XSTRATA COAL:

Tahmoor Colliery - Longwall 27

Management Plan for Potential Impacts to Public, Commercial and Residential Structures

AUTHORISATION OF MANAGEMENT PLAN

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DOCUMENT REGISTER

Date	Report No.	Rev	Comments
Mar-06	MSEC286-10	A	Draft for SMP Application
Aug-06	MSEC286-10	B	Complete for LW24B
May-08	MSEC286-10	C	Amended to include additional management measures for LW24A
Sep-08	MSEC286-10	D	Amended to include additional management measures for LW25 and LW26 Combined with public amenities and commercial establishments
Feb-11	MSEC446-12	A	Updated for LW26
Sep-12	MSEC567-12	A	Updated for LW27
Nov-12	MSEC567-12	B	Updated to include farm dams

References:-

AS/NZS 4360:1999 Risk Management

Tahmoor Colliery Longwalls 27 to 30 - The Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Natural Features and Items of Surface Infrastructure due to mining Longwalls 27 to 30 at Tahmoor Colliery in support of the SMP Application. (Report MSEC355, Revision B, July 2009), prepared by Mine Subsidence Engineering Consultants

Gale, W. and Sheppard, I. (2011). *Investigation into Abnormal Increased Subsidence above Longwall Panels at Tahmoor Colliery*. Mine Subsidence Technological Society, Proceedings of the 8th Triennial Conference on Mine Subsidence, May 2011.

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Tables

Tables are prefaced by the number of the chapter in which they are presented.

Figures

Figures are prefaced by the number of the chapter or the letter of the appendix in which they are presented.

Drawings

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

Drawing No.	*Description*	*Revision*
MSEC567-00-01	Observed Incremental Subsidence due to LW26	A
MSEC567-00-02	Observed Subsidence due to LW24A to LW26	A
MSEC567-00-03	Monitoring over LW27	B
MSEC567-12-01	Structures	A

1.1. Introduction

Tahmoor Colliery is located approximately 80 kilometres south west of Sydney in the township of Tahmoor NSW. It is managed and operated by Xstrata Coal. Tahmoor Colliery has previously mined 26 longwalls to the north and west of the mine's current location.

Longwall 27 is a continuation of a series of longwalls that extend into the Tahmoor North Lease area, which began with Longwall 22. It is located between the Bargo River in the south-east, the township of Thirlmere in the west and Picton in the north. Longwall 27 is located beneath the urban area of Tahmoor.

Longwall 27 is approximately 283 metres wide (rib-to-rib) and approximately 3.0 kilometres long. The width of the chain pillar between Longwalls 26 and 27 is 40 metres.

As at 20 September 2012, a total of 1522 houses, public amenities and commercial and business establishments have experienced subsidence movements during the mining of Longwalls 22 to 26. While impacts have been observed to some structures, mine subsidence has not directly exposed residents to any immediate or sudden safety hazards.

This Management Plan provides detailed information about how the risks associated with the mining beneath structures will be managed by Tahmoor Colliery in coordination with the Mine Subsidence Board.

Separate management plans have been developed for the following structures:

- Structures owned by owners of services infrastructure, such as bridges, culverts and sewage pumping stations.
- Heritage structures

This Management Plan is an update of previous management plans, taking into account experiences gained during the mining of Longwalls 22 to 26.

The Management Plan is a live document that can be amended at any stage of mining.

1.2. Objectives

The objectives of this Management Plan are to establish procedures to measure, control, mitigate and repair potential impacts that might occur to structures.

The objectives of the Management Plan have been developed to:-

- Ensure the safety and serviceability of all structures. Public safety is paramount. Disruption and inconvenience should be kept to minimal levels.
- Monitor ground movements and the condition of structures during mining.
- Initiate or coordinate action with the Mine Subsidence Board to mitigate or remedy potential significant impacts that are expected to occur to structures.
- Provide a plan of action in the event that the impacts of mine subsidence are greater than those that are predicted.
- Provide a forum to report, discuss and record impacts to the surface. This will involve Tahmoor Colliery, Mine Subsidence Board, Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS), and consultants as required.
- Establish lines of communication and emergency contacts.

1.3. Scope

The Management Plan is to be used to protect and monitor the condition of the items of infrastructure identified to be at risk due to mine subsidence. The major items at risk are:-

- Residential Establishments
- Public Amenities
- Commercial and Business Establishments

The Management Plan describes measures that will be undertaken as a result of mining Longwall 27 only.

Separate management plans have been developed for the following structures:

- Structures owned by owners of services infrastructure, such as bridges, culverts and sewage pumping stations.
- Heritage structures

1.4. Proposed Mining Schedule

It is planned that each longwall will extract coal working northwest from the southeastern ends. This Management Plan covers longwall mining until completion of mining in Longwall 27 and for sufficient time thereafter to allow for completion of subsidence effects.

The current schedule of mining is shown in Table 1.1.

Table 1.1 Schedule of Mining

Longwall	Start Date	Completion Date
Longwall 27	November 2012	October 2013

1.5. Definition of Active Subsidence Zone

As a longwall progresses, subsidence begins to develop at a point in front of the longwall face and continues to develop after the longwall passes. The majority of subsidence movement typically occurs within an area 150 metres in front of the longwall face to an area 450 metres behind the longwall face.

This is termed the “active subsidence zone” for the purposes of this Management Plan, where surface monitoring is generally conducted. The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 metres in front and 450 metres behind the active longwall face, as shown by Fig. 1.1.

Fig. 1.1 Diagrammatic Representation of Active Subsidence Zone

2.1. Maximum Predicted Systematic Parameters

Predicted mining-induced systematic subsidence movements were provided in Report No. MSEC355, which was prepared in support of Tahmoor Colliery's SMP Application for Longwalls 27 to 30.

A summary of the maximum predicted incremental systematic subsidence parameters, due to the extraction of each of the proposed longwalls, is provided in Table 2.1. A summary of the maximum predicted cumulative systematic subsidence parameters, after the extraction of each of the proposed longwalls, is provided in Table 2.2. A summary of the maximum predicted travelling parameters, during the extraction of each of the proposed longwalls, is provided in Table 2.3.

Table 2.1 Maximum Predicted Incremental Systematic Subsidence Parameters due to the Extraction of Each of the Proposed Longwalls 27 to 30

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Maximum Predicted Incremental Hogging Curvature (1/km)	Maximum Predicted Incremental Sagging Curvature (1/km)
After LW27	755	6.0	0.07	0.14
After LW28	735	5.9	0.07	0.13
After LW29	735	5.9	0.06	0.13
After LW30	725	5.8	0.06	0.13

Table 2.2 Maximum Predicted Cumulative Systematic Subsidence Parameters after the Extraction of Each of the Proposed Longwalls 27 to 30

Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tilt (mm/m)	Maximum Predicted Cumulative Hogging Curvature (1/km)	Maximum Predicted Cumulative Sagging Curvature (1/km)
After LW27	1260	6.3	0.09	0.15
After LW28	1270	6.2	0.09	0.14
After LW29	1270	6.1	0.09	0.14
After LW30	1270	6.3	0.09	0.14

The values provided in the above table are the maximum predicted cumulative systematic subsidence parameters which occur within the general SMP Area, including the predicted movements resulting from the extraction of Longwalls 22 to 30.

Table 2.3 Maximum Predicted Travelling Subsidence Parameters during the Extraction of Each of the Proposed Longwalls 27 to 30

Longwall	Maximum Predicted Travelling Tilt (mm/m)	Maximum Predicted Travelling Hogging Curvature (1/km)	Maximum Predicted Travelling Sagging Curvature (1/km)
During LW27	3.1	0.04	0.03
During LW28	3.0	0.03	0.03
During LW29	3.0	0.03	0.03
During LW30	3.0	0.03	0.03

2.2. Observed Subsidence during the mining of Longwalls 22 to 26

Extensive ground monitoring within the urban areas of Tahmoor has allowed detailed comparisons to be made between predicted and observed subsidence, tilt, strain and curvature during the mining of Longwalls 22 to 26.

In summary, there is generally a good correlation between observed and predicted subsidence, tilt and curvature. Observed subsidence was generally slightly greater than predicted in areas that were located directly above previously extracted areas and areas of low level subsidence (typically less than 100 mm) was generally observed to extend further than predicted.

While there is generally a good correlation between observed and predicted subsidence, substantially increased subsidence has been observed above most of Longwall 24A and the southern end of Longwall 25. This was a very unusual event for the Southern Coalfield.

Observed Increased Subsidence during the mining of Longwall 24A

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

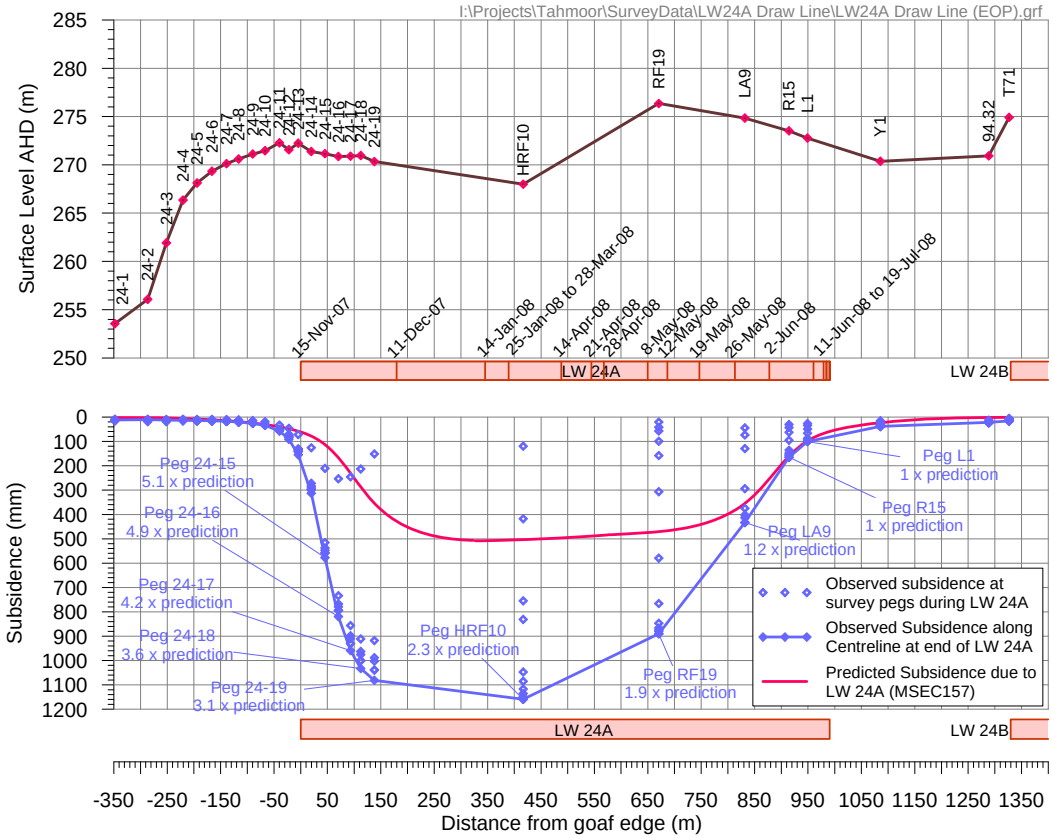

Fig. 2.1 Observed Subsidence along Centreline of Longwall 24A

It can be seen from Fig. 2.1 that observed subsidence was more than twice the predicted maximum value, reaching to a maximum of 1169 mm at Peg HRF10. It is possible that actual maximum subsidence developed somewhere between Pegs HRF10 and RF19, though this was not measured. Observed subsidence was similar to prediction near Peg R15 on Remembrance Drive. Survey pegs RF19 and LA9 are located within a transition zone where subsidence gradually reduced from areas of maximum increased subsidence to areas of normal subsidence.

Observed Increased Subsidence during the mining of Longwall 25

Increased subsidence was observed during the first stages of mining Longwall 25. These observations are shown graphically in Fig. 2.2, which shows observed subsidence at survey pegs located along the centreline of Longwall 25.

It can be seen from Fig. 2.2 that observed subsidence was approximately twice the predicted maximum value, with maximum subsidence of 1216 mm at Peg 25-28.

Observed subsidence is similar to but slightly more than predicted at Peg RE7 and is similar to prediction at Peg Y20 and at all pegs located further along the panel. Survey pegs A6, A7, A8 and A9 are located within a transition zone where subsidence has gradually reduced from areas of maximum increased subsidence to areas of normal subsidence.

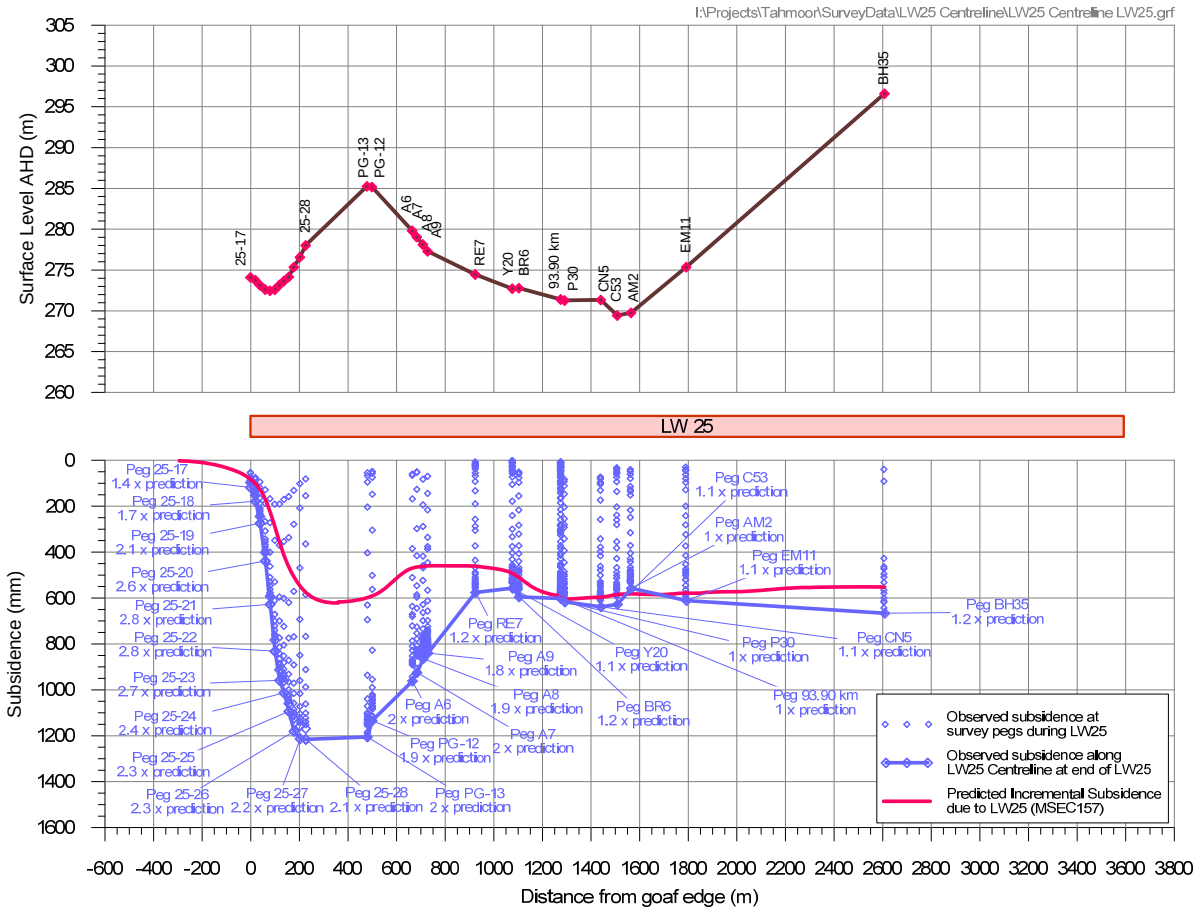

Fig. 2.2 Observed Subsidence along Centreline of Longwall 25

Observed Increased Subsidence during the mining of Longwall 26

Increased subsidence was observed during the first stages of mining Longwall 26, but at a reduced magnitude compared to the subsidence observed above Longwalls 24A and 25. These observations are shown graphically in Fig. 2.3, which shows observed subsidence at survey pegs located along the centreline of Longwall 26. The graph shows the latest survey results for each monitoring line as at August 2012. It is likely that further small increases in subsidence will be observed at these pegs when they are surveyed at the completion of Longwall 26.

It can be seen from Fig. 2.3 that observed subsidence was approximately 1.3 times the predicted maximum value, with maximum subsidence of 867 mm at Peg TM26.

Observed subsidence reduced along the panel until Peg Y40 on York Street, where it was less than prediction. Survey pegs S9, and RE27 are located within a transition zone where subsidence has gradually reduced from areas of maximum increased subsidence between Pegs TM26 and MD4 to areas of normal subsidence at Peg Y40 and beyond.

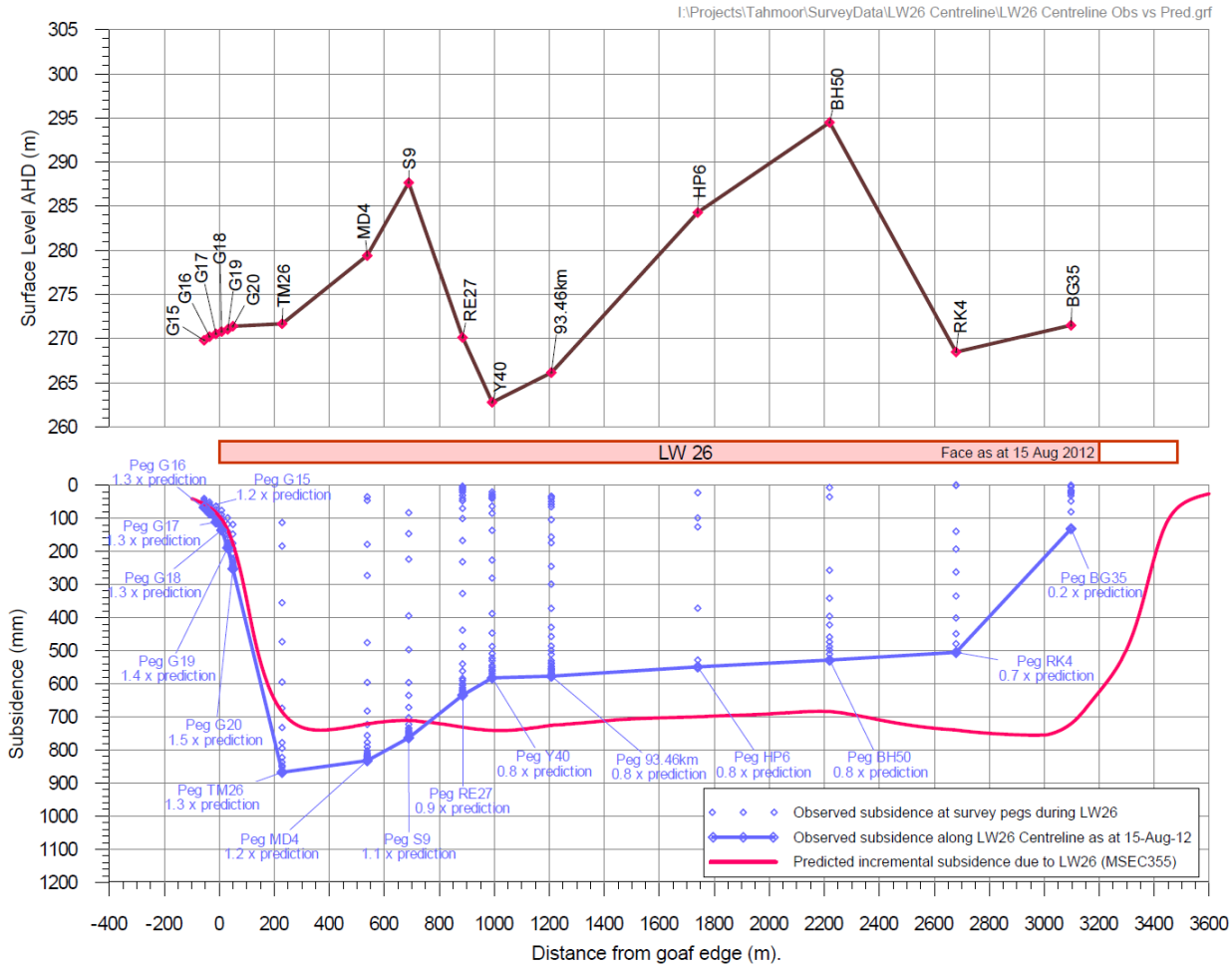

Fig. 2.3 Observed Subsidence along Centreline of Longwall 26 as at August 2012

Analysis and commentary

The cause for the increased subsidence has been investigated by Strata Control Technologies on behalf of Tahmoor Colliery (Gale and Sheppard, 2011). The investigations concluded that the increased subsidence is consistent with localised weathering of joint and bedding planes above a depressed water table adjacent to an incised gorge.

In light of the above observations, the region above the extracted longwalls at Tahmoor has been partitioned into three zones:

1. Normal subsidence zone – where the observed vertical subsidence is within the normal range and correlates well with predictions
2. Maximum increased subsidence zone – where the observed vertical subsidence is substantially greater than predictions but has reached it upper limit. Maximum subsidence above the centreline of the longwalls appears to be approximately 1.2 metres above Longwalls 24A and 25, and 900 mm above Longwall 26.
3. Transition zone – where the subsidence behaviour appears to have transitioned between areas of maximum increased subsidence and normal subsidence.

When the locations of the three zones are plotted on a map, as shown in Drawing No. MSEC567-00-01 (refer Appendix), it can be seen that the transition zone is roughly consistent in width above Longwall 24A, Longwall 25 and Longwall 26. The orientation of the transition zone is also roughly parallel to the Nepean Fault and not the Bargo River.

Prior to the mining of Longwall 26, it was not yet known whether the location of the transition zone was related to the alignment of the Nepean Fault or the Bargo River as both features were aligned approximately parallel to each other adjacent to previously extracted Longwalls 24A and 25.

The Bargo River, however, abruptly turns a sharp bend near the end of Longwalls 25 and 26 and observations during the mining of Longwall 26 were able to provide a first indication that the location of the transition zone was related to the alignment of the Nepean Fault, rather than the Bargo River.

The magnitude of subsidence above Longwall 26 is reduced compared to Longwalls 24A and 25. Given that the alignment of the Nepean Fault moves away from the Bargo River above Longwall 26, it appears that the magnitude of increased subsidence is linked to the proximity of the Bargo River. This observation confirms the findings of Gale and Sheppard that the increased subsidence is linked to localised weathering of joint and bedding planes above a depressed water table adjacent to the incised gorge of the Bargo River.

In summary, it appears that the location of increased subsidence is linked to the alignment of the Nepean Fault and the magnitude of the increased subsidence is linked to the proximity to the Bargo River.

The zones have been projected above Longwalls 27 to 30 from the observed zones above Longwalls 24A and 26, as shown in Drawing No. MSEC567-00-02 (refer Appendix). The projection is based on the orientation of the Nepean Fault. It can be seen that the transition zone extends to sections of Myrtle Creek Avenue, Remembrance Drive, Myrtle Creek and the Main Southern Railway.

Given that Longwall 27 is located further away from the Bargo River than Longwall 26, it is expected that the magnitude of maximum subsidence at the commencing end of Longwall 27 will be less than 900 mm. The amount of reduction in maximum subsidence is difficult to predict. The difference in maximum subsidence between Longwalls 24A and 25 and Longwall 26 is approximately 300 mm. If maximum subsidence at the commencing end of Longwall 27 reduces a further 300 mm, the magnitude of subsidence at the commencing end will return to normal levels.

It is recognised that despite the above analysis and projections, substantially increased subsidence could develop as the mining of Longwall 27 progresses. This Management Plan has been developed to manage potential impacts if substantial additional subsidence were to occur.

2.3. Predicted Strain

The prediction of strain is more difficult than the predictions of subsidence, tilt and curvature. The reasons for this are that strain is affected by many factors, including ground curvature and horizontal movement, as well as local variations in the near surface geology, the locations of joints at bedrock, and the depth of bedrock. The measurements are also affected by survey tolerance. The profiles of observed strain can, therefore, be irregular even when the profiles of observed subsidence, tilt and curvature are relatively smooth.

The relative frequency distribution of maximum observed tensile strains and compressive strains for survey bays located directly above goaf is provided in Fig. 2.4.

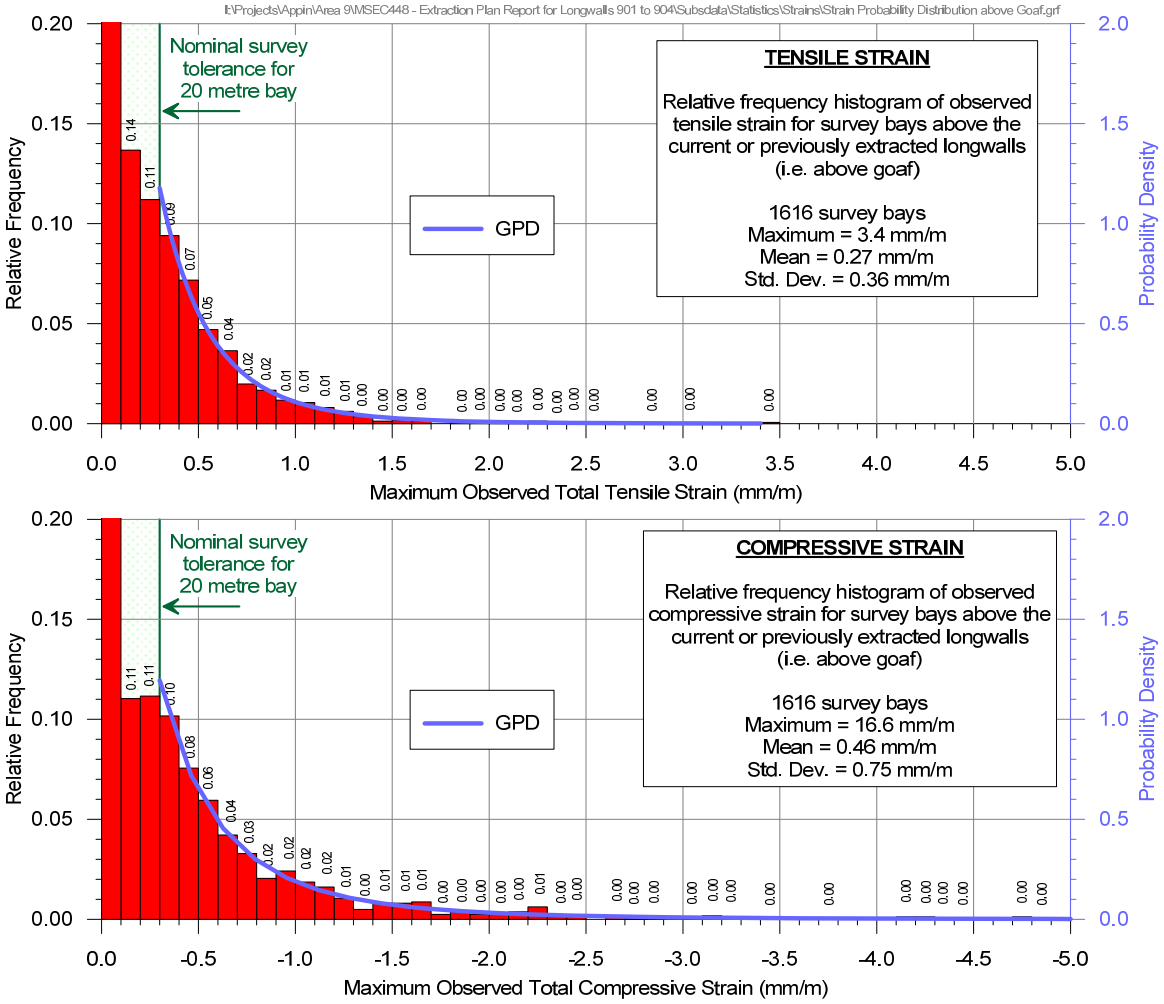

Fig. 2.4 Distributions of Measured Maximum Tensile and Compressive Strains at Any Time for Pegs Located Above Goaf in the Southern Coalfield

While not shown in Fig. 2.4, it is noted that the maximum observed compressive strain of 16.6 mm/m, which occurred along the T-Line above Appin Longwall 408, was the result of movements along a low angle thrust fault within the Cataract Tunnel. All remaining compressive strains in this dataset (which exclude valley related movements) were less than 5 mm/m.

The relative frequency distribution of maximum observed tensile strains and compressive strains above solid coal is provided in Fig. 2.5.

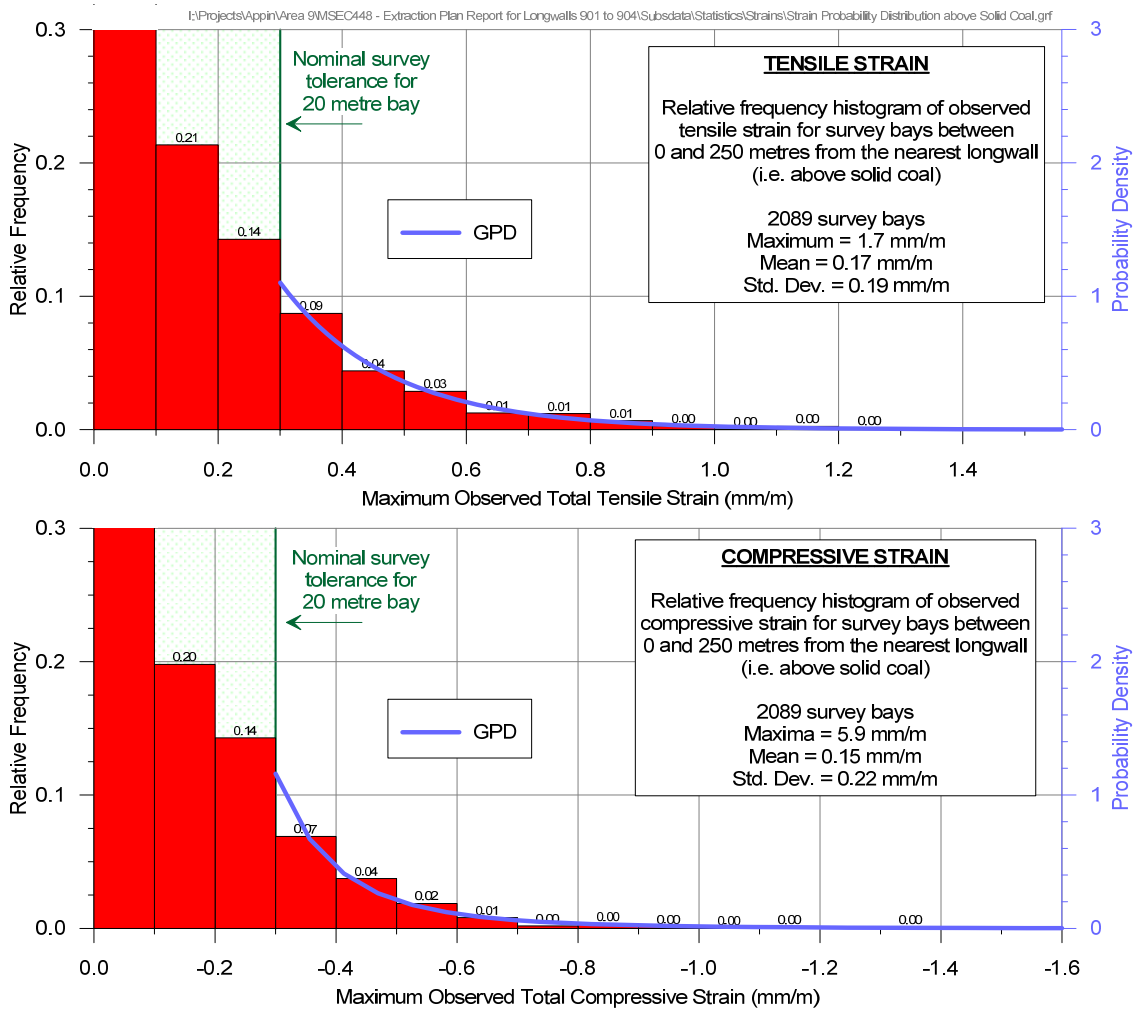

Fig. 2.5 Distributions of Measured Maximum Tensile and Compressive Strains at Any Time for Pegs Located Above Solid Coal in the Southern Coalfield

While not shown in Fig. 2.5, it is noted that the maximum observed compressive strain of 5.9 mm/m, which occurred along the T-Line above Appin Longwall 408, was the result of movements along a low angle thrust fault within the Cataract Tunnel as Longwall 408 approached the monitoring line. A maximum observed compressive strain of 3.1 mm/m was observed across the fault at the completion of Longwall 407. All remaining compressive strains in this dataset (which exclude valley related movements) were less than 5 mm/m.

3.1. General

The Australian/New Zealand standard for Risk Management defines the terms used in the risk management process, which includes the identification, analysis, assessment, treatment and monitoring of risk. In this context:-

3.1.1. Consequence

'The outcome of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with an event.'[1] The consequences of a hazard are rated from very slight to very severe.

3.1.2. Likelihood

'Used as a qualitative description of probability or frequency.'[2] The likelihood can range from very rare to almost certain.

3.1.3. Hazard

'A source of potential harm or a situation with a potential to cause loss.'[3]

3.1.4. Risk

'The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood.'[4] The risk combines the likelihood of an impact occurring with the consequence of the impact occurring. The risk is rated from very low to extreme. In this study, the likelihood and consequence are combined via the qualitative risk analysis matrix shown in Table 3.1, to determine an estimated level of risk for particular events or situations.

The Risk Analysis Matrix is similar to the example provided in AS/NZS 4360:1995, Appendix D, p.25.

Table 3.1 Qualitative Risk Analysis Matrix

Likelihood	CONSEQUENCES				
	Very Slight	Slight	Moderate	Severe	Very Severe
Almost Certain	Low	Moderate	High	Extreme	Extreme
Likely	Low	Moderate	High	Very High	Extreme
Moderate	Low	Low	Moderate	High	Very High
Unlikely	Very Low	Low	Moderate	High	High
Rare	Very Low	Very Low	Low	Moderate	High
Very Rare	Very Low	Very Low	Low	Moderate	Moderate

This Management Plan adopts a common system of nomenclature to summarise each risk analysis, which is **"LIKELIHOOD / CONSEQUENCE → LEVEL OF RISK".**

For example, if the likelihood of a risk is assessed as "**UNLIKELY**", and the consequence of a risk is assessed as "**SEVERE**", the risk analysis would be summarised as **"UNLIKELY / SEVERE → HIGH"**.

[1] AS/NZS 4360:1999 – Risk Management pp2
[2] AS/NZS 4360:1999 – Risk Management pp2
[3] AS/NZS 4360:1999 – Risk Management pp2
[4] AS/NZS 4360:1999 – Risk Management pp3

4.1. Experience of mining beneath structures during the mining of Longwalls 22 to 26

As at 20 September 2012, a total of 1522 houses, public amenities and commercial and business establishments have experienced subsidence movements during the mining of Longwalls 22 to 26. The following observations are made:

- Mine subsidence has not directly exposed residents to any immediate or sudden safety hazards.
- The MSB has received a total of 415 claims from individual properties (not including refused claims) of which 373 claims include impacts to main structures. The remaining 42 claims from properties relate solely to claims of damage to small improvements such as swimming pools, sheds and pavements.
- This represents an overall claim rate of 373 out of 1522 main structures, or 25%. Conversely, no impacts have been reported for 75% of main structures.
- The rate of impact is understandably greater for structures located directly above extracted mining domains. A total of 1100 houses, public amenities and commercial and business establishments are located directly above the extracted longwalls (or pillars between them). A total of 371 claims have been made from this subset, which represents a claim rate of 34% for structures above goaf.
- The claim rate for structures within the predicted limit of subsidence but not located directly above extracted coal (that is, structures on 'solid coal') is 44 claims out of a total of 679 structures, or 6.5%.
- The majority of impacts are considered very slight to slight and consist of sticky doors and minor impacts to internal walls, ceilings or floor finishes. However, 2.6% of impacts are considered to be moderate or greater. In ten of these cases (i.e: 0.7 % of all building structures), the impacts were substantial and the costs to repair these structures were deemed to be greater than the costs to rebuild.

4.2. Impact Assessment on Structures

The methods for predicting and assessing impacts on building structures have developed over time as knowledge and experience has grown. MSEC has provided predictions and assessments for structures potentially affected by mining at Tahmoor Colliery using the latest methods available at the time.

The information collected during the mining of Longwalls 22 to 24A has been reviewed in two parallel studies: one as part of a funded ACARP Research Project C12015 and one at the request of the Department of Primary Industries (DPI).

The outcomes of the studies include:

- Review of the performance of the previous method
- Recommendations for improving the current method of Impact Classification
- Recommendations for improving the current method of Impact Assessment

A summary is provided in Appendix C of Report No. MSEC355 (2009).

The predictions of subsidence, tilt and curvature for each structure due to the extraction of Longwalls 22 to 27 are provided in Table F.02 of Report No. MSEC355 (2009).

The probability of impacts for each house has been assessed based on the parameters of predicted ground curvature and type of construction, in accordance with the revised method of assessing impacts on structures. The results are provided in Table F.02 of Report No. MSEC355 (2009).

4.3. Managing Public Safety

The primary risk associated with mining beneath structures is public safety. Comfort is drawn from the observation that residents have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mine subsidence movements. This includes the recent experience at Tahmoor, which has affected more than 1500 houses and civil structures.

Emphasis is placed on the words "immediate and sudden" as in rare cases, some structures have experienced severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time to repair the structure and/or relocate residents.

Based on experiences at Tahmoor and elsewhere in the NSW coalfields, likelihood of a public safety incident occurring due to mine subsidence impacts on structures is considered to be **VERY RARE**. The

worst possible consequence could, however, be **VERY SEVERE**, even though none such incident has been experienced to date. The risk is therefore considered to be **VERY RARE / VERY SEVERE → MODERATE**, based on the worst possible consequence.

Tahmoor Colliery has developed and acted in accordance with a risk management plan to manage potential impacts on structures during the mining of Longwalls 22 to 26. The management strategy has been reviewed and updated based on experiences gained during the mining of Longwalls 22 and 26 and the strategy for Longwall 27 includes the following:

- Regular consultation with the community before, during and after mining as described in Section 5.3. This includes letters and door knocking to all residents of structures that will soon be affected by subsidence. The letters invite the residents to contact Tahmoor Colliery should have any concerns with their structure, or alternatively contact the Mine Subsidence Board for a pre-mining inspection.
- Site-specific investigations, where they are necessary and appropriate, into the conditions of buildings and associated structures and their surrounding environment (where access is allowed). The site-specific investigations include the following:
  - At the time of preparing Report No. MSEC355 (2009) in support of Tahmoor Colliery's SMP Application, structures were identified from aerial photograph, with structure types identified from kerbside inspections.
  - Additional front of house inspections by Tahmoor Colliery in company with a structural engineer for all properties that are located directly above Longwall 27. The purpose of the inspections is to identify potentially unstable structures that may warrant a structural inspection, subject to approval by the landowner.
  - Pre-mining geotechnical inspections of structures located on steep slopes
  - Pre-mining structural inspections of the following structures
    - Public amenities and commercial and business establishments that are located directly above longwalls.
    - Structures on steep slopes that have been recommended for structural inspection by the geotechnical engineer.
    - Structures that have been identified as being potentially unstable or unsafe.
    - Structures of heritage significance.
  - Pre-mining inspections conducted by the Mine Subsidence Board (MSB)
    - Pre-mining building inspections of the following structures (if not undertaken by the MSB):
    - Public amenities and commercial and business establishments with a maximum plan dimension of 15 metres or greater (none are identified above Longwall 27).
    - Structures located on steep slopes, if recommended by the geotechnical engineer.
  - Pre-mining building checks of the following structures, where access is available and which have not already been directly mined beneath by previous longwalls:
    - Houses and units located above hidden creeks.
    - Houses and units located outside any Mine Subsidence District that are predicted to experience more than 150 mm of subsidence.
    - Houses estimated to have been constructed prior to the declaration of the Mine Subsidence District (1975) that are predicted to experience more than 150 mm of subsidence.
- Surveys and inspections during mining within the active subsidence area (refer Table 5.2 for timing and frequencies):
  - Detailed visual inspections and vehicle based inspections along the streets
  - Ground surveys along streets
  - Visual inspections of public amenities and industrial, commercial and business establishments
  - Visual inspections of structures that have already reported impacts
  - Visual inspections of pool fences
  - Specific ground surveys and visual inspections for selected properties, where recommended by a geotechnical or structural engineer due to their proximity to steep slopes or pre-existing condition.

4.4. Residential Structures

This section describes observations and management measures for specific types of residential structures that have been identified as being potential more vulnerable to subsidence movements.

4.4.1. Structures on Steep Slopes

A total of 22 properties above Longwalls 22 to 27 have been inspected by geotechnical engineer, GHD Geotechnics. Structures and dams on these properties were assessed to have been located on steep slopes, which are conservatively defined as a slope greater than 1 in 3. There are no structures located near cliffs. It is possible, though unlikely, that tension cracks may form at the top of the slope and these may coincide with some houses and cause additional impacts to them. It is considered extremely unlikely that the houses would be severely damaged due to large-scale slope failure. No impacts have been observed to steep slopes during the mining of Longwalls 22 to 26, including steep slopes on the banks of Myrtle Creek.

Structural inspections by John Matheson & Associates (JMA) have also been undertaken where recommended by the geotechnical engineer. A summary of assessments, recommendations and findings are listed in Table 4.1 for structures that may be affected by subsidence movements during the mining of Longwall 27.

Table 4.1 Summary of Assessments, Recommendations and Actions for Structures on Steep Slopes

Prop. Ref.	Street	LW directly beneath	Structure(s) of interest	Landslide Risk Assessment (GHD Geotechnics)	Recommendations by GHD	Management actions by Tahmoor Colliery
K09	Huen Pl	LW24B	House	Very Low	None, though structural issues noted	Previously Structural inspection Ground survey Visual inspections (None for LW27)
K10	Huen Pl	LW24B	House	Very Low and Low	None	Previously Visual inspection Ground survey (None for LW27)
M09	Denmead St	LW22	Dam	Very Low	None	Previously Visual inspections (None for LW27)
T75	Bridge St	LW25	Potters' Shed	Very Low to Moderate	None	Previously Visual inspections (None for LW27)
T77	Bridge St	LW26	Granny flat (dwelling)	Low or Very Low	None	Owner refuses inspections
W23	Tickle Dr	LW27	Dam	Low (if empty) Moderate (if full)	None	Visual inspections
W42	Hilton Park Rd	LW27	Dam, Pool	Low (pool) Moderate (dam)	None for dam Ground survey for pool	Visual inspection Ground survey of pool
X60	Elphin St	LW25	House	Moderate	Structural inspection Monitoring	Structural inspection Ground survey Visual inspections
X61	Elphin St	LW25	House, retaining wall	Low & Very Low (house) Moderate (wall)	Structural inspection Monitoring	Structural inspection Ground survey Visual inspections
Y59	York St	LW26	House, sheds	Very Low (house) Moderate (sheds)	None	Visual inspections
Y60	York St	LW26	House, pool	Very Low (house) Moderate (pool)	Survey pool	Visual inspections Survey pool (installed prior to LW25)
Y61	York St	LW26	House	Very Low	None	Visual inspections

Prop. Ref.	Street	LW directly beneath	Structure(s) of interest	Landslide Risk Assessment (GHD Geotechnics)	Recommendations by GHD	Management actions by Tahmoor Colliery
Y62	York St	LW26	House, sheds, retaining wall	Very Low (house) Very High (wall)	Advise owner to demolish wall or monitor for impacts during subsidence	Advise owner to demolish wall Structural inspection Visual inspections Consider erection of fencing and warning signs with landowner Consider survey
Y63	York St	LW26	House	Very Low	None	Visual inspections
Y64	York St	LW26	House, BBQ	Low to Very Low (house) Very High (BBQ)	Advise owner of risk to BBQ. Structural inspection of house due to existing cracking Ground survey of house and valley	Advise owner of risk to BBQ. Visual inspections Structural inspection Ground survey around house and across Myrtle Creek (installed prior to LW25)
Y65	York St	LW26	House, retaining wall	Very Low (house) Very High (wall)	Advise owner to demolish wall or monitor for impacts during subsidence (Owner has since built a new buttressed block retaining wall)	Advise owner to demolish wall (owner has since built a new wall) Structural inspection Visual inspections
Y66	York St	LW26	House	Very Low	None	Visual inspections
Y67	York St	LW26	House, deck	Low to Moderate (house) High (deck)	Structural inspection of deck. Ground survey of house, deck and valley	Visual inspections Structural inspection Ground survey around house, deck and across Myrtle Creek
Y68	York St	LW26	House	Low to Very Low	None	Visual inspections
Y69	York St	LW27	Small room	Low	None	Visual inspections
BB51	Myrtle Creek Ave	LW27	House, shed	Moderate	None	Visual inspections
BB66	Remembrance Dr	LW26	House	Very Low	None	Visual inspections

Additional information regarding the key structures of interest is provided below:

- **Property Ref. K09**: Weekly visual inspections, wall tilt monitoring and baseline ground survey were recommended for the house during periods of active subsidence. Monitoring was undertaken during the mining of Longwalls 24B and 26 and no impacts were observed. Minor impacts to external brickwork were observed during the mining of Longwall 25. No specific monitoring actions are proposed to be undertaken during the mining of Longwall 27, as the property is located approximately 900 metres from the longwall.
- **Property Ref. W42**: Weekly visual inspections and baseline ground survey were recommended for a pool, which is located above Longwall 27. While visual inspections were undertaken during the mining of Longwall 26, no access was made available to install ground survey marks.
- **Property Ref. X60:** Weekly visual inspections, wall tilt monitoring and baseline ground survey were recommended for the house during periods of active subsidence. Monitoring was undertaken during the mining of Longwalls 24B and 26 and no impacts were observed. Monitoring will continue during the mining of Longwall 27.
- **Property Ref. X61**: Weekly visual inspections, wall tilt monitoring and baseline ground survey were recommended for the house during periods of active subsidence. Monitoring was undertaken during the mining of Longwalls 24B and 25 and no impacts were observed. Minor internal cracking was reported during the mining of Longwall 26. Monitoring will continue during the mining of Longwall 27.
- **Property Ref. Y62**: A poorly constructed 1.2 m high blockwork retaining wall has been identified at the rear property boundary backing onto Myrtle Creek. GHD recommends that Tahmoor Colliery encourage the owner to demolish the wall or conduct regular inspections and a baseline ground survey. GHD advises that there is no mechanism for landslide of the house.
  The retaining wall has not been demolished by the owner. A structural inspection was arranged by Tahmoor Colliery and sandbags were stacked at the base of the wall in accordance with recommendations from John Matheson & Associates. Visual inspections were undertaken during the mining of Longwall 26 and no impacts have been reported.
- **Property Ref. Y64**: A small brick BBQ is located on the crest of the slope into Myrtle Creek. GHD recommends that the owner be made aware of the risk. The dwelling is considered a very low to low landslide risk. However, existing cracking is observed and GHD recommends a structural inspection and baseline survey.
  Tahmoor Colliery will advise the owner of the risks to the BBQ. Survey pegs have been installed around the house and across Myrtle Creek and a baseline survey was undertaken. A pre-mining inspection has been completed. A structural inspection was arranged by Tahmoor Colliery and star pickets were installed at the base of the low height retaining wall in accordance with recommendations from John Matheson & Associates.
  Ground surveys and visual inspections were undertaken on a weekly basis during the mining of Longwall 26. The sides of Myrtle Creek Valley closed approximately 60 mm during the mining of Longwall 26, with the majority of valley closure concentrating on the southern bank of the Creek at the base of the slope beneath the property. No impacts were observed. Monitoring will continue during the mining of Longwall 27.
- **Property Ref. Y65**: A poorly constructed retaining wall had been identified at the rear property boundary backing onto Myrtle Creek. GHD recommended that Tahmoor Colliery encourage the owner to demolish the wall. The owner has since demolished the wall and replaced it with a new buttressed block wall, which was observed by structural engineer John Matheson & Associates on behalf of Tahmoor Colliery.
- **Property Ref. Y67**: A timber deck is located on the crest of the steep slope into Myrtle Creek. There were no foundation details available to GHD at the time of inspection and GHD advised that the risk assessment can be reduced if it is found that the deck is founded on deep footings. GHD has assessed the risk for the adjoining house to be LOW. A structural inspection and installation of baseline survey marks was recommended.
  A pre-mining inspection and structural inspection was undertaken by Tahmoor Colliery and a baseline ground survey was undertaken.
  Ground surveys and visual inspections were undertaken on a weekly basis during the mining of Longwall 26. The sides of Myrtle Creek Valley closed approximately 70 mm during the mining of Longwall 26, with the majority of valley closure concentrating between the crest of the slope on the southern bank at the deck and a survey peg that is located on the northern bank of the Creek. Minor floor movement has been reported during mining. Monitoring will continue during the mining of Longwall 27.

The following properties will be inspected prior to 400 metres of extraction of Longwall 27:

- Property Refs. Y71, Y72, CC84 and CC89. These properties are located along the banks of Myrtle Creek.

The following properties will be inspected prior to commencement of Longwall 28:

- Property Refs. CC98, CC100 and CC102. These properties are located along the banks of Myrtle Creek.

4.4.2. Structures above 'Hidden' Creeks

A number of houses are located above hidden creeks, some of which are above Longwall 27 in the vicinity of Myrtle Creek Avenue and Remembrance Drive. Hidden creeks are defined as natural watercourses that appear to have been covered during development of a property or road. Hidden creeks have been identified from surface contours and historical aerial photographs.

These houses are considered to have a greater chance of experiencing non-systematic upsidence and closure movements during mining. When tested against observations during the mining of Longwalls 22 to 26, however, no clear increase in frequency of impact is observed.

A total of 49 houses above hidden creeks have experienced subsidence during the mining of Longwalls 22 to 26 and 17 houses have experienced impacts. The impacted houses include some on Oxley Grove, where a creek had been infilled, and houses on York Street and Remembrance Drive where a small tributary to Myrtle Creek had been infilled. The claim rate is higher than the overall claim rate of 25% and may represent a trend, though the impacts to these houses have been generally very minor (less than Category 1) and the sample size is small.

The observations of very minor impacts may be explained by the fact that the valleys in which the houses are located are very small and may not be sufficiently incised to generate significant upsidence and closure movements. If any movements do occur, it is also possible that they may not be completely transferred from the bedrock to the house through the constructed fill, depending on the design of the building foundations.

Tahmoor Colliery will conduct a pre-mining check on all houses and units that are located near hidden creeks.

4.4.3. Houses Prone to Flooding or Inundation

Potential flood prone areas have been identified along Myrtle and Redbank Creeks. None are located directly above Longwalls 27 to 30.

A flood study has been undertaken by Hughes Trueman which concluded that the proposed mining is not likely to result in any habitable floor levels subsiding below the 100 year ARI flood level, based on the predictions of subsidence provided.

The ground levels at most houses are currently above the 100 year ARI flood level, with the exception of houses K09a, K10a, X80a. The floor levels of all houses are currently above the 100 year ARI flood level and this is predicted to remain the case after mining Longwall 27. There was, however, one house (Ref. X80a) where the estimated freeboard is predicted to reduce from 200 mm to approximately 100 mm above the 100 year ARI flood level. The prediction of 100 mm is less than the stated accuracy of the flood level estimation.

This study has recently been updated as a result of the clearance of sediment from Myrtle Creek culvert increasing the cross sectional area. The study findings are essentially the same while structural steel ribs are in place to manage potential subsidence risks to the Myrtle Creek Culvert, that is, the steel ribs offset the increase in waterway opening created by the sediment clearance. However, once the culvert strengthening works are removed, House X80a would have a freeboard of approximately 2.0 metres above the 100 year ARI flood level, assuming that the culvert is kept clear of sediment (Reference: *Myrtle Creek Railway Culvert Flood Study*. Hughes Trueman, Job No. 07s659, July 2008)

The likelihood of any habitable floor levels subsiding below the 100 year ARI flood level is therefore considered **UNLIKELY**.

The houses near flood prone areas are located along the banks of Myrtle and Redbank Creeks, and are generally constructed on piers to accommodate the sloping surface. If it is found that a habitable floor level subsides below the 100 year ARI flood level, it may be possible to raise the height of the floor by jacking the foundations. The consequence of this impact is therefore considered **MODERATE**.

The risk is therefore assessed as **UNLIKELY / MODERATE → MODERATE.**

4.4.4. Houses outside any Mine Subsidence District

There are over one hundred houses that may experience subsidence but are not located within any Mine Subsidence District. The houses are located near the township of Thirlmere, north of Redbank Creek. A small number of houses have experienced subsidence movements during the mining of Longwall 26 and a lesser number will experience movements during the mining of Longwall 27. The hazard associated with these houses is that they may be less tolerant to mine subsidence movements as their designs have not been checked and approved by the Mine Subsidence Board. As discussed in Report No. MSEC355, the majority of the houses are single-storey buildings that are less than 30 metres long and less than 30 years old.

Tahmoor Colliery will conduct a pre-mining check on all houses located outside the Mine Subsidence District that are predicted to experience more than 150 mm of subsidence.

4.4.5. Older Houses

Approximately 20% of houses are estimated to have been constructed prior to the proclamation of the Bargo Mine Subsidence District in 1975. The hazard associated with these houses is that these houses may be less tolerant to mine subsidence movements as their designs have not been checked and approved by the Mine Subsidence Board. Some old houses may also be in poor condition. Many of the houses, particularly houses over 39 years old, are constructed with timber frames and weatherboard panels or fibro sheets.

Analysis of impacts to structures during the mining of Longwalls 22 to 25 in December 2008 did not find any significant trend between the rate of impacts and structure age.

Tahmoor Colliery will conduct a pre-mining check on all houses on all houses that were constructed prior to 1975 that are predicted to experience more than 150 mm of subsidence.

4.4.6. Future House Construction

As discussed in Report No. MSEC355, an analysis on the rate of growth of Tahmoor suggests that approximately 1 new house is constructed per month at Tahmoor.

The hazard associated with these houses is considered to be generally low for the following reasons.

- The design for new houses will be approved by the Mine Subsidence Board (unless they are located outside any Mine Subsidence District),
- The condition of the houses will generally be high as they are newly constructed.

Tahmoor Colliery proposes to notify all residents immediately prior to the commencement of subsidence movements. If it is discovered during this period that a new house has been constructed, Tahmoor Colliery will offer a pre-mining inspection by the MSB and offer to conduct and provide an impact assessment and risk analysis to the landowner upon request.

In the event that a new house is assessed to have a moderate level of risk or greater, the results of the risk analysis will be provided to the NSW Department of Trade and Investment, Regional Infrastructure and Services, Division of Resources and Energy (DTIRIS) and the Mine Subsidence Board. Standard risk control procedures will be applied to these houses, which are provided in this Management Plan.

4.5. Flats or Units

A total of 20 flats or units have been identified within the general mining area. Flats or units have been defined in this report as any properties that contain at least one structure and which contain at least three strata units.

This definition is necessary because there are many single-dwelling or semi-detached houses within the affected area that are called “units”. These structures have been classified as houses. However, housing estates that contain a number of multi-dwelling structures have been classified as units, even if some of the structures only contain two strata units.

The hazard associated with units is that they may be damaged due to mine subsidence impacts, and potentially damaged to the extent that they are rendered unserviceable or unsafe. This is the same hazard as for other structures, and the likelihood and consequence of this risk are considered to be the same those outlined for other structures.

4.6. Pools

4.6.1. Pool Damage

As of September 2012, a total of 125 pools have experienced mine subsidence movements during the mining of Longwalls 22 to 26. A total of 18 pools have reported impacts, all of which are located directly above the extracted longwalls. This represents an impact rate of approximately 14%. A higher proportion of impacts have been observed for in-ground pools, particularly fibreglass pools.

The majority of the impacts related to tilt or cracking, though in a small number of cases the impacts are limited to damage to skimmer boxes or the edge coping.

Mining-induced tilts are more noticeable in pools than other structures due to the presence of the water line and small gap to the edge coping, particularly when the pool lining has been tiled. Skimmer boxes are also susceptible of being lifted above the water line due to mining tilt. The Australian Standard AS2783-1992 (Use of reinforced concrete for small swimming pools) requires that pools be constructed level within ± 15 mm. This represents a tilt of approximately 3.3 mm/m for pools that are 10 metres in length. Australian Standard AS/NZS 1839:1994 (Swimming pools – Premoulded fibre-reinforced plastics – Installation) also requires that pools be constructed with a tilt not exceeding 3 mm/m.

4.6.2. Pool Gates

The hazard to pool gates is that they may not close due to mine subsidence impacts, even if they are spring-loaded.

A number of pool gates have been impacted by mine subsidence during the mining of Longwall 22 to 26. While the gates can be easily repaired, the consequence of breaching pool fence integrity is considered to be severe.

Tahmoor Colliery will inspect pool fences on a weekly basis during the active subsidence period. Any damage to pool fences and gates caused by mine subsidence will be repaired by the Mine Subsidence Board.

4.7. Septic Tanks

The risk to septic tanks is that they could be damaged and/or rendered unserviceable from mine subsidence impacts. There are two types of potential damage to septic tanks.

- Compressive ground strains could cause cracking and leaking of tanks.
- Shearing could also occur at the joint connecting the sewer pipes to the septic tank, as sewer pipes are generally able to slide as the ground moves horizontally beneath them, while the septic tanks are fixed and unable to slide relative to the sewer pipes.

Given that tanks are quite small (usually less than three (3) metres in diameter), constructed of reinforced concrete, and are usually bedded in sand and backfilled, the likelihood of cracking to septic tanks is assessed as very rare. It is noted that no impacts to septic tanks have been reported during the mining of Longwalls 22 to 26.

Pipe joints are usually flexible and consist of relatively short lengths, due to the proximity of the septic tank to the house. However, given that both the house and septic tank are effective ground anchors, it is possible that pipe joints can pull out or shear as a result of subsidence. The MSB reports that this has been observed in a small number of cases during the mining of Longwalls 22 to 26. This impact is relatively easy to repair.

The MSB also report that on two occasions during the mining of Longwalls 22 to 26, the grade of the sewer pipe to the septic tank has been reversed. The impacts are considered to have been partially due to very low pre-mining grades. In both cases, the repairs have been straight-forward, where the pipes were re-laid at an improved fall, entering the septic tank at a slightly lower level.

4.8. Sheds and Other Domestic Structures

The risk to sheds and other domestic structures is that they could be damaged and/or rendered unserviceable from mine subsidence impacts. These include garages, sheds, carport, tanks, greenhouses, hothouses, playhouses and shade structures.

These structures are able to withstand greater subsidence impacts than houses as they are generally lighter, more flexible in construction, and smaller in size. The risk of damage to sheds and other domestic structures is therefore considerably less when compared to houses.

A small number of sheds and other domestic structures have reported impacts during the mining of Longwalls 22 to 26, all of which are considered to be relatively minor and easy to repair. Any damage to sheds and other domestic structures will be repaired by the Mine Subsidence Board.

4.9. Private Roads and Walking Trails in close proximity of steep slopes

There are a small number of private driveways that are located on steep slopes. These driveways are found on properties along the banks of Myrtle Creek, and at the end of Tickle Drive on a spur of the Redbank Range.

It is possible that tension cracks may form at the tops of the slopes, and compression ridges may form at the bottoms of the slopes, and that these may coincide with private driveways. If the tension cracks are left untreated, these may cause erosion to occur, which may further damage driveways. It is unlikely that large-scale slope failure will occur.

Small ripples have been observed at locations along the private driveway of a house on Tickle Drive during the mining of Longwall 26.

4.10. Public Amenities

A number of public amenities have experienced subsidence movements during the mining of Longwalls 22 to 26. There are no public amenities located directly above Longwall 27, though some amenities will experience small additional movements (less than 100 mm of vertical subsidence) during the mining of Longwall 27.

The hazard associated with public amenities is that they may be damaged due to mine subsidence impacts, and potentially damaged to the extent that they are rendered unserviceable or unsafe. This is the same hazard as for other structures, and the likelihood and consequence of this risk are considered to be the same those outlined for other structures. However, there are a number of additional issues associated with public amenities, which may affect the way these hazards are managed.

- Public amenities are used and enjoyed by many members of the community.
- In the case of hospitals, schools, shopping centres and public utility buildings, it is not economically or socially feasible to temporarily or permanently close the amenities.
- While it is possible to temporarily close some public amenities and relocate any activities, it is extremely inconvenient to the public.
- Public amenities must maintain access and mobility standards throughout the mining period.

Predictions and impact assessments have been made for all public amenities in Report No. MSEC355.

Given that public amenities have remained safe and serviceable during the mining of Longwalls 22 and 26, and that they will experience less than 100 mm of additional subsidence during the mining of Longwall 27, the potential for impacts on public safety at public amenities due to subsidence impacts is considered to be very low.

4.11. Commercial and Business Establishments

4.11.1. Other Commercial and Business Establishments

The business and commercial establishments within the SMP Area have been identified and are described in Report No. MSEC355. There are no known commercial and business establishments located directly above Longwall 27, though establishments will experience small additional movements (less than 100 mm of vertical subsidence) during the mining of Longwall 27.

The hazard associated with commercial and business establishments is that they may be damaged due to mine subsidence impacts, and potentially damaged to the extent that they are rendered unserviceable or unsafe. This is the same hazard as for other structures, and the likelihood and consequence of this risk are considered to be the same those outlined for other structures. However, there are a number of additional issues associated with commercial and business establishments, which may affect the way these hazards are managed.

- Commercial and business establishments are used and enjoyed by many members of the community and a workplace for others. Many of the establishments are also described as public amenities.
- While it is possible to temporarily close commercial and business establishments and relocate any activities, it is extremely inconvenient to the owner of the establishment, its employees and its customers. There are many additional consequences associated with temporarily relocating commercial and business establishments.
- Retail establishments must maintain access and mobility standards throughout the mining period.

Predictions and impact assessments have been made for all commercial and business establishments in Report No. MSEC355.

Given that commercial and business establishments have remained safe and serviceable during the mining of Longwalls 22 and 26, and that they will experience less than 100 mm of additional subsidence during the mining of Longwall 27, the potential for impacts on public safety due to subsidence impacts at commercial and business establishments is considered to be very low.

4.12. Risks associated with Existing Structural Condition

The existing structural condition of structures varies above Longwall 27. This is a function of age, structural design, construction workmanship and maintenance. Pre-mining inspections undertaken by Tahmoor Colliery have identified elements of structures that did not appear to comply fully with Australian Standards, in regard to design and construction. In a small number of cases, the existing structural condition has been considered unsafe and Tahmoor Colliery has undertaken measures to repair the defect, or has informed the landowner of the hazard.

There is a remote possibility that the comparatively small additional contribution of mine subsidence movements could be sufficient to result in the structures that do not meet Australian Standards to become potentially unsafe. While the warnings appear dire, it should be noted that the likelihood of structural failure is still considered to be remote as no structures have collapsed as a result of mine subsidence movements in the Southern Coalfield.

The experience from the mining of Longwalls 22 to 26, affecting a total of 1522 structures shows that residents have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mine subsidence movements. In rare cases, some structures have experienced severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time to relocate residents.

The management strategy described in Section 4.3 includes measures to identify potentially ‘unstable structures:

A total of 854 pre-mining inspections and 226 pre-mining checks have been undertaken by the Mine Subsidence Board and Tahmoor Colliery to date. Tahmoor Colliery has undertaken a total of 3,900 visual inspections of structures during the mining of Longwall 26 (up 20 September 2012). A similar frequency of inspections is expected to be undertaken during the mining of Longwall 27, though the overall number of inspections is expected to reduce as there are fewer structures above this longwall.

Tahmoor Colliery will undertake a structural inspection of any structures that have been identified as being potentially unstable. Further management measures may be implemented following the findings of the inspection.

Structural inspections are currently being arranged for Properties BB14, BB45, BB48, BB53 and BB57 on Myrtle Creek Avenue. These will be undertaken prior to active subsidence of these houses during the mining of Longwall 27.

4.13. Farm dams

A total 45 dams have been directly mined beneath by Longwalls 22 to 26 and no impacts have been reported. This includes some large water treatment dams above Longwall 24A. A similar experience is found at dams located above other extracted longwalls at Appin and West Cliff Collieries, where the depth of cover is similar. While no impacts have been reported to dam walls, seepage was observed at the base of one dam wall that is located above Longwall 702 at Appin Colliery.

A total of 9 dams are located directly above Longwall 27 and part of one dam is located directly above the chain pillar between Longwalls 26 and 27.

The dams are typically constructed from cohesive soils with reasonably high clay contents. The walls of the farm dams should be capable of withstanding tensile strains of up to 3 mm/m without significant impacts, because of their inherent plasticity.

The likelihood of leakage of the dam wall or floor due to subsidence is considered to be **VERY RARE**. If impacts occur to the dams, Tahmoor Colliery will supply water to the landowner on a temporary basis until the dam is repaired by the Mine Subsidence Board. The consequence of loss of water storage is therefore considered to be **MODERATE**. The risk is therefore assessed as **VERY RARE / MODERATE → LOW.**

As undertaken during the mining of Longwalls 22 to 26, Tahmoor Colliery will visually inspect the dams immediately prior to and immediately after active subsidence of the dam. If impacts occur to the dams, Tahmoor Colliery will supply water to the landowner on a temporary basis until the dam is repaired by the Mine Subsidence Board.

From a public safety point of view, there are no structures or driveways located immediately downstream of the dams above Longwall 27.

One small dam, labelled V02/1f is located approximately 9 metres upstream of Bridge Street, Thirlmere. The top of the dam wall is at a similar elevation to the road pavement. A 450 mm diameter concrete culvert (Ref. C08) is buried directly beneath the pavement at this location. While a mine subsidence induced failure of an earthen dam wall has not occurred previously in the Southern Coalfield at similar depths of cover to Longwall 27, there is a very remote possibility that the dam wall could fail, leading to material from the dam wall or base blocking the small culvert. During a large storm event, this may result in water building up behind the small road embankment and flowing over the pavement.

The likelihood of failure of the dam wall leading to blockage of the culvert and potential build up of water over the pavement during a storm event is considered to be **VERY RARE**. The consequence of water flowing over the Bridge St pavement is considered to be **SEVERE**. The risk is therefore assessed as **VERY RARE / SEVERE → MODERATE.**

While acknowledging the very small likelihood of this event occurring, the risk will be managed by ground survey and visual inspections along Bridge Street during the mining of Longwall 27. In the event of irregular subsidence or ground deformation developing in the vicinity of the Dam V02/1f, Tahmoor Colliery will conduct an inspection of the dam wall and consider whether additional management measures might be required in consultation with the landowner and Wollondilly Shire Council. These might include undertaking additional monitoring, an inspection by a geotechnical engineer and/or temporarily dewatering the dam until subsidence movements cease developing.

5.1. Structures Management Group (SMG)

The SMG is responsible for taking the necessary actions required to manage the risks that are identified from monitoring of structures. The SMG's key members are:

- Tahmoor Colliery
- John Matheson and Associates
- Mine Subsidence Engineering Consultants
- Mine Subsidence Board

The SMG may invite other specialist consultants from time to time, including GHD Geotechnics or Sunrise Building and Property Services where issues relate to slope stability.

5.2. Mitigation Measures

Mitigation measures have been undertaken to strengthen a small number of structures prior to the influence of mine subsidence movements prior to the mining of Longwalls 24A and 25. No additional structures have been identified for strengthening prior to the mining of Longwall 27 at the writing this management plan.

5.3. Community Consultation

Experiences during the mining of Longwalls 22 to 26 have found that the most effective method of managing potential impacts on the safety and serviceability of structures are by way of community consultation. Residents living within the active subsidence zone have often provided early feedback to Tahmoor Colliery and the Mine Subsidence Board about impacts developing at their houses or along their local roads. Contact is made well before impacts develop to a level of severity sufficient to become a safety hazard.

The initial community consultation commenced when the Colliery applied for development consent to mine. A commission of inquiry was undertaken as part of this process. Following approval to mine beneath the town, Tahmoor Colliery continued to develop their mine plans. These plans were discussed with the Tahmoor Colliery Community Consultative Committee (TCCCC), which was set up in accordance with the conditions of development consent. Prior to mining the first longwall beneath Tahmoor, the Colliery increased the level of communication with the community.

The approaches adopted by Tahmoor Colliery are listed below.

- *Undertake conservative predictions and impact assessments*
  Tahmoor Colliery and MSEC have adopted a conservative approach to predicting subsidence and assessing impacts. This reduces the likelihood of under-stating the predicted impacts. For example, predictions for each structure have been made by predicting the maximum subsidence, tilt and strain within a 20 metre radius around each structure.

- *Undertake detailed predictions and impact assessments*
  By undertaking detailed subsidence predictions, the Colliery is able to provide residents with predictions for their own structures. Individual assessments provide some comfort to concerned residents. This is particularly helpful for residents that live beyond the extent of mining and are expected to experience only small movements.

- *Community Open Days*
  A number of advertised open days are held by the Colliery through the year. The Open Days allow members of the community to directly meet Colliery representatives and its consultants. The Mine Subsidence Board is also present on Open Days to answer questions.
  The information exchanged at Open Days also assist the Colliery, as members of the community sometimes provide information about particular surface features or impacts that the Colliery might not have been aware of.

- *Tahmoor Colliery Community Consultative Committee*
  This committee meets at regular (bi-monthly to quarterly) intervals. It allows the Colliery to present information to the committee and receive feedback. The committee is committed to ensuring that the concerns of the community are well understood by the Colliery. Many of the members have been part of the committee for several years, and this allows for informed discussion to take place.

- *Letters and door knocking to residents*
  The Colliery sends many letters to community advising of imminent longwall mining in their area. These letters invite residents to contact the colliery about any concerns that they might have and to remind them to organise a pre-mining inspection if they wish to do so. Some letters may be specifically targeted to residents if the Colliery wishes to conduct its own inspection of the property, which include all public amenities and old houses and houses that are located outside declared Mine Subsidence Districts.
  Letters are also sent to residents just before the longwalls mine directly beneath their homes. These letters again invite residents to arrange a pre-mining inspection and includes a fridge magnet with key phone numbers in the event of an emergency or impact occurring. The Colliery also attempts to make direct contact with residents by door knocking at this time.
  By continuing to engage with residents at each stage of mining, the Colliery is able to find new residents who might not have been aware that mining was taking place.

- *Individual meetings with residents*
  Many members of the community prefer to meet with Colliery representatives face to face. The Colliery has held many individual meetings with concerned residents to explain how mine subsidence develops and what the impacts might be. This is a time consuming but rewarding process for residents and the Colliery.

- *Newspaper advertisements*
  The Colliery places advertisements in the newspaper from time to time to advise the community at large about recent mining applications.

- *Weekly reporting*
  The Colliery provides regular updates on the progress of mining in the area. This is conducted mainly by group email to any member of the community who wishes to be regularly informed. The updates advise the current position of the longwall and what impacts have been observed during the past week.

- *Prompt response to reported impacts*
  While this is traditionally the role of the MSB, the Colliery also responds quickly to impacts that are reported by the community. If a severe impact is reported, the Colliery checks neighbouring properties to see whether the incident is localised or part of a larger potential issue.

- *Ongoing monitoring if impacts occur*
  Where impacts have been reported, the Colliery offers to continue monitoring the property for further impacts. This offer is in addition to those provided by the Mine Subsidence Board, who also monitors the property as mining continues.

The Mine Subsidence Board also plays a very important role in managing the expectations of the community. The MSB's concerted efforts to quickly respond to residents' concerns, particularly where they relate to emergency repairs to doors, gates or service pipes, have greatly assisted the community in coping with any inconvenience that may have occurred as a result of mine subsidence.

5.4. Site-Specific Structure Inspections

5.4.1. Pre-mining Kerbside and Front of House inspections

At the time of preparing Report No. MSEC355 (2009) in support of Tahmoor Colliery's SMP Application, structures were identified from aerial photograph, with structure types identified from kerbside inspections.

Additional front of house inspections are being undertaken by Tahmoor Colliery in company with a structural engineer to identify potentially unstable structures that may warrant a structural inspection, subject to approval by the landowner. The inspections include houses located directly above Longwall 27.

5.4.2. Pre-mining Geotechnical Inspections of Steep Slopes

A qualified geotechnical engineer (GHD Geotechnics) has inspected steep slopes on which structures are located to determine whether there is any potential for slope instability prior to, during or after mining. The inspection findings are detailed in Section 4.4.1.

Four additional properties on the southern bank of Myrtle Creek will be inspected prior to 400 metres of extraction of Longwall 27.

5.4.3. Pre-mining Structural Inspections

Structural inspections are currently being arranged for Properties BB14, BB45, BB48, BB53 and BB57 on Myrtle Creek Avenue, based on a kerbside inspection that detected a feature that was potentially unstable or unsafe. These will be undertaken prior to active subsidence of these houses during the mining of Longwall 27.

5.4.4. Pre-mining Building Inspections

Pre-mining building inspections will be conducted for the following structures, as shown in Fig. 5.1:

- Public amenities, commercial, industrial and business establishments, with a maximum plan dimension of 15 metres or greater (there are none directly above Longwall 27)
- All houses and units located on steep slopes, if recommended by the geotechnical engineer.

The building inspection includes the following actions:

- **A pre-mining inspection for Mine Subsidence Board purposes**
  Building inspections will be undertaken for the Mine Subsidence Board (MSB). Inspections will record the incidence and locations of defects in hard or finished surfaces (internal or external), including cracking and any pre-existing misalignments or bows in walls and floors.
- **A pre-mining check for potential stability issues**
  A check for any potential stability issues on the property.
- **A relative level survey (Zip level survey)**
  Relative level surveys (Zip level survey) measures vertical heights relative to a base mark. Levels will be measured using the Technidea ZipLevel Pro-2000 (or equivalent), which is an electronic elevation measurement system with a stated accuracy of approximately ±3 mm. The levelling tool adopts the principles of water pressure to measure changes in elevation, which is ideal for level surveys around and inside buildings as measurements can be taken without requiring a line of sight. The ZipLevel has also been chosen by the MSB for its future surveys.
  As shown in Fig. 5.4, levels will be measured at all external and internal corners of the building and at the centre of each external side of reasonable length (this will depend on the overall size of the building, but is approximately 10 metres), any construction joints and articulation joints within the building and at a point within the building at a hard surface if the shortest axis of the building is a reasonable length (approximately 10 metres). Full descriptions of each survey point will be recorded, as permanent marks will not be left on residential structures.
  Due to the variability in access available to conduct level surveys, it is anticipated that there will be some cases where the above principles cannot be followed.
  Where possible, levels will be taken at roughly the same elevation around the building. For example, in the case of brick buildings on reasonably level ground, levels will be taken along the same brick course. By following this procedure, it should be possible to develop an understanding of any pre-existing tilts within the external walls, as well as providing a uniform point of reference for analysis and future surveys. Levels will be taken at approximately one metre above ground level for ease and safety of surveying.

- **Vertical tilts of Walls**
  A spirit level will be used to estimate vertical tilt on walls at external corners.
- **Written Report**

Many pre-mining inspections have been completed, as shown in Fig. 5.3. The remainder will be undertaken prior to active subsidence of each property during the mining of Longwall 27, subject to landowner approval.

5.4.5. Pre-mining Building Checks

Pre-mining building checks will be conducted at structures shown in Fig. 5.2, where access is available and which have not already been directly mined beneath by previous longwalls. The structures include the following:

- Houses and units located above hidden creeks.
- Houses and units located outside any Mine Subsidence District that are predicted to experience more than 150 mm of subsidence.
- All houses estimated to have been constructed prior to the declaration of the Mine Subsidence District (1975), and which are predicted to experience more than 150 mm of subsidence.

This type of inspection checks for potential stability issues on the property. The inspection is conducted by a licensed builder with experience in mine subsidence or a structural engineer. Many pre-mining checks have been completed, as shown in Fig. 5.3. The remainder will be undertaken prior to active subsidence of each property during the mining of Longwall 27, subject to landowner approval.

5.4.6. Pre-Mining Inspections by the Mine Subsidence Board

The Mine Subsidence Board (MSB) has undertaken a number of pre-mining inspections above Longwalls 22 to 27. These are shown in Fig. 5.3. Further inspections may be conducted by the MSB in the future if requested by a landowner. Tahmoor Colliery will undertake pre-mining inspections on behalf of the MSB if requested by the landowner, or if access is only available after business hours or on weekends.

5.4.7. Visual kerbside inspections during mining

Detailed visual inspections will be undertaken along streets on a weekly basis within the active subsidence area during the mining of Longwall 27, commencing after 200 metres of extraction.

A second, vehicle based inspection will also be undertaken once a week within the active subsidence area during the mining of Longwall 27, commencing after 200 metres of extraction.

The frequency of inspections can be increased, if required, based on actual observations.

5.4.8. Visual Inspections of Structures during mining

Weekly visual inspections will be conducted for the following structures or slopes when they are located within the active subsidence zone:

- Public amenities and commercial and business establishments
- Houses and units that have experienced impacts as a result of mining previous longwalls
- Pool gates
- Structures and driveways located on steep slopes, where recommended by the geotechnical engineer or structural engineer.
- Farm dams immediately prior to and after the period of active subsidence for each dam.

A final inspection will also be conducted at the completion of Longwall 27.

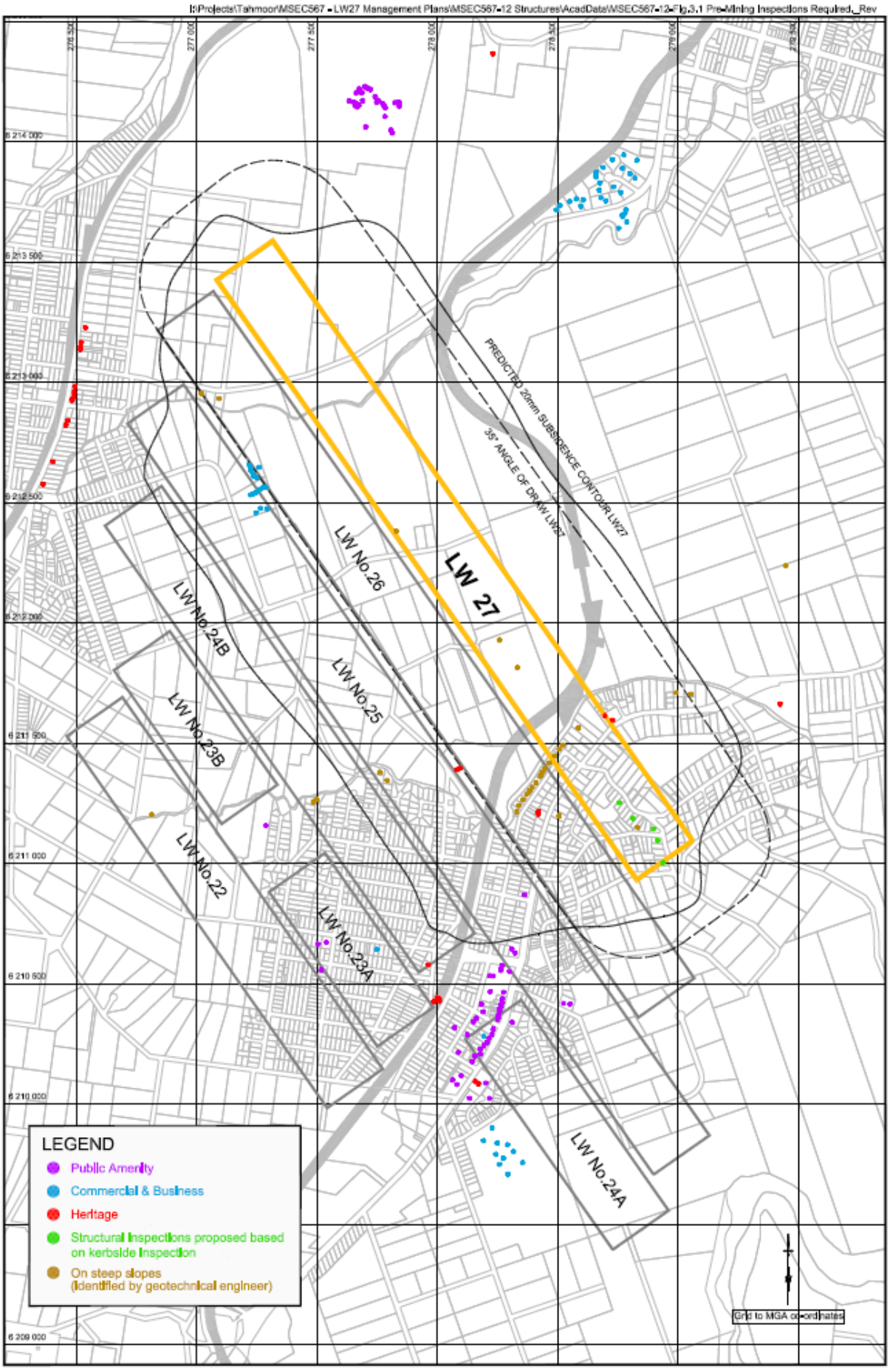

Fig. 5.1 Location of all Structures selected for Pre-Mining Inspections

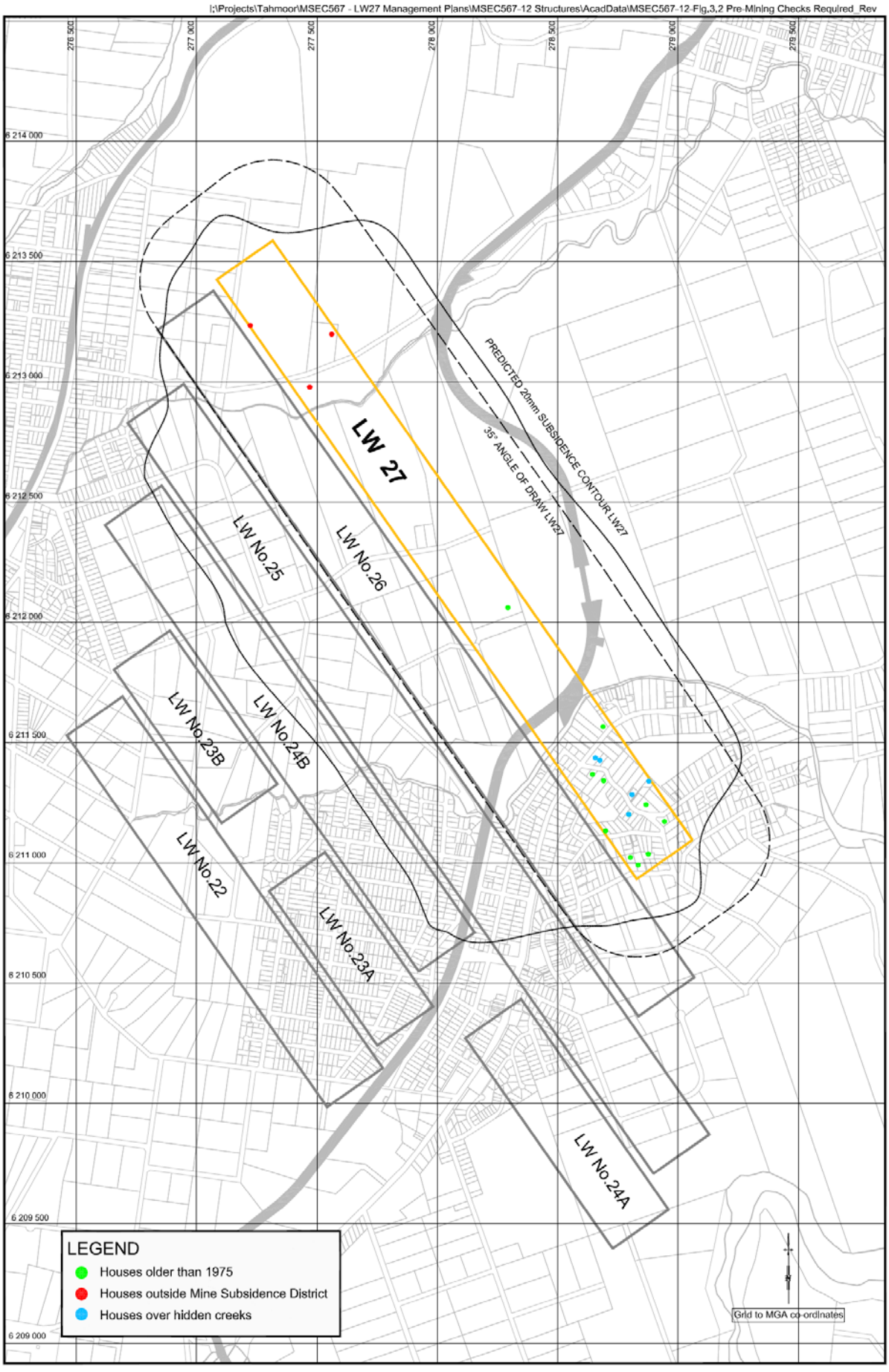

Fig. 5.2 Location of all Structures selected for Pre-Mining Checks

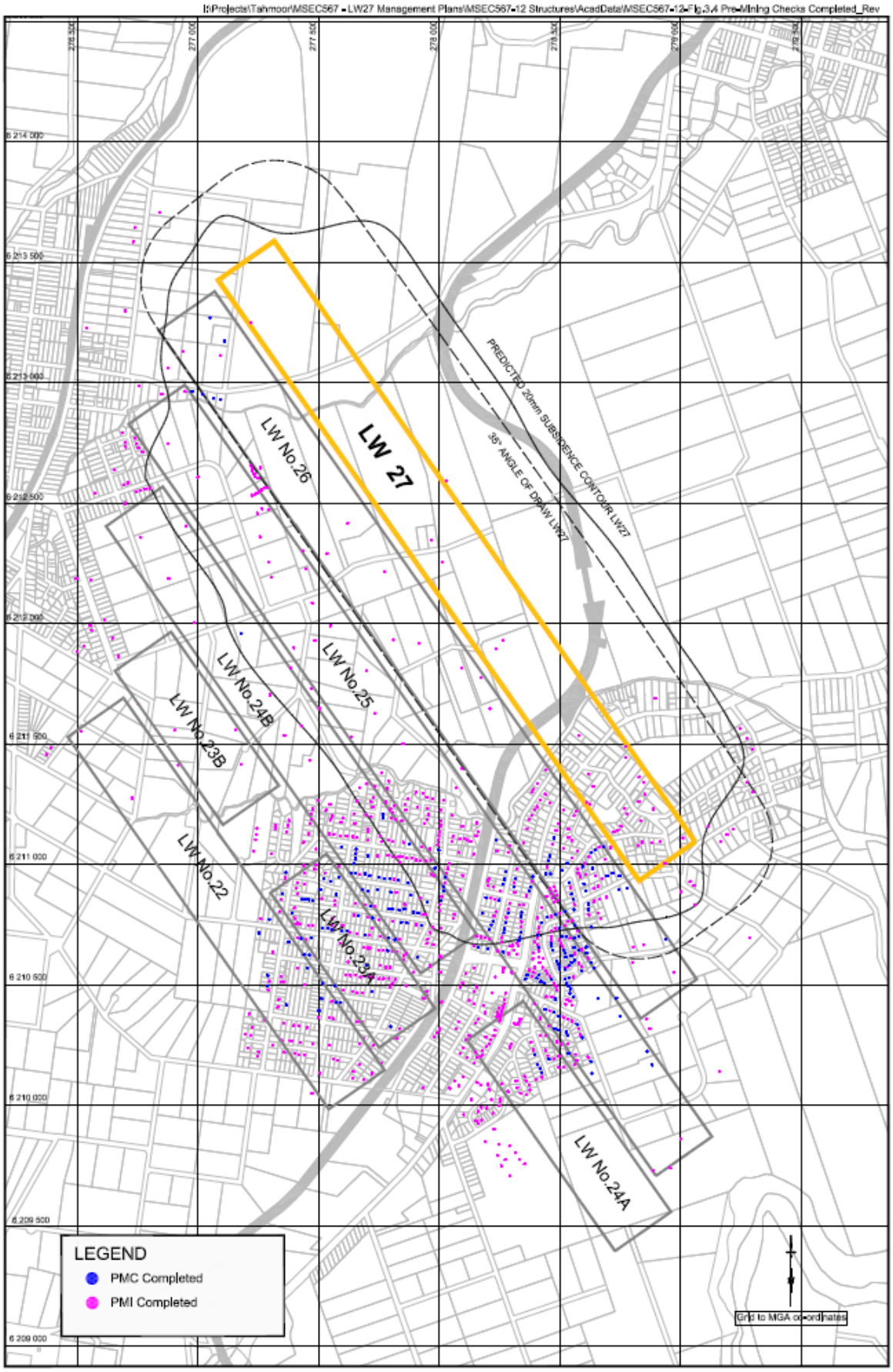

Fig. 5.3 Properties for which Pre-Mining Inspections or Pre-Mining Checks have been completed

5.5. Ground and Structure Monitoring Plan

5.5.1. Ground Surveys along Streets

Monitoring lines have been installed along all streets within the urban area above Longwall 27, as shown in Drawing No. MSEC567-00-03. The monitoring lines have been initially surveyed to provide a baseline reference. Monitoring of street survey lines will be conducted for every 200 metres of longwall travel as a minimum for pegs located within the active subsidence zone.

5.5.2. Specific Structure Surveys

Tahmoor Colliery will undertake building surveys where recommended by a geotechnical or structural engineer. Table 5.1 lists where specific structure surveys will be undertaken or baseline monitoring installed during the mining of Longwall 27:

Table 5.1 Building Surveys scheduled during the mining of Longwall 27

Structure Ref.	Structure Type	Ground monitoring	Reason
X60	House	Installed	House on slope, monitoring as recommended by structural engineer
X61	House	Installed	House on slope, monitoring as recommended by structural engineer
Y60	Pool	Installed	Recommended by geotechnical engineer due to proximity of pool to slope
Y64	House	Installed	Recommended by geotechnical engineer due to existing condition of house (not due to slope stability).
Y67	House	Installed	Recommended by geotechnical engineer due to proximity of deck to slope.
W42	Pool	No access available	Recommended by geotechnical engineer due to proximity of pool to slope, but no access is available. Visual inspections only.
BB57	House	Install prior to 100m of extraction	Recommended by structural engineer due to proximity of house to slope

Ground surveys around structures are used as a baseline monitoring tool. Surveys are undertaken following completion of each longwall unless impacts or high tilts are observed. Tahmoor Colliery will place permanent ground survey pegs around each subject building. The Colliery will endeavour to place pegs at each external and internal corner of the building, and one peg at the centre of each external side of reasonable length (this will depend on the overall size of the building, but is approximately 10 metres).

The Colliery will record the reduced levels of each peg, as well as the horizontal distance between each peg around the perimeter of the building. The survey information will provide subsidence, tilt, curvature and strain information on the ground around the building. This general surveying scheme is illustrated in Fig. 5.4. It is recognised that in some cases, it will not be possible to gain access and suitable lines of sight to the entire perimeter of the building, and in some cases, the number of survey pegs may be reduced. However, as a minimum, survey marks will be placed at every corner of the building.

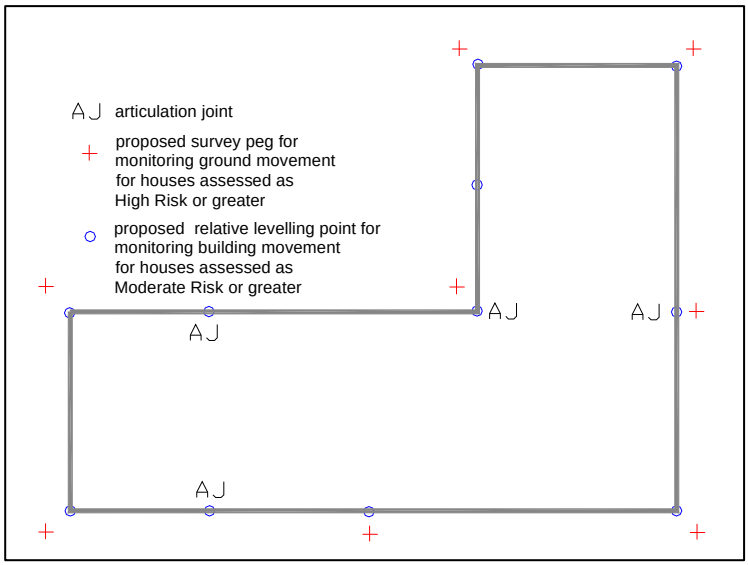

Fig. 5.4 Schematic layout for ground movement and building level surveys around a typical building

5.6. Schedule of Inspections and Surveys

A schedule of inspections and surveys is maintained using an electronic database. Weekly job sheets are issued by Tahmoor Colliery to all inspection and survey contractors. Tahmoor Colliery can, at any time, provide a copy of the schedule of inspections to DTIRIS.

5.7. Inspection and Survey Register

A register will be kept by Tahmoor Colliery, recording when inspections and surveys are conducted. Tahmoor Colliery can, at any time, provide a copy of the register to DTIRIS.

5.8. Triggers and Responses

Trigger levels have been developed by Tahmoor Colliery based on observed ground movements or impacts. Trigger levels for each monitoring parameter are described in the risk control procedures in Table 5.2.

Structural inspections will be undertaken for any structure where ground tilts is observed to exceed 7 mm/m or curvature is observed to exceed 0.2 km^{-1}.

Tahmoor Colliery will coordinate with the Mine Subsidence Board and ensure that building contractors are on standby for immediate call out and service in the event of impacts occurring. Temporary alternative accommodation will also be arranged by Tahmoor Colliery in the unlikely event that a residence becomes unsafe as a result of mine subsidence impacts.

Immediate responses will be undertaken by Tahmoor Colliery or the Mine Subsidence Board for the following impacts:

- Impacts that create a serious public safety hazard
- Impacts to all entry and exit doors, and all other doors that must remain operational for security and fire egress reasons, even if further impacts are anticipated. This includes access gates for child care centres.
- Impacts that impair any essential services.
- Impacts that impair access and mobility to public amenities and commercial and business establishments, even if further impacts are anticipated.
- Impacts to the aesthetic appearance of commercial and business establishments, even if further impacts are anticipated.
- Impacts to food preparation areas that result in a potential breach of health regulations, even if further impacts are anticipated.
- Impacts to sensitive equipment, even if further impacts are anticipated.

5.9. Risk Control Procedures for Longwall 27

The risk control procedures for the management of potential impacts to residential, public amenities and commercial or business establishments are provided in Table 5.2.

Table 5.2 Risk Control Procedures for Residential Establishments, Public Amenities and Business and Commercial Establishments for Longwall 27

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?
Houses, Units, Public Amenities, Business and Commercial Establishments that will experience mine subsidence movements due to the mining of Longwall 27	Impacts occur	Low to Moderate	Baseline monitoring for LW27	Kerbside inspection to identify any potentially unstable structures	Completed first time in 2009	Tahmoor Colliery (MSEC)
				Front of house inspection to identify any potentially unstable structures, for all properties located directly above Longwall 27	Prior to influence of LW27 on each property	Tahmoor Colliery & JMA
			Prior to mining	Contact residents to inform them of commencement of mine subsidence. Request owners for information on any potential issues with existing structures	Prior to subsidence occurring	Tahmoor Colliery
				Conduct geotechnical assessment of steep slopes in vicinity of structure to check whether there is any potential for slope instability prior to, during or after mining.	Complete, except for 4 properties above LW27. These will be completed prior to 400m	Tahmoor Colliery (GHD Geotechnics)
				Conduct pre-mining structural inspection and assessment of: • Public amenities and commercial and business establishments (none directly above LW27). • Structures that have been recommended for structural inspection by the geotechnical engineer • Structures that have been identified as being potentially unstable	Complete, except for 5 properties on Myrtle Creek Ave These will be completed prior to commencement of LW27.	Tahmoor Colliery (JMA)
				Conduct pre-mining building inspection of the following structures: • Public amenities and commercial and business establishments with maximum plan dimension of 15 metres or greater • Structures on steep slopes if recommended by geotechnical engineer	Prior to subsidence occurring	Tahmoor Colliery (SBPS)
				Conduct pre-mining check of all houses for any potential issues that fall into one of the following descriptions. • Houses built outside Mine Subsidence District which are predicted to experience more than 150 mm of subsidence • Houses built prior to declaration of the Mine Subsidence District (1975) and predicted to experience more than 150 mm of subsidence • Houses above potential hidden creeks	Prior to subsidence occurring	Tahmoor Colliery (SBPS)
				Installation of additional monitoring measures or mitigation/strengthening measures as recommended by structural engineer	Complete	Tahmoor Colliery
				Install survey lines on all streets above Longwall 27 and survey initial levels and strain distances (as shown in Drawing No. MSEC567-00-03).	Complete, except for Thompson Pl, and extension of Moorland Rd, Park Avenue and River Rd. These will be will be installed and baseline surveyed prior to commencement of LW27	Tahmoor Colliery (SMEC Urban)
			Discovery of potential structural issue prior to mining	Conduct structural pre-mining inspection and assessment and consider: - any mitigation / strengthening measures to improve the existing structural condition - any management measures that should be undertaken prior to or during mining - any monitoring and inspection measures, triggers and responses during mining	Prior to subsidence occurring	SMG
				Advise property owner, MSB and I&I of findings of structural engineer	Prior to subsidence occurring	Tahmoor Colliery

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?
Houses, Units, Public Amenities, Business and Commercial Establishments that will experience mine subsidence movements due to the mining of Longwall 27	Impacts occur	Low to Moderate	During mining of Longwall 27	Survey levels on street survey lines within active subsidence area	Every 200 metres of longwall face movement	Tahmoor Colliery (SMEC Urban)
				Conduct kerbside visual inspection of streets and structures	Detailed inspection once a week Vehicle based inspection once a week within active subsidence area	Tahmoor Colliery
				Assess subsidence results and project likely ground movements for all structures directly affected by LW27. Provide subsidence monitoring report and commentary.	Weekly after 200 m of extraction of LW27	Tahmoor Colliery (MSEC)
				Confirm arrangements through MSB for building contractors to remain on standby for immediate call out and service in the event of impacts affecting safety or serviceability.	Prior to subsidence occurring	Tahmoor Colliery
				Conduct inspections during mining for following structures: a) Public amenities and commercial business establishments b) Structures that have previously experienced mine subsidence impacts c) Pool gates d) Any other structures recommended for regular inspections and/or structure surveys by geotechnical or structural engineer due to their proximity to steep slopes or pre-existing condition	Weekly within active subsidence zone, or as required by geotechnical or structural engineer & end of LW	Tahmoor Colliery (SBPS)
			Observed tilts are greater than 7 mm/m or observed curvatures are greater than 0.2 km^{-1} near structure	Conduct inspection of building and provide photographic survey and impact report	Within one week	Tahmoor Colliery (SBPS)
				Consider structural inspection/additional monitoring and/or mitigation/strengthening measures	Immediately after building inspection.	Tahmoor Colliery (JMA)

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?
Houses, Units, Public Amenities, Business and Commercial Establishments that will experience mine subsidence movements due to the mining of Longwall 27	Impacts occur	Low to Moderate	Significant non-systematic movement occurs or Impacts observed to any surface infrastructure (not just structures) or Slope slippage observed	Consider whether any additional management measures are required in light of observations, including additional geotechnical or structural inspections	As required by SMG	SMG
				Notify landowner, Tahmoor Colliery, Mine Subsidence Board, DTIRIS	Within one week	Tahmoor Colliery
			Any impact occurs to structure	Notify landowner, Tahmoor Colliery, Mine Subsidence Board, Industry and Investment, NSW	Within 24 hours	Tahmoor Colliery
				Inspect impact of subsidence on building	As soon as possible	MSB
				Inspect condition of building	Once a week with active subsidence area or as agreed with owner	Tahmoor Colliery (SBPS)
				Rectify any adverse impacts that impair upon: - the safety, access and mobility, security or fire egress - any essential services - aesthetic appearance of commercial and business establishments - food preparation areas that result in a potential breach of health regulations - sensitive equipment used for commercial and business establishments	As soon as possible at any stage during mining	Tahmoor Colliery and/or MSB
				Repair damage to structure	When subsidence impacts cease	MSB
			Observed impacts are greater than predicted impacts	Investigate cause(s) for greater impacts, including possibility of non-systematic or anomalous movements, type of structure. Investigate spatial trends in data to identify any pattern.	Within one week of observation	Tahmoor Colliery
			Observed impact is AS2870 Category 3 or greater	Notify landowner, Tahmoor Colliery, Mine Subsidence Board, DTIRIS	Within 24 hours	Tahmoor Colliery
				Inspect structural condition of building.	Within two days and then as recommended by structural engineer	Tahmoor Colliery
				Reassess final level of damage based upon likelihood of further damage and structural condition.	Immediately after structural re-inspection.	SMG
				Consider additional monitoring and/or mitigation/strengthening measures	Immediately after structural re-inspection.	SMG
			SMG considers that property is likely to be unsafe during or after mining	Coordinate with MSB and provide temporary accommodation for residents.	Immediately	MSB &Tahmoor Colliery
				Utilise acquisition and compensation procedure from DA67/98-1999 Development Consent Conditions 18-26 and MSB procedures	Immediately	MSB &Tahmoor Colliery
			Property owner does not accept acquisition	Temporarily relocate residents until building is repaired	Immediately	MSB &Tahmoor Colliery

Infrastructure	Hazard / Impact	Risk	Trigger	Control Procedure/s	Timing and Frequency	By Whom?
Houses	House subsides below 100 year ARI flood level	Moderate	Prior to Mining	Assess potential for houses to subside below 100 year ARI flood level, including transverse ground surveys of Myrtle and Redbank Creeks.	Complete	Tahmoor Colliery
			Completion of Mining	Conduct transverse ground surveys of Myrtle and Redbank Creeks	Completion of mining when subsidence movements along Myrtle and Redbank Creeks cease	Tahmoor Colliery (SMEC Urban)
				Assess whether any houses has subsided below 100 year ARI flood level	Completion of mining when subsidence movements along Myrtle and Redbank Creeks cease	Tahmoor Colliery
			House(s) subside below 100 year ARI flood level	Raise house so that floor level is above 100 year ARI flood level	As required	Tahmoor Colliery
Houses	Impacts to future houses	Low to Moderate	Prior to mining	Contact residents to inform them of commencement of mine subsidence. Request owners for information on whether any new houses have been constructed since 2009.	Prior to subsidence occurring	Tahmoor Colliery
			Owner notifies of new house	Conduct pre-mining inspection by MSB, if requested	Prior to subsidence occurring	MSB
				Conduct impact assessment and risk analysis, if requested	Prior to subsidence occurring	Tahmoor Colliery (MSEC)
			New house has maximum plan dimension greater than 30 m	Conduct subsidence predictions, impact assessment and risk analysis	Prior to subsidence occurring	Tahmoor Colliery (MSEC)
				Follow risk control procedures, as for other houses	Immediately	Tahmoor Colliery
Swimming pools and pool gates	Damage to pool	Low	None	Notify owner of potential impacts to pool	Before mine subsidence impacts occur	Tahmoor Colliery
	Pool gate – won't shut	High	None	Notify owner of potential impact to pool gate and fence	Before mine subsidence impacts occur	Tahmoor Colliery
				Visually inspect pool gate to check that it is operating properly	Weekly when each pool is within active subsidence zone, and at completion of each longwall	Tahmoor Colliery (SBPS)
			Pool gate won't close	Contact MSB to repair gate	Immediately	Tahmoor Colliery
				Repair gate	As soon as possible	MSB
Farm dams	Loss of water storage due to leakage of dam wall or floor	Low	During mining	Visual inspection of dam	Immediately prior to and after period of active subsidence at each dam	Tahmoor Colliery (Geoterra)
			Cracks observed in dam	Repair cracks	As required	MSB
			Loss of water supply due to leakage of dam wall or floor	Supply water to landowner	As required	Tahmoor Colliery
	Failure of wall of Dam V02/1f upstream of Bridge Street, leading to blockage of culvert with material and water overflowing Bridge St during storm events	Moderate	During mining	Ground surveys along Bridge Street	Weekly after 2300m of extraction	Tahmoor Colliery (SMEC Urban)
				Visual inspections along Bridge Street	Weekly when Bridge Street is within active subsidence zone	Tahmoor Colliery
			Irregular subsidence movements observed from ground survey or ground deformation observed in vicinity of Dam V02/1f	Inspect dam wall	Within 1 week	Tahmoor Colliery
				Consider whether any additional management measures are required in light of observations, including additional monitoring, geotechnical inspections and/or dewatering dam in consultation with landowner and Wollondilly Shire Council	As required by SMG	SMG

6.0 SMG REVIEW MEETINGS

SMG meetings will be held between for discussion and resolution of issues raised in the operation of the Management Plan. The frequency of meetings shall be as agreed by the parties.

SMG meetings will discuss any incidents reported in relation to the relevant surface feature, the progress of mining, the degree of mine subsidence that has occurred, and comparisons between observed and predicted ground movements.

It will be the responsibility of the meeting representatives to determine whether the incidents reported are due to the impacts of mine subsidence, and what action will be taken in response.

In the event that a significant risk is identified for a particular surface feature, any member of the SMG may call an emergency SMG Meeting, with one day's notice, to discuss proposed actions and to keep other parties informed of developments in the monitoring of the surface feature.

7.0 AUDIT AND REVIEW

All Management Plans within this document have been agreed between parties. The Management Plan will be reviewed following extraction of each longwall.

Should an audit of the Management Plan be required during that period, an auditor shall be appointed by the Tahmoor Colliery to review the operation of the Management Plan and report at the next scheduled Plan Review Meeting.

Other factors that may require a review of the Management Plan are:-

- Observation of greater impacts on surface features due to mine subsidence than was previously expected.
- Observation of fewer impacts or no impacts on surface features due to mine subsidence than was previously expected.
- Observation of significant variation between observed and predicted subsidence.

8.0 RECORD KEEPING

Tahmoor Colliery will keep and distribute minutes of any SMG Meeting.

9.0 CONTACT LIST

Organisation	Contact (* SMG Member)	Phone	Email / Mail	Fax
NSW Department of Trade and Investment, Regional Infrastructure and Services, Division of Resources and Energy (DTIRIS)	Phil Steuart	(02) 4931 6648	phil.steuart@industry.nsw.gov.au	(02) 4931 6790
	Gang Li	(02) 4931 6644 0409 227 986	gang.li@industry.nsw.gov.au	(02) 4931 6790
	Ray Ramage	(02) 4931 6645 0402 477 620	ray.ramage@industry.nsw.gov.au	(02) 4931 6790
John Matheson & Associates (JMA)	John Matheson*	(02) 9979 6618 0418 238 777	jma.eng@bigpond.net.au	(02) 9999 0121
Mine Subsidence Board (MSB)	Darren Bullock*	(02) 4577 1967 0425 275 567	d.bullock@minesub.nsw.gov.au	(02) 4677 2040
Mine Subsidence Engineering Consultants (MSEC)	Daryl Kay*	(02) 9413 3777 0416 191 304	daryl@minesubsidence.com	(02) 9413 3822
Sunrise Building and Property Services (SBPS)	John Schwarz*	(02) 4883 9030 0400 390058	sunbuilding@bigpond.com.au	(02) 4883 9738
Xstrata Coal Tahmoor Colliery – Environment and Community Manager	Ian Sheppard*	(02) 4640 0156 0408 444 257	isheppard@xstratacoal.com.au	(02) 4640 0140
Xstrata Coal Tahmoor Colliery – Community Coordinator	Belinda Clayton*	(02) 4640 0133	bclayton@xstratacoal.com.au	(02) 4640 0140
Tahmoor Colliery 24 hour contact	Tahmoor Colliery Control	1800 154 415	-	-

APPENDIX A. DRAWINGS

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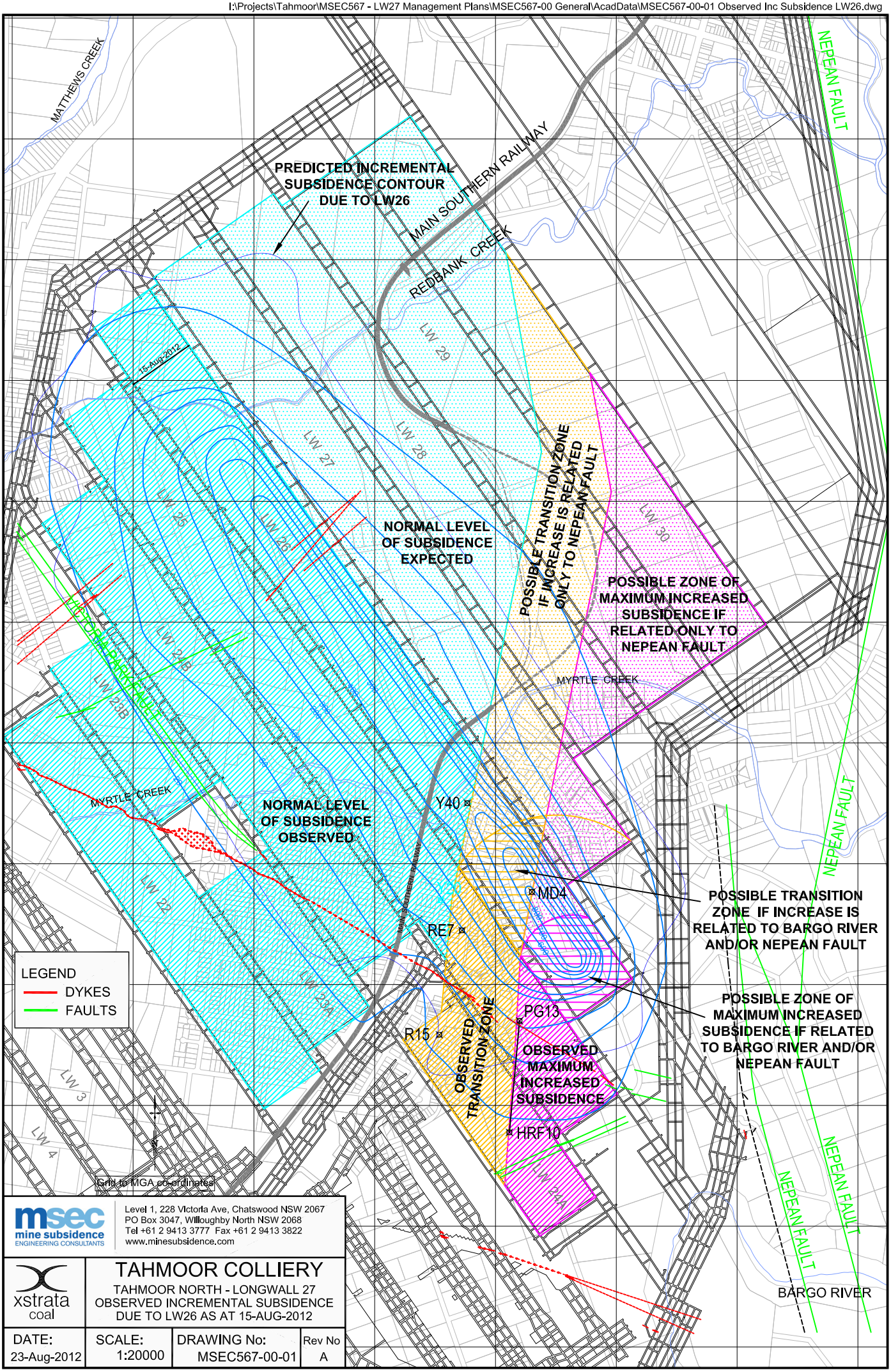

msec mine subsidence ENGINEERING CONSULTANTS
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Tel +61 2 9413 3777 Fax +61 2 9413 3822
www.minesubsidence.com

xstrata coal

TAHMOOR COLLIERY

TAHMOOR NORTH - LONGWALL 27
OBSERVED INCREMENTAL SUBSIDENCE
DUE TO LW26 AS AT 15-AUG-2012

DATE:	SCALE:	DRAWING No:	Rev No
23-Aug-2012	1:20000	MSEC567-00-01	A

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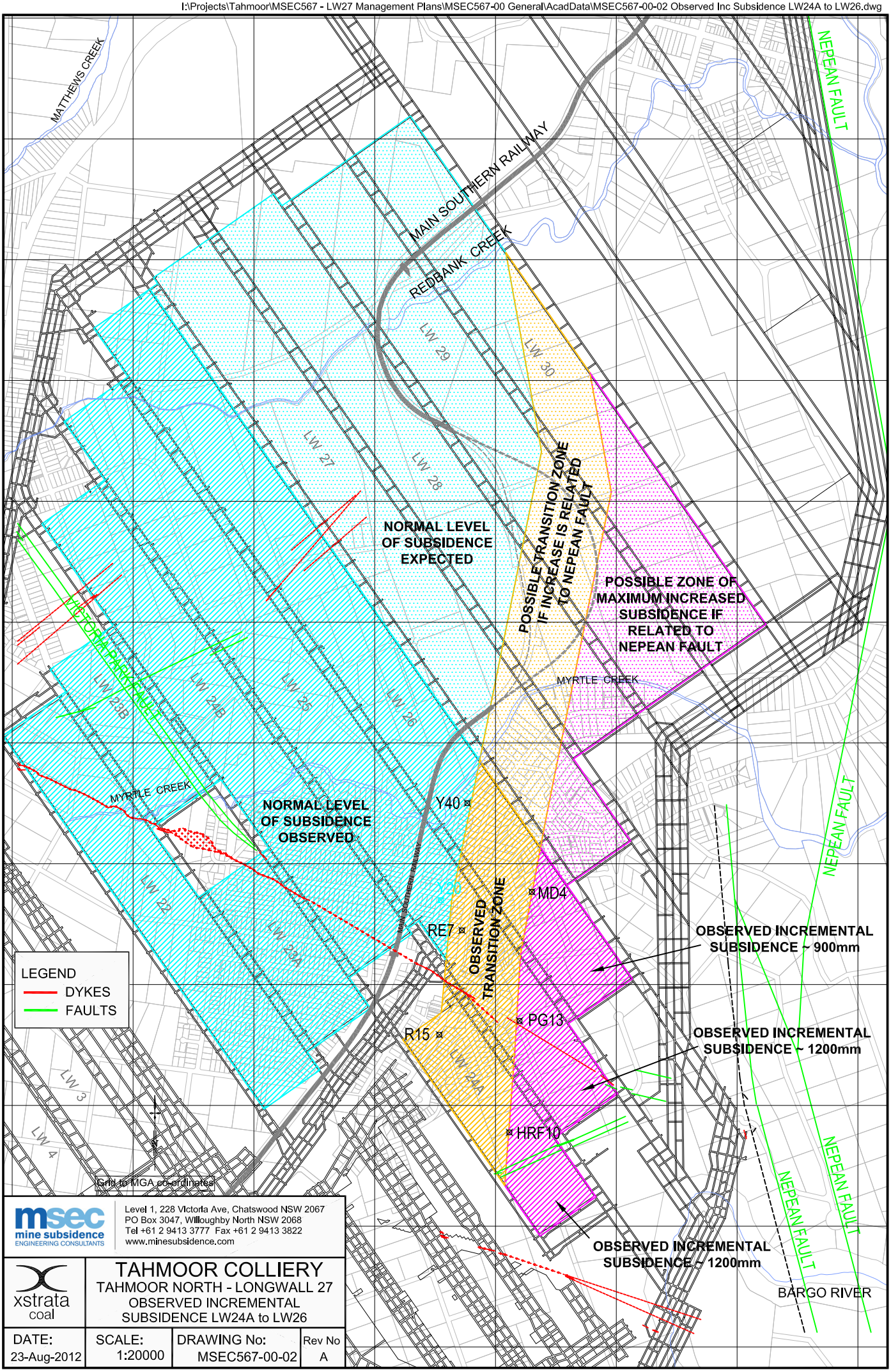

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TAHMOOR COLLIERY

TAHMOOR NORTH - LONGWALL 27
OBSERVED INCREMENTAL SUBSIDENCE LW24A to LW26

DATE:	SCALE:	DRAWING No:	Rev No
23-Aug-2012	1:20000	MSEC567-00-02	A

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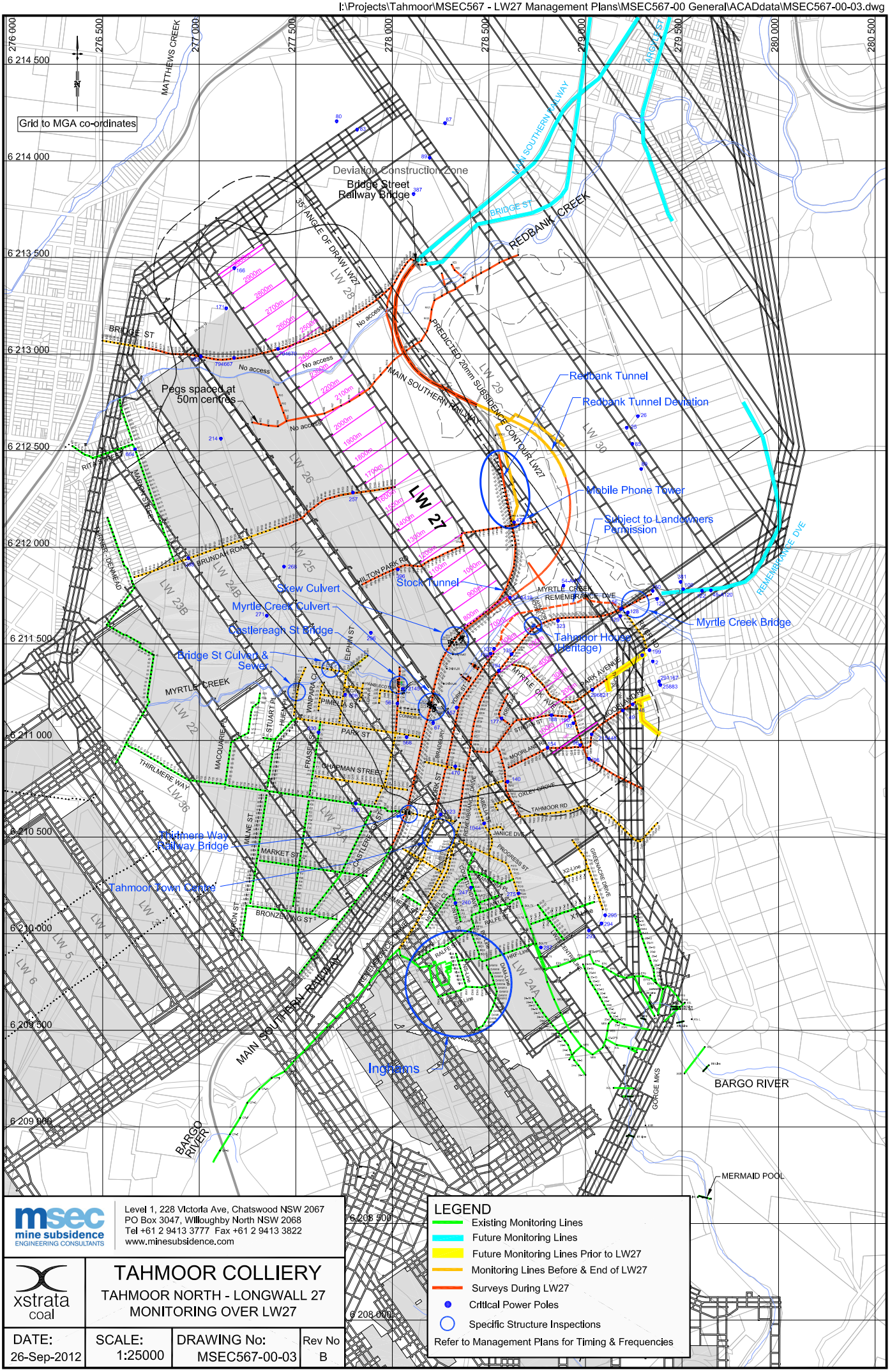

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TAHMOOR COLLIERY

TAHMOOR NORTH - LONGWALL 27 MONITORING OVER LW27

DATE:	SCALE:	DRAWING No:	Rev No
26-Sep-2012	1:25000	MSEC567-00-03	B

LEGEND

- Existing Monitoring Lines
- Future Monitoring Lines
- Future Monitoring Lines Prior to LW27
- Monitoring Lines Before & End of LW27
- Surveys During LW27
- Critical Power Poles
- Specific Structure Inspections

Refer to Management Plans for Timing & Frequencies

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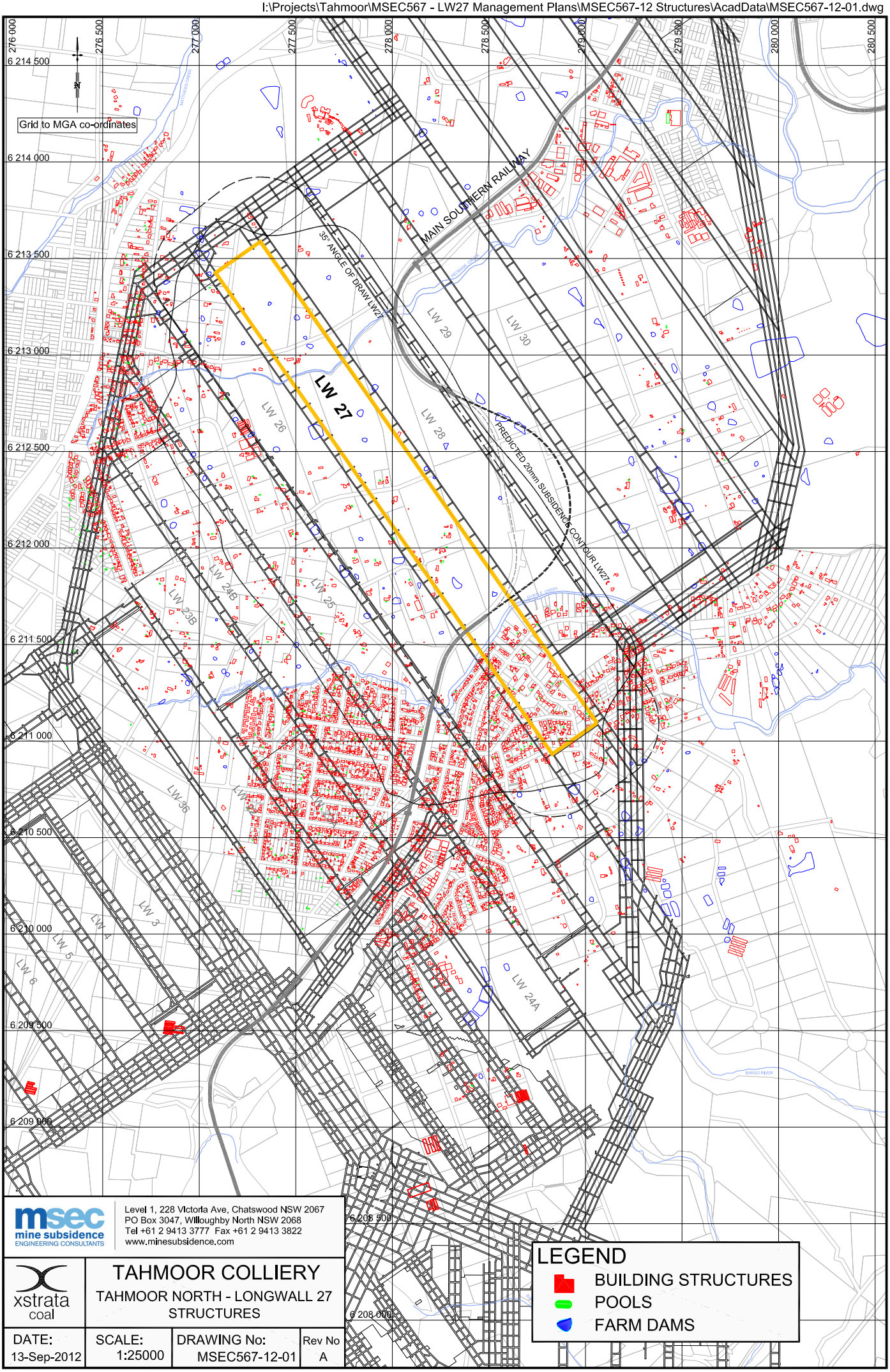

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TAHMOOR COLLIERY

TAHMOOR NORTH - LONGWALL 27 STRUCTURES

DATE:	SCALE:	DRAWING No:	Rev No
13-Sep-2012	1:25000	MSEC567-12-01	A

LEGEND

- BUILDING STRUCTURES
- POOLS
- FARM DAMS