SIMEC Mining:

Tahmoor Coking Coal Operations – Longwall 32

Management Plan for Potential Impacts to Building 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
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Oct-18	MSEC945-12	A	Updated for Longwall 32
Oct-18	MSEC945-12	B	Updated for Longwall 32

References:

AS/NZS 4360:2004 — Risk Management

AS/NZS ISO 31000:2009 — Risk Management – Principles and guidelines

GHD (2018) — SIMEC Mining – Tahmoor Coking Coal Operations – Landslide Risk Assessment for identified ‘steep’ slopes – Specific properties in environs of LW32. GHD Geotechnics, Report No. 221896, dated July 2018.

Glencore (2014) — Glencore Coal Assets Australia Risk Management Matrix, Glencore, September 2014

Tahmoor Colliery (2018) — Environmental Risk Assessment: Tahmoor Underground – Longwall 32 Surface and Subsurface Infrastructure – Built Structures, Tahmoor Coking Coal Operations, May 2018.

MSEC (2014) — Tahmoor Colliery Longwalls 31 to 37 - Subsidence Predictions and Impact Assessments for Natural and Built Features in support of the SMP Application. Report MSEC647 (Revision A, December 2014), prepared by Mine Subsidence Engineering Consultants.

MSEC (2018) — Tahmoor Coking Coal Operations – Modification of SMP Application for Longwall 32 – The Effects of the Proposed Modification of Longwall 32 on Previous Subsidence Predictions and Impact Assessments. Report MSEC969 (Revision B, July 2018), prepared by Mine Subsidence Engineering Consultants.

MSO (2017) — Managing risks of subsidence – Guide | WHS (Mines and Petroleum Sites) Legislation, NSW Department of Planning and Environment, Resources Regulator, Mine Safety Operations, February 2017.

SCT (2018a) — Structure determinations of the Nepean Fault adjacent to Tahmoor Mine, SCT Operations, Report No. TAH4817, May 2018.

SCT (2018b) — Investigation into the Potential Impact of the Nepean Fault on Longwall 32 Subsidence, SCT Operations, Report No. TAH4821, May 2018.

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

Drawing No.	***Description***	***Revision***
MSEC945-00-01	Monitoring over Longwall 32	F
MSEC945-12-01	Structures	A

1.1. Background

Tahmoor Coking Coal Operations is located approximately 80 km south-west of Sydney in the township of Tahmoor, New South Wales (NSW). It is managed and operated by SIMEC Mining. Tahmoor Coking Coal Operations has previously mined 31 longwalls to the north and west of the mine's current location. The longwalls are being extracted in accordance with the current Development Consent (DA 67/98) and Subsidence Management Plan Approval.

Longwall 32 is a continuation of a series of longwalls that extend into the Tahmoor North Lease area, which began with Longwall 22. The longwall panels are located between the Bargo River in the south-east, the township of Thirlmere in the west and Picton in the north.

Longwall 32 is located beneath the rural area between Tahmoor, Thirlmere and Picton, including part of the South Picton industrial area. A small number of structures are located directly above Longwall 32.

A summary of the dimensions of Longwall 32 is provided in Table 1.1.

Table 1.1 Longwall Dimensions

Longwall	Overall void length including the installation heading (m)	Overall void width including the first workings (m)	Overall tailgate chain pillar width (m)
Longwall 32	2378	283	39

The length of longwall extraction (i.e. excluding the installation heading) is 2370 m. The width of the longwall extraction face (i.e. excluding the first workings) is 272 m. The longwall will be extracted from the south-east towards the north-west.

The surface and seam levels along the centreline of Longwall 32 are illustrated in Fig. 1.1. The main roads, railway and creeks are also indicated in this figure.

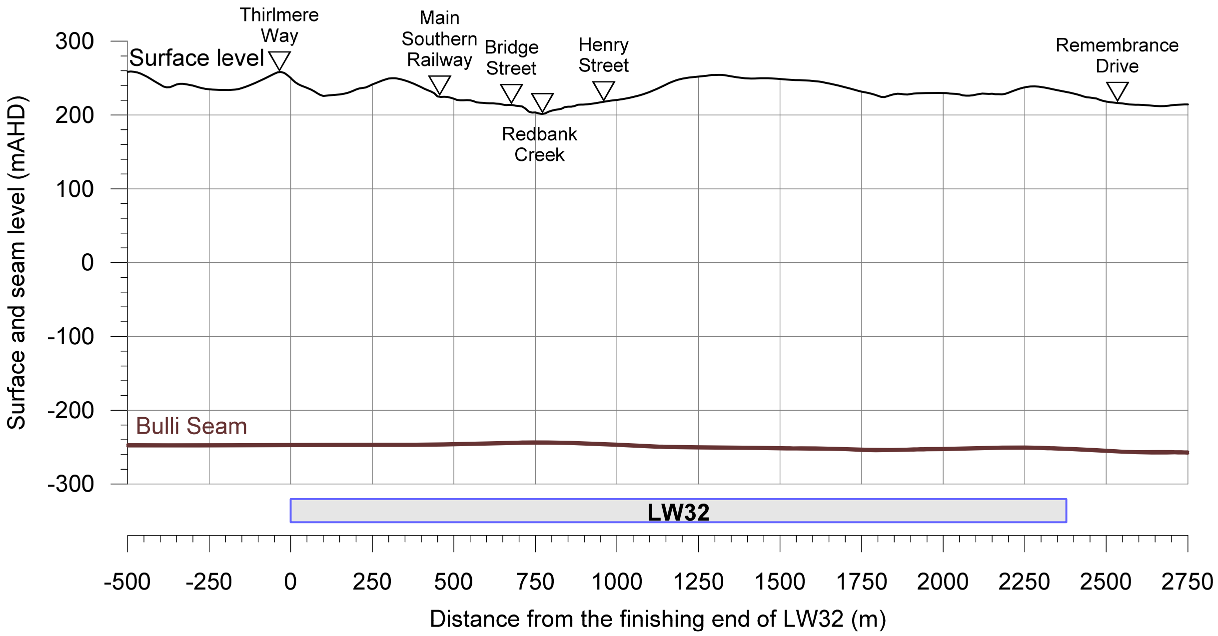


Fig. 1.1 Surface and seam levels along the centreline of Longwall 32

The depth of cover to the Bulli Seam, directly above Longwall 32, varies between a minimum of 440 m along Redbank Creek and a maximum of 510 m near the middle of the longwall. There are small ridgelines located near the longwall commencing and finishing ends where the depths of cover are up to 505 m. The longwall will mine a constant height of 2.2 m.

This Management Plan is an update of previous management plans, taking into account the experiences gained during the mining of Longwalls 22 to 31. The plan provides detailed information about how the risks associated with the mining of Longwall 32 beneath structures will be managed by Tahmoor Coking Coal Operations. 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 building structures and infrastructure. Public safety is paramount. Ensure that the health and safety of people who may be present in structures are not put at risk due to mine subsidence;
- disruption and inconvenience should be avoided or, if unavoidable, kept to minimal levels;
- monitor ground movements and the conditions of the building structures and associated infrastructure during mining;
- establish procedures to measure, monitor, control, mitigate and repair building structures and associated infrastructure;
- initiate and coordinate action to mitigate or remedy potential significant impacts that are expected to occur to the building structures;
- provide a plan of action in the event that the impacts of mine subsidence are greater than those that are predicted;
- establish a clearly defined decision-making process to ensure timely implementation of risk control measures for high consequence but low likelihood mine subsidence induced hazards that involve potential serious injury or illness to a person or persons at the properties that may require emergency evacuation, entry restriction or suspension of work activities;
- provide a forum to report, discuss and record impacts to the surface. This will involve Tahmoor Coking Coal Operations, the affected landowner and/or resident, relevant government agencies and consultants, as required; and
- establish lines of communication and emergency contacts.

1.3. Scope

The Management Plan is to be used to protect and monitor the condition of structures identified such that the health and safety of people who may be present at structures are not put at risk due to mine subsidence. The major items at risk are:

- residential establishments;
- non-residential structures;
- public amenities; and
- commercial and business establishments.

The locations of the structures near Longwall 32 are shown in Drawing No. MSEC945-12-01, in Appendix A.

This Management Plan describes measures that will be undertaken due to the mining Longwall 32 only. The plan will be updated later for future longwalls at Tahmoor Coking Coal Operations.

Separate management plans have been or will be developed for the following structures:

- structures owned by owners of services infrastructure, such as bridges, culverts and sewage pumping stations;
- commercial and business establishments along Bridge Street, Redbank Place, Bollard Place, Henry Street and Wonga Road, in South Picton;
- structures within commercial nursery at No. 155 Stilton Lane, Picton;
- Wollondilly Emergency Control Centre for the Rural Fire Services and SES, Busy Bees Pre-School and Long Day Care Centre, Hishouse Church and Plymouth Brethren Christian Church;
- structures associated with the Picton High School;
- structures associated with the Picton Water Recycling Plant; and
- heritage structures at Koorana House, Mill Hill and the former Fairley Residence.

1.4. Limitations

The Management Plan is based on the predicted subsidence effects and assessed impacts on the building structures and associated infrastructure, as provided in Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018). The first report supported the Subsidence Management Plan (SMP) Application for Longwalls 31 to 37. The second report supported the Modification Application for Longwall 32 due to the shortened commencing end.

The predictions are based on the planned configuration of Longwall 32, as shown in Drawing No. MSEC945-12-01, along with the available geological information and data from numerous subsidence studies for longwalls previously mined in the area. The structures and infrastructure considered in this Management Plan have been identified from aerial photographs, site visits and from discussions between Tahmoor Coking Coal Operations and the property and business owners.

The impacts of mining on the building structures and associated infrastructure have been assessed in detail. However, it is recognised that the prediction and assessment of subsidence can be relied upon only to a certain extent. The limitations of the prediction and assessment of mine subsidence are discussed in Reports Nos. MSEC647 and MSEC969.

As discussed in these reports, there is a low probability that ground movements and their impacts could exceed the predictions and assessments. However, if these potentially higher impacts are considered prior to mining, they can be managed. This Management Plan will not necessarily prevent impacts from longwall mining but it will limit the impacts by establishing appropriate procedures that can be followed should evidence of increased impacts emerge.

1.5. Descriptions of the structures

The *Study Area* for this management plan has been defined as the surface area that is located within the predicted limit of vertical subsidence, taken as the predicted 20 mm subsidence contour due to the extraction of Longwall 32. The predicted 20 mm subsidence contour for Longwall 32 is shown in Drawing No. MSEC945-12-01, in Appendix A.

The building structures and associated infrastructure that are located within the Study Area include: houses, rural structures, commercial structures, public amenities and public utilities. A summary of the structures located within the Study Area for Longwall 32 is provided in Table 1.2.

Table 1.2 Structures located within the Study Area for Longwall 32

Type	Number of structures		
	Above Longwall 32	Outside Longwall 32	Total within the Study Area
Houses	11	103	114
Rural structures	33	307	340
Commercial structures	38	115	153
Public amenities	7	68	75
Public utilities	0	3	3
All structures	**89**	**596**	**685**

There is a total of 685 structures that are located within the Study Area, of which, 89 structures are located directly above Longwall 32.

1.6. Proposed mining schedule

Longwall 32 will be mined from the south-east towards the north-west. The current schedule of mining for this longwall is shown in Table 1.3.

Table 1.3 Schedule of mining for Longwall 32

Longwall	Start Date	Completion Date
Longwall 32	October 2018	October 2019

Please note the above Schedule is subject to change due to unforeseen impacts on mining progress. This Management Plan covers the mining of Longwall 32 and for sufficient time thereafter to allow for completion of subsidence effects.

1.7. 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 m in front of the longwall face to an area 450 m 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 m in front and 450 m behind the active longwall face, as shown by Fig. 1.2.

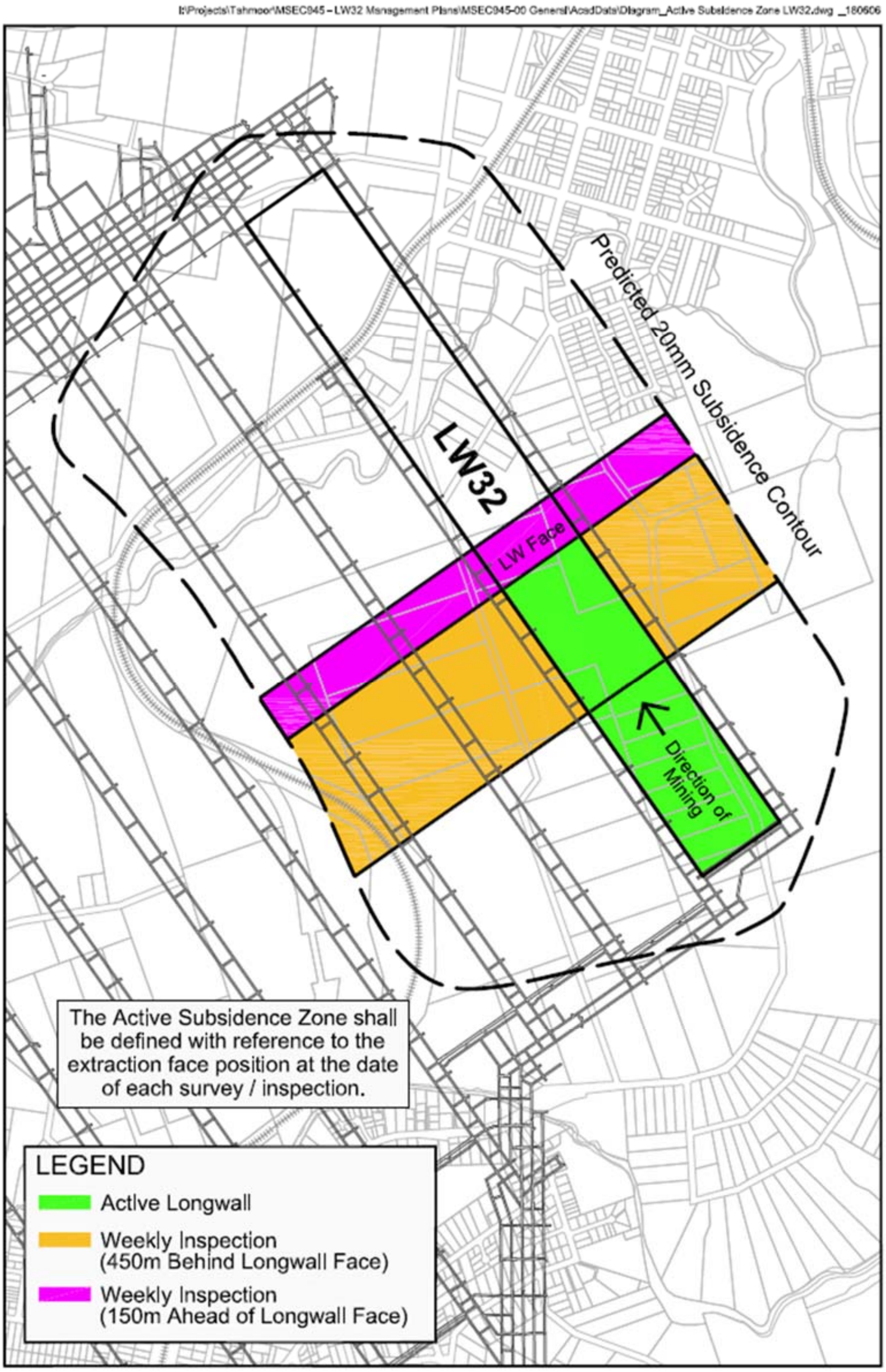


Fig. 1.2 Diagrammatic representation of the active subsidence zone

2.1. Maximum predicted conventional subsidence parameters

The predicted conventional subsidence effects (i.e. movements) for Longwall 32 were provided in Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018). The first report supported the Subsidence Management Plan (SMP) Application for Longwalls 31 to 37. The second report supported the Modification Application for Longwall 32 due to the shortened commencing end.

A summary of the maximum predicted conventional subsidence parameters is provided in Table 2.1. The incremental values represent the maximum predicted additional movements due to the extraction of Longwall 32 only. The total values represent the maximum predicted accumulated movements anywhere within the general mining area due to the extraction of Longwalls 22 to 32.

Table 2.1 Maximum Predicted Conventional Subsidence Parameters due to the Extraction of Longwall 32

Longwall	Maximum predicted vertical subsidence (mm)	Maximum predicted tilt (mm/m)	Maximum predicted hogging curvature (1/km)	Maximum predicted sagging curvature (1/km)
Increment due to Longwall 32 only	700	5.5	0.06	0.12
Total after extraction of Longwalls 22 to 32	1225	6.0	0.09	0.13

The maximum predicted total vertical subsidence occurs above the previously extracted longwalls (i.e. it is not directly above Longwall 32). The maximum predicted total vertical subsidence directly above Longwall 32 is approximately 800 mm.

2.2. Observed subsidence during the mining of Longwalls 22 to 31

The extraction of longwalls at Tahmoor Coking Coal Operations has generally resulted in mine subsidence movements that were typical of those observed above other collieries in the Southern Coalfield of NSW at comparable depths of cover.

However, observed subsidence was greater than the predicted values over Longwalls 24A and the southern parts of Longwalls 25 to 27. Monitoring during the mining of Longwalls 28 to 31 has found that subsidence behaviour has returned to normal levels.

Ground surveys will continue to be undertaken above Longwall 32. The survey results will be checked against predictions to confirm whether subsidence continues to develop in a normal manner during the mining of Longwall 32.

2.3. Potential non-conventional ground movements associated with the Nepean Fault

2.3.1. Identification of geological structures

Longwall 32 will be extracted alongside the Nepean Fault, which is a well-known geological feature that is an extension of the Lapstone Monocline.

Tahmoor Coking Coal Operations commissioned an engineering geologist from Strata Control Technology (SCT, 2018a and 2018b) to undertake site inspections and mapping of the Nepean Fault. This work has provided detailed information on the nature and location of the Nepean Fault and second order geological structures associated with the fault.

The Nepean Fault is mapped as "*an en-echelon distribution of first order faults with major offsets. Ramps are developed between these en-echelon fault surfaces. Numerous first order north-south faults, each of limited extent, step across the area investigated.*" (SCT, 2018a).

SCT further advise that the fault is sub-vertical from surface to seam, based on site investigations and geological information gathered by Tahmoor Coking Coal Operations since 2014. The cross-section provided by SCT (2018a) has been reproduced in Fig. 2.1.

In addition to the mapped first order faults, SCT has mapped second order faults, which are described as "*mainly conjugate sets of strike slip faults and splay faults being observed between the en-echelon first order faults*." (SCT, 2018a).

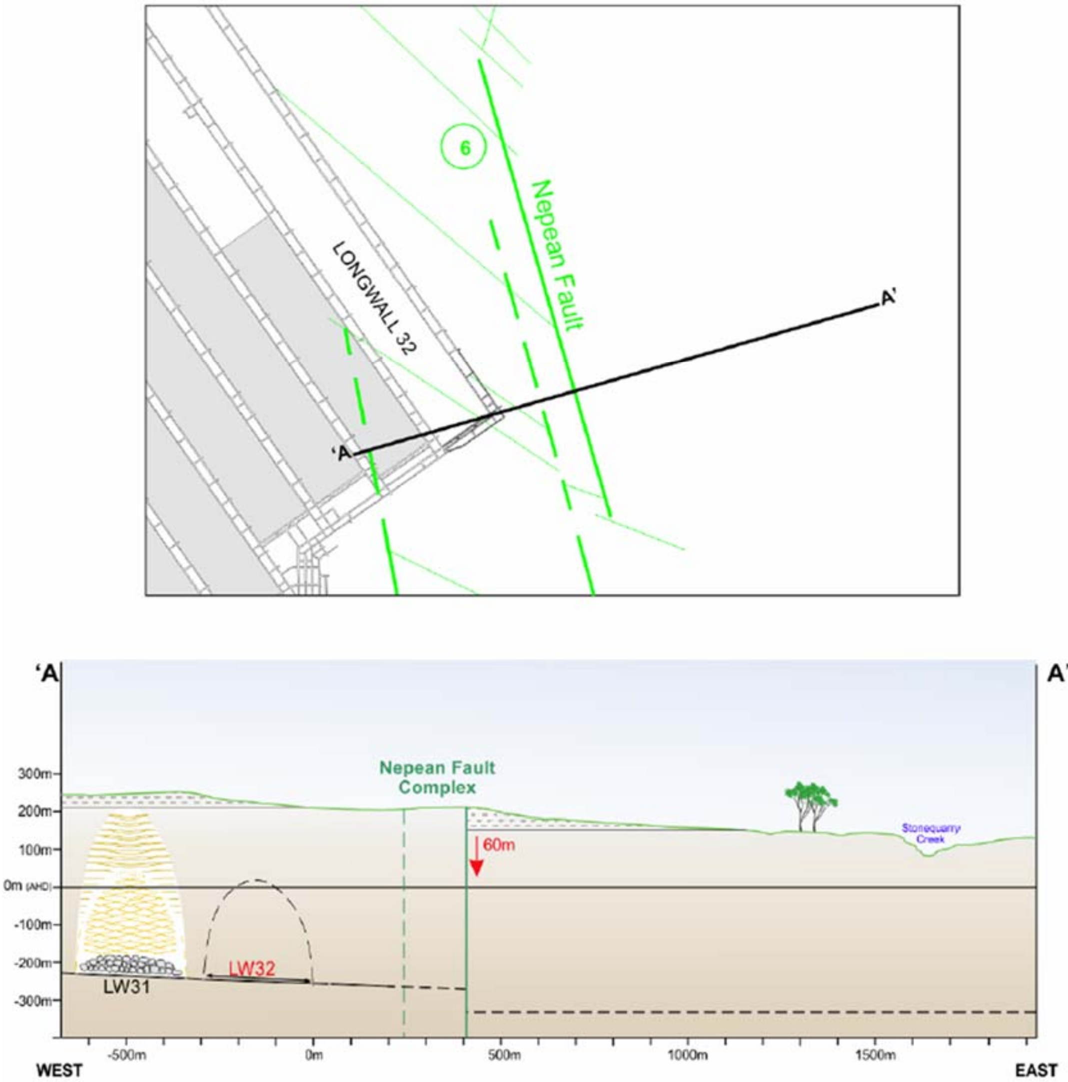


Fig. 2.1 Cross-section of Nepean Fault near Longwall 32 by SCT (2018a)

The geological structures as mapped by SCT (2018a) have been overlaid with built structures within and adjacent to Longwall 32. These are shown in Drawing No. MSEC945-12-01.

There are nine residential properties with built structures that are predicted to experience more than 20 mm of subsidence and are located above or close to mapped first order faults or second order conjugate faults.

In addition to the above, the mapped first order and second order conjugate faults intersect with structures at the Picton Water Recycling Plant, Picton High School, commercial and industrial properties on Remembrance Drive, Henry Street and Bollard Place, and a commercial nursery on Stilton Lane. Potential impacts at these sites are described in separate management plans.

2.3.2. Experience of subsidence movements between previously extracted longwalls and Nepean Fault at Tahmoor Coking Coal Operations

Tahmoor Coking Coal Operations has surveyed subsidence along many streets during the mining of previous Longwalls 24A to 31. Some of these monitoring lines are located over solid, unmined coal, between the extracted longwalls and the Nepean Fault.

None of the survey lines cross first order faults, though two survey lines (Stilton Dam Line and Remembrance Drive East Line) cross mapped second order conjugate faults.

A study has been completed to ascertain whether irregular subsidence have occurred along the survey lines. The information provides an indication of the likelihood of irregular movements during the extraction of Longwall 32.

The locations of the survey lines relative to the Nepean Fault and associated geological structures is shown in Fig. 2.2.

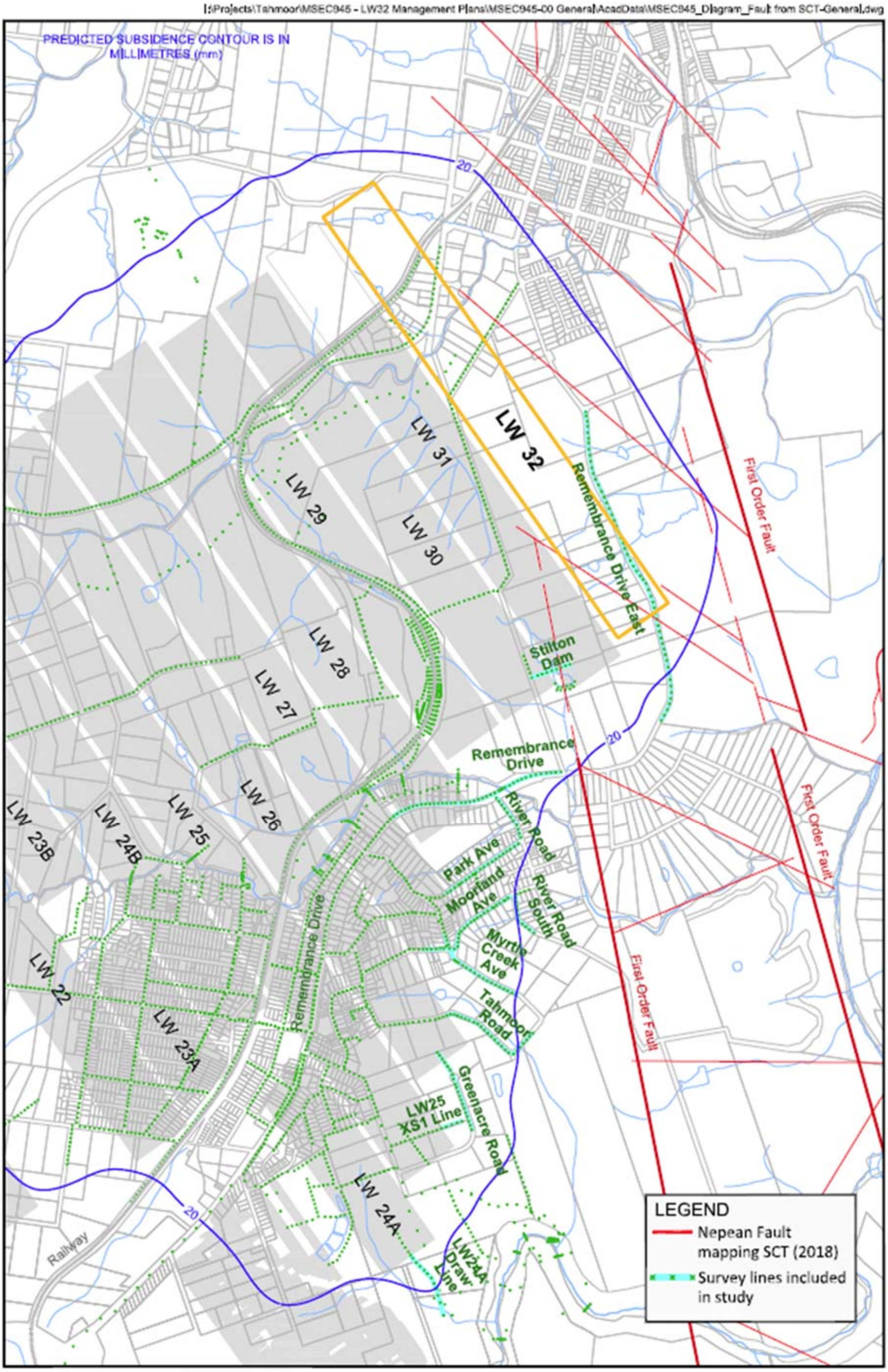


Fig. 2.2 Locations of ground survey lines in relation to the mapped geological structures by SCT (2018a)

The monitoring lines examined included.

- 900-Line, due to the extraction of LWs 12 and 13 (not shown in Fig. 2.2),
- LW24 Draw Line, due to the extraction of LWs 24A and 25
- LW25-XS1 Line, due to the extraction of LWs 25 and 26
- Greenacre Drive, due to the extraction of LWs 25 and 26
- Tahmoor Road Line, due to the extraction of LWs 25 to 27
- Myrtle Creek Avenue, due to the extraction of LWs 25 to 28
- Moorland Road, due to the extraction of LWs 25 to 28
- River Road South, due to the extraction of LWs 27 and 28
- Park Avenue, due to the extraction of LWs 25 to 28
- River Rd, due to the extraction of LWs 26 to 28
- Remembrance Drive, due to the extraction of LWs 24A to 30
- Remembrance Drive, due to the extraction of LWs 24A to 27
- Stilton Dam Northern Line, due to the extraction of LWs 29 to 31 (refer Fig. 2.5)
- Remembrance Drive East, due to the extraction of LW31 (refer Fig. 2.6)

The study found no increased subsidence, tilt or strains were measured along the survey lines that were located over unmined, solid coal areas between the extracted longwalls and the Nepean Fault.

A histogram of the maximum observed tensile and compressive strains measured along the selected survey lines for survey bays located over solid coal between previously extracted longwalls at Tahmoor and the Nepean Fault is provided in Fig. 2.3.

It can be seen from Fig. 2.3 that observed ground strains have been, on average, within survey tolerance. A pair of outlying data points are labelled in Fig. 2.3.

Pegs RE77 and RE78 are located within the base of Myrtle Creek, which is the main watercourse in the area. Whilst Myrtle Creek has experienced a small amount of valley closure at this location due to the mining of Longwalls 29 and 30, it can be seen from Fig. 2.4 that measured strains across the base of the Creek have varied greatly over time. The main reason for the variations is that the pegs are spaced only 3 metres apart, meaning that survey tolerance has a much greater influence on the measured result. Most survey bays in the Southern Coalfield are spaced apart by nominally 20 metres. The second reason is that variations have occurred after periods of heavy rainfall, where the pegs have been affected by swelling of the natural soils.

Pegs MD29 to MD30 appear to have been disturbed by construction works. The changes occurred after the completion of Longwall 26. The pegs, however, are located approximately 35 metres from the commencing end of Longwall 27, as shown in Fig. 2.4, but they experienced no changes during the mining of this longwall.

Notwithstanding these outliers, the statistics demonstrate that observed ground strains have been very small for survey pegs over solid coal, beyond the edges of the extracted longwalls at Tahmoor Coking Coal Operations.

Two survey lines (Stilton Dam Line and Remembrance Drive East Line) cross mapped second order conjugate faults. As shown in Fig. 2.5 and Fig. 2.6, observed subsidence, tilt and strain have been very low at these intersections. A very small bump was, however, observed along the Remembrance Drive East Line approximately 20 metres from the intersection point. Ground strains remained within survey tolerance at this location.

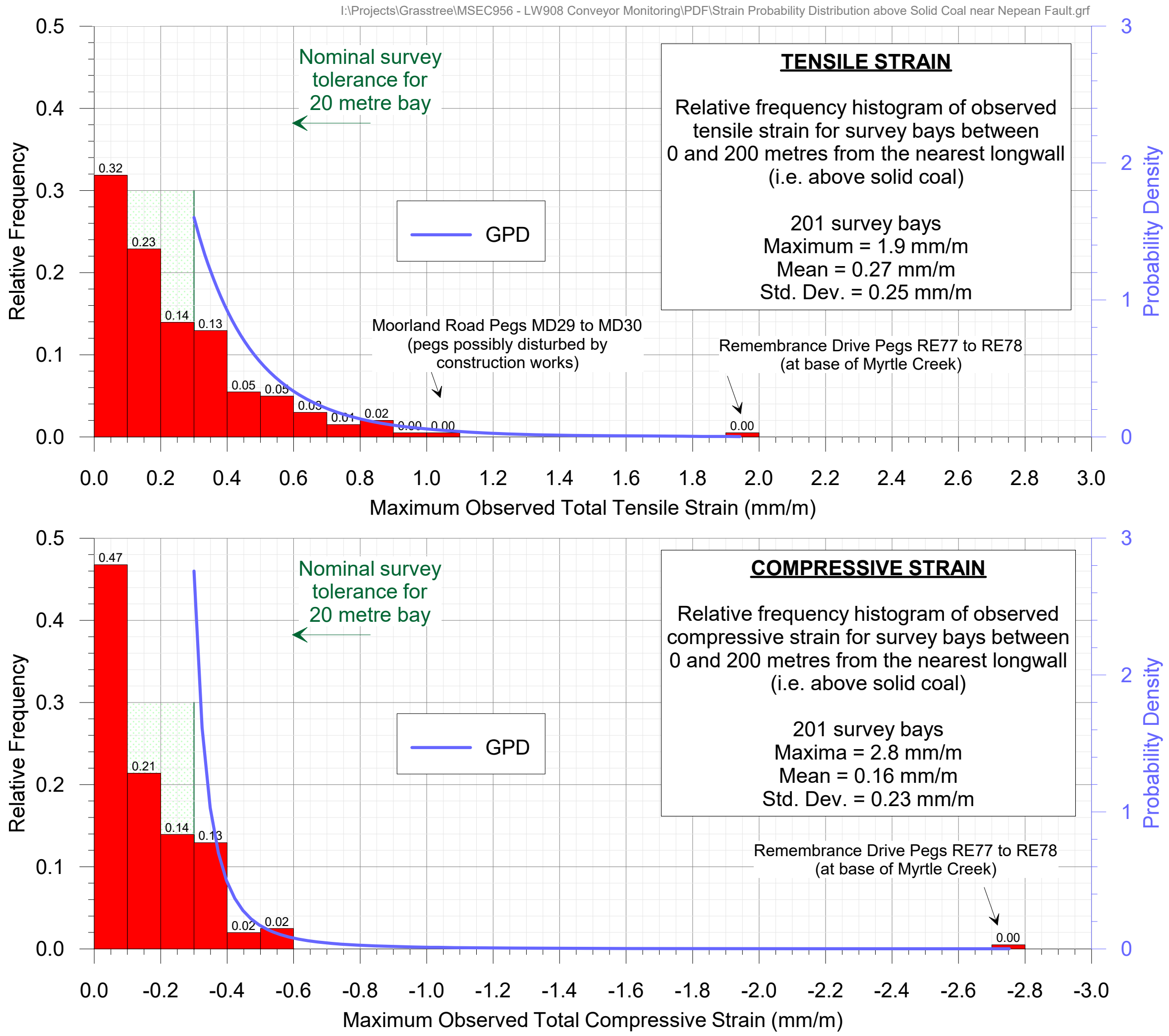


Fig. 2.3 **Distributions of the Measured Maximum Tensile and Compressive Strains for Bays Located over Solid Coal between previously extracted longwalls at Tahmoor Coking Coal Operations and the Nepean Fault**

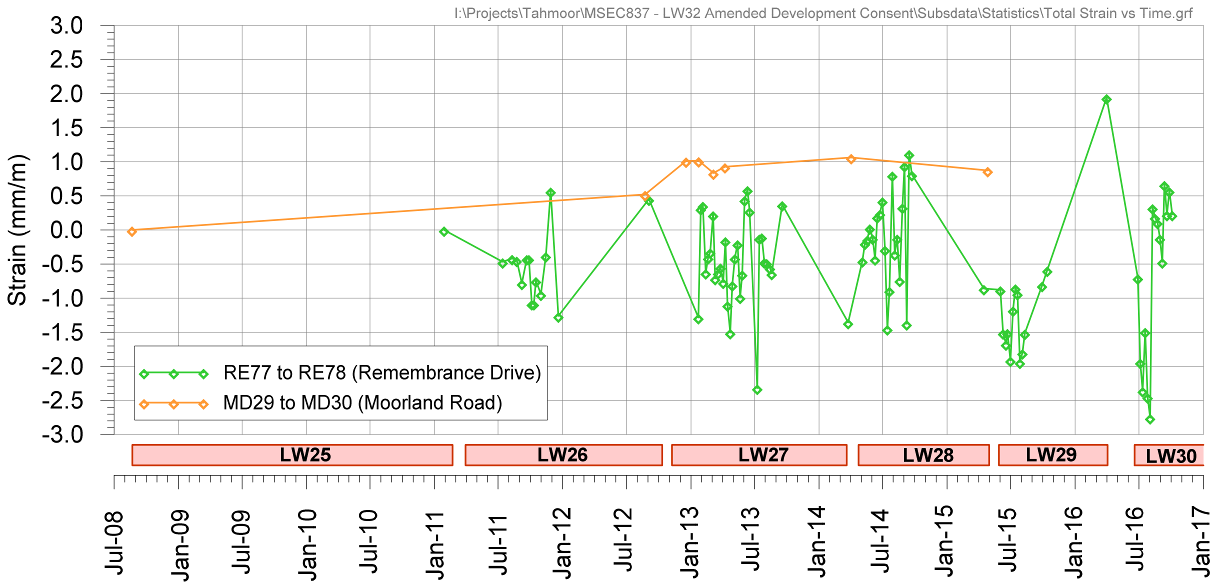


Fig. 2.4 **Observed ground strains at selected sites during the mining of Longwalls 25 to 30**

Tahmoor Colliery
Relative 3D surveys along Stilton Northern Dam Line
Total profiles during LW31

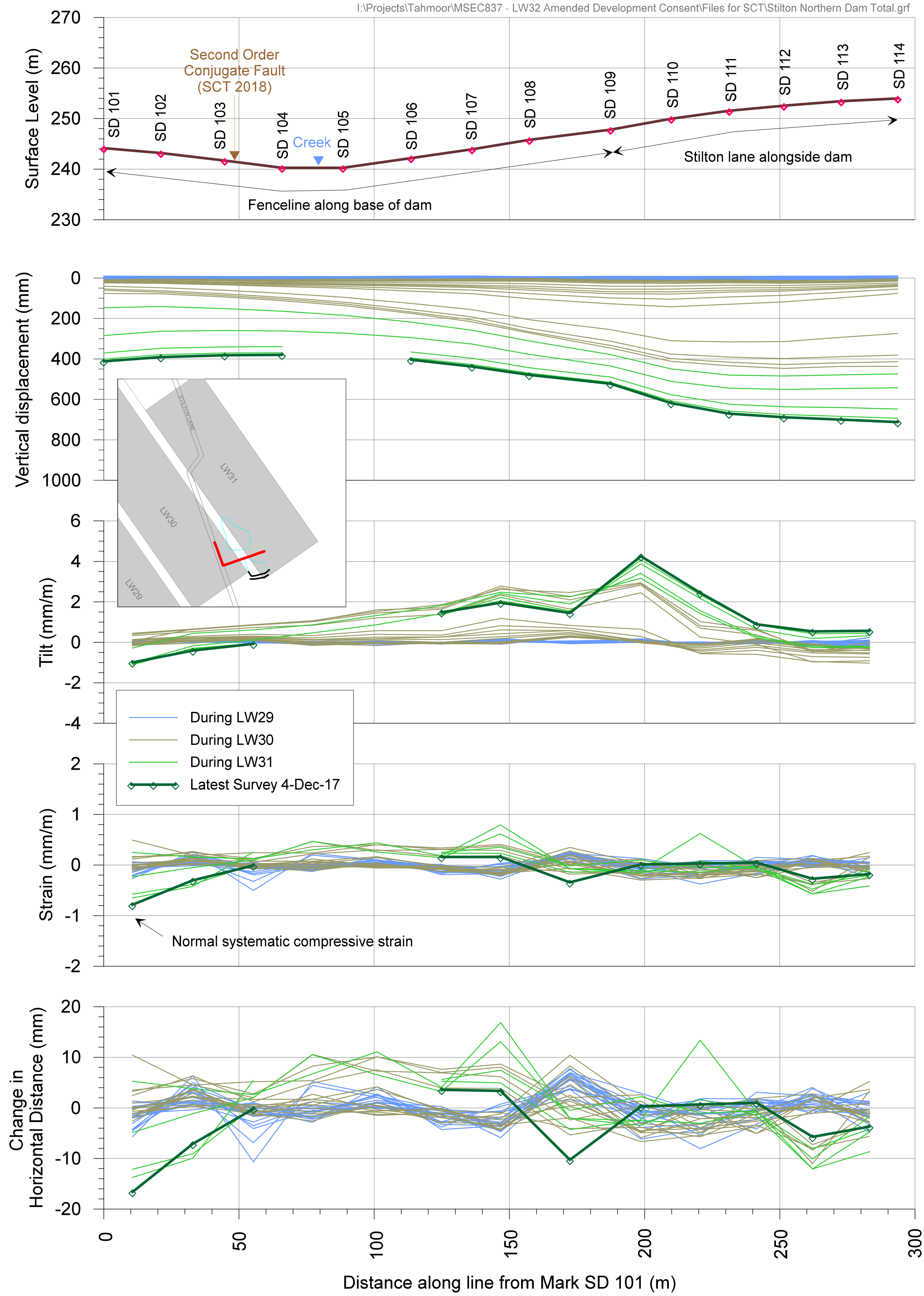


Fig. 2.5 **Observed total subsidence profiles along the Stilton Northern Dam Line during the mining of Longwalls 29 to 31**

Tahmoor Colliery - Longwall 31
Incremental Subsidence Profiles along Remembrance Drive East

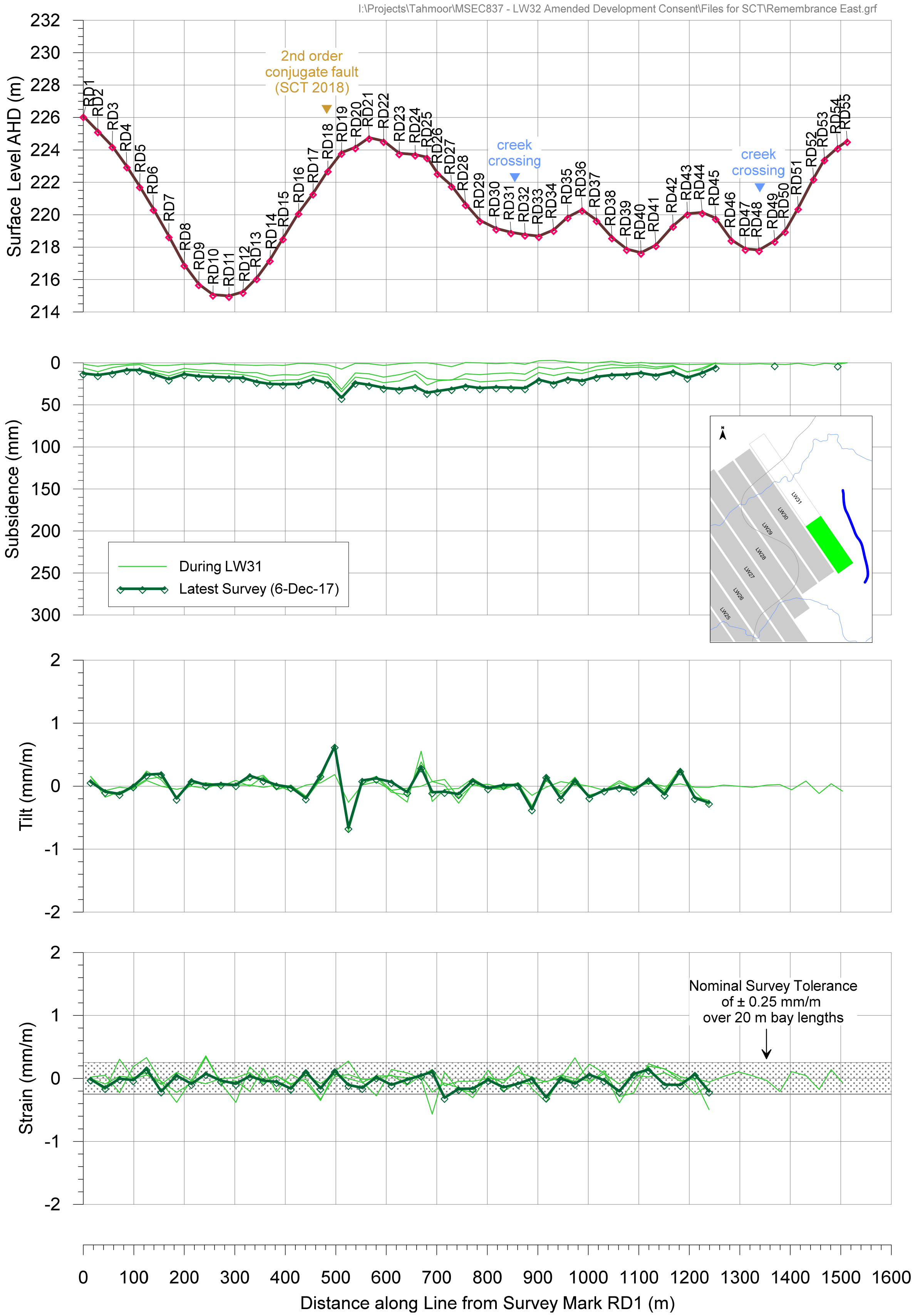


Fig. 2.6 Observed total subsidence profiles along the Remembrance Drive East Line during the mining of Longwall 31

2.3.3. Potential effects of geological structures on the development of subsidence at built structures during the extraction of Longwall 32

SCT (2018b) has undertaken a thorough and systematic review of subsidence outcomes that could reasonably be considered to be potentially significant. The following potential outcomes were investigated:

1. *"The potential for greater than predicted (abnormal) subsidence over the LW32 panel to cause greater subsidence beyond the panel edges.*
2. *The potential for unconventional subsidence movements occurring beyond the edge of LW32, including at or across the Nepean Fault.*
3. *The potential for mining-induced stress changes near the Nepean Fault to cause the fault plane to be mobilised.*
4. *The potential for movements that might occur quickly than conventional subsidence because of the presence of the fault and increase normal mining induced micro-seismic activity due to the isolating effect of the fault."*

SCT (2018b) concluded that "*none of the potential outcomes could reasonably be considered to have potential to be significant*". The conclusion is based on the following reasons (SCT, 2018b):

- The mapped planes of the first order Nepean Fault are remote from Longwall 32. Any differential vertical movement that may occur at the location of the Nepean Fault would be limited to less than a few tens of millimetres.
- Whilst increased subsidence was previously observed above the commencing ends of Longwalls 24A to 28, increased subsidence was not observed beyond the panel edges. Recent observations, including those during the mining of Longwall 31 indicate that subsidence has returned to normal levels.
- The Nepean Fault and associated fault structures are mapped as being sub-vertical. The geological structures that are recognised to be associated with unconventional subsidence are typically sub-horizontal i.e. bedding planes.
- Whilst mining induced stress changes are expected to occur on the fault because of longwall mining, they are not of a nature that would allow the fault plan to be destabilised and slip. This is because the stresses acting on the fault plane are not such that the fault is in limiting equilibrium, i.e. on the verge of instability.
- The high stresses and absence of massive strata in the Southern Coalfield of NSW mean that fracturing and downward movement occurs gradually and incrementally as the longwall retreats. Micro-seismic activity occurs regularly and so has low magnitude.

The conclusions by SCT (2018b) are supported by the results of the subsidence studies at Tahmoor Coking Coal Operations, as described in Section 2.3.2.

SCT (2018b) also advises that "*unconventional subsidence unrelated to the Nepean Fault may occur within the subject area during mining of LW32. Unconventional subsidence movements are observed at Tahmoor from time to time and therefore, may occur within the subject area*." MSEC concurs with this view, noting that the observed frequency of impacts beyond the edges of the longwalls have been infrequent and have been relatively slight in nature.

A map showing the locations of residential structures, and reported impacts after the mining of Longwall 31 and the mapped Nepean Fault by SCT (2018a) is shown in Fig. 2.7. It can be seen that very few impacts have occurred beyond the panel edges, including in locations between the extracted longwalls and the Nepean Fault.

Whilst the potential for significant differential movements is considered to be relatively low beyond the edges of Longwall 32, it is possible, however, that significant differential movements could occur at sites located directly above Longwall 32, including where second order geological structures associated with the Nepean Fault have been identified. Whilst no impacts have been observed at the Stilton Lane dam site in Fig. 2.5, differential movements have been observed where other geological structures have intersected the surface.

The experience from the mining of Longwall 31 has found that no structures located directly above the mapped faults have experienced impacts. One house that is located approximately 50 metres from a mapped first order fault has experienced significant impacts during the mining of Longwall 31, which mined directly beneath it. The impacts include damage to brickwork to the northern wing of the main dwelling, and impacts on the swimming pool, pool gate, paved areas, driveway, rear gardens, garden walls at the rear pergola support piers. The house has likely experienced non-conventional subsidence movements based on floor levels measured around the house. The cause of the non-conventional movements is not known.

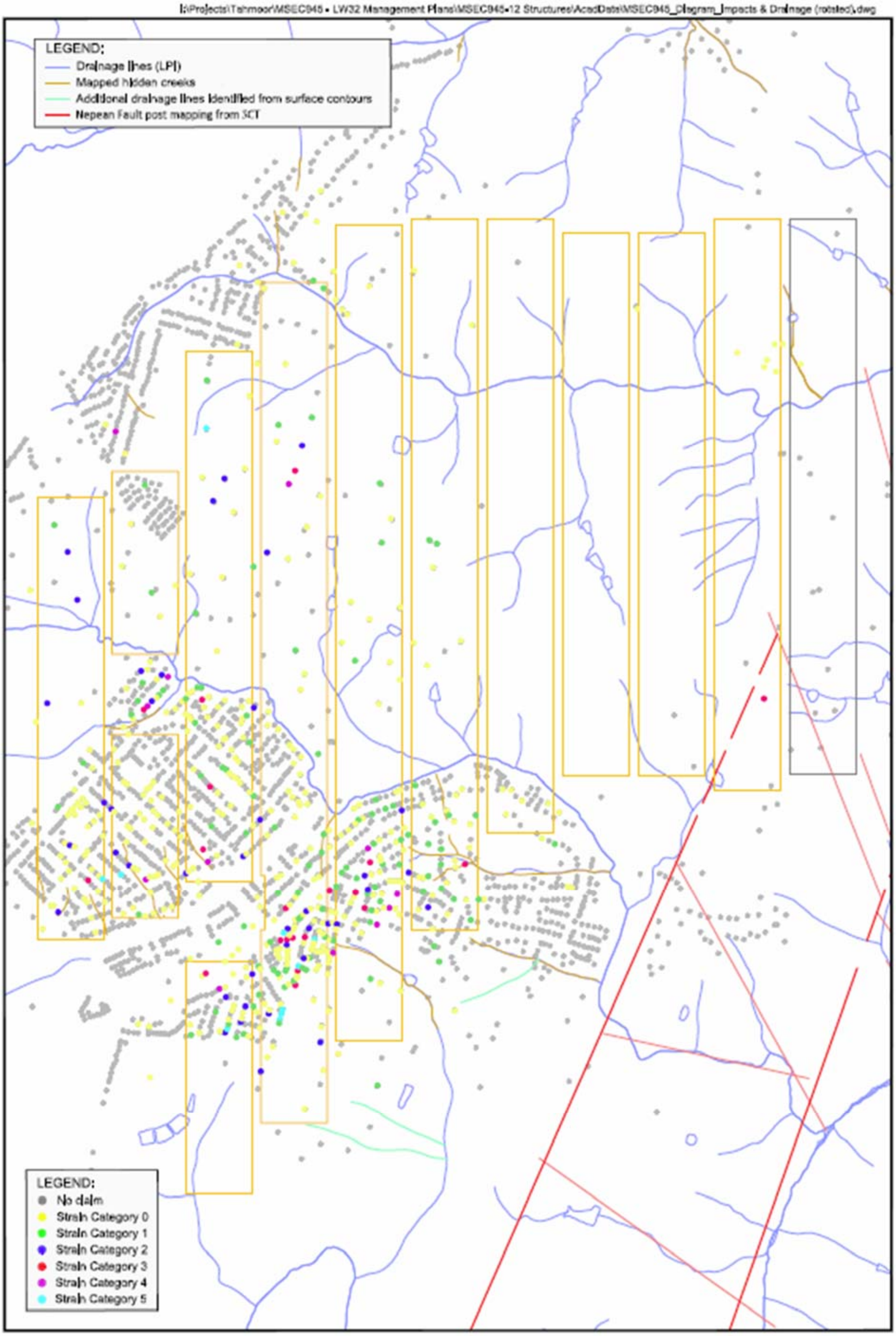


Fig. 2.7 Observed Impacts to Structures at Tahmoor Colliery, overlaid with mapped geological structures by SCT (2018a) and creeks

2.4. Potential non-conventional ground movements on structures located above hidden creeks

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.

Houses above hidden creeks are considered to have a greater chance of experiencing non-conventional upsidence and closure movements during mining. When tested against observations during the mining of Longwalls 22 to 31, however, no clear increase in frequency of impact is observed.

A total of 52 houses above hidden creeks have experienced subsidence during the mining of Longwalls 22 to 27 and 22 houses have experienced impacts, including five houses directly above Longwall 27. 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 42 % 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. Furthermore, the majority of impacts occurred at houses that were located directly above the extracted longwalls, rather than beyond the panel edges.

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.

Three hidden creeks have been identified within the area of influence of Longwall 32. The creeks are located near Redbank Place, Rumker Street and Coachwood Crescent.

The hidden creek near Redbank Place passes beneath four commercial and industrial buildings and is located directly above Longwall 32. Whilst no valley closure was observed across the creek during the mining of Longwall 31, some minor impacts were observed to concrete pavements. Separate management plans have been developed for these properties.

A watercourse carries surface water beneath the Main Southern Railway near the end of Rumker Street. The watercourse flows alongside Bridge Street before it crosses the road and joins Redbank Creek. One house at the end of Rumker Street may have been constructed partly on the side of this creek. The house is located more than 200 metres to the side of Longwall 32 and will not be directly mined beneath.

A buried creek is situated in a broad valley on Coachwood Crescent, with an estimated depth of approximately 5 metres. The creek is located beneath houses in Coachwood Crescent, the closest of which is approximately 390 metres from the side of Longwall 32. Predictions of subsidence, tilt, curvature, valley closure and upsidence along the buried creek is provided in Fig. 2.8. The predicted valley closure is very low due to the offset distance of the creek to Longwall 32 and the relatively shallow valley depth. While the predicted movements are low, there remains a possibility that unconventional, valley closure related differential movements may occur.

The survey study described in Section 2.3.2 also identified locations where survey lines crossed drainage lines, including hidden creeks at similar offset distances to longwalls as the buried creeks at Rumker Street and Coachwood Crescent. These include the Myrtle Creek Avenue Line, the River Road South Line and the Remembrance Drive East Line (Fig. 2.6). Valley closure and upsidence movements were not observed at these locations during the mining of previous longwalls.

The map of impacted structures, which was shown in Fig. 2.7, included mapped locations of creeks, including hidden creeks beyond the edges of the longwall panels. It can be seen that many houses are located near other creeks, particularly near Longwalls 27 and 28. Houses have remained safe and serviceable during and after mining in these areas, with a low frequency of minor impacts.

Notwithstanding the above, it is possible that unconventional subsidence could occur due to the geological complexities indicated by the presence of the buried creek. With the implementation of a robust subsidence management plan, unconventional subsidence movements and associated impacts can be detected at an early stage in their gradual development, allowing sufficient time to respond before they might develop into a severe impact.

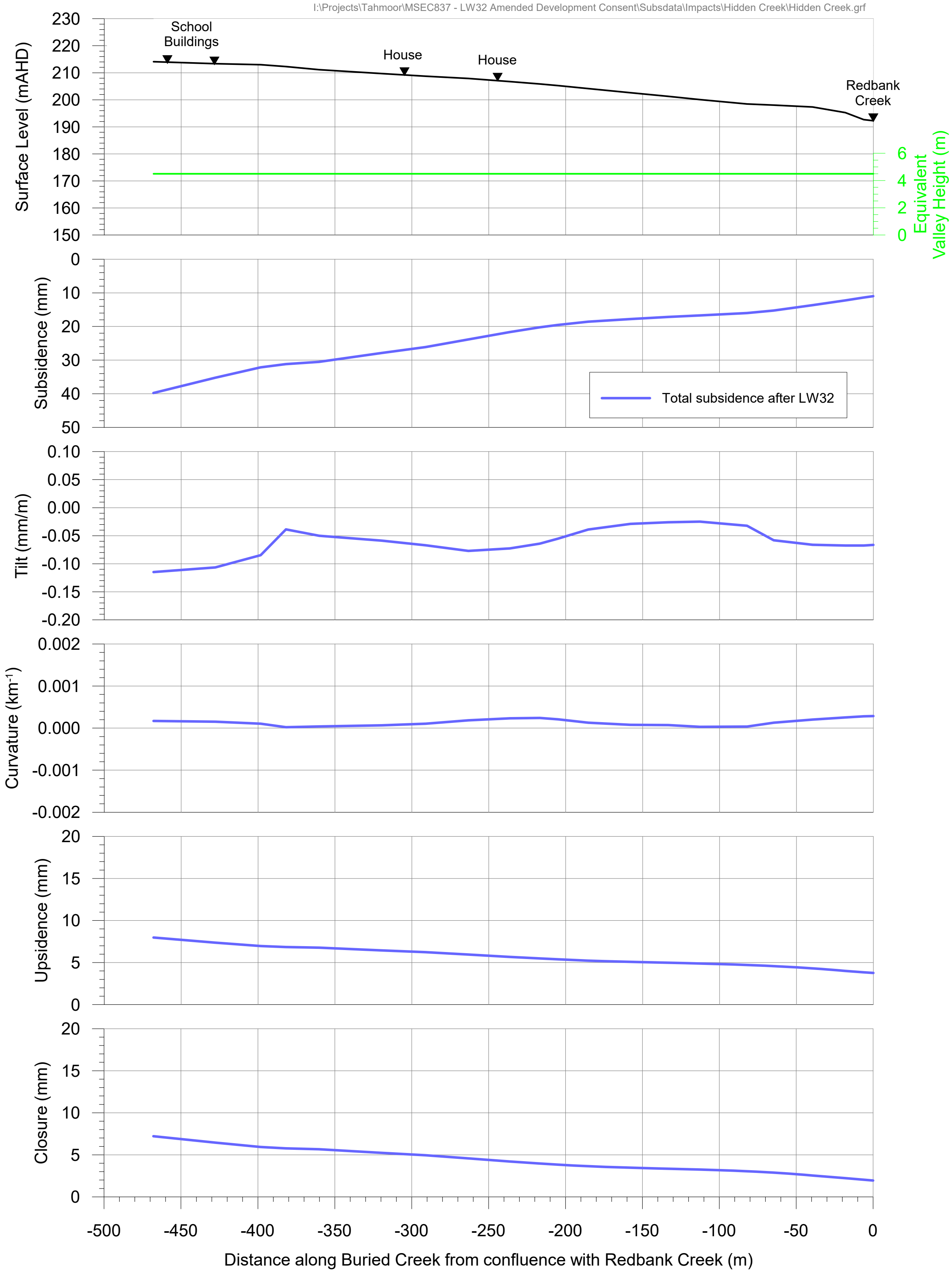


Fig. 2.8 Predicted subsidence profiles along buried creek within and downstream of Coachwood Crescent

2.5. Predicted strain

The prediction of strain is more difficult than the predictions of subsidence, tilt and curvature. The reason for this is that strain is affected by many factors, including curvature and horizontal movement, as well as local variations in the near surface geology, the locations of pre-existing natural joints at bedrock, and the depth of bedrock. Survey tolerance can also represent a substantial portion of the measured strain, in cases where the strains are of a low order of magnitude. The profiles of measured strain, therefore, can be irregular even when the profiles of measured subsidence, tilt and curvature are relatively smooth.

In previous MSEC subsidence reports, predictions of conventional strain were provided based on the best estimate of the average relationship between curvature and strain. Similar relationships have been proposed by other authors. The reliability of the strain predictions was highlighted in these reports, where it was stated that measured strains can vary considerably from the predicted conventional values.

Adopting a linear relationship between curvature and strain provides a reasonable prediction for the conventional tensile and compressive strains. The locations that are predicted to experience hogging or convex curvature are expected to be net tensile strain zones and locations that are predicted to experience sagging or concave curvature are expected to be net compressive strain zones. In the Southern Coalfield, it has been found that a factor of 15 provides a reasonable relationship between the maximum predicted curvatures and the maximum predicted conventional strains.

At a point, however, there can be considerable variation from the linear relationship, resulting from non-conventional movements or from the normal scatters which are observed in strain profiles. When expressed as a percentage, observed strains can be many times greater than the predicted conventional strain for low magnitudes of curvature. In this report, therefore, we have provided a statistical approach to account for the variability, instead of just providing a single predicted conventional strain.

The data used in an analysis of measured strains included those resulting from both conventional and non-conventional anomalous movements but did not include those resulting from valley related movements, which are addressed separately in this management plan. The strains resulting from damaged or disturbed survey marks have also been excluded.

A number of probability distribution functions were fitted to the empirical data. It was found that a *Generalised Pareto Distribution (GPD)* provided a good fit to the raw strain data. Confidence levels have been determined from the empirical strain data using the fitted GPDs. In the cases where survey bays were measured multiple times during a longwall extraction, the maximum tensile strain and the maximum compressive strain were used in the analysis (i.e. single tensile strain and single compressive strain measurement per survey bay).

For features that are in discrete locations, such as building structures, it is appropriate to assess the frequency of the measured maximum strains for individual survey bays.

2.5.1. Predictions of strain above goaf

The survey database has been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of Longwalls 22 to 28 at Tahmoor Coking Coal Operations, for survey bays that were located directly above goaf or the chain pillars that are located between the extracted longwalls, which has been referred to as "*above goaf*".

The histogram of the maximum observed total tensile and compressive strains measured in survey bays above goaf at Tahmoor Coking Coal Operations is provided in Fig. 2.9. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

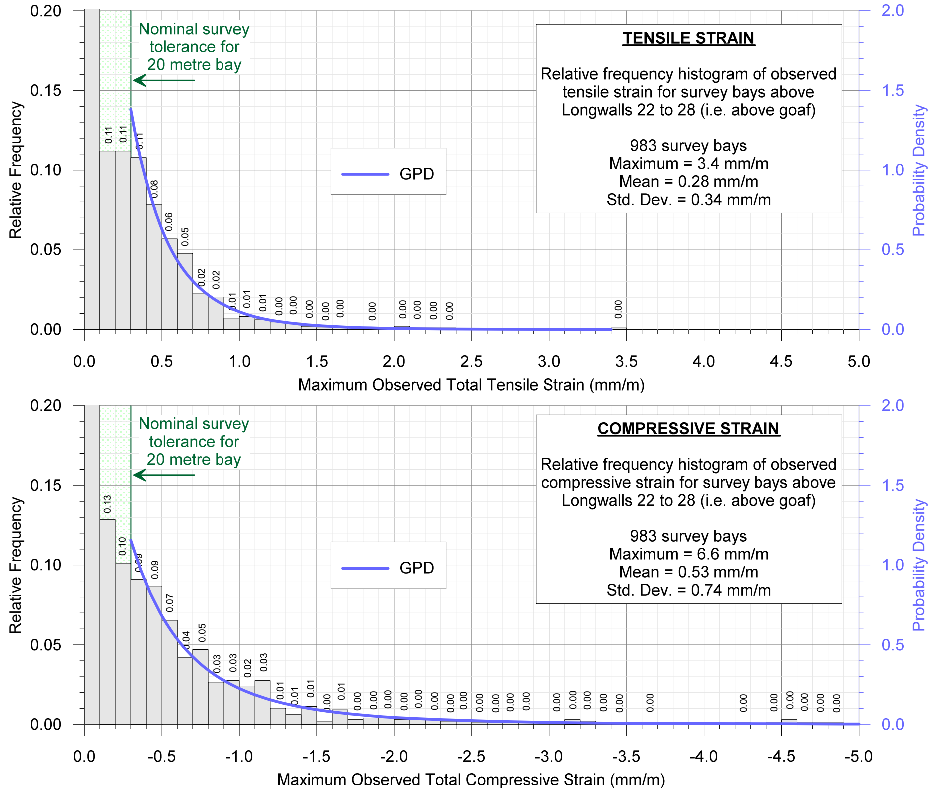


Fig. 2.9 Distributions of the measured maximum tensile and compressive strains for surveys bays located above goaf

The 95 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining are 0.9 mm/m tensile and 1.8 mm/m compressive. The 99 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining are 1.5 mm/m tensile and 3.5 mm/m compressive.

2.5.2. Predictions of strain above solid coal

The survey database has also been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of Longwalls 22 to 28 at Tahmoor Coking Coal Operations, for survey bays that were located outside and within 200 m of the nearest longwall goaf edge, which has been referred to as "*above solid coal*".

The histogram of the maximum observed tensile and compressive strains measured in survey bays above solid coal at Tahmoor Coking Coal Operations is provided in Fig. 2.10. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

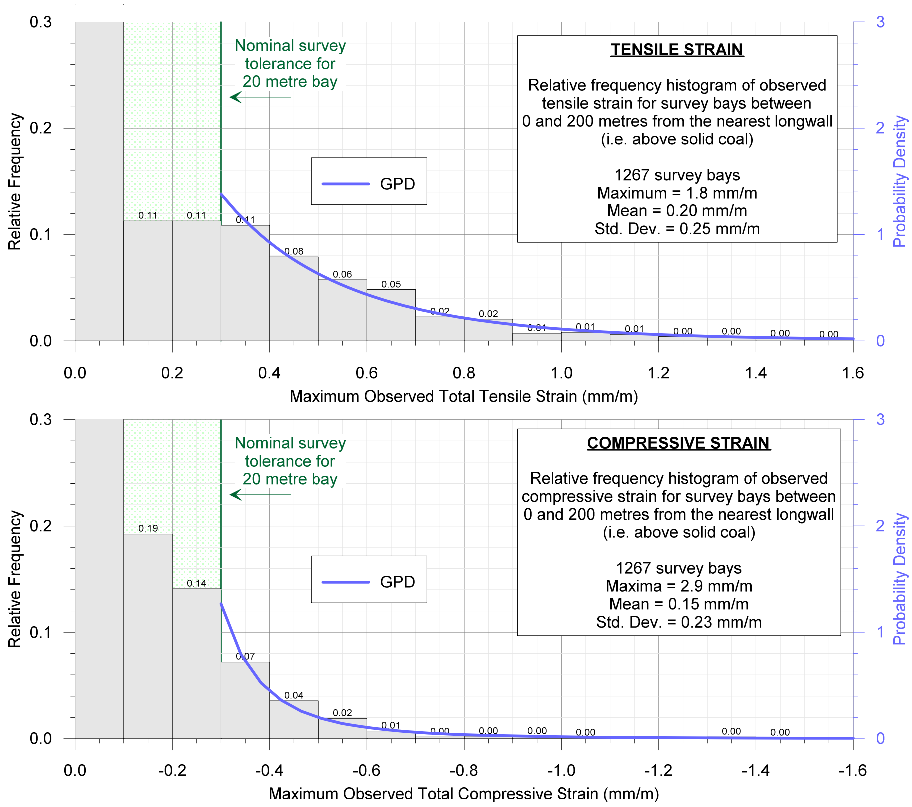


Fig. 2.10 Distributions of the measured maximum tensile and compressive strains for survey bays located above solid coal

The 95 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining are 0.6 mm/m tensile and 0.5 mm/m compressive. The 99 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining are 1.1 mm/m tensile and 0.9 mm/m compressive.

3.1. NSW Work Health and Safety Legislation

All persons conducting a business or undertaking (PCBUs), including mine operators and contractors, have a primary duty of care to ensure the health and safety of workers they engage, or whose work activities they influence or direct. The responsibilities are legislated in *Work Health and Safety Act 2011* and the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and associated Regulations (collectively referred to as the 'WHS laws').

The *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* commenced on 1 February 2015 and contains specific regulations in relation to mine subsidence.

As outlined in the Guide by the NSW Department of Trade & Investment Mine Safety:

"a PCBU must manage risks to health and safety associated with mining operations at the mine by:

- *complying with any specific requirements under the WHS laws*
- *identifying reasonably foreseeable hazards that could give rise to health and safety risks*
- *ensuring that a competent person assesses the risk*
- *eliminating risks to health and safety so far as is reasonably practicable*
- *minimising risks so far as is reasonably practicable by applying the hierarchy of control measures, any risks that it is are not reasonably practical to eliminate*
- *maintaining control measures*
- *reviewing control measures*

The mine operator's responsibilities include developing and implementing a safety management system that is used as the primary means of ensuring, so far as is reasonably practicable:

- *the health and safety of workers at the mine, and*
- *that the health and safety of other people is not put at risk from the mine or work carried out as part of mining operations."*

Detailed guidelines have also been released by the NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations (MSO, 2017).

The risk management process has been carried out in accordance with guidelines published by the NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations (MSO, 2017). The following main steps of subsidence risk management have been and will be undertaken, in accordance with the guidelines.

1. identification and understanding of subsidence hazards;
2. assessment of risks of subsidence;
3. development and selection of risk control measures;
4. implementation and maintenance of risk control measures; and
5. continual improvement and change management.

Each of the above steps have been or will be conducted together with the following processes.

1. consultation, co-operation and co-ordination; and
2. monitoring and review.

This Management Plan documents the risk control measures that are planned to manage risks to health and safety associated with the mining of Longwall 32 directly beneath and adjacent to structures in accordance with the WHS laws.

3.2. General

The method of assessing potential mine subsidence impacts in the Management Plan is consistent with the Australian/New Zealand Standard for Risk Management. The Standard defines the terms used in the risk management process, which includes the identification, analysis, assessment, treatment and monitoring of potential mine subsidence impacts. In this context:

3.2.1. 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.

3.2.2. Likelihood

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

3.2.3. Hazard

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

3.2.4. Method of assessment of potential mine subsidence impacts

The method of assessing potential mine subsidence impacts combines the likelihood of an impact occurring with the consequence of the impact occurring. In this Management Plan, the likelihood and consequence are combined via the Glencore Risk Matrix to determine an estimated level of risk for particular events or situations. A copy of the Risk Matrix is included in the Appendix of this Management Plan.

[1] AS/NZS 4360:2004 – Risk Management pp2
[2] AS/NZS 4360:2004 – Risk Management pp2
[3] AS/NZS 4360:2004 – Risk Management pp2

4.1. Predicted subsidence effects for the structures

The predicted conventional subsidence effects (i.e. movements) for Longwall 32 were provided in Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018). The first report supported the Subsidence Management Plan (SMP) Application for Longwalls 31 to 37. The second report supported the Modification Application for Longwall 32 due to the shortened commencing end.

A summary of the maximum predicted incremental subsidence parameters due to the extraction of Longwall 32 only and the maximum predicted total conventional subsidence parameters due to the extraction of Longwalls 22 to 32, are provided in Table 4.1.

Table 4.1 Maximum Predicted Conventional Subsidence Parameters due to the Extraction of Longwall 32

Longwall	Maximum Predicted Subsidence (mm)	Maximum Predicted Tilt (mm/m)	Maximum Predicted Hogging Curvature (1/km)	Maximum Predicted Sagging Curvature (1/km)
Increment due to LW32 only	700	5.5	0.06	0.12
Total after extraction of LWs 22 to 32	1,225	6.0	0.09	0.13

The maximum predicted total tilt is 6.0 mm/m (i.e. 0.6 %, or 1 in 167). The maximum predicted curvatures for these structures are 0.09 km^{-1} hogging and 0.13 km^{-1} sagging, which represent minimum radii of curvature of 11 km and 8 km, respectively.

The predicted distributions of strain for the 132 structures (including 14 houses) that are located directly above the longwalls are provided in Section 2.5.1. The 95 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining are 0.9 mm/m tensile and 1.8 mm/m compressive.

There are approximately 828 structures that are located predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. The majority of these structures (a total of 696) are located to the side of Longwall 32. These structures are predicted to experience lower levels of movement compared to the maximum predicted values provided in Section 2.5.1.

The maximum predicted total tilt for the structures located outside of the mining area is 3.0 mm/m (i.e. 0.3 %, or 1 in 333). The maximum predicted curvatures for these structures are 0.04 km^{-1} hogging and 0.02 km^{-1} sagging, which represent minimum radii of curvature of 25 km and 50 km, respectively.

The predicted distributions of strain for the structures that are located outside the extents of the longwalls are provided in Section 2.5.2. The 95 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining are 0.6 mm/m tensile and 0.5 mm/m compressive.

5.1. Experience of mining beneath structures

There is extensive experience of mining beneath building structures at Tahmoor Coking Coal Operations, as well as other mines elsewhere in the Southern Coalfield.

A total of 1955 houses, public amenities and commercial and business establishments have experienced subsidence movements, at the Tahmoor Coking Coal Operations, during the mining of Longwalls 22 to 30. The following observations have been made based on this experience of mining beneath building structures in the Southern Coalfield:

- mine subsidence has not directly exposed residents to any immediate or sudden safety hazards;
- Subsidence Advisory NSW (SA NSW) had received 547 claims from individual properties (not including refused claims), at the completion of Longwall 30, of which, 489 claims included impacts to main structures. The remaining 58 claims relate solely to damage to small improvements such as swimming pools, sheds and pavements;
- the overall claim rate at the completion of Longwall 30 is 489 out of 1955 main structures, or 25 %. In other words, no impacts have been reported for 75 % of the main structures;
- the rate of impact for structures located directly above the longwalls is greater than that based on all structures located within the predicted limit of vertical subsidence. There are 1190 houses, commercial and business establishments and public amenities located directly above Longwalls 22 to 27 (or the pillars between them). A total of 385 claims have been made from this subset, which represents a claim rate of 32 % for structures that are located above goaf;
- the rate of impact for structures located outside the mining area is less. There are 352 houses, commercial and business establishments and public amenities located outside of Longwalls 22 to 27 but within the predicted limit of vertical subsidence. A total of 48 claims have been made from this subset, which represents a claim rate of 14 % for structures that are located above solid coal; and
- the majority of impacts are considered very slight to slight (i.e. Categories R0 to R2) and consist of sticky doors and minor impacts to internal walls, ceilings or floor finishes. However, 2.5 % of impacts are considered to be moderate or greater (i.e. Categories R3 or greater). In 12 of these cases (i.e. 0.5 % 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 (i.e. Category R5).

5.2. Managing public safety

The primary risk associated with mining beneath structures is public safety. Tahmoor Coking Coal Operations has previously directly mined beneath or adjacent to more than 1900 houses and civil structures, commercial and retail properties, the Main Southern Railway and local roads and bridges. Tahmoor Coking Coal Operations has implemented extensive measures prior to, during and after mining to ensure that the health and safety of people have not been put at risk due to mine subsidence. People have not been exposed to immediate and sudden safety hazards as a result of impacts that have occurred due to mine subsidence movements.

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.

The potential for impacts on public safety have been assessed on a case by case basis. The assessments include an inspection by a structural engineer. The findings of the assessments are described in this Management Plan in the sections below.

5.2.1. Subsidence impact management process

Tahmoor Coking Coal Operations has developed a *risk management process* to manage the potential impacts on structures due to the extraction of Longwall 32. This plan has been developed based on the experience of mining beneath and adjacent to structures due to the extraction of Longwalls 22 to 31. This management process will be reviewed and updated based on continuing experiences gained from the mining of longwalls at Tahmoor Coking Coal Operations.

The risk management process for Longwall 32 includes the following processes, which are illustrated in the flowchart in Fig. 5.1:

1. Regular consultation, cooperation and coordination with the community before, during and after mining as described in Section 6.3. This includes letters and door knocking to all residents of structures that will soon be affected by subsidence. The letters offer a free pre-mining inspection and hazard identification inspection by a structural engineer;
2. 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 have been and will continue to be undertaken early so that there is adequate time, if required, to arrange additional inspections and/or surveys and implement any mitigation measures before mining-induced impacts are experienced;

   As a general rule, site-specific investigations are undertaken before the longwall face approaches to within 300 m of travel prior to directly mining beneath each property. For properties located directly above the first 300 m of the commencing end of a longwall, the investigations are targeted to be undertaken prior to extraction or at the latest, they will be undertaken prior to the first 200 m of extraction of the longwall.

   The site-specific investigations include the following:

   a) At the time of preparing Report No. MSEC647 (2014) in support of Tahmoor Coking Coal Operations' SMP Application, structures were identified from aerial photographs, with structure types identified from kerbside inspections. The identified structures in the vicinity of Longwall 32 were checked and updated against the most recently acquired aerial photographs from July 2018;
   b) Front of house risk and visual screening inspections by Tahmoor Coking Coal Operations in company with a structural engineer for all properties that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. The purpose of the inspections is to identify hazards where access has not been granted by the landowner.

      In some cases, particularly in semi-rural and rural areas, it is difficult to inspect a structure that is remote from the street front. Where these cases involve properties that are located directly above Longwall 32, Tahmoor Coking Coal Operations will request access to conduct a pre-mining inspection and hazard identification inspection by a structural engineer;
   c) Tahmoor Coking Coal Operations will request access to conduct pre-mining geotechnical inspections of structures located on or immediately adjacent to steep slopes that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32 (refer Section 5.3.1);
   d) Tahmoor Coking Coal Operations will request access to conduct pre-mining hazard identification inspections by a structural engineer (where access is allowed by the landowner) to properties with structures that have been specifically targeted on the basis that may be more sensitive to mine subsidence movements due to the extraction of Longwall 32. These include:
      i) Commercial and business establishments, public amenities and public utilities that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32 (refer to Sections 5.11 and 0);
      ii) Structures of heritage significance that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32 (refer Section 5.3.2);
      iii) Structures that are located above hidden creeks that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32 (refer Section 5.3.3);
      iv) Structures that are located above mapped geological structures that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32 (refer Section 5.3.4);
      v) Structures that are located on or adjacent to steep slopes or that have been recommended for structural inspection by the geotechnical engineer;
      vi) Structures that have been identified as being potentially unstable or unsafe by landowners (Item 1), or from the front of house inspections (Item 2b);
      vii) Houses and units located outside the declared Mine Subsidence Districts that are predicted to experience more than 150 mm of subsidence (refer Section 5.3.6); and
      viii) Houses and units estimated to have been constructed prior to the declaration of the Bargo Mine Subsidence District (in November 1975) that are predicted to experience more than 150 mm of subsidence (refer Section 5.3.7).

3. Implementation of mitigation measures following inspections by the geotechnical engineer and the structural engineer, in consultation and agreement with the landowner. These will be implemented before the longwall face approaches to within 100 m of travel prior to directly mining beneath each property;

4. Surveys and inspections during mining within the active subsidence area (refer Table 6.1 for timing and frequencies):
   i) detailed visual inspections and vehicle-based inspections along the streets;
   ii) ground surveys along the streets;
   iii) baseline ground surveys of pegs installed around semi-rural and rural houses that are remote from local streets and located directly above Longwall 32;
   iv) specific ground surveys for selected properties, where recommended by the geotechnical engineer or structural engineer due to their proximity to steep slopes or pre-existing condition;
   v) visual inspections of residential structures that are either: located on or adjacent to steep slopes, are in poor existing condition (based on the hazard identification inspections), have previously reported impacts, or where recommended by the Structures Response Group;
   vi) visual inspections of pool fences and gates; and
   vii) visual inspections of commercial, industrial and business establishments, public amenities and public utilities.

The *subsidence impact management process* has been developed in consideration of the following facts and observations:

1. Australian standards have been available for use in the design of structures since 1948. The majority of structures at Tahmoor and Thirlmere (approximately 80 %) have been constructed after the declaration of the Bargo Mine Subsidence District in November 1975;
2. There is sufficient redundancy in structural design such that ductile deformation will develop and be noticeable to residents before structural failure occurs;
3. Subsidence movements develop gradually over time at Tahmoor Coking Coal Operations as they have above other previously extracted longwalls at similar depths of cover;
4. Experiences during the mining of Longwalls 22 to 31 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 Coking Coal Operations and/or SA NSW 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;
5. On the basis of the above, there is sufficient time for residents to notify Tahmoor Coking Coal Operations or the SA NSW of significant displacement or deflection well before structural failure will occur; and
6. The conclusions are supported by 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 at Tahmoor Coking Coal Operations and above other previously extracted longwalls at similar depths of cover. This includes the recent experience at Tahmoor Coking Coal Operations during the mining of Longwalls 22 to 31, which have affected more than 1900 houses and civil structures.

   While severe impacts have developed during the mining of Longwalls 22 to 31, there is sufficient redundancy in structural design such that when structures have experienced severe impacts, they have developed gradually with ample time for residents to notify Tahmoor Coking Coal Operations or SA NSW to repair the structure and/or relocate residents before structural failure occurs. This conclusion is supported by structural engineer John Matheson & Associates (JMA, 2014).

While the three most important factors in managing risks to public safety are redundancy in structural design, gradual development of subsidence movements and an effective community consultation program, a number of additional management measures have been or will be undertaken including: site-specific investigations, regular surveys and inspections during mining and triggered response measures as detailed in this Management Plan.

A flowchart illustrating the Subsidence Impact Management Process prior to, during and after each structure potentially experiencing impacts is shown in Fig. 5.1.

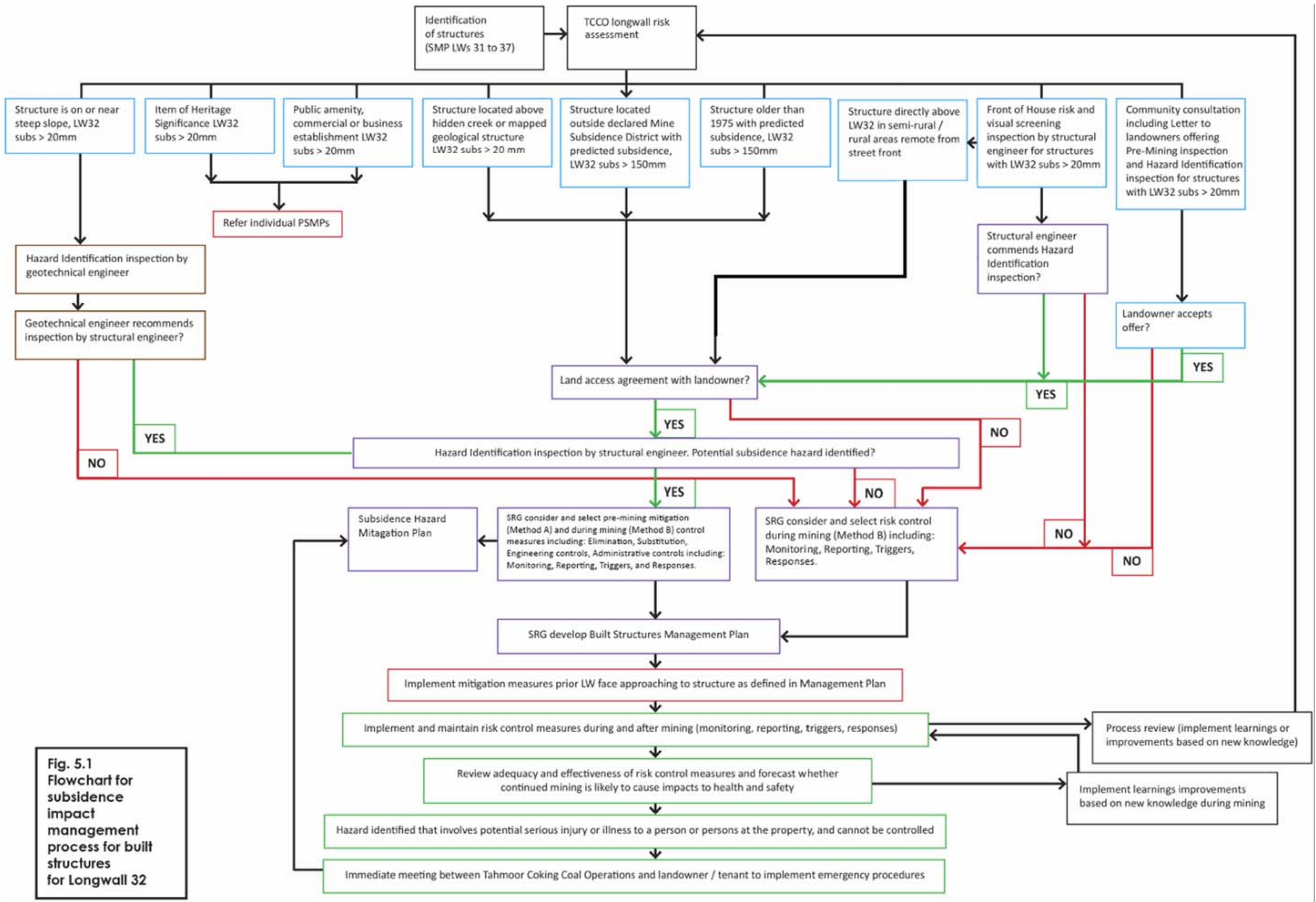


Fig. 5.1 Flowchart for subsidence impact management process for built structures for Longwall 32

5.3. Residential structures

A total of 121 houses are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32, of which 14 are located directly above Longwall 32.

Tahmoor Coking Coal Operations has and will continue to request access to conduct pre-mining hazard identification inspections by a structural engineer (where access is allowed by the landowner) to properties with structures that have been specifically targeted on the basis that may be more sensitive to mine subsidence movements due to the extraction of Longwall 32, including those outlined in the following sections.

5.3.1. Structures on steep slopes

A steep slope has been defined in this management plan as an area of land having a natural gradient greater than 1 in 3 (i.e. a grade of 33 %, or an angle to the horizontal of 18°). The areas with steep slopes were determined from the 1 m surface level contours generated from an airborne laser scan of the area and are shown in Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018).

Areas with natural steep slopes have been identified above Longwall 32. The steep slopes are associated with small ridgelines and along the creaks and drainage lines. There are also artificial steep slopes along the alignments of the roads and railway.

A total of 129 structures above Longwalls 22 to 32 have been inspected by geotechnical engineer, GHD Geotechnics. Structures and dams on these properties were assessed to have been located on or immediately adjacent to 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 31, including steep slopes on the banks of Myrtle Creek and along the Redbank Range.

5.3.2. Structures of heritage significance

The building structures within the Study Area of heritage significance are associated with Mill Hill, the Fairley Residence and the Koorana Homestead Complex. Separate management plans have been or will be developed for these heritage structures prior to the influence of mining of Longwall 32.

5.3.3. Structures above ‘hidden’ creeks

A total of 17 structures have been identified above hidden creeks that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32.

There is a hidden creek located directly above Longwall 32 at Redbank Place within the Picton Industrial Area. Minor tensile strain impacts were observed at two industrial properties during the mining of Longwall 31. Separate PSMPs will be developed for these properties.

There is a buried creek located to the side of Longwall 32 at Coachwood Crescent. Structural hazard identification inspections will be conducted at these properties prior to the influence of Longwall 32.

5.3.4. Structures above mapped geological structures

As described in Section 2.3, geological structures have been mapped by SCT (2018a) and their locations are shown in Drawing No. MSEC945-12-01.

Structural hazard identification inspections will be conducted at properties that located above mapped first and second order geological structures, for structures that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction for Longwall 32.

5.3.5. Houses prone to flooding or inundation

Potential flood prone areas have been identified along Redbank Creek. None are located directly above Longwall 32.

5.3.6. Houses outside declared Mine Subsidence Districts

There is one house that may experience more than 150 mm of vertical subsidence during the mining of Longwall 32 but is not located within any Mine Subsidence District. The house is located directly above the finishing end of Longwall 32.

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 Subsidence Advisory NSW. As discussed in Report No. MSEC647, the majority of the houses are single-storey buildings that are less than 30 metres long and less than 30 years old.

Tahmoor Coking Coal Operations has or will conduct a hazard identification inspection on houses that are located outside a Mine Subsidence District and are predicted to experience more than 150 mm of subsidence during the mining of Longwall 32.

5.3.7. Older Houses

There are 4 houses that have or may experience more than 150 mm of vertical subsidence during the mining of Longwall 32 but 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 they may be less tolerant to mine subsidence movements, as their designs have not been checked and approved by SA NSW (i.e. the Subsidence Advisory NSW). Some old houses may also be in poor condition. Many of the houses 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 Coking Coal Operations has or will conduct a hazard identification inspection on houses that were constructed prior to 1975 that are predicted to experience more than 150 mm of subsidence during the mining of Longwall 32.

5.3.8. Future house construction

New houses have been identified from an aerial photograph captured in 2018. The houses have been mapped and included in Drawing No. MSEC945-12-01.

Longwall 32 will extract within a semi-rural area but alongside an urban area. It is therefore possible that new houses could be constructed since July 2018, though the number of new houses will be small. No large-scale developments are currently under construction in this area, with the exception of Picton High School.

The hazard associated with new houses is considered to be generally low for the following reasons:

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

As described in Section 6.3, Tahmoor Coking Coal Operations attempts to notify landowners at multiple stages during the mining process. New landowners may be contacted in this manner.

If it is discovered that a new house has been constructed, Tahmoor Coking Coal Operations will offer a pre-mining hazard identification inspection by the structural engineer and to conduct an impact assessment and risk analysis to the landowner upon request.

Standard risk control procedures will be applied to these new houses, which are provided in this Management Plan.

5.4. Flats or Units

There are no flats or units affected by the extraction of Longwall 32.

5.5. Pools

5.5.1. Pool structures

A total of 24 pools are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. The majority of the pools are located to the side of Longwall 32, with only 4 pools located directly above the longwall panel.

As of June 2017, a total of 157 pools have experienced mine subsidence movements during the mining of Longwalls 22 to 30. A total of 36 pools have reported impacts, which represents an impact rate of approximately 23 %. 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 – Pre-moulded fibre-reinforced plastics – Installation) also requires that pools be constructed with a tilt not exceeding 3 mm/m.

5.5.2. 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 due to mining in the Southern Coalfield. While the gates can be easily repaired, the consequence of breaching the pool fence integrity is considered to be severe.

Consultation with the pool owners is considered to be the most effective method of managing potential impacts on pool gates. Tahmoor Coking Coal Operations will inspect the pool fences on a weekly basis, during the active subsidence period, where access is allowed to the property. The pool owners will monitor the pool gates where Tahmoor Coking Coal Operations has not been provided with access to the property. Any damage to pool fences and gates caused by mine subsidence will be repaired immediately.

5.6. 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 the tanks; and
- shearing could also occur at the joint connecting the sewerage pipes to the septic tank, as sewerage 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 sewerage pipes.

Given that tanks are quite small (usually less than 3 m 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 31.

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. SA NSW reports that this has been observed in a small number of cases during the mining of Longwalls 22 to 31. This impact is relatively easy to repair.

SA NSW 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.

5.7. Sheds and other associated structures

A total of 386 sheds and associated structures are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. The risk to sheds and other associated 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 movements 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.

Impacts have been reported to a small number of sheds and other domestic structures during the mining of Longwalls 22 to 31, all of which are considered to be relatively minor and easy to repair.

5.8. General services

There are many services on the properties within the Study Area for Longwall 32. These services include potable water pipes, wastewater pipes, stormwater pipes, electrical services and communications services.

Pipes and ducts are generally flexible and will be able to withstand the levels of mine subsidence movements that are predicted to occur. Water, wastewater, stormwater and gas pipes have been directly mined beneath in many locations in the Southern Coalfield and very few impacts have been observed, all of which have been minor.

Cables are extremely flexible and will be able to withstand the levels of the mine subsidence movements that are predicted to occur. Very few impacts have been observed to cables due to previous longwall mining in the Southern Coalfield.

5.9. Private roads and walking trails close to steep slopes

There are a small number of private driveways that are located on steep slopes.

It is possible that tension cracks may form at the tops or sides of the slopes and compression ridges may form at the bottoms of the slopes. These impacts may coincide with the 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 were observed at locations along the private driveway of a house on Tickle Drive during the mining of Longwall 26.

5.10. Access and mobility

It is possible that cracks or steps might form in the natural ground or external pavements that might affect access to the properties. The impacts that adversely impacts on access and mobility will be repaired immediately.

5.11. Commercial, industrial and business establishments

A total of 175 commercial, industrial and business are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. The commercial and business establishments have been identified and are described in Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018). The commercial and business establishments that are located within the Study Area for Longwall 32 include:

- commercial, industrial and business establishments along Bridge Street and Redbank Place in South Picton;
- commercial establishment on Stilton Lane, which is located directly above the commencing end of Longwall 31; and
- commercial, industrial and business establishments along Wonga Road located to the north-east of Longwall 32.

Separate management plans have been or will be developed for these commercial and business establishments prior to the influence of mining of Longwall 32.

5.12. Public amenities and utilities

A total of 79 public amenities and utilities structures are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. The public amenities and utilities have been identified and are described in Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018).

The public amenities that are located within the Study Area for Longwall 32 include:

- Hishouse Church (Ref. HH14a) is located directly above Longwall 32;
- The Wollondilly Emergency Control Centre for the Rural Fire Services and SES (Ref. HH25a to HH25d, HH29a and HH29b) are located directly above Longwall 32;
- Picton Fire Station (Ref. PAR_310_pa01) is located approximately 270 metres to the north-east of Longwall 32;
- Picton High School (Ref. PAR_210) is located 190 m north-east of Longwall 32;
- Busy Bees Pre-School and Long Day Care Centre (Refs. PBR_016_pa01 to pa03) is located 300 m north-east of Longwall 32; and
- Plymouth Brethren Christian Church (Ref. PWG_001_pa01) is located 360 m north-east of Longwall 32.

The public utilities that are located within the Study Area for Longwall 32 include:

- Picton Water Recycling Plant (Refs. PRE_020_pu22, pu23 and pu24) is located adjacent to the maingate of Longwall 32, near the commencing end of this longwall;
- Endeavour Energy Maintenance Depot (Ref. HH06/1a, 1b and 1c) is located directly above previously mined Longwall 31.

Separate management plans have been or will be developed for these public amenities and public utilities establishments prior to the influence of mining of Longwall 32.

5.13. Risks associated with existing structural condition

The existing structural condition of structures varies within the general mining area. This is a function of age, structural design, construction workmanship and maintenance. Tahmoor Coking Coal Operations has undertaken thousands of pre-mining hazard identification inspections of structures during the mining of Longwalls 22 to 31. Pre-mining hazard identification inspections 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 Coking Coal Operations 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 31, affecting more than 1900 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 5.2 includes measures to identify potentially ‘unstable structures. The residential properties that are located within the predicted 20 mm subsidence contour due to Longwall 32 have been offered a hazard identification inspection by a structural engineer. These inspections have specifically targeted the structures that could have increased risks due to their existing structural conditions, including the older structures and structures that are located outside of declared Mine Subsidence Districts.

The structural engineer has recommended additional management measures to be undertaken at a total of 8 properties prior to the commencement of Longwall 32 as result of either pre-mining hazard identification inspections, or pre-mining Front of House risk and visual screening inspections. Details are provided in Table A.1, which is included in the Appendix.

5.14. Farm dams

A total of 43 dams are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32, of which 10 dams are located directly above the longwall panel.

Tahmoor Coking Coal Operations has mined directly beneath or adjacent to 67 dams during the mining of Longwalls 22 to 31, with no significant impacts observed. One leak has been reported to a farm dam located directly above the extracted Longwall 27. This represents an impact rate of less than 0.5%. The dataset 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.

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 Coking Coal Operations will supply water to the landowner on a temporary basis until the dam is repaired.

As undertaken during the mining of Longwalls 22 to 31, Tahmoor Coking Coal Operations will visually inspect the dams immediately prior to and immediately after active subsidence of the dam. If impacts occur to the dams, Tahmoor Coking Coal Operations will supply water to the landowner on a temporary basis until the dam is repaired.

From a public safety point of view, there are no structures located immediately downstream of the dams directly above Longwall 32. The Main Southern Railway is located downstream of two small dams and potential impacts on the railway culverts and embankments are being managed by Tahmoor Coking Coal Operations and ARTC.

A property is located downstream of a large dam on Sydney Water's Picton Water Recycling Plant property. An unsealed road crosses the creek immediately downstream of the dam, which is located approximately 340 metres to the side of Longwall 32. While the potential for adverse impacts is extremely low at this location, potential impacts on the dam wall are being managed by Tahmoor Coking Coal Operations and Sydney Water , with procedures in place to immediately consult with the landowner should adverse subsidence movements or impacts be observed during the mining of Longwall 32.

5.15. Summary of potential impacts

A summary of the assessed levels of potential impacts on the building structures is provided in Table 5.1. The risk assessment has been undertaken in accordance with the Glencore Risk Matrix, which is included in the Appendix A. The assessment has been based on the credible worst case, with the implementation of the proposed management strategies and preventive measures outlined in this plan.

Table 5.1 Summary of potential mine subsidence impacts on building structures

Risk	Likelihood	Consequence	Level of potential impact
Structures			
Impacts on health and safety	Rare	Major	Medium (10)
Damage to structures	Possible	Minor	Medium (8)
Pools			
Impacts on health and safety due to damage to pool gate	Rare	Major	Medium (10)
Damage to structures	Likely	Minor	Medium (12)
Septic Tanks			
Damage to structures	Rare	Negligible	Low (1)
Farm dams			
Leak of dam water	Rare	Minor	Low (3)

5.16. Identification of subsidence hazards that could give rise to risks to health and safety

Clause 34 of the Work Health and Safety Regulation (2017) requires that the duty holder (in this case Tahmoor Coking Coal Operations), in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.

This section of the Management Plan summarises hazards that have been identified for the structures that could give rise to risks to health and safety of people.

Using the processes described in Section 5.2 of this Management Plan, mine subsidence hazards have been identified, investigated and analysed in a systematic manner by examining each aspect of the property, as described in Sections 5.3 to 0 of this Management Plan. Each of the aspects below could potentially experience mine subsidence movements that give rise to risks to the health and safety of people:

- the building structure(s);
- services to the property, including pipes, cables, fire protection, security, access and mobility;
- items noted during inspection by competent person in workplace health and safety;
- finishes;
- machinery and equipment, where present; and
- external pavements, fences and gates.

The following mine subsidence hazards were identified that could give rise to risks to health and safety for structures due to the extraction of Longwall 32:

- potential mine subsidence damage to building structures (refer Sections 5.3 and 5.7);
- steep slopes (refer to Sections 5.3.1 and 5.9);
- potential damage to pool gates (refer Section 5.5);
- potential damage or loss of services to the property (refer Section 5.8); and
- potential development of trip hazards on internal floors and pavements (refer Section 5.10).

As shown in Table 5.1 the Structures Response Group assessed the likelihood of the above hazards affecting health and safety, and the severity of potential health and safety consequences during the risk assessment as a group, based on the assessed worst-case consequence. The results of the risk assessment are included in the report attached to this Management Plan.

The identification and risk assessment process took into account the location of the structures relative to Longwall 32 and the associated timing and duration of the subsidence events, as described in Section 1.7 of this Management Plan.

Whilst mine subsidence predictions and extensive past experiences from previous mining at Tahmoor Coking Coal Operations were taken into account, the identification and risk assessment process recognised that there are uncertainties in relation to predicting subsidence movements, and uncertainties in how mine subsidence movements may adversely impact the property, as discussed in Section 1.4 and Chapter 2 of this Management Plan.

Tahmoor Coking Coal Operations has considered the outcomes of the hazard identification and risk assessment process when developing measures to manage potential impacts on the health and safety of people, and potential impacts on the property in general. These are described in Chapter 6 of this Management Plan.

6.1. Structures Response Group (SRG)

The Structures Response Group (SRG) is responsible for taking the necessary actions required to manage the risks that are identified from monitoring of structures. The SRG's key members are:

- Tahmoor Coking Coal Operations;
- JMA Solutions; and
- MSEC.

SA NSW also participates at SRG meetings as observers when available. The SRG may invite other specialist consultants from time to time, including GHD Geotechnics where issues relate to slope stability.

6.2. Mitigation measures

Mitigation measures have been or will be undertaken where recommended by the structural engineer based on hazard identification inspections. Details are provided in Table A.1, which is included in Appendix A of this Management Plan.

6.3. Community consultation, co-operation and co-ordination

Experiences during the mining of Longwalls 22 to 31 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 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. Tahmoor Coking Coal Operations continued to develop their mine plans after development approval was received. 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 Coking Coal Operations are listed below.

- *Undertake conservative predictions and impact assessments*

  Tahmoor Coking Coal Operations 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 m radius around each structure;

- *Undertake detailed predictions and impact assessments*

  By undertaking detailed subsidence predictions, Tahmoor Coking Coal Operations 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 information days*

  A number of advertised information days are held by Tahmoor Coking Coal Operations through the year. The information days allow members of the community to directly meet Tahmoor Coking Coal Operations representatives and its consultants. SA NSW is also present on information days to answer questions;

  The information exchanged at information days also assist Tahmoor Coking Coal Operations, as members of the community sometimes provide information about particular surface features or impacts that Tahmoor Coking Coal Operations might not have been aware of;

- *Tahmoor Colliery Community Consultative Committee*

  This committee meets at regular (quarterly) intervals. It allows Tahmoor Coking Coal Operations 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 Tahmoor Coking Coal Operations. 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*

  Tahmoor Coking Coal Operations sends many letters to community advising of imminent longwall mining in their area. By continuing to engage with residents at each stage of mining, Tahmoor Coking Coal Operations is able to find new residents who might not have been aware that mining was taking place. The letters include:

  - Notification of preparation of SMP application for Longwalls 31 to 37 and notification of lodgement of SMP Application. The notification letter attached a Subsidence Information Pack, which included information on longwall mining and mine subsidence, claims process with SA NSW, recommendation to undertake pre-mining hazard identification inspections, a list of emergency contact numbers and point of contact at Tahmoor Coking Coal Operations;
  - Notification to all landowners within the application area of SMP approval for Longwall 32. These were within 30 days of the date of approval in accordance with Clause 7 of the SMP approval. The Subsidence Information Pack was resent as part of this notification;
  - Notification of imminent commencement of each longwall. The letter is sent to all landowners whose properties are located directly above the active longwall panel plus landowners whose properties are located directly above the next longwall panel. The letter encourages the landowners to undertake pre-mining hazard identification inspections;
  - For properties where pre-mining hazard identification inspections have been or will be undertaken in accordance with this Management Plan, Tahmoor Coking Coal Operations have or will make direct contact to arrange access with the landowner by mail, letterbox drop, phone and/or door knocking;
  - Door knocking of houses located directly above the active longwall:
    - This exercise is an attempt to directly engage with residents and is undertaken in conjunction with front of house inspections;
    - This exercise will be undertaken before the longwall face approaches within 300 m of each property, so that there is adequate time, if required, to arrange additional inspections and/or surveys and implement any mitigation measures if required before mining-induced impacts are experienced;

- *Individual meetings with residents*

  Many members of the community prefer to meet with Tahmoor Coking Coal representatives face to face. Tahmoor Coking Coal Operations 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 Tahmoor Coking Coal Operations;

- *Newspaper advertisements*

  Tahmoor Coking Coal Operations places advertisements in the newspaper from time to time to advise the community at large about community consultation opportunities, including community information days;

- *Monthly reporting*

  Tahmoor Coking Coal Operations provides regular updates on the progress of mining in the area. This is conducted mainly by community newsletter by mail, email, website and notice boards for 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*

  Tahmoor Coking Coal Operations responds quickly to impacts that are reported by the community. If a severe impact is reported, Tahmoor Coking Coal Operations 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, Tahmoor Coking Coal Operations offers to continue monitoring the property for further impacts.

6.4. Development and selection of risk control measures

Tahmoor Coking Coal Operations has developed and selected risk control measures in consultation, co-ordination and co-operation with the landowners in accordance with WHS legislation. In accordance with Clauses 35 and 36 in Part 3.1 of the Work Health and Safety regulation (2017) and the guidelines (MSO, 2017), a hierarchy of control measures has been considered and selected where reasonably practicable, using the following process:

1. eliminate risks to health and safety so far as is reasonably practicable, and
2. if it is not reasonably practicable to eliminate risks to health and safety – minimise those risks so far as is reasonably practicable, by doing one or more of the following:
   - (a) substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk
   - (b) isolating the hazard from any person exposed to it
   - (c) implementing engineering controls
3. if a risk then remains, minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls.
4. if a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by ensuring the provision and use of suitable personal protective equipment.

A combination of the controls set out in this clause may be used to minimise risks, so far as is reasonably practicable, if a single control is not sufficient for the purpose.

There are primarily two different methods to control the risks of subsidence, namely:

Method A – Selection of risk control measures to be implemented prior to the development of subsidence, (Items 1 and 2 above), and

Method B – Selection of risk control measures to be implemented during the development of subsidence (Items 3 and 4 above).

Method A and B risk control measures are described in Sections 6.5 to 6.11. Prior to selecting Method B risk control measures, Tahmoor Coking Coal Operations has investigated and confirmed that the measures are feasible and effective for the site-specific conditions due to the extraction of Longwall 32.

6.5. Avoidance and mitigation measures

Based on its own assessments, and the assessments by the structural engineer and geotechnical engineer, Tahmoor Coking Coal Operations considered Method A and B risk control measures, in accordance with the process described in Section 6.4.

Elimination

In this instance, no reasonably practicable controls could be identified that would eliminate the identified risks.

Substitution

In this instance, no reasonably practicable controls could be identified that will change the environment so the hazards could be substituted for hazards with a lesser risk.

Isolation

In this instance, no reasonably practicable controls could be identified to isolate a hazard from any person exposed to it.

Engineering controls

The hazard identification inspections by the structural engineer have identified elements that are in poor existing condition or elements that could be susceptible to mine subsidence movements. The structural engineer has recommended engineering controls and monitoring to minimise risk.

A summary of the inspections, engineering controls and monitoring that have been recommended by the structural engineer, to date, are provided in Table A.1, in Appendix A. The engineering controls will be implemented prior to the structure experiencing active subsidence from Longwall 32, i.e. before the longwall face approaches to within 100 m of travel of mining beneath the structure.

The hazards identified from the inspections have been risk assessed and these are summarised in the structural inspection reports. The assessed levels of risk for the building structures including the implementation of the engineering controls are summarised in Table 5.1.

Additional engineering controls will be developed as further hazard identification inspections are completed by the structural engineer. The properties that are pending or still require hazard identification inspections prior to active subsidence are illustrated in Fig. 6.3. The hazard identification inspections will be undertaken before the longwall face approaches to within 300 m of travel of mining beneath each property.

Administrative controls

The following administrative Controls were identified and selected that will put in place procedures on site to minimise the potential of impacts on health and safety:

- implementation of a Monitoring Plan and Trigger Action Response Plan (TARP). As described in Table 6.1, the SRG has developed and implemented a management strategy of detecting early the development of potential adverse subsidence movements, so that contingency response measures can be implemented before impacts on the safety and serviceability develop. The TARP includes the following:
  - ground monitoring and visual inspections along the streets in the active subsidence zone;
  - baseline ground surveys of pegs installed around semi-rural and rural houses that are remote from local streets and located directly above Longwall 32;
  - specific ground surveys for selected properties, where recommended by the geotechnical engineer or structural engineer due to their proximity to steep slopes or pre-existing condition;
  - visual inspections of residential structures that are either: located on or adjacent to steep slopes, are in poor existing condition (based on the hazard identification inspections), have previously reported impacts, or where recommended by the Structures Response Group;
  - visual inspections of pool fences and gates;
  - visual inspections of commercial, industrial and business establishments, public amenities and public utilities;
  - additional surveys and inspections, if required, such as regular recording of widths of any new cracks that might appear;
  - repair of impacts that create a serious public safety hazard;
  - repair of impacts that impair any essential services;
  - repair of impacts that impair access and mobility to the property, even if further impacts are anticipated; and
  - in the worst case, as a last resort, advise the landowner to restrict entry to part of the property or emergency evacuate the premises.

With the implementation of the above management strategies, Tahmoor Coking Coal Operations will ensure that the health and safety of people on the properties will not be put at risk due to differential mine subsidence movements due to the extraction Longwall 32.

6.6. Site-specific structure inspection plan

6.6.1. Identification of building structures

At the time of preparing Reports Nos. MSEC647 (MSEC, 2014) and MSEC969 (MSEC, 2018), in support of the SMP and Modification Applications, structures were identified from aerial photographs, with structure types identified from kerbside inspections. Further structures have been identified from the latest aerial photograph in July 2018 and from kerbside inspections as part of the preparation of this Management Plan.

Front of house risk and visual screening inspections have been carried out by a structural engineer for the properties that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32, where they were visible from the street. The purpose of these inspections is to identify structures that are in poor existing condition or elements that could be sensitive to mine subsidence movements, where access was not granted by the owner for the hazard identification inspections.

In some cases, particularly in semi-rural and rural areas, it is difficult to inspect a structure that is remote from the street front. Where these cases involve properties that are located directly above Longwall 32, Tahmoor Coking Coal Operations will request access to conduct a pre-mining inspection and hazard identification inspection by a structural engineer.

The locations of residential structures where Front of House risk and visual screening inspections have been completed by the structural engineer prior to commencement of Longwall 32 are shown in Fig. 6.1.

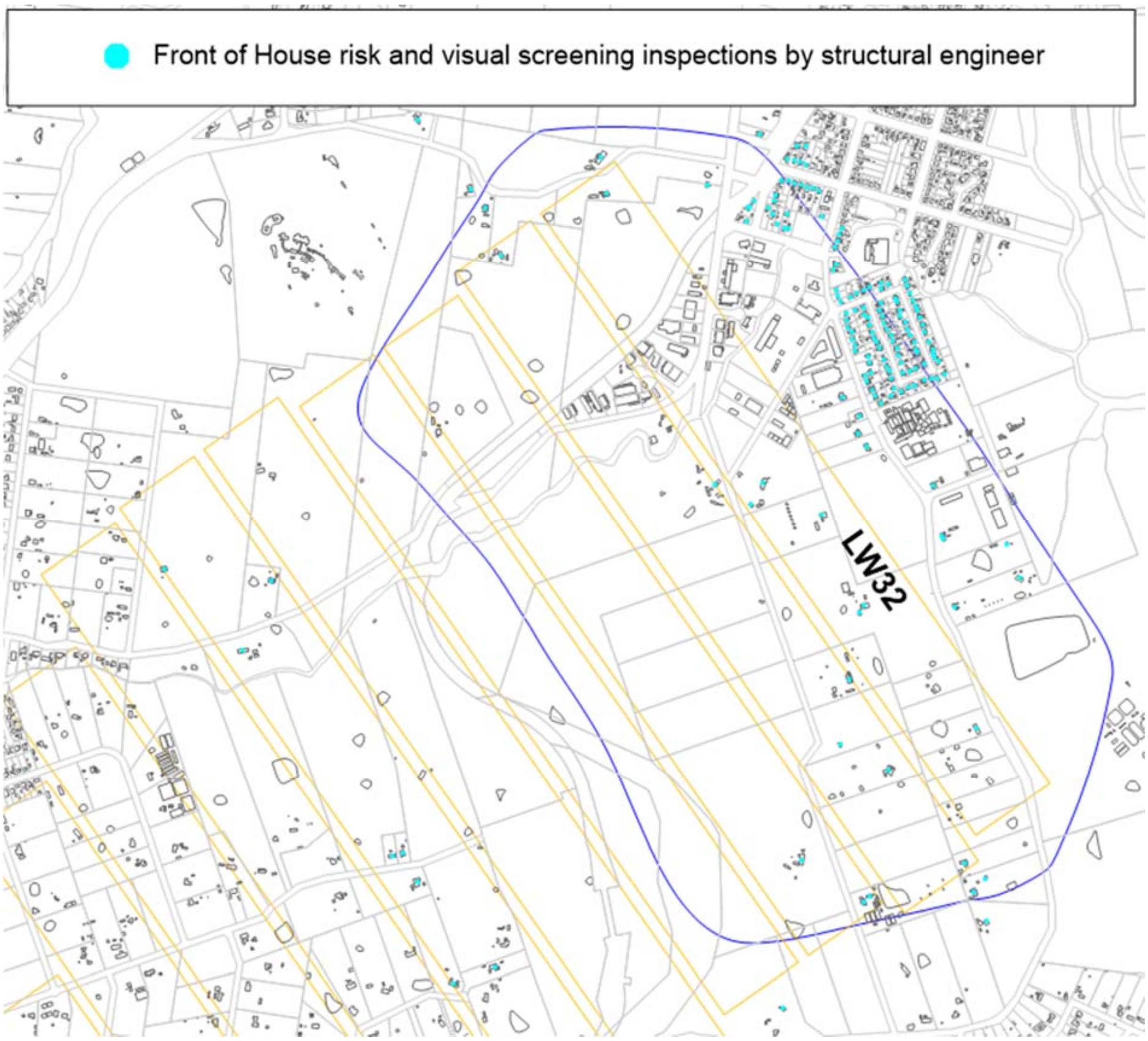


Fig. 6.1 Locations of residential structures where Front of House risk and visual screening inspections have been completed by the structural engineer prior to commencement of Longwall 32

6.6.2. Pre-mining hazard identification inspections by geotechnical engineer

A qualified geotechnical engineer (GHD Geotechnics) has inspected the 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 5.3.1.

A total of 94 structures have been identified on or near steep slopes that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of Longwall 32. Their locations are shown in Fig. 6.2. The great majority of these structures have been inspected by GHD Geotechnics prior to the commencement of Longwall 32. No issues have been identified.

One property is required to be inspected by GHD Geotechnics and this will be undertaken prior to the Longwall 32 face approaching within 300 metres of it.

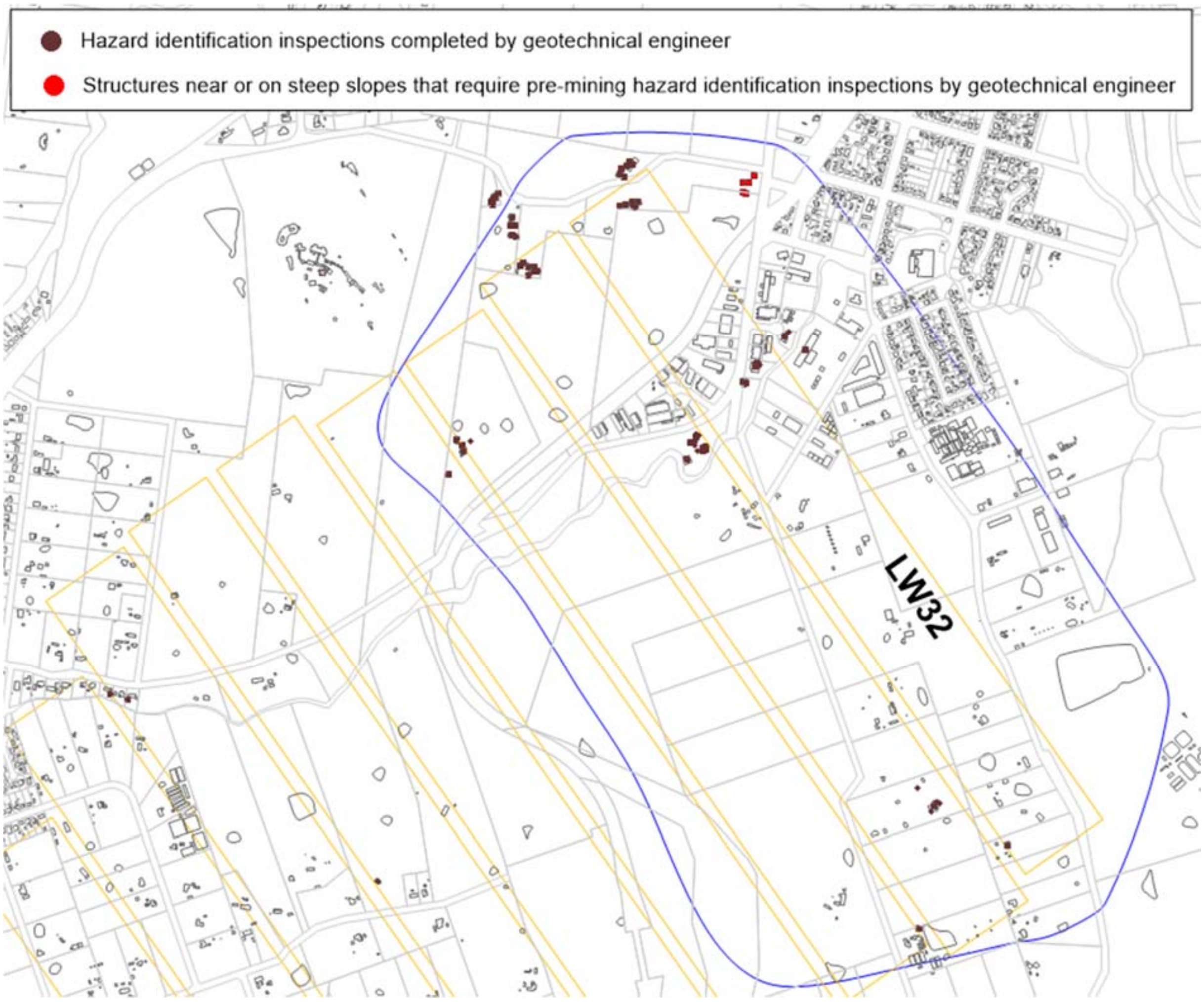


Fig. 6.2 Locations of structures near steep slopes that require pre-mining hazard inspection by geotechnical engineer for Longwall 32

6.6.3. Pre-mining hazard identification inspections by structural engineer

Tahmoor Coking Coal Operations have written letters to properties that are located within the predicted 20 mm subsidence contour due to Longwall 32, offering a pre-mining hazard identification inspection by a structural engineer.

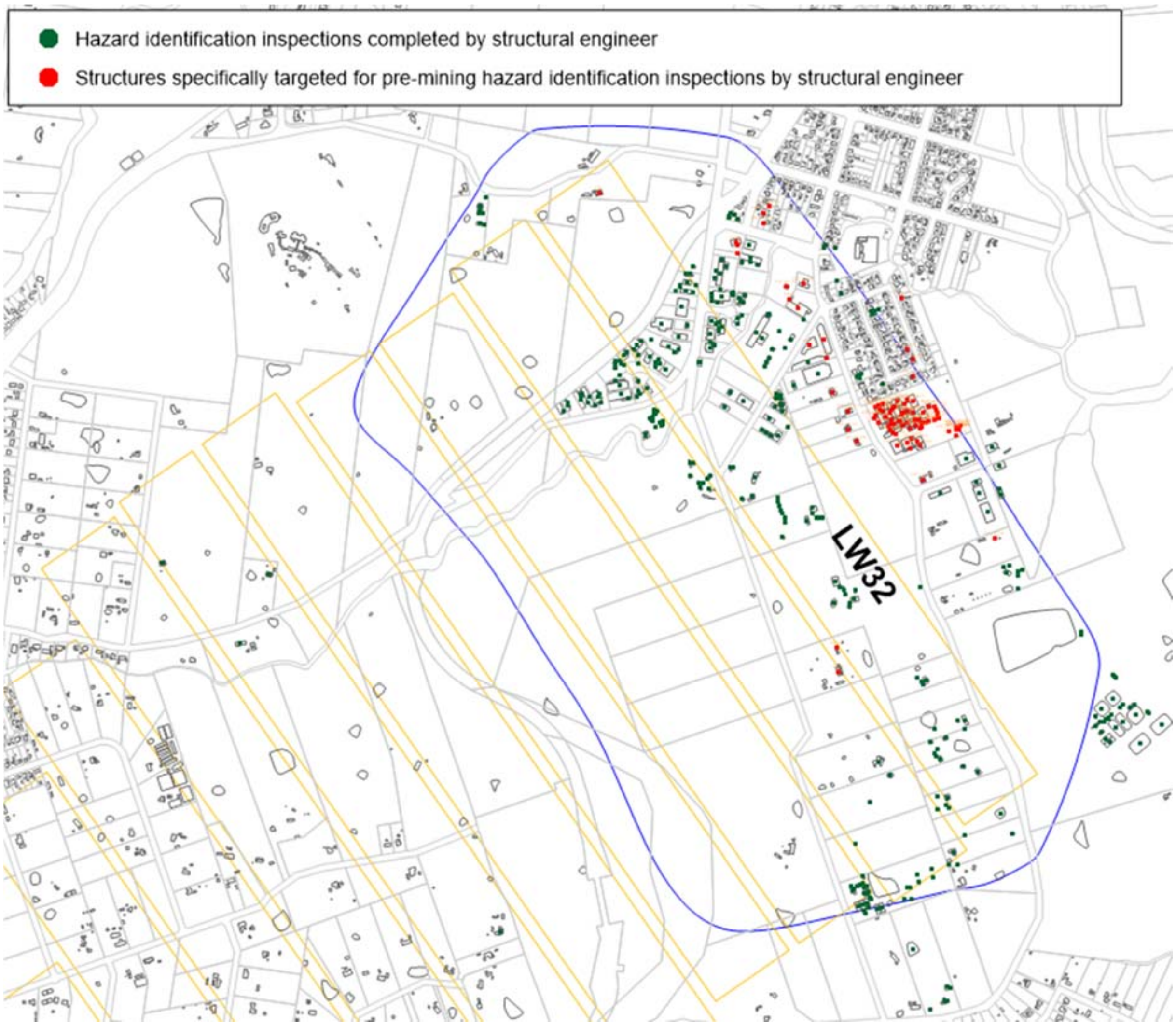
In addition to the letters, Tahmoor Coking Coal Operations have requested access to conduct pre-mining hazard identification inspections at properties with structures that have been specifically targeted on the basis that may be more sensitive to mine subsidence movements due to the extraction of Longwall 32, as outlined in Section 5.2.

The hazard identification inspections required to be completed will be undertaken before the longwall face approaches to within 300 m of travel prior to directly mining beneath each property. Where access is not granted by the landowner, inspections are limited to Front of House inspections where the structures are visible from the street.

A total of 282 structures have been identified to require a pre-mining hazard identification inspection by a structural engineer due to the extraction of Longwall 32. Their locations are shown in Fig. 6.3. The great majority of these structures have been inspected by structural engineer JMA Solutions prior to the commencement of Longwall 32.

A separate hazard identification has been undertaken by Tahmoor Coking Coal Operations and Sydney Water in relation to the Picton Water Recycling Plant, with the Picton High School.

It can be seen from Fig. 6.3 that hazard identifications inspection for structures located above the commencing end of Longwall 32 have been completed. The inspections will be undertaken prior to the Longwall 32 face approaching within 300 metres of each structure.



Note: all properties that are predicted to experience more than 20 mm of incremental subsidence have been offered a pre-mining hazard identification inspection.

Fig. 6.3 Locations of structures that require pre-mining hazard inspection by structural engineer for Longwall 32

6.6.4. Pre-mining inspections by SA NSW

SA NSW has undertaken a number of pre-mining inspections above Longwalls 22 to 32. These are shown in Fig. 6.4. Further inspections may be conducted by SA NSW in the future, if requested by a landowner.

In order to reduce inconvenience to landowners, Tahmoor Coking Coal Operations will offer to conduct a pre-mining inspection for SA NSW to be conducted by the structural engineer at the same time as the hazard identification inspection. The landowner is not obliged to take up the offer when agreeing to the hazard identification inspection.

6.6.5. Visual kerbside inspections during mining

Detailed visual inspections will be undertaken along streets on a weekly basis within the active subsidence area from the commencement of Longwall 32. A second, vehicle-based inspection will also be undertaken once a week within the active subsidence area during the mining of Longwall 32, commencing after 200 m of extraction.

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

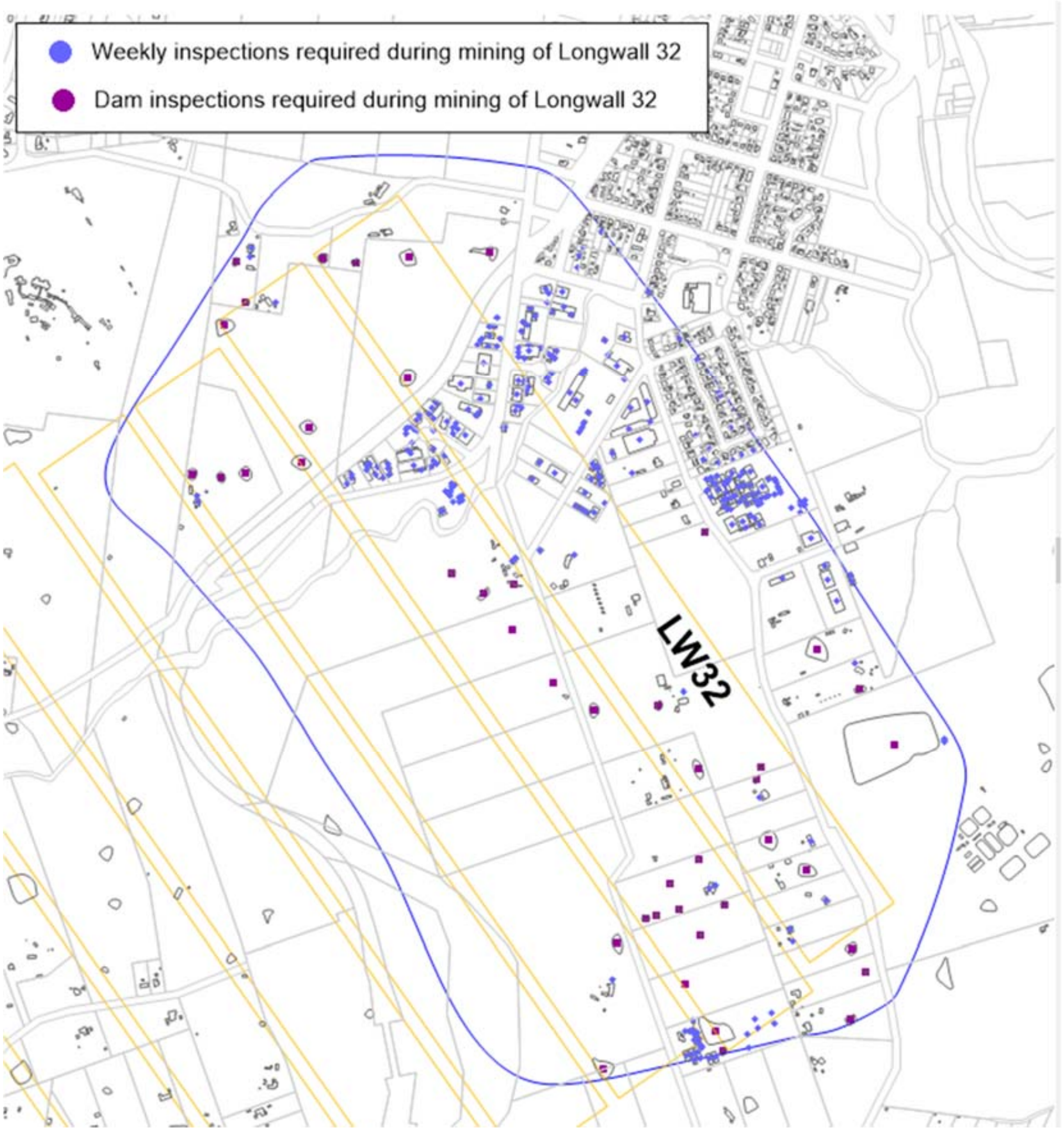
6.6.6. Visual Inspections of structures during mining

Weekly visual inspections will be conducted for the following structures, when they are located within the active subsidence zone, where access is provided by the landowner:

- residential structures that are located on or adjacent to steep slopes, where recommended by the geotechnical or structural engineer;
- residential structures that are in poor existing condition, based on the hazard identification inspections by the structural engineer;
- residential structures that have experienced impacts as a result of mining previous longwalls, or where recommended by the SRG;
- pool fences and gates;
- farm dams immediately prior to and after the period of active subsidence for each dam;
- commercial, industrial and business establishments; and
- public amenities and utilities.

The inspections during active subsidence for the building structures are illustrated in Fig. 6.4. The active subsidence zone is described in Section 1.7, with the weekly inspections of the houses carried out from when they are 150 m in front of the longwall face to 450 m behind the longwall face.

The weekly inspections of the structures located near the longwall commencing end will start after the first 200 m of longwall extraction. The weekly inspections of the structures that are located beyond the longwall finishing will be carried out for the last 300 m of extraction.



Note: Weekly inspections will also be conducted within the PWRP, though not shown above

Fig. 6.4 Inspections during active subsidence

6.7. Ground and structure monitoring plan

6.7.1. Ground surveys along the streets

Monitoring lines have been installed along streets above and adjacent to Longwall 32, as shown in Drawing No. MSEC945-00-01. The monitoring lines have been initially surveyed to provide a baseline reference. Monitoring of street survey lines will be conducted for every 200 m of longwall travel as a minimum for the marks located within the active subsidence zone.

6.7.2. Specific structure surveys

Tahmoor Coking Coal Operations will undertake building surveys where recommended by the geotechnical or structural engineer. Tahmoor Coking Coal Operations will also install and baseline survey pegs around semi-rural and rural houses that are remote from local streets and located directly above Longwall 32.

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 Coking Coal Operations will place permanent ground survey marks around each subject building. Tahmoor Coking Coal Operations will endeavour to place marks at each external and internal corner of the building, and one mark at the centre of each external side of reasonable length (this will depend on the overall size of the building, but is approximately 10 m).

Tahmoor Coking Coal Operations will record the reduced levels of each mark, as well as the horizontal distance between each mark 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. 6.5. 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.

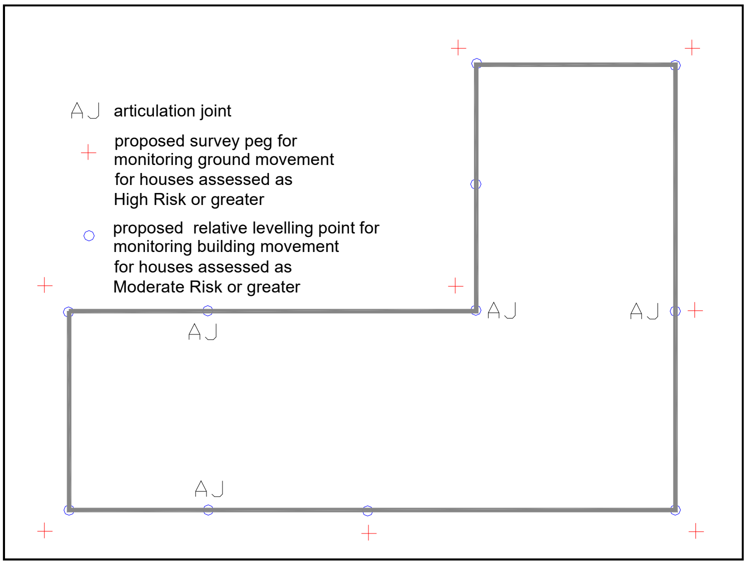


Fig. 6.5 Schematic layout for ground movement and building level surveys around a typical building

6.8. Schedule of inspections and surveys

A schedule of inspections and surveys is maintained by Tahmoor Coking Coal Operations.

6.9. Inspection and survey register

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

6.10. Triggers and responses

Trigger levels have been developed by Tahmoor Coking Coal Operations based on observed ground movements or impacts. Trigger levels for each monitoring parameter are described in the risk control procedures in Table 6.1. Structural inspections will be undertaken for any structure where ground tilt is observed to exceed 7 mm/m or curvature is observed to exceed 0.2 km^{-1}.

Tahmoor Coking Coal Operations will coordinate 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 Coking Coal Operations in the unlikely event that a residence becomes unsafe as a result of mine subsidence impacts.

Immediate responses will be undertaken by Tahmoor Coking Coal Operations 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;
- impacts that impair any essential services;
- impacts to sensitive equipment, even if further impacts are anticipated; and
- in the worst case, restriction on entry to part of the property and the provision of alternative accommodation for the resident.

The risk control measures described in this Management Plan have been developed to ensure that the health and safety of people who may be present at the properties are not put at risk due to mine subsidence. It is also an objective to avoid disruption and inconvenience to owner, or if unavoidable, keep disruption and inconvenience to minimal levels.

No potential hazards have been identified that could reasonably give rise to the need for an emergency response for the building structures that will be affected by Longwall 32. As a precautionary measure, however, residents will be relocated at a house that has experienced significant impacts during the mining of Longwall 31, prior to the influence of Longwall 32. It is further noted that pool gates can malfunction during the period of active subsidence and these will be repaired immediately. It is possible that irregular ground movements could cause a severe impact on a building structure; however, this will develop gradually allowing the risk to be managed.

The mine subsidence movements will develop gradually and there will be ample time to identify the development of potentially adverse differential subsidence movements early, consider whether any additional management measures are required, and repair or adjust affected surface features, in close consultation with the landowner.

Tahmoor Coking Coal Operations and the SRG will review and assess monitoring reports and consider whether any additional management measures are required on a weekly basis. If irregular movements or adverse impacts are detected, it is anticipated that a focussed inspection will be undertaken for the affected property, and a decision will likely be made to increase the frequency of surveys and/or inspections. Additional management measures may also be implemented. It is therefore expected that, as a potential adverse situation escalates, Tahmoor Coking Coal Operations will be present on site on a more frequent basis to survey or inspect the property, and that the landowner will be consulted on a more frequent basis.

Given the gradual development of subsidence movements, it is extremely unlikely that a situation will arise where observations change from a benign scenario to an emergency scenario within one week. Notwithstanding this, Tahmoor Coking Coal Operations will brief the landowners on what signs to look for to detect the development of potential impacts.

Notwithstanding the above, if a hazard has been identified that involves potential serious injury or illness to a person or persons at the property, and it cannot be controlled, the immediate response is to remove people from the hazard. If such a situation is observed or is forecast to occur by either Tahmoor Coking Coal Operations or by people at the property, Tahmoor Coking Coal Operations and the landowner will immediately meet and implement emergency procedures.

The implementation of emergency procedures may include any or a combination of the following:

- restriction of access to the hazardous area; and/or
- in the worst case, the relocation of the residents to alternative accommodation until the hazard is rectified.

6.11. Risk control procedures for Longwall 32

The risk control procedures for the management of potential impacts to residential, commercial and business establishments, public amenities and public utilities are provided in Table 6.1.

Table 6.1 Risk control procedures for built structures for Longwall 32

Infrastructure	Hazard / impact	Risk	Trigger	Control procedure/s	Timing and frequency	By whom?
Items of heritage significance, public amenities, commercial, business and industrial establishments predicted to experience more than 20 mm of subsidence due to the extraction of Longwall 32				Refer separate Property Subsidence Management Plans		
Residential structures that will experience mine subsidence effects due to the mining of Longwall 32	Impacts occur	Low to Moderate	Prior to mining	Community consultation, including letters to landowners offering a Pre-Mining Inspection and Hazard Identification inspection for structures predicted to experience more than 20 mm of subsidence due to the extraction of Longwall 32	Complete	Tahmoor Coking Coal Operations
				Front of house screening inspection to identify any potentially unstable structures, for structures predicted to experience more than 20 mm of subsidence due to the extraction of Longwall 32	Complete	Tahmoor Coking Coal Operations (JMA)
				Conduct pre-mining hazard identification inspection and assessment by geotechnical engineer of structures on or near steep slopes to check whether there is any potential for slope instability prior to, during or after mining, for structures predicted to experience more than 20 mm of subsidence due to the extraction of Longwall 32	Complete	Tahmoor Coking Coal Operations (GHD Geotechnics)
				Conduct pre-mining hazard identification inspection and assessment by structural engineer, including: • structures requested for inspection by landowner during community consultation • structures directly above Longwall 32 in semi-rural / rural areas remote from street front, where front of house screening is not practicable • structures that have been recommended for structural inspection by the geotechnical engineer • structures that have been recommended for structural inspection during front of house screening inspections • structures built outside Mine Subsidence District that are predicted to experience more than 150 mm of subsidence due to the extraction of Longwall 32 • structures built prior to declaration of the Mine Subsidence District (1975) and predicted to experience more than 150 mm of subsidence due to the extraction of Longwall 32 • structures above potential hidden creeks that are predicted to experience more than 20 mm of subsidence due to the extraction of Longwall 32 • structures above mapped geological structures that are predicted to experience more than 20 mm of subsidence due to the extraction of Longwall 32	Prior to longwall face approaching to within 300 m of each property.	Tahmoor Coking Coal Operations (JMA)
				Installation of additional monitoring measures or mitigation/strengthening measures as recommended by structural engineer	Prior to longwall face approaching within 100 m of each property	Tahmoor Coking Coal Operations
				Install ground monitoring lines on all streets above Longwall 32 and survey initial levels and strain distances (as shown in Drawing No. MSEC945-00-01).	For new survey pegs, install prior to longwall face approaching to within 400 m of each property.	Tahmoor Coking Coal Operations (SMEC)
				Install ground pegs for structures directly above Longwall 32 in semi-rural / rural areas remote from street front and survey initial levels and strain distances (as shown in Drawing No. MSEC945-00-01).	Complete	Tahmoor Coking Coal Operations (SMEC)
				Confirm arrangements 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 Coking Coal Operations
			Discovery of potential structural issue prior to mining	Conduct structural hazard identification 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	Within 1 week of discovery	Tahmoor Coking Coal Operations
				Advise property owner, SA NSW and MSO of findings of structural engineer	Within 1 week of inspection	Tahmoor Coking Coal Operations
				Undertake mitigation / strengthening measures if decided by SRG	Prior to longwall face approaching to within 100 m of structure	Tahmoor Coking Coal Operations

Infrastructure	Hazard / impact	Risk	Trigger	Control procedure/s	Timing and frequency	By whom?
Residential structures that will experience mine subsidence effects due to the mining of Longwall 32	Impacts occur	Low to Moderate	During the mining of Longwall 32	Survey levels of street survey lines within active subsidence area, including Remembrance Drive, Henry Street / Stilton Lane, Bridge Street, Redbank Place, Bollard Place, Wonga Street, Wood Street and Coachwood Crescent	Weekly for pegs located within active subsidence zone	Tahmoor Coking Coal Operations (SMEC)
				Conduct kerbside visual inspection of streets and structures	Detailed inspection once a week Vehicle based inspection once a week within active subsidence area	Tahmoor Coking Coal Operations
				Conduct inspections during mining for following structures: a) Structures that have previously experienced mine subsidence impacts, where recommended by the SRG b) Pool gates c) Any other structures recommended for regular inspections and/or structure surveys by geotechnical or structural engineer following pre-mining hazard identification inspection and assessment	Weekly within active subsidence zone, or as required by geotechnical or structural engineer	Tahmoor Coking Coal Operations
				Analyse and report results of monitoring and inspections to SRG	Weekly from start of LW32	Tahmoor Coking Coal Operations (MSEC)
				SRG discuss results and consider whether any additional management measures are required	Weekly from start of LW32	SRG
			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 Coking Coal Operations
				Consider structural inspection/additional monitoring and/or mitigation/strengthening measures	Immediately after building inspection	Tahmoor Coking Coal Operations (JMA)
			Significant non-conventional 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, increase frequency of surveys and inspections, additional community consultation	As required by SRG	SRG
				Notify landowner, Tahmoor Coking Coal Operations, SA NSW and MSO	Within one week	Tahmoor Coking Coal Operations

Infrastructure	Hazard / Impact	Risk	Trigger	Control procedure/s	Timing and frequency	By whom?
Residential establishments that will experience mine subsidence movements due to the mining of Longwall 32	Impacts occur	Low to Moderate	Any impact occurs to structure	As information can come from many possible sources: If not already done, notify landowner, Tahmoor Coking Coal Operations, SA NSW	Within 24 hours	Tahmoor Coking Coal Operations
				Inspect impact of subsidence on building	As soon as possible	Tahmoor Coking Coal Operations
				Inspect condition of building by structural engineer, where recommended by the SRG based on feedback from SA NSW	As recommended by SRG with active subsidence area or as agreed with owner	Tahmoor Coking Coal Operations
				Rectify any adverse impacts that impair upon: - the safety, access and mobility, security or fire egress - any essential services - sensitive equipment	As soon as possible at any stage during mining	Tahmoor Coking Coal Operations
				Repair damage to structure	When subsidence impacts cease	Tahmoor Coking Coal Operations
			Observed impacts are greater than predicted impacts	Investigate cause(s) for greater impacts, including possibility of non-conventional or anomalous movements, type of structure. Investigate spatial trends in data to identify any pattern.	Within one week of observation	Tahmoor Coking Coal Operations
			Structure has become or is likely to be become hazardous as a result of subsidence	Notify landowner, Tahmoor Coking Coal Operations, SA NSW and MSO	Within 24 hours	Tahmoor Coking Coal Operations
				Inspect structural condition of building.	Within two days and then as recommended by structural engineer	Tahmoor Coking Coal Operations (JMA)
				Reassess final level of damage based upon likelihood of further damage and structural condition.	Immediately after structural re-inspection.	SRG
				Consider additional monitoring and/or mitigation/strengthening measures	Immediately after structural re-inspection.	SRG
			A hazard has been identified that involves potential serious injury or illness to a person or persons at the property, and cannot be controlled	Provide temporary accommodation for residents in coordinate with SA NSW	Immediately	Tahmoor Coking Coal Operations
				Notify MSO	Within 24 hours	Tahmoor Coking Coal Operations
				Utilise acquisition and compensation procedure from DA67/98-1999 Development Consent Conditions 18-26 and SA NSW procedures	Immediately	Tahmoor Coking Coal Operations
			Property owner does not accept acquisition	Temporarily relocate residents until building is repaired	Immediately	Tahmoor Coking Coal Operations

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 Coking Coal Operations
			Completion of Mining	Conduct transverse ground surveys of Myrtle and Redbank Creeks	Complete for Myrtle Creek Completion of mining when subsidence movements along Redbank Creek ceases	Tahmoor Coking Coal Operations (SMEC)
				Assess whether any houses has subsided below 100 year ARI flood level	Complete for Myrtle Creek Completion of mining when subsidence movements along Redbank Creek ceases	Tahmoor Coking Coal Operations
			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 Coking Coal Operations
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 in the last year.	Prior to subsidence occurring	Tahmoor Coking Coal Operations
			Owner notifies of new house	Conduct pre-mining hazard identification inspection, if access provided by landowner	Prior to subsidence occurring	Tahmoor Coking Coal Operations (JMA)
				Follow risk control procedures, as for other houses	Immediately	Tahmoor Coking Coal Operations (MSEC)
			New house has maximum plan dimension greater than 30 m	Conduct subsidence predictions, impact assessment and risk assessment	Prior to subsidence occurring	Tahmoor Coking Coal Operations (MSEC)
				Follow risk control procedures, as for other houses	Immediately	Tahmoor Coking Coal Operations
Swimming pools and pool gates	Damage to pool	Low	None	Notify owner of potential impacts to pool	Before mine subsidence impacts occur	Tahmoor Coking Coal Operations
	Pool gate – won't shut	High	None	Notify owner of potential impact to pool gate and fence	Before mine subsidence impacts occur	Tahmoor Coking Coal Operations
				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 Coking Coal Operations
			Pool gate won't close	Notify resident and/or landowner, contact Subsidence Advisory NSW to repair gate	Immediately	Tahmoor Coking Coal Operations
				Repair gate	As soon as possible	Tahmoor Coking Coal Operations
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 Coking Coal Operations (GeoTerra)
			Cracks observed in dam	Repair cracks	As required	Tahmoor Coking Coal Operations
			Loss of water supply due to leakage of dam wall or floor	Supply water to landowner	As required	Tahmoor Coking Coal Operations

7.0 SRG REVIEW MEETINGS

The SRG undertakes reviews and, as necessary, revises and improves the risk control measures to manage risks to health and safety and the potential impacts to building structures. The reviews are undertaken regularly during active subsidence based on the results of the weekly surveys and visual inspections and summarised in the monitoring reports, as described in Section 6.3.

The purposes of the reviews are to:

- detect changes, including the early detection of potential impacts on health and safety and impacts to building structures;
- verify the risk assessments previously conducted;
- ensuring the effectiveness and reliability of risk control measures; and
- supporting continual improvement and change management.

SRG meetings will be held 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.

SRG 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 SRG may call an emergency SRG 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.

8.0 AUDIT AND REVIEW

This Management plan can be reviewed and updated to continually to improve the risk management systems based on audit, review and learnings from the development of subsidence during mining and manage changes in the nature, likelihood and consequence of subsidence hazards.

The review process will be conducted to achieve the following outcomes:

- gain an improved understanding of subsidence hazards based on ongoing subsidence monitoring and reviews, additional investigations and assessments as necessary, ongoing verification of risk assessments previously conducted, ongoing verification of assumptions used during the subsidence hazard identification and risk assessment process, ongoing understanding of subsidence movements and identified geological structures at the mine;
- revise risk control measures in response to an improved understanding of subsidence hazards;
- gain feedback from stakeholders in relation to managing risks, including regular input from property and business owners;
- ensure on-going detection of early warnings of changes from the results of risk assessments to facilitate corrective or proactive management actions or the commencement of emergency procedures in a timely manner;
- ensure timely implementation of a contingency plan in the event that the implemented risk control measures are not effective.

Some examples where review may be applied include:

- 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; and
- observation of significant variation between observed and predicted subsidence.

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

9.0 RECORD KEEPING

Tahmoor Coking Coal Operations will keep and distribute minutes of the SRG meetings.

10.0 CONTACT LIST

Organisation	Contact	Phone	Email / Mail	Fax
NSW Department of Planning and Environment – Resources Regulator (RR)	Phil Steuart	(02) 4063 6484	phil.steuart@planning.nsw.gov.au	-
	Gang Li	(02) 4063 6429 0409 227 986	gang.li@planning.nsw.gov.au	-
	Ray Ramage	(02) 4063 6485 0442 551 293	ray.ramage@planning.nsw.gov.au	-
JMA Solutions (JMA)	John Matheson*	(02) 9979 6618	john@jmasolutions.com.au	(02) 9999 0121
Subsidence Advisory NSW (SA NSW)	Matthew Montgomery	(02) 4677 1967 0425 275 564	matthew.montgomery@finance.nsw.gov.au	(02) 4677 2040
Mine Subsidence Engineering Consultants (MSEC)	Daryl Kay*	(02) 9413 3777 0416 191 304	daryl@minesubsidence.com	-
SIMEC Mining Tahmoor Coking Coal Operations Environment and Community Manager	Ron Bush	(02) 4640 0156 0437 266 998	Ron.Bush@simecgfg.com	(02) 4640 0140
SIMEC Mining Tahmoor Coking Coal Operations – Environment and Community Officer	Belinda Clayton*	(02) 4640 0133 0436 331 630	Belinda.Clayton@simecgfg.com	(02) 4640 0140
Tahmoor Coking Coal Operations	Tahmoor Coking Coal Operations Control 24 hour contact	1800 154 415	-	-

* denotes member of Structures Response Group

APPENDIX A.

Please refer to the following documents:

- Drawing No. MSEC945-00-01 Monitoring over Longwall 32
- Drawing No. MSEC945-12-02 Structures
- Glencore (2017) Glencore Coal Assets Australia Risk Management Matrix
- Tahmoor Coal (2018) Environmental Risk Assessment: Tahmoor Underground – Longwall 32 Surface and Subsurface Infrastructure – Built Structures, Tahmoor Coking Coal Operations, May 2018.
- Table A.1 Hazard identification and engineering controls for Longwall 32
- GHD (2018) SIMEC Mining – Tahmoor Coking Coal Operations – Landslide Risk Assessment for identified 'steep' slopes – Specific properties in environs of LW32. GHD Geotechnics, Report No. 221896, dated July 2018.

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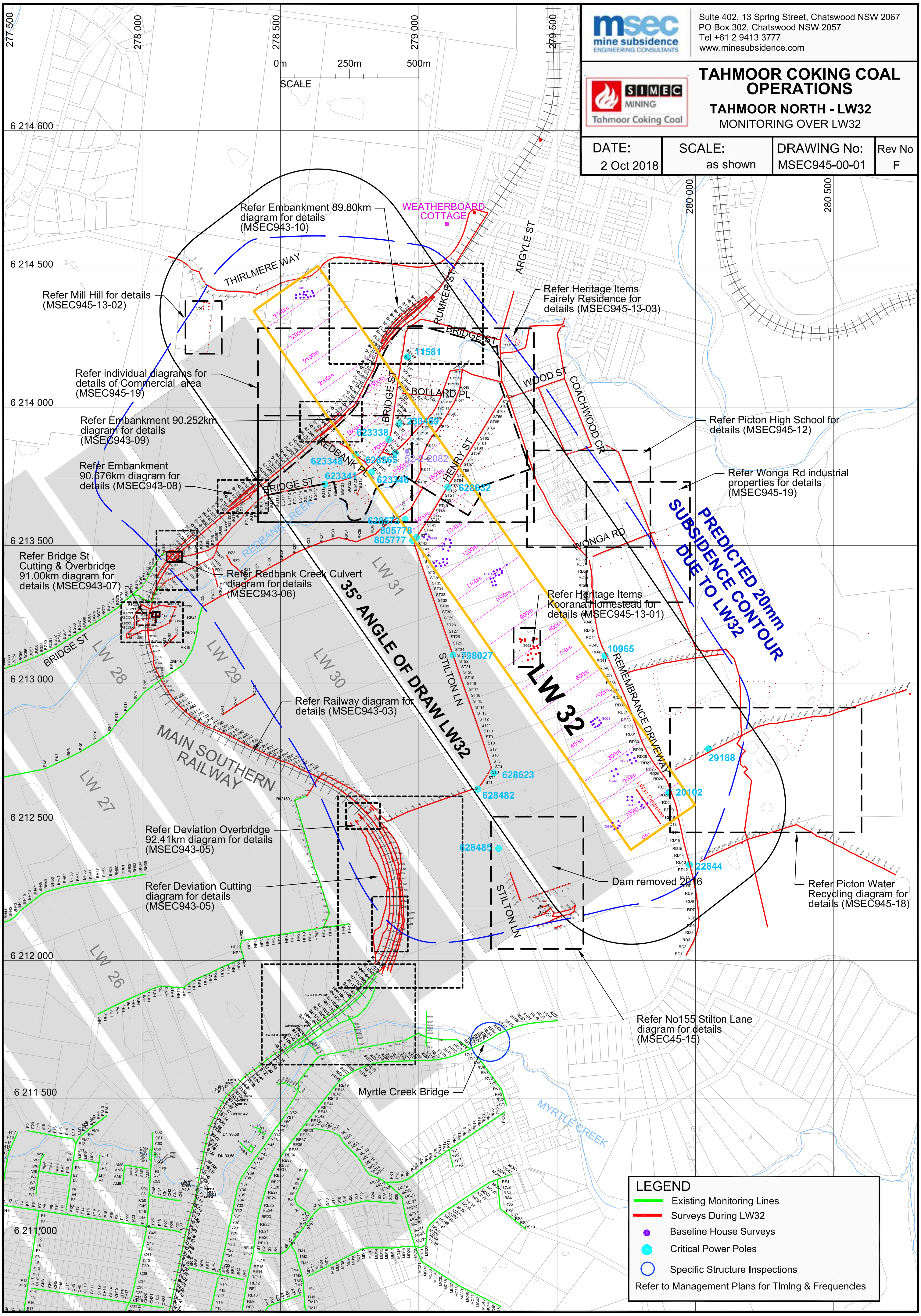
SIMEC MINING Tahmoor Coking Coal

TAHMOOR COKING COAL OPERATIONS

TAHMOOR NORTH - LW32

MONITORING OVER LW32

DATE:	SCALE:	DRAWING No:	Rev No
2 Oct 2018	as shown	MSEC945-00-01	F



LEGEND

- Existing Monitoring Lines
- Surveys During LW32
- Baseline House Surveys
- Critical Power Poles
- Specific Structure Inspections

Refer to Management Plans for Timing & Frequencies

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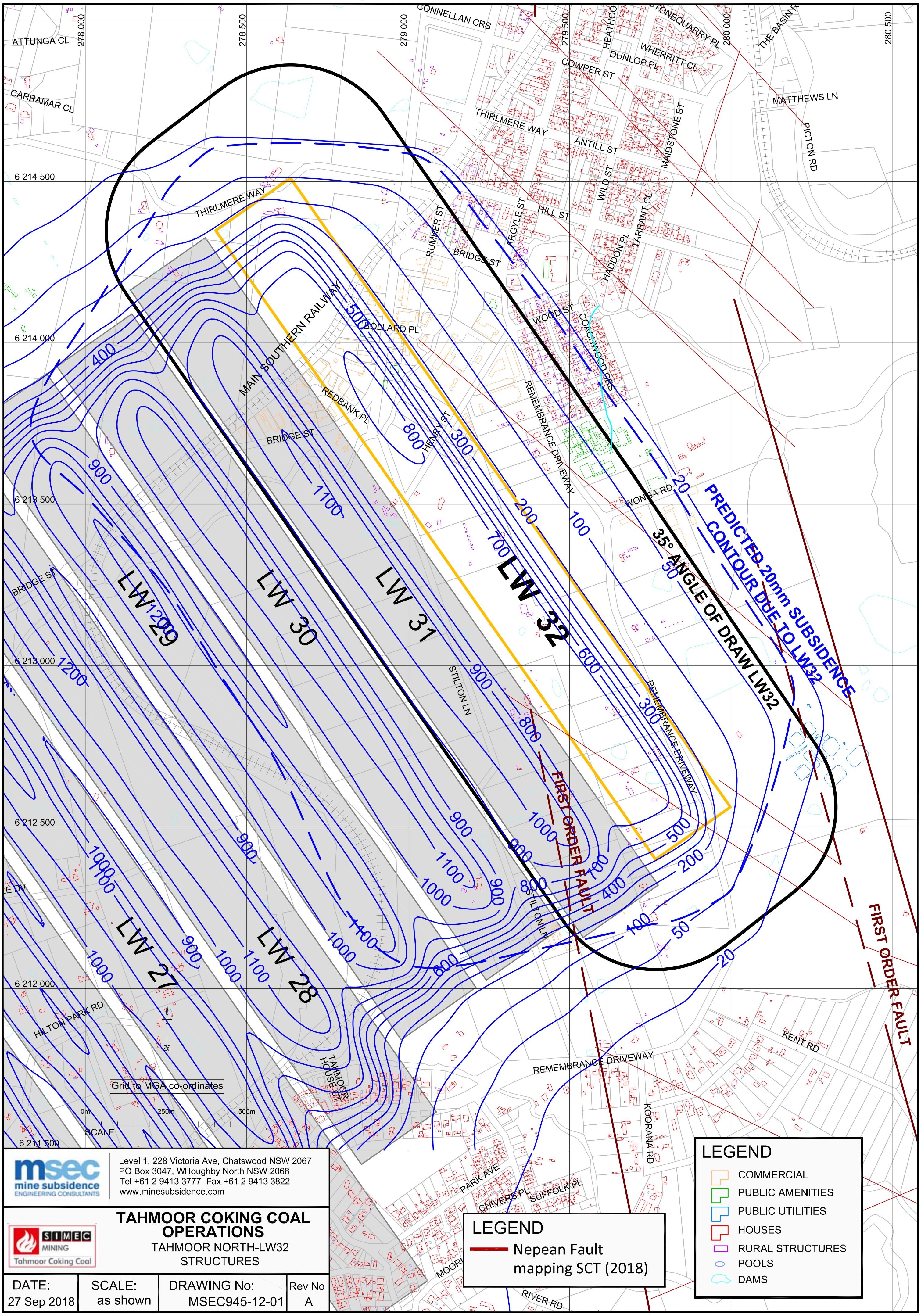

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SIMEC MINING Tahmoor Coking Coal

TAHMOOR COKING COAL OPERATIONS

TAHMOOR NORTH-LW32 STRUCTURES

DATE:	SCALE:	DRAWING No:	Rev No
27 Sep 2018	as shown	MSEC945-12-01	A

Appendix A - Glencore Coal Assets Australia Risk management Matrix

GLENCORE COAL ASSETS AUSTRALIA RISK MATRIX

CONSEQUENCE [potential foreseeable outcome of the event]

	Health & Safety	Environment	Financial Impact	Image & Reputation / Community	Legal & Compliance
5 Catastrophic	• Multiple fatalities • Multiple cases of permanent total disability / health effects	• Environmental damage or effect (permanent; >10 years) • Requires major remediation	• >$600M investment return • >$100M operating profit • >$20M property damage	• Negative media coverage at international level • Loss of multiple major customers or large proportion of sales contracts • Loss of community support • Significant negative impact on the share price	• Major litigation / prosecution at Glencore corporate level • Nationalisation / loss of licence to operate
4 Major	• Fatality or permanent incapacity / health effects	• Long-term (2 to 10 years) impact • Requires significant remediation	• $60-600M investment return • $20-100M operating profit • $2-20M property damage	• Negative media coverage at national level • Scrutiny from government and NGOs • Complaints from multiple "final" customers • Loss of major customer • Loss of community support • Negative impact on share price	• Major litigation / prosecution at Division level
3 Moderate	• Lost time / disabling injury / occupational health effects / multiple medical treatments	• Medium-term (<2 years) impact • Requires moderate remediation	• $6-60M investment return • $2-20M operating profit • $200K-2M property damage	• Negative media coverage at local / regional level over more than one day • Complaint from a "final" customer • Off-spec product • Community complaint resulting in social issue	• Major litigation / prosecution at Operation level
2 Minor	• Medical Treatment Injury (MTI) / occupational health effects • Restricted Work Injury (RWI)	• Short-term impact • Requires minor remediation	• $600K-6M investment return • $200K-2M operating profit • $10-200K property damage	• Complaint received from stakeholder or community • Negative local media coverage	• Regulation breaches resulting in fine or litigation
1 Negligible	• First Aid Injury (FAI) / illness	• No lasting environmental damage or effect • Requires minor or no remediation	• <$600K investment return • <$200K operating profit • <$10K property damage	• Negligible media coverage	• Regulation breaches without fine or litigation

LIKELIHOOD [of the event occurring <u>with that consequence</u>]

Basis of Rating	E - Rare	D - Unlikely	C - Possible	B - Likely	A – Almost Certain
LIFETIME OR PROJECT OR TRIAL OR FIXED TIME PERIOD OR NEW PROCESS / PLANT / R&D	Unlikely to occur during a lifetime OR Very unlikely to occur OR No known occurrences in broader worldwide industry	Could occur about once during a lifetime OR More likely <u>NOT</u> to occur than to occur OR Has occurred at least once in broader worldwide industry	Could occur more than once during a lifetime OR As likely to occur as not to occur OR Has occurred at least once in the mining / commodities trading industries	May occur about once per year OR More likely to occur than not occur OR Has occurred at least once within Glencore	May occur several times per year OR Expected to occur OR Has occurred several times within Glencore
5 Catastrophic	15 (M)	19 (H)	22 (H)	24 (H)	25 (H)
4 Major	10 (M)	14 (M)	18 (H)	21 (H)	23 (H)
3 Moderate	6 (L)	9 (M)	13 (M)	17 (H)	20 (H)
2 Minor	3 (L)	5 (L)	8 (M)	12 (M)	16 (M)
1 Negligible	1 (L)	2 (L)	4 (L)	7 (M)	11 (M)

Consequence Category	Consequence Type	Ownership	Action
Cat. 5	Catastrophic Hazard	Divisional / Functional / Operational / Asset Leadership	• Quantitative or semi-quantitative risk assessment required. • Capital expenditure will be justified to achieve ALARP ('As Low As Reasonably Practicable'). • Catastrophic Hazard Management Plans (CHMP) must be implemented where practical, Crisis Management Plans (CMP) tested and Catastrophic Event Recovery Plans (CERP) developed.
Cat. 4 (Health & Safety consequence)	Fatal Hazard	Divisional / Functional / Operational / Asset Leadership	• Glencore SafeWork Fatal Hazard Protocols or appropriate management plans must be applied. • Capital expenditure will be justified to achieve ALARP.
Risk Rank	**Risk Rating**	**Ownership**	**Action**
17 to 25	High Risk	Divisional / Functional / Operational / Asset Leadership	• Install additional HARD and SOFT controls to achieve ALARP. • Capital expenditure will be justified to achieve ALARP.
7 to 16	Medium Risk	Operational / Asset Leadership	• install additional HARD and SOFT controls if necessary to achieve ALARP. • Capital expenditure may be justified.
1 to 6	Low Risk	Operational / Asset Leadership	• Install additional controls if necessary to achieve ALARP. • Capital expenditure is not usually justified.

Table 3-3 - Risk Control Effectiveness (RCE)

RCE	Guide
Poor or no existing controls	• Significant control gaps or no credible control; • Either controls do not treat root causes, are non-existent or, if they exist, they are ineffective; • Management has no confidence that any degree of control is being achieved due to poor control design; • Very limited or no operational effectiveness.
Require improvement	• Most controls are designed correctly and are in place and effective; • Controls may only treat some of the root causes of the risk, and/or are not currently effective and/or there may be an over-reliance on "reactive" controls; • Management has doubts about operational effectiveness and reliability; • More work is required to improve operating effectiveness.
Satisfactory	• Controls are well designed and appropriate for the risk; • Controls are largely "preventative" and address the root causes; • Management believes that they are effective and reliable at all times; • Nothing more to be done except review and monitor the existing controls.

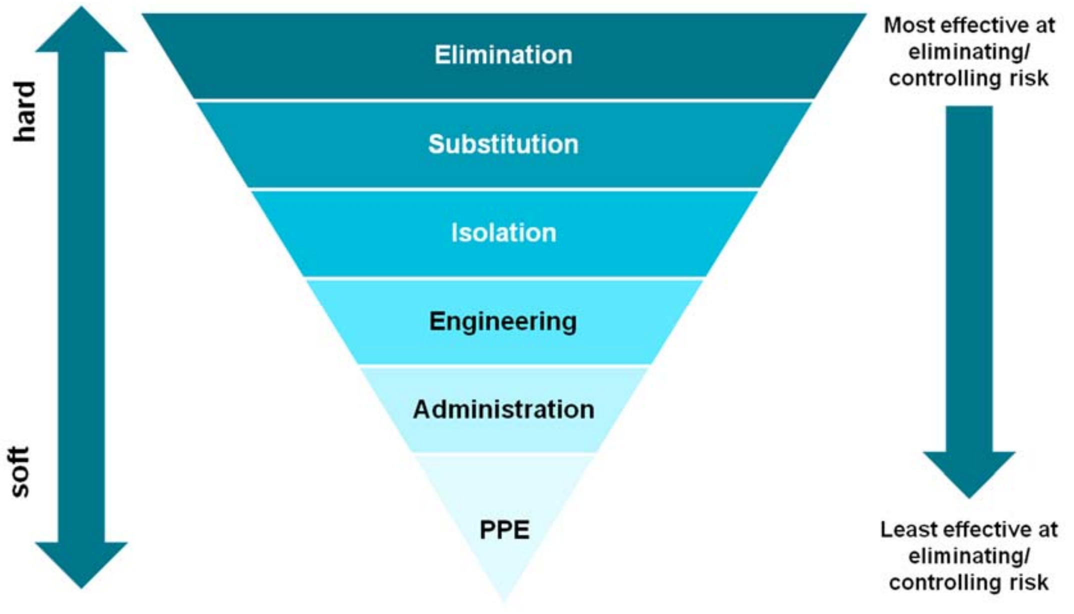

Figure 3-4 – Hierarchy of control

Table 3-4 - Priority for risk treatment authority for continued toleration of risk (applicable for risk assessment level 3 and 4)

Current risk rank	Action	Timing for authority	Authority for continued toleration of current level of risk
23 to 25	The activity must be stopped immediately until action to reduce the level of risk to less than 23 is undertaken or authority to continue is received.	Immediately to within 24 hours.	CE/COO Notification to CE prior to granting of authority to continue
17 to 22	The activity must be stopped immediately until action to reduce the level of risk to less than 17 is under taken or authority to continue is received.	The activity must be stopped immediately until action to reduce the level of risk to less than 17 is under taken or authority to continue is received.	Directors/COO Notification to COO prior to granting of authority to continue
10 to 16	Take action to reduce the level of risk to less than 10 or authority to continue is received.	Within 1 month.	General Managers / Operations Managers / Project Managers
7 to 9	Take action to reduce the level of risk to less than 7 or authority to continue is received.	Within 1 month.	Superintendents/ Managers / Project Team
1 to 6	Tolerable risk unless circumstances change	Ongoing control as part of a management system.	N/A

Environmental Risk Assessment: Tahmoor Underground - Longwall 32 Surface and Subsurface Infrastructure

	Step 2: Assess Type; Key Elements-These change depending on TYPE of Risk Assessment			Step 3: Identify the risks, causes and potential consequences			Step 4: Identify the existing controls to manage the identified risks	Step 5: Determine RCE	Steps 6, 7 & 8: Determine the Expected Consequence / Likelihood applicable to the Expected Consequence / Current level of risk				Step 10: PMC		Step 11: Treat the Risks					
Appendix B	Type of Risk Assessment	Key Element (CURA Context/Category)	Sub Key Element (If applicable)	Risk Description - Something happens......	Consequence - resulting in:	Causes - Caused by	Existing Control Description	Risk Control Effectiveness	Expected Consequence Category	Expected Risk Consequence	Risk Likelihood	Current Risk Rating	Potential Maximum Consequence	Potential Maximum Category	Treatment plans/tasks (Description)	Task Owner	Due Date	Comments	Date Assessment carried out	Action# (CURA/ Xstrasafe)
Tahmoor Underground	Equipment	Structures	Built structures	Impact on health and safety of people	Injury to person	Subsidence resulting in failure of a structural element.	Pre-mining inspections, inc. structural and geotech inspections where required (including structures located over and/or adjacent to mapped secondary geological structures) Implementation of mitigation measures if recommended by structural/geotech engineers Consultation, coordination and cooperation with residents Ground survey along streets Visual inspections TARP including repair of structures, relocation if required Analysis and reporting Consultation, coordination and cooperation with Subsidence Advisory NSW	2	Health & Safety	4	E	10	4	Health & Safety	Infrastructure Management Plan for LW32 (including TARP - including emergency evacuation procedure).	Belinda Clayton	31-Jul-18			
Tahmoor Underground	Equipment	Structures	Built structures	Damage to structures	Repair of structures	Subsidence	Pre-mining inspections, inc. structural and geotech inspections where required (including structures located over and/or adjacent to mapped secondary geological structures) Implementation of mitigation measures if recommended by structural/geotech engineers Consultation, coordination and cooperation with residents Ground survey along streets Visual inspections TARP including repair of structures, relocation if required Analysis and reporting Consultation, coordination and cooperation with Subsidence Advisory NSW	2	Property Damage	2	C	8	2	Property Damage	Infrastructure Management Plan for LW32 (including TARP - including emergency evacuation procedure).	Belinda Clayton	31-Jul-18			
Tahmoor Underground	Equipment	Pools	Built structures	Impact on health and safety of people	Injury to person / single fatality	Subsidence causing damage to pool gate	Pre-mining inspections, inc. structural and geotech inspections where required (including structures located over and/or adjacent to mapped secondary geological structures) Implementation of mitigation measures if recommended by structural/geotech engineers Consultation, coordination and cooperation with residents Ground survey along streets Visual inspections Weekly check of pool gates and fences TARP including repair of structures, relocation if required Analysis and reporting Consultation, coordination and cooperation with Subsidence Advisory NSW	2	Health & Safety	4	E	10	4	Health & Safety	Infrastructure Management Plan for LW32 (including TARP - including emergency evacuation procedure).	Belinda Clayton	31-Jul-18			
Tahmoor Underground	Equipment	Pools	Built structures	Damage to pools	Repair of pool	Subsidence	Pre-mining inspections, inc. structural and geotech inspections where required (including structures located over and/or adjacent to mapped secondary geological structures) Implementation of mitigation measures if recommended by structural/geotech engineers Consultation, coordination and cooperation with residents Ground survey along streets Visual inspections Weekly check of pool gates and fences TARP including repair of structures, relocation if required Analysis and reporting Consultation, coordination and cooperation with Subsidence Advisory NSW	2	Property Damage	2	B	12	2	Property Damage	Infrastructure Management Plan for LW32 (including TARP - including emergency evacuation procedure).	Belinda Clayton	31-Jul-18			
Tahmoor Underground	Equipment	Septic tanks	Built structures	Damage to septic tanks	Repair of tanks	Subsidence	Pre-mining inspections, inc. structural and geotech inspections were required Implementation of mitigation measures if recommended by structural/geotech engineers Consultation, coordination and cooperation with residents Ground survey along streets Visual inspections TARP including repair of structures, relocation if required Analysis and reporting Consultation, coordination and cooperation with Subsidence Advisory NSW	2	Property Damage	1	E	1	2	Property Damage	Infrastructure Management Plan for LW32 (including TARP - including emergency evacuation procedure).	Belinda Clayton	31-Jul-18			
Tahmoor Underground	Equipment	Farm dams	Built structures	Damage to septic tanks	Leak of dam water	Subsidence	Subsidence Management Plan for LW31 (including TARP - including emergency evacuation procedure). Pre-mining inspections, incl structural and geotech inspections were required Implementation of mitigation measures if recommended by structural/geotech engineers Consultation, coordination and cooperation with residents Ground survey along streets Visual inspections TARP including repair of structures, relocation if required Analysis and reporting Consultation, coordination and cooperation with Subsidence Advisory NSW	3	Environment	2	E	3	2	Environment						

Subtotal CountA (ignoring hidden values)

Table A.1 - Hazard Identification and Engineering Controls for LW32

Structure Reference	Structure Type	Description	Hazard identification and recommendations by structural engineer	Hazard identification and recommendations by geotechnical engineer	Mine operator's management actions in response to engineer's recommendations	Requirement for a Subsidence Hazard Mitigation Plan	Expected active subsidence period affecting property
V06a	H	House	Brick chimneys are essential plumb and within normal construction tolerances. Baseline tilt measurements taken. Ground surveys and inspections during period of active subsidence. Small shed in poor condition. Barricade around structure to prevent access. Inground pool damaged, disused and full of vegetation cuttings. Control safe access to pool.	The house is set back from the crest of the slope and is not expected to be impacted. A shed has steep slopes to the east in the adjacent property. The slopes appear to be back scarps of old slope instability features associated with long-term slope retreat processes and as such will be prone to regress over time. Risk is unchanged with subsidence impacts from LW32.	Structure of Heritage Significance. Refer separate PSMP, which includes ground surveys and visual inspections. No impacts observed during mining of LW31.	No	Sep-19 to Oct-19
V07a	H	House	No issues identified.	The house is set back from the crest of the slope and is not expected to be impacted. A swimming pool and levelled pad next to it has steep slopes to the east. The slopes appear to be back scarps of old slope instability features associated with long-term slope retreat processes and as such will be prone to regress over time. Risk is unchanged with subsidence impacts from LW32.	Survey line installed along fenceline to adjacent property. Pool is scheduled for weekly inspections during LW31.	No	Aug-19 to Oct-19
V08a	H	House	No issues identified.	Natural slopes within property but no issues identified. Some local distress observed to a retaining structure beneath tanks, which is being addressed by the landowner.	No additional management actions to standard actions specified in Built Structures Management Plan. Survey line along Thirlmere Way is approximately 70m from structures.	No	Aug-19 to Oct-19
V09b	H	House	No issues identified.	Inspection required prior to 1850m of extraction.	Survey lines along Thirlmere Way and Main Southern Railway. Reconsider following inspection by geotechnical engineer.	No	Jul-19 to Oct-19
V11a	H	House	No issues identified.	Moderately sloping ground. No mass movement features observed.	Impacts previously observed but no hazards to health and safety. House directly above previosly mined LW30. No additional management actions to standard actions specified in Built Structures Management Plan.	No	Jul-19 to Oct-19
V15a	H	House	No issues identified.	Steep slopes comprise grassed paddock with no evidence of mass movement.	No additional management actions to standard actions specified in Built Structures Management Plan. Survey line along Thirlmere Way is approximately 20m from structures.	No	Sep-19 to Oct-19
GG11a	H	House	The house has four brick chimneys, with significant existing tilts of 68mm/m west and 12mm/m west for the two, 30 brick course chimneys that are closest to Stilton Lane. Further investigations are recommended to determine a suitable management strategy.	Not required.	Determine management strategy for leaning chimneys.	Yes	Apr-19 to Jul-19
GG28a	H	House	Many brick piers and foundation walls have significant tilt. Brick chimney has 27 brick courses above the roof, with a 4mm/m existing tilt to the west. Weekly visual inspections are recommended during mining.		Weekly visual inspections during mining.	No	Apr-19 to Jul-19
GG31a	H	House	Pre-existing damage to western wall of closed-in verandah. Additional bracing recommended and installed. Potential hazards associated with inadequate support of rood structure due to tilting of walls. An inspection of the roof cavity is recommended. Two piers supporting the verandah roof are in poor condition and require replacement. Timber structure supporting water tank is in very poor condition. It is recommended to drain the tank and remove or replace the support structure. The two-storey shed appears to have suffered termite damage. Access to the shed should be restricted.	Not required.	Refer Subsidence Hazard Identification, dated 31 July 2018. Installed structural bracing and supports to western wall of closed-in verandah. Inspect within roof cavity to confirm support condition of rafters on walls. Review serviceability of internal walls. Replace corner and central piers of verandah. Advise landowner to restrict access to two-storey shed, which appears to be termite damaged. Drain water tank and remove dilapidated tank support structure.	Yes	Mar-19 to May-19
GG36a	H	House	Significant impacts during LW31 on the northern wing of the main dwelling, and impacts on the swimming pool, pool gate, paved areas, driveway, rear gardens, garden walls at the rear pergola support piers. Significant additional damage likely to occur during mining of LW32.	House is setback from slopes. A timber retaining wall is bulging outwards.	Refer LW31 Subsidence Event Notification, dated 26 April 2018. Temporary repairs during LW31, including replacement of pool fencing and repair of pool gate, removal of rear pergola, repairs of internal floor, ceilings and windows. Landowner will be relocated prior to influence of LW32. Property will be vacant during active subsidence of LW32, after which it will be repaired.	Yes	Nov-18 to Feb-19
GG38e	C	Greenhouse	No issues identified.	The dam was inspected by geotechnical engineer, with no issues observed.	Refer separate PSMP for No. 155 Stilton Lane.	No	Oct-18 to Feb-19
GG41a	H	House	No issues identified.	Not required.	No additional management actions required.	No	Oct-18 to Feb-19
GG44a	H	House	No issues identified.	Not required.	No additional management actions required.	No	Oct-18 to Feb-19
GG46a	H	House	Inspect condition of upper chimney structure. Visually monitor the eastern elevation foundataion wall, which has lost mortar from the bed and perpend joints through weathering. Visually inspect semi-circular verandah, concrete path along northern side of building and two sheds that are south of the main residence, which are in poor existing condition.	No issues identified.	Inspect condition of upper chimney and consider additional management actions. Visually monitor during mining.	No	Oct-18 to Jan-19

Table A.1 - Hazard Identification and Engineering Controls for LW32

Structure Reference	Structure Type	Description	Hazard identification and recommendations by structural engineer	Hazard identification and recommendations by geotechnical engineer	Mine operator's management actions in response to engineer's recommendations	Requirement for a Subsidence Hazard Mitigation Plan	Expected active subsidence period affecting property
GG47a	H	House	Inspect and provide additional support if required to a steel post that support a central laminated timber beam that supports the roof above the living room. The timber deck is supported by a shelf angle that is bolted to the brick veneer wall of the residence. The masonry anchors have caused loss of support of these types of structure in the past and it is recommended that masonry bolts be inspected weekly during active subsidence.	No issues identified.	Inspect and support steel post as recommended. Visual inspections during active subsidence, as recommended. Baseline survey marks around house. Weekly surveys of pegs above centreline of LW32, which include pegs at the house.	No	Oct-18 to Jan-19
GG50a	H	House	Drain water tank on south side of house until the supporting piers are corrected. Outwards leaning tilt of brick foundation wall at rear of house. Temporary support is recommended during mining.	Not required.	Drain water tank until support is reinstated. Provide 900mm high x 600 x600 sandbag buttresses at 2.0m centres to shore-up the tilting northern foundation wall of the old residence.	Yes	Nov-18 to Jan-19
GG51a	H	House	Whilst unlikely to be affected by subsidence, it is recommended that landowner restrict access to 3 old timber sheds upslope of the house. Monitor slab joints between the verandah and main house during mining.	Not required.	Weekly visual inspections during mining.	No	Nov-18 to Jan-19
GG53a	H	House	No issues identified.	Not required.	No additional management actions required.	No	Dec-18 to Feb-19
PAR_226_h01	H	House	No issues identified.	Not required.	No additional management actions required.	No	Apr-19 to Jul-19
PAR_264_h01	H	House	Concrete slab supporting rainwater tank on southern side of shed has a crack and step of 30mm. Baseline level survey has been conducted. Weekly visual inspections recommended. Chimney present on property with no issues identified.	Not required.	Structure of Heritage Significance. Refer separate PSMP, which will be developed and agreed with landowner prior to influence of LW32.	No	Jun-19 to Aug-19
PCD_004_h01	H	House	Brick arch collapsed above side gate.	Not required.	Notify resident of hazard.	No	Apr-19 to Jul-19
PCD_013_h01	H	House	No issues identified.	Not required.	No additional management actions required.	No	Apr-19 to Jun-19
PCD_057_h01	H	House	No issues identified.	Not required.	No additional management actions required.	No	Apr-19 to Jul-19
PRE_015_h01	H	House	The timber framed machinery shed has been damaged by termite activity. The owner should be advised to access at own risk. The timber posts supporting the pergola to the rear of the laundry are easily moved. It is recommended that they be tied back to the wall.	Not required.	Advise owner to access timber framed machinery shed at own risk. Tie back loose timber posts supporting pergola at rear of laundry.	Yes	Dec-18 to Mar-19
PRU_009_h01	H	House	No issues identified.	Not required.	No additional management actions required.	No	Jul-19 to Oct-19
PWD_001_h01	H	House	No issues identified.	Not required.	No additional management actions required.	No	May-19 to Aug-19