## **APPENDIX A. FIGURES AND DRAWINGS**

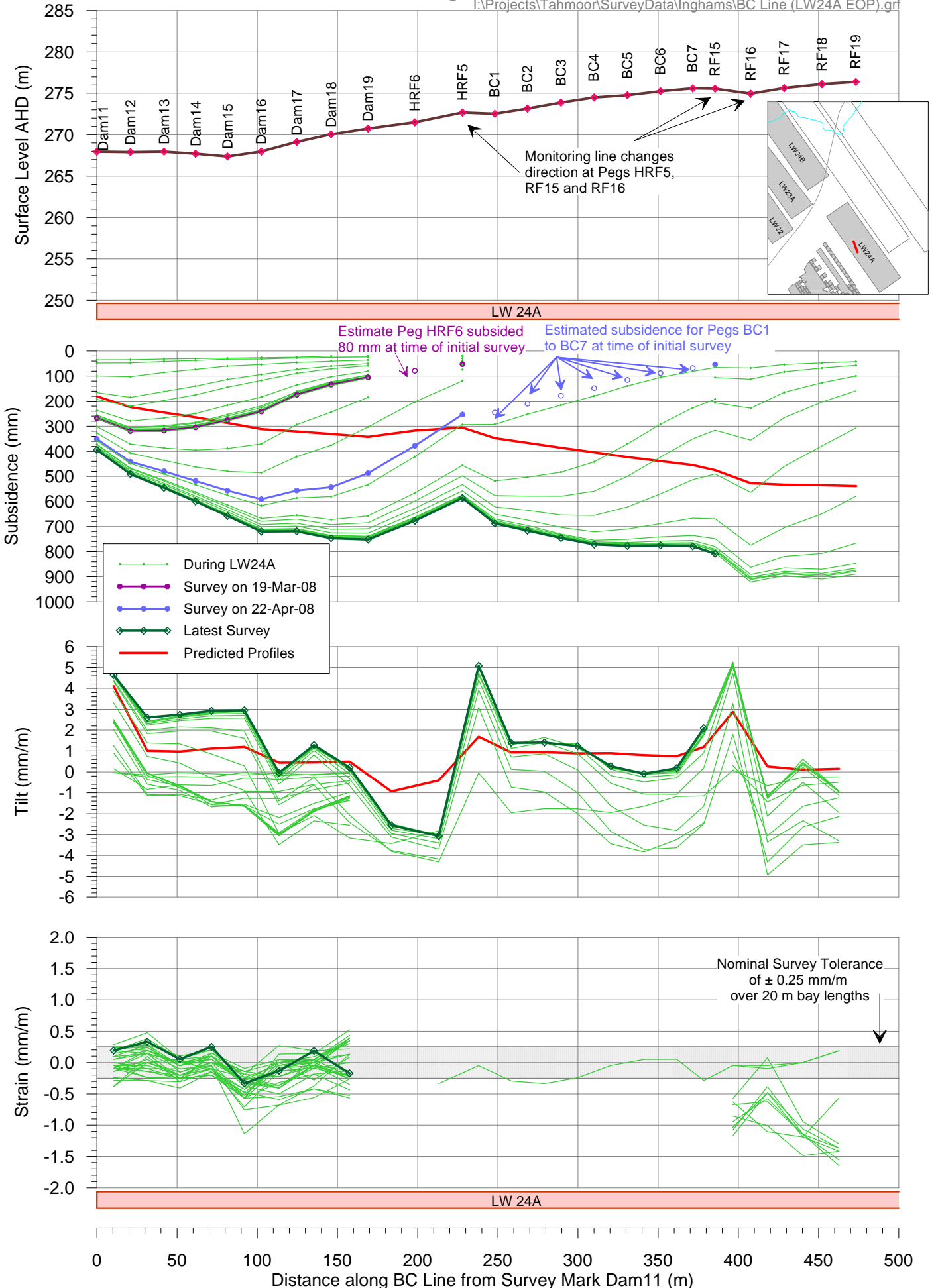
# Tahmoor Colliery - Total Subsidence Profiles along Bradbury Street Line

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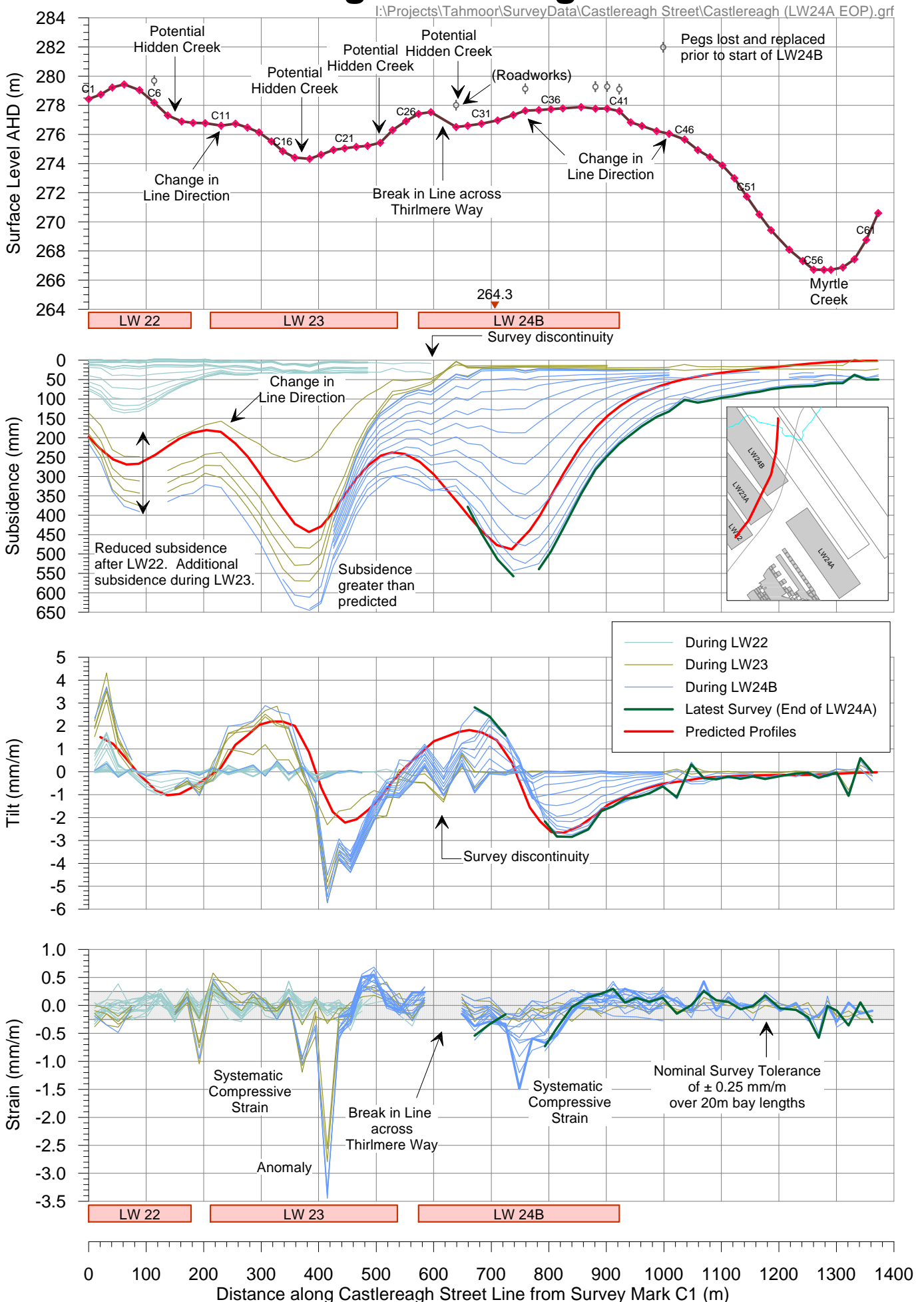


# Tahmoor Colliery - Total Subsidence Profiles along BC Line

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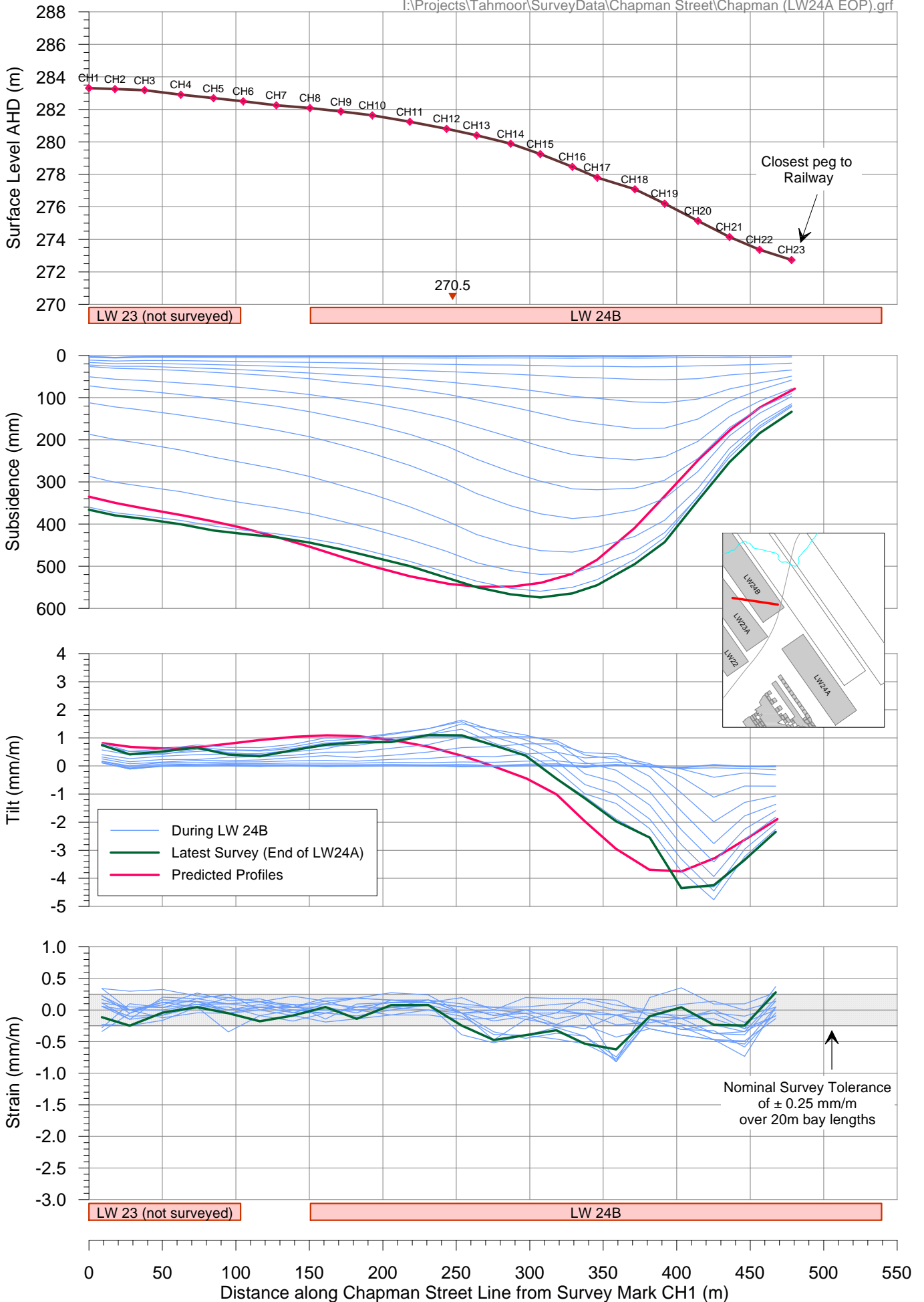


# Tahmoor Colliery - Total Subsidence Profiles along Castlereagh Street



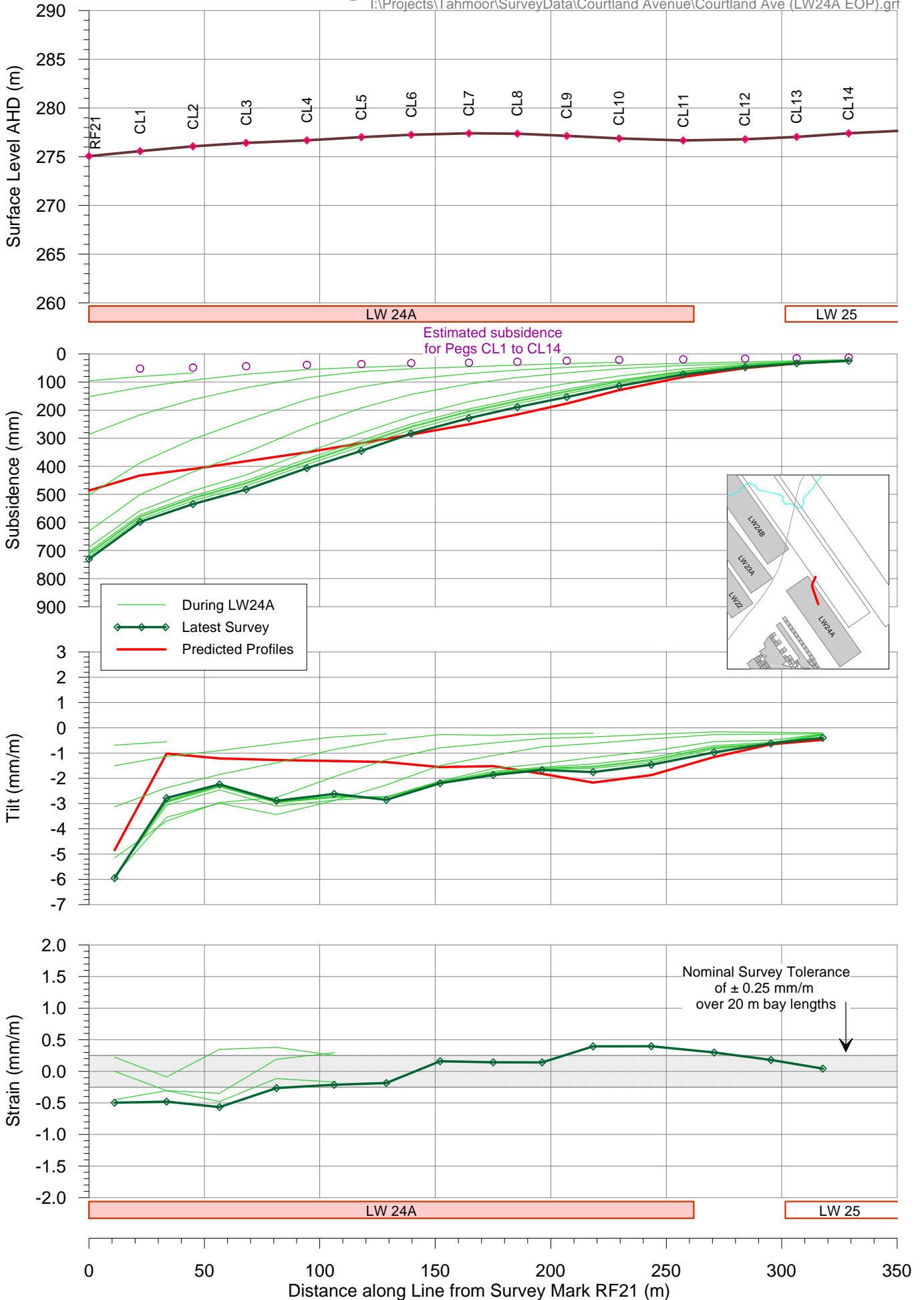
# Tahmoor Colliery - Total Subsidence Profiles along Chapman Street Line

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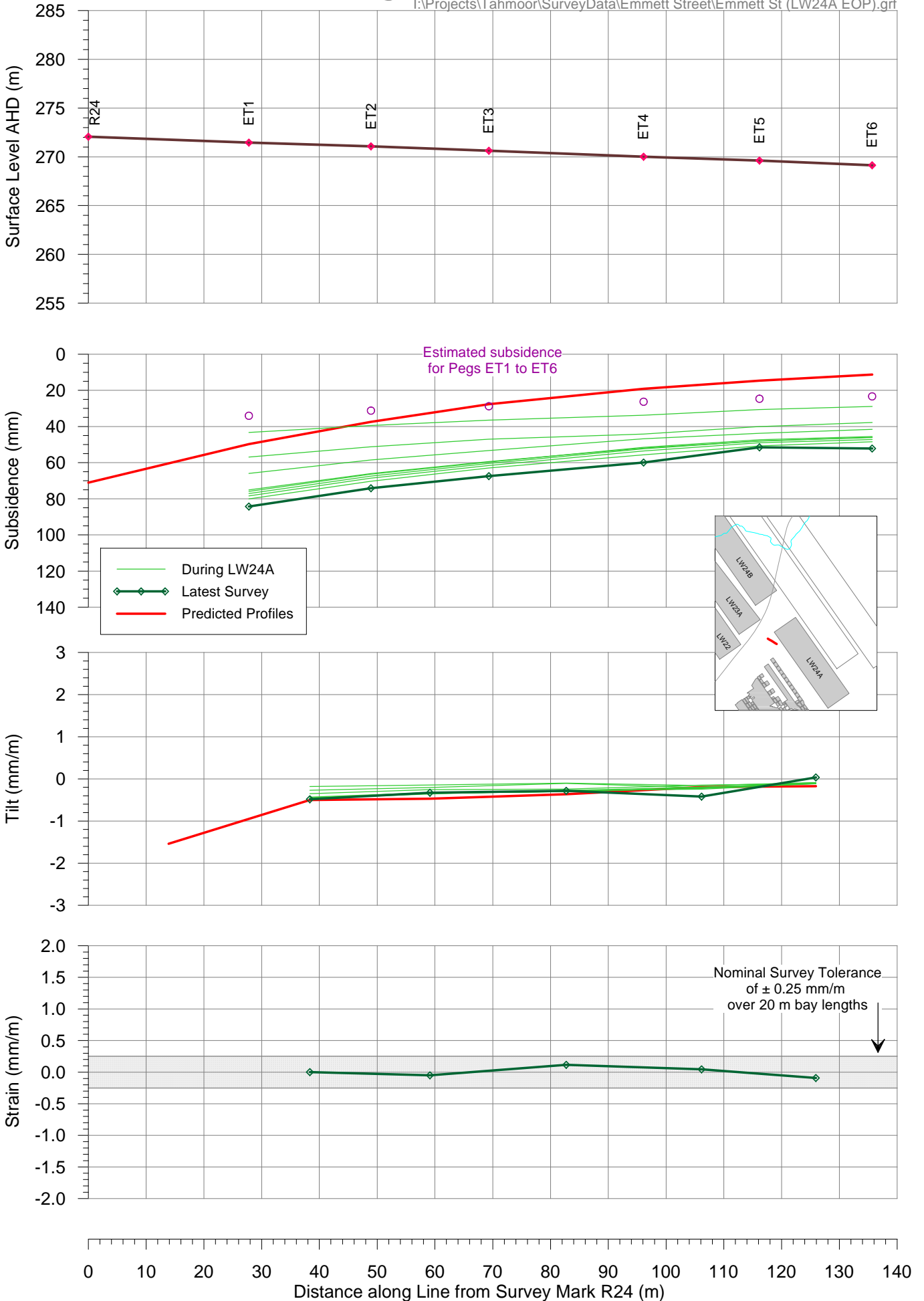
# Tahmoor Colliery - Total Subsidence Profiles along Courtland Avenue

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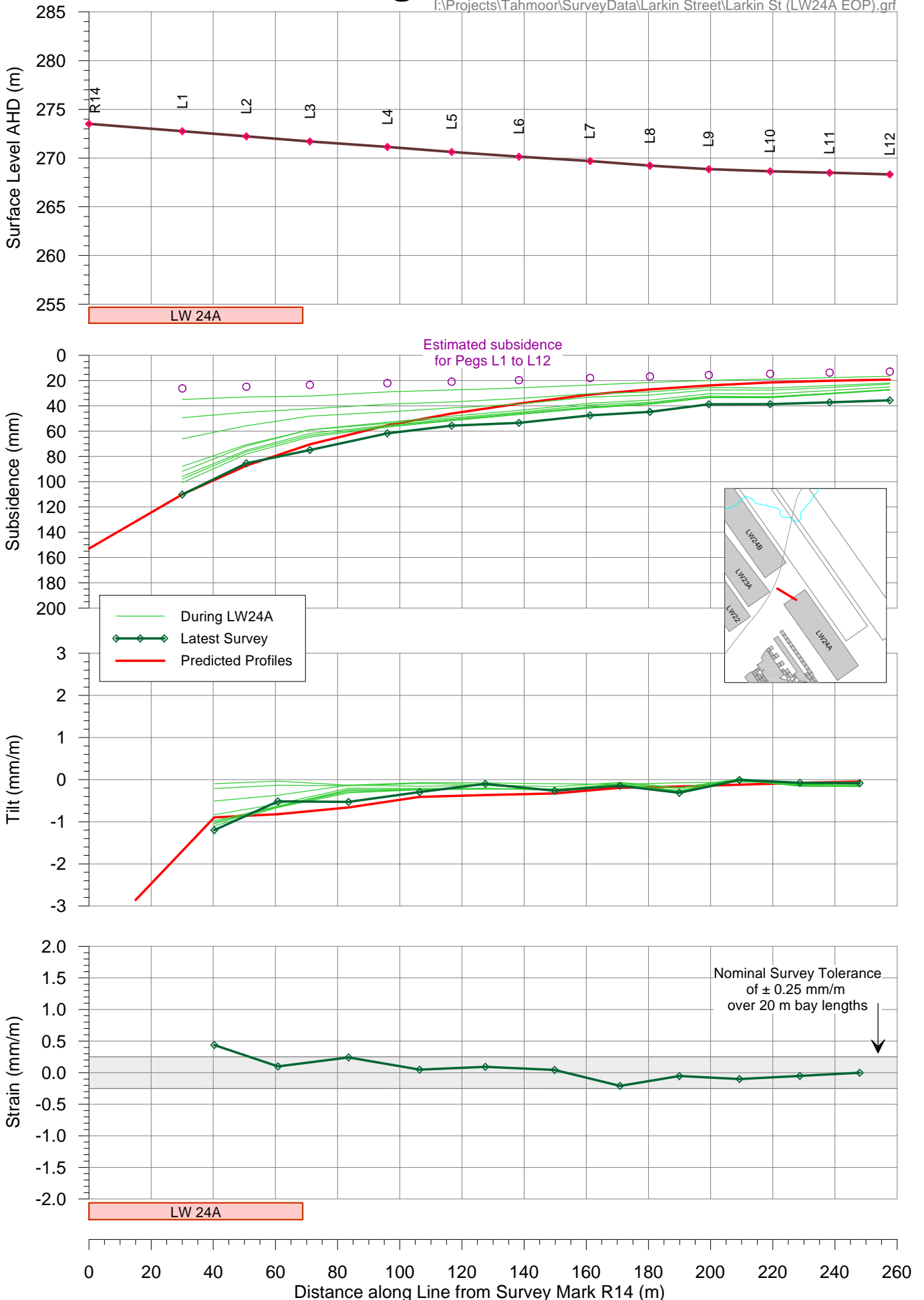
# Tahmoor Colliery - Total Subsidence Profiles along Emmett Street

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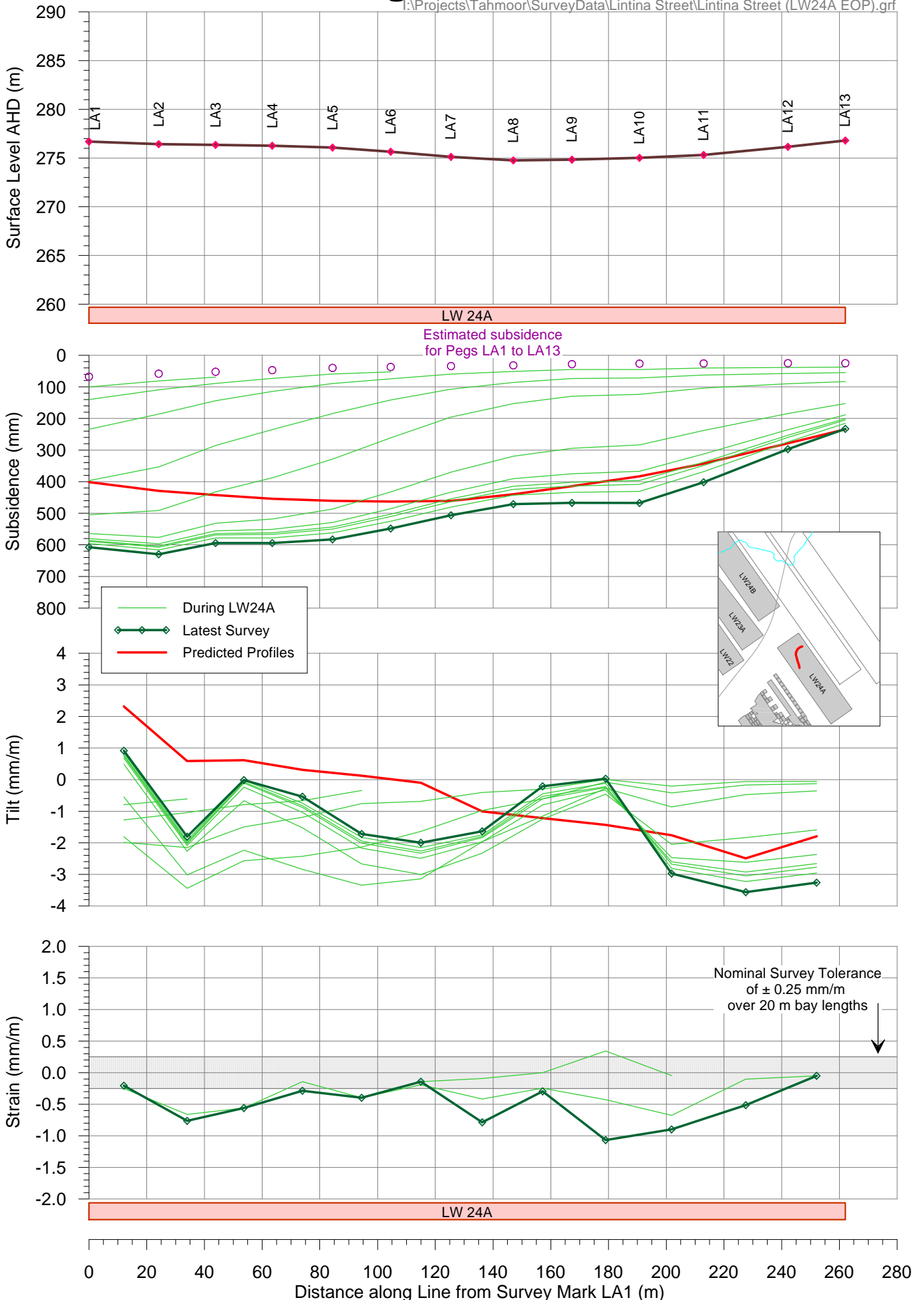
# Tahmoor Colliery - Total Subsidence Profiles along Larkin Street

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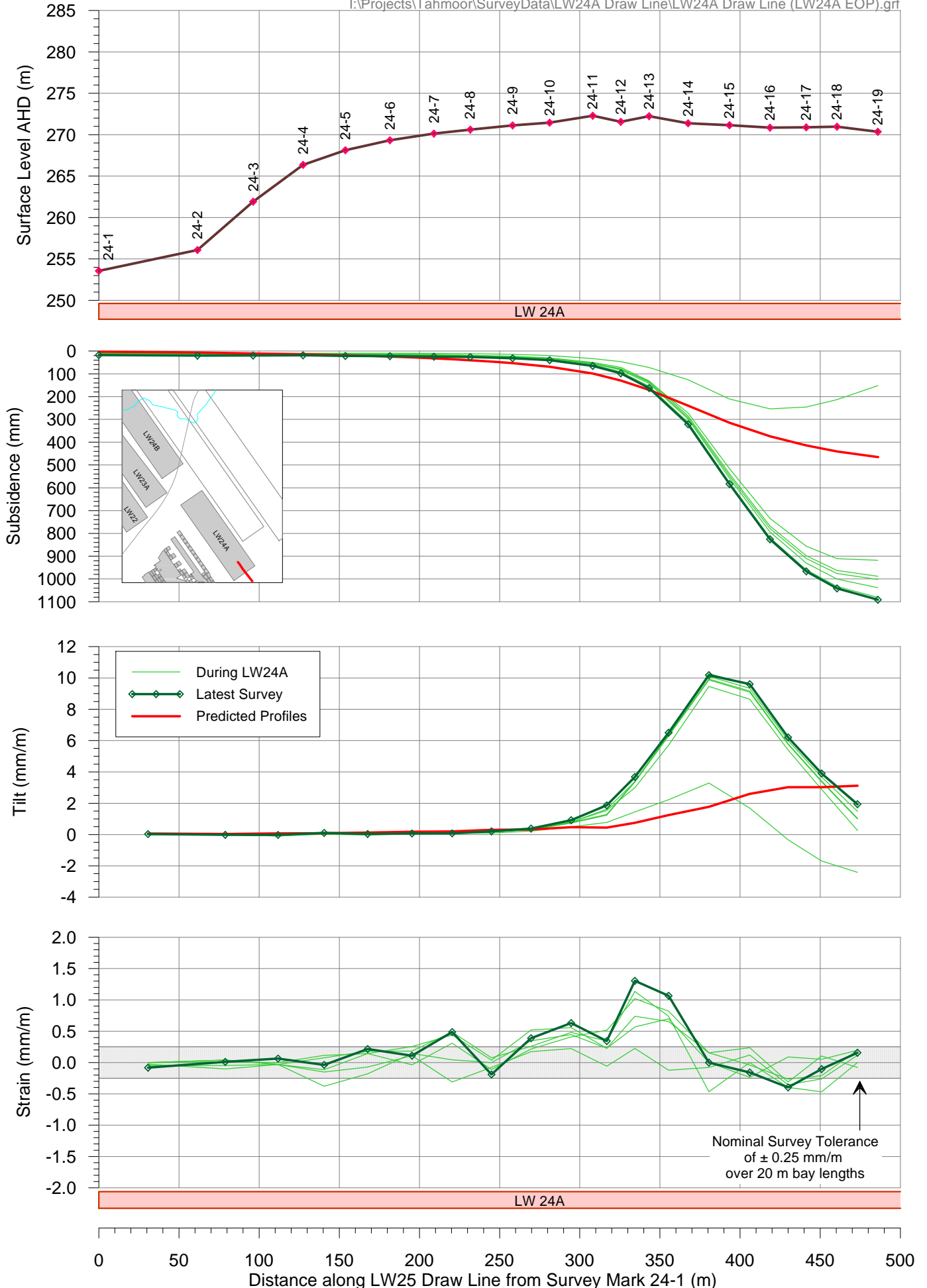
# Tahmoor Colliery - Total Subsidence Profiles along Lintina Street

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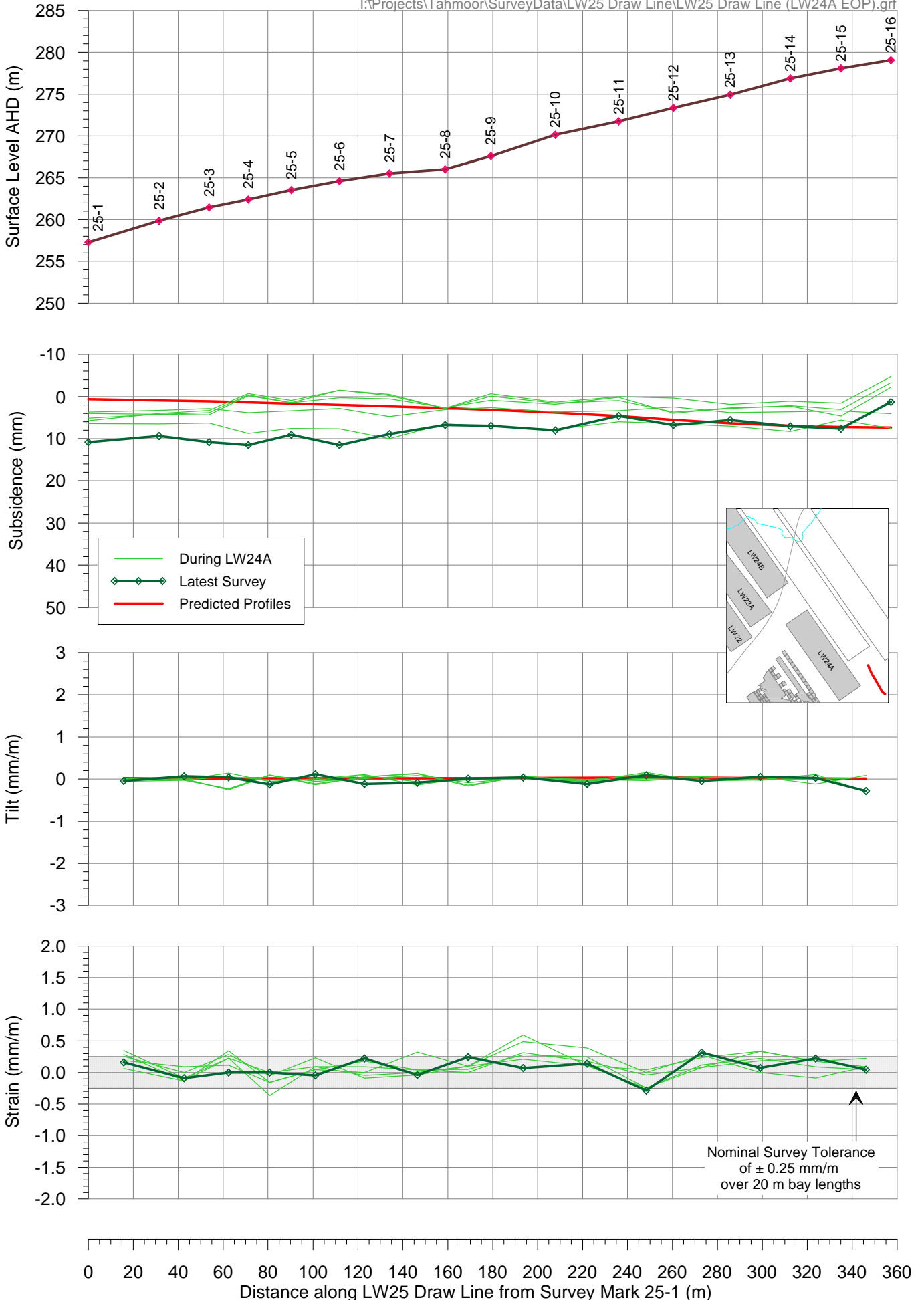
# Tahmoor Colliery - Total Subsidence Profiles along LW24A Draw Line

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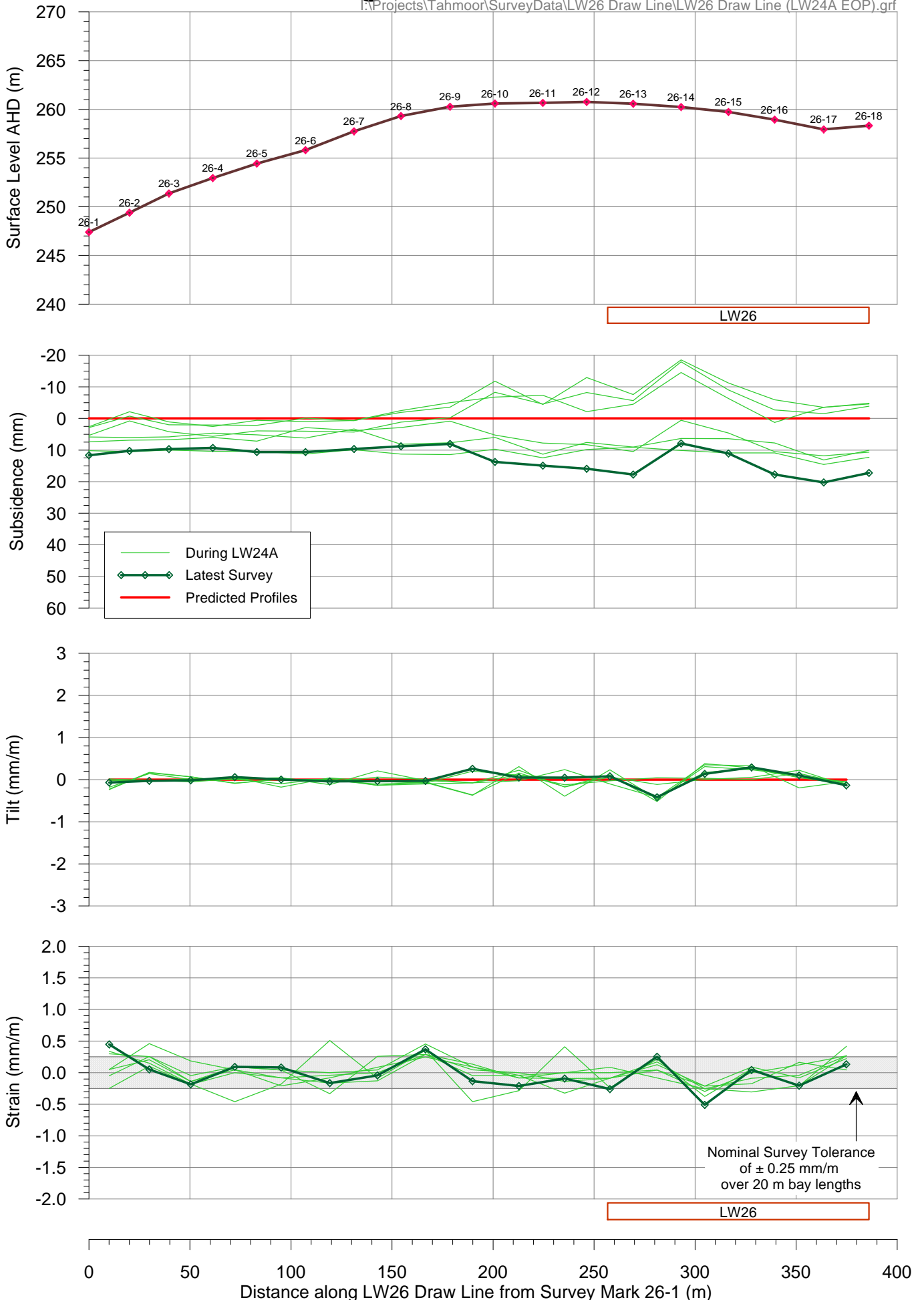
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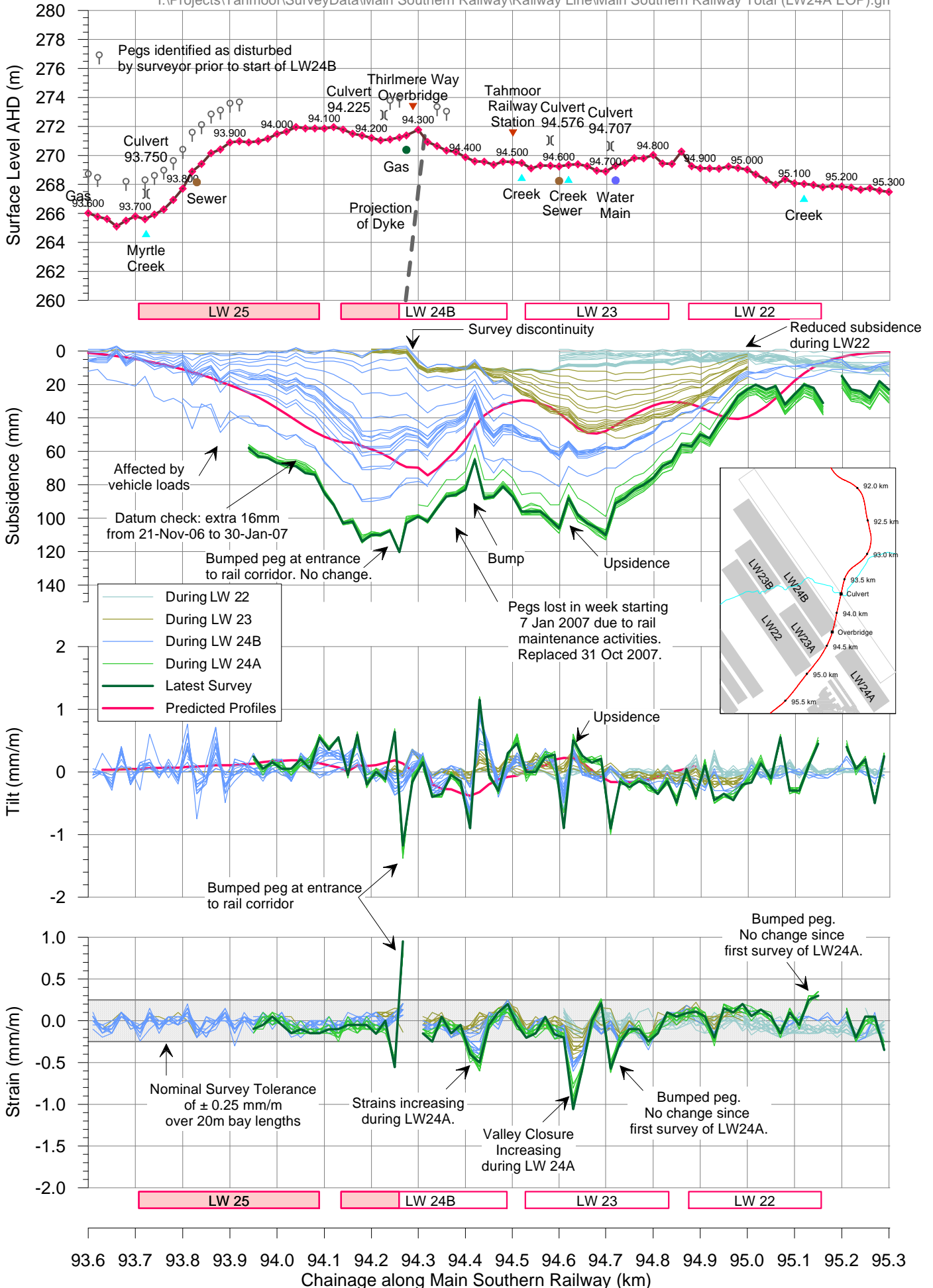
# Tahmoor Colliery - Total Subsidence Profiles along LW26 Draw Line

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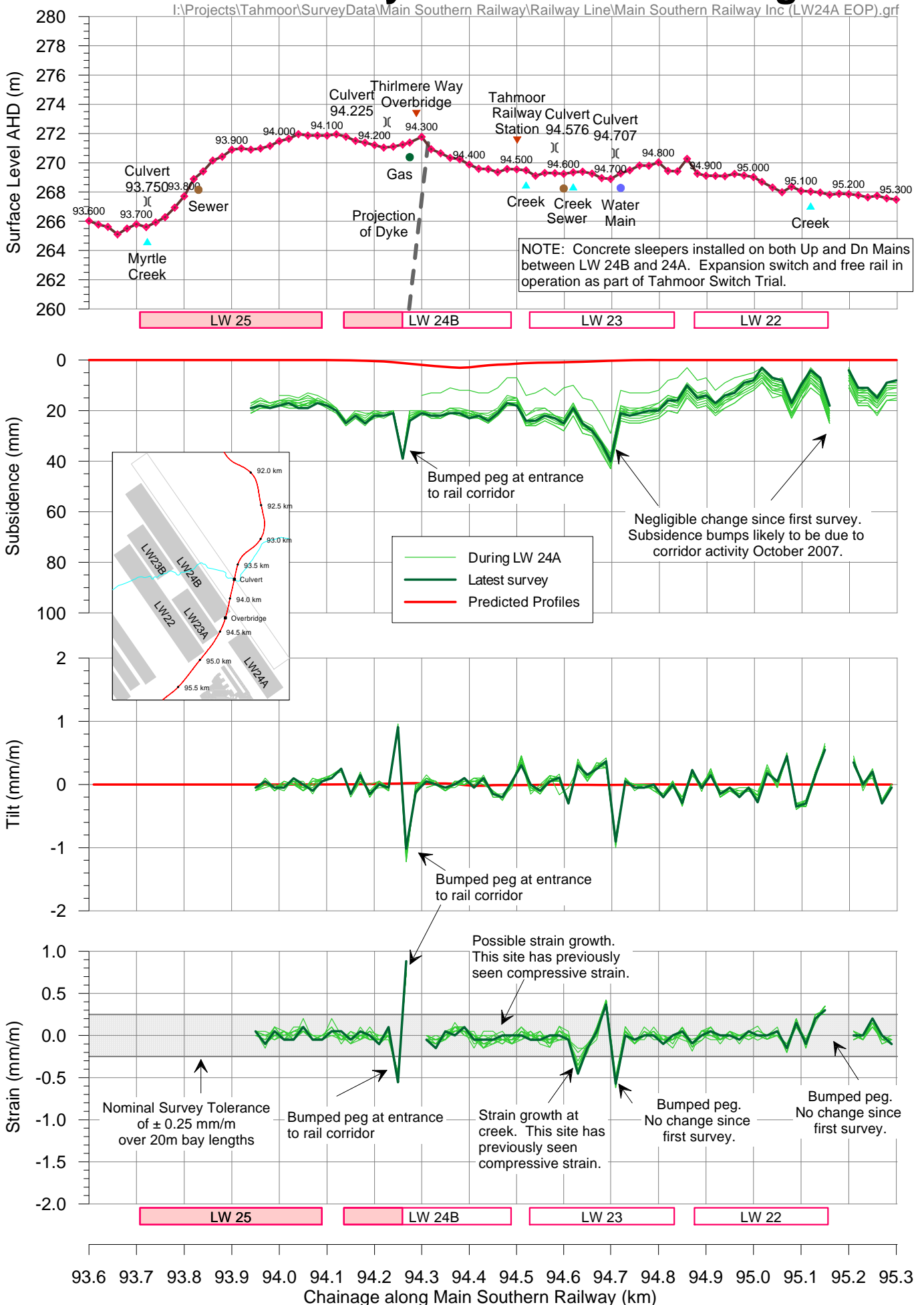


# Tahmoor Colliery - Total Subsidence Profiles along Main Southern Railway Corridor Line

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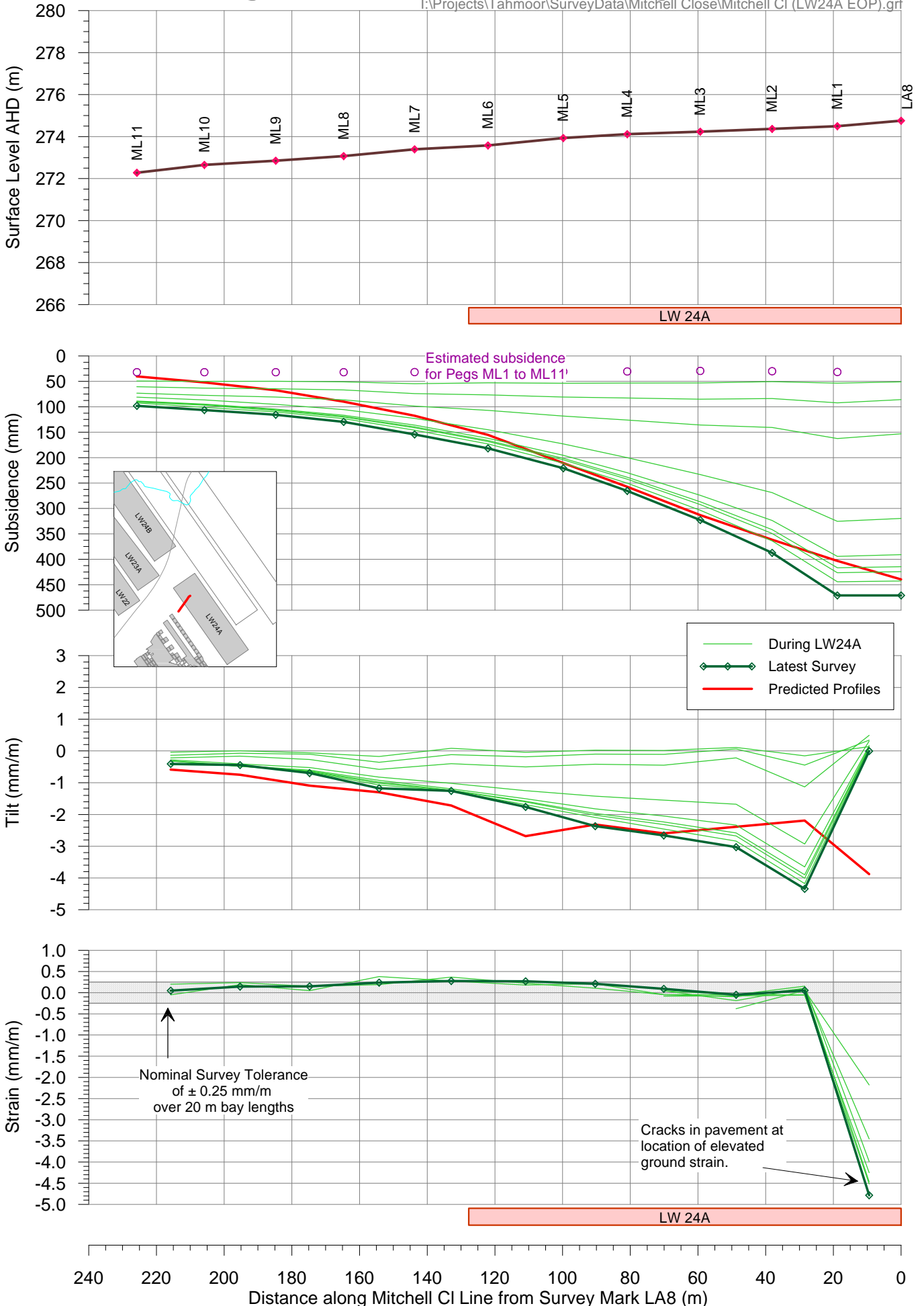


# Tahmoor Colliery - Incremental Subsidence Profiles Main Southern Railway Corridor Line during LW24A



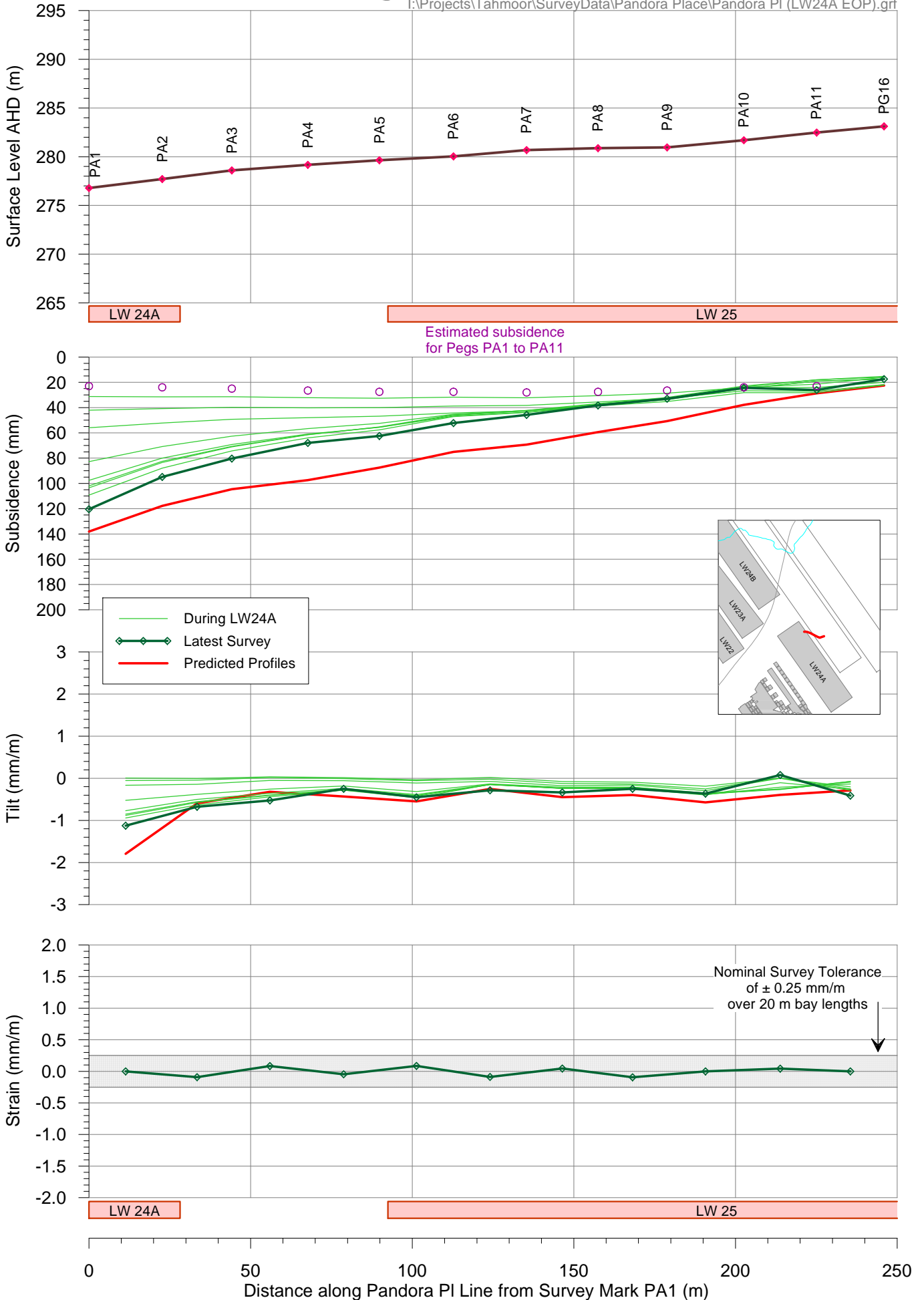
# Tahmoor Colliery - Total Subsidence Profiles along Mitchell Close during LW24A

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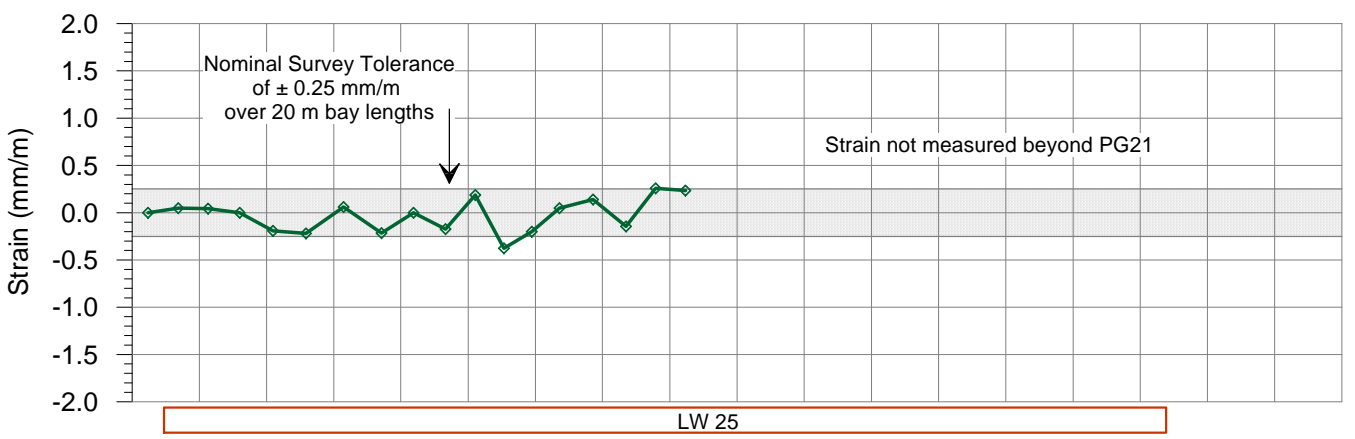
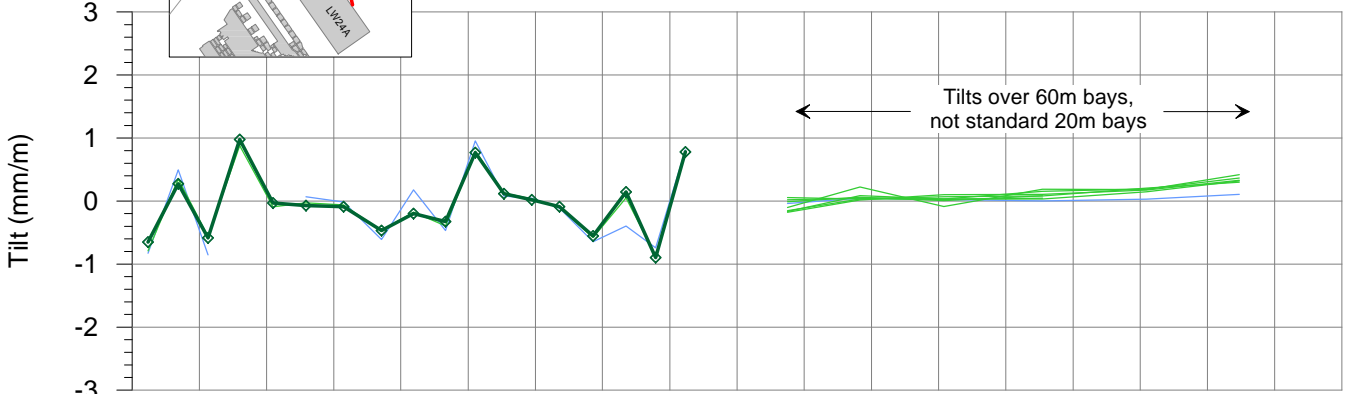
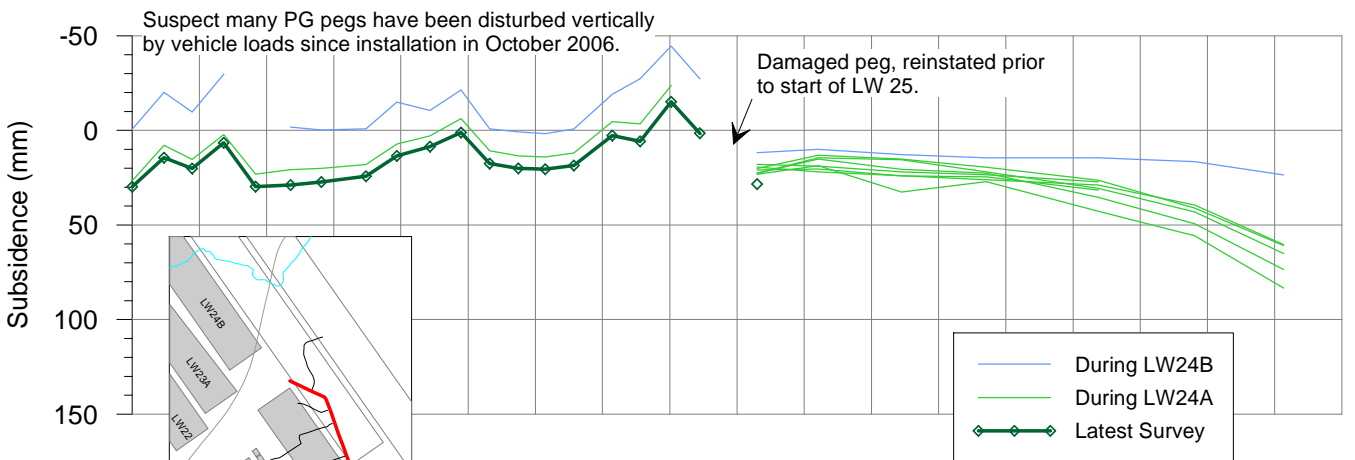
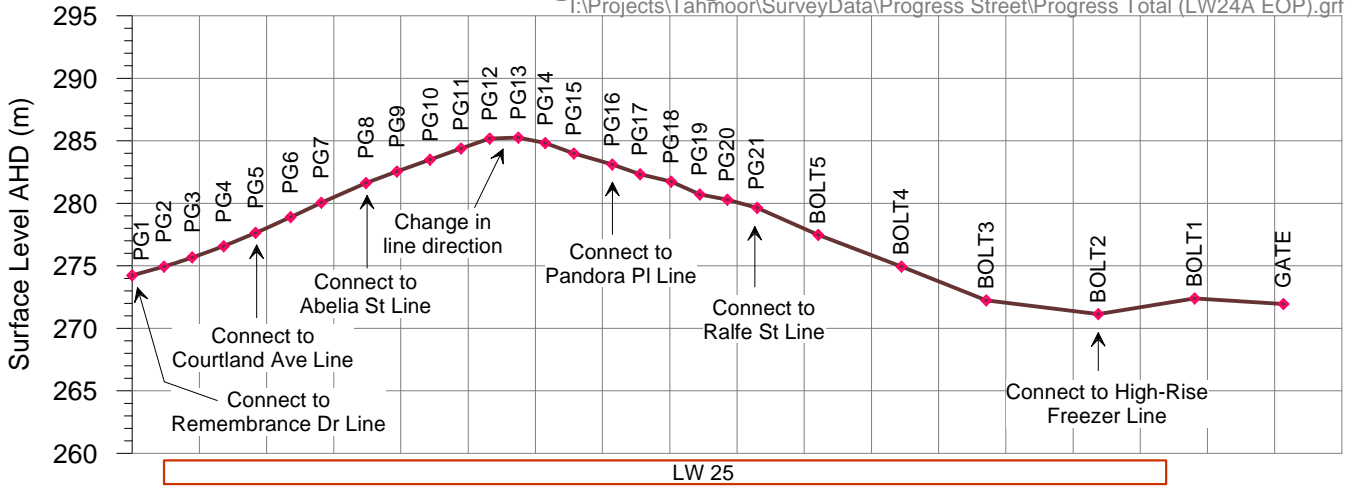
# Tahmoor Colliery - Total Subsidence Profiles along Pandora Place

I:\Projects\Tahmoor\SurveyData\Pandora Place\Pandora PI (LW24A EOP).grf



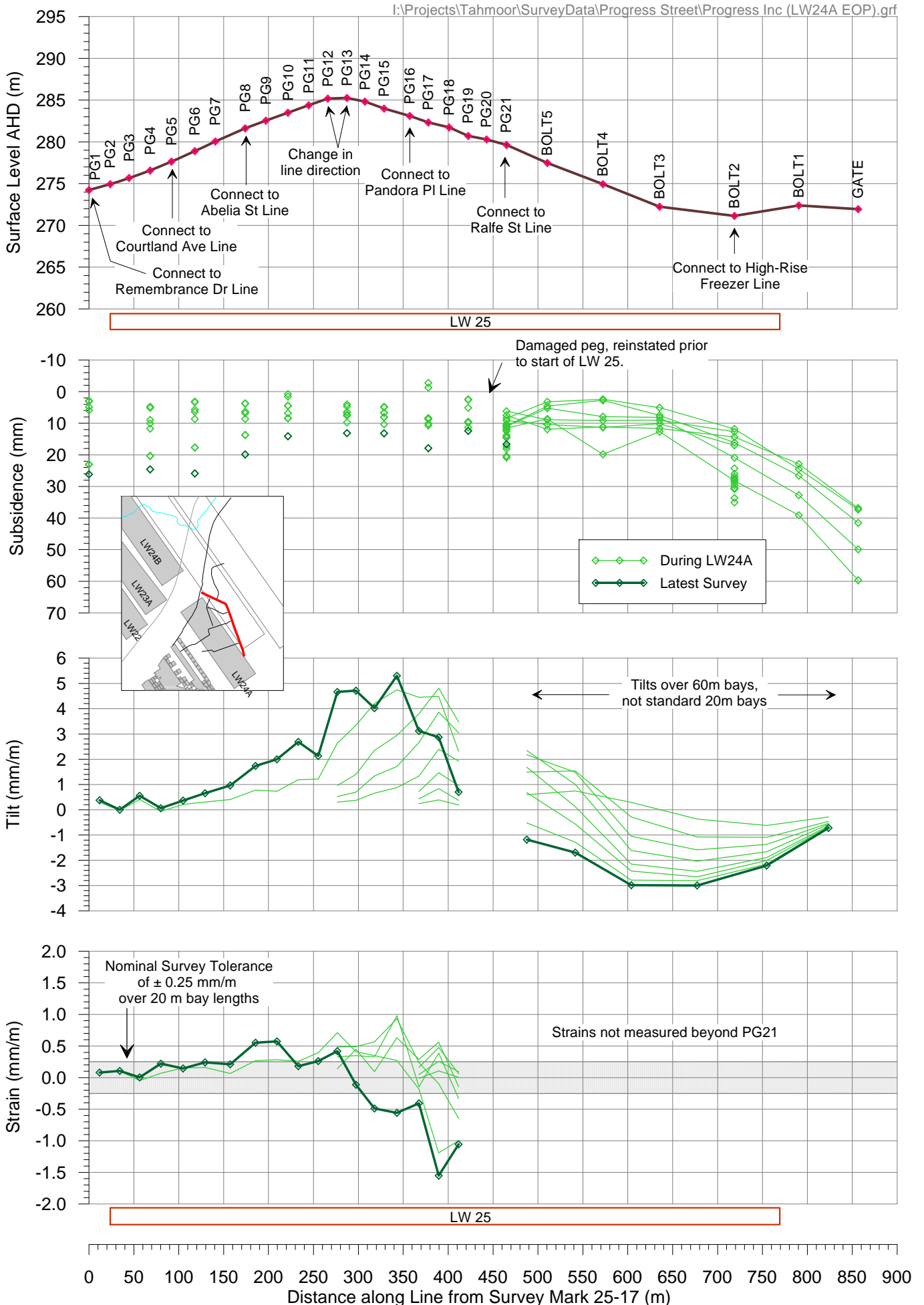
# Tahmoor Colliery - Total Subsidence Profiles along Progress Street

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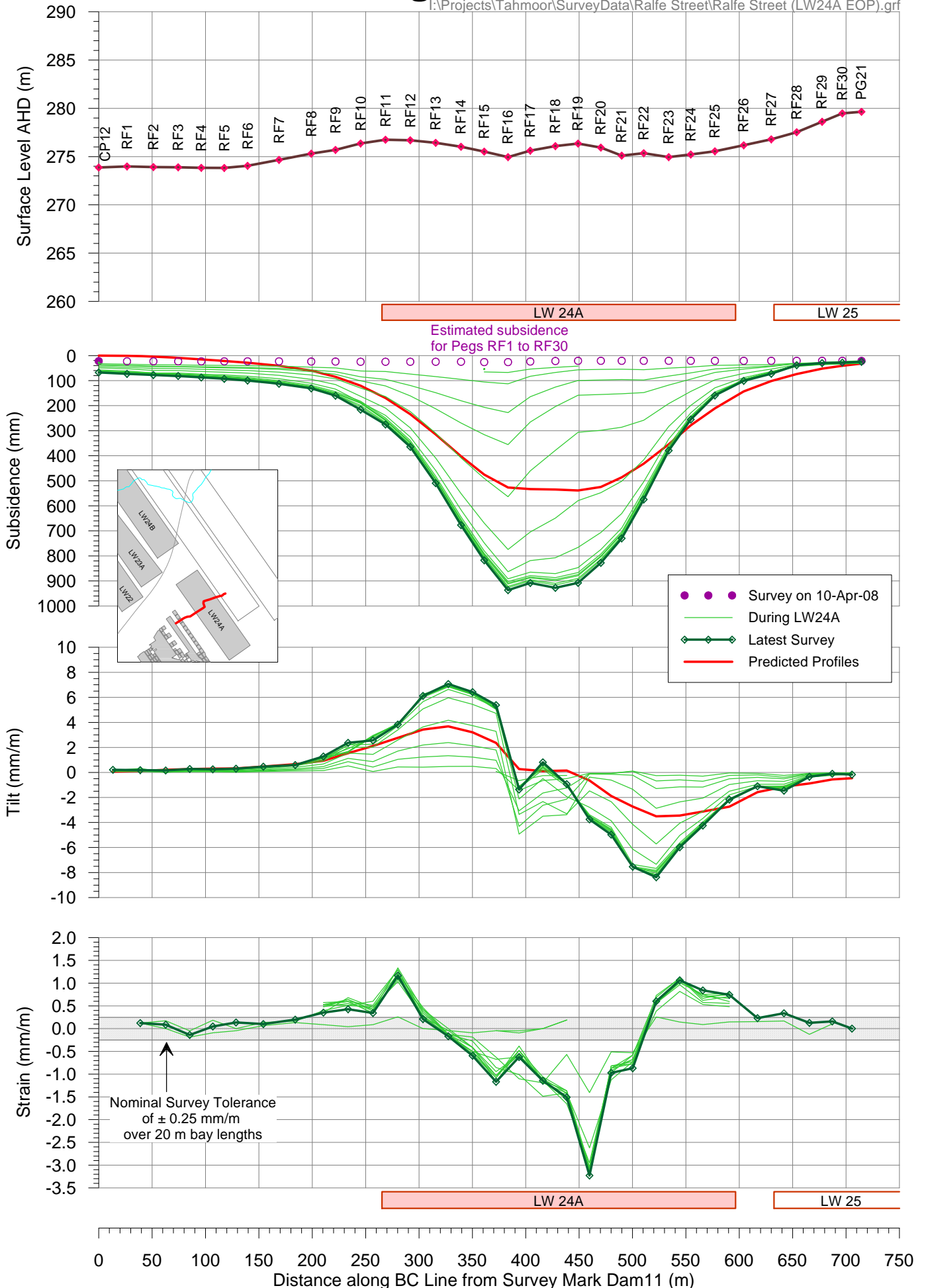
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900  
Distance along Line from Survey Mark 25-17 (m)

# Tahmoor Colliery - Incremental Subsidence Profiles along Progress Street during LW24A



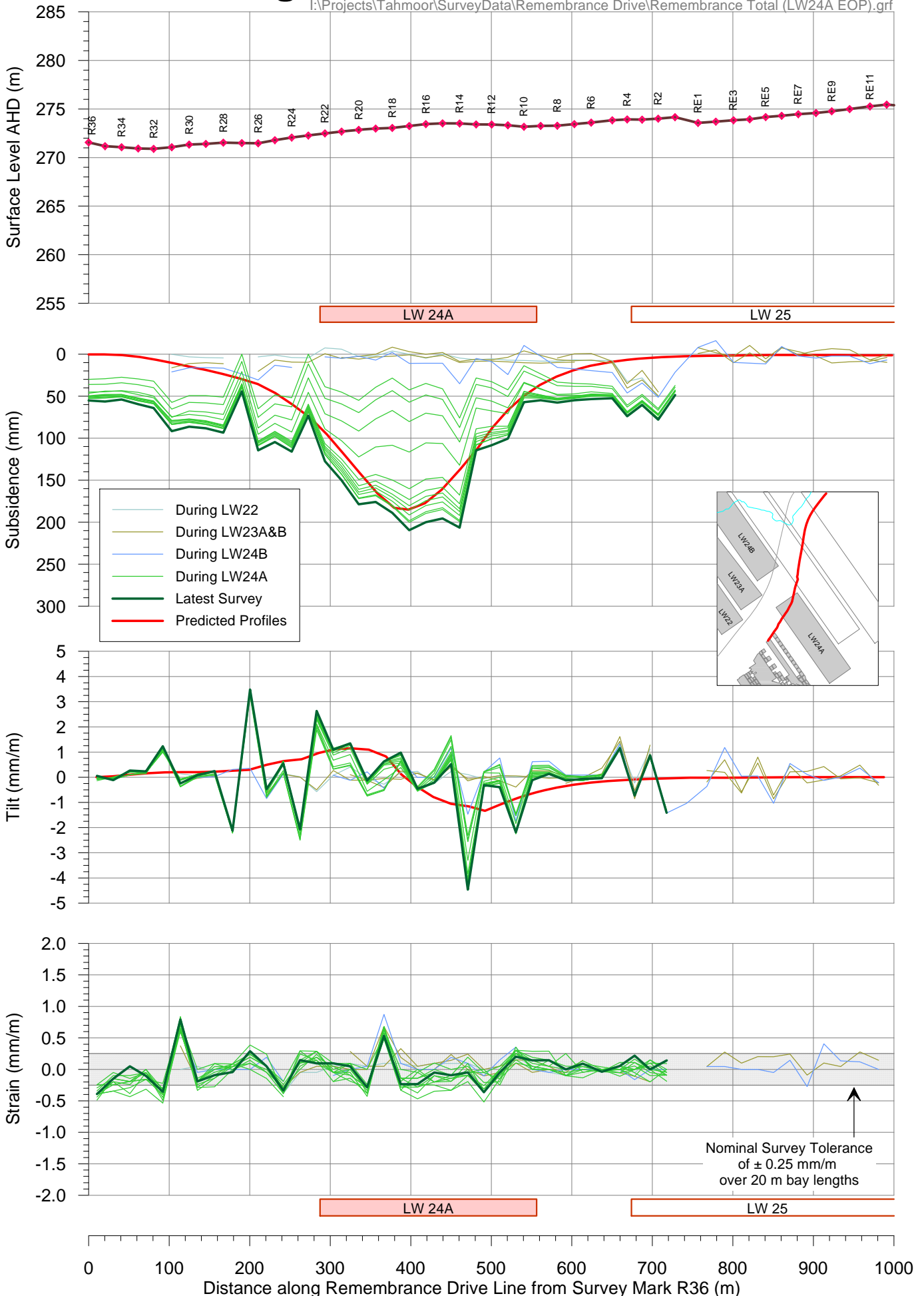
# Tahmoor Colliery - Total Subsidence Profiles along Ralfe Street

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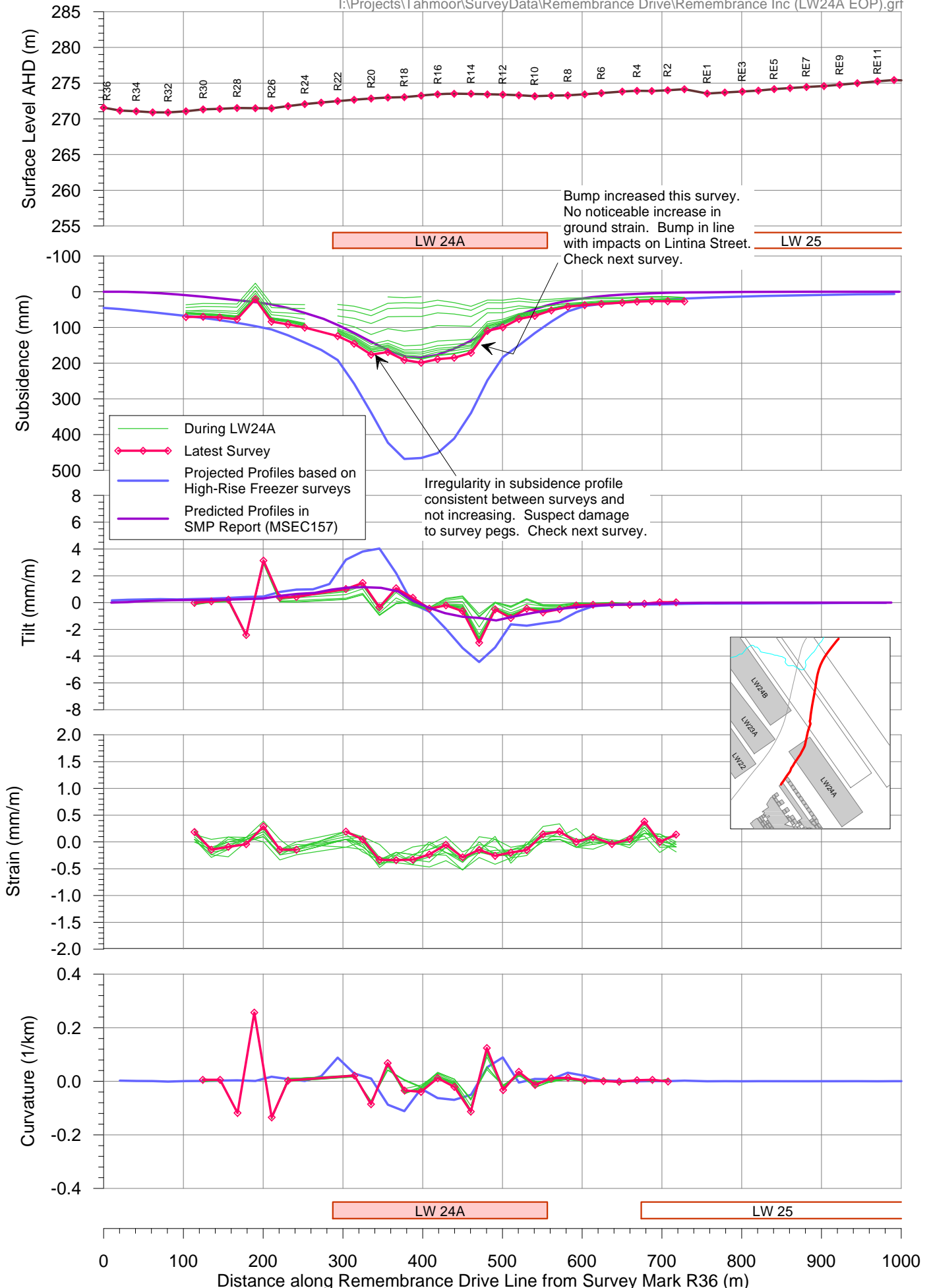
# Tahmoor Colliery - Total Subsidence Profiles along Remembrance Drive Line

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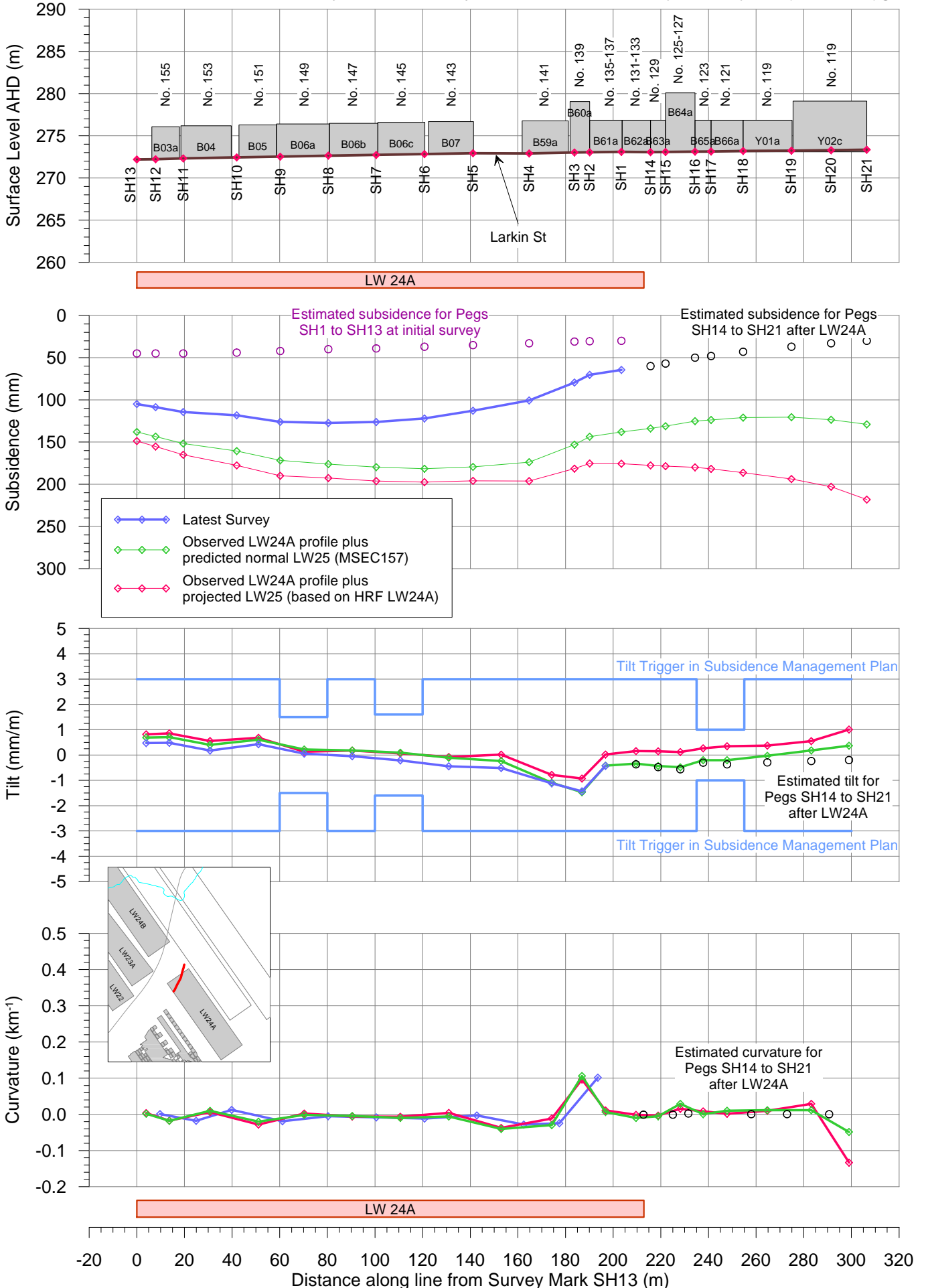
# Tahmoor Colliery - Incremental Subsidence Profiles along Remembrance Drive due to LW24A

I:\Projects\Tahmoor\SurveyData\Remembrance Drive\Remembrance Inc (LW24A EOP).grf



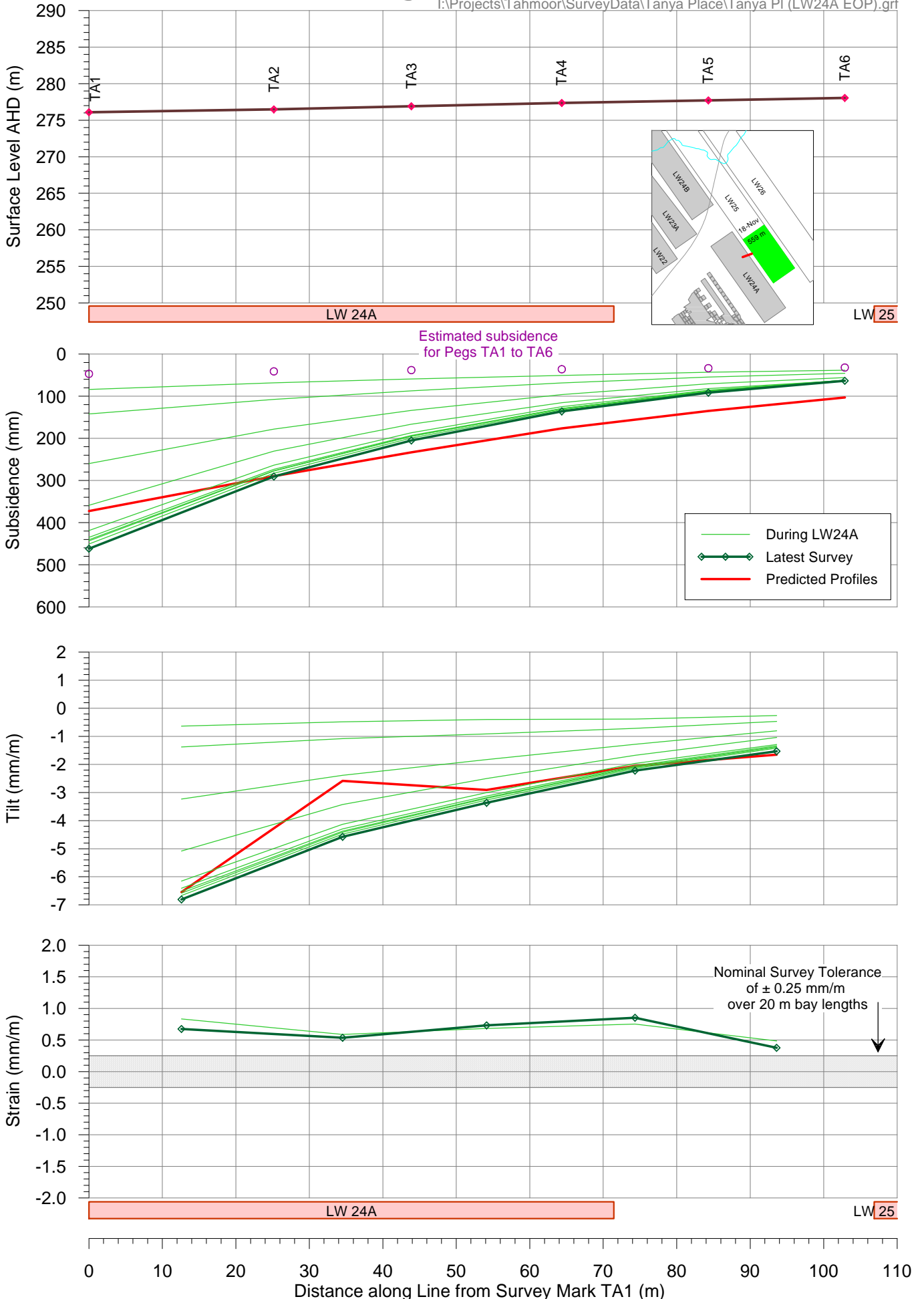
# Tahmoor Colliery - Total Subsidence Profiles along Remembrance Drive Shopfronts

I:\Projects\Tahmoor\SurveyData\Remembrance Drive\Shopfronts\Shopfronts (LW24A EOP).grf

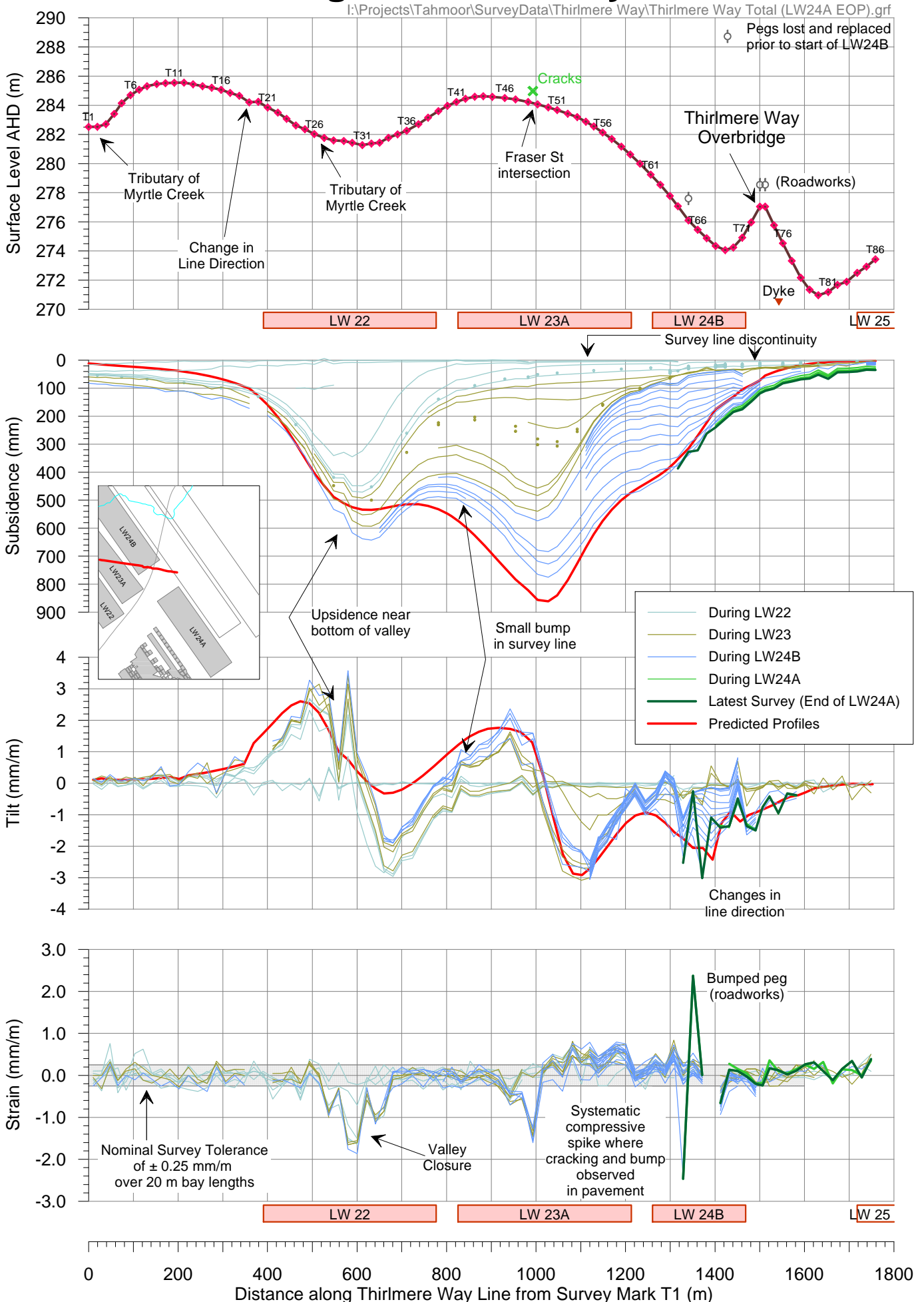


# Tahmoor Colliery - Total Subsidence Profiles along Tanya Place

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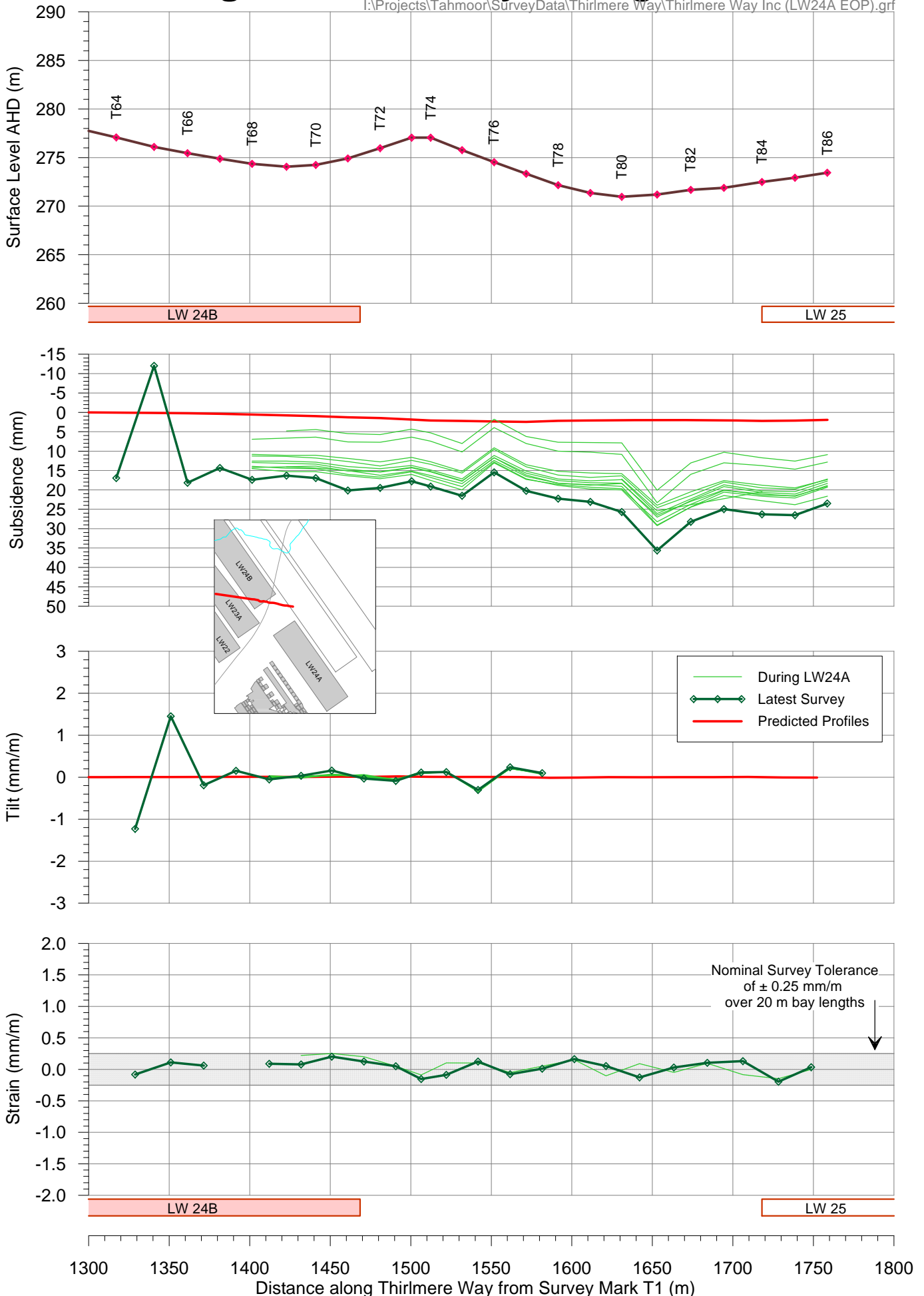


# Tahmoor Colliery - Total Subsidence Profiles along Thirlmere Way Line



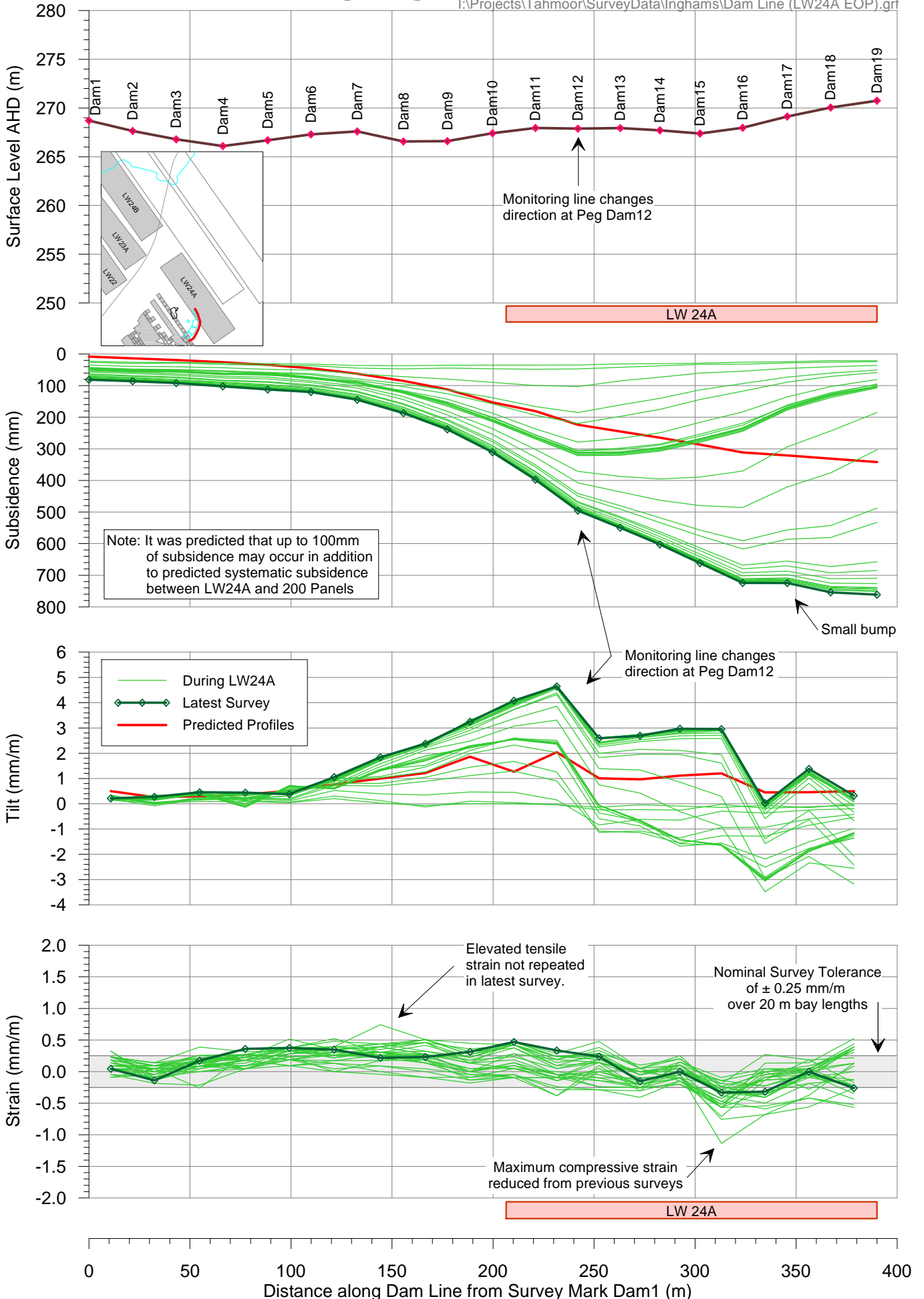
# Tahmoor Colliery - Incremental Subsidence Profiles along Thirlmere Way during LW24A

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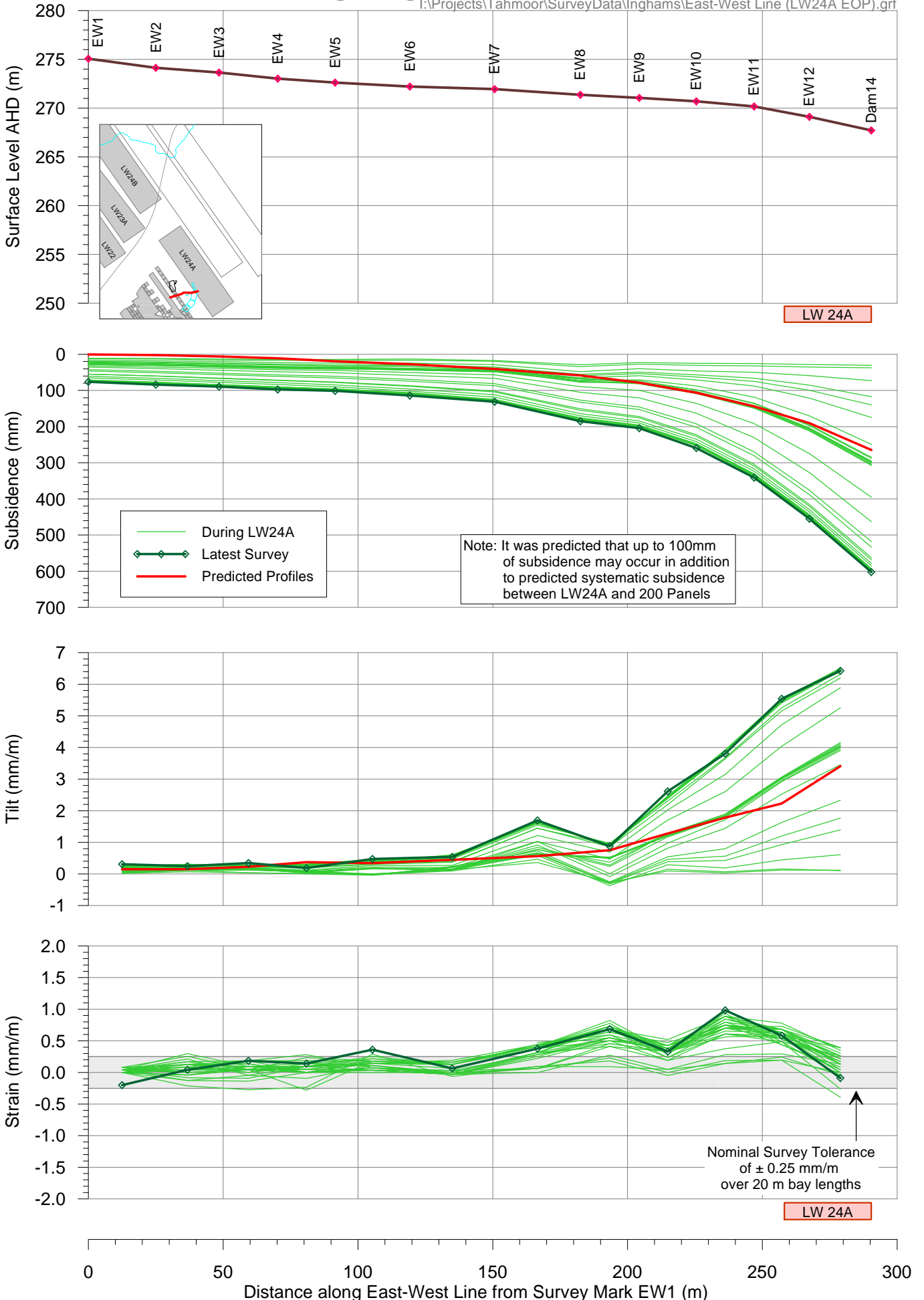
# Tahmoor Colliery - Total Subsidence Profiles along Inghams Dam Line

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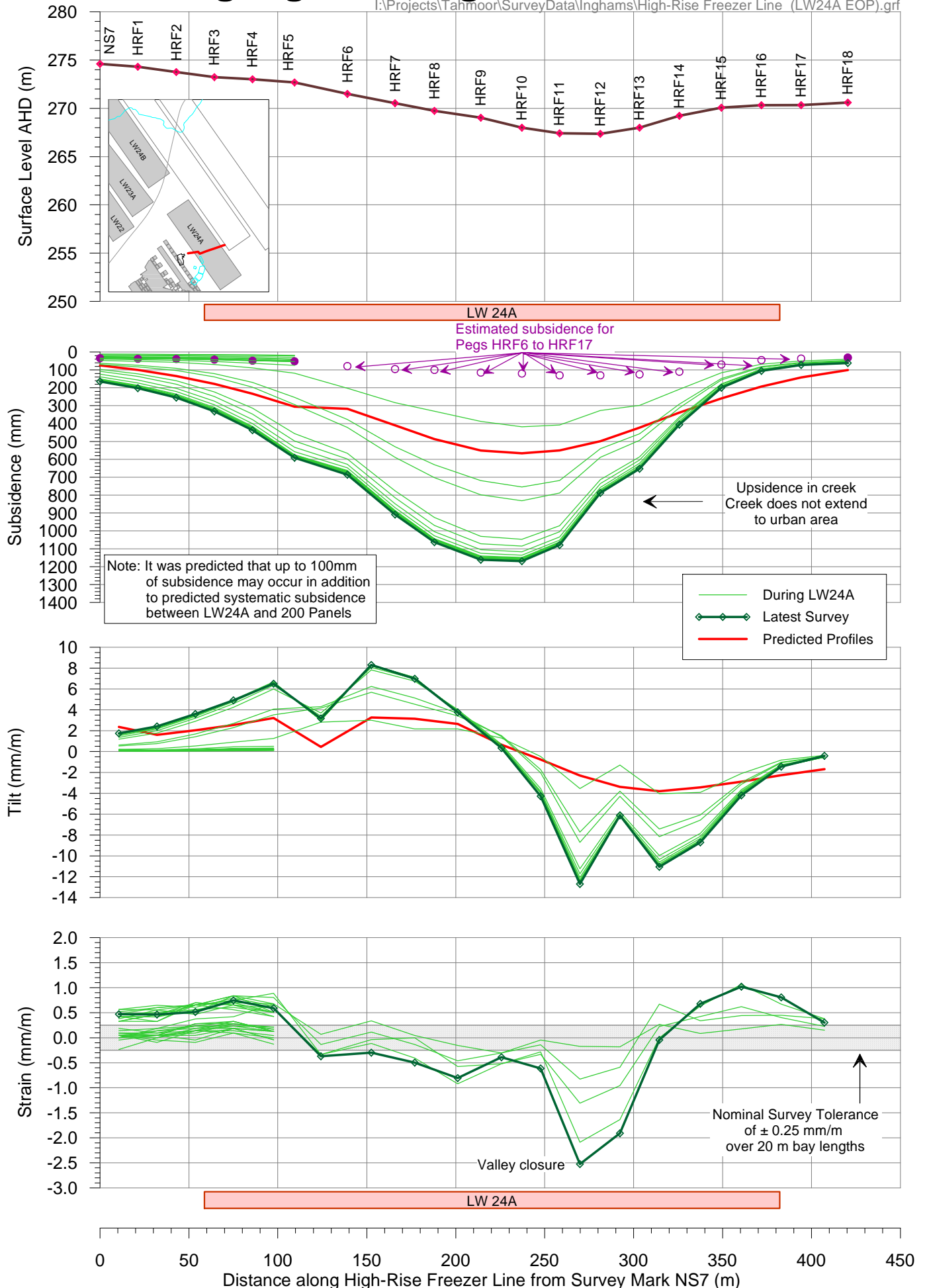
# Tahmoor Colliery - Total Subsidence Profiles along Inghams East-West

I:\Projects\Tahmoor\SurveyData\Inghams\East-West Line (LW24A EOP).grf



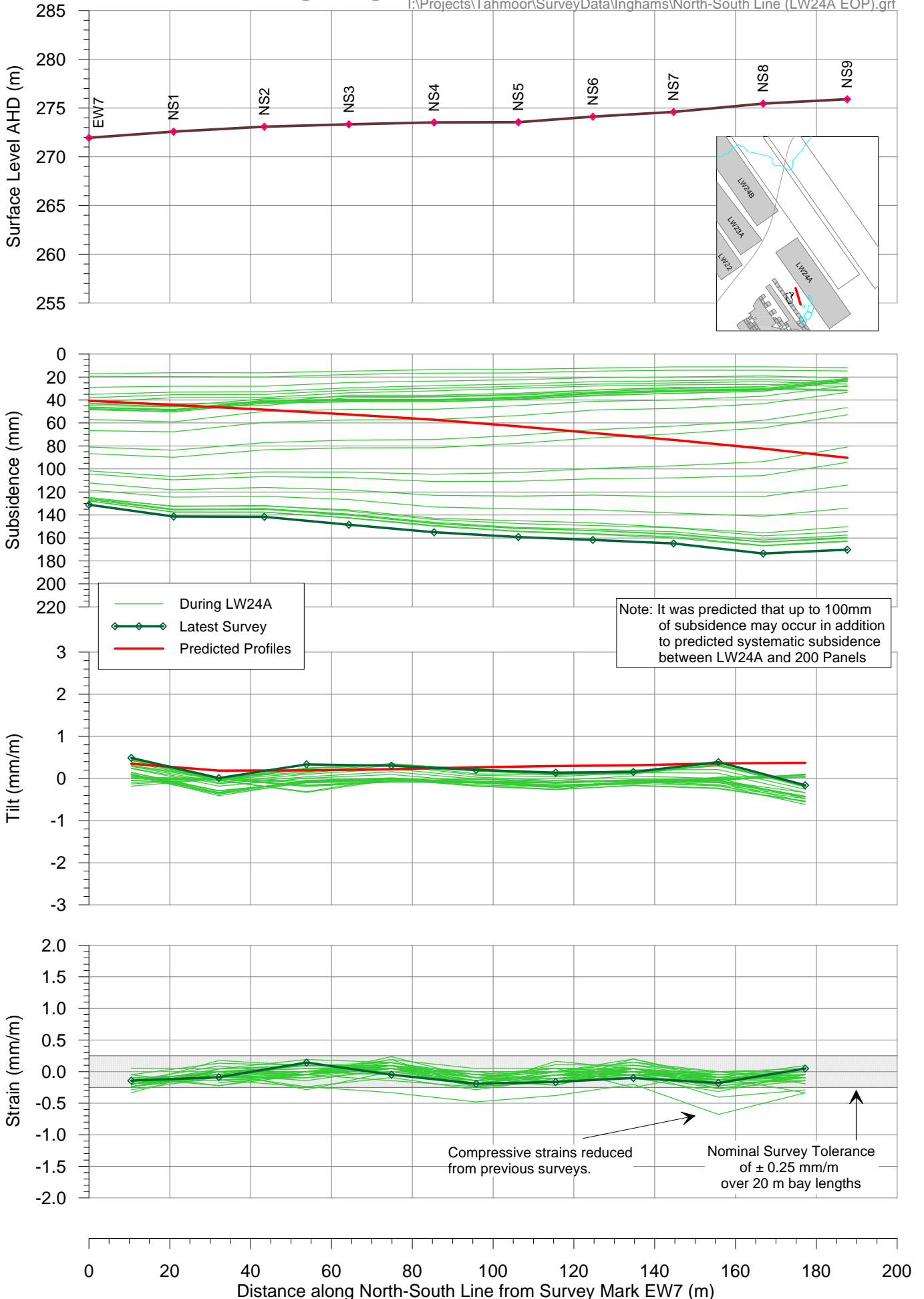
# Tahmoor Colliery - Total Subsidence Profiles along Inghams High-Rise Freezer Line

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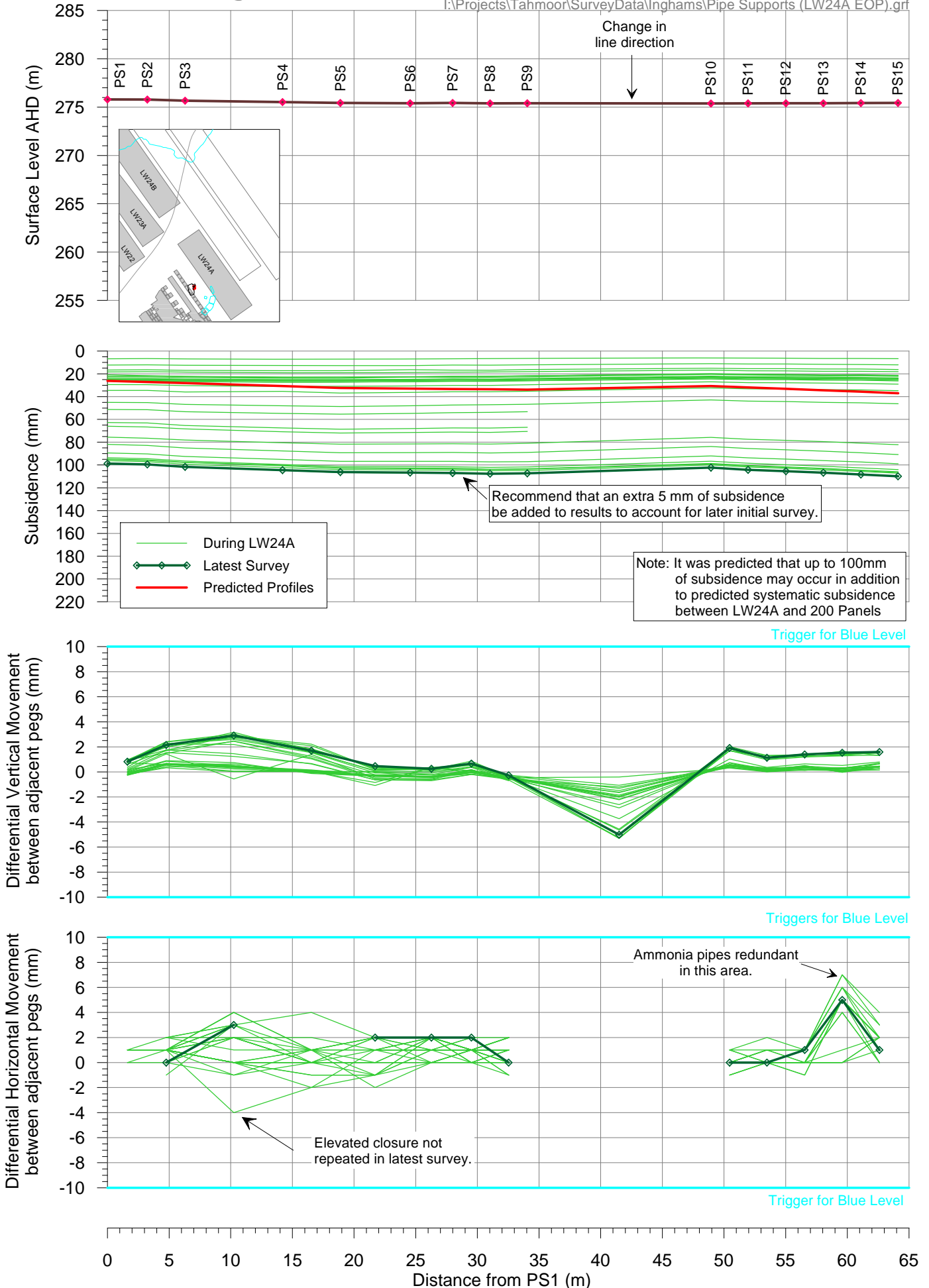
# Tahmoor Colliery - Total Subsidence Profiles along Inghams North-South

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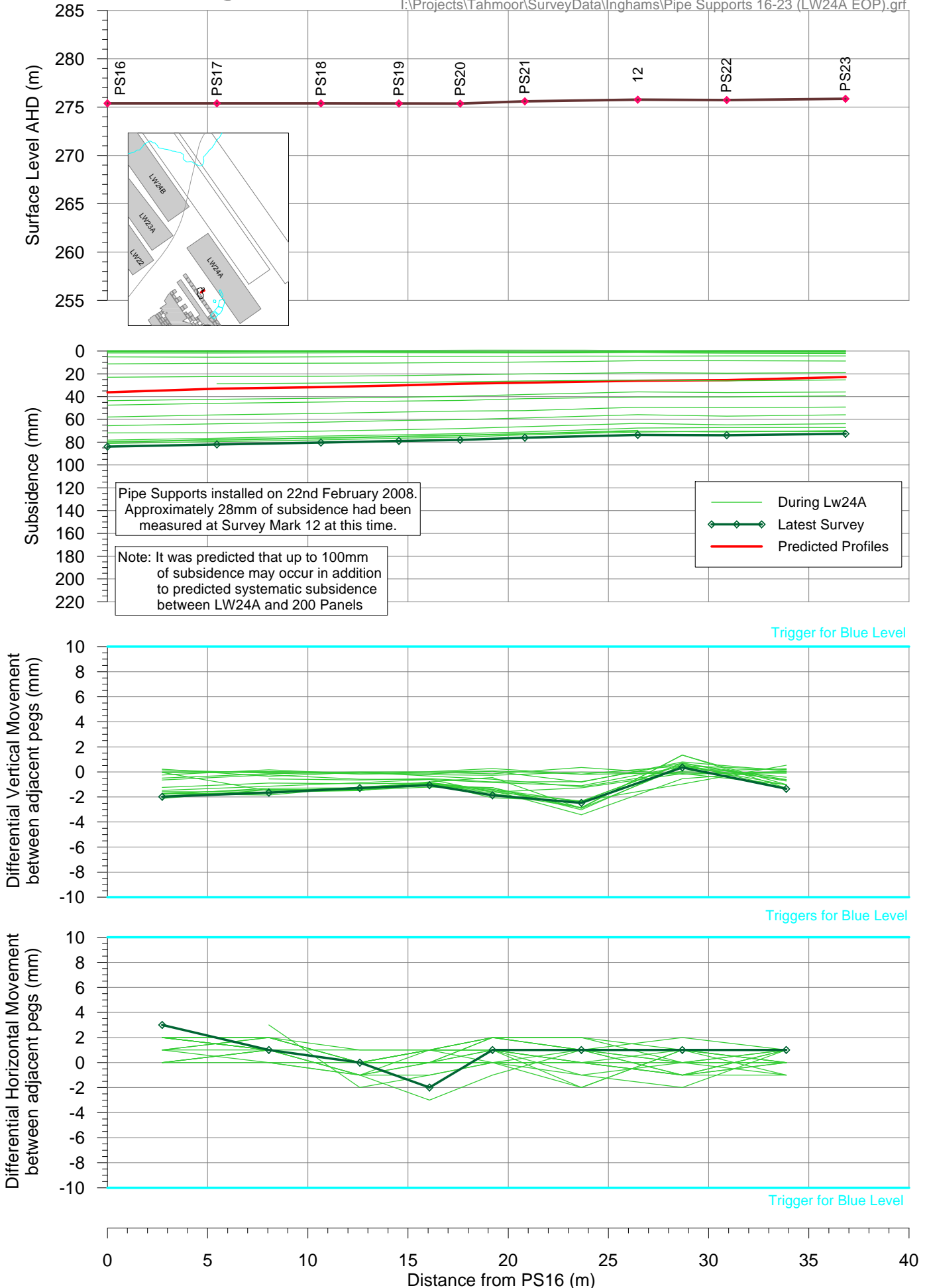
# Tahmoor Colliery - Total Subsidence Profiles along Pipe Support Line (PS1 to PS15)

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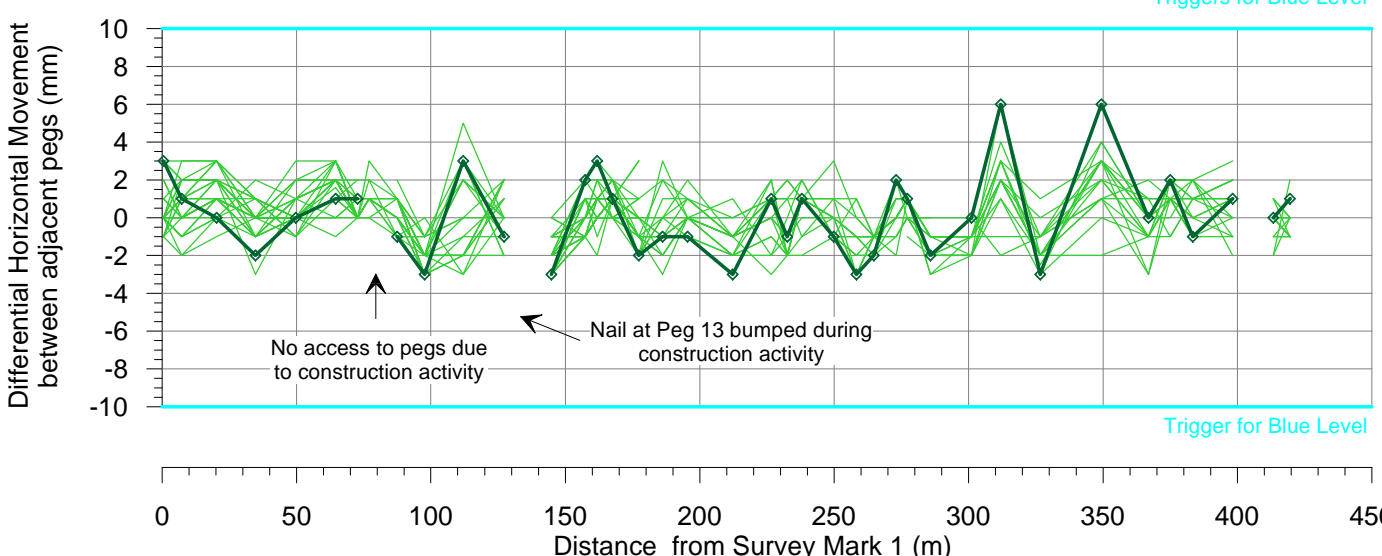
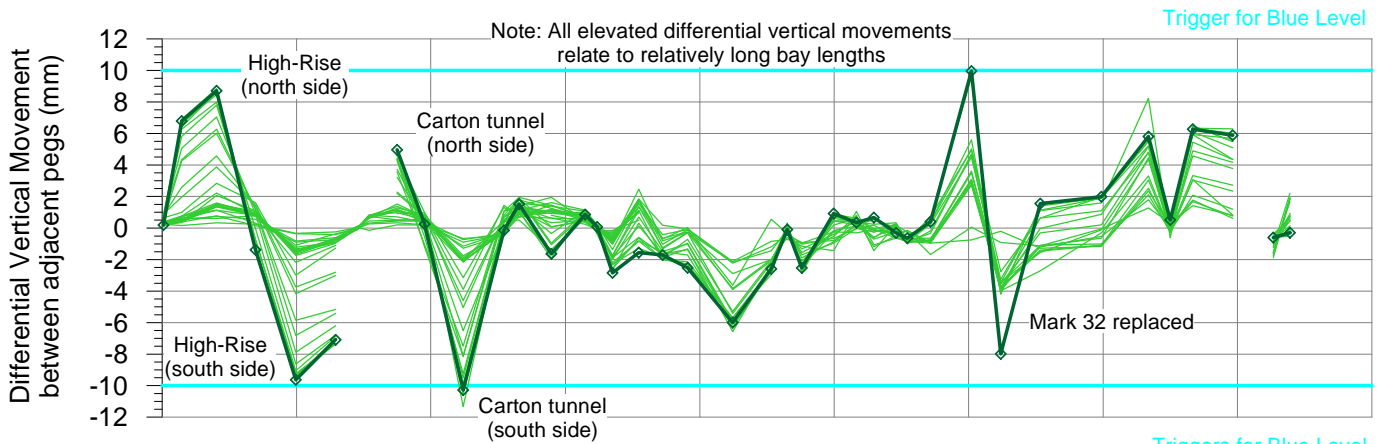
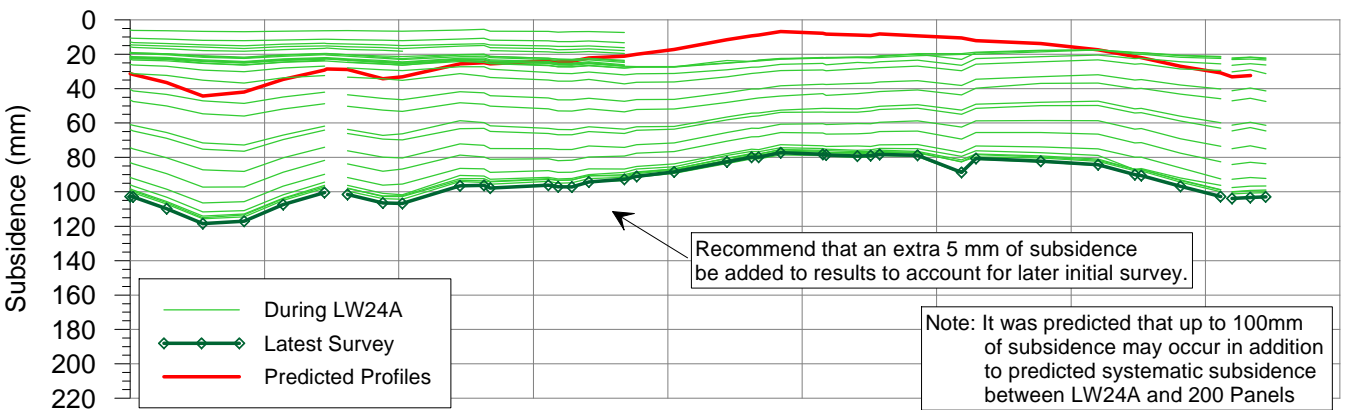
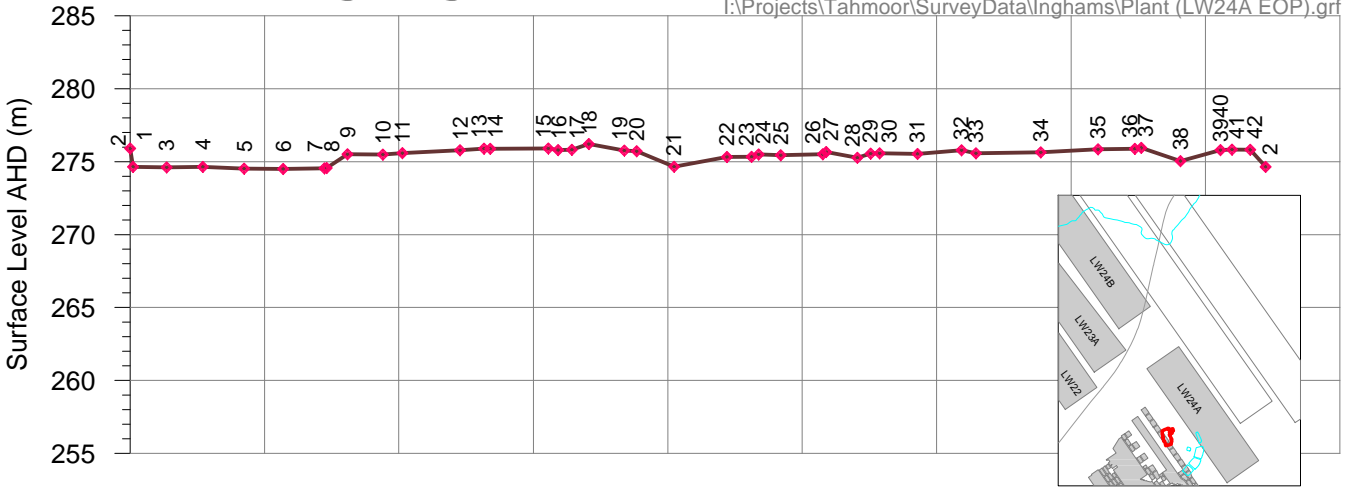
# Tahmoor Colliery - Total Subsidence Profiles along Pipe Support Line (PS16 to PS23)

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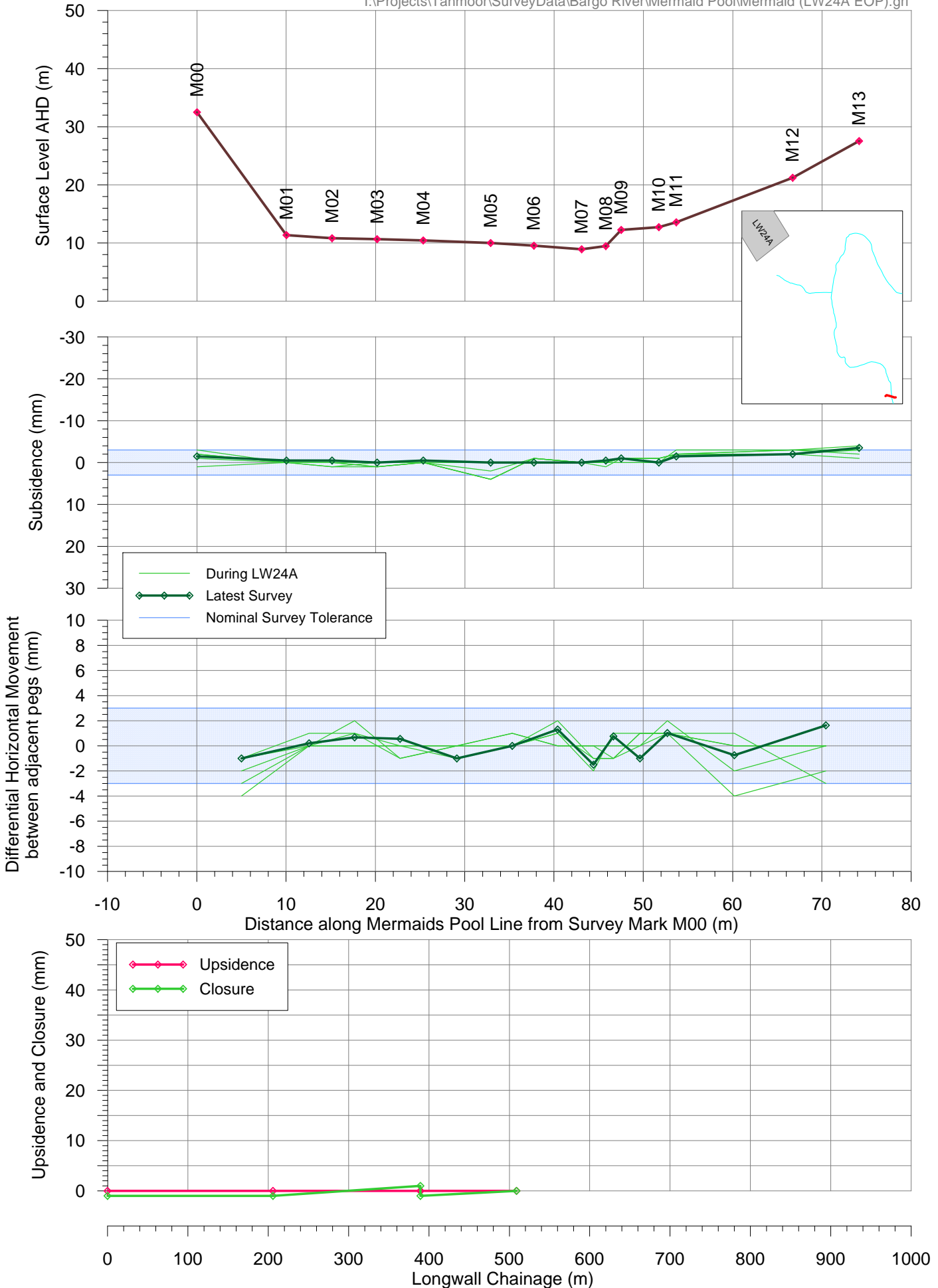
# Tahmoor Colliery - Total Subsidence Profiles along Inghams Plant Perimeter Line

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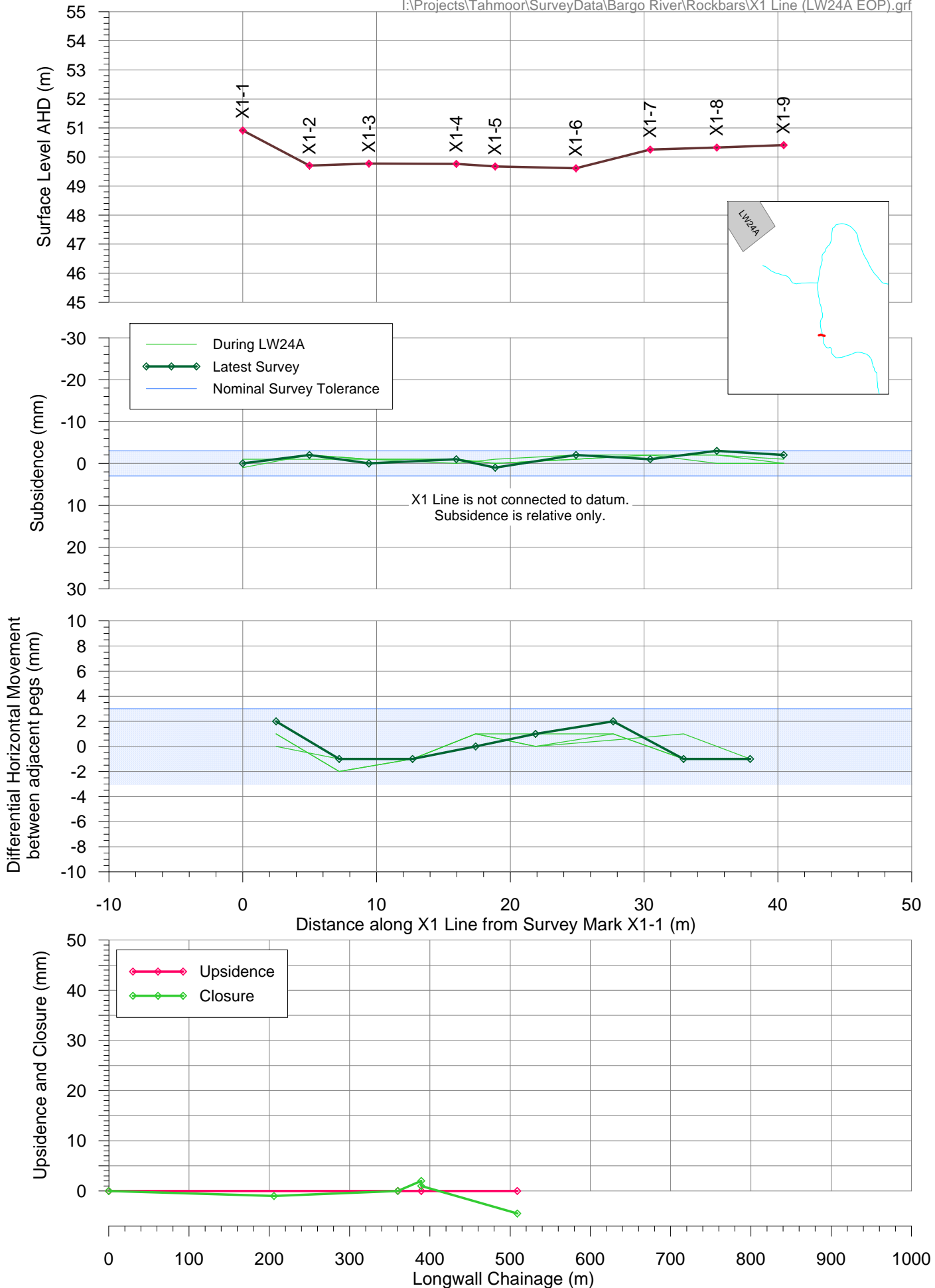
# Tahmoor Colliery - Total Subsidence Profiles along Mermaids Pool Line across the Bargo River

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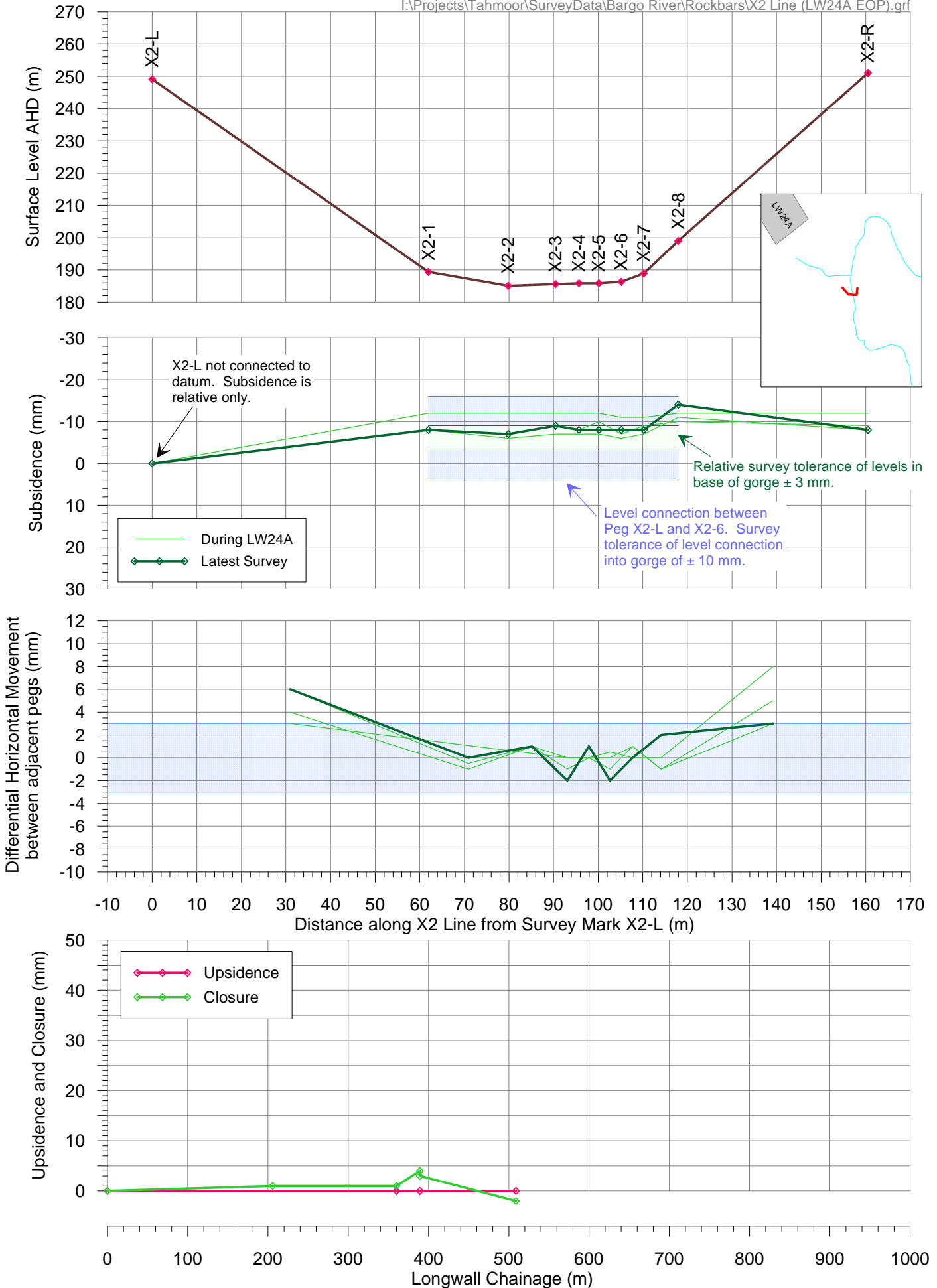
# Tahmoor Colliery - Total Subsidence Profiles along X1 Line across the Bargo River

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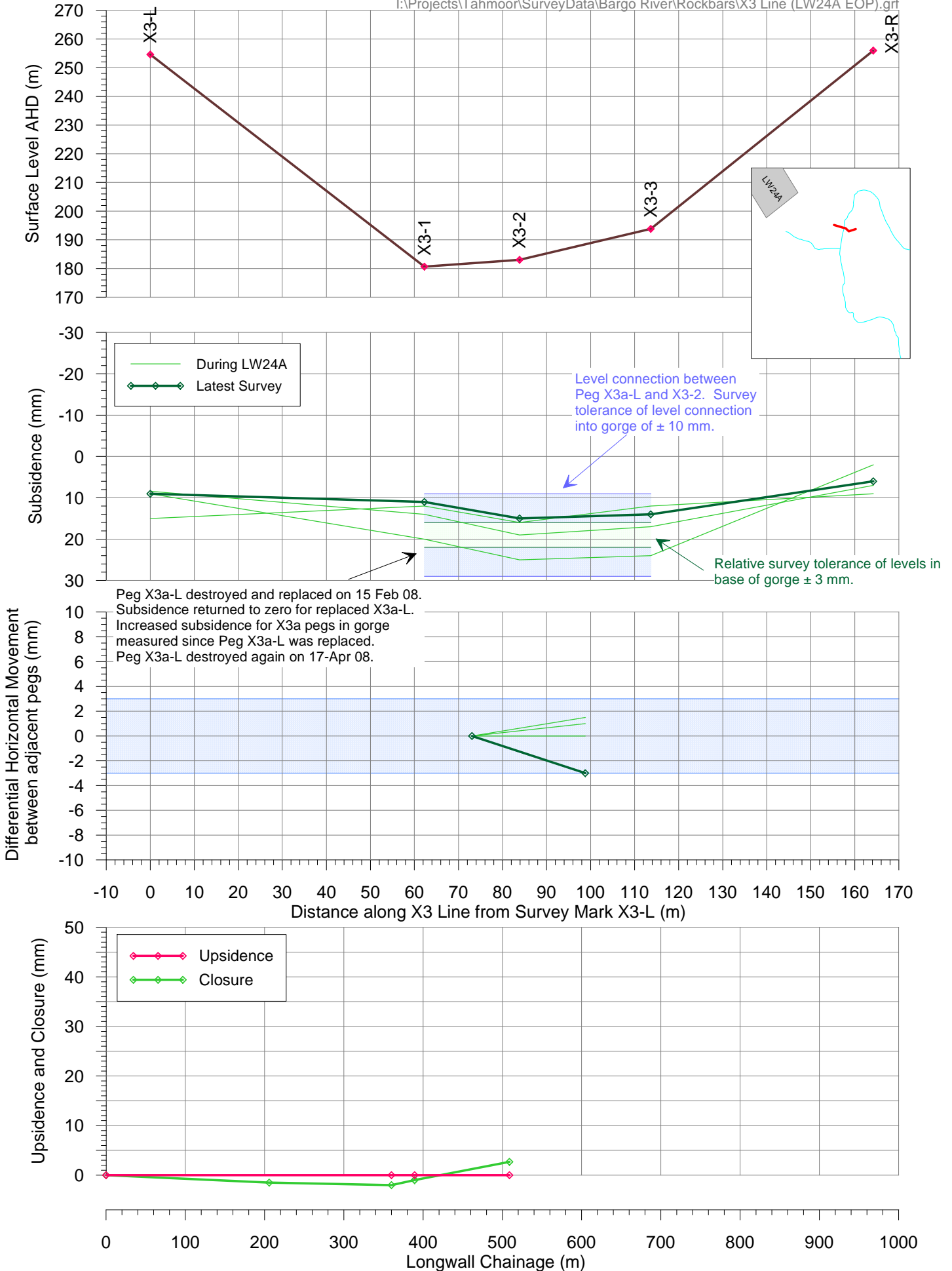
# Tahmoor Colliery - Total Subsidence Profiles along X2 Line across the Bargo River

I:\Projects\Tahmoor\SurveyData\Bargo River\Rockbars\X2 Line (LW24A EOP).grf



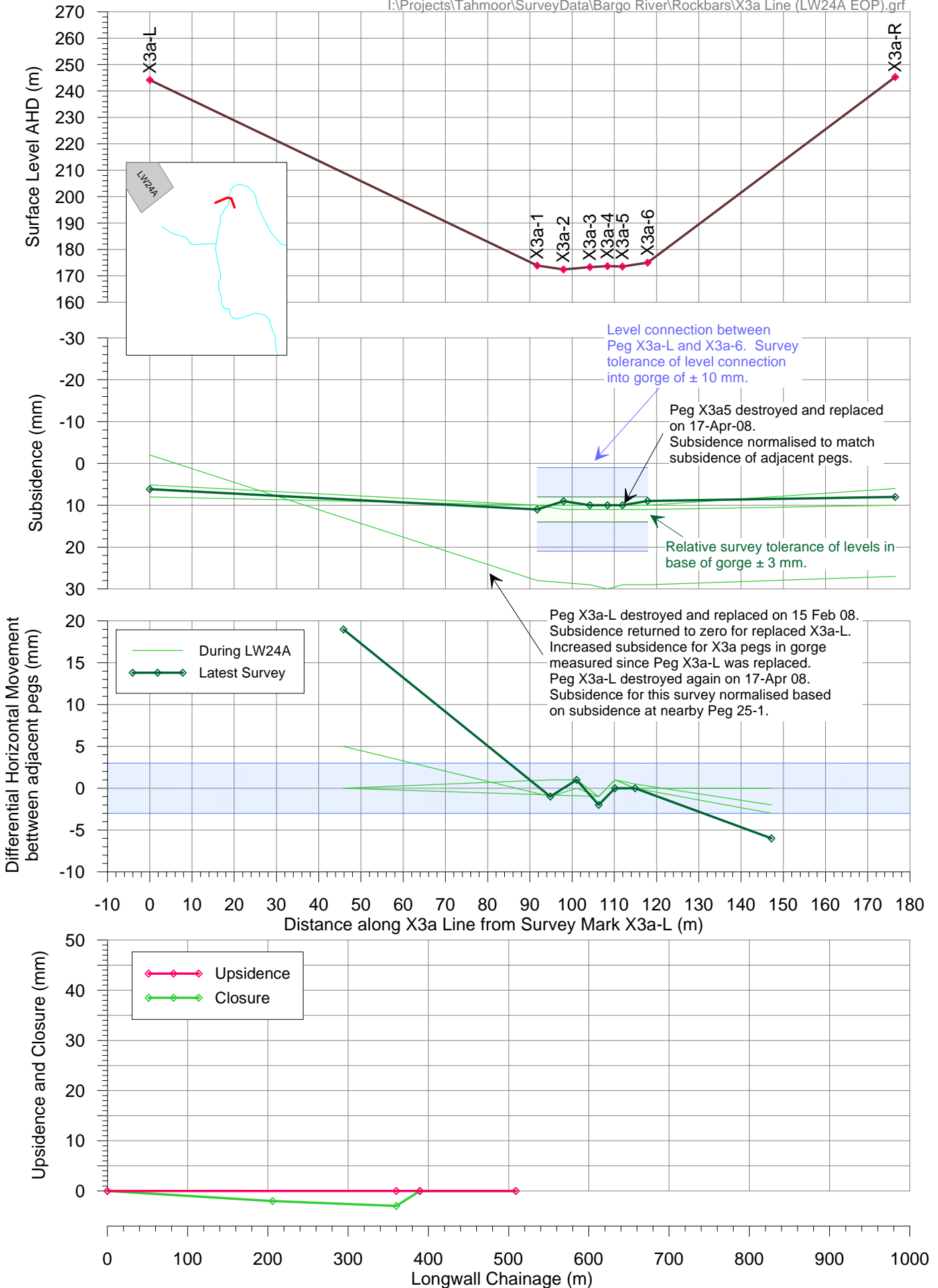
# Tahmoor Colliery - Total Subsidence Profiles along X3 Line across the Bargo River

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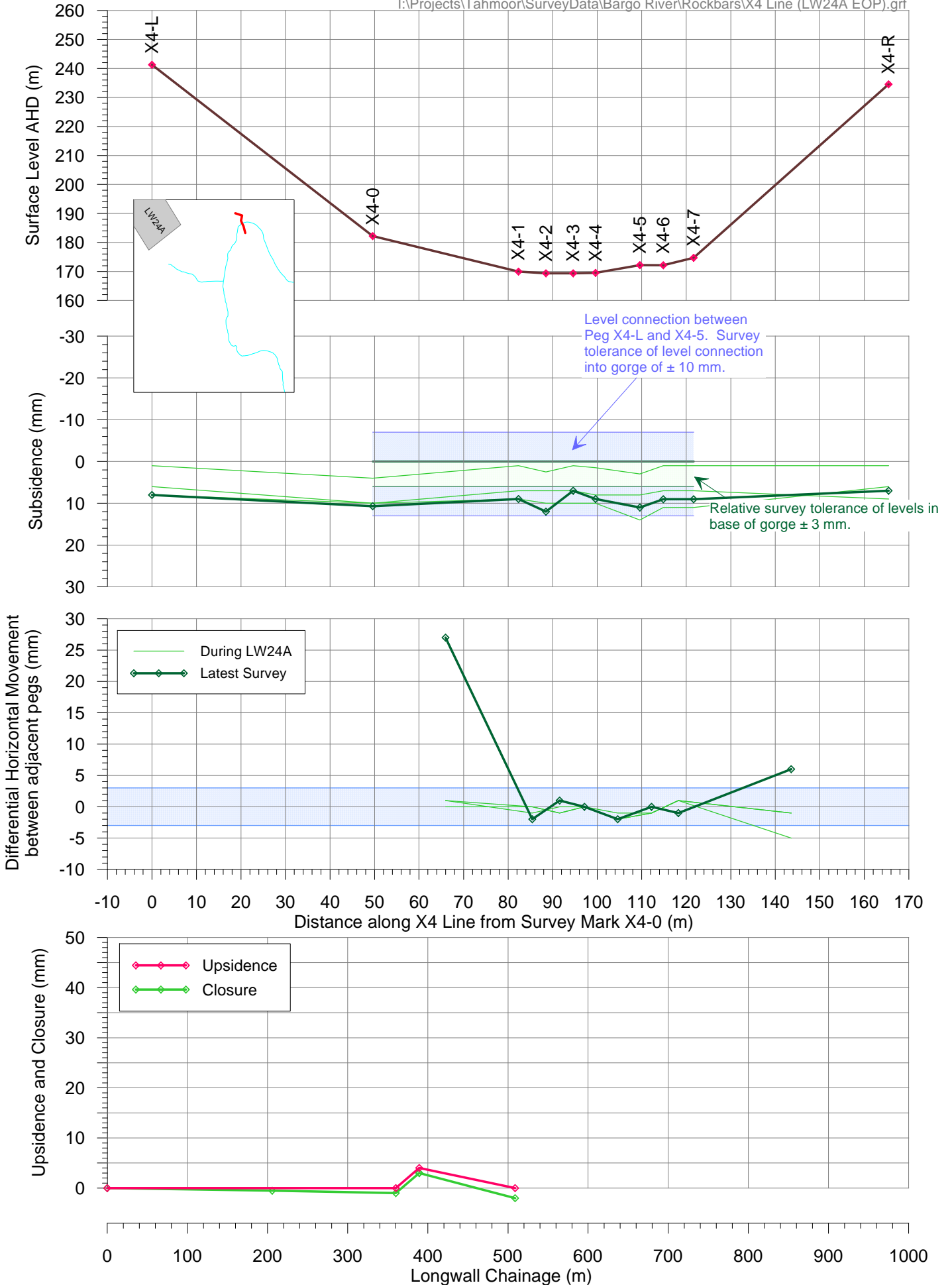
# Tahmoor Colliery - Total Subsidence Profiles along X3a Line across the Bargo River

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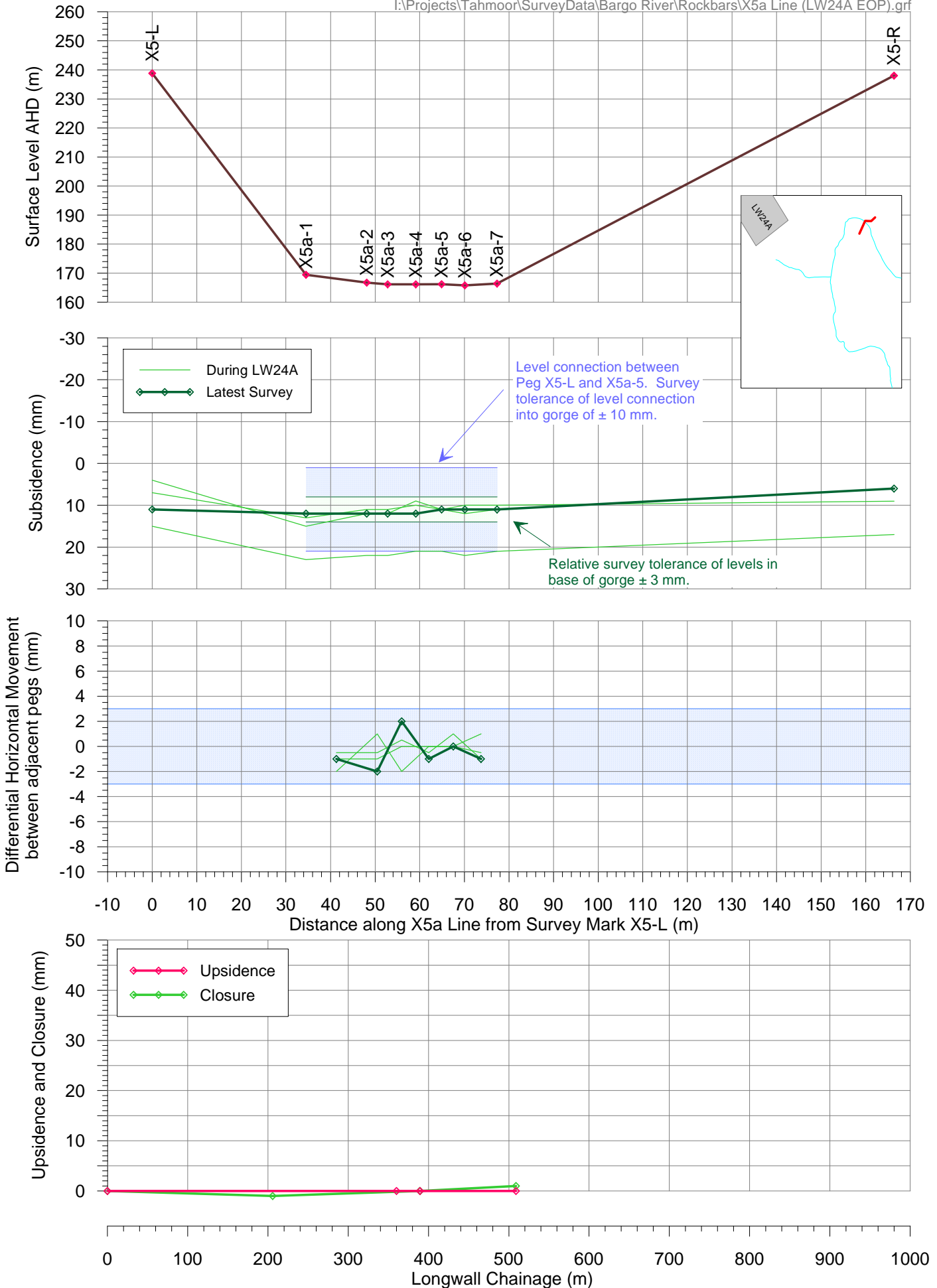
# Tahmoor Colliery - Total Subsidence Profiles along X4 Line across the Bargo River

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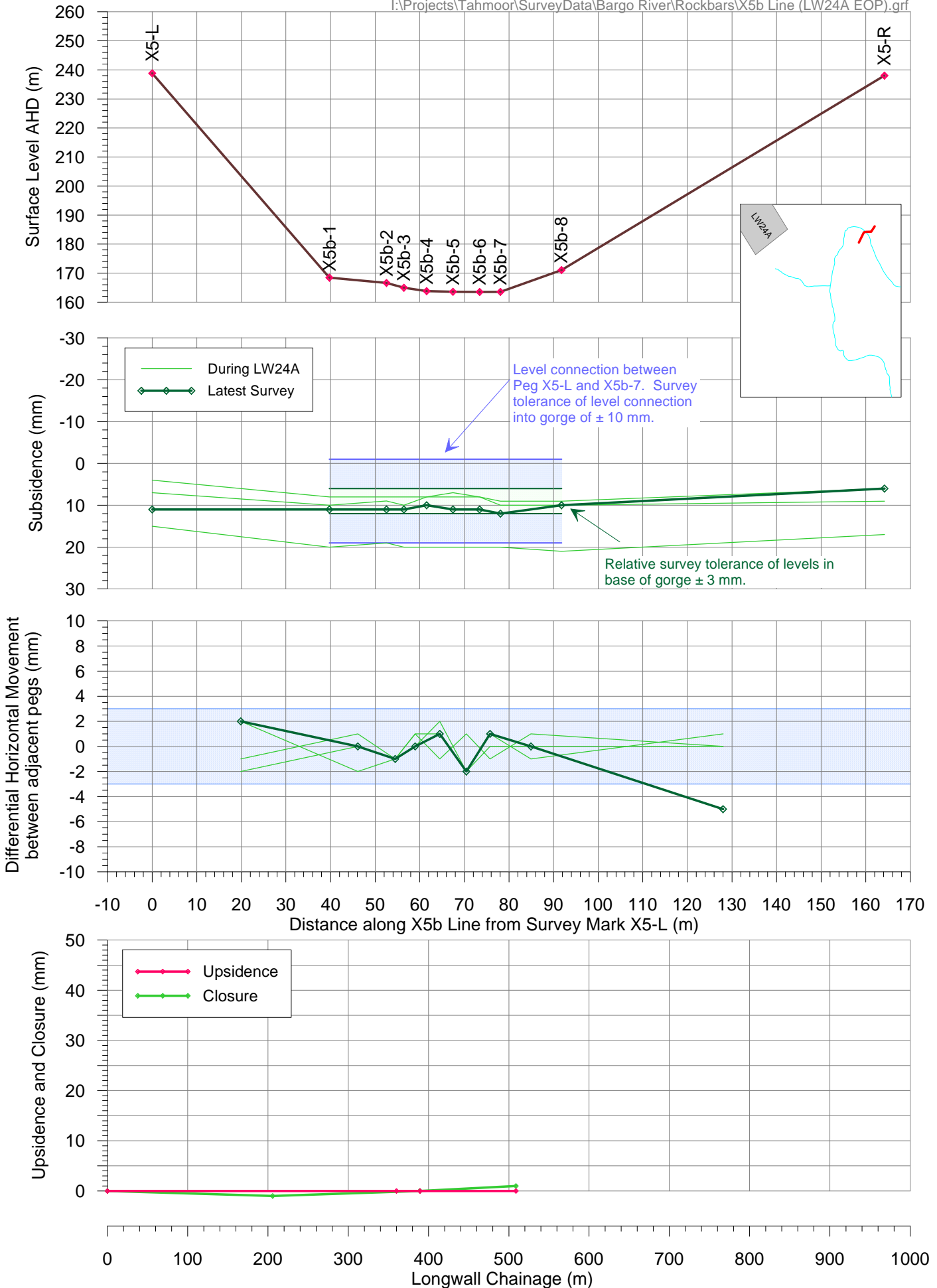
# Tahmoor Colliery - Total Subsidence Profiles along X5a Line across the Bargo River

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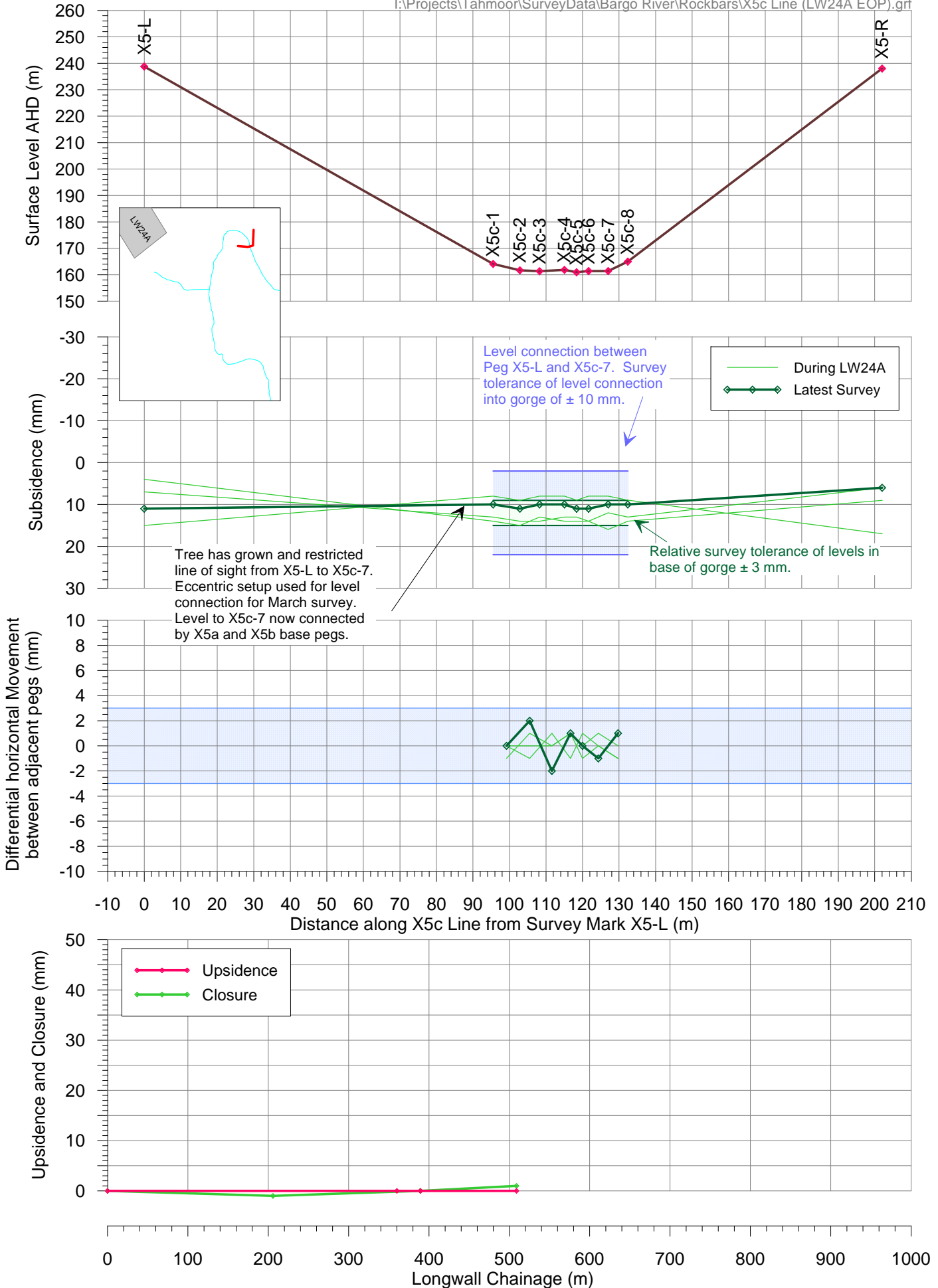
# Tahmoor Colliery - Total Subsidence Profiles along X5b Line across the Bargo River

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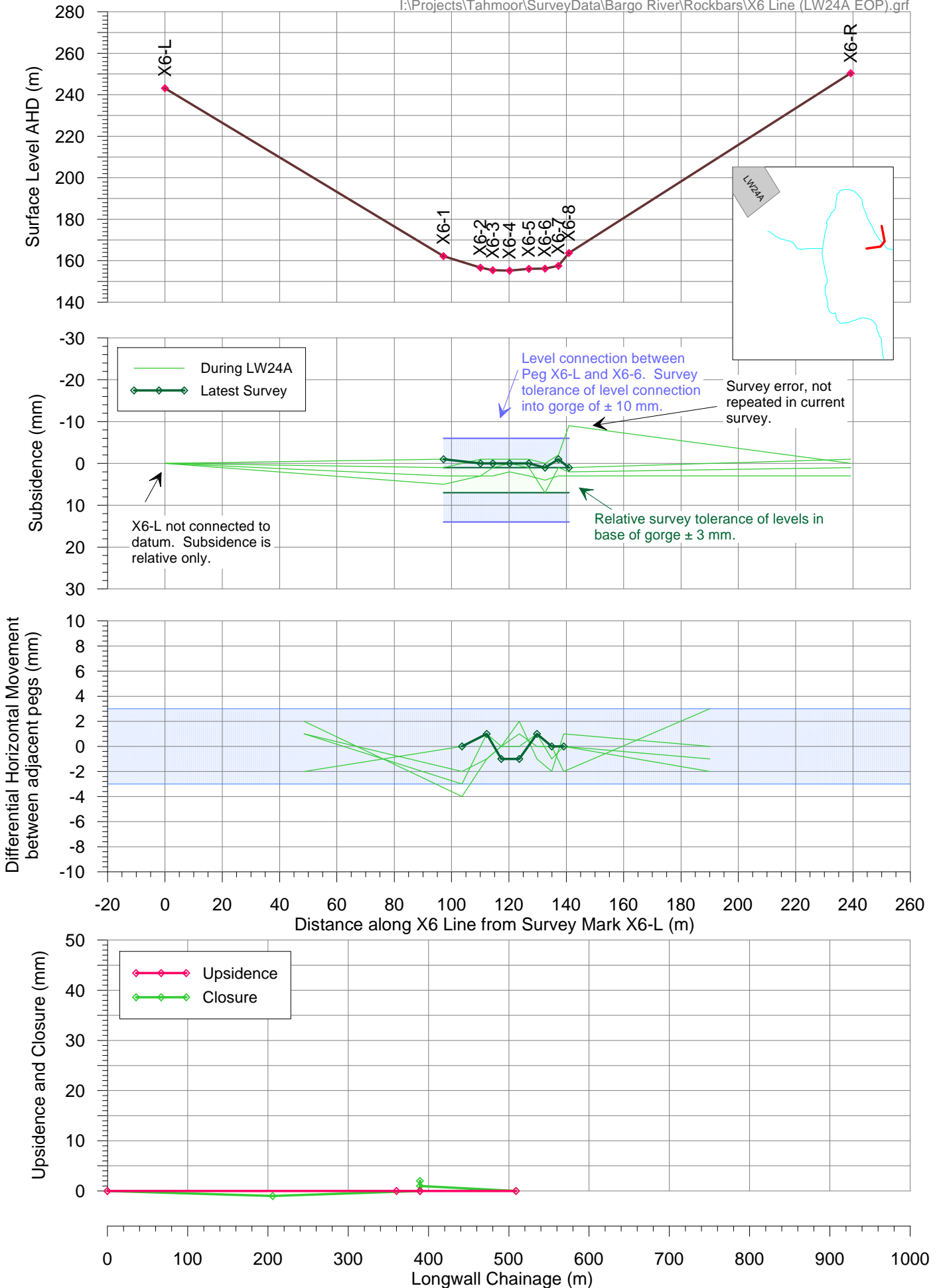
# Tahmoor Colliery - Total Subsidence Profiles along X5c Line across the Bargo River

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# Tahmoor Colliery - Total Subsidence Profiles along X6 Line across the Bargo River

I:\Projects\Tahmoor\SurveyData\Bargo River\Rockbars\X6 Line (LW24A EOP).grf





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PO Box 3047, Willoughby North, NSW 2068  
Tel. (02) 9413 3777 Fax: (02) 9413 3822



# TAHMOOR COLLIERY

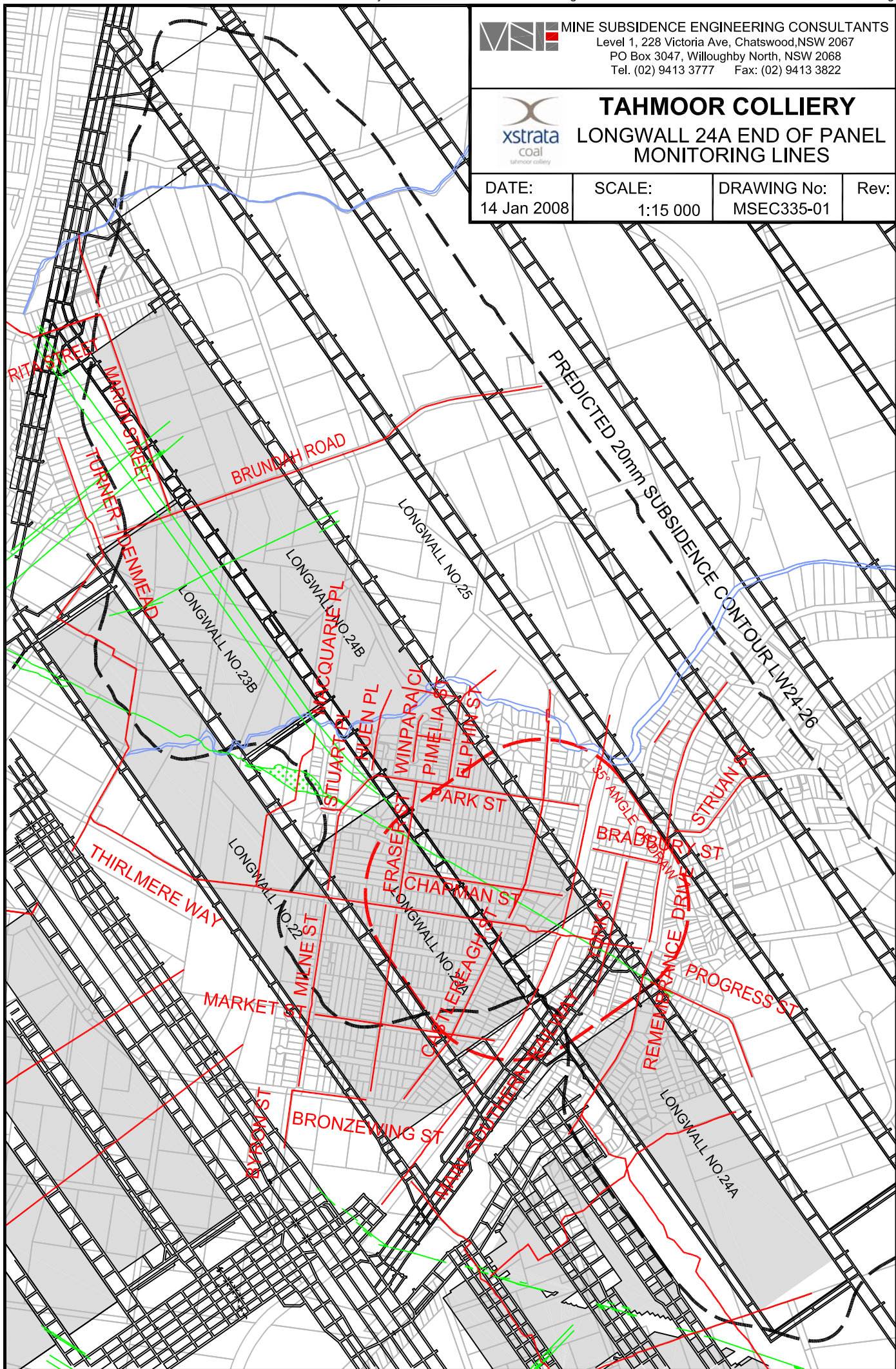
## LONGWALL 24A END OF PANEL MONITORING LINES

DATE:  
14 Jan 2008

SCALE:  
1:15 000

DRAWING No:  
MSEC335-01

Rev:





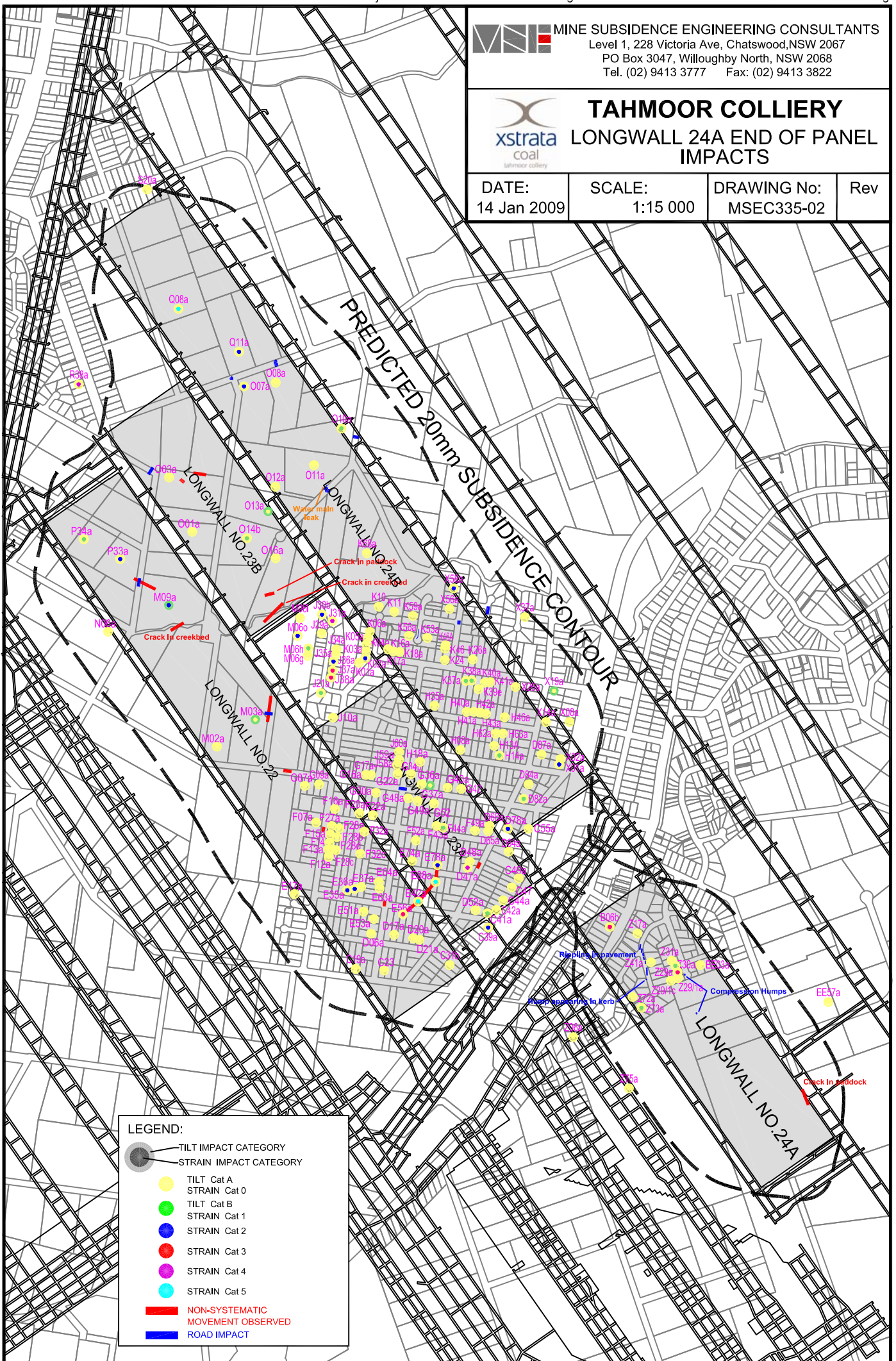
MINE SUBSIDENCE ENGINEERING CONSULTANTS  
 Level 1, 228 Victoria Ave, Chatswood, NSW 2067  
 PO Box 3047, Willoughby North, NSW 2068  
 Tel. (02) 9413 3777 Fax: (02) 9413 3822



# TAHMOOR COLLIERY

## LONGWALL 24A END OF PANEL IMPACTS

DATE: 14 Jan 2009	SCALE: 1:15 000	DRAWING No: MSEC335-02	Rev
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**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
- NON-SYSTEMATIC MOVEMENT OBSERVED
- ROAD IMPACT

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**TAHMOOR COLLIERY**  
**LONGWALL 24A**  
 OBSERVED INCREMENTAL SUBSIDENCE

<b>DATE:</b> 15 Jan 2009	<b>SCALE:</b> 1:10000	<b>DRAWING No:</b> MSEC335-03	<b>Rev No</b> A
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