SIMEC Mining:

# Tahmoor North Western Domain Longwalls West 1 and West 2

Management Plan for Potential Impacts to Sydney Water Potable Water Infrastructure

## AUTHORISATION OF MANAGEMENT PLAN

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## DOCUMENT REGISTER

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| Aug-19 | MSEC1045-03 | A | Draft for submission to Sydney Water |
| Sep-19 | MSEC1045-03 | B | Final following consultation with Sydney Water |
| | | | |
| | | | |

References:-


AS/NZS 4360:1999 Risk Management

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

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

MSEC (2019) Tahmoor Coal - Longwalls W1 and W2 - Subsidence Predictions and Impact Assessments for Natural and Built Features due to the Extraction of the Proposed Longwalls W1 and W2 in Support of the Extraction Plan Application. (Report No. MSEC1019, Revision B, July 2019), prepared by Mine Subsidence Engineering Consultants.

Sydney Water (2018) Risk and Opportunity Matrix, Sydney Water, Version 7.0

Tahmoor Coal (2019) Risk Assessment Report – Infrastructure. Tahmoor North – Western Domain, Longwalls West 1 and West 2, April 2019.

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## LIST OF TABLES AND FIGURES

### Tables

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



### Figures

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



### Drawings

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

| *Drawing No.* | *Description* | *Revision* |
|---|---|---|
| MSEC945-00-01 | Monitoring over LW W1-W2 | 03 |
| MSEC1045-03-01 | Water Infrastructure | 01 |

## 1.1. Background

Tahmoor Coal is located approximately 80 km south-west of Sydney in the township of Tahmoor NSW. It is managed and operated by SIMEC Mining. Tahmoor Coal has previously mined 31 longwalls to the north and west of the mine's current location. It is currently mining Longwall 32.

Longwalls West 1 and West 2 (LW W1-W2) are the first two longwalls to be mined in the Western Domain. The longwall panels are located to the north of the current longwall series, and to the south of Cedar and Stonequarry Creeks. Potable water infrastructure owned by Sydney Water is located within this area.

A summary of the dimensions of LW W1-W2 are 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) |
|---|---|---|---|
| LW W1 | 1875 | 283 | - |
| LW W2 | 1685 | 283 | 39 |

This Management Plan provides detailed information about how the risks associated with mining beneath Sydney Water's potable water infrastructure will be managed by Tahmoor Coal and Sydney Water.

The Management Plan is a live document that can be amended at any stage of mining, to meet the changing needs of Tahmoor Coal and Sydney Water.

## 1.2. Sydney Water's Potable Water assets potentially affected by LW W1-W2

The locations of Sydney Water's Potable Water infrastructure in relation to LW W1-W2 are shown in Drawing No. MSEC1045-03-01.

The potable water infrastructure comprises 100 mm and 180 mm diameter uPVC pipes that generally follow the local roads. Part of the network is located directly above the southern end of LW W1. The total length of pipelines located directly above LW W1 is approximately 500 metres.

## 1.3. Consultation

### 1.3.1. Consultation with Sydney Water

Tahmoor Coal regularly consults with Sydney Water in relation to mine subsidence effects from mining. This includes consultation during the development of Subsidence Management Plans for previous Longwalls 22 to 32, and regular reporting of subsidence movements and impacts.

Details regarding consultation and engagement are outlined below:

- Provision of the draft Subsidence Management Plan for LW W1-W2 to Troy Cooper (Sydney Water) by Daryl Kay (MSEC) in August 2019.
- Provision of final Subsidence Management Plan for LW W1-W2 following feedback provided by Troy Cooper (Sydney Water) on 17 September 2019.

Tahmoor Coal will continue to consult regularly with Sydney Water during the extraction of LW W1-W2 in relation to mine subsidence effects from mining.

### 1.3.2. Consultation with Government Agencies & Key Infrastructure Stakeholders

Government agencies including the NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations, Subsidence Advisory NSW and key infrastructure stakeholders including Wollondilly Shire Council, Endeavour Energy, Telstra and Jemena have also been consulted as part of the Extraction Plan approval process.

## 1.4. Limitations

This Management Plan is based on the predictions of the effects of mining on surface infrastructure as provided in Report No. MSEC1019 by Mine Subsidence Engineering Consultants (MSEC, 2019). Predictions are based on the planned configuration of LW W1-W2 at Tahmoor Coal (as shown in Drawing No. MSEC1045-03-01), along with available geological information and data from numerous subsidence studies for longwalls previously mined in the area.

Infrastructure considered in this Plan has been identified from site visits and aerial photographs and from discussions between Tahmoor Coal and Sydney Water representatives.

The impacts of mining on surface and sub-surface features 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 report MSEC1019 by Mine Subsidence Engineering Consultants.

As discussed in the report, 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 will limit the impacts by establishing appropriate procedures that can be followed should evidence of increased impacts emerge.

## 1.5. Objectives

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

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

- Ensure the safe and serviceable operation of all surface infrastructure. Public and workplace safety is paramount. Ensure that the health and safety of people who may be present on public property are not put at risk due to mine subsidence.
- Avoid disruption and inconvenience, or, if unavoidable, keep to minimal levels.
- Monitor ground movements and the condition of infrastructure during mining.
- Initiate action to mitigate or remedy potential significant impacts that are expected to occur on the surface.
- 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 that may require emergency evacuation, entry or access restriction or suspension of work activities.
- Provide a forum to report, discuss and record impacts to the surface. This will involve Tahmoor Coal, Sydney Water, relevant government agencies as required, and consultants as required.
- Establish lines of communication and emergency contacts.

## 1.6. Scope

The Management Plan is to be used to protect and monitor the condition of the Sydney Water infrastructure identified to be at risk due to mine subsidence and to ensure that the health and safety of people who may be present on public property or Sydney Water property are not put at risk due to mine subsidence.

The major items at risk are:-

- Water pipelines

The pipelines are shown in Drawing No. MSEC1045-03-01, classified by pipe size and by pipe type.

The Management Plan only covers the potable water infrastructure that is located within the limit of subsidence, which defines the extent of land that may be affected by mine subsidence as a result of mining LW W1-W2 only. The management plan does not include other potable water infrastructure owned by Sydney Water which lies outside the extent of this area.

This Management Plan does not include Sydney Water sewer infrastructure. There is no Sydney Water sewer infrastructure above LW W1-W2.

## 1.7. Proposed Mining Schedule

It is planned that LW W1-W2 will extract coal working south from the northern end. This Management Plan covers longwall mining until completion of mining in LW W2 and for sufficient time thereafter to allow for completion of subsidence effects. The current schedule of mining is shown in Table 1.2.

**Table 1.2 Schedule of Mining**

| Longwall | Start Date | Completion Date |
|---|---|---|
| LW W1 | October 2019 | August 2020 |
| LW W2 | September 2020 | May 2021 |

Please note the above Schedule is subject to change due to unforeseen impacts on mining progress. Tahmoor Coal will keep Sydney Water informed of changes.

## 1.8. Definition of Active Subsidence Zone

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

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

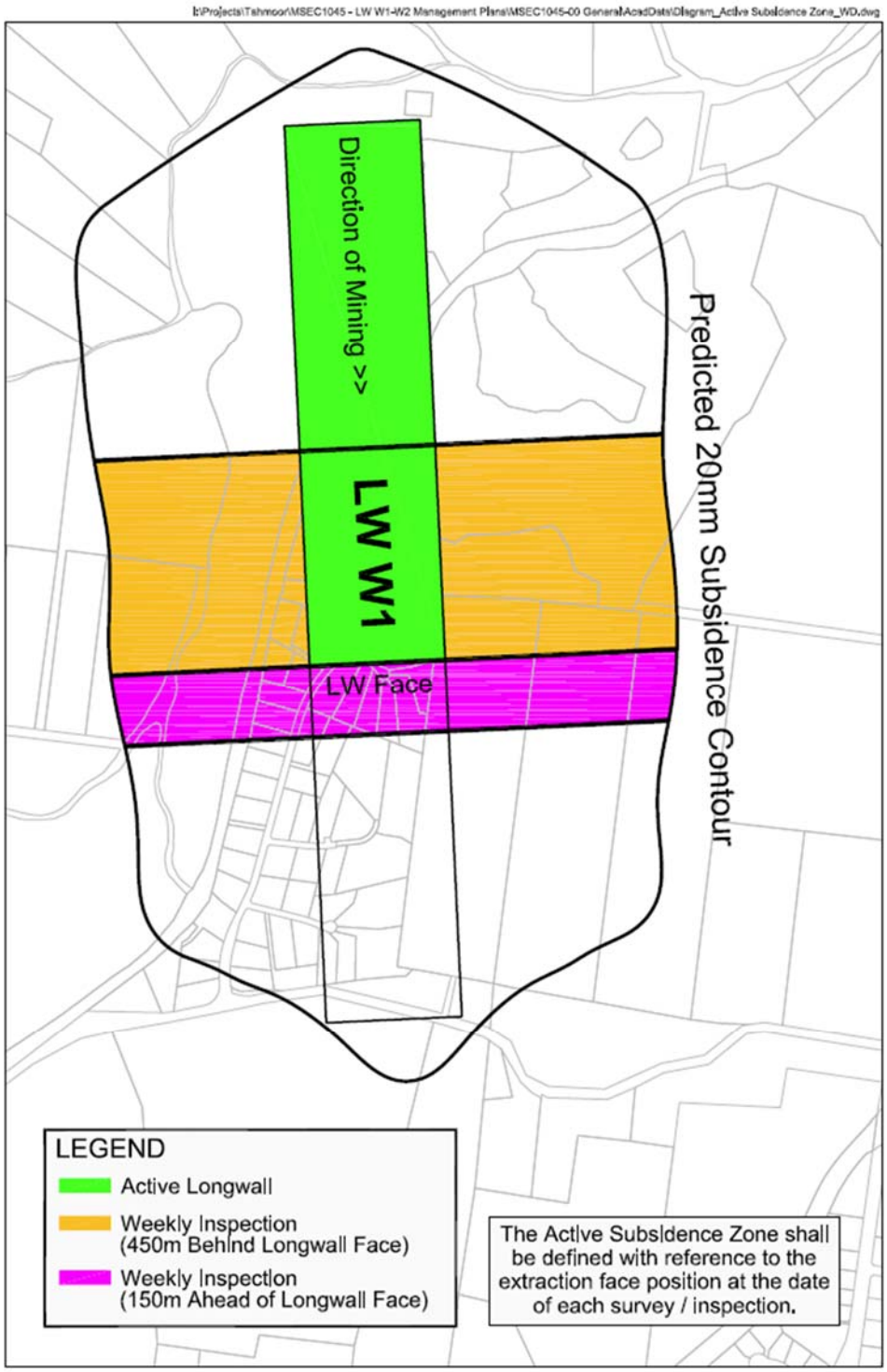



**Fig. 1.1 Diagrammatic Representation of Active Subsidence Zone**

## 1.9. Compensation

The *Coal Mine Subsidence Compensation Act 2017* (MSC Act) is administered by Subsidence Advisory NSW (Mine Subsidence Board).

Currently, under the *Coal Mine Subsidence Compensation Act 2017*, any claim for mine subsidence damage needs to be lodged with Subsidence Advisory NSW. Subsidence Advisory NSW staff will arrange for the damage to be assessed by an independent specialist assessor. If the damage is attributable to mine subsidence, a scope will be prepared and compensation will be determined. For further details please refer to *Guidelines – Process for Claiming Mine Subsidence Compensation* at www.subsideneadvisory.nsw.gov.au.

## 2.1. NSW Work Health & 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 LW W1-W2 in accordance with the WHS laws.

## 2.2. General

The method of assessing potential mine subsidence impacts in the Management Plan is consistent with the Australian/New Zealand Standard for Risk Management (AS/NZS ISO 31000:2009). 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:-

### 2.2.1. 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.' The consequences of a hazard are rated from negligible to catastrophic.

### 2.2.2. Likelihood

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

### 2.2.3. Hazard

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

### 2.2.4. 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 SIMEC 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.

The assessment was repeated using Sydney Water's risk criteria (2018), which is attached to the Appendix.

## 3.1. Maximum predicted conventional subsidence parameters

Predicted mining-induced conventional subsidence movements were provided in Report No. MSEC1019, which was prepared in support of Tahmoor Coal's Extraction Plan for LW W1-W2. A summary of the maximum predicted total subsidence parameters due to the extraction of LW W1-W2 are provided in Table 3.1.

**Table 3.1 Maximum predicted conventional subsidence parameters for LW W1-W2**

| Longwall | Maximum predicted subsidence (mm) | Maximum predicted tilt (mm/m) | Maximum predicted hogging curvature (1/km) | Maximum predicted sagging curvature (1/km) |
|---|---|---|---|---|
| After LW W1 | 475 | 3.0 | 0.03 | 0.06 |
| After LW W2 | 750 | 5.5 | 0.06 | 0.11 |

The values provided in the above table are the maximum predicted conventional subsidence parameters which occur within the general mining area.

## 3.2. Comparison of measured and predicted subsidence for single panels

Predictions using MSEC's Incremental Profile Method have been continually tested and refined during the mining of previous Longwalls 22 to 31, as described in Report No. MSEC1019.

In this case, LW W1-W2 will be extracting in a new longwall series, which is located to the north of current LW 32.

Observed subsidence above single panels is typically more variable than above subsequent longwall panels in a series. The variations are due to different strengths of the overburden strata above the panel, which is supported on all four sides of the longwall.

A study on observed subsidence above previously extracted single panels at Tahmoor Mine was conducted by MSEC, with results provided in Report No. MSEC1019.

Whilst a reasonable correlation between measured and predicted subsidence was found for LW 22, which was the most recently extracted single panel in the Tahmoor North lease, a study of the overall history of subsidence above single panels at Tahmoor Mine found that actual subsidence above LW W1 could be greater than predicted. There are also other cases in the Southern Coalfield where measured subsidence above a single panel has been substantially less than predicted.

It is therefore planned to monitor the development of subsidence during the early stages of extraction of LW W1 to compare observations with predictions. This will initially be achieved by regular surveys along the centreline of LW W1, followed by monitoring of subsidence along the Picton-Mittagong Loop Line and survey lines along local roads.

## 3.3. 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, where the strains are of a low order of magnitude. The profiles of observed strain, therefore, can be irregular even when the profiles of observed 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 observed 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 report. The strains resulting from damaged or disturbed survey marks have also been excluded.

### 3.3.1. Analysis of strains measured in survey bays

For features that are in discrete locations, such as building structures, farm dams and archaeological sites, it is appropriate to assess the frequency of the observed maximum strains for individual survey bays.

*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 31 at Tahmoor Mine, 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*".

A histogram of the maximum observed total tensile and compressive strains measured in survey bays above goaf at Tahmoor Mine is provided in Fig. 3.1. 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, and this is also shown in this figure.

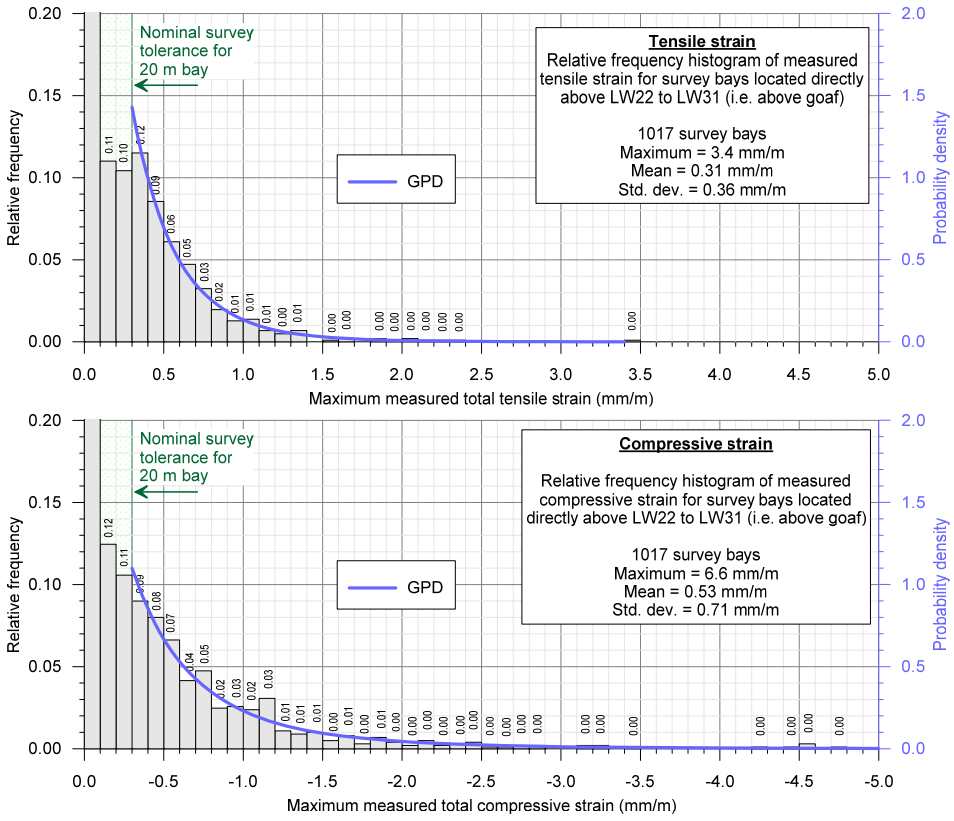



**Fig. 3.1 Distributions of the maximum measured tensile and compressive strains during the extraction of previous longwalls for survey bays located above goaf**

The 95 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining were 1.0 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 1.6 mm/m tensile and 3.4 mm/m compressive.

*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 31 at Tahmoor Mine, for survey bays that were located outside and within 200 metres of the nearest longwall goaf edge, which has been referred to as "*above solid coal*".

A histogram of the maximum observed tensile and compressive strains measured in survey bays above solid coal at Tahmoor Mine is provided in Fig. 3.2. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

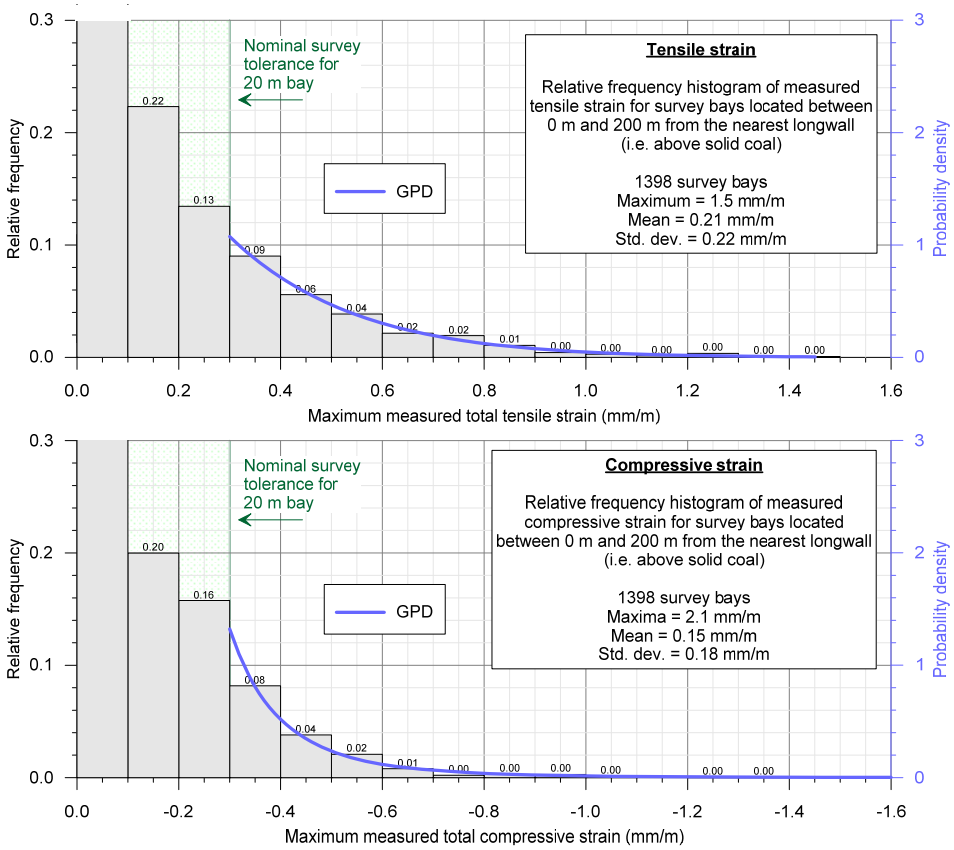



**Fig. 3.2 Distributions of the maximum measured tensile and compressive strains during the extraction of previous longwalls for survey bays located above solid coal**

The 95 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining were 0.7 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 1.0 mm/m tensile and 0.8 mm/m compressive.

### 3.3.2. Analysis of strains measured along whole monitoring lines

For linear features such as roads, cables and pipelines, it is more appropriate to assess the frequency of the maximum observed strains along whole monitoring lines, rather than for individual survey bays. That is, an analysis of the maximum strains measured anywhere along the monitoring lines, regardless of where the strain actually occurs.

A histogram of maximum measured total tensile and compressive strains measured anywhere along the monitoring lines, at any time during or after the extraction of the previous longwalls at the mine, is provided in Fig. 3.3.

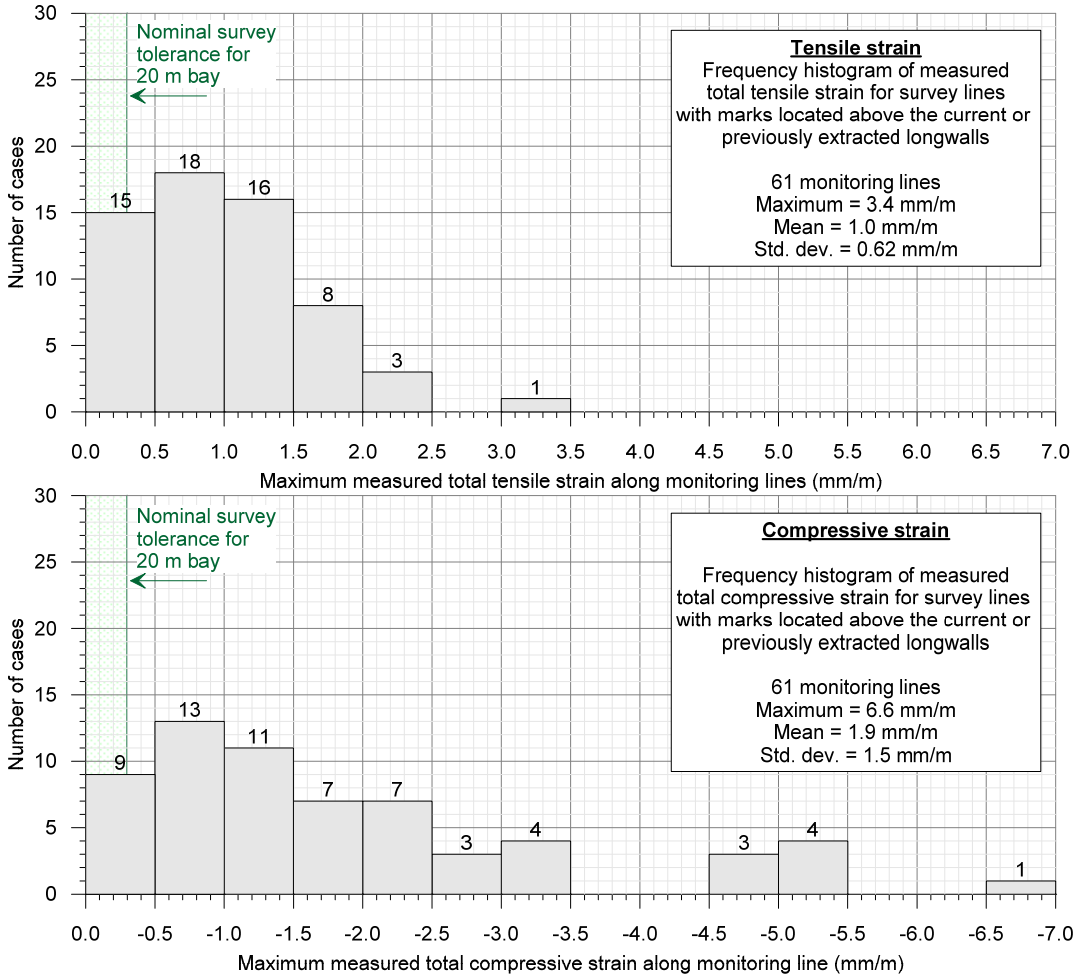



**Fig. 3.3 Distributions of maximum measured tensile and compressive strains along monitoring lines during the extraction of previous longwalls at the mine**

It can be seen from the above figure, that 33 of the 61 monitoring lines (i.e. 54 %) had recorded maximum total tensile strains of 1.0 mm/m, or less, and that 57 monitoring lines (i.e. 93 %) had recorded maximum total tensile strains of 2.0 mm/m, or less. It can also be seen, that 40 of the 61 monitoring lines (i.e. 66 %) had recorded maximum compressive strains of 2.0 mm/m, or less, and that 54 of the monitoring lines (i.e. 89 %) had recorded maximum compressive strains of 4.0 mm/m, or less.

## 3.4. Managing Public Safety

The primary risk associated with mining beneath Sydney Water infrastructure 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. It 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.

In the case of this Subsidence Management Plan, the potential for impacts on public safety has been assessed on a case by case basis.

### 3.4.1. Subsidence Impact Management Process for Infrastructure

Tahmoor Coal has developed and acted in accordance with a subsidence management plan to manage potential impacts during the mining of Longwalls 22 to 32. The management strategy has been reviewed and updated based on experiences gained during the mining of Longwalls 22 to 32 and the strategy for LW W1-W2 includes the following process:

1. Regular consultation with Sydney Water before, during and after mining.
2. Site-specific investigations.
3. Surveys and inspections during mining within the active subsidence area:
   - Detailed visual inspections and vehicle-based inspections along the streets
   - Ground surveys along streets
   - Specific ground surveys and visual inspections, where recommended by an engineer based on the inspections and assessments.

A flowchart illustrating the subsidence impact management process prior to, during and after Sydney Water infrastructure experiences mine subsidence movements is shown in Fig. 3.4.

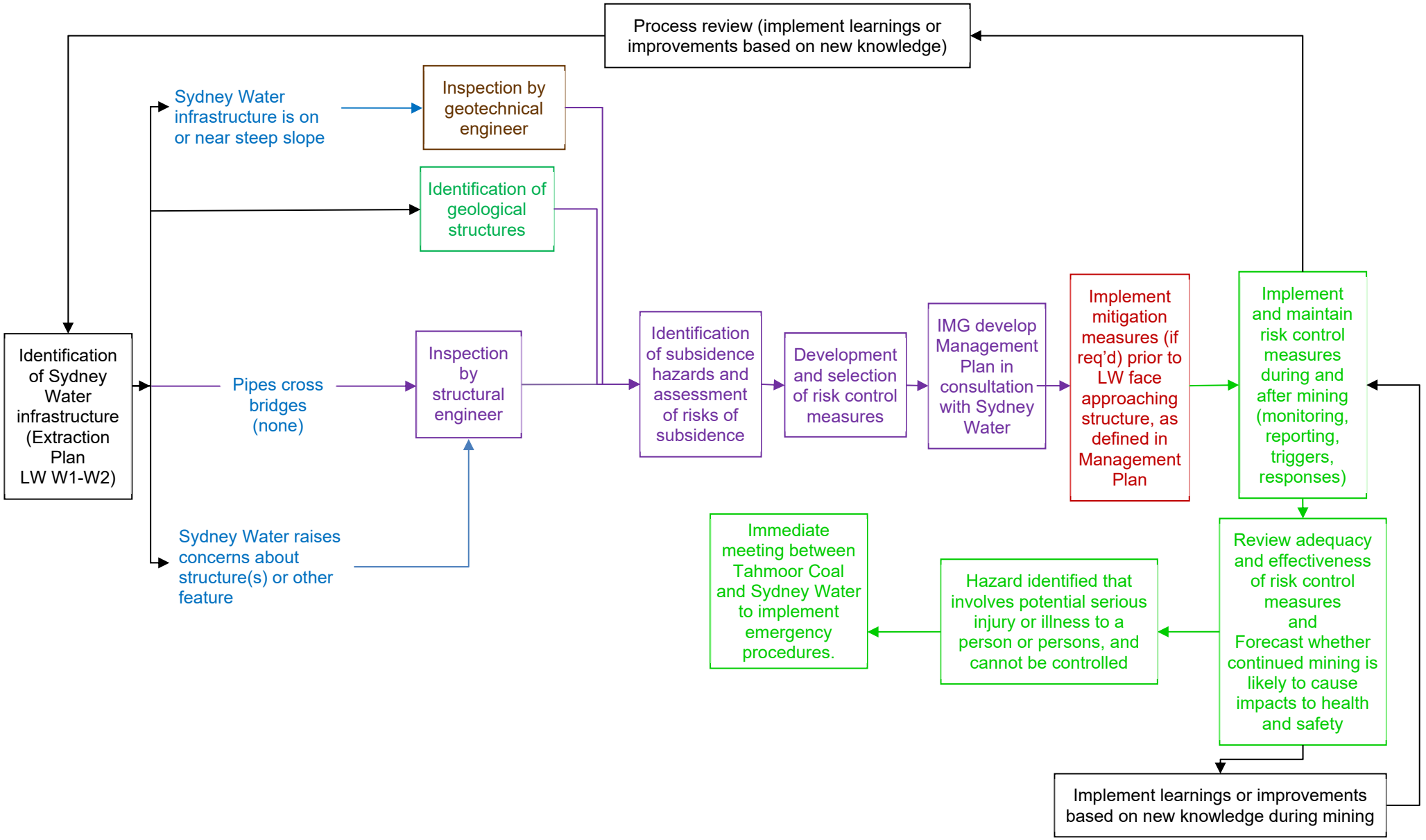



**Fig. 3.4 Flowchart for Subsidence Impact Management Process**

## 3.5. Summary of Potential Impacts

A summary of potential impacts on Sydney Water's Potable Water infrastructure is provided in Table 3.2. The summary is consistent with the risk assessment undertaken by Tahmoor Coal (2019), and was separately assessed according to Sydney Water's Risk Criteria (Sydney Water, 2018). The results of the risk assessment are included in the Appendix.

**Table 3.2 Summary of Potential Mine Subsidence Impacts**

| Risk | Likelihood | Consequence | Level of Potential Impact |
|---|---|---|---|
| **Tahmoor Coal Assessment** | | | |
| Leakage of the joints | UNLIKELY | MINOR | LOW |
| **Sydney Water Assessment** | | | |
| Leakage of the joints | UNLIKELY | NEGLIGIBLE | LOW |
| Leakage of water not detected or repaired for a long period of time, causing wastage of water and adding stress to water supply system | UNLIKELY | NEGLIGIBLE | LOW |

Additional information on each potential impact is provided below.

## 3.6. 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 Coal), 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 in Chapter 3, which could give rise to risks to health and safety of people in the vicinity of potable water infrastructure.

Using the processes described in Section 3.4 of this Management Plan, mine subsidence hazards have been identified, investigated and analysed in a systematic manner by examining each aspect of the infrastructure, as described in Section 3.7 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.

- Local reticulation network
- Water pipelines at creek crossings.

The following mine subsidence hazards were identified that could give rise to risks to health and safety due to the extraction of LW W1-W2.

- Water main break

The identification and risk assessment process took into account the location of infrastructure relative to LW W1-W2 and the associated timing and duration of the subsidence event, as described in Section 1.8 of this Management Plan.

Whilst mine subsidence predictions and extensive past experiences from previous mining at Tahmoor Coal 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 Sydney Water infrastructure, as discussed in Section 1.4 and Chapter 3 of this Management Plan. In this case, hidden creeks have been mapped that intersect water pipelines.

Tahmoor Coal 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 Sydney Water property in general. These are described in Chapter 4 of this Management Plan.

## 3.7. Potable water pipelines

There are a number of potable water pipelines that are located directly above or adjacent to LW W1-W2, as shown in Drawing No. MSEC1045-03-01.

- 180 mm diameter uPVC water mains

  As shown in Drawing No. MSEC1045-03-01, 180 mm diameter uPVC water mains are located directly above and adjacent to LW W1-W2. The water mains follow the alignments of Thirlmere Way and Stonequarry Creek Road. The pipe traverses Rumker Gully on Stonequarry Creek Road and also crosses small valleys along Stonequarry Creek Road at Carramar Close and Booyong Close.

- 100 mm diameter uPVC water mains along Carramar Close, Attunga Close and Booyong Close.

  As shown in Drawing No. MSEC1045-03-01, 100 mm diameter uPVC water mains are located directly above and adjacent to LW W1-W2. The water mains follow the alignments of Carramar Close, Attunga Close and Booyong Close.

### 3.7.1. Predicted subsidence movements

The potable water pipelines located above and adjacent to LW W1-W2 generally follow the alignments of the local roads.

The predicted profiles of conventional subsidence, tilt and curvature for the 180 mm diameter water main along Thirlmere Way is shown in Fig. 3.5. The predicted profiles of conventional subsidence, tilt and curvature for the 180 mm diameter water main along Stonequarry Creek Road is shown in Fig. 3.6.

A summary of the maximum predicted conventional subsidence, tilt and curvature for each of the potable water pipelines, after the extraction of LW W1-W2, is provided in Table 3.3 for Thirlmere Way and Table 3.4 for Stonequarry Creek Road. The values are the maximum predicted parameters anywhere along the sections of pipelines located within the predicted limit of vertical subsidence for LW W1-W2.

**Table 3.3 Maximum predicted total conventional subsidence, tilt and curvature for Thirlmere Way**

| Longwall | Maximum predicted total subsidence (mm) | Maximum predicted total tilt (mm/m) | Maximum predicted total hogging curvature (1/km) | Maximum predicted total sagging curvature (1/km) |
|---|---|---|---|---|
| After LW W1 | 80 | < 0.5 | 0.01 | < 0.01 |
| After LW W2 | 100 | < 0.5 | 0.02 | < 0.01 |

**Table 3.4 Maximum predicted total subsidence, tilt and curvature for Stonequarry Creek Road**

| Longwall | Maximum predicted total subsidence (mm) | Maximum predicted total tilt (mm/m) | Maximum predicted total hogging curvature (1/km) | Maximum predicted total sagging curvature (1/km) |
|---|---|---|---|---|
| After LW W1 | 425 | 2.0 | 0.02 | 0.05 |
| After LW W2 | 700 | 3.0 | 0.03 | 0.05 |

The water pipelines cross small tributaries directly above LW W1, including Rumker Gully and, therefore, could experience valley related effects.

The predicted profiles of total vertical subsidence, upsidence and closure along Rumker Gully are shown in Fig. 3.7. The maximum predicted valley related effects for the pipeline crossing at Stonequarry Creek Road are 50 mm upsidence and closure.

The maximum predicted valley related effects for the pipeline crossings along Stonequarry Creek Road at Carramar Close and Booyong Close are also 50 mm upsidence and closure.

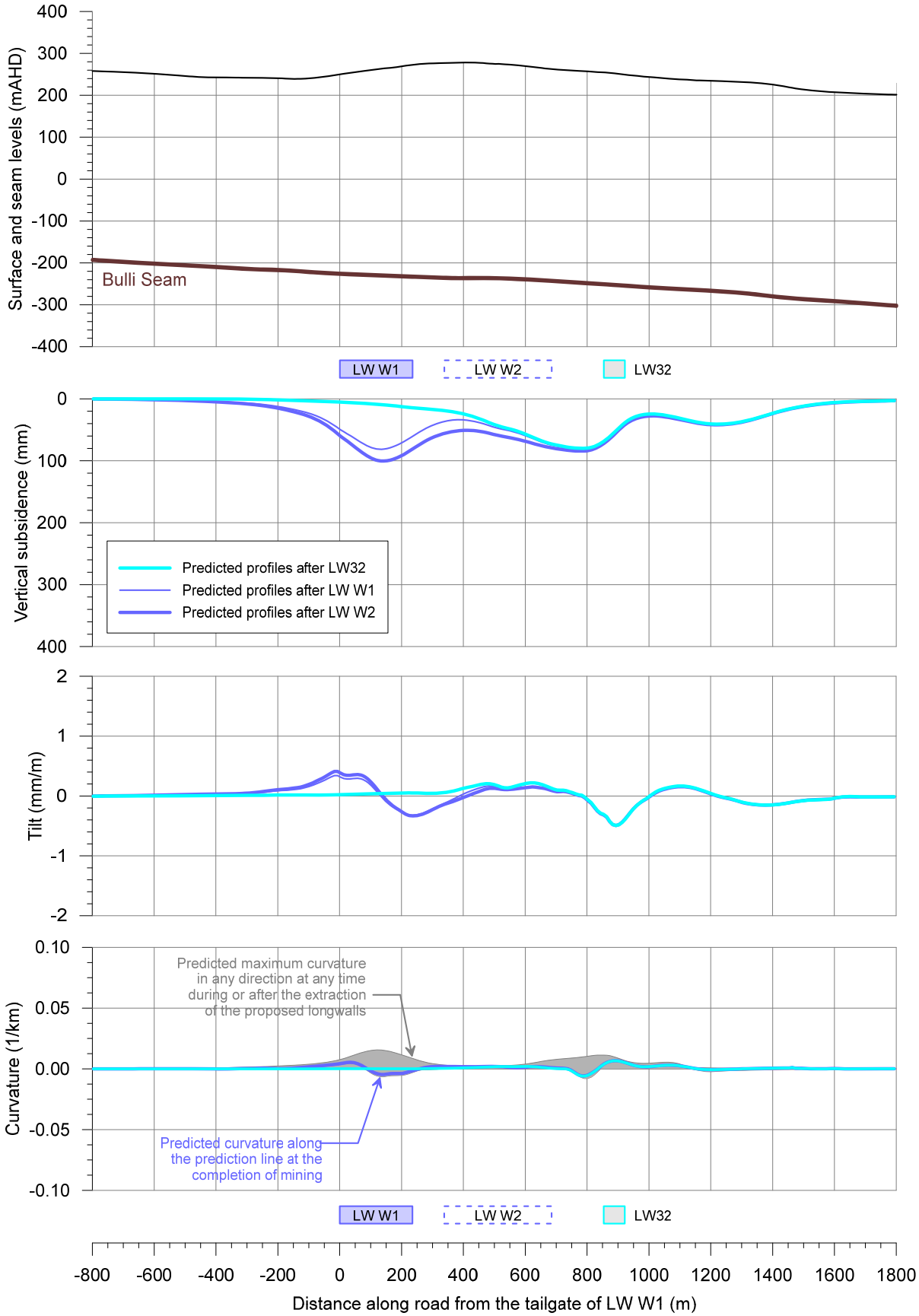



**Fig. 3.5 Predicted profiles of total subsidence, tilt and curvature for the water main along Thirlmere Way after the mining of LW W1-W2**

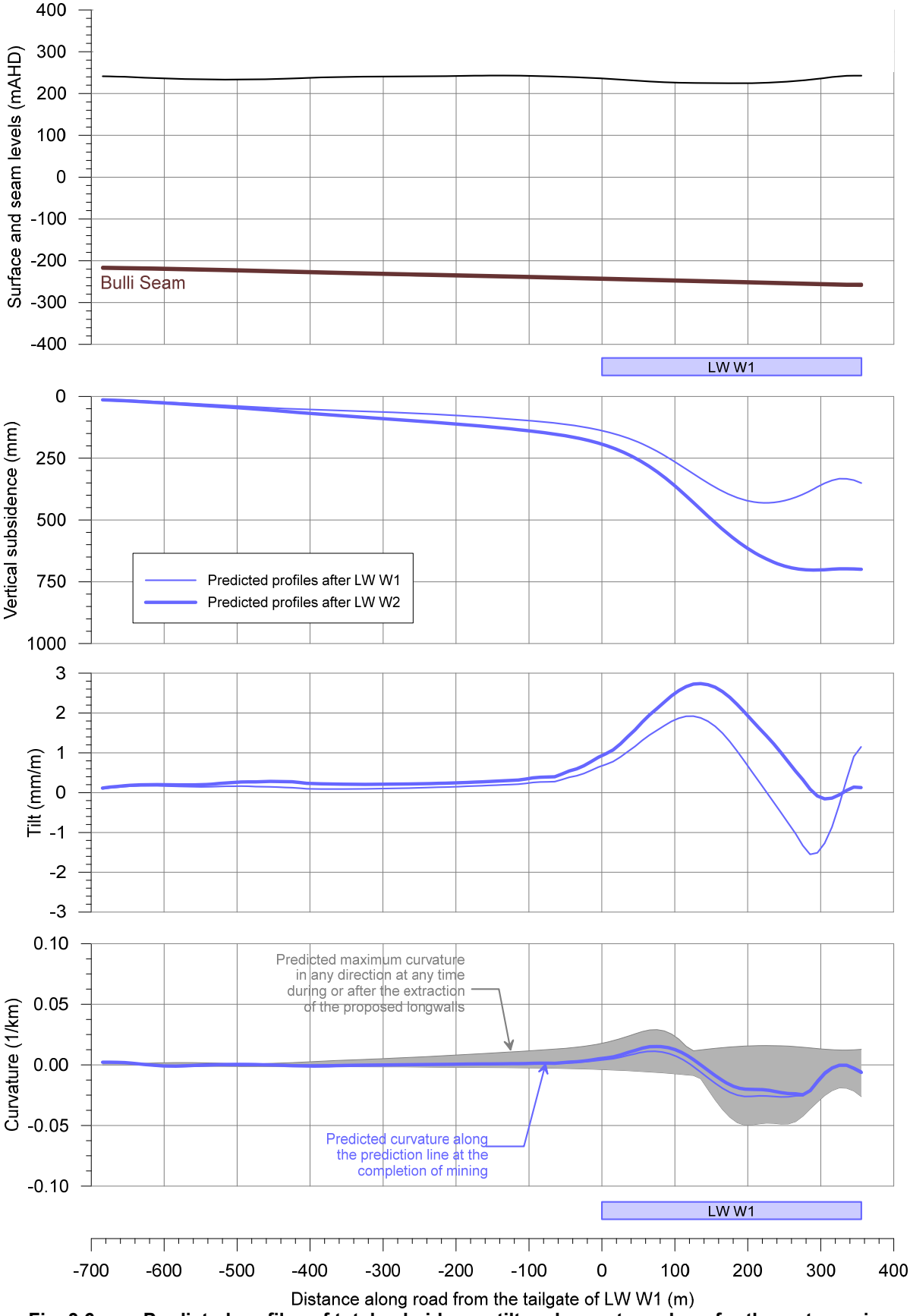



**Fig. 3.6 Predicted profiles of total subsidence, tilt and curvature along for the water main along Stonequarry Creek Road after the mining of LW W1-W2**

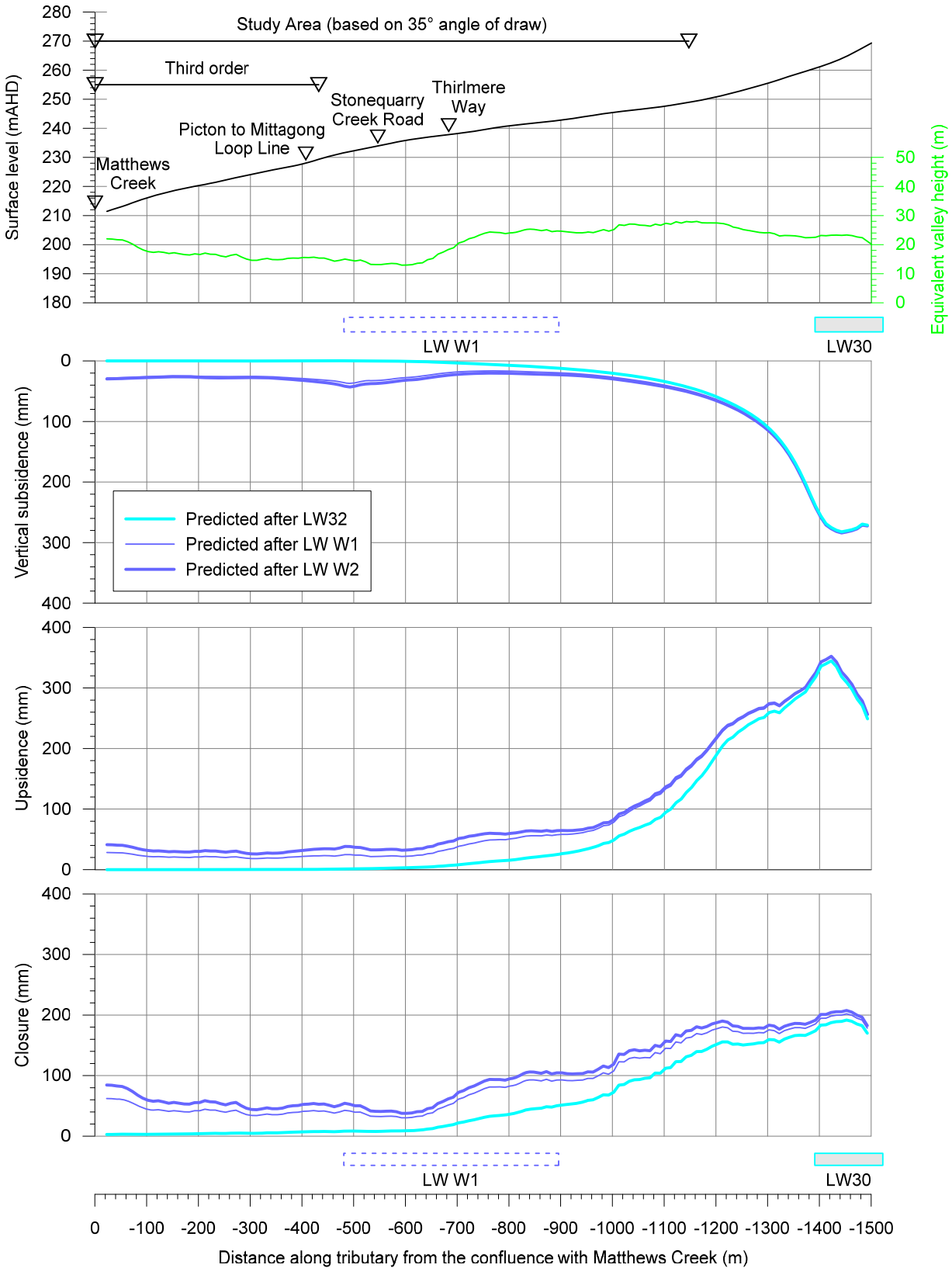



**Fig. 3.7 Predicted profiles of total subsidence, upsidence and closure along Rumker Gully after the mining of LW W1-W2**

### 3.7.2. Potential subsidence impacts on water pipelines

Longwalls 22 to 32 have directly mined beneath approximately 19.5 km CICL pipelines and approximately 5.8 km of DICL pipelines with only minimal adverse impacts on the distribution network. The reported adverse impacts on the potable water pipelines at Tahmoor Mine include:

- A leak in a CICL water main on Glenanne Place in June 2007 during the mining of Longwall 24B. While there was no ground survey data to quantify the ground movements, the leak coincided with damage to the road pavement and damage to a fence. It is considered that non-systematic movements developed at this location;
- A water leak was observed in a CICL water main on York Street opposite the Tahmoor Town Centre during the mining of Longwall 25. While no impacts were reported to the road pavement and no elevated ground strain was observed at the leak, a bump was observed in the subsidence profile near the location of the leak;
- A CICL water main leaked on Moorland Road during Longwall 26, where increased ground strains and a small bump in the subsidence profile were observed. The pipe was repaired the same day;
- A CICL water leak was observed on York Street on two occasions during Longwall 26, at a site where increased strain and a bump in the subsidence profile were observed. The leak was repaired each time;
- A very small number of minor leaks have also been observed to consumer connection pipes on private properties. Remedial works were undertaken and the leaks repaired; and
- A leak in a 100 mm diameter CICL water main on Myrtle Creek Avenue in January 2013 during the mining of Longwall 27, at a site where increased strain and a bump in the subsidence profile were observed. The leak was repaired the same day.
- A leak in the 200 mm diameter CICL water main on Remembrance Drive in February 2019 during the mining of Longwall 32, at a site where increased strain and a bump in the subsidence profile were observed. The leak was repaired the same day.

It is possible, but unlikely, that minor adverse impacts could occur to the potable water pipelines that are located directly above or immediately adjacent to LW W1-W2, similar to those observed above the previously extracted longwalls. The newer uPVC pipelines located within the Study Area are expected to be less susceptible to impacts from mine subsidence than the DICL and CICL pipelines located above the previously extracted longwalls. It is expected that the impacts would be relatively minor and that these could be readily repaired.

Sydney Water advises that the Bargo – Picton area (Nepean WFP) is currently under pressure to supply water during long periods of dry weather in the summer months due to a steady increase in customers in the region. Sydney Water has invested heavily in water saving measures in the last year. If mine subsidence movements were to result in leakages that go undetected over a long period of time, the loss of water would add stress to the existing system. It is further noted that there is no automated monitoring of water usage in the area due to the relatively small size of the network and Sydney Water currently relies upon notification by the public to identify and repair leaks. The risk due to mine subsidence can, however, be effectively managed by weekly visual inspections during the period of active subsidence.

Tahmoor Coal has developed and selected risk control measures in consultation, co-ordination and co-operation with Sydney Water in accordance with WHS legislation. The controls have been implemented during the mining of Longwalls 22 to 32.

In this instance, there are no reasonably practicable controls which could eliminate, substitute or isolate the identified risks, nor engineering controls that could put in place a structure or item that prevents or minimises risks. Tahmoor Coal has identified controls that will manage potential issues associated with damage to pipelines resulting in damage to potable water pipelines during the extraction of LW W1-W2 by implementing the following measures.

- Regular ground surveys along streets located within the active subsidence zone;
- Regular visual inspections along streets located within the active subsidence zone;
- Regular consultation with the community to report potential impacts;
- Exposing pipeline to relieve it of stress if triggered by monitoring results; and
- In the worst case, repair of damaged pipeline.

## 4.1. Infrastructure Management Group (IMG)

The Infrastructure Management Group (IMG) is responsible for taking the necessary actions required to manage the risks that are identified from monitoring the infrastructure and to ensure that the health and safety of people who may be present on public property or Sydney Water property are not put at risk due to mine subsidence. The IMG develops and reviews this management plan, collects and analyses monitoring results, determines potential impacts and provides advice regarding appropriate actions. The members of the IMG are highlighted in Chapter 8.

## 4.2. Development and Selection of Risk Control Measures

Tahmoor Coal has developed and selected risk control measures in consultation, co-ordination and co-operation with the infrastructure owner 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 Section 4.3 to Section 4.6. Prior to selecting Method B risk control measures, Tahmoor Coal has investigated and confirmed that the measures are feasible and effective for the site-specific conditions during the extraction of LW W1-W2.

## 4.3. Selection of Risk Controls for Potable Water Infrastructure

Based on the above assessments, Tahmoor Coal considered Method A and Method B risk control measures, in accordance with the process described in Section 4.2.

*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*

In this instance, no reasonably practicable engineering controls could be identified to put in place a structure or item that prevents or minimises risks.

*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 the health and safety of people in relation to mining-induced damage to potable water infrastructure.

- Implementation of a Monitoring Plan and Trigger Action Response Plan (TARP)
  As described in the Management Plan, Tahmoor Coal and Sydney Water has developed and implemented a management strategy of detecting early the development of potential adverse subsidence movements in the ground, so that contingency response measures can be implemented before impacts on the safety and serviceability develop. The TARP includes the following:
    - Local 2D surveys along local roads as shown in Drawing No. MSEC1045-00-01. These include streets along which potable water pipelines are located, including Thirlmere Way, Stonequarry Creek Road, Carramar Close, Attunga Close and Booyong Close.
    - Visual inspections along the streets within the active subsidence zone.
    - Additional surveys and/or inspections, if triggered by monitoring results.
    - Regular consultation with the community to report potential impacts.
    - Follow Sydney Water procedures to monitor and respond to high water pressure levels at water reducing valves.
    - Exposing pipeline to relieve it of stress if triggered by monitoring results
    - In the worst case, repair of damaged pipeline.

## 4.4. Monitoring Measures

A number of monitoring measures will be undertaken during mining.

### 4.4.1. Ground Surveys along streets and centrelines of LW W1-W2

Survey lines will be installed along the centrelines of LW W1-W2, as shown in Drawing No. MSEC1045-00-01, subject to approval for access by landowners.

The purpose of the survey lines is to establish the general magnitude and shape of surface subsidence along the centrelines of LW W1-W2. The observed subsidence movements will be used to provide early subsidence information to inform Tahmoor Mine and affected stakeholders prior to built surface features experiencing active subsidence, the majority of which are located at the central to southern end of LW W1-W2. The information will assist Tahmoor Mine and affected stakeholders in considering whether any additional measures are required to manage potential impacts on the built features.

The information will also be used by Tahmoor Mine as part of its ongoing review of subsidence effects on natural features.

The survey lines will consist of pegs spaced nominally every 20 metres, where access is available, noting that the centrelines pass through private property and building structures. Surveys will measure levels and horizontal distances between adjacent pegs.

Survey lines will be installed along Barkers Lodge Road, Thirlmere Way, Stonequarry Creek Road, Carramar Close, Attunga Close and Booyong Close, as shown in Drawing No. MSEC1045-00-01. The survey pegs will be surveyed during the period of active subsidence of these features during the extraction of LW W1-W2.

The surveys measure changes in height and changes in horizontal distances between adjacent pegs

### 4.4.2. Visual Inspections

Visual inspections will be undertaken during the period of active subsidence by an experienced inspector appointed by Tahmoor Coal who is familiar with mine subsidence impacts. The inspector will undertake the following:

- Visual inspections along streets within the active subsidence zone.
- Visual inspections at pipeline crossings under creeks.

### 4.4.3. Changes to Monitoring Frequencies

Monitoring frequencies will continue while Sydney Water infrastructure is experiencing active subsidence due to the extraction of LW W1-W2. As a general guide, monitoring is likely to continue until the longwall has moved away from the property by a distance of approximately 450 metres. Monitoring, however, may continue if ongoing adverse impacts are observed.

## 4.5. Triggers and Responses

Trigger levels have been developed by Tahmoor Coal based on engineering assessments and consultation with Sydney Water.

Trigger levels for each monitoring parameter are described in the risk control procedures in Table 4.1.

Immediate responses, if triggered by monitoring results, may include:

- Increase in survey and inspection frequencies if required by the IMG.
- Additional surveys and inspections.
- Exposing pipeline to relieve it of stress
- Repair of impacts that create a serious public safety hazard.
- In the worst case, restriction on entry, or access to, Sydney Water infrastructure.

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

With respect to the extraction of LW W1-W2, no potential hazards have been identified that could reasonably give rise to the need for an emergency response. Of the potential hazards identified in Section 3.6, only a water main break could possibly give rise to the need for an emergency response. The likelihood is considered extremely remote and would require substantial differential subsidence movements to develop before such an event occurs.

As discussed in Section 3.1, 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 Sydney Water.

As documented in Section 4.6, Tahmoor Coal and the IMG will review and assess monitoring reports and consider whether any additional management measures are required on a weekly basis. If potentially adverse differential subsidence movements are detected, it is anticipated that a focussed inspection will be undertaken in the affected area, 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 Coal will be present on site on a more frequent basis to survey or inspect the affected site, and that Sydney Water will be consulted on a more frequent basis.

Notwithstanding the above, if a hazard has been identified that involves potential serious injury or illness to a person or persons on public property or in the vicinity of potable water infrastructure, and 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 Coal or by people on public property, Tahmoor Coal and Sydney Water will immediately meet and implement emergency procedures.

## 4.6. Subsidence Impact Management Procedures

The procedures for the management of potential impacts to Sydney Water infrastructure are provided in Table 4.1.

**Table 4.1 Risk Control Procedures during the extraction of Tahmoor Coal LW W1-W2**

| INFRASTRUCTURE | HAZARD / IMPACT | RISK | TRIGGER | CONTROL PROCEDURE/S | FREQUENCY | BY WHOM? |
|---|---|---|---|---|---|---|
| Potable water infrastructure | Impacts to Sydney Water potable water infrastructure | Low | None | 2D survey lines along centrelines of LW W1-W2 | Install and baseline survey above LW W1 prior to commencement of LW W1.<br>Install and baseline survey above LW W2 prior to commencement of LW W2.<br>Monthly survey for pegs located within active subsidence zone after the length of the extraction of LW W1 and LW W2 exceeds 200 metres.<br>Full length at end of LW W1-W2 | Tahmoor Coal (SMEC) |
| | | | | Conduct visual inspections for surface deformations and water leaks along local roads within active subsidence zone | Weekly within active subsidence zone, commencing after 800 m of extraction, until one month after completion of LW W1-W2 | Tahmoor Coal |
| | | | | Conduct surveys along Stonequarry Creek Road<br>*Survey extending to the south to include pegs within the active subsidence zone, then reducing extent to the north beyond active subsidence zone unless ongoing adverse movements are observed* | Install and baseline survey prior to 500m of extraction of LW W1.<br>Weekly after 800 m of extraction of LWW1 and LW W2 until one month after completion of each LW unless ongoing adverse movements are observed | Tahmoor Coal (SMEC) |
| | | | | Conduct surveys along Booyong Close | Install and baseline survey prior to 500m of extraction of LW W1.<br>Weekly between 950 m of extraction and 1600 m of extraction of LW W1 and LW W2, unless ongoing adverse movements are observed | Tahmoor Coal (SMEC) |
| | | | | Conduct surveys along Attunga Close | Install and baseline survey prior to 1000m of extraction of LW W1.<br>Weekly after 1300 m of extraction until one month after completion of LW W1 and LW W2, unless ongoing adverse movements are observed | Tahmoor Coal (SMEC) |
| | | | | Conduct surveys along Carramar Close | Install and baseline survey prior to 1000m of extraction of LW W1.<br>Weekly after 1450 m of extraction until one month after completion of LW W1 and LW W2, unless ongoing adverse movements are observed | Tahmoor Coal (SMEC) |
| | | | | Conduct surveys along Thirlmere Way | Install and baseline survey prior to 1000m of extraction of LW W1.<br>Weekly after 1650 m of extraction until one month after completion of LW W1 and LW W2 until one month after completion of each LW, unless ongoing adverse movements are observed | Tahmoor Coal (SMEC) |
| | | | | Inform Sydney Water Call Centre of mining in area and possible issues. | Completed | Sydney Water |
| | | | | Notify residents of potential mine subsidence impacts and contact numbers. | Completed | Tahmoor Coal |
| | | | | Analyse and report results to IMG, including information on the position of the longwall face | Monthly from start of LW W1 and LW W2<br>Weekly after 800 m of extraction of LWW1 and LW W2 until one month after completion of each LW, unless ongoing adverse movements are observed | Tahmoor Coal |
| | | | | IMG discuss results and consider whether any additional management measures are required | Monthly from start of LW W1 and LW W2<br>Weekly after 800 m of extraction of LWW1 and LW W2 until one month after completion of each LW, unless ongoing adverse movements are observed | Tahmoor Coal |
| | | | Non-conventional ground movement detected | Notify Sydney Water | Within 24 hours | Tahmoor Coal |
| | | | | Infrastructure Management Group (IMG) meets to consider whether any additional management measures should be undertaken, including:<br>- increasing the frequency of surveys and visual inspections in vicinity of the non-conventional movement;<br>- investigating for potential of damage occurring to Sydney Water infrastructure; and/or<br>- relieving stresses on the pipes by locally excavating and exposing the pipes in the affected area. | As agreed between Tahmoor Coal and Sydney Water | IMG |
| | | | Leakage of water observed | Notify all stakeholders, including Sydney Water, Tahmoor Coal, Subsidence Advisory NSW and Resources Regulator | Within 24 hours | Tahmoor Coal |
| | | | | Repair leak. | As per Sydney Water procedures | Sydney Water |
| | | | | Provide alternative water supply to customers | As required | Tahmoor Coal |
| | | | | Consider increasing the frequency of surveys and visual inspections in vicinity of water leak, if appropriate. | As agreed between Tahmoor Coal and Sydney Water | Tahmoor Coal |

| INFRASTRUCTURE | HAZARD / IMPACT | RISK | TRIGGER | CONTROL PROCEDURE/S | FREQUENCY | BY WHOM? |
|---|---|---|---|---|---|---|
| | | | A hazard has been identified that involves potential serious injury or illness to a person or persons on public property or, or in vicinity of potable water infrastructure and cannot be controlled | IMG, Tahmoor Coal and Sydney Water meet to decide whether any additional management measures are required, including:<br>- emergency evacuation of hazardous area<br>- demarcation to prevent people entering hazardous area | Immediately | Tahmoor Coal and Sydney Water |
| | | | | Notify SRG of trigger exceedance and any management decisions undertaken (incl Subsidence Advisory NSW, Resources Regulator) | Within 24 hours of decision | Tahmoor Coal |

## 5.1. Consultation, Co-operation and Co-ordination

Substantial consultation, co-operation and co-ordination has taken place between Tahmoor Coal and Sydney Water prior to the development of this Management Plan, as detailed in Section 1.3.1.

The following procedures will be implemented during and after active subsidence of the property to ensure the continued effective consultation, co-operation and co-ordination of action with respect to subsidence between Tahmoor Coal and Sydney Water.

- Reporting of observed impacts to Tahmoor Coal either during the weekly visual inspection or at any time directly to Tahmoor Coal.
- Distribution of monitoring reports, which will provide the following information on a weekly basis during active subsidence:
    - Position of longwall;
    - Summary of management actions since last report;
    - Summary of consultation with Sydney Water since last report;
    - Summary of observed or reported impacts, incidents, service difficulties, complaints;
    - Summary of subsidence development;
    - Summary of adequacy, quality and effectiveness of management process;
    - Any additional and/or outstanding management actions; and
    - Forecast whether there will be any subsidence impacts to the health and safety of people due to the continued extraction of LW W1-W2.
- Convening of meetings between Tahmoor Coal and Sydney Water at any time as required, as discussed in Section 5.2.
- Arrangements to facilitate timely repairs, if required.
- Immediate contact between Tahmoor Coal and Sydney Water if a mine subsidence induced hazard has been identified that involves potential serious injury or illness to a person or persons on public property or Sydney Water property and may require emergency evacuation, entry restriction or suspension of work activities.

## 5.2. IMG Meetings

The IMG undertakes reviews and, as necessary, revises and improves the risk control measures to manage risks to health and safety, and potential impacts to infrastructure.

The reviews are undertaken weekly during the period of active subsidence based on the results of the weekly surveys and visual inspections and summarised in the monitoring reports, as described in Section 5.1.

The purpose of the reviews are to:

- Detect changes, including the early detection of potential impacts on health and safety and impacts to Sydney Water infrastructure;
- Verify the risk assessments previously conducted;
- Ensure the effectiveness and reliability of risk control measures; and
- Support continual improvement and change management.

IMG meetings may be held between Tahmoor Coal and Sydney Water for discussion and resolution of issues raised in the operation of the Management Plan. The frequency of IMG Meetings will be as agreed between Tahmoor Coal and Sydney Water.

IMG Meetings will discuss any incidents reported in relation to the relevant infrastructure, 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 mine subsidence impact is observed, any party may call an emergency IMG Meeting, with one day's notice, to discuss proposed actions and to keep other parties informed of developments in the monitoring of the infrastructure.

## 6.0 AUDIT AND REVIEW

This Management Plan has been agreed between parties and can be reviewed and updated to continually 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 business or property 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.
- 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 Coal to review the operation of the Management Plan and report at the next scheduled Plan Review Meeting. The Management Plan shall be audited for compliance with ISO 31000, or alternative standard agreed with Sydney Water.

## 7.0 RECORD KEEPING

Tahmoor Coal will keep and distribute minutes of any IMG Meeting.

## 8.0 CONTACT LIST

| Organisation | Contact | Phone | Email |
|---|---|---|---|
| NSW Department of Planning and Environment – Resources Regulator | Phil Steuart | (02) 4063 6484 | phil.steuart@planning.nsw.gov.au |
| | Gang Li | (02) 4063 6429<br>0409 227 986 | gang.li@planning.nsw.gov.au |
| | Ray Ramage | (02) 4063 6485<br>0442 551 293 | ray.ramage@planning.nsw.gov.au |
| Subsidence Advisory NSW | Matthew Montgomery | (02) 4677 1967<br>0425 275 564 | Matthew.Montgomery@customerservice.nsw.gov.au |
| Mine Subsidence Engineering Consultants (MSEC) | Daryl Kay* | (02) 9413 3777<br>0416 191 304 | daryl@minesubsidence.com |
| SIMEC Mining Tahmoor Coal<br>Acting Environment and Community Manager | David Talbert* | (02) 4640 0028<br>0414 905 565 | David.Talbert@simecgfg.com |
| SIMEC Mining Tahmoor Coal<br>Approvals Coordinator | April Hudson* | (02) 4640 0022<br>0466 380 992 | April.Hudson@simecgfg.com |
| Sydney Water | Emergency Line | 13 20 90 | |
| Sydney Water – Systems Delivery Officer<br>Area Team West | Troy Cooper* | (02) 8763 8622 | troy.cooper@sydneywater.com.au |

* denotes member of Infrastructure Management Group

# APPENDIX A. Drawings and Supporting Documentation

The following supporting documentation is provided in Appendix A.

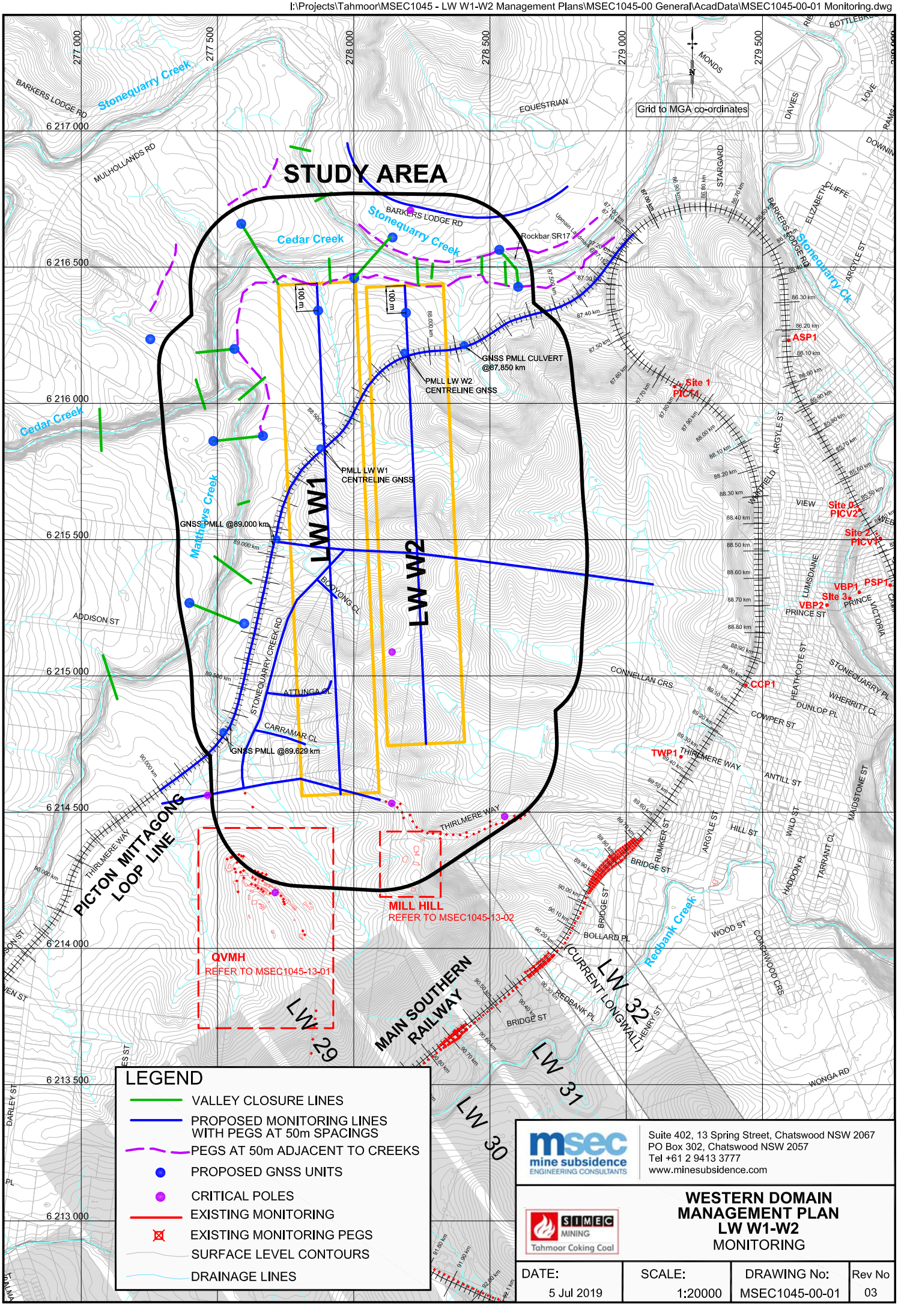
**Drawings**

| *Drawing No.* | *Description* | *Revision* |
|---|---|---|
| MSEC1045-00-01 | Monitoring over LW W1-W2 | 03 |
| MSEC1045-03-01 | Water Infrastructure | 01 |

**Supporting Documentation**

| | |
|---|---|
| Sydney Water (2018) | Risk and Opportunity Matrix, Sydney Water, Version 7.0 |
| Tahmoor Coal (2019) | Risk Assessment Report – Infrastructure. Tahmoor North – Western Domain, Longwalls West 1 and West 2, April 2019. |

I:\Projects\Tahmoor\MSEC1045 - LW W1-W2 Management Plans\MSEC1045-00 General\AcadData\MSEC1045-00-01 Monitoring.dwg





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www.minesubsidence.com


SIMEC MINING Tahmoor Coking Coal

# WESTERN DOMAIN MANAGEMENT PLAN LW W1-W2 MONITORING

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 5 Jul 2019 | 1:20000 | MSEC1045-00-01 | 03 |

I:\Projects\Tahmoor\MSEC1045 - LW W1-W2 Management Plans\MSEC1045-03 SW Potable\AcadData\MSEC1045-03-01 Water Infrastructure.dwg

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# WESTERN DOMAIN MANAGEMENT PLAN LW W1-W2

SIMEC MINING Tahmoor Coking Coal

SYDNEY WATER
POTABLE WATER & SEWERAGE INFRASTRUCTURE

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 27 Jun 2019 | 1:12500 | MSEC1045-03-01 | 01 |

**LEGEND**
- PROPOSED LONGWALLS
- EXISTING LONGWALLS
- CADASTRAL
- ROADS
- RAILWAYS
- WATERCOURSE

277 000 277 500 278 000 278 500 279 000

6 217 000 6 216 500 6 216 000 6 215 500 6 215 000 6 214 500

BARKERS LODGE RD
MULHOLLANDS RD
Stonequarry Creek
Cedar Creek
Newlands Gully
Matthews Creek
Rumker Gully
Stonequarry

**STUDY AREA**

LW W1
LW W2
LW 31
LW 32 (CURRENT LONGWALL)

Wastewater Treatment Plant

PICTON MITTAGONG LOOP LINE

Type: uPVC
Size: 180mmØ

Type: uPVC
Size: 100mmØ

BOOYONG CL
ADDISON ST
STONEQUARRY CREEK RD
ATTUNGA CL
CARRAMAR CL
CONNELLAN CRS
THIRLMERE WAY
MAIN SOUTHERN RAILWAY
RUMKER ST
BRIDGE ST

Grid to MGA co-ordinates

Pressure Reducing Valve

SIMEC

MEMBER OF GFG ALLIANCE

## Tahmoor Coal Pty Ltd

# RISK ASSESSMENT REPORT - INFRASTRUCTURE

## Tahmoor North – Western Domain
## Longwalls West 1 and West 2

**Date Held: 26 March 2019**

**April 2019**

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Document Control

| | |
|---|---|
| **DOCUMENT TITLE:** | Tahmoor North – Western Domain LW W1-W2 – Infrastructure Risk Assessment |
| **PUBLICATION DATE:** | April 2019 |
| **DOCUMENT STATUS:** | Final (Version 1) |
| **PREPARED BY:** | April Hudson<br>Approvals Coordinator<br>Tahmoor Coking Coal Operations – SIMEC Mining |
| **APPROVED BY:** | Ron Bush<br>Environment and Community Manager<br>Tahmoor Coking Coal Operations – SIMEC Mining |

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# Table of Contents



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# 1 Introduction

## 1.1 Background

Tahmoor Coal is located approximately 80 kilometres south-west of Sydney in the township of Tahmoor NSW. It is managed and operated by SIMEC Mining. Tahmoor Coal has previously mined 31 longwalls to the north and west of the mine's current pit top location. It is currently mining Longwall 32, in accordance with current Development Consent (DA 67/98) and Subsidence Management Plan Approval for the extraction of Longwall 32.

Tahmoor Coal proposes to extend underground coal mining to the north-west of the Main Southern Railway, which will include Longwalls West 1 to West 4 (**LW W1-W4**) at Picton (refer to **Figure 1-1**). Mining of Longwalls West 1 and West 2 (**LW W1-W2**) is expected to commence in November 2019, and first workings of development headings for LW W1 have commenced.

Under Condition 13H of the Development Consent (DA 67/980, as modified, an Extraction Plan is required for all second workings from LW W1 and subsequent longwalls. The first Extraction Plan to be prepared will cover LW W1-W1, which are located in the Tahmoor North Lease area. The Extraction Plans will be required to be approved by the NSW Department of Planning and Environment (**DPE**), and relevant Infrastructure Management Plans are required to be approved by the relevant infrastructure owners.

The Extraction Plan shall address the Study Area for LW W1-W2, which is comprised of both the predicted 20 mm Total Subsidence Contour and the 35$^{o}$ Angle of Draw Line (refer to **Figure 1-1**).

The Extraction Plan will provide detailed information on how the risks associated with mining under the Study Area will be managed by Tahmoor Coal during and following the extraction of LW W1-W2.

A Risk Assessment Workshop was held at the Administration Building at the Tahmoor Coking Coal Operations (**TCCO**) site on 26 March 2019 to determine the major infrastructure risks associated with LW W1-W2 that may impact on achieving timely approval for the commencement of LW W1-W2 extraction, as well as the completion of extraction of LW W1-W2.

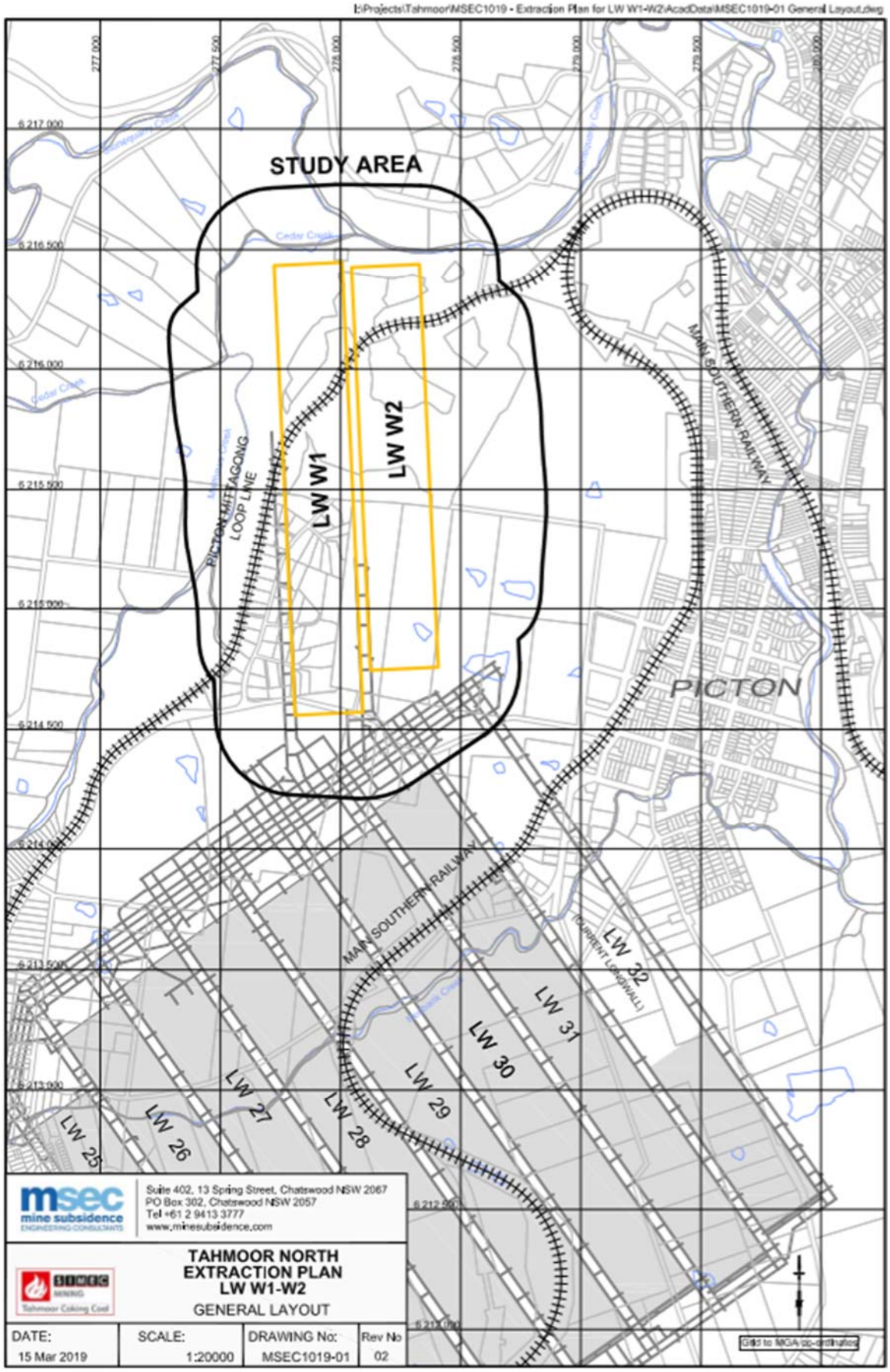



**Figure 1-1 Study Area for LW W1-W2**

## 1.2 Methodology

This risk assessment was completed using the Workplace Risk Assessment and Control methodology (**WRAC**).

It was compiled by a team of specialist personnel including:

- Compliance Officer and Risk Assessment Facilitator, Tahmoor Coal: Diana Harris;
- Environment and Community Manager, Tahmoor Coal: Ron Bush;
- Approvals Coordinator, Tahmoor Coal: April Hudson;
- Subsidence Engineer, MSEC: Daryl Kay;
- Structural Engineer, JMA Solutions: John Matheson; and
- Building Inspector, Building Inspection Services: Adam Walker.

The 12 step Risk Management process which forms part of the Tahmoor Coking Coal Operations Risk Management Standard has been adhered to in this risk assessment.

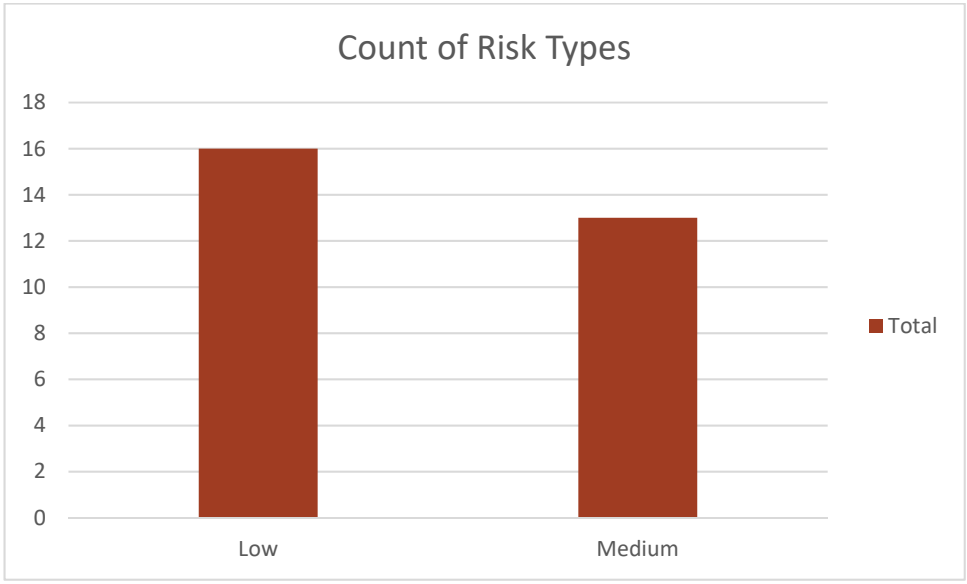
The risk matrix has been used to prioritise risk treatments.

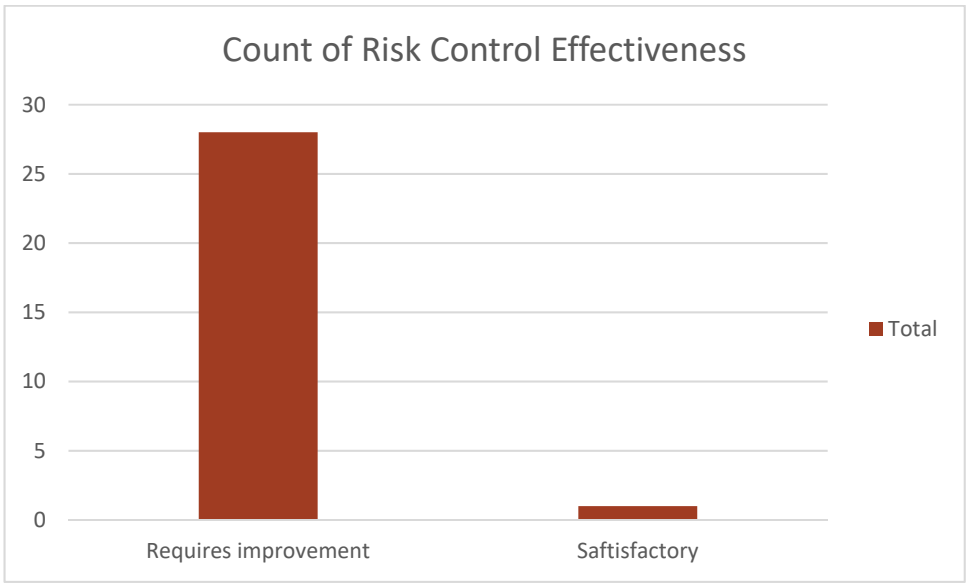
Prior to this risk assessment any previous risk assessments, safety alerts and High Potential Risk incidents have been sourced and put forward for consideration within the risk assessment workshop.

## 1.3 Outcome

This risk assessment identified a total of 29 risks / hazards (refer to **Figure 1-2**), which included:

- 13 medium risks and 16 low risks;
- One risk that was satisfactory and did not require any further risk control, and 28 risks that required further improvement;
- Risk consequences included:
    - Two risks with environmental impact consequences;
    - Seven risks with health and safety consequences; and
    - 20 risks with property damage consequences.



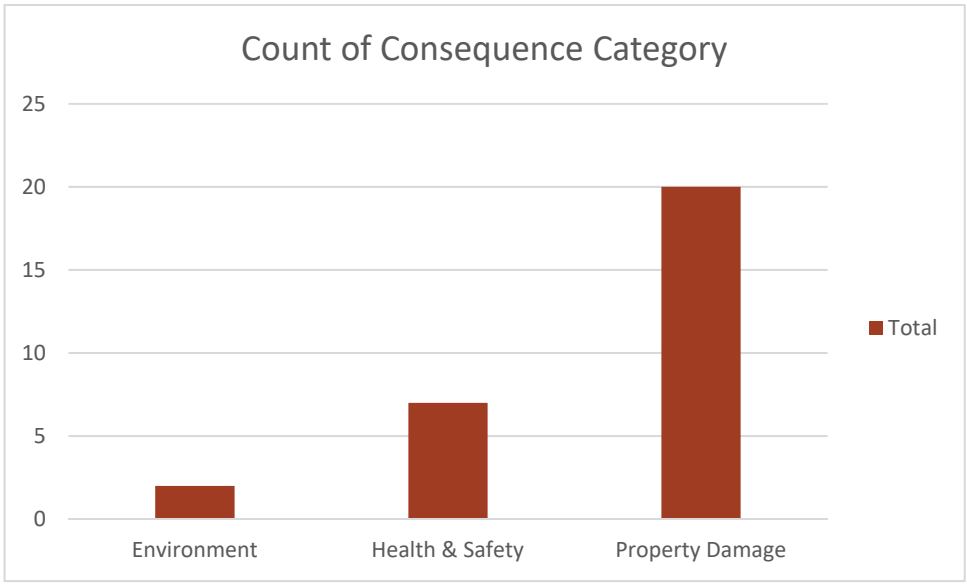




**Figure 1-2 Graphs of Risk Type, Risk Control Effectiveness and Consequence Category**

## 1.4 Further Actions

Further actions as identified in the Risk Assessment are identified in **Table 1-1**.

**Table 1-1 Table of Further Actions**

| Treatment plans/tasks | Task Owner | Due Date |
|---|---|---|
| Develop Endeavour Energy Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Endeavour Energy to complete Critical Poles Audit | April Hudson | 10-Oct-2019 |
| SMEC to complete survey of critical poles | April Hudson | 10-Oct-2019 |
| Building Inspection Services to complete baseline tilt measurement of poles | April Hudson | 10-Oct-2019 |
| Develop Sydney Water Potable Water Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Develop Stonequarry Creek Estate Water Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Develop Jemena Management Plan including TARP and contact details for Jemena | April Hudson | 10-Oct-2019 |
| Complete baseline gas detection survey (Macarthur Gas) | April Hudson | 10-Oct-2019 |
| Develop Telecommunications Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Develop Wollondilly Shire Council Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Develop traffic control plan for emergency repairs | April Hudson | 10-Oct-2019 |
| Develop Spatial Services Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Notify Spatial Services via POSI application of predicted subsidence movements of the permanent survey control marks | April Hudson | 10-Oct-2019 |
| Ongoing monitoring and review of far field monitoring network, including GNSS network | April Hudson | 10-Oct-2019 |
| Develop Built Structures Management Plan including TARP for emergency evacuation procedures | April Hudson | 10-Oct-2019 |
| Prepare QVMH Management Plan including TARP | April Hudson | 10-Oct-2019 |
| Consultation plan to be developed | Samantha Beresford | 10-Oct-2019 |
| Prepare Mill Hill Management Plan including TARP | April Hudson | 10-Oct-2019 |

# 2 Objective

The purpose of the Risk Assessment was to:

- Ensure the required infrastructure management plans for the proposed longwalls are approved and in place in a timely manner to manage infrastructure impacts during mining;
- Ensure the safe and serviceable operation of all surface infrastructure and structures in the Study Area;
- Ensure that the health and safety of people who may be present in the Study Area are not put at risk due to mine subsidence; and
- Assist in the establishment of procedures to measure, monitor, control, mitigate and repair infrastructure in the Study Area.

The Risk Assessment will also be used to:

- Develop, review and improve the treatment plans / tasks identified as a result of the identified risks;
- Provide a basis to determine whether the identified risk management measures are sufficient to address the identified risks;
- Meet the statutory requirements of legislation and regulation that relate to impacts to infrastructure; and
- Identify those processes requiring a more detailed level of risk assessment due to the Potential Maximum Consequence (**PMC**) level of risk.

# 3 Context

## 3.1 Scope

The risk assessment considered the areas below:

- Management of infrastructure owned by Endeavour Energy (electrical), Sydney Water (potable water only), Stonequarry Creek Estate Sewerage Plant (sewer), Jemena (gas), Telstra (telecommunications), NBN (telecommunications), Wollondilly Shire Council (roads, culverts and bridges), Spatial Services (survey control marks);
- Impacts to rural properties and structures such as built structures, pools, septic tanks, and farm dams; and
- Historical heritage buildings including Queen Victoria Memorial Home and Mill Hill.

## 3.2 Internal Context

This risk assessment was conducted for the Environment and Community Department of Tahmoor Coal to help identify the risks to infrastructure associated with LW W1-W2.

The risk assessment was conducted in accordance with the Risk Management Standard, utilising a cross-section of site personnel, relevant civil works experts, and an internal facilitator.

## 3.3 External Context

The risk assessment process is completed to satisfy Tahmoor Coking Coals requirements in relation to WHS and in compliance to Mining regulations and conditions and is completed in consultation with key stakeholders.

Key Stakeholders include:

- Tahmoor Coking Coal management;
- NSW Department of Planning and Environment (Planning, Resources and Geoscience);
- Resources Regulator (Subsidence, Environment);
- NSW Office of Environment and Heritage;
- Subsidence Advisory NSW;
- NSW Environment Protection Authority;
- NSW Department of Primary Industries (Agriculture);
- Dam Safety Committee;
- Crown Lands Division;
- NSW Roads and Maritime Services;
- WaterNSW;
- NSW State Emergency Services;
- Wollondilly Shire Council;
- Other utility providers including Endeavour Energy (electrical), Sydney Water (potable water only), Stonequarry Creek Estate Sewerage Plant (sewer), Jemena (gas), Telstra (telecommunications), NBN (telecommunications), Wollondilly Shire Council (roads, culverts and bridges), Spatial Service (survey control marks);
- Heritage stakeholders; and
- Landowners.

The external context for this Risk Management Process included consideration of:

- NSW Department of Planning and Environment as the approver of the Extraction Plan;
- NSW *Work Health and Safety (Mines and Petroleum Sites) Regulations 2014*;
- AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines; and
- Risk Management Handbook for the Mining Industry (MDG1010).

## 3.4 Exclusions / Assumptions

The participants in the risk assessment agreed to the following exclusions:

- Community effects will be managed as per Tahmoor Coal procedures and EMS (dust, lighting and noise);
- A detailed risk assessment for rail operational risks associated with LW W1-W2 will be conducted separately; and
- A broad risk assessment focusing on approvals, environmental and general infrastructure risks has been completed for LW W1-W2 on 12 February 2019 (CMO ID 201902202). Consideration of infrastructure risks addressed in this previously completed risk assessment were excluded. These considerations included:
    - Infrastructure Owner do not approve Infrastructure Management Plan;
    - Failure to implement Infrastructure Management Plan actions;
    - Greater than predicted subsidence in Study Area;
    - Stress to landowner/business owner;
    - Formation of Community Action Group; and
    - Land owners do not sign Land Access Agreements.

The participants in the risk assessment agreed to the following assumptions:

- All plant and equipment is fit for purpose;
- Personnel are competent and authorised;
- Inspection systems are in place and effective;
- People (employees, contractors) do present themselves fit for work;
- The appropriate PPE is utilised where required; and
- Observations and learnings from Longwall 32.

# 4 Issue / Reason for Review

The risk assessment was completed to identify significant implications relating to approval, environmental and infrastructure risks, and to identify the controls necessary to effectively manage these risks.

# 5 Risk Analysis Method

## 5.1 Risk Management Standard

All risk assessments are conducted in accordance with Tahmoor Coking Coal Operations Risk Management Standard.

The Tahmoor Coking Coal Operations Risk Management Standard is based on the ***ISO31000:2009 Risk Management – Principles and Guidelines International Standard.***

## 5.2 Risk Management Process

The risk management process is set out in the 12 Steps Risk Management Process (refer to **Figure 5-1**).

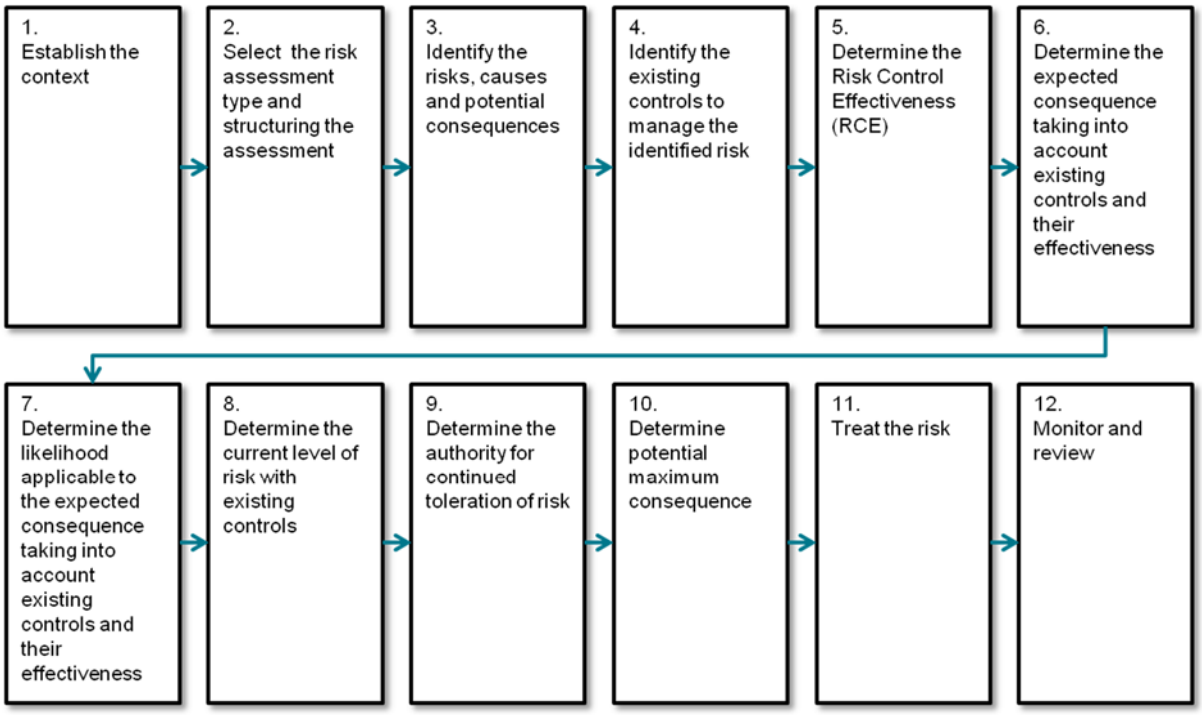



**Figure 5-1 The 12 Steps Risk Management Process**

## 5.3 Risk Matrix

The analyses of the risks identified in the workshop have undergone categorisation by the use of the risk matrix outlined within the Tahmoor Coking Coal Operations Risk Management Standard.

A copy of the risk matrix from Tahmoor Coking Coal Operations Risk Management Standard is provided in **Appendix A.**

## 5.4 Hierarchy of Controls

During the risk management process additional treatments and controls have been categorised using the hierarchy of controls table (refer to **Figure 5-2**).

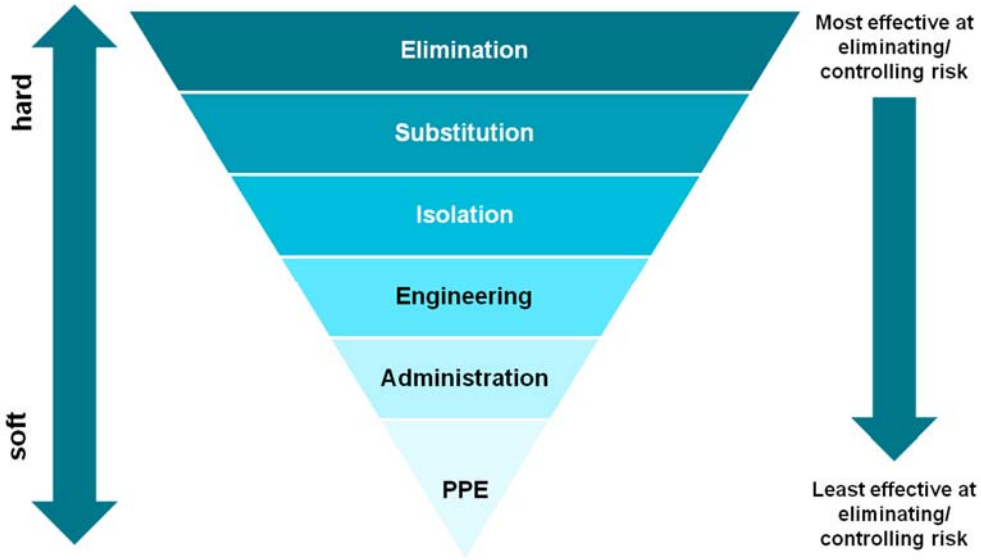



**Figure 5-2 Hierarchy of Controls**

## 5.5 Risk Assessment Team Members

Participating risk assessment team members are listed in **Table 5-1.**

**Table 5-1 Participating Risk Assessment Team Members**

| Name | Position | Organisation | Qualifications | Related Experience |
|---|---|---|---|---|
| Ron Bush | Environment & Community Manager | SIMEC | BSc (Geol), GCEng, GD GW, MPlan, MProDev, MEng | 30yrs |
| Diana Harris | Facilitator – Compliance Officer | SIMEC | Cert IV OH&S, G3 Risk Management | 4yrs |
| April Hudson | Approvals Coordinator | SIMEC | B Env Sci (Hons) | 9yrs |
| John Matheson | Structural Engineer | JMA Solutions | BE Struct (Hons) | 20yrs |
| Daryl Kay | Subsidence Engineer | MSEC | BE, LLB | 16yrs |
| Adam Walker | Building Inspector | Building Inspection Services | Cert IV Building | 30yrs |

A copy of the signed attendance sheet is attached in **Appendix B**.

# 6 Risk Assessment Register

The Risk Assessment Register is attached within **Appendix C**.

# 7 Treatment Plan

A treatment plan is provided in **Section 1.4.1**.

# 8 Risk Assessment Review Period

A review period for the risk assessment has not been identified.

# Appendix A – Risk Matrix

## RISK MATRIX

### CONSEQUENCE [potential foreseeable outcome of the event]

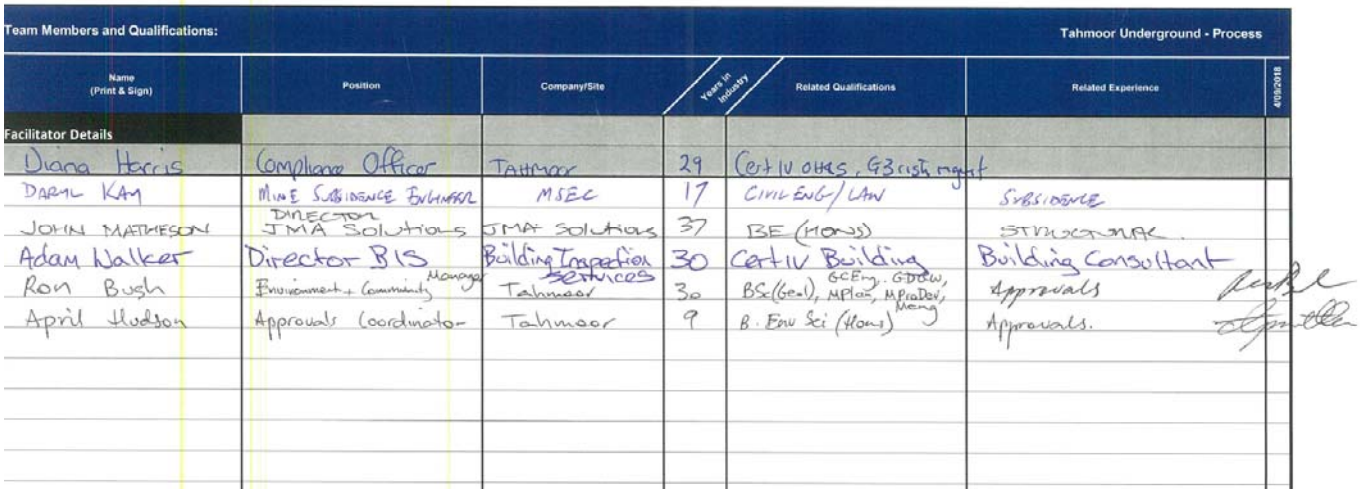
| | Health & Safety | Environment | Financial Impact | Image & Reputation / Community | Legal & Compliance |
|---|---|---|---|---|---|
| **5 Catastrophic** | • Multiple fatalities (5 or more fatalities in a single incident)<br>• Multiple cases (5 or more) of Permanent Damage Injuries or Diseases that result in permanent disabilities in a single incident | • Unconfined and widespread<br>• Environmental damage or effect (permanent; >10 years)<br>• Requires major remediation | • >$600M investment return<br>• >$100M operating profit<br>• >$20M property damage | • Loss of multiple major customers or large proportion of sales contracts<br>• Sustained campaign by one or more international NGOs resulting in physical impact on the assets or loss of ability to operate<br>• Security incident resulting in multiple fatalities or major equipment damage<br>• Formal expression of significant dissatisfaction by government<br>• Grievance from internal or external stakeholder alleging human rights violation resulting in multiple fatalities | • Major litigation / prosecution at SIMEC corporate level<br>• Nationalisation / loss of licence to operate |
| **4 Major** | • Single incident resulting in: Less than 5 Fatalities<br>• Permanent Damage Injury or Disease that results in a permanent disability- less than 5 cases in a single incident | • Long-term (2 to 10 years) impact<br>• Requires significant remediation | • $60-600M investment return<br>• $20-100M operating profit<br>• $2-20M property damage | • Security/ stakeholder incident resulting in single loss of life or equipment damage<br>• Grievance from internal or external stakeholder alleging human rights violation resulting in single fatality or serious injuries<br>• Topic of broad societal concern and criticism<br>• Negative media coverage at international level resulting in a Corporate statement within 24 hours<br>• Investigation from government and/ or international (or high-profile) NGOs<br>• Complaints from multiple "final" customers<br>• Loss of major customer<br>• Negative impact on share price | • Major litigation / prosecution at Department level |
| **3 Moderate** | • Lost Time Injury (LTI)<br>• Lost Time Disease (LTD)<br>• Permanent Disabling Injury (PDI)<br>• Permanent Disabling Disease (PDD)<br>• Single incident that results in multiple medical treatments | • Medium-term (<2 years) impact (typically within a year)<br>• Requires moderate remediation | • $6-60M investment return<br>• $2-20M operating profit<br>• $200K-2M property damage | • Negative media coverage at national level over more than one day<br>• Complaint from a "final" customer<br>• Off-spec product<br>• Local Stakeholder action resulting in national societal scrutiny | • Major litigation / prosecution at Operation level |
| **2 Minor** | • Medical Treatment Injury (MTI)<br>• Medical Treatment Disease (MTD)<br>• Restricted Work Injury (RWI)<br>• Restricted Work Disease (RWD) | • Near source<br>• Short-term impact (typically <week)<br>• Requires minor remediation | • $600K-6M investment return<br>• $200K-2M operating profit<br>• $10-200K property damage | • Negative local/ regional media coverage<br>• Complaint received from an internal or external stakeholder | • Regulation breaches resulting in fine or litigation |
| **1 Negligible** | • First Aid Injury (FAI) or illness (not considered disease or disorder) | • Near source and confined<br>• No lasting environmental damage or effect (typically <day)<br>• Requires minor or no remediation | • <$600K investment return<br>• <$200K operating profit<br>• <$10K property damage | • Negligible media interest | • 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<br>OR<br>PROJECT OR TRIAL OR FIXED TIME PERIOD<br>OR<br>NEW PROCESS / PLANT / R&D | Unlikely to occur during a lifetime<br>OR<br>Very unlikely to occur<br>OR<br>No known occurrences in broader worldwide industry | Could occur about once during a lifetime<br>OR<br>More likely <u>NOT</u> to occur than to occur<br>OR<br>Has occurred at least once in broader worldwide industry | Could occur more than once during a lifetime<br>OR<br>As likely to occur as not to occur<br>OR<br>Has occurred at least once in the mining / commodities trading industries | May occur about once per year<br>OR<br>More likely to occur than not occur<br>OR<br>Has occurred at least once within Tahmoor Mine | May occur several times per year<br>OR<br>Expected to occur<br>OR<br>Has occurred several times within Tahmoor Mine |
| **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** | Department / Functional / Operational / Asset Leadership | • Quantitative or semi-quantitative risk assessment required.<br>• Capital expenditure will be justified to achieve ALARP ('As Low As Reasonably Practicable').<br>• 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** | Department / Functional / Operational / Asset Leadership | • Fatal Hazard Protocols or appropriate management plans must be applied.<br>• Capital expenditure will be justified to achieve ALARP. |
| **Risk Rank** | **Risk Rating** | **Ownership** | **Action** |
| **17 to 25** | **High Risk** | Department / Functional / Operational / Asset Leadership | • Install additional HARD and SOFT controls to achieve ALARP.<br>• 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.<br>• Capital expenditure may be justified. |
| **1 to 6** | **Low Risk** | Operational / Asset Leadership | • Install additional controls if necessary to achieve ALARP.<br>• Capital expenditure is not usually justified. |

# Appendix B – Risk Assessment Attendance Sheet



Team Members and Qualifications: Tahmoor Underground - Process

| Name (Print & Sign) | Position | Company/Site | Years in Industry | Related Qualifications | Related Experience | 4/05/2018 |
|---|---|---|---|---|---|---|
| Facilitator Details | | | | | | |
| Diana Harris | Compliance Officer | Tahmoor | 29 | Cert IV OHES, G3 risk mgmt | | |
| DARYL KAM | MINE SUBSIDENCE ENGINEER | MSEC | 17 | CIVIL ENG/LAW | SUBSIDENCE | |
| JOHN MATHESON | DIRECTOR JMA Solutions | JMA Solutions | 37 | BE (Mons) | STRUCTURAL | |
| Adam Walker | Director BIS | Building Inspection Services | 30 | Cert IV Building | Building Consultant | |
| Ron Bush | Environment + Community Manager | Tahmoor | 30 | BSc(Geol), GCEng. GDCW, MPlan, MPraDev, Mang | Approvals | |
| April Hudson | Approvals Coordinator | Tahmoor | 9 | B. Env Sci (Hons) | Approvals. | |

# Appendix C – Risk Assessment Register

# Environmental Risk Assessment: Tahmoor Underground - Extraction Plan LW W1-W2 - 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<br>Site | Type of Risk Assessment | Key Element (CURA Context/Categ ory) | Sub Key Element (If applicable) | Risk Description - Something happens..... | Consequence - resulting in: | Causes - Caused by | Risk Owner | Existing Control Description | Control Owner (Contact) | Fatal Hazard Protocol (as applicable) | 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 |
| Tahmoor Underground | Environmental | | Sydney Water Potable Water Infrastructure | Leakage of the joints | Reduced water supply requiring emergency repair or replacement of pipework | Subsidence | | Sydney Water Potable Water Management Plan for LW W1-W2 to be prepared and will contain the following controls to manage subsidence (as per previous Management Plans for LW32) (AC):<br>* Ground survey - weekly<br>* Visual inspections - weekly<br>* TARP including evacuation and relief of stress or repair of pipeline if required<br>* Analysis and reporting<br>* Consultation, coordination and cooperation with Sydney Water Potable UPVC pipes reduces potential for breakage (EC) | | | 2 | Property Damage | 2 | D | 5 | 2 | Property Damage | Develop Sydney Water Potable Water Management Plan including TARP | April Hudson | 10-Oct-19 | |
| | 1 | | | 1 | 1 | Subtotal CountA (ignoring hidden values) | | | | | 1 | | | | 1 | 1 | | | | | |
| Tahmoor Underground | Broad Brush | | | | | | | | | | | | | | | #N/A | | | | | |
| Tahmoor Underground | Life of Mine | | | | | | | | | | | | | | | #N/A | | | | | |
| Tahmoor Underground | Business | | | | | | | | | | | | | | | | | | | | |
| Tahmoor Underground | Major Project | | | | | | | | | | | | | | | #N/A | | | | | |
| Tahmoor Underground | Environmental/Health/Process | | | | | | | | | | | | | | | #N/A | | | | | |
| Tahmoor Underground | Equipment | | | | | | | | | | | | | | | #N/A | | | | | |