



SIMEC

SIMEC Mining:

**Tahmoor North Western Domain
Longwalls West 3 and West 4**

Management Plan for potential impacts to Jemena Gas Infrastructure



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References:-

	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 (2021)	Tahmoor Coal - Longwalls W3 and W4 - Subsidence Predictions and Impact Assessments for Natural and Built Features due to the extraction of the proposed Longwalls W3 and W4 in support of the Extraction Plan Application. (Report No. MSEC1112, Revision A, March 2021), prepared by Mine Subsidence Engineering Consultants.
Tahmoor Coal (2020)	Risk Assessment Report – Infrastructure. Tahmoor North – Western Domain, Longwalls West 3 and West 4, September 2020.

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Drawings

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Drawing No.	Description	Revision
MSEC1173-05-01	Monitoring plan	A
MSEC1173-05-01	Jemena Gas Pipelines	A

1.1. Background

Tahmoor Coal owns and operates Tahmoor Mine, an existing underground coal mine that is located approximately 80 km south-west of Sydney in the Southern Coalfield of NSW. Tahmoor Coal is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group. Tahmoor Coal has previously mined 34 longwalls to the north and west of the mine's current location.

Longwalls West 1 and West 2 (LW W1-W2) were the first two longwalls to be mined in the Western Domain, located northwest of the Main Southern Railway and between the townships of Thirlmere and Picton.

Longwalls West 3 and West 4 (LW W3-W4) are the final two longwalls to be mined in the Western Domain. Infrastructure owned by Jemena is located within this area.

A summary of the dimensions of LW W3-W4 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 W3	1552	283	39
LW W4	1004	285	44

This Management Plan provides detailed information about how the risks associated with mining beneath the infrastructure will be managed by Tahmoor Coal and Jemena.

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 Jemena.

1.2. Jemena assets potentially affected by LW W3-W4

The locations of Jemena infrastructure in relation to LW W3-W4 are shown in Drawing No. MSEC1173-05-01.

The gas infrastructure comprises buried 32 mm, 50 mm and 75 mm nylon (NY) pipelines along Thirlmere Way, Stonequarry Creek Road, Attunga Close, Booyong Close and Carramar Close. These pipelines are partly located above the southern end of previously extracted LW W1.

Buried 32 mm and 50 mm nylon (NY) pipelines are located along Hill Street and Thirlmere Way to the southeast of LW W4. No gas pipelines are located directly above LW W3-W4.

1.3. Consultation

1.3.1. Consultation with Jemena

Tahmoor Coal regularly consults with Jemena in relation to mine subsidence effects. This includes consultation during the development of subsidence management plans for previous Longwalls 22 to 32 and LW W1-W2, and regular reporting of subsidence movements and impacts.

Details regarding consultation and engagement are outlined below:

- Discussion with Andrew Walker (Jemena), David Talbert (Tahmoor Coal), April Hudson (Tahmoor Coal) and Daryl Kay (MSEC) via email in August 2019 regarding the draft Subsidence Management Plan for LW W1-W2.
- Meeting with Andrew Walker (Jemena), David Talbert (Tahmoor Coal) and Daryl Kay (MSEC) on 16 September 2019 regarding the draft Subsidence Management Plan for LW W1-W2.
- Consultation with Andrew Walker (Jemena), David Talbert (Tahmoor Coal), Amanda Fitzgerald (Tahmoor Coal) and Daryl Kay (MSEC) regarding low level gas leak near the corner of Carramar Close and Stonequarry Creek Road between November 2020 and April 2021.
- Consultation with Andrew Walker (Jemena), Darryl Tolentino (Jemena), Muhammad Umer Siddiqui (Jemena), Ross Barber (Tahmoor Coal), Amanda Fitzgerald (Tahmoor Coal) and Daryl Kay (MSEC) on 5 October 2021, regarding the draft Subsidence Management Plan for LW W3-W4.

Tahmoor Coal will continue to consult regularly with Jemena during the extraction of LW W3-W4 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, Sydney Water, Telstra, NBN, TfNSW, Transport Heritage NSW and ARTC 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. MSEC1112 by Mine Subsidence Engineering Consultants (MSEC, 2021). Predictions are based on the planned configuration of LW W3-W4 at Tahmoor (as shown in Drawing No. MSEC1173-05-01), along with available geological information and data from numerous subsidence studies for longwalls previously mined in the area.

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

The impacts of mining on surface and sub-surface features have been assessed in detail. It is recognised, however, 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 MSEC1112 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 Jemena gas infrastructure.

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, Jemena, relevant government agencies as required, and consultants as required; and
- 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 items of Jemena infrastructure identified to be at risk due to mine subsidence and to ensure that the health and safety of people who may be present in the vicinity or on Jemena property are not put at risk due to mine subsidence. The major items at risk are:

- Local nylon (NY) and polyethylene (PE) gas pipelines; and
- Gas pipelines at creek crossings.

The gas pipelines are shown in Drawing No. MSEC1173-05-01 classified by pipe size and by pipe type.

The Management Plan only covers 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 W3-W4 only. The management plan does not include other gas infrastructure owned by Jemena which lies outside the extent of this area.

1.7. Proposed mining schedule

It is planned that LW W3-W4 will extract coal working south from the northern end. This Management Plan covers longwall mining until completion of mining in LW W4 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 W3	September 2021	March 2022
LW W4	April 2022	August 2022

Please note the above schedule is subject to change due to unforeseen impacts on mining progress. Tahmoor Coal will keep Jemena 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.

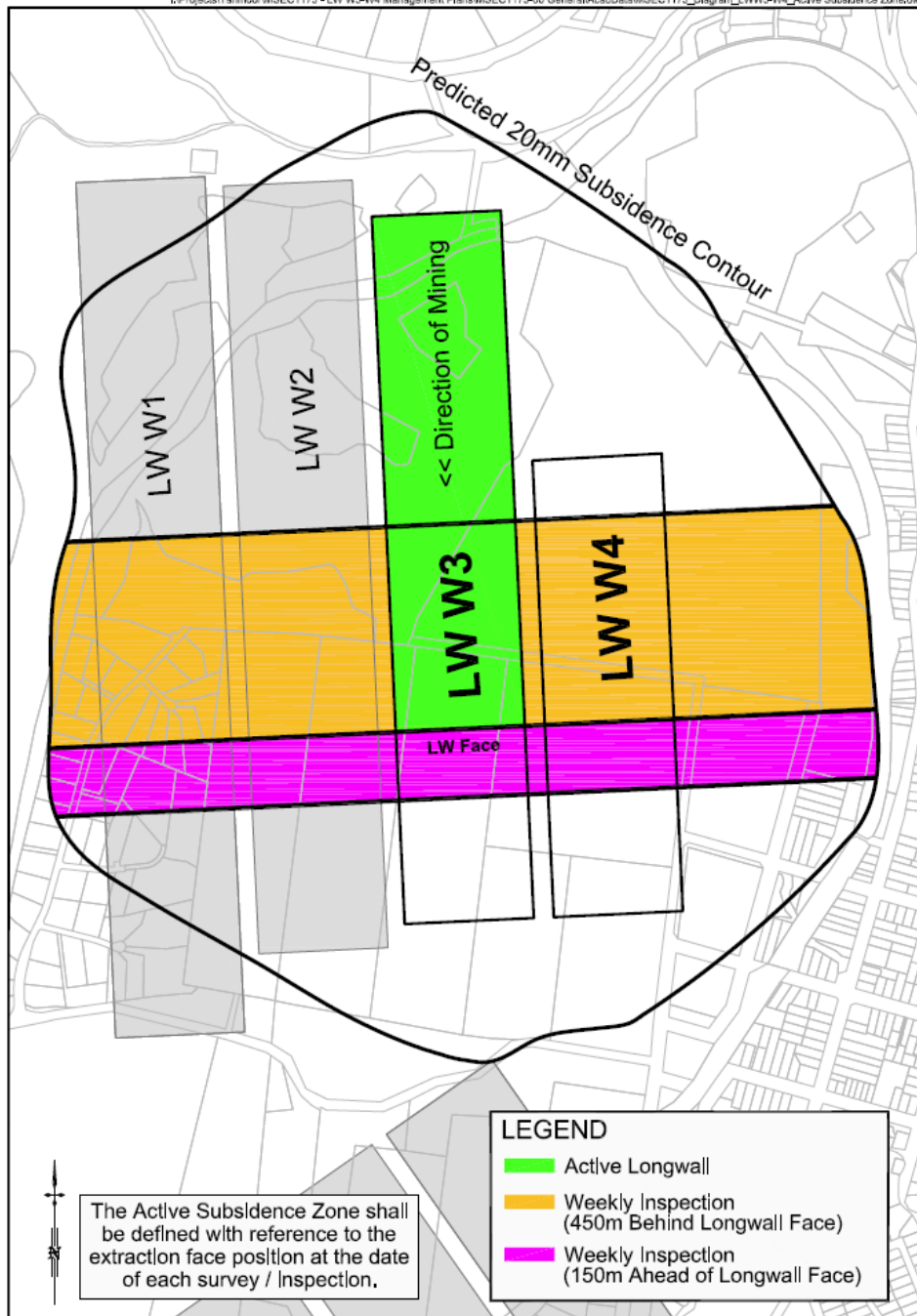


Fig. 1.1 Diagrammatic Representation of Active Subsidence Zone

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 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 W3-W4 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.

3.1. Maximum predicted conventional subsidence parameters over Study Area

Predicted mining-induced conventional subsidence movements were provided in Report No. MSEC1112, which was prepared in support of Tahmoor Coal's Extraction Plan for LW W3-W4. A summary of the maximum predicted total subsidence parameters over the Study Area due to the extraction of LW W3-W4 are provided in Table 3.1.

Table 3.1 Maximum predicted conventional subsidence parameters for LW W3-W4

Longwall	Maximum predicted total vertical subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km ⁻¹)	Maximum predicted total sagging curvature (km ⁻¹)
LW W3	950	5.0	0.06	0.10
LW W4	1025	5.0	0.06	0.10

The values provided in the above table are the maximum predicted conventional subsidence parameters which occur within the Study Area.

3.2. Comparison of measured and predicted subsidence for LW W1-W2

Predictions using MSEC's Incremental Profile Method have been continually tested and refined during the mining of previous Longwalls 22 to 32, as described in Report No. MSEC1112.

In this case, LW W1-W2 have been extracted in a new longwall series, which is located to the north of the completed LW 32.

LW W1

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. MSEC1112.

Ground surveys during the mining of LW W1 have found that subsidence has been substantially less than predicted (approximately 50%). The experience is new for Tahmoor Mine but it has been previously observed for nearby longwalls at Appin Colliery, including LW901 and the southern section of LW703.

A comparison between measured and predicted profiles of vertical subsidence along the Picton-Mittagong Loop Line are provided in Fig. 3.1 after the extraction of LW W1.

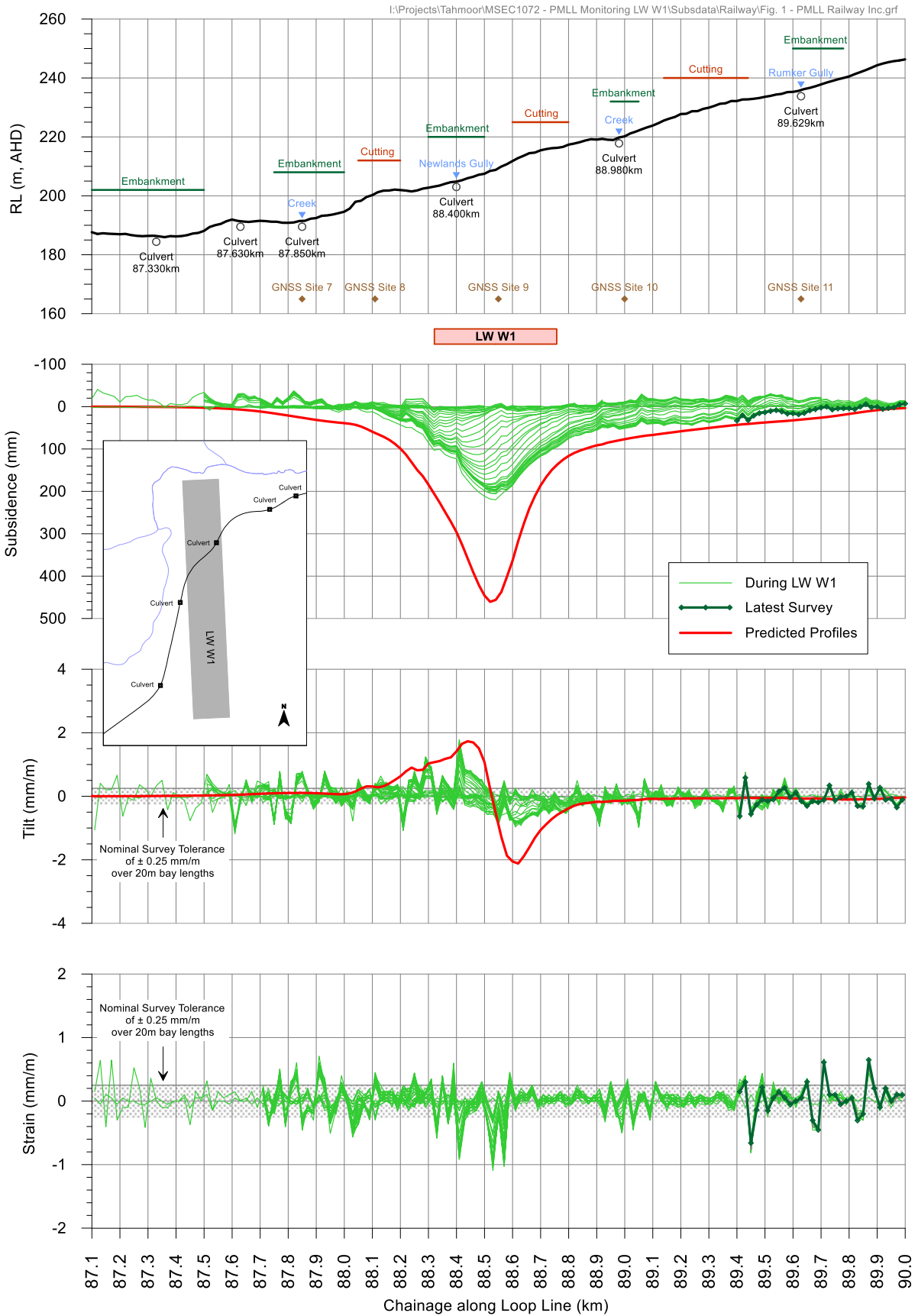


Fig. 3.1 Observed subsidence along Picton-Mittagong Loop Line during the mining of LW W1

LW W2

As of 1 June 2021, subsidence surveys above LW W2 have measured less subsidence than predicted. Observed subsidence along the Picton-Mittagong Loop Line after the extraction of LW W2 is shown in Fig. 3.2. Observed subsidence along the LW W1 W2 crossline after the extraction of LW W2 is shown in Fig. 3.3.

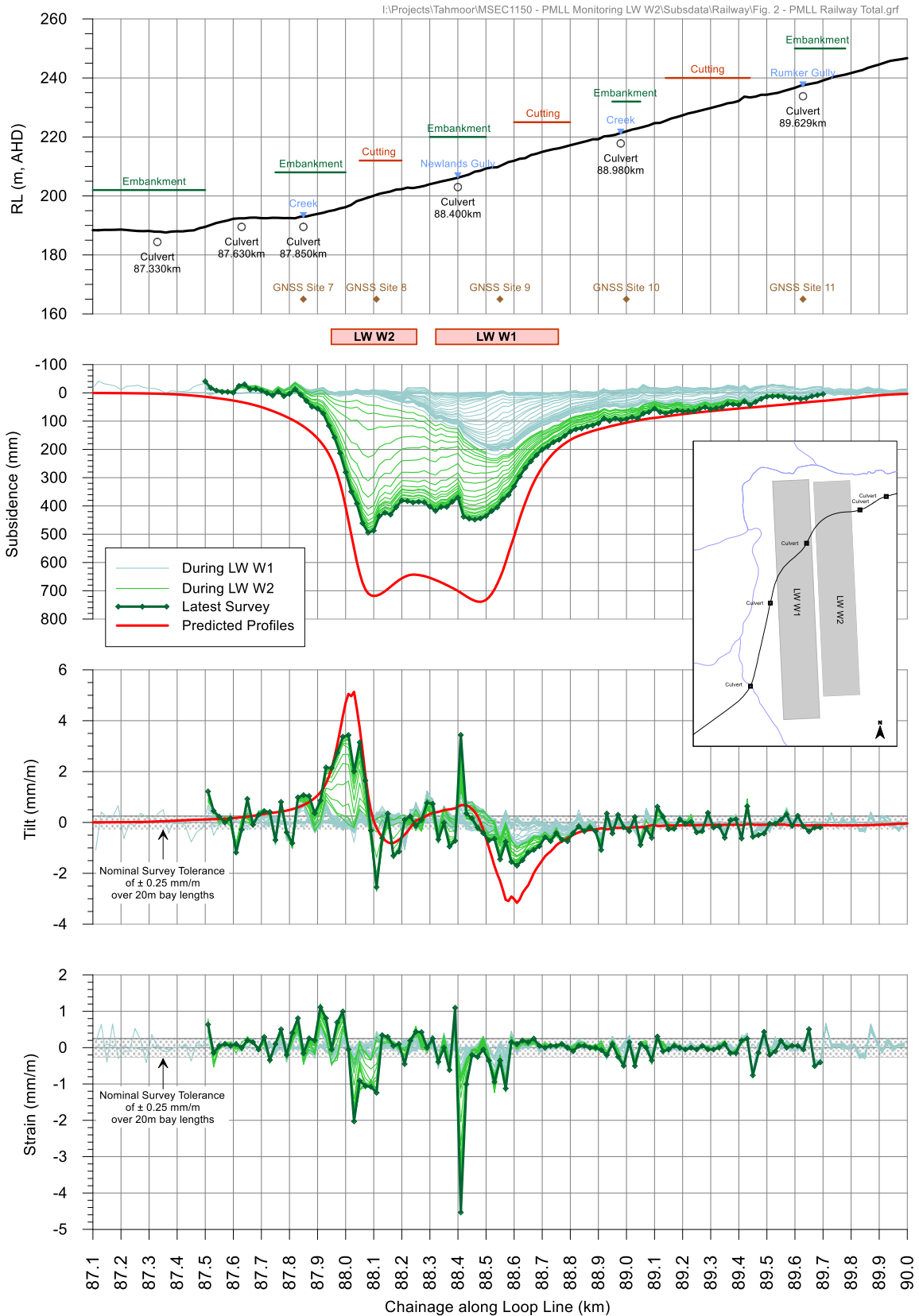


Fig. 3.2 Observed subsidence along Picton-Mittagong Loop Line during the mining of LW W1-W2

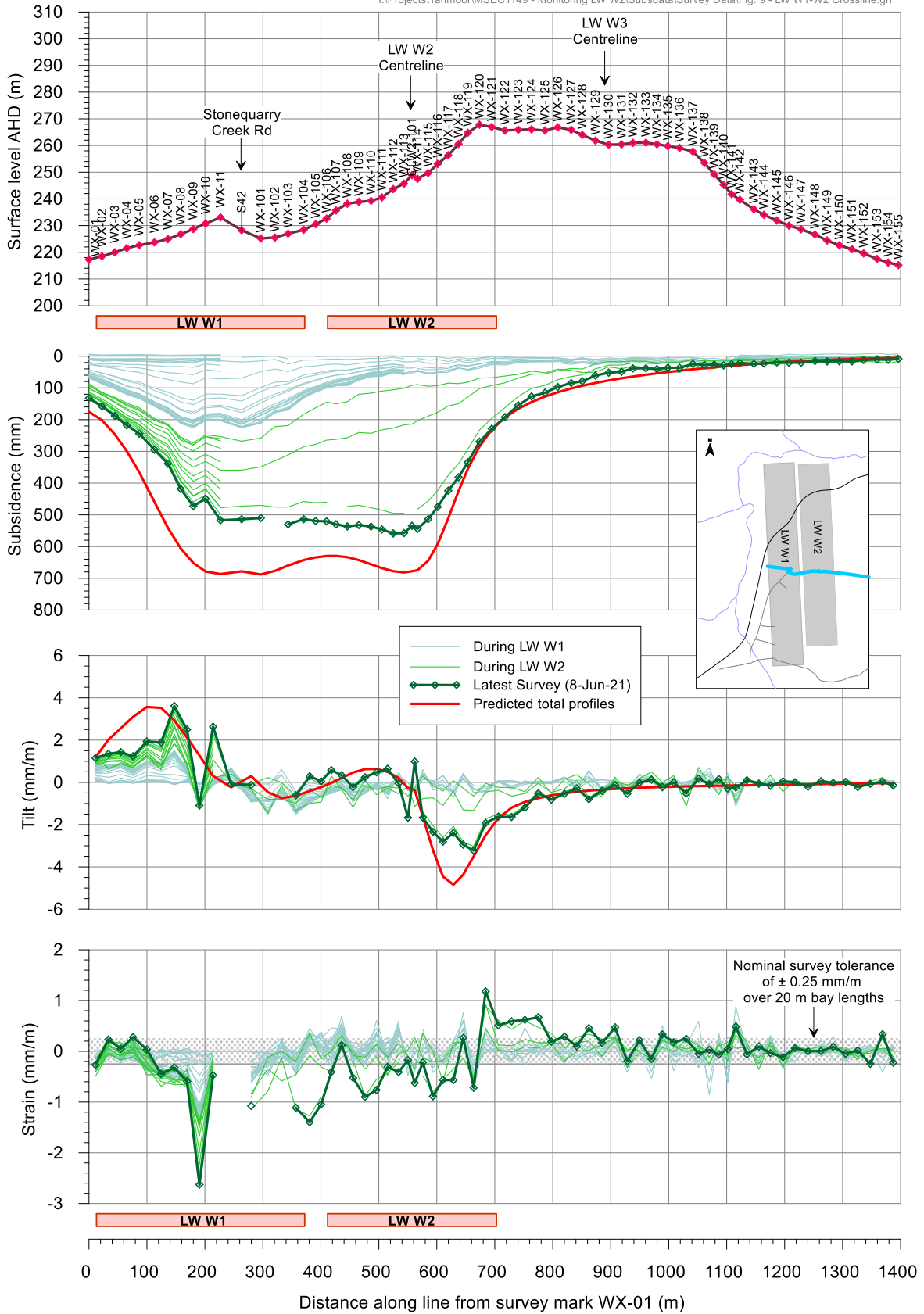


Fig. 3.3 Observed subsidence along LW W1-W2 crossline during the mining of LW W1-W2

Whilst observed subsidence above LW W1 and LW W2 was less than predicted, subsidence due to the extraction of LW W3-W4 may not follow the same pattern, and may return to normal levels. Subsidence may also be greater than predicted.

It is therefore planned to monitor the development of subsidence during the extraction of LW W3-W4 to compare observations with predictions. Measures have been developed in this Management Plan to manage potential impacts on Jemana's gas infrastructure, even when actual subsidence is substantially greater than the magnitudes that have been predicted above LW W3-W4.

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 ground 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 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 predicted maximum curvatures and the predicted maximum 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, rather than providing a single predicted conventional strain.

The data used in the analysis of observed strains included those resulting from both conventional and non-conventional anomalous movements, but did not include those resulting from valley-related effects, which are discussed separately in the impact assessments for the natural and built features provided in Chapters 5 and 6. 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 32 and LW W1 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. 3.4. 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.

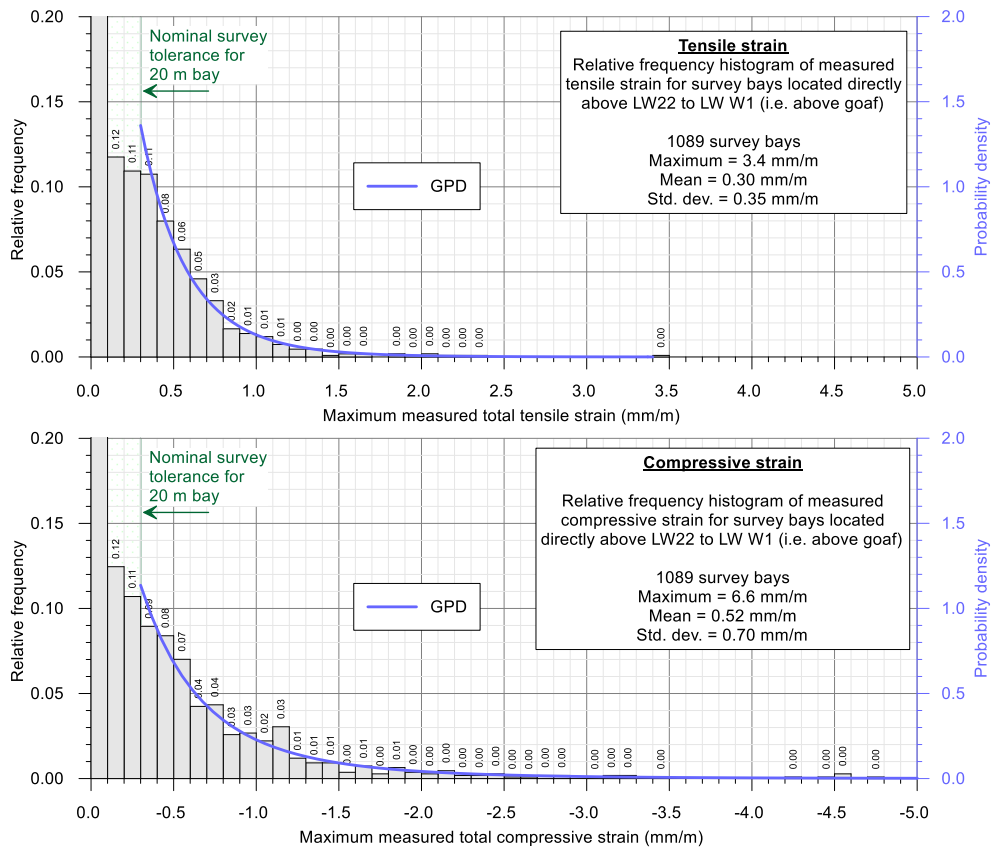


Fig. 3.4 Distributions of the maximum measured tensile and compressive strains during the extraction of previous longwalls for survey bays located above goaf

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 1.7 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 were 1.5 mm/m tensile and 3.3 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 previous longwalls at the mine, for survey bays that were located outside and within 250 m 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. 3.5. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

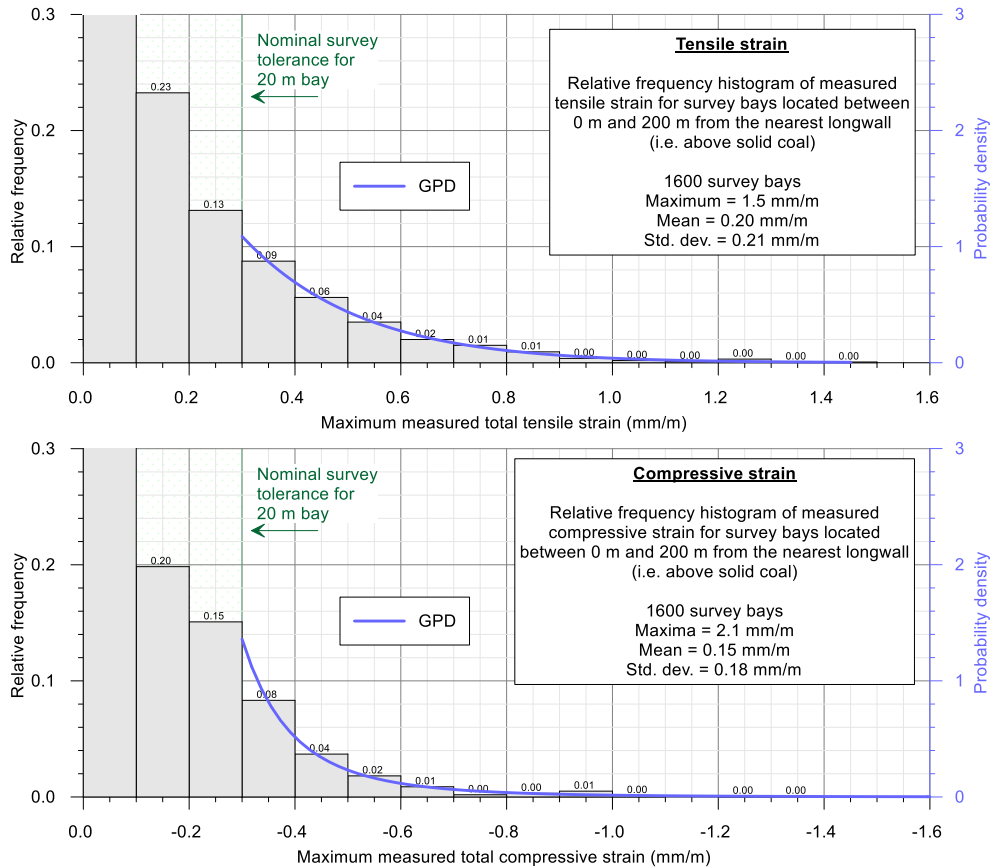


Fig. 3.5 Distributions of the maximum measured tensile and compressive strains during the extraction of previous longwalls for survey bays located above solid coal

The 95 % confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 0.6 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 were 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 strains measured 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 occurs.

A histogram of maximum observed 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. 3.6.

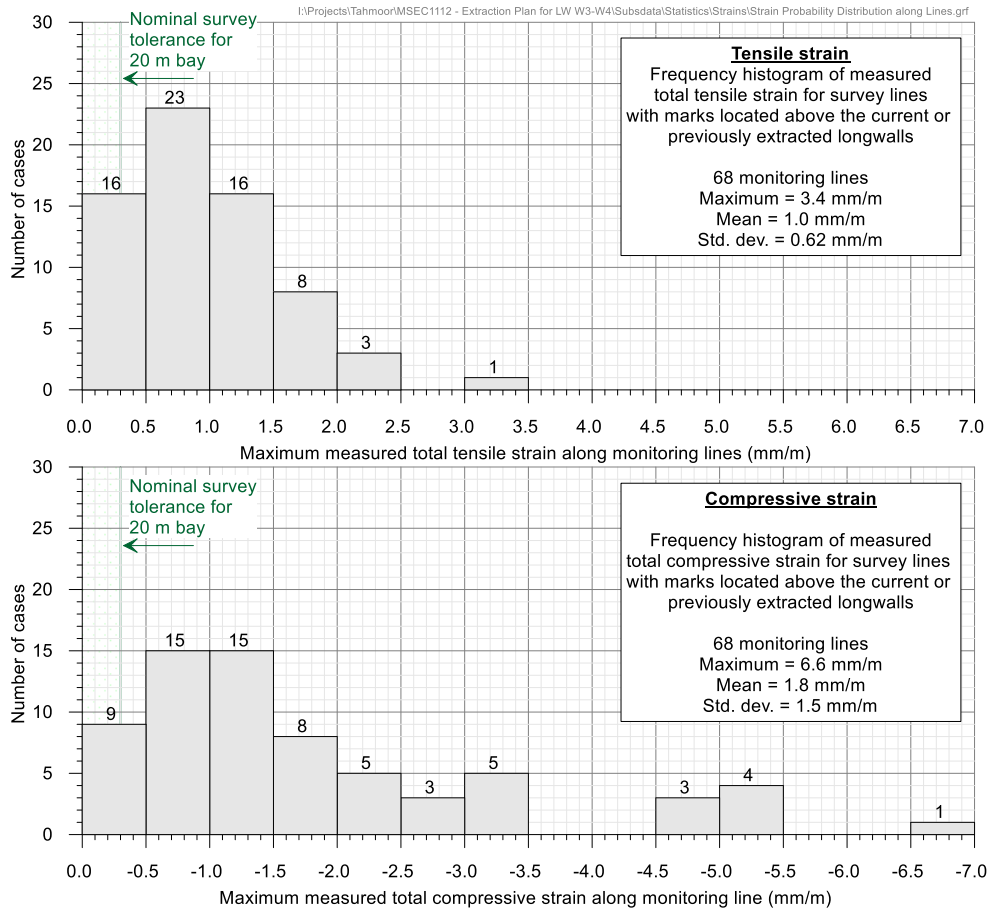


Fig. 3.6 Distributions of maximum measured tensile and compressive strains along monitoring lines during the extraction of previous longwalls at the mine

It can be seen from the above figure, that 39 of the 68 monitoring lines (i.e. 57 %) had recorded maximum total tensile strains of 1.0 mm/m or less, and that 63 monitoring lines (i.e. 93 %) had recorded maximum total tensile strains of 2.0 mm/m or less. It can also be seen, that 47 of the 68 monitoring lines (i.e. 69 %) had recorded maximum compressive strains of 2.0 mm/m or less, and that 60 of the monitoring lines (i.e. 88 %) had recorded maximum compressive strains of 4.0 mm/m or less.

3.4. Managing public safety

The primary risk associated with mining beneath Jemena infrastructure is public safety. Tahmoor Coal has previously directly mined beneath or adjacent to more than 2000 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 agreed subsidence management plans to manage potential impacts during the mining of Longwalls 22 to 32 and LW W1-W2. The management strategy has been reviewed and updated based on experiences gained during the mining of these longwalls and the strategy for LW W3-W4 includes the following process:

1. Regular consultation with Jemena before, during and after mining;
2. Site-specific investigations;
3. Implementation of mitigation measures following inspections by Jemena; and
4. Surveys and inspections during mining within the active subsidence area:
 - Detailed visual inspections and vehicle-based inspections along the streets;
 - Ground surveys along streets; and
 - 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 Jemena infrastructure experiences mine subsidence movements is shown in Fig. 3.7.

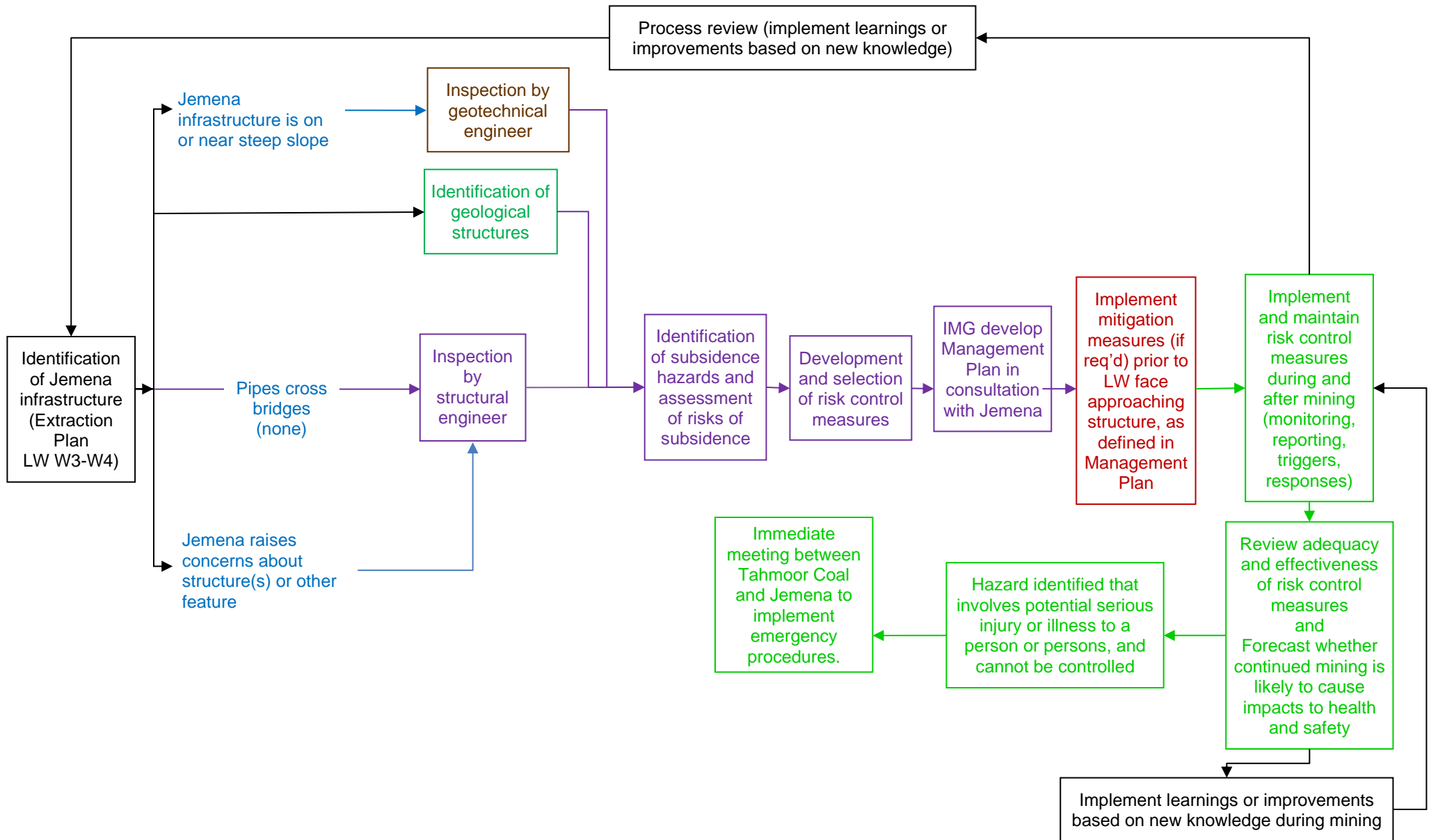


Fig. 3.7 Flowchart for Subsidence Impact Management Process

3.5. Summary of potential impacts

A summary of potential impacts on Jemena infrastructure is provided in Table 3.2. The summary is consistent with the risk assessment undertaken by Tahmoor Coal (2020). 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
Damage resulting in gas leak	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 rise to risks to health and safety of people in the vicinity of Jemena 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 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 nylon (NY) and polyethylene (PE) gas pipelines; and
- Gas pipelines at creek crossings.

The following mine subsidence hazards were identified that could give rise to risks to health and safety on Jemena infrastructure due to the extraction of LW W3-W4.

- Potential damage to pipes resulting in a gas leak (refer Section 3.7).

The identification and risk assessment process took into account the location of infrastructure relative to LW W3-W4 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 Jemena infrastructure, as discussed in Section 1.4 and Chapter 3 of this Management Plan. In this case, creeks have been mapped that intersect gas 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 Jemena infrastructure in general. These are described in Chapter 4 of this Management Plan.

3.7. Gas pipelines

No gas pipelines are located directly above LW W3-W4.

Buried 32 mm and 50 mm nylon (NY) pipelines are located along Hill Street and Thirlmere Way, respectively, to the southeast of LW W4, as shown in Drawing No. MSEC1173-05-01.

A network of 32 mm, 50 mm and 75 mm diameter nylon (NY) gas pipelines are located directly above and adjacent to previously extracted LW W1. The pipelines follow the alignments of local roads, including Thirlmere Way, Stonequarry Creek Road, Carramar Close, Attunga Close and Booyong Close. One branch follows a driveway easement to service a property on Stonequarry Creek Road.

On 24 April 2019, Macarthur Gas completed a pre-mining gas detection survey of pipelines that are located within the Study Area for LW W1-W2, which covered the pipelines of local roads, including Thirlmere Way, Stonequarry Creek Road, Carramar Close, Attunga Close and Booyong Close. No leaks were recorded above the reportable limit of 5000 ppm to Jemena.

In November 2020, Macarthur Gas conducted a gas detection survey for Tahmoor Coal in response to observations of mining-induced damage to the road pavement at the cul-de-sac end of Carramar Close when LW W1 was completed. Whilst no gas was detected at the pavement impact site, the survey detected a very low level leak of 166 ppm at the intersection of Carramar Close and Stonequarry Creek Road. Macarthur Gas reported that the grass was dead where the leak was detected, which suggested that the leak had been present for a long time and was likely unrelated to subsidence.

Macarthur Gas undertook follow-up tests that confirmed the leak, with a small increase to 440 ppm in March 2021. Weekly testing was completed until the leak was repaired in April 2021. Site investigations at the time of repair confirmed that the leak was not caused by mine subsidence related movements.

3.7.1. Predicted subsidence movements

The gas pipelines located to the west of LW W4 within the Study Area run along Thirlmere Way. The predicted profiles of conventional subsidence, tilt and curvature for the 50 mm gas pipelines along Thirlmere Way are shown in Fig. 3.8. Less than 20 mm subsidence is predicted to occur along the 50 mm diameter pipeline due to the extraction of LW W3-W4.

The gas pipelines located directly above and adjacent to previously extracted LW W1-W2 generally follow the alignments of the local roads. The predicted profiles of conventional subsidence, tilt and curvature for the 50 mm gas pipelines along Stonequarry Creek Road are shown in Fig. 3.9. Up to 100 mm of additional vertical subsidence is predicted to develop along Stonequarry Creek Road at the northern end.

Predicted subsidence is similar along Booyong Close and Attunga Close. Carramar Close is predicted to experience less than 20 mm of additional vertical subsidence due to the extraction of LW W3-W4.

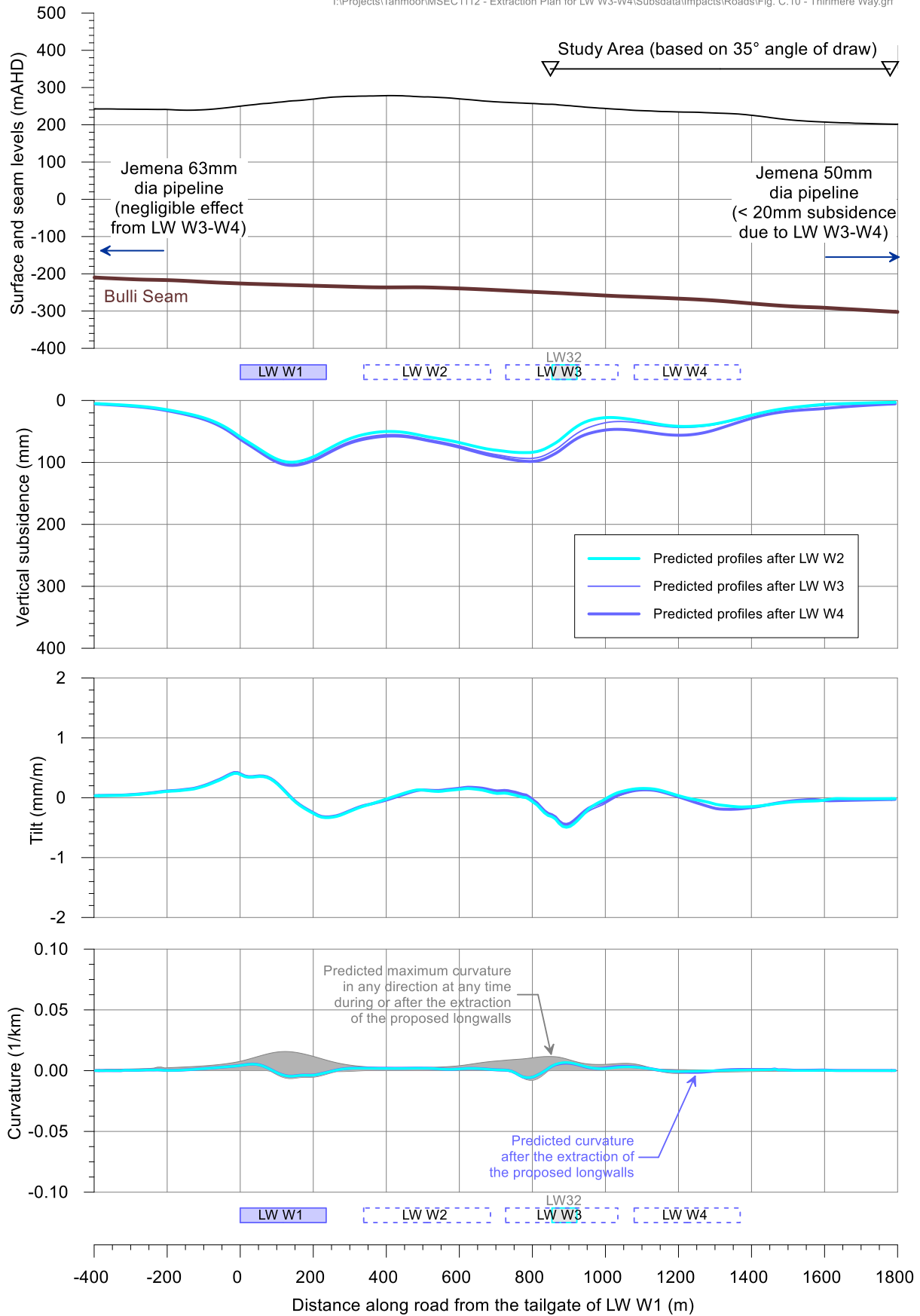


Fig. 3.8 Predicted profiles of total subsidence, tilt and curvature for the gas pipeline along Thirlmere Way after the mining of LW W3-W4

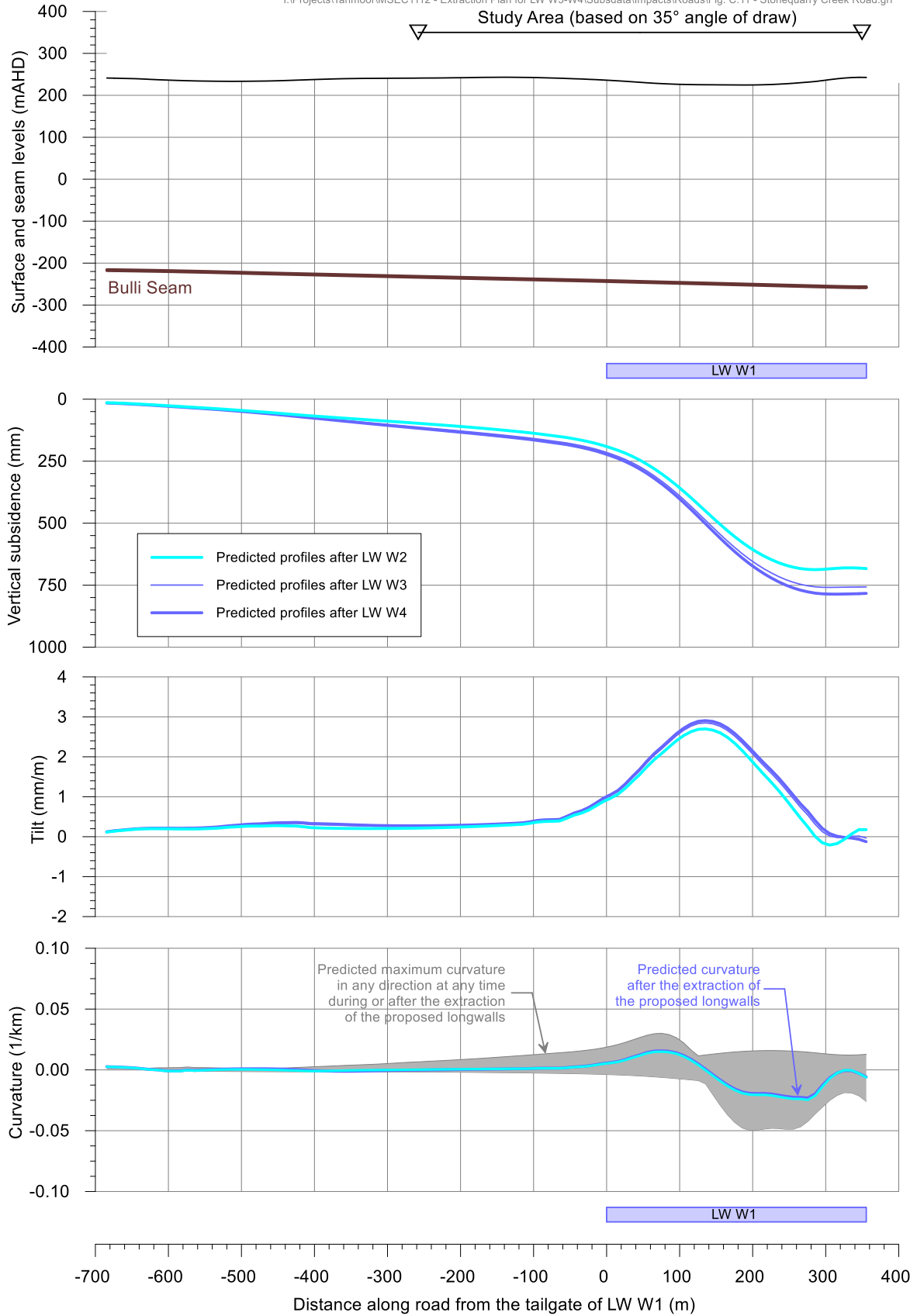


Fig. 3.9 Predicted profiles of total subsidence, tilt and curvature for the gas pipeline along Stonequarry Creek Road after the mining of LW W3-W4

3.7.2. Potential subsidence impacts on gas pipelines

Longwalls 22 to 32 and LW W1-W2 have directly mined beneath approximately 19.7 km of gas pipelines and no adverse impacts have been reported to date. The nylon pipelines are very flexible and have demonstrated that they can withstand the full range of subsidence experienced at Tahmoor Mine.

A low-level gas leak was detected near the intersection of Stonequarry Creek Road and Carramar Close during the mining of LW W1. Site investigations at the time of repair in April 2021 confirmed that the leak was not caused by mine subsidence related movements.

Past experiences include the extraction of Longwall 25 beneath Abelia Street, where a large compressive strain of 6.5 mm/m (over a 22 m bay length) was measured between Marks A12 and A13, coinciding with a vertical bump in the subsidence profile and a hump in the road pavement. No impacts on the local gas pipelines were reported.

It is possible, but unlikely, that minor adverse impacts could occur to the gas infrastructure that is located directly above or immediately adjacent to previously extracted LW W1-W2. It is expected that any impacts would be relatively minor and that these could be readily repaired.

While no adverse impacts to the gas pipelines have been experienced to date, the most vulnerable elements of the system are considered to be the rigid copper pipe connections between the gas mains and properties, and glued joints in the nylon pipes at T-intersections. However, there are no local gas pipelines located directly above LW W3-W4 and, hence, it is unlikely that there will be any impact to rigid copper pipe connections.

Tahmoor Coal has developed and selected risk control measures in consultation, co-ordination and co-operation with Jemena in accordance with WHS legislation. The controls have been implemented during the mining of Longwalls 22 to 32 and LW W1-W2.

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 gas leaks during the extraction of LW W3-W4 by implementing the following measures:

- Pre-mining gas detection survey of gas pipelines potentially affected by the extraction of LW W1-W2 (completed);
- Pre-mining gas detection survey of gas pipelines that are located along Thirlmere Way from the Main Southern Railway to Argyle Street, which may potentially be affected by the extraction of LW W4 (prior to the influence of LW W4);
- Regular ground surveys along streets located within the active subsidence zone;
- Baseline survey of existing survey pegs along Remembrance Drive / Argyle Street for the section between Hill Street and Wood Street, prior to the extraction of LW W4.
- Regular visual inspections along streets located within the active subsidence zone;
- Regular consultation with the community to report potential impacts. As the gas has been odourised, the community are more likely to report gas leaks if they occur;
- Additional inspections and gas patrols if triggered by observations of increased ground strains, ground curvature or localised surface deformations;
- Exposing pipeline to relieve it of stress if triggered by monitoring results; and
- In the worst case, repair of damaged pipeline by temporary squeezing off the pipeline, and replacing the damaged section.

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 Jemena 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 landowner 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 W3-W4.

4.3. Selection of risk control measures for gas infrastructure

Based on its own 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 gas infrastructure:

- Implementation of a Monitoring Plan and Trigger Action Response Plan (TARP)
As described in the Management Plan, Tahmoor Coal and Jemena 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:
 - Pre-mining gas detection survey within the area potentially affected by the extraction of LW W1-W2 (completed).
 - Pre-mining gas detection survey of gas pipelines that are located along Thirlmere Way from the Main Southern Railway to Argyle Street, which may potentially be affected by the extraction of LW W4 (prior to the influence of LW W4).
 - Local 2D surveys along local roads and Main Southern Railway as shown in Drawing No. MSEC1173-05-01. These include streets along which gas pipelines are located, including Thirlmere Way, Stonequarry Creek Road, 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. As the gas has been odourised, the community are more likely to report gas leaks if they occur.
 - Gas detection patrols, if triggered by monitoring results.
 - Additional inspections and gas patrols by Jemena if triggered by observations of increased ground strains, ground curvature or localised surface deformations
 - Exposing pipeline to relieve it of stress if triggered by monitoring results
 - In the worst case, repair of damaged pipeline by temporary squeezing off the pipeline, and replacing the damaged section; and
 - Follow Jemena procedures to monitor and respond to impacts.

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 W3-W4

A survey line has been installed along the centreline of LW W3. A survey line has been installed along the centreline of LW W4, as shown in Drawing No. MSEC1173-05-01.

The purpose of the survey lines is to establish the general magnitude and shape of surface subsidence along the centrelines of LW W3-W4. 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 northern to southern end of LW W3. 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 have been installed along Barkers Lodge Road, Thirlmere Way, Stonequarry Creek Road, Attunga Close, Booyong Close and the Main Southern Railway, as shown in Drawing No. MSEC1173-05-01. The survey pegs will be surveyed during the period of active subsidence of these features during the extraction of LW W3-W4. The surveys measure changes in height and changes in horizontal distances between adjacent pegs.

Survey pegs were installed along Remembrance Drive / Argyle Street prior to the influence of previously extracted LW 32. While the 160 mm PE gas main is located is unlikely to be affected by the extraction of LW W3-W4, Tahmoor Coal will conduct a survey of the existing pegs prior to the start of LW W4 for the section between Hill Street and Wood Street. Additional surveys can be conducted if there are concerns with the gas main, based on observations from regular surveys during the extraction of LW W4.

4.4.2. Visual inspections

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

4.4.3. Gas patrols

On 24 April 2019, Macarthur Gas completed a pre-mining gas detection survey of pipelines that are located within the Study Area shown in Drawing No. MSEC1173-05-01.

A pre-mining gas detection survey will be completed along Thirlmere Way between the Main Southern Railway and Argyle Street, prior to the influence of LW W4.

Additional gas detection surveys can be undertaken if triggered by monitoring results.

4.4.4. Changes to monitoring frequencies

Monitoring frequencies will continue while Jemena infrastructure is experiencing active subsidence due to the extraction of LW W3-W4. As a general guide, monitoring is likely to continue until the longwall has moved away from a site 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 Jemena.

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 gas detection surveys;
- Additional surveys and inspections;
- Exposing pipeline to relieve it of stress;
- Repair of impacts that create a serious public safety hazard; and
- In the worst case, restriction on entry, or access to, Jemena 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 Jemena 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 W3-W4, 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 3.7, only a gas leak could possibly result in severe impacts that could 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 Jemena. Regular consultation with the community is important. As the gas has been odourised, the community are more likely to report gas leaks if they occur.

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 Jemena 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 Jemena 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 Jemena will immediately meet and implement emergency procedures.

4.6. Subsidence Impact Management Procedures

The procedures for the management of potential impacts are provided in Table 4.1.

Table 4.1 Risk Control Procedures during the extraction of Tahmoor LW W3-W4

Level	Control measures	Frequency	Analysis	Trigger level	Action
1	<p><u>Ground inspections:</u></p> <ul style="list-style-type: none"> - 2D survey - ground inspection 	<p><u>Ground surveys by Tahmoor Coal:</u> Monthly 2D survey along centrelines of LW W3-W4 for pegs located within active subsidence zone after 20 mm of vertical subsidence is measured by the Initial Goaf GNSS unit, or the length of the extraction of LW W3 and LW W4 exceeds 200 metres, whichever occurs first. Weekly surveys along Stonequarry Creek Road when within active subsidence zone. 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 Weekly surveys along Main Southern Railway, Booyong Close, Attunga Close and Thirlmere Way when within active subsidence zone Baseline survey of pegs along Remembrance Drive / Argyle Street between Hill Street and Wood Street prior to start of LW W4. <u>Ground inspections by Tahmoor Coal:</u> Weekly inspection including at the creek crossings within the active subsidence zone</p>	<p>Tahmoor Coal surveys and provides Jemena with</p> <ul style="list-style-type: none"> - ground surveys - ground movements / features reports 	<p><u>Ground movement survey and measurements:</u></p> <ul style="list-style-type: none"> * Radius of ground curvature greater than 4 (km) * Ground strain 0 to 2 (mm/m) * Ground movements rate of change steady <p><u>Ground conditions monitoring:</u></p> <ul style="list-style-type: none"> - ground cracks reported - ground subsidence reported 	<p>Go to LEVEL 2 if LEVEL 1 limit is exceeded:</p> <ul style="list-style-type: none"> * normal ground patrol by Jemena pipeline officer <p>Jemena actions following receipt of reported incidents:</p> <ul style="list-style-type: none"> inspects site to confirm operation of gas facilities not affected <p>Assess potential for impacts on pipe crossings due to valley closure. Consider trigger level for Level 2.</p>
	<p><u>Ground subsidence validations:</u></p> <ul style="list-style-type: none"> - Observed against predictions 	<p>On receipt of data: verify and track results against predictions</p>	<p>MSEC analyses and reports findings to stakeholders</p>	<p>- ground movements showing a <u>step change</u> indicating shear and / or <u>discontinuity</u> in humps near the gas services</p>	<p>* undertake additional inspection e.g. exposing and inspecting gas service as applicable to determine gas facilities integrity</p>
	<p><u>Baseline Gas Detection Survey:</u> Stonequarry Estate above LW W1-W2 completed 24 April 2019 Undertake a pre-mining gas detection survey along Thirlmere Way between Main Southern Railway and Argyle Street prior to 400 metres of extraction of LW W4.</p>		<p>Jemena reviews:</p> <ul style="list-style-type: none"> - 2D ground surveys report - pipe integrity - ground conditions report 	<p>*based on above findings, undertake corrective action per Level 3 activities where gas services integrity affected</p>	
2	<p><u>Ground inspections:</u></p> <ul style="list-style-type: none"> - 2D survey - ground inspection 	<p>Submit data within 24 hours duration Twice weekly 2D survey</p>	<p>Tahmoor Coal surveys and provides Jemena with</p> <ul style="list-style-type: none"> - ground surveys - ground movements / features reports 	<p><u>Ground movement survey and measurements:</u></p> <ul style="list-style-type: none"> * Radius of ground curvature 2 to 4 (km) * Ground strain 2 to 5 (mm/m) * Ground movements rate of change increasing with increasing upward trend 	<p>Go to LEVEL 3 if LEVEL 2 limit is reached:</p> <ul style="list-style-type: none"> * weekly ground patrol by Jemena pipeline officer
	<p><u>Ground subsidence validations:</u></p> <ul style="list-style-type: none"> - Observed against predictions 	<p>Twice weekly: verify and track results against predictions</p>	<p>MSEC analyses and reports findings to stakeholders</p>	<p>* Subsidence is delayed (such as subsidence not developing within expectations, and/or reports of no caving underground)</p>	<p>Jemena actions following receipt of reported incidents:</p> <ul style="list-style-type: none"> inspects site to confirm operation of gas facilities not affected
			<p>Jemena reviews:</p> <ul style="list-style-type: none"> - 2D ground surveys report - pipe integrity - ground conditions report 	<p><u>Ground conditions monitoring:</u></p> <ul style="list-style-type: none"> - ground cracks reported - ground subsidence reported 	<p>* based on above findings, undertake corrective action per Level 3 activities where gas services integrity affected</p> <p>* if no immediate corrective actions required, Jemena may put field construction on standby</p>
3	<p><u>Ground inspections:</u></p> <ul style="list-style-type: none"> - 2D survey - ground inspection 	<p>Submit data within 24 hours duration Daily 2D survey</p>	<p>Tahmoor Coal surveys and provides Jemena with</p> <ul style="list-style-type: none"> - ground surveys - ground movements / features reports 	<p><u>Ground movement survey and measurements:</u></p> <ul style="list-style-type: none"> * Radius of ground curvature less than 2 (km) * Ground strain greater than 5 (mm/m) * ground movements showing a <u>step change</u> indicating shear and / or <u>discontinuity</u> in humps near the gas services. 	<p>Jemena's field corrective actions:</p> <ul style="list-style-type: none"> - mobilisation construction in the field - excavate affected area - inspect gas facilities to confirm integrity - repair and / or replace gas services as applicable to maintain supply and safe operation
	<p><u>Ground subsidence validations:</u></p> <ul style="list-style-type: none"> - Observed against predictions 	<p>Daily: verify and track results against predictions</p>	<p>MSEC analyses and reports findings to stakeholders</p>		
			<p>Jemena reviews:</p> <ul style="list-style-type: none"> - 2D ground surveys report - pipe integrity - ground conditions report (as applicable) 		

5.1. Consultation, co-operation and co-ordination

Substantial consultation, co-operation and co-ordination has taken place between Tahmoor Coal and Jemena 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 to ensure the continued effective consultation, co-operation and co-ordination of action with respect to subsidence between Tahmoor Coal and Jemena:

- 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 Jemena 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 W3-W4.
- Convening of meetings between Tahmoor Coal and Jemena at any time as required, as discussed in Section 5.2;
- Arrangements to facilitate timely repairs, if required; and
- Immediate contact between Tahmoor Coal and Jemena 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 private 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 is to:

- Detect changes, including the early detection of potential impacts on health and safety and impacts to Jemena 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 Jemena 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 Jemena.

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; and
- 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 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 Jemena.

7.0 RECORD KEEPING

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

8.0 CONTACT LIST

Organisation	Contact	Phone	Email
Jemena Control Centre	Emergency Contact	131909	
Jemena Engineering Support Manager	John Martin	(02) 9867 7219 0407 105 128	John.Martin@jemena.com.au
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Jemena Engineer	Darryl Tolentino*	(02) 9867 7237	darryl.tolentino@jemena.com.au
Jemena Engineer	Muhammad Umer Siddiqui*	(02) 9867 7237	muhammad.siddiqui@jemena.com.au
Jemena Engineering Services Specialist	Layton Manuel	(02) 9867 7335	layton.manuel@jemena.com.au
NSW Department of Planning and Environment – Resources Regulator	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
Subsidence Advisory NSW	Matthew Montgomery	(02) 4677 1967 0425 275 564	Matthew.Montgomery@customerservice.nsw.gov.au
Mine Subsidence Engineering Consultants (MSEC)	Daryl Kay*	(02) 9413 3777 0416 191 304	daryl@minesubsidence.com
SIMEC Mining Tahmoor Coal Project Manager	Ross Barber*	(02) 4640 0028 Mob: 0419 466 143	ross.barber@simecgfg.com
SIMEC Mining Tahmoor Coal Approvals Specialist	April Hudson*	(02) 4640 0022 0466 380 992	April.Hudson@simecgfg.com

* denotes member of Infrastructure Management Group

APPENDIX A. Drawings and Supporting Documentation

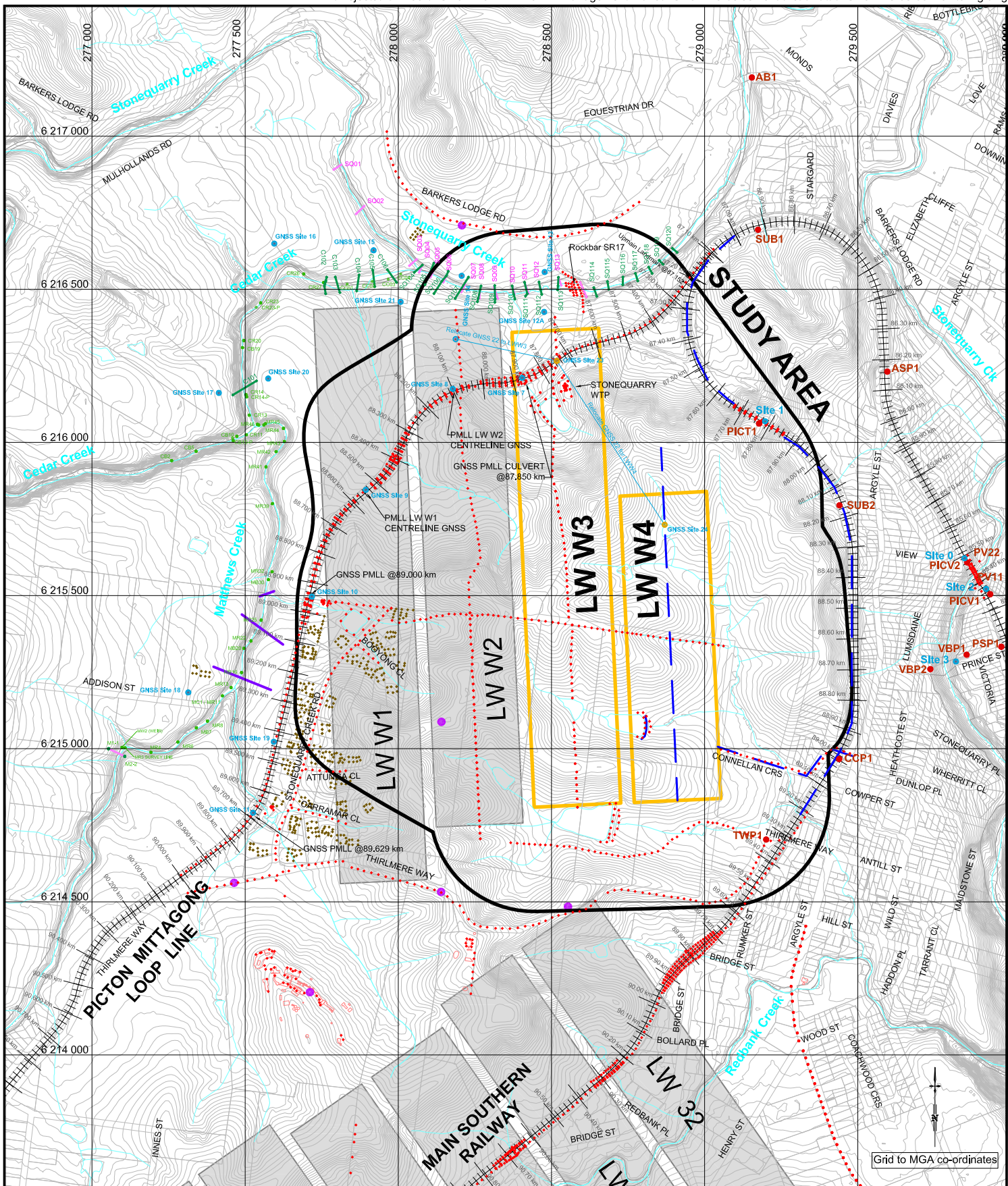
The following supporting documentation is provided in Appendix A.

Drawings

<i>Drawing No.</i>	<i>Description</i>	<i>Revision</i>
MSEC1173-05-01	Monitoring plan	A
MSEC1173-05-01	Jemena Gas Pipelines	A

Supporting Documentation

Tahmoor Coal (2020)	Risk Assessment Report – Infrastructure. Tahmoor North – Western Domain, Longwalls West 3 and West 4, September 2020.
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LEGEND

- ROCKBAR / VALLEY FLOOR CLOSURE LINES
- EXISTING VALLEY CLOSURE LINES
- PROPOSED VALLEY CLOSURE LINES
- PROPOSED LINES WITH PEGS AT 20m SPACING
- EXISTING FAR FIELD PEGS
- EXISTING GNSSS UNITS
- PROPOSED GNSSS UNITS
- CRITICAL POWER POLES
- EXISTING MONITORING PEGS
- EXISTING MONITORED PEGS AROUND HOUSES
- SURFACE LEVEL CONTOURS
- DRAINAGE LINES

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**WESTERN DOMAIN
MANAGEMENT PLAN
LW W3-W4
MONITORING**

DATE: 6 Oct 2021	SCALE: as shown	DRAWING No: MSEC1173-05-01	Rev No A
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LEGEND

- PROPOSED LONGWALLS
- EXISTING LONGWALLS
- CADASTRAL
- ROADS
- RAILWAYS
- WATERCOURSE
- GAS PIPELINES**
- Ø 32mm NY
- Ø 50mm NY
- Ø 63mm NY
- Ø 160mm PE



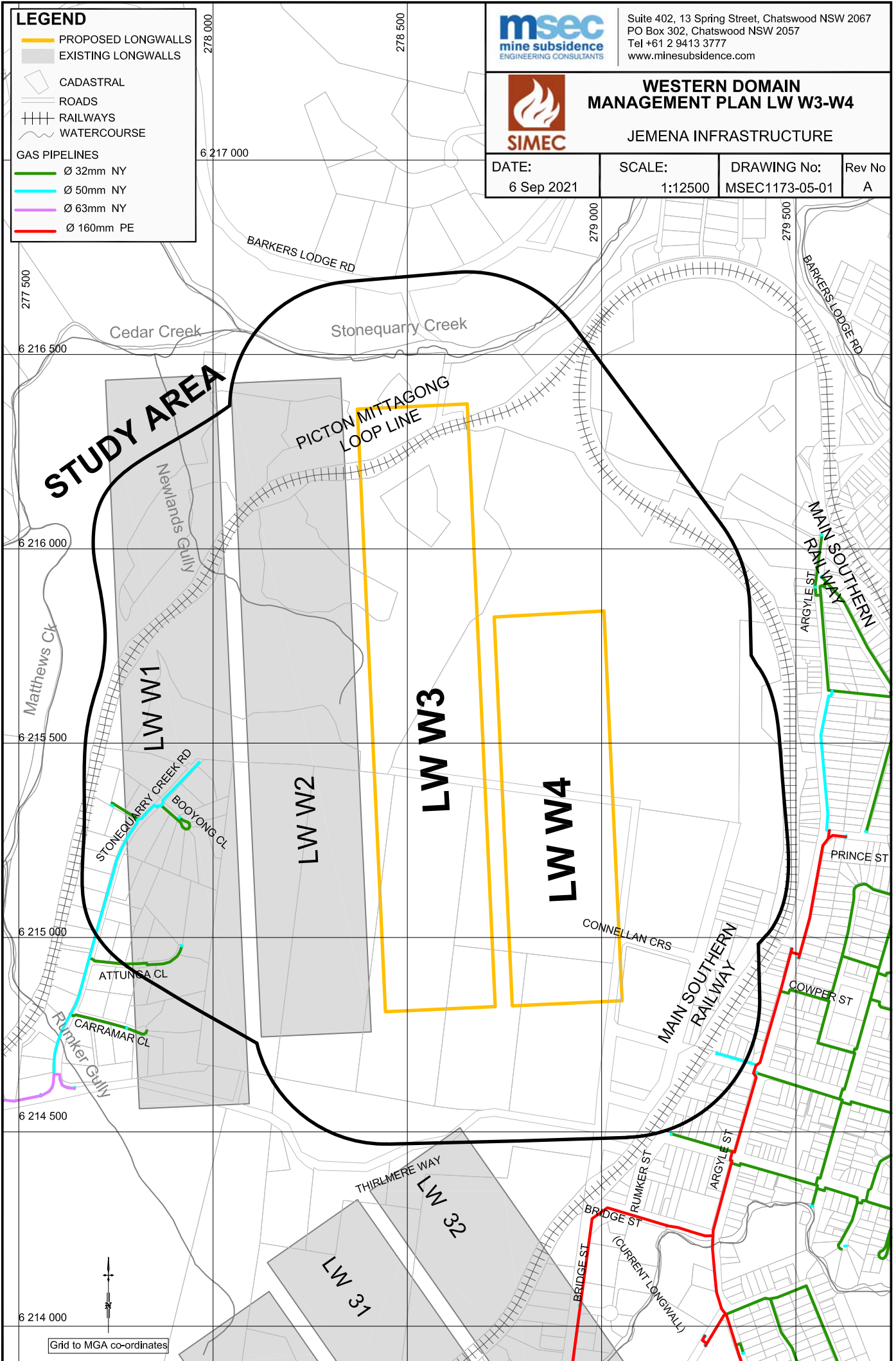
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**WESTERN DOMAIN
 MANAGEMENT PLAN LW W3-W4**

JEMENA INFRASTRUCTURE

DATE: 6 Sep 2021	SCALE: 1:12500	DRAWING No: MSEC1173-05-01	Rev No A
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Grid to MGA co-ordinates

Major Project Risk Assessment: Tahmoor Underground - Extraction Plan LW W3-W4

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

Site	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
Tahmoor Underground	Major Project	Built Infrastructure	Jemena gas infrastructure	Damage to gas infrastructure	Gas leak, emergency repair	Subsidence	<ul style="list-style-type: none"> * Management Plans prepared for previous longwalls (AC) * Previous ground survey and visual inspection as part of LW 22-W2 management (AC) * Previous consultation, coordination and cooperation with Jemena (AC) * Design of gas line flexible pipework (EC) * Gas is odourous - community more likely to report gas leaks if they occur (EC) 	2	Health & Safety	1	D	2	1	Health & Safety	Complete Jemena Management Plan including TARP and contact details for Jemena	April Hudson	01-Sep-21	

1 1 1 1 Subtotal CountA (ignoring hidden values) 1 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						