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Tahmoor Coal Pty Ltd

HERITAGE MANAGEMENT PLAN

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

August 2021

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Document Control

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1 Introduction

1.1 Background

Tahmoor Coal Mine (Tahmoor Mine) is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney between the towns of Tahmoor and Bargo, New South Wales (NSW) (refer to **Figure 1-1**). Tahmoor Mine produces up to three million tonnes of Run of Mine coal per annum from the Bulli Coal Seam. Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Product coal is transported via rail to Port Kembla and Newcastle for Australian domestic customers and export customers.

Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced in 1979 using bord and pillar mining methods, and via longwall mining methods since 1987. 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 Tahmoor Mine's current pit top location. The current mining area, the 'Western Domain', is located north-west of the Main Southern Rail between the townships of Thirlmere and Picton. The Western Domain is within the Tahmoor North mining area and is within Mining Lease (ML) 1376 and ML 1539.

The mine plan for the Western Domain includes four longwalls - Longwalls West 1 to West 4. An Extraction Plan for the first two longwalls in the Western Domain, Longwalls West 1 and West 2 (LW W1-W2), was approved by the NSW Department of Planning, Industry and Environment (DPIE) on 8 November 2019. Longwalls West 1 (LW W1) was the first longwall to be extracted in the Western Domain and was completed on 6 November 2020. The extraction of Longwalls West 2 (LW W2) was completed on 17 June 2021.

The proposed Longwalls West 3 and West 4 (LW W3-W4) are an extension of LW W1-W2 and will be the focus of the current Extraction Plan. LW W3-W4 are illustrated in **Figure 1-2**.

1.2 Purpose

This Heritage Management Plan (HMP) has been prepared to support an Extraction Plan for the secondary extraction of coal from LW W3-W4. This HMP has been designed to identify the monitoring and management measures for heritage sites within the Extraction Plan Study Area that are required to be implemented to demonstrate that the relevant performance measures are achieved.

1.3 Scope

The Study Area applicable to this HMP consists of a combination of the Predicted 20 millimetre (mm) Total Subsidence Contour and the 35° Angle of Draw Line as shown on **Figure 1-2**. Relevant environmental features within a 600 metre (m) buffer from extraction that could be susceptible to far-field or valley related movements have also been included for consideration.

This HMP:

- Addresses specific requirements set by DA 67/98 Condition 13H(vii)(f) (refer to **Section 2.1**);
- Addresses related regulatory requirements (refer to **Section 2.2**);
- Addresses the monitoring and management of potential subsidence-related impacts to Aboriginal and historical heritage (refer to **Section 5**); and
- Provides a Trigger Action Response Plan (TARP) to be implemented to manage and protect known heritage values within the Study Area (refer to **Appendix A**).

This HMP has been prepared based on the contents of the following technical reports:

- Aboriginal Heritage Technical Report (AHTR) (EMM, 2021a) (**Appendix B**);
- Historical Heritage Technical Report (HHTR) (EMM, 2021b) (**Appendix C**);
- Main Southern Railway Inspection Report (EMM, 2021d) (**Appendix D**); and
- Subsidence Predictions and Impact Assessment (MSEC, 2021) (**Volume 1**).

The LW W3-W4 Stonequarry Creek Rockbar Management Plan (SCRMP) is a sub-plan to this HMP and details the monitoring and management of the axe grinding groove site (AHIMS #52-2-2068) and surrounding rockbar platform.



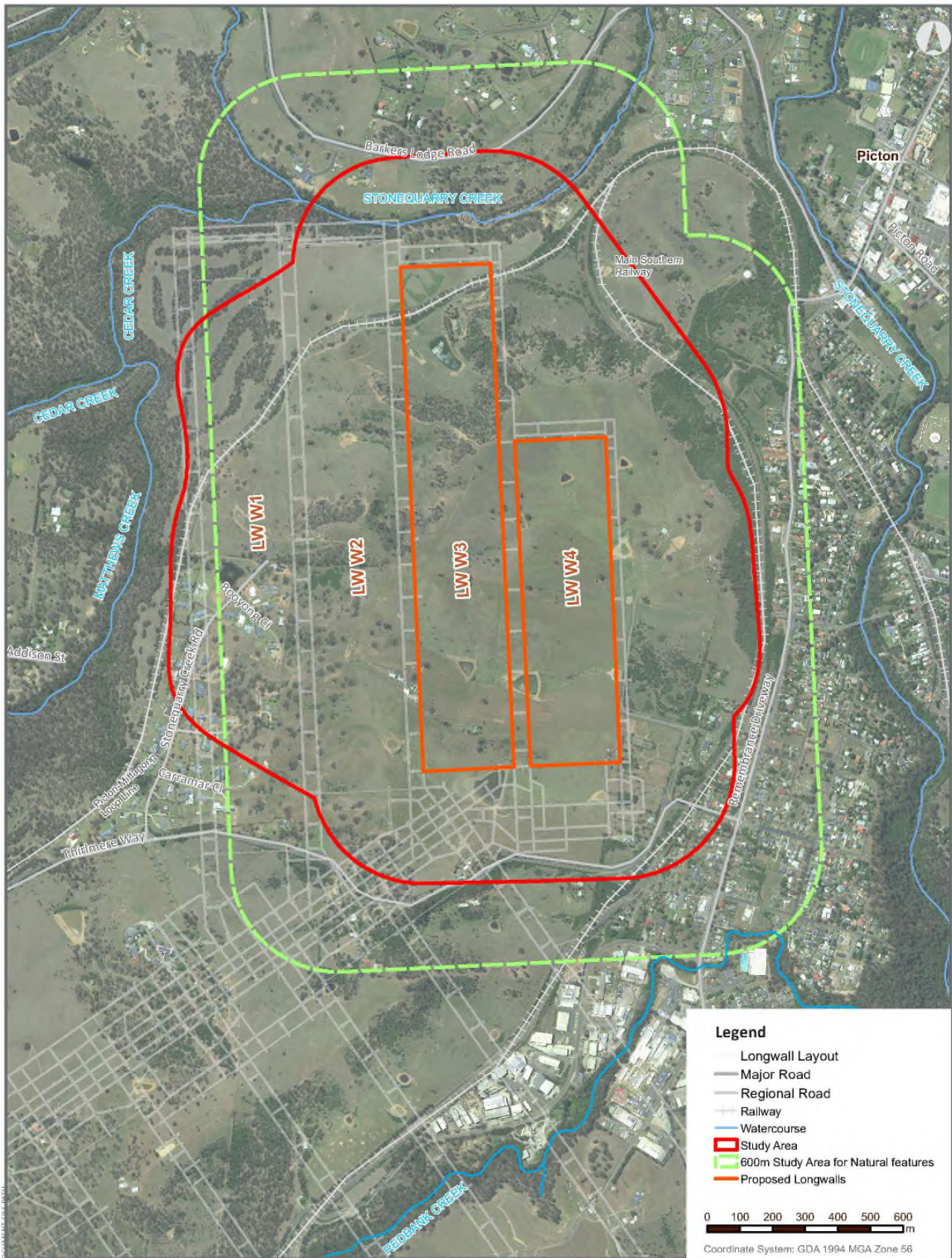
Tahmoor North Western Domain Longwalls West 3 and West 4 Extraction Plan

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EXTRACTION PLAN STUDY AREA

SIMEC Tahmoor North Western Domain Longwalls West 3 and West 4
Extraction Plan



FIGURE 1-2

Date: 10/05/2021

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2 Regulatory Requirements

2.1 Project Approval

2.1.1 Development Consent

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety, and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database.

The proposed LW W3-W4 will be operating in the Tahmoor North mining area under Development Consents DA 57/93 and DA 67/93, as discussed further in **Section 3.2.1** of the Extraction Plan Main Document.

DA 67/98 provides the conditional planning approval framework for mining activities in the Western Domain to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to this HMP from DA 67/98 are detailed in **Table 2-1**.

Table 2-1 Key Conditions from DA 67/98 regarding Aboriginal and Historical Heritage

Condition	Condition Requirement		Section(s) Addressed
SUBSIDENCE			
Performance Measures – Natural and Heritage Features etc.			
13A	The Applicant must ensure that extraction of Longwall 33 and subsequent longwalls does not cause any exceedances of the performance measures in Table 1. <i>Note: The Applicant will be required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent.</i>		Section 5, Section 6, Appendix A, the SCRMP
Excerpt from Table 1	Feature	Performance Measure	
	Heritage Sites		
	Heritage sites	- Negligible subsidence impacts or environmental consequences. - Negligible loss of heritage value.	
	Other Aboriginal and heritage sites	Negligible subsidence impacts or environmental consequences.	
13B	Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.		Section 5, Section 6, Appendix A, the SCRMP

Condition	Condition Requirement	Section(s) Addressed
13C	If the Applicant exceeds the performance measures in Table 1 and the Secretary determines that: (i) it is not reasonable or feasible to remediate the subsidence impact or environmental consequence; or (ii) remediation measures implemented by the Applicant have failed to satisfactorily remediate the subsidence impact or environmental consequence, then the Applicant must provide a suitable offset to compensate for the subsidence impact or environmental consequence, to the satisfaction of the Secretary.	Noted. Performance measures in Table 1 of DA 67/98 are not anticipated to be exceeded.
13D	The offset must give priority to like-for-like physical environmental offsets, but may also consider payment into any NSW Offset Fund established by EES, or funding or implementation of supplementary measures such as: (i) actions outlined in threatened species recovery programs; (ii) actions that contribute to threat abatement programs; (iii) biodiversity research and survey programs; and/or (iv) rehabilitating degraded habitat. Note: Any offset required under this condition must be proportionate with the significance of the impact or environmental consequence	Noted. Performance measures in Table 1 of DA 67/98 are not anticipated to be exceeded.
Extraction Plan		
13H(vi)	describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 1 and Table 2, and manage or remediate any impacts and/or environmental consequences;	Section 5.1, Section 5.2, Section 6, the SCRMP
13H(vii)(f)	Heritage Management Plan which has been prepared in consultation with Heritage NSW and relevant stakeholders for heritage items which provides for the management of potential environmental consequences of the proposed second workings on heritage items;	Section 6
13H(vii)(h)	Trigger Action Response Plan/s addressing all features in Table 1 and Table 2, which contain:	Section 6.3, Section 6.5, Appendix A, the SCRMP
	appropriate triggers to warn of increased risk of exceedance of any performance measure; and	
	specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded;	
	an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	
	adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 1 or Table 2, or where any such exceedance appears likely; and	

Condition	Condition Requirement	Section(s) Addressed
13H(vii)(i)	Contingency Plan that expressly provides for:	Section 5.3, Section 6.4, Section 6.5, Appendix A, the SCRMP
	adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 1 and Table 2, or where any such exceedance appears likely; and	
	an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures; and	
	includes a program to collect sufficient baseline data for future Extraction Plans.	

2.1.2 Extraction Plan Guideline

This HMP has been prepared in accordance with the DPIE *Draft Guidelines for the Preparation of Extraction Plans V5* (Department of Planning and Environment (DPE), 2015), as illustrated in **Table 2-2**.

Table 2-2 Extraction Plan Guideline Requirements for Key Component Plans

Extraction Plan Guideline Content Requirements for Key Component Plans	Section(s) Addressed
An overview of all landscape features, heritage sites, environmental values, built features or other values to be managed under the component plan.	Section 3
Setting out all performance measures included in the development consent relevant to the features or values to be managed under the component plan.	Section 2.1.1, Section 5.1
Setting out clear objectives to ensure the delivery of the performance measures and all other relevant statutory requirements (including relevant safety legislation).	Section 2, Section 5.1, Section 6
Proposing performance indicators to establish compliance with these performance measures and statutory requirements.	Section 5.1
Describe the landscape features, heritage sites and environmental values to be managed under the component plan, and their significance.	Section 3
Describe all currently predicted subsidence impacts and environmental consequences relevant to the features, sites and values to be managed under the component plan.	Section 4
Describe all measures planned to remediate these impacts and/or consequences, including any measures proposed to ensure that impacts and/or consequences comply with performance measures and/or the Applicant's commitments.	Section 6, Appendix A
Describe the existing baseline monitoring network and the current baseline monitoring results, including pre-subsidence photographic surveys of key landscape features and key heritage sites which may be subject to significant subsidence impacts (such as significant watercourses, swamps and Aboriginal heritage sites).	Section 3, Section 5.2
Fully describing the proposed monitoring of subsidence impacts and environmental consequences.	Section 5.2
Describe the proposed monitoring of the success of remediation measures following implementation.	Section 6.4, Appendix A
Describe adaptive management proposed to avoid repetition of unpredicted subsidence impacts and/or environmental consequences.	Section 6.5
Describe contingency plans proposed to prevent, mitigate or remediate subsidence impacts and/or environmental consequences which substantially exceed predictions or which exceed performance measures.	Section 6.4, Appendix A

Extraction Plan Guideline Content Requirements for Key Component Plans	Section(s) Addressed
Listing responsibilities for implementation of the plan.	Section 7.3
An attached Trigger, Action, Response Plan (effectively a tabular summary of most of the above).	Appendix A

2.2 Relevant Legislation

This HMP has been prepared in accordance with the principles of the Australia ICOMOS Burra Charter, 2013 (Burra Charter). The Burra Charter provides guidance for the conservation and management of places of cultural significance and sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians.

Items of heritage significance in NSW are protected by a series of acts whose purpose it is to ensure that change is appropriately managed to ensure that significance is not lost. In NSW, the *NSW Heritage Act 1977* (Heritage Act), *National Parks and Wildlife Act 1974* (NPW Act) and the *Environmental Planning and Assessment Act 1979* (EP&A Act) are the primary statutory controls protecting Aboriginal and historical heritage and archaeology within NSW. Listing on statutory registers provides legal protection for heritage items.

The relevant Acts and regulations protecting and managing Aboriginal and historical heritage in New South Wales are discussed in the sections below.

2.2.1 National Parks and Wildlife Act 1974

Aboriginal objects and places are protected in NSW under the Part 6 of the NPW Act. Section 90 of the NPW Act requires an Aboriginal Heritage Impact Permit (AHIP) for harm to an Aboriginal object or Aboriginal place. Significant penalties are in place for harm to Aboriginal objects or places regardless of whether the harm was committed knowingly or not. Defences against prosecution include impacts in compliance with an AHIP, acting in accordance with specified codes of practice or the conduct of certain low impact activities. The Act defines an Aboriginal object as:

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains.

Harm is defined as:

any act or omission that: (a) destroys, defaces or damages the object or place, or (b) in relation to an object—moves the object from the land on which it had been situated, or (c) is specified by the regulations, or (d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c), but does not include any act or omission that: (e) desecrates the object or place, or (f) is trivial or negligible, or (g) is excluded from this definition by the regulations.

An AHIP (AHIP C0005707) for LW W1-W2 was issued on 16 March 2020 for potential harm to rock shelters and a grinding groove site (AHIMS site #52-2-2068) within the LW W1-W2 Study Area. An application for variation of AHIP C0005707 to include potential impact to AHIMS site #52-2-2068 due to LW W3-W4 extraction was submitted to Heritage NSW on 30 March 2021. The AHIP variation application is currently being assessed.

2.2.2 National Parks and Wildlife Regulation 2009

The *National Parks and Wildlife Regulation 2009* (NPW Regulation) is subsidiary legislation made under its parent act, the NPW Act. The NPW Regulation provides codes of practice, documents and guidelines that relate to the NPW Act, which include:

- The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (Due Diligence Guidelines) (DECCW, 2010a) is adopted by the NPW Regulation under Clause 80A. Compliance with the Due Diligence Guidelines provide a defence for harming Aboriginal objects and places in certain circumstances;
- Section 80D of the NPW Regulation requires an Aboriginal Cultural Heritage Assessment (ACHA) report to be completed to accompany any AHIP application. The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) sets out the information required to support an AHIP;
- The *Aboriginal Consultation Requirements for Proponents 2010* (DECCW, 2010c) set out the consultation requirements for proponents seeking an AHIP. These requirements are under Section 80C of the NPW Regulation; and
- The *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (the Code) (DECCW, 2010b) has been adopted by clause 3A of the NPW Regulation. Acts carried out in accordance with the Code are excluded from the definition of harm.

An ACHA covering proposed works in the Western Domain (LW W1-W4) has been prepared by EMM on behalf of Tahmoor Coal (EMM, 2021c), and submitted to Heritage NSW on 30 March 2021 as part of the variation application for AHIP C0005707 to include for potential impact to AHIMS site #52-2-2068 due to LW W3-W4 extraction.

2.2.3 Environmental Planning and Assessment Act 1979

Aboriginal Heritage Requirements for the Western Domain

An AHIP under Section 90 of the NPW Act is required to harm Aboriginal objects for projects assessed under the EP&A Act, except for projects assessed under Part 4 Division 4.7 (State Significant Development (SSD)) and Part 5.2 (State Significant Infrastructure (SSI)) of the EP&A Act. An AHIP is required for any impacts resulting from LW W3–W4 as it is not SSD or SSI.

Although likelihood of impact for the artefact sites and the modified tree within the Study Area is assessed to be very unlikely and the likelihood of harm to the grinding groove site within the Study Area is considered unlikely (i.e 0.015 to 0.018%), the residual risk of harming Aboriginal objects as defined in the NPW Act will still be present.

EMM prepared an ACHA for LW W1–W4 and an AHIP for LW W1–W2 was obtained on 16 March 2020 (AHIP C0005707) which overlaps with the grinding groove site (#52-2-2068). EMM prepared an updated ACHA for LW W1-W4 which specifically addresses the impacts from underground mining of LW W3-W4. The ACHA was developed to support an AHIP variation application that was lodged in March 2021 and is pending approval.

Historical Heritage

The EP&A Act establishes the framework for cultural heritage values to be formally assessed in the planning and development consent process in NSW. The EP&A Act requires that environmental impacts are considered before land development, including impacts on cultural heritage items and places as well as archaeological sites and deposits.

The EP&A Act requires that local governments prepare planning instruments, such as Local Environment Plans (LEPs) and Development Control Plans (DCPs) to provide guidance on the level of environmental assessment. This includes identification of heritage items, as listed on the heritage schedules of an LEP.

The Study Area is within the Wollondilly Shire Local Government Area (LGA), and therefore the *Wollondilly Local Environment Plan 2011* (WLEP) is applicable.

2.2.4 Heritage Act 1977

The Heritage Act is the statutory framework for the identification and conservation of heritage in NSW.

Relics are defined by the Heritage Act as “*any artefact, object or material evidence which relates to the settlement of that area that comprises New South Wales, not being Aboriginal settlement, and is of State or local significance.*” Relics are protected under Section 139 of the Heritage Act. Where there exists the potential for relics, the land in which it is found cannot be disturbed or excavated without an excavation permit under s140 of the Heritage Act.

The State Heritage Register (SHR) is a list of places and objects of particular importance to the people of NSW. When a place is listed on the SHR or is affected by an interim heritage order, approval under Section 60 of the Heritage Act, is required for any major work. The purpose of this requirement is to ensure that change to significant places is managed appropriately and does not detract from the heritage significance of the place.

State government agencies have responsibilities under Section 170 of the Heritage Act that requires them to identify, conserve and manage heritage assets owned, occupied or managed by that agency. Each agency is required to maintain a S170 register of all heritage assets and assess the significance of each asset.

Section 118 of the Heritage Act allows for a minimum standard of maintenance and repair, provided conditions in the section are met.

2.3 Consultation

NSW Department of Planning, Industry and Environment – Environment, Energy and Science (EES) Group, Heritage NSW, and Registered Aboriginal Parties (RAPs) were consulted during the preparation of this HMP.

A summary of consultation undertaken is provided in **Section 2.1.2** of the Extraction Plan Main Document, and a copy of the incoming Government Agency correspondence is provided in **Appendix C** of the Extraction Plan Main Document. A summary of RAP consultation is also provided in **Section 2.5.1** and detailed in **Appendix C** of the AHTR (**Appendix B**).

EMM prepared an ACHA for LW W1–W4 and an AHIP for LW W1–W2 was obtained on 16 March 2020 (AHIP C0005707) which overlaps with the grinding groove site (#52-2-2068). EMM prepared an updated ACHA (EMM, 2021c) for LW W1-W4 which specifically addresses the impacts from underground mining of LW W3-W4. The ACHA was developed to support an AHIP variation application that was lodged in March 2021 and is pending approval.

The preparation of the ACHA involved formal consultation in accordance with the guidelines for *Aboriginal Cultural Heritage Consultation requirements for proponents* (DECCW, 2010c). The ACHA resulted in wider consultation and further opportunity for RAPs to provide cultural input into the assessment of the LW W3-W4 Study Area.

Further Aboriginal consultation has been undertaken as part of the development of the SCRMP and is documented within the SCRMP.

3 Existing Environment

3.1 Aboriginal Heritage Items

There are eight registered Aboriginal sites recorded in the Study Area comprising one grinding groove site, six open artefact sites, and one modified tree. **Table 3-1** and **Figure 3-1** provide an overview of all the identified registered Aboriginal sites within the Study Area.

Further information about the registered Aboriginal heritage sites can be found in the ACHA reports (EMM, 2021c). The AHTR (EMM, 2021a) also provides a discussion on the landscape potential for archaeology, a more detailed review of the Aboriginal sites, and a summary of archaeological significance of the sites discussed below.

3.1.1 AHIMS Registered Sites within the Study Area

A search of the Aboriginal Heritage Information Management System (AHIMS) database on 17 September 2020 identified a total of 93 registered sites within a 10 km x 10 km area centred on the Study Area. Eight of these registered sites are located within the Study Area (EMM, 2021a).

The Aboriginal site of highest significance within the Study Area is a substantial axe grinding groove site, with 120 grinding grooves (#52-2-2068) (**Figure 3-1**). It is located on a large rockbar within Stonequarry Creek in the north of the Study Area. Originally recorded as 91 grooves, subsequent assessment has identified 120 grooves, in three groupings. The grinding groove site is a rare and extensive example of its type on a local and regional level and has high research value because of its complexity and easy accessibility (EMM, 2021a).

The predominant Aboriginal site type within the Study Area are artefact sites (**Figure 3-1**). Five sites are isolated finds, located on the lower hill slopes to the north and south of Stonequarry Creek in the north of the Study Area. Two isolated finds are located directly above LW W3 (#52-2-2069, #52-2-2070). One site is an artefact scatter, identified in an eroding bank to the south of Stonequarry Creek, approximately 150 m west of the grinding groove site (EMM, 2021a).

A modified tree (#52-2-2100) is situated directly above LW W2 (**Figure 3-1**) beside the Loop Line railway in a paddock that has been cleared of vegetation for pastoral use. The White Mahogany eucalypt has been hollowed out by termites and the upper branches are dead. However, the tree is still alive although the scar is now closed over by overgrowth (EMM, 2021a).

Table 3-1 Aboriginal Heritage Sites within the Study Area (EMM, 2021a)

AHIMS site number	Site name	Site type	Description	Landform	Significance
52-2-2068	Stonequarry Creek 1	Grinding groove site	Three clusters of axe grinding grooves on a stone platform in the bed of Stonequarry Creek. A total of approximately 120 grooves.	Creek bed	High
52-2-2069	Isolated Finds 5	Isolated find	Silcrete flake identified in a paddock used as grazing pasture.	Lower hillslope	Low
52-2-2070	Isolated Finds 9	Isolated find	Stone artefact identified on pastoral grazing land.	Lower hillslope	Low

AHIMS site number	Site name	Site type	Description	Landform	Significance
52-2-2071	Isolated Finds 2	Isolated find	Flaked piece of white quartz, near a small tributary of Stonequarry Creek.	Lower hillslope	Low
52-2-2072	Isolated Finds 1	Isolated find	Chert flake near a small tributary of Stonequarry Creek.	Lower hillslope	Low
52-2-2073	Isolated Finds 3	Isolated find	Retouched silcrete flake with possible use-wear in a paddock.	Lower hillslope	Low
52-2-2100	Clearview	Modified tree	White mahogany tree with scar 0.3x 0.75 cm (now concealed by overgrowth) on pastoral land.	Mid hillslope	Moderate
52-2-4549	SQC 1	Artefact scatter	Eleven flakes (silcrete, chert and IMT) found within a 20 m ² area of eroding bank beside Stonequarry Creek.	Creek bank	Moderate

3.1.2 AHIMS Registered Sites near the Study Area

There are a number of identified rockshelters within the AHIMS search area but outside the Study Area. The closest rockshelters are located beside Cedar Creek and Matthews Creek, approximately 800 m to 1.5 km from the LW W3-W4 footprint. Six of these rockshelters are rock art sites, primarily with figurative art, and one with an extensive collection of hand stencils. One of the rockshelters with art and artefacts also contains a series of grinding grooves on a boulder (#52-2-4430) (EMM, 2021a).

These registered AHIMS sites will not be monitored as part of the LW W3-W4 heritage monitoring program.



Figure 3-1 Aboriginal Sites within the Study Area (EMM, 2021a)

3.2 Historical Heritage Items

3.2.1 Registered Historical Heritage Sites

A review of the following databases was undertaken in December 2020 (EMM, 2021b):

- Commonwealth Heritage List (CHL);
- National Heritage List (NHL);
- SHR;
- WLEP (2011), schedule 5;
- Wingecarribee LEP (2010), schedule 5;
- NSW Department of Health s170 register;
- Rail Corp s170 register;
- Australian Rail Track Corporation (ARTC) s170 register; and
- National Trust register.

There are no heritage items within the Study Area that are registered on the CHL, NHL, SHR or National Trust registers.

Within the Study Area, there are six registered heritage items of local heritage significance that are registered on the WLEP (2011), the ARTC S170 Register, and the Department of Health S170 register. These items comprise the Mushroom Tunnel, Picton Tunnel, Weatherboard Cottage, Antill Street Underbridge, Rural Landscape (Thirlmere Way), and Redbank Uniting Church. None of these registered heritage items are located directly above the footprint of the longwalls.

A number of registered heritage sites are located outside the Study Area. However, three listed heritage sites have been included in this report as they may be sensitive to far-field horizontal movements during extraction of LW W3–W4. These items comprise the Picton Viaduct, Argyle Street Underbridge (Hole in the Wall), and a pedestrian overbridge at 86.1 km (EMM, 2021b).

Details of these registered heritage items within and outside the Study Area are listed in **Table 3-2** and are shown on **Figure 3-2**. Further detail of these heritage items can be found in the HHTR (EMM, 2021b).

3.2.2 Non-Registered Historical Heritage Sites

The Picton-Mittagong Loop Line Railway Line (hereafter referred to as the 'Loop Line') is listed on the Wingecarribee LEP (2010) (I473) for the section of the line between Buxton and Mittagong, but the section of the Loop Line within the Wollondilly Shire LGA (and within the Study Area) is not listed on the WLEP (EMM, 2021b).

The Loop Line crosses directly above the northern ends of LW W3–W4. Two sandstone and three brick culverts are situated along the section of this railway line within the Study Area. An additional brick culvert (87.300) is situated beneath the disused embankment for the original railway alignment. The sandstone culverts are likely to date to the construction of the original line in 1863, and the brick culverts to additional works in 1919 (EMM, 2021b).

The culverts have local significance as individual items and as a group. The sandstone culverts located along the Loop Line have historical significance as part of the works and structures constructed to overcome the challenging terrain during the construction of the Main Southern Railway during the 1860s, while the brick culverts which were added in 1919, have historical significance as part of the story of the development of the railway in NSW and the changing construction techniques (EMM, 2021b).

The culverts were found to be generally in fair to good condition. While cracking of the brick culverts along the Loop Line was mostly confined to the mortar, the brick culvert at chainage 87.300 under the disused embankment displayed additional cracking to the bricks themselves around the entrance to the culvert (EMM, 2021b).

Details of these un-registered heritage items are listed in **Table 3-2** and are shown on **Figure 3-3**. Further detail of these heritage items can be found in the HHTR (EMM, 2021b).

A number of non-registered items are located on the Main Southern Railway that are either within the Study Area or are outside the Study Area by may be susceptible to far field movement. These items include the following:

- Main Southern Railway culverts— three culverts within the Study Area and four culverts adjacent to the Study Area along the eastern boundary;
- Subway (88.133 km) adjacent to the Study Area;
- High retaining wall (84.687 km) located outside the Study Area;
- Bridge on Matthews Lane (84.551 km) located outside the Study Area;
- Connellan Crescent Overbridge (89.080 km); and
- Prince Street Overbridge (85.171 km).

Table 3-2 Registered and Non-Registered Historical Heritage Sites in the Study Area and Surrounds (EMM, 2021b; EMM, 2021d)

Heritage List	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
<i>Registered heritage sites within the Study Area</i>					
WLEP	Cottage (Weatherboard) (I211)	796-800 Thirlmere Way, Picton	Dates to the late nineteenth century. Twin brick chimneys and a hipped tin roof. Aesthetic contribution to the street and to the historical landscape of Picton.	80 m south of LW W4	Local
WLEP	Redbank Uniting Church (I146)	385 Argyle Street, Picton	Wesleyan Chapel constructed in 1849 using stone quarried in Stonequarry Creek.	330 m north-west of LW W4 (abuts the Study Area)	Local
WLEP	Mushroom Tunnel (former Mainline Railway Tunnel) (I144)	239 Argyle Street, Picton	Formerly part of the Mainline Railway Tunnel, this tunnel was opened in 1867 and closed when the double track tunnel on the main line was opened in 1919.	380 m north-east of LW W4	Local
ARTC S170 Register	Picton Tunnel (part of the Picton Deviation Works)	Chainage 85.500-88.000 km Main Southern Railway	Incorporates a number of heritage items within the 1919 deviation section of the Main Southern Railway line.	240 m north-east of LW W4 north-east at its closest point	Local
ARTC S170 Register	Picton Antill Street Underbridge (also referred to as Thirlmere Way Rail Underbridge)	88.133 km Main Southern Railway	Incorrectly listed on the ARTC S170 Register as located at 88.133 km, this item is located at 89.326 on Thirlmere Way.	430 m east of LW W4	Local

Heritage List	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
Department of Health S170 Register	Rural Landscape – Thirlmere Way	Thirlmere Way, Picton	The rural landscape provides the picturesque setting for The Queen Victoria Memorial Hospital (QVMH) precinct. The site dates from c.1882 with a dam added in 1910 and further modifications between 1920-1930. The boundary of this item is defined as the setting for the QVMH.	250 m south-east of LW W4	Local
Additional registered heritage sites considered within this report					
SHR	Picton Railway Viaduct over Stonequarry Creek (01051)	Main Southern Railway	Double track stone arch viaduct over Stonequarry Creek built during 1862-69.	850 m east of LW W4	State
ARTC S170 Register	Picton Stonequarry Creek Underbridge				Local
WLEP	Picton Argyle Street Underbridge	Argyle Street 86.160 km Main Southern Railway	Railway bridge over Argyle Street, also known as 'Hole in the Wall'.	720 m north-east of LW W4	Local
ARTC S170 Register	Picton pedestrian overbridge 86.1	86.1 km Main Southern Railway	Overbridge constructed on bearings on concrete footings.	650 m north-east of LW W4	Local
Non-registered heritage sites within the Study Area					
(none)	Loop Line brick culvert 87.300	Picton-Mittagong Loop Line	Located beneath the disused embankment for the original railway alignment. Bricks cracked at northern headwall. Not in association with a creek line.	150 m east of LW W3	Local

Heritage List	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
(none)	Loop Line brick culvert 87.330	Picton-Mittagong Loop Line	Drainage channels of rendered brick have been constructed on either side of the embankments in order to funnel water into the culvert. Cracking is along the mortar only and the condition of the bricks is good.	230 m north-east of LW W3	Local
(none)	Loop Line brick culvert 87.630	Picton-Mittagong Loop Line	Concrete skin on base and rubble at the mouth. Mortar tuck pointed. Headwall and abutment in good condition. Recent embankment to the south-east means water is largely diverted away from the culvert.	Directly above LW W3	Local
(none)	Loop Line brick culvert 87.850	Picton-Mittagong Loop Line	Missing some bricks above the arch. Multiple existing cracks along the mortar.	Directly above LW W3	Local
(none)	Loop Line sandstone culvert 88.400	Picton-Mittagong Loop Line	Integrity of structure and condition of the sandstone is good.	400 m west of LW W3	Local
(none)	Loop Line sandstone culvert 88.980	Picton-Mittagong Loop Line	Poorly “restored” as part of the Stonequarry Estate Development, resulting in exfoliation of sandstone blocks particularly on the roof of the culvert.	700 m west of LW W3	Local
(none)	Brick culvert 87.331	Main Southern Railway	Brick and concrete culvert with multiple outlets in good condition.	290 m east of LW W3	Local

Heritage List	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
(none)	Brick culvert 87.918	Main Southern Railway	A brick culvert was not identified at chainage 87.918 km, however a concrete drain was visible.	330 m north-east of LW W4	None, concrete drain did not reach the threshold for local contributory significance (Appendix D).
(none)	Brick culvert 89.216	Main Southern Railway	Brick culvert, currently in use over a tributary to Matthews Creek, in good condition despite a moderate amount of graffiti.	260 m east of LW W4	Local
Non-registered heritage sites outside the Study Area					
(none)	Brick culvert 88.091	Main Southern Railway	Brick culvert currently in use over tributary creek to Stonequarry Creek, in good condition despite a moderate amount of vegetation overgrowth.	410 m east of LW W4	Local
(none)	Brick culvert 88.232	Main Southern Railway	Brick culvert no longer in use, in good condition despite a moderate amount of vegetation overgrowth.	460 m east of LW W4	Local
(none)	Brick culvert 88.496	Main Southern Railway	Brick culvert currently in use over tributary creek to Stonequarry Creek, only a terracotta pipe outlet in good condition was identified during site visit.	460 m east of LW W4	Local

Heritage List	Heritage Item	Address	Description of Item	Distance from Longwalls	Significance
(none)	Brick culvert 88.698	Main Southern Railway	Brick culvert currently in use over tributary creek to Stonequarry Creek, in good condition with cement sandbag shoring evident.	450 m east of LW W4	Local
(none)	Subway 88.133	Main Southern Railway	A pedestrian walkway providing passage underneath the railway line, in good condition.	410 m east of LW W4	Local
(none)	High retaining wall 84.687	Main Southern Railway	Retaining wall adjacent to the Main Southern Railway that is not within a valley or stream channel, in good condition.	1 km east of LW W4	Local
(none)	Connellan Crescent Overbridge 89.080	Connellan Crescent	An overbridge crossing the Great Southern Railway Line supported by reinforced concrete arch and has brick masonry walls either side of the road, in good condition despite a moderate amount of graffiti.	400 m east of LW W4	Local
(none)	Bridge on Matthews Lane 84.551	Matthews Lane	A single lane timber beam bridge over the Main Southern Railway supported by timber trestles on concrete upstand beams, in good condition.	1040 m east of LW W4	Local
(none)	Prince Street Overbridge 85.171	Prince Street	Steel framed bridge with steel guard rails supported by concrete headstocks over brick arched piers that cross over the Main Southern Railway at Picton Station, in good condition, despite a moderate amount of graffiti.	960 m east of LW W4	Local

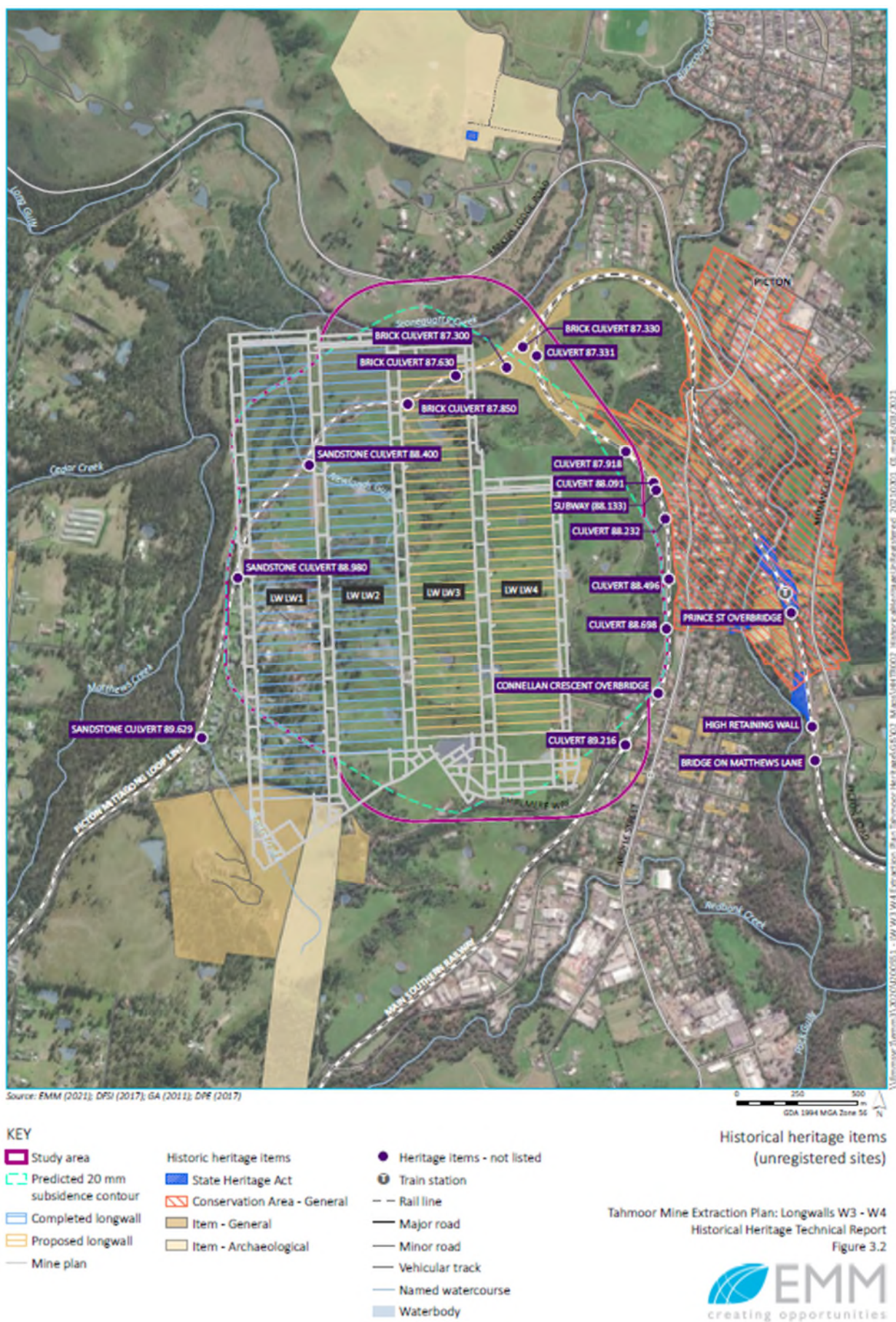


Figure 3-3 Historical Heritage Items (unregistered sites) in the Study Area and Surrounds (EMM, 2021b)

4 Predicted Subsidence Impacts and Environmental Consequences

4.1 Aboriginal Heritage Items

Mine Subsidence Engineering Consultants (MSEC) has prepared a subsidence impact assessment for the Aboriginal heritage sites within and outside of the Study Area. The likelihood of damage occurring at the Aboriginal heritage sites was assessed on criteria which considers theoretical cracking limits caused by strains and tilts. A detailed discussion of the likely impacts to Aboriginal items in the Study Area as a result of subsidence is provided in **Section 4.1** of the AHTR (EMM, 2021a).

A summary of the predicted impacts of subsidence on Aboriginal site types in the Study Area is summarised in **Table 4-1**, noting that discussion of potential impact to the grinding groove site (AHIMS site #52-2-2068) is omitted from this section and detailed in the SCRMP.

Table 4-1 Aboriginal Heritage Sites within LW W3-W4 Extraction Plan Study Area and Predicted Likelihood of Impact (EMM, 2021a)*

Aboriginal Heritage Sites	Description of Sites (AHIMS number or site name)	Possible Environmental Consequences	Probability of Impact Rating
Isolated finds/ artefact scatters	1 artefact scatter (SQC 1) 5 isolated finds (AHIMS numbers 52-2-2069, 52-2-2070, 52-2-2071, 52-2-2072, 52-2-2073)	Negligible environmental consequences.	Extremely unlikely
Scarred tree	1 modified tree (AHIMS #52-2-2100)	Negligible environmental consequences.	Extremely unlikely

* Table 4-1 excludes reference to the grinding groove site (AHIMS site #52-2-2068 as it is referred to in detail in the SCRMP.

4.1.1 Isolated Finds and Artefact Scatter

Impacts to open sites, such as open artefact scatters, are limited to cracking in the surface soils which could lead to erosion channels if left untreated. It is unlikely that the artefacts themselves would be impacted by any potential surface cracking (MSEC, 2021; (p.202)).

Subsidence movements are not expected to have observable effects on artefact scatters and isolated finds in open terrain, and this is very unlikely to constitute 'harm' as defined by the NPW Act. The predicted likelihood of impact on artefact sites is considered to be extremely unlikely (EMM, 2021a).

4.1.2 Scarred Tree

The modified tree (#52-2-2100) is located directly above LW W2 and was assessed following the completing of LW W1. No impacts to the tree were observed. Experience from the Southern Coalfield is that the impact of longwall mining on trees is very low (MSEC 2021). Impacts generally only occur at very shallow depths of cover, in the order of 50 m, or on very steeply sloping terrain, in the order of 1 in 1 or greater (MSEC 2021). The depth of cover for the modified tree is over 490 m and the natural surface slopes are less than 1 in 3.

The modified tree is approximately 250 m from LW W3. As cracking in surface soils above longwall mining tends to be isolated and minor, typically in the top few metres of the surface soils, mediation is therefore not generally required. The likelihood of impact to the scarred tree is therefore assessed to be extremely unlikely (MSEC 2021).

4.2 Historical Heritage Items

4.2.1 Subsidence Predictions for Historical Heritage Sites

MSEC has prepared a subsidence assessment for the historical sites within the Study Area. The likelihood of damage occurring at the sites was assessed on criteria which consider theoretical cracking limits caused by strains and tilts. A detailed discussion of the likely impacts to historical heritage items in the Study Area as a result of subsidence is provided in **Section 4.1** of the HHTR (EMM, 2021b).

As the proposed longwalls do not mine directly beneath the Main Southern Railway and given that the predicted conventional subsidence movements along the Main Southern Railway due to the extraction of the proposed LW W3-W4 are very small and well within operational tolerances for the railway, impacts to most heritage items associated with the railway are deemed to be unlikely or very unlikely. The exception is the two brick culverts above LW W3 where impacts are predicted to be possible (EMM, 2021b).

Non-railway related heritage items including the Weatherboard Cottage, Redbank Uniting Church and Rural Landscape (Thirlmere Way) are very unlikely to experience impacts.

A summary of the predicted impacts of subsidence on historical heritage sites is summarised in **Table 4-2**.

Table 4-2 Historical Heritage Sites and Predicted Likelihood of Impact (EMM, 2021b; EMM, 2021d)

Site Name	Site Type	Significance	Location in relation to LWs	Predicted Probability of Impact
<i>Listed heritage sites within the Study Area</i>				
Cottage (Weatherboard) (I211)	Built structure	Local	180 m south-east of LW W4	Very unlikely
Redbank Uniting Church (I146)	Built structure	Local	330 m south-east of LW W4	Very unlikely
Mushroom Tunnel (former Mainline Railway Tunnel) (I144)	Built structure	Local	500 m east of LW W3 370 m north-east of LW W4	Very unlikely

Site Name	Site Type	Significance	Location in relation to LWs	Predicted Probability of Impact
Picton Tunnel (part of the Railway Deviation Works)	Built structure	Local	430-585 m east of LW W3 295-320 m north-east of LW W4	Very unlikely
Picton Antill Street Underbridge (also referred to as Thirlmere Way Rail Underbridge)	Landscape	Local	250 m south-east of LW W4	Unlikely
Additional listed heritage sites considered within this report				
Picton Railway Viaduct over Stonequarry Creek (01051)	Built structure	State	1200 m east of LW W3 850 m east of LW W4	Very unlikely
Picton Argyle Street Underbridge (Hole in the Wall)	Built structure	Local	720 m north-east of LW W4	Very unlikely
Picton pedestrian overbridge 86.1	Built structure	Local	650 m north-east of LW W4	Very unlikely
Non-registered heritage sites within the Study Area				
Brick culvert 87.300	Built structure	Local	150 m east of LW W3	Unlikely
Brick culvert 87.330	Built structure	Local	230 m north-east of LW W3	Unlikely
Brick culvert 87.630	Built structure	Local	Directly above LW W3	Possible
Brick culvert 87.850	Built structure	Local	Directly above LW W3	Possible
Sandstone culvert 88.400	Built structure	Local	400 m west of LW W3	Unlikely
Sandstone culvert 88.980	Built structure	Local	700 m west of LW W3	Unlikely
Main Southern Railway brick culvert 87.331	Built structure	Local	290 m east of LW W3	Unlikely
Main Southern Railway brick culvert 89.216	Built structure	Local	260 m east of LW W4	Very unlikely
Non-registered heritage items outside the Study Area				
Main Southern Railway brick culvert 88.091	Built structure	Local	410 m east of LW W4	Very unlikely
Main Southern Railway brick culvert 88.232	Built structure	Local	460 m east of LW W4	Very unlikely
Main Southern Railway brick culvert 88.496	Built structure	Local	460 m east of LW W4	Very unlikely
Main Southern Railway brick culvert 88.698	Built structure	Local	450 m east of LW W4	Very unlikely
Subway, Main Southern Railway 88.133	Built structure	Local	410 m east of LW W4	Very unlikely
High retaining wall, Main Southern Railway 84.687	Built structure	Local	1 km east of LW W4	Very unlikely
Connellan Crescent Overbridge 89.080	Built structure	Local	400 m east of LW W4	Very unlikely

Site Name	Site Type	Significance	Location in relation to LWs	Predicted Probability of Impact
Bridge on Matthews Lane 84.551	Built structure	Local	1040 m east of LW W4	Very unlikely
Prince Street Overbridge 85.171	Built structure	Local	960 m east of LW W4	Very unlikely

5 Subsidence Monitoring Program

5.1 Performance Measures and Indicators

Performance measures for Aboriginal and historical heritage sites are provided in Table 1 of Condition 13A of DA 67/98 and are summarised in relation to Aboriginal and historical heritage sites in **Table 5-1**.

It is noted that the monitoring program for the grinding groove site (AHIMS site #52-2-2068) is omitted from this section and detailed in the SCRMP.

Table 5-1 Subsidence Performance Measures and Performance Indicators for Aboriginal and Historical Heritage Sites (EMM, 2021a; EMM, 2021b)

Feature / Site	Subsidence Performance Measures	Probability of Subsidence Impact	Subsidence Performance Indicators and Triggers
Isolated finds/ artefact scatters	Negligible subsidence impacts or environmental consequences	Extremely unlikely	No performance indicators are currently established as impacts are predicted to be negligible.
Scarred tree	Negligible subsidence impacts or environmental consequences	Extremely unlikely	This performance indicator will be considered to be triggered if: • subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or • subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage.
Mushroom Tunnel (former Mainline Railway Tunnel (I144))	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Very unlikely	This performance indicator will be considered to be triggered if: • subsidence monitoring identifies cracking of external brick work or other physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.
Picton Tunnel	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Unlikely	This performance indicator will be considered to be triggered if: • subsidence monitoring identifies cracking of external brick work or other physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.

Feature / Site	Subsidence Performance Measures	Probability of Subsidence Impact	Subsidence Performance Indicators and Triggers
Cottage (Weatherboard) (I211)	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies damage to external cladding or internal finishes.
Redbank Uniting Church	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Antill Street Underbridge (also referred to as Thirlmere Way Rail Underbridge)	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.
Rural landscape – Thirlmere Way	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Unlikely	This performance indicator will be considered to be triggered if: visible subsidence, surface cracks.
Picton Viaduct (SHI 01051)	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking or spalling.
Argyle Street Underbridge (Hole in the Wall) (I149)	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies physical impacts to the historical heritage values of the bridge, measurable tilt or visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Pedestrian overbridge 86.1 km	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking.

Feature / Site	Subsidence Performance Measures	Probability of Subsidence Impact	Subsidence Performance Indicators and Triggers
Loop Line sandstone culverts	Negligible subsidence impacts or environmental consequences	Unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, spalling, block movement or block fall.
Loop Line brick culverts	Negligible subsidence impacts or environmental consequences	Impacts to the culverts at chainage 87.850 km and 87.630 km are possible. Impacts to the other culverts are unlikely.	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Main Southern Railway culverts	Negligible subsidence impacts or environmental consequences	Impacts to the culvert at chainage 88.331 km is unlikely. Impacts to the other culverts are very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Subway 88.133 km	Negligible subsidence impacts or environmental consequences	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
High retaining wall 84.687 km	Negligible subsidence impacts or environmental consequences	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Bridge on Matthews Lane	Negligible subsidence impacts or environmental consequences	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Prince Street Overbridge	Negligible subsidence impacts or environmental consequences	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.

Feature / Site	Subsidence Performance Measures	Probability of Subsidence Impact	Subsidence Performance Indicators and Triggers
Connellan Crescent Overbridge	Negligible subsidence impacts or environmental consequences	Very unlikely	This performance indicator will be considered to be triggered if: subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.

For the purpose of this Extraction Plan and associated documents, ‘negligible’ is defined as being ‘so small and insignificant as to not be worth considering’.

Based on the predicted subsidence impacts (MSEC, 2021), it is considered that the performance measures (negligible subsidence impacts and environmental consequences) for the Aboriginal and historical heritage sites within the Study Area will be achieved (EMM, 2021a; EMM, 2021b). While the extraction of LW W3–W4 may result in impacts on historical sites, these can be managed through early detection via monitoring and early response through the implementation of the TARP (Appendix A).

A monitoring program, which was put in place to monitor the impacts and consequences of subsidence effects on known Aboriginal and historical heritage sites during the extraction of LW W1-W2, will continue during the extraction of LW W3-W4. Additional historical heritage items within the LW W3-W4 Study Area will undergo a similar process.

In addition, Picton Viaduct (SHR 01051), while outside the limits of subsidence as assessed by MSEC (2021) which means that subsidence is predicted to be less than 20 mm, is being and will continue to be monitored. Monitoring will continue until approximately 12 months after the completion of longwall mining in the Western Domain (estimated by the end of 2022). Other listed heritage items that are outside the Study Area but considered to be at risk of far field movement and will be or will continue to be monitored include the Argyle Street Underbridge (Hole in the Wall); and the pedestrian overbridge (86 km).

5.2 Subsidence Monitoring Program

A subsidence monitoring program for Aboriginal and historical heritage items will be implemented to confirm if impacts remain within predictions and identify any management or mitigation measures as required (**Table 5-2**). Further detail of the proposed subsidence monitoring program for Aboriginal and historical heritage items is provided in the AHTR (EMM, 2021a) and HHTR (EMM, 2021b). The location of monitoring for Aboriginal heritage and historical heritage items is illustrated in **Figure 3-1** and **Figure 3-2**, respectively.

The aim of the monitoring program is to identify where there is a risk of impact to Aboriginal and historical heritage items as a result of mining activities. The monitoring program provides for the opportunity to record the condition of the site during the following three phases:

- Prior to Mining – baseline survey of the condition of the site before the commencement of mining, also referred to as the baseline check;
- During Mining – monitoring of the condition of the site during active subsidence to establish whether there has been any change to the site or if changes have occurred from the effects of subsidence. This monitoring is also referred to as the post mining initial condition check; and
- Post Mining – monitoring of the condition of the site after mining to identify whether there has been any change to the site in the period since mining, and to determine if the ground

surface conditions have stabilised. This monitoring is also referred to as the post mining secondary condition check.

If an impact is identified to have occurred or is likely to occur, the TARP (refer to **Appendix A**) should then be referred to for the identification of appropriate mitigation strategies.

Table 5-2 Monitoring Program for Heritage Features (EMM, 2021a; EMM, 2021b; EMM, 2021d)

Heritage Sites / Item	Monitoring Component	Monitoring		
		Prior to Mining	During Mining	Post Mining
Isolated finds/ artefact scatters	Monitoring not required.	N/A	N/A	N/A
Scarred tree	Recording and photography.	Baseline monitoring to record the condition of the tree was undertaken prior to the commencement of LW W1 (completed). Monitoring at the completion of LW W1-W2 (prior to commencement of LW W3) to be completed.	N/A	Visual inspection conducted by an archaeologist at the completion of each longwall.
Mushroom Tunnel (former Mainline Railway Tunnel (I144))	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Picton Tunnel	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed). Additional monitoring for track systems installed (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Cottage (Weatherboard) (I211)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Baseline recording of the site before mining, noting any existing cracks or damages (completed).	Regular monitoring as per the Weatherboard Cottage Management Plan.	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Redbank Uniting Church	None required (abuts the Study Area)	None required.	None required.	None required.

Heritage Sites / Item	Monitoring Component	Monitoring		
		Prior to Mining	During Mining	Post Mining
Antill Street Underbridge (also referred to as Thirlmere Way Rail Underbridge)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Rural landscape – Thirlmere Way	None required.	None required.	None required.	None required.
Picton Viaduct (SHI 01051)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed). Additional monitoring for track systems installed (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Argyle Street Underbridge (Hole in the Wall) (I149)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Pedestrian overbridge 86.1 km	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection and structural assessment to be conducted at the completion of LW W4.
Loop Line sandstone culverts	Visual inspection. Baseline recording (photographs). Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a system, which will monitor ground movements on and around the culverts (completed).	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.

Heritage Sites / Item	Monitoring Component	Monitoring		
		Prior to Mining	During Mining	Post Mining
		Reinforcement for specific culverts as identified by structural engineer (in place).		
Loop Line brick culverts	Visual inspection. Baseline recording (photographs). Survey control points. Structural assessment of culverts, particular attention given to 87.850 and 87.630.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a monitoring system, which will monitor ground movements on and around the culverts (completed).	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Main Southern Railway culverts	Visual inspection. Baseline recording (photographs). Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a monitoring system, which will monitor ground movements on and around the culverts.	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Subway 88.133 km	Visual inspection. Baseline recording (photographs). Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage (completed)	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection to be conducted at the completion of LW W4.
High retaining wall 84.687 km	Visual inspection. Baseline recording (photographs). Structural assessment.	Baseline recording of the site before mining, noting any existing cracks or damage (completed)	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection to be conducted at the completion of LW W4.

Heritage Sites / Item	Monitoring Component	Monitoring		
		Prior to Mining	During Mining	Post Mining
Bridge on Matthews Lane	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection to be conducted at the completion of LW W4.
Prince Street Overbridge	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection to be conducted at the completion of LW W4.
Connellan Crescent Overbridge	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Visual inspection to be conducted at the completion of LW W4.

5.3 Baseline Monitoring for Future Extraction Plans

5.3.1 Aboriginal Heritage Baseline Monitoring

To assist in the preparation of future Extraction Plans, monitoring of Aboriginal heritage items would be completed in accordance with the monitoring program in **Table 5-2**. Monitoring data collected during the baseline recording phase and during the mining of LW W3-W4 would be used for comparisons to determine any impacts from mining, which will assist the understanding of potentially impacts for future Extraction Plans.

5.3.2 Historical Heritage Baseline Monitoring

To assist in the preparation of future Extraction Plans, monitoring of historical heritage items would be completed in accordance with the monitoring program in **Table 5-2**. Monitoring data collected during the mining of LW W3-W4 would be used in the review of observed subsidence impacts for future Extraction Plans.

6 Subsidence Management Strategies

6.1 Mine Design Considerations

Tahmoor Coal submitted a Subsidence Management Plan Application (SMP Application) for Longwalls 31 to 37 in the Bulli Coal Seam in December 2014, which included longwalls in the Western Domain. The current mine plan has been modified since the 2014 SMP Application to consider feedback received following submission of the SMP Application in 2014, and additional information gathered from underground conditions. The revision of the mine plan has been redesigned specifically to avoid significant impact to the sensitive surface features of the environment, particularly avoiding mining directly under streams of third order or above. The revision of the mine plan also resulted in the re-orientation of longwalls in the Western Domain. Further discussion of mine design considerations is provided in **Section 3.6.1** of the Extraction Plan Main Document.

The current mine plan proposes to continue underground mining operations through the extraction of LW W3-W4 in the Western Domain, which will continue on from the active longwall series (LW W1-W2). The proposed LW W3-W4 are located to the west of the township of Picton, between Matthews, Cedar and Stonequarry Creeks, the Main Southern Railway and the previous longwall series (refer to **Figure 1-2**).

6.2 General Mitigation Measures

6.2.1 Remediation Measures for Aboriginal heritage items

If an impact to Aboriginal heritage occurs, the type of remediation that is undertaken will be dependent on (EMM, 2021a):

- The location of the site (e.g. open paddock, creek bed);
- The site type;
- The nature of the damage and its location within the site;
- The impact on the heritage values of the site (e.g. a crack across grinding grooves);
- Cultural advice from the local Aboriginal community to the proposed remediation measures (e.g. sealants used on cracks); and
- Compliance with relevant AHIP conditions, if granted for the activity.

Therefore, remediation measures, if needed, will be assessed on a case by case basis in the light of these considerations in order to ensure that performance measures are met.

6.2.2 Remediation Measures for Historical Heritage Items

If an impact to a historical heritage item occurs, the type of remediation that is undertaken will be dependent on (EMM, 2021b):

- The nature of the damage;
- The scale of the damage;
- The impact on the historical heritage values of the site; and
- Expert advice regarding practical and historically sympathetic remediation measures.

Therefore, remediation measures, if needed, will be assessed on a case by case basis in the light of these considerations in order to ensure that performance measures are met and that there are no negative outcomes to historical heritage values.

Mitigation measures should follow best practice principles of heritage management. Any mitigation measures should be visually inconspicuous and preserve the appearance of the heritage item in its setting. Any attachments to the fabric of the structure should be designed to be reversible and to do no harm to the fabric of the heritage item.

A number of specific remediation measures have been prescribed for registered heritage items and are described in **Section 6.3** of the HHTR (**Appendix C**).

6.2.3 Unexpected Finds Procedures

Discovery of Aboriginal Objects

Under Section 89A of the NPW Act, it is a requirement that Heritage NSW is notified of the existence of Aboriginal objects as soon as practicable after they are first identified. This is done through the completion of a Site Card which is submitted to the Registrar of AHIMS for inclusion on the Aboriginal site database. Information regarding AHIMS and site recording forms can be downloaded from the Heritage NSW website located at <http://www.environment.nsw.gov.au/licences/DECCAHISSiteRecordingForm.htm>.

Under s85A of the NPW Act, Aboriginal objects remain the property, and under the protection of, the Crown until formal transfer to a person or persons of a class prescribed by the regulations occurs (EMM, 2021a).

Reporting Impact to Aboriginal Sites

An Aboriginal Site Impact Recording Form must be completed following impacts to AHIMS sites that are (EMM, 2021a):

- A result of test excavation carried out in accordance with the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW*;
- Authorised by an AHIP issued by Heritage NSW;
- Undertaken for the purpose of complying with Secretary's environmental assessment requirements issued by the DPIE for:
 - SSD;
 - SSI;
 - A major project; or
 - Authorised by a StatSSD/SSI/former Part 3A consent/approval under the EP&A Act.

Completed forms must be submitted to the AHIMS Registrar at www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm.

Aboriginal Site Impact Recording Forms can be downloaded from the Heritage NSW website located at <https://www.environment.nsw.gov.au/resources/cultureheritage/aboriginal-site-recording-form-180307.pdf>.

Discovery of Human Skeletal Remains

In the event that known or suspected human skeletal remains are encountered within the Study Area, the following procedure must be followed (EMM, 2021a):

- The immediate vicinity will be secured to protect the find and the find will be immediately reported to the work supervisor who will immediately advise the site supervisor or other nominated senior staff member;
- The environmental manager or other nominated senior staff member will notify the police and the state coroner on the same day of the find (as required for all human remains discoveries);
- The environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material;
- If it is determined that the skeletal material is ancestral Aboriginal remains, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains;
- The site will be recorded in accordance with the NPW Act and Heritage NSW guidelines;
- If the remains are historical and not of Aboriginal origin, Heritage NSW will be notified for further instruction; and
- Works will not recommence until written approval is received.

Discovery of Historical Heritage Items

Due to the nature of the extraction activities, it is unlikely relics will be uncovered however, if they are the following steps should be taken (EMM, 2021b):

- No further harm to the object;
- Immediately cease all work at the particular location;
- Secure the area so as to avoid further harm to the relic; and
- Contact an archaeologist for further information and advice.

6.3 Trigger Action Response Plan

A TARP has been developed using the performance indicators for management of Aboriginal and historical heritage items as a result of LW W3-W4 mining (refer to **Appendix A**). Level 1 of the TARP indicates that, based on monitoring results, the environment is performing within normal levels. Where performance indicators indicate that a level of risk has been triggered greater than a normal level (Levels 2 or higher with escalating corresponding risk), a response in the form of management / corrective actions is required to be implemented as outlined in the TARP.

It is noted that the monitoring and management for the grinding groove site (AHIMS site #52-2-2068) is detailed in the SCRMP, which includes a site-specific TARP for the site.

6.4 Contingency Plan

In the event that performance measures are considered to have been exceeded or are likely to be exceeded, a response will be undertaken in accordance with the TARP provided in **Appendix A**. This response is a contingency plan that describes the management / corrective actions which can be implemented where required to remedy the exceedance.

In the event that a management / corrective actions are Corrective Action Management Plan (CAMP) is required in accordance with the TARP, this plan will be prepared in accordance with **Section 3.6.3** of the Extraction Plan Main Document. The success of remediation measures that has been implemented for any TARP exceedance would be reviewed as part of any CAMP, the Annual Review and Six Monthly Subsidence Impact Reports (refer to **Section 6.1** of the Extraction Plan Main Document).

6.5 Adaptive Management Strategy

An Adaptive Management Report has reviewed mining-induced ground movement and impacts on the streams in proximity to LW W2 (Cedar Creek and Stonequarry Creek, particularly Pool SR17) to inform considerations for the amendment of the commencing position of LW W3. This Report considers information from a detailed monitoring program and concluded that no change to the commencement position of LW W3. The Report was submitted to DPIE in June 2021.

7 Review and Improvement

This section of the HMP describes the key elements of implementation relevant to Aboriginal and historical heritage. A description of general reporting requirements, reviews and key responsibilities that are applicable to extraction of LW W3-W4 are discussed in the Extraction Plan Main Document.

7.1 Reporting Requirements

Generic reporting requirements for the LW W3-W4 Extraction Plan are discussed in **Section 6.1** of the Extraction Plan Main Document.

7.1.1 Reporting Requirements Specific to Aboriginal Heritage

In accordance with DA 67/98 Condition 48 or as triggered by the TARP, if an incident occurs relating to heritage material whereby performance measures are exceeded and harm to Aboriginal heritage is threatened or caused, a letter report will be issued within one (1) week of the event notifying DPIE, Wollondilly Shire Council, Heritage NSW, RAPs and any other relevant agencies. The detailed report that will be provided to DPIE will be sent within seven days of the incident including details of the actions being undertaken to prevent recurrence (EMM, 2021a).

7.1.2 Reporting Requirements Specific to Historical Heritage

In accordance with DA 67/98 Condition 48 or as triggered by the TARP, if an incident occurs relating to heritage material whereby performance measures are exceeded and harm to historical heritage is threatened or caused, a letter report will be issued within one (1) week of the event notifying DPIE, Wollondilly Shire Council, Heritage NSW and any other relevant agencies. The detailed report that will be provided to DPIE will be sent within seven days of the incident including details of the actions being undertaken to prevent recurrence (EMM, 2021b).

7.2 Review and Auditing

Generic review and auditing requirements for the LW W3-W4 Extraction Plan are discussed in **Section 6.2** of the Extraction Plan Main Document.

7.2.1 Review and Auditing Requirements Specific to Aboriginal Heritage

Changes to the AHTR and this HMP will be made in the following circumstances:

- Where new Aboriginal sites are discovered, they must be added to the inventory in the AHTR and this HMP within three months of the find; and
- Where AHIP C0005707 variation is approved, this HMP will be reviewed and updated where necessary to comply with the requirements of any AHIP conditions.

Where significant changes are made to the AHTR and HMP (other than minor plan updates), a draft of the modified plan will be provided to RAPs for their review. However, minor plan updates to the AHTR and HMP will not require review by the RAPs. Although RAPs are not required to review the AHTR for minor plan updates, they will be notified if new sites are identified and of updates relating to the status of Aboriginal sites (EMM, 2021a).

Matters raised in consultation which are specific to the changes in the plan will be acknowledged and addressed in the modified plan. Any changes made to the AHTR and HMP will be made in consultation with the DPIE, and a copy of the revised report and management plan will be supplied to the Secretary of the DPIE for approval (EMM, 2021a).

7.2.2 Review and Auditing Requirements Specific to Historical Heritage

Any additional historical heritage sites identified during extraction of LW W3–W4, which are determined to be at risk of subsidence impact, will need to be monitored. Assessment and monitoring measures will be developed in consultation with a heritage consultant or archaeologist and the HHTR updated accordingly (EMM, 2021b).

Where new historical heritage sites are discovered, they must be added to the inventory in the HHTR and HMP within three months of the find, including an assessment of potential impacts from subsidence. Any changes made to the HHTR and HMP will be made in consultation with the DPIE, and a copy of the revised report and management plan will be supplied to the Secretary of the DPIE for approval (EMM, 2021b).

7.3 Roles and Responsibilities

Generic roles and responsibilities applicable for the implementation of the LW W3-W4 Extraction Plan are discussed in **Section 6.3** of the Extraction Plan Main Document. There are no roles and responsibilities specific to the implementation of Aboriginal heritage or historical heritage management measures identified for the extraction of LW W3-W4.

8 Document Information

This section provides a compiled list of references, terms, and abbreviations used in this document. In addition, this section provides the change information for this document.

8.1 References

- Australia ICOMOS (2013), Charter for Places of Cultural Significance (The Burra Charter).
- DECCW (2010a), Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW.
- DECCW (2010b), Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.
- DECCW (2010c), Aboriginal Cultural Heritage Consultation Requirements for Proponents.
- NSW Department of Planning and Environment (DPE) (2015), Draft Guidelines for the Preparation of Extraction Plans V5.
- EMM Consulting (2021a), Tahmoor Mine Extraction Plan: Longwalls West 3 and West 4 – Aboriginal Heritage Technical Report, report for Tahmoor Coal, August 2021, document J200551 RP#3.
- EMM Consulting (2021b), Tahmoor Mine Extraction Plan: Longwalls West 1 and West 2 – Historical Heritage Technical Report, report for Tahmoor Coal, March 2021, document J200551 RP4.
- EMM Consulting (2021c), Tahmoor Coal Mine Study Area LW W1-W4: Impact Assessment LW W3-W4, Aboriginal Cultural Heritage Assessment, report for Tahmoor Coal.
- EMM Consulting (2021d), Tahmoor LW W3-W4: Main Southern Railway Inspection Report, letter to Tahmoor Coal, August 2021.
- Mine Subsidence Engineering Consultants (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. Prepared for Tahmoor Coal, March 2021, document MSEC1112.
- Niche Environment and Heritage (Niche) (2014), Tahmoor North Longwalls 31 to 37: Aboriginal and European Heritage Assessment, report for Tahmoor Coal Pty Ltd.
- Niche (2018), Redbank Creek 4: Aboriginal Cultural Heritage Assessment, report for Tahmoor Coal.
- NSW Department of Planning (DoP) (2008), Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield: Strategic Review.
- OEH (2011), Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW.

8.2 Abbreviations

Abbreviations used in this document are provided below in **Table 8-1**.

Table 8-1 **Abbreviations**

Abbreviation	Definition
ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AHTR	Aboriginal Heritage Technical Report (EMM, 2021a)
ARTC	Australian Rail Track Corporation
Burra Charter	Australia ICOMOS Burra Charter, 2013
CAMP	Corrective Action Management Plan
CHL	Commonwealth Heritage List
The Code	<i>Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW</i>
Cubbitch Barta	Cubbitch Barta Native Title Claimants
DCP	Development control plan
DECCW	Department of Environment Climate Change and Water
DoP	Department of Planning
DPE	Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment (formerly DPE)
Due Diligence Guidelines	<i>Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW</i>
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EES	NSW Department of Planning, Industry and Environment— Environment, Energy and Science Group
Heritage Act	<i>NSW Heritage Act 1977</i>
Heritage NSW	Heritage NSW of the Office of Premier and Cabinet
HHTR	Historical Heritage Technical Report (EMM, 2021b)
HMP	Heritage Management Plan
Km	Kilometre/s
LEP	Local Environment Plan
LGA	Local Government Area
Loop Line	Picton-Mittagong Loop Line Railway Line
LW	longwall
LW W1	Longwall West 1
LW W1-W2	Longwalls West 1 to West 2
LW W2	Longwall West 2
LW W3-W4	Longwalls West 3 to West 4
LW W4	Longwall West 4
m	Metre/s
mm	Millimetre/s

Abbreviation	Definition
MSEC	Mining Subsidence Engineering Consultants
Niche	Niche Environment and Heritage
NHL	National Heritage List
NPW Act	<i>NSW National Parks and Wildlife Act 1974</i>
NPW Regulation	<i>NSW National Parks and Wildlife Regulation 2009</i>
OEH	Office of Environment and Heritage (now Heritage NSW)
PAD	Potential Archaeological Deposit
RAP	Registered Aboriginal party
RMZ	Risk management zone
SCRMP	LW W3-W4 Stonequarry Creek Rockbar Management Plan
SHR	State Heritage Register
SMP Application	Subsidence Management Plan Application
SSD	State Significant Development
SSI	State Significant Infrastructure
Study Area	As defined in Section 1.3
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TLALC	Tharawal Local Aboriginal Land Council
WLEP	<i>Wollondilly Local Environment Plan 2011</i>
WSC	Wollondilly Shire Council

8.3 Glossary of Terms

The Extraction Plan Main Document provides a compiled Glossary of Terms in **Section 8.3**.

8.4 Change Information

Table 8-2 provides the details of document history of this HMP.

Table 8-2 Document History

Version	Date Reviewed	Reviewed By	Change Summary
1.0	May 2021	Zina Ainsworth, David Talbert, Malcolm Waterfall	New document
2.0	August 2021	Zina Ainsworth	Updated to include the LW W3-W4 Stonequarry Creek Rockbar Management Plan and incorporate findings from the Main Southern Railway Inspection Report (EMM, 2021d).

Appendix A – Trigger Action Response Plan

Trigger Action Response Plan – Heritage Management Plan

Feature	Management		
	Trigger	Action	Response
Aboriginal Heritage items*	Level 1		
	Aboriginal heritage site monitoring indicates no detectable environmental consequences.	Continue monitoring as per monitoring program.	No response required.
	Level 2		
	Aboriginal heritage site monitoring indicates potential detectable environmental consequences.	- Continue monitoring as per monitoring program. - Convene Tahmoor Coal Environmental Response Group to review response. - An archaeologist to inspect the relevant site(s) within the area of potential impact. - Review monitoring program and modify if necessary.	- If impacts to heritage sites are observed, notify DPIE and Heritage NSW within one week of the event. - Notify RAPs within one week of the event and co-ordinate a site inspection with RAPs. - Investigate and implement any additional management measures as required in consultation with RAPs, Heritage NSW and DPIE.
	Level 3		
	Aboriginal heritage site monitoring indicates environmental consequences to heritage site(s).	- Continue monitoring as per monitoring program. - Convene Tahmoor Coal Environmental Response Group to review response. - Investigate exceedance of subsidence prediction. - Review mine design/predictions against mine criteria. - Review monitoring program and modify if necessary.	- Notify RAPs within 1 week of the event and co-ordinate a site inspection with RAPs. - Notify DPIE and Heritage NSW within one week of the event. - Investigate and implement any additional management measures as required in consultation with RAPs, Heritage NSW and DPIE.

*This TARP outlines performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to the Aboriginal modified tree within the Study Area, Clearview (#52-2-2100) and considers the management or remediation of any impacts and/or environmental consequences relating to this Aboriginal heritage site. A site-specific TARP for Stonequarry Creek 1 is included in the SCRMP.

Feature	Management		
	Trigger	Action	Response
Historical Heritage	Level 1		
	Historical heritage site monitoring indicates no detectable environmental consequences.	Continue monitoring as per monitoring program.	No response required.
	Level 2		
	Historical heritage site monitoring indicates potential detectable environmental consequences but with negligible impacts to heritage site(s).	Continue monitoring as per monitoring program.	No response required.
	Level 3		
	Historical heritage site monitoring indicates environmental consequences to heritage site(s).	- Continue monitoring as per monitoring program. - Convene Tahmoor Coal Environmental Response Group to review response. - Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect. - Investigate exceedance of subsidence prediction. - Review mine design/predictions against mine criteria. - Review monitoring program and modify if necessary.	- Notify DPIE and Heritage NSW within one week of the event. - Investigate and implement any additional management measures as recommended and contingency plan as required in consultation with Heritage NSW and DPIE.

Appendix B – Aboriginal Heritage Technical Report

Tahmoor Mine Extraction Plan: LW W3–W4

Aboriginal Heritage Technical Report

Prepared for Tahmoor Coal Pty Ltd
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Tahmoor Mine Extraction Plan: LW W3–W4

Aboriginal Heritage Technical Report

Report Number

J200551 RP#3

Client

Tahmoor Coal Pty Ltd

Date

20 August 2021

Version

v2 Final

Prepared by



Pamela Chauvel
Senior archaeologist
12 March 2021

Approved by



Ryan Desic
Associate Archaeologist - Heritage Team Leader
12 March 2021

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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Executive Summary

This Aboriginal Heritage Technical Report (AHTR) has been prepared by EMM Consulting Pty Limited (EMM) to support an Extraction Plan for the secondary extraction of coal from Longwalls West 3 and West 4 (LW W3–W4). The objectives of the AHTR are to identify Aboriginal cultural heritage values within the LW W3–W4 Study Area and to provide for the monitoring and management of potential subsidence related environmental impacts on Aboriginal heritage sites to demonstrate that the relevant performance measures are met.

The proposed LW W3–W4 will be operating in the Tahmoor North mining area under Development Consent DA 57/93 granted on 7 September 1994 and DA 67/98 granted on 25 February 1999. This AHTR has been developed in accordance with the conditional planning approval framework for mining activities in the area to the north-west of the Main Southern Railway (the Western Domain) within the Tahmoor North mining area.

There are eight Aboriginal sites recorded in the Study Area, comprising one grinding groove site, six open artefact sites and one modified tree.

Overall, it is assessed that the impacts to these sites are unlikely. The grinding groove site is assessed as unlikely to be impacted but given its location on a large platform within a creek bed, there is potential for valley related subsidence effects of upsidence and valley closure. This site is therefore being closely monitored.

To maintain that the performance measures are met, an ongoing monitoring program will be implemented to monitor the subsidence impacts and environmental consequences of subsidence effects during extraction of LW W3–W4 on relevant known Aboriginal sites within the Study Area, specifically the grinding groove site Stonequarry Creek 1 (#52-2-2068) and the modified tree (#52-2-2100). Additionally, detailed monitoring and management measures for Stonequarry Creek 1 are provided in the Stonequarry Creek Rockbar Management Plan (SCRMP) which includes a site specific Trigger Action Response Plan (TARP). The SCRMP is a sub-plan of the Heritage Management Plan (HMP), as part of the Extraction Plan for LW W3–W4.

The risk of impacts to artefact sites is very low and these sites will not be monitored. The proposed monitoring program, which commenced with the extraction of LW W1 under the Extraction Plan for LW W1–W2, recorded the condition of the relevant sites before mining (baseline survey and baseline check) and will record the condition of the relevant sites after mining (post mining initial condition and post mining secondary condition check). Baseline recording carried out by EMM in March 2019 will be used to assist with monitoring and assessment of whether impacts from mining have occurred to Aboriginal sites within the Study Area.

In the event of unpredicted impacts, the Trigger Action Response Plan (TARP) will be implemented.

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1 Introduction

1.1 Introduction

Tahmoor Coal Mine (Tahmoor Mine) is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney between the towns of Tahmoor and Bargo, New South Wales (NSW) (refer to Figure 1.1). Tahmoor Mine produces up to three million tonnes of Run of Mine coal per annum from the Bulli Coal Seam. Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Product coal is transported via rail to Port Kembla and Newcastle for Australian domestic customers and export customers.

The Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced in 1979 using bord and pillar mining methods, and via longwall mining methods since 1987. Tahmoor Coal is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group.

Tahmoor Coal has previously mined 33 longwalls to the north and west of the Tahmoor Mine's current pit top location (refer to Figure 1.2) in accordance with Development Consents and Subsidence Management Plan Approval.

Tahmoor Coal is now extending underground coal mining to the northwest of the Main Southern Railway at Picton and Thirlmere (referred to as the 'Western Domain') within Mining Lease (ML) 1376 and ML 1539. An Extraction Plan for the first two longwalls to be mined, Longwall West 1–West 2 (LW W1–W2) was approved by the NSW Department of Planning, Industry and Environment (DPIE) on 8 November 2019. Extraction of LW W1 commenced on 15 November 2019 and was completed on 6 November 2020. LW W2 commenced on 7 December 2020. Tahmoor Coal is proposing to mine a further two longwalls in the Western Domain known as Longwall West 3–West 4 (LW W3–W4).

The extraction of the next two longwalls, LW W3–W4, are the subject of this technical report.

1.2 Purpose

This Aboriginal Heritage Technical Report (AHTR) has been prepared by EMM Consulting Pty Limited (EMM) to support an Extraction Plan for the secondary extraction of coal from LW W3–W4. The objectives of the AHTR are to identify Aboriginal cultural heritage values within the LW W3–W4 Study Area and to provide for the monitoring and management of potential subsidence related environmental impacts on Aboriginal heritage sites to demonstrate that the relevant performance measures are met.

1.3 Scope

This AHTR:

- addresses specific requirements set by DA 67/98 Condition 13H(vii)(f) (refer to Section 2.1 and 2.2);
- addresses related regulatory requirements (refer to Section 2.3);
- addresses the monitoring and management of potential subsidence-related impacts to Aboriginal cultural heritage values resulting from the extraction of LW W3–W4 (refer to Sections 5 and 6);
- provides a Trigger Action Response Plan (TARP) to be implemented to manage and protect known Aboriginal cultural heritage values within the Study Area (refer to Section 6.2 and Appendix A); and

- identifies a process of review and improvement (refer to Section 7.2).
- includes a site-specific management plan for the Stonequarry Creek Rockbar S17 which contains grinding groove site Stonequarry Creek 1 (#52-2-2068). This is addressed in the Stonequarry Creek Rockbar Management Plan (SCRMP), a sub-plan of the Heritage Management Plan (HMP), and part of the Extraction Plan for LW W3-W4.

The AHTR is primarily informed by the following:

- an Aboriginal and European Heritage Assessment prepared for LW 31–37, a previous mine plan and study area for longwalls in the Western Domain, which included the current Study Area for LW W3–W4 (Niche 2014);
- archaeological survey and baseline recording of Aboriginal sites in the Study Area completed by EMM in March 2019, with assistance from the local Aboriginal community;
- an Aboriginal cultural heritage assessment (ACHA) prepared by EMM for LW W1–W4 (EMM 2019a); and
- subsidence data provided by Mining Subsidence Engineering Consultants (MSEC 2021) to measure subsidence impacts and associated environmental consequences.

This AHTR has been prepared in consultation with local Aboriginal community organisations identified during a formal consultation process for the adjacent LW W1-W2 (refer to Section 2.5) and will be reviewed by Heritage NSW.

The AHTR applies to all Aboriginal archaeological sites within the Study Area as shown in Figure 3.1.

1.4 Study Area

1.4.1 The Study Area

The Study Area has been defined as the surface area that could be affected by the mining of LW W3–W4 (Figure 1.2). The extent of the Study Area has been calculated by combining the areas bound by the following limits:

- a 35-degree angle of draw from the extents of LW W3–W4;
- the predicted limit of vertical subsidence, taken as the 20-millimetre (mm) subsidence contour resulting from the extraction of the proposed longwalls; and
- features that could experience far-field or valley-related movements and could be sensitive to such movements

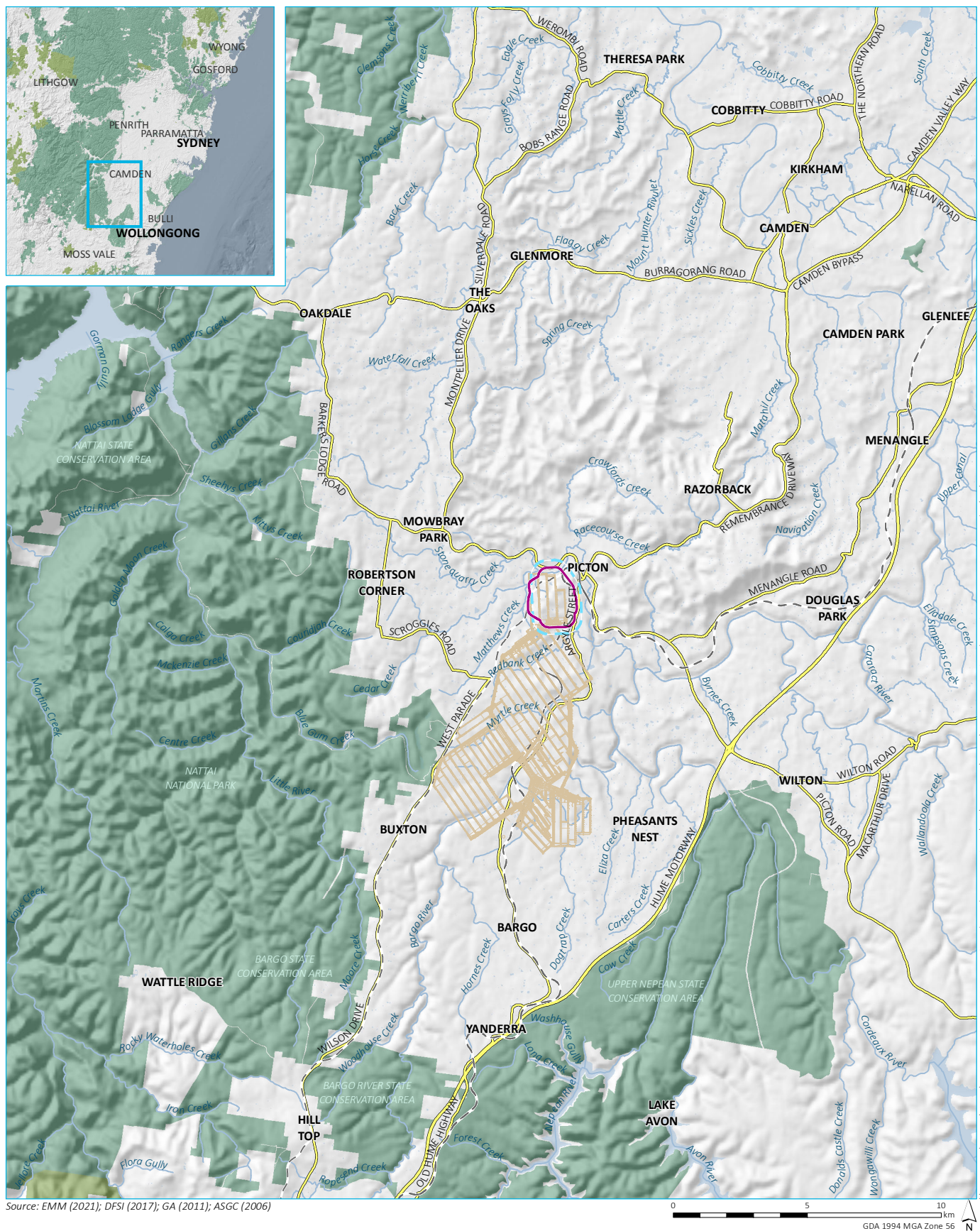
1.4.2 The Investigative Area

A 600 metre (m) buffer of the extents of LW W3–W4 including portions of Cedar Creek and Stonequarry Creek is also considered, and is referred to as the Investigative Area. A minimum of 600 m from the nearest edge of longwalls was recommended in the independent inquiry report titled *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield – Strategic Review* (NSW Department of Planning (DoP), 2008).

The Study Area and Investigative Area are shown in Figure 1.2.

1.5 Report Authors

EMM was commissioned by Tahmoor Coal to prepare this AHTR to support an Extraction Plan for Tahmoor Mine LW W3–W4. This AHTR was prepared by Pamela Chauvel (Archaeologist) with input and review from Ryan Desic (Associate Archaeologist).



KEY

- Study area
- Investigative area
- Mine plan
- Rail line
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

Study area location

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Aboriginal Heritage Technical Report
Figure 1.1



KEY

- | | |
|--|--|
| Project area | T Train station |
| Investigative area | Rail line |
| Predicted 20 mm subsidence contour | Major road |
| 35 degree angle of draw | Minor road |
| Completed longwall | Vehicular track |
| Current longwall | Named watercourse |
| Mine plan | Waterbody |

The study area and investigative area

Tahmor Mine Extraction Plan: Longwalls W3 - W4
Aboriginal Heritage Technical Report
Figure 1.2

2 Statutory requirements

2.1 Project approval

2.1.1 Development consent

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety, and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database.

The proposed LW W3–W4 will be operating in the Tahmoor North mining area under DA 57/98 and DA 67/98 approved by DPIE.

DA 67/98 provides the conditional planning approval framework for mining activities in the Western Domain of the Tahmoor North mining area to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to this AHTR from DA 67/98 are detailed in Table 2.1. Performance measures relevant to this AHTR (as described in Table 1 of DA 67/98 Condition 13A) are detailed separately in Table 2.2.

Table 2.1 Key conditions of DA 67/98 relating to Aboriginal cultural heritage

Condition	Condition Requirement	Section(s) Addressed									
SUBSIDENCE											
Performance Measures – Natural and Heritage Features etc.											
13A	The Applicant must ensure that extraction of Longwall 33 and subsequent longwalls does not cause any exceedances of the performance measures in Table 1. <i>Note: The Applicant will be required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent.</i>	Sections 5 and 6 The SCRMP									
Table 1	<table><tr><th>Feature</th><th>Performance Measure</th></tr><tr><td colspan="2">Heritage Sites</td></tr><tr><td rowspan="2">Heritage sites show in the figures in Appendix 7¹</td><td>Negligible subsidence impacts or environmental consequences.</td></tr><tr><td>Negligible loss of heritage value.</td></tr><tr><td>Other Aboriginal and heritage sites</td><td>Negligible subsidence impacts or environmental consequences.</td></tr></table>	Feature	Performance Measure	Heritage Sites		Heritage sites show in the figures in Appendix 7 ¹	Negligible subsidence impacts or environmental consequences.	Negligible loss of heritage value.	Other Aboriginal and heritage sites	Negligible subsidence impacts or environmental consequences.	Section 4 The SCRMP
Feature	Performance Measure										
Heritage Sites											
Heritage sites show in the figures in Appendix 7 ¹	Negligible subsidence impacts or environmental consequences.										
	Negligible loss of heritage value.										
Other Aboriginal and heritage sites	Negligible subsidence impacts or environmental consequences.										
13B	Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.	Section 5 The SCRMP									

Table 2.1 Key conditions of DA 67/98 relating to Aboriginal cultural heritage

Condition	Condition Requirement	Section(s) Addressed
Extraction Plan		
13H	The Applicant must prepare an Extraction Plan for all second workings in Longwall 33 and subsequent longwalls to the satisfaction of the Secretary. Each Extraction Plan must:	Extraction Plan Main Document
13H(vi)	Describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 1 and Table 2, and manage or remediate any impacts and/or environmental consequences;	Section 5.1, Section 5.2 and Section 6 The SCRMP
13H(vii)(f)	Include a Heritage Management Plan which has been prepared in consultation with Heritage NSW and relevant stakeholders for heritage items which provides for the management of potential environmental consequences of the proposed second workings on heritage items;	This document and the Heritage Management Plan
13H(vii)(h)	Include a Trigger Action Response Plan/s addressing all features in Table 1 and Table 2, which contain:	Appendix A (TARP) The SCRMP
	• appropriate triggers to warn of increased risk of exceedance of any performance measure; and	Appendix A (TARP), Section 6.2 The SCRMP
	• specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded; and	Appendix A (TARP), Section 6; The SCRMP
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	Appendix A (TARP), Section 6.1.1; The SCRMP
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 1 or Table 2, or where any such exceedance appears likely.	Section 6.1; The SCRMP
13H(vii)(i)	A Contingency Plan that expressly provides for:	
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 1 and Table 2, or where any such exceedance appears likely; and	Section 6.1; The SCRMP
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures; and	Section 6; Appendix A (TARP); The SCRMP
	• includes a program to collect sufficient baseline data for future Extraction Plans.	Section 5; The SCRMP

Note: ¹ As there is no Appendix 7 in DA 67/98 Modification 5, it is interpreted that this refers to Aboriginal heritage sites listed on the Aboriginal Heritage Information Management System, *Wollondilly Local Environmental Plan 2011*, State Heritage Register, and the Australian Heritage Database.

2.2 Subsidence performance measures

Performance measures for Aboriginal and historical heritage sites are provided in Table 1 of Condition 13A of DA 67/98 and summarised in Table 2.2. Definitions and discussion around what constitute negligible impacts is presented in Section 5.1 and discussed in more detail for grinding groove site Stonequarry Creek 1 in the SCRMP.

Table 2.2 Heritage performance measures

Heritage item	Subsidence performance measures
Heritage sites shown in the figures in Appendix 7 ¹	• Negligible subsidence impacts or environmental consequences; and • Negligible loss of heritage value.
Other Aboriginal and heritage sites	• Negligible subsidence impacts or environmental consequences.

Note: ¹ As there is no Appendix 7 in DA 67/98 Modification 5, it is interpreted that this refers to Aboriginal heritage sites listed on the Aboriginal Heritage Information Management System, *Wollondilly Local Environmental Plan 2011*, State Heritage Register, and the Australian Heritage Database.

2.3 Relevant legislation

2.3.1 National Parks and Wildlife Act 1974

Aboriginal objects and places are protected in NSW under the Part 6 of the *National Parks and Wildlife Act 1974* (NPW Act). Section 90 of the NPW Act requires an Aboriginal Heritage Impact Permit (AHIP) for harm to an Aboriginal object or Aboriginal place. Significant penalties are in place for harm to Aboriginal objects or places regardless of whether the harm was committed knowingly or not. Defences against prosecution include impacts in compliance with an AHIP, acting in accordance with specified codes of practice or the conduct of certain low impact activities. The Act defines an Aboriginal object as:

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains.

Harm is defined as:

any act or omission that: (a) destroys, defaces or damages the object or place, or (b) in relation to an object—moves the object from the land on which it had been situated, or (c) is specified by the regulations, or (d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c), but does not include any act or omission that: (e) desecrates the object or place, or (f) is trivial or negligible, or (g) is excluded from this definition by the regulations.

2.3.2 National Parks and Wildlife Regulation 2009

The *National Parks and Wildlife Regulation 2009* (NPW Regulation) is subsidiary legislation made under its parent act, the NPW Act. The NPW Regulation provides codes of practice, documents and guidelines that relate to the NPW Act.

The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (Due Diligence Guidelines) (DECCW 2010a) is adopted by the NPW Regulation under Clause 80A. Compliance with the Due Diligence Guidelines provide a defence for harming Aboriginal objects and places in certain circumstances.

Section 80D of the NPW Regulation requires a cultural heritage assessment report to be completed to accompany any AHIP application. The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (DECCW 2011) sets out the information required to support an AHIP.

The *Aboriginal Consultation Requirements for Proponents 2010* (DECCW 2010c) set out the consultation requirements for proponents seeking an AHIP. These requirements are under section 80C of the NPW Regulation.

The *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (the Code) (DECCW 2010b) has been adopted by clause 3A of the NPW Regulation. Acts carried out in accordance with the Code are excluded from the definition of harm.

2.3.3 Environmental Planning and Assessment Act 1979

An AHIP under section 90 of the NPW Act is required to harm Aboriginal objects for projects assessed under the EP&A Act, except for projects assessed under Part 4 Division 4.7 (State Significant Development) and Part 5.2 (State Significant Infrastructure) of the EP&A Act. An AHIP will be required for any impacts resulting from LW W3–W4 as it is not State significant development or infrastructure.

2.4 Additional approval requirements

Although likelihood of impact for all sites in the Study Area (refer Section 4.2) is assessed to be very unlikely and the risk of harm is considered unlikely, the residual risk of harming Aboriginal objects as defined in the NPW Act is still present. As specified in Section 2.3 it is illegal to harm Aboriginal objects without an AHIP. EMM prepared an ACHA for LW W1–W4 and Tahmoor Coal pursued and obtained an AHIP for LW W1–W2 (AHIP C0005707) which overlaps with the grinding groove site (#52-2-2068). EMM has prepared an updated ACHA for LW W1–W4 which specifically addresses the impacts from underground mining of LW W3–W4. The ACHA was developed to support an AHIP variation application that was lodged in March 2021 and is pending approval.

Any AHIP conditions of approval issued by Heritage NSW may result in additional requirements and management measures to those present in this AHTR. Accordingly, this AHTR may require updating subject to any AHIP approval. Procedures for AHTR review and updates are presented in Section 7.

2.5 Consultation

On 28 January 2020, a letter via email was sent to Heritage NSW introducing the Extraction Plan for LW W3–W4 and providing a figure of the Extraction Plan Study Area and an overview of the longwalls. No response to the letter of consultation has been received from Heritage NSW.

On 16 September 2020, a letter via email was sent to NSW Department of Planning, Industry and Environment – Environment, Energy and Science (EES) Group introducing the Extraction Plan for LW W3–W4. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. An email response was received from EES on 21 September 2020 with a list of data requests. Tahmoor provided the data to EES on 25 September 2020 and 15 January 2021. While preliminary comments were received from EES on 29 January 2021, none of these comments concerned heritage.

2.5.1 Consultation with the local Aboriginal community

Consultation with the local Aboriginal community regarding the intention for longwall mining within and adjacent to the Study Area has been ongoing since 2014. Niche, on behalf of Tahmoor Coal, previously consulted with Cubbitch Barta Native Title Claimants (Cubbitch Barta) and Tharawal Local Aboriginal Land Council (TLALC) for a now superseded longwall configuration which included the Study Area (Niche 2014). This included an archaeological survey with Aboriginal community representatives. Cubbitch Barta and TLALC were invited to assist with fieldwork to support this AHTR (EMM 2019b) on 28 March 2019 which is summarised in Section 3.2.2ii and 5.2.1. More detailed information can be found in the LW W1–4 ACHA (EMM 2019a).

In 2019, EMM prepared an ACHA for the broader LW W1–W4 Study Area to support an AHIP application for mining activities associated specifically with the first two longwalls, LW W1–W2 (EMM 2019a). This has involved formal consultation in accordance with the Heritage NSW guideline *Aboriginal Cultural Heritage Consultation requirements for proponents* (DECCW 2010c). Thirteen Aboriginal parties registered for consultation on the ACHA for the LW W1–

W4 Study Area which encompasses the Study Area that is the subject of this AHTR (Table 2.3). A draft version of the ACHA (EMM 2019a) was issued to all Registered Aboriginal Parties (RAPs) on 15 August 2019 and their comments were incorporated into the report.

The AHTR that was prepared to accompany the Extraction Plan for LW W1–W2 was sent to RAPs for review on 4 June 2019. No RAP responses were received in relation to the AHTR.

On 11 September 2019, representatives from Cubbitch Barta and TLALC participated in conducting drone photography of the grinding groove site (#52-2-2068).

On 14 October 2019, RAPs were notified that the AHIP application for Tahmoor Coal LW W1–W2 had been lodged and were provided with images of the grinding groove site taken with the drone.

On 2 January 2020, an email was sent to RAPs with an update on the project. RAPs were advised that extraction of LW W1 had commenced and that the rockshelters along Matthew Creek and Cedar Creek as well as the grinding groove site in Stonequarry Creek were being monitored. They were advised that an end of panel inspection of the rockshelters and grinding groove site would be undertaken once extraction of LW W1 was finished (towards the end of the year).

On 27 March 2020, RAPs were advised via email that Tahmoor Coal had received an Aboriginal Heritage Impact Permit (AHIP C0005707) from DPIE (Now Heritage NSW) on 16 March 2020 for the potential harm to certain Aboriginal objects through the longwall mining of LW W1–W2.

On 14 July 2020, RAPs were notified that the milestone of 1000 m of extraction from LW W1 had been reached and a site inspection would be undertaken as part of the management plan. As per existing RAP fieldwork arrangements with Tahmoor Coal, representatives from Cubbitch Barta and TLALC were invited to participate. The email advised RAPs that subsidence monitoring and inspections of the creek beds, rock bars and cliff lines have been completed at monthly intervals by subsidence specialists since the commencement of underground mining of LW W1. No impacts to Aboriginal sites have been observed. An end of panel inspection was completed for LW W1 and representatives from Cubbitch Barta and TLALC were invited to participate. Further information regarding the ongoing monitoring program is provided in Section 5.3.

The email also notified RAPs of Tahmoor Coal's intention to extract LW W3–W4 and that a separate ACHA document will be prepared to support an AHIP application for the additional two longwalls, along with an additional Aboriginal heritage technical report for the extraction plan for LW W3–W4.

Table 2.3 provides a list of the RAPs for the LW W1–W4 Study Area, which are the Aboriginal groups consulted for this AHTR.

Table 2.3 Aboriginal groups consulted for this AHTR

Cubbitch Barta Native Title Claimants	A1 Indigenous Services
Tharawal Local Aboriginal Land Council	Didge Ngunawal Clan
Darug Land Observations Pty Ltd	Amanda Hickey Cultural Services
Barraby Cultural Services	Yurandaali Cultural Services
Barking Owl Corporation	Yulay Cultural Services
Goodradigbee Cultural and Heritage Corporation	Butcarabin Aboriginal Corporation
Ngambaa Cultural Connections	

A log of consultation undertaken, including letters and relevant correspondence, is provided in Appendix C.

Further Aboriginal consultation has been undertaken as part of the development of the SCRMP and is documented within the SCRMP.

3 Existing environment

3.1 The landscape and its implications for archaeology

3.1.1 Landscape overview

Topographic features of the Study Area are shown in Figure 3.1.

The Study Area is located on the south-western edge of the Sydney Basin within the Wollondilly Local Government Area. It sits within the Cumberland Lowlands in a transitional zone between the Cumberland Plain, to the north, and the Woronora Plateau, to the south-east. The topography of the Study Area is generally hilly and undulating in a rural district that has been largely cleared for pastoral grazing.

The Study Area is dominated by a broad ridge line that is generally on a north-east/south-west axis. From this major ridgeline there are a series of spur lines, occasionally forming large benches at certain contours, that primarily lead west and east from the ridgeline but occasionally curve to have north-facing aspects. The spurs occur at a range of gradients, often decreasing in slope at the base of the hills and fanning into foot slopes and flats.

Within the Study Area, the underlying geology is the Wiannamatta Group Shales with Hawkesbury Sandstone exposed along incised and downstream sections of the creeks. Despite the underlying Hawkesbury Sandstone geology extending beyond the limits of incised creeks, it is rarely exposed due to the absence of concentrated erosional processes. Stonequarry Creek (a fifth order creek) flows west to east across the north of the Study Area and contains a long rock pool, approximately 670 m long, retained by a rockbar. The surrounding landscape is cleared pastoral land with a riparian corridor beside the creek.

3.1.2 Implications for archaeology

An aim of this AHTR is to address the potential subsidence-related impacts to Aboriginal cultural heritage values resulting from the extraction of LW W3–W4. Accordingly, the focus of the AHTR is on identifying and managing Aboriginal site types susceptible to subsidence impacts, which includes Aboriginal rockshelters and grinding groove sites on outcropping Hawkesbury Sandstone geology. These sandstone-type sites are known and predicted to occur along stream channels of major creeks. Sandstone-type sites are not known or predicted to occur outside of the alignment of the creeks.

Rockshelters have been identified in the cliffs and steep incised valleys beside higher order creeks in the local area. However, there are no cliffs located within the Study Area for LW W3–W4 or within the Investigative Area. Cliffs located along Matthews and Cedar Creeks are over 740 m to the west of LW W3. While minor cliffs and rock outcrops have also been identified along the valleys of Matthews and Cedar Creeks, they are located over 700 m from LW W3–W4.

The rockbar within Stonequarry Creek (SR17, see MSEC 2021) is approximately 100 m from the commencing end of LW W3. This rockbar is approximately 40 m x 70 m and contains a substantial Aboriginal grinding groove site (#52-2-5208). See Section 4.1.3.

Although other non-sandstone type Aboriginal sites (including open stone artefact sites) are known and predicted to occur elsewhere in the Study Area above both Hawkesbury Sandstone and Ashfield Shale geology, they are far less likely to be impacted by subsidence-related impacts and additional monitoring for these sites is not warranted (refer to Section 4.1.3).

3.2 Aboriginal sites within the Study Area

3.2.1 AHIMS sites

A search of the Aboriginal Heritage Information Management System (AHIMS) database on 17 September 2020 for a 10 km x 10 km area centred on the Study Area returned a total of 93 registered sites. Of these, there are eight registered Aboriginal sites within the Study Area. Table 3.1 provides details of each of these sites and an assessment of their significance. More detailed information about their significance is included in Appendix B. The location of AHIMS Aboriginal sites within the Study Area is shown in Figure 3.1.

The Aboriginal site of highest significance within the Study Area is a substantial axe grinding groove site, with 120 grinding grooves (#52-2-2068). It is located on a large rockbar within Stonequarry Creek in the north of the Study Area (Plate 4.1). Originally recorded as 91 grooves, subsequent assessment has identified 120 grooves, in three groupings. The grinding groove site is a rare and extensive example of its type on a local and regional level and has high research value because of its complexity and easy accessibility. More detail regarding the site and its significance are provided in the ACHA (EMM 2019a).

The predominant Aboriginal site type within the Study Area are artefact sites. Five sites are isolated finds, located on the lower hill slopes to the north and south of Stonequarry Creek in the north of the Study Area. One site is an artefact scatter, identified in an eroding bank to the south of Stonequarry Creek, approximately 150 m west of the grinding groove site.

A modified tree (#52-2-2100) is situated directly above LW W2 (Plate 4.2) beside the Loop Line railway in a paddock that has been cleared of vegetation for pastoral use. The White Mahogany eucalypt has been hollowed out by termites and the upper branches are dead. However, the tree is still alive although the scar is now closed over by overgrowth.

There are a number of identified rockshelters within the AHIMS search area but outside the Study Area. The closest rockshelters are located beside Cedar Creek and Matthews Creek, approximately 800 m to 1.5 km from the LW W3–W4 footprint. Six of these rockshelters are rock art sites, primarily with figurative art, and one with an extensive collection of hand stencils. One of the rockshelters with art and artefacts also contains a series of grinding grooves on a boulder (#52-2-4430). The management of these sites is addressed in the AHTR for LW W1–W2 (EMM 2019b).

An additional Investigative Area (600 m buffer) was also considered to capture Aboriginal sites in proximity to the Study Area. However, there are no additional registered Aboriginal sites within the Investigative Area.

Table 3.1 Aboriginal sites within the Study Area

AHIMS number	Site name	Site type	Description	Landform	Significance
52-2-2068	Stonequarry Creek 1	Grinding groove site	Three clusters of axe grinding grooves on a stone platform in the bed of Stonequarry Creek. A total of approximately 120 grooves.	Creek bed	High
52-2-2069	Isolated Finds 5	Isolated find	Silcrete flake identified in a paddock used as grazing pasture.	Lower hillslope	Low
52-2-2070	Isolated Finds 9	Isolated find	Stone artefact identified on pastoral grazing land.	Lower hillslope	Low
52-2-2071	Isolated Finds 2	Isolated find	Flaked piece of white quartz, near a small tributary of Stonequarry Creek.	Lower hillslope	Low

Table 3.1 **Aboriginal sites within the Study Area**

AHIMS number	Site name	Site type	Description	Landform	Significance
52-2-2072	Isolated Finds 1	Isolated find	Chert flake near a small tributary of Stonequarry Creek.	Lower hillslope	Low
52-2-2073	Isolated Finds 3	Isolated find	Retouched silcrete flake with possible use-wear in a paddock.	Lower hillslope	Low
52-2-2100	Clearview	Modified tree	White mahogany tree with scar 0.3 x 0.75 cm (now concealed by overgrowth), on pastoral land.	Mid hillslope	Moderate
52-2-4549	SQC 1	Artefact scatter	Eleven flakes (silcrete, chert and IMT) found within a 20 m ² area of eroding bank beside Stonequarry Creek.	Creek bank	Moderate



Aboriginal sites within the study area

Tahmoor Mine Extraction Plan:
Longwalls W3 - W4
Aboriginal Heritage Technical Report
Figure 3.1

3.2.2 Previous assessments within the Study Area

i Niche (2014)

Niche Environment and Heritage (Niche) completed an Aboriginal and European Heritage Assessment for a previous mine plan and study area for longwalls in the Western Domain, which included the current Study Area for LW W3–W4 (Niche 2014).

They found that on the plateau and rolling hills, away from major drainage lines, the archaeological record consisted primarily of stone artefact sites, although detection was limited to areas of exposure and erosion. The report predicted that the extensive clearing of timber on the plain would have removed most culturally modified trees in the landscape. Niche (2014) observed that the grinding groove site on an exposed sandstone platform (#52-2-2068) is typical for the region and represents utilitarian use of these areas by Aboriginal people in the past.

ii EMM (2019a)

EMM conducted a survey of the LW W1–W4 Study Area, in conjunction with baseline recording of all rockshelters within the LW W1–W4 Study Area, over four days from 25–28 March 2019.

The survey sampling strategy targeted land where outcropping sandstone is predicted to occur, localised to the channels of Cedar, Matthews and Stonequarry Creeks, primarily on scarp and cliff landforms and outcropping sandstone bedrock associated with stream channels. The survey aimed to identify obtrusive site types, particularly those that are theoretically susceptible to subsidence impacts, ie rockshelters, rock carvings, grinding groove sites and rock pools (Plate 4.1).

Thirteen AHIMS rockshelter sites were inspected and recorded, and four new rockshelter sites were identified and recorded. The rockshelter sites are all located outside the Study Area for this report.

The grinding groove site (#52-2-2068) was inspected and recorded. Originally recorded on AHIMS as comprising 91 grooves. EMM has identified a total of 120 grooves, in three clusters, from subsequent site inspections and photogrammetric baseline recording of the site.

The AHIMS open artefact sites were not inspected as access was not permitted. However, these types of sites are at low risk of subsidence impacts and will not warrant additional management and monitoring (see Section 4.2). An additional open artefact site (SQC1 in Figure 3.1) was identified in the eroding bank beside Stonequarry Creek, approximately 200 m west of the grinding groove site (#52-2-2068). This surface scatter represents what is most likely a much wider area of potential archaeological deposit (PAD).

The scarred tree (#52-2-2100) was inspected and recorded. Although largely hollowed out by termites and the upper branches are dead, the tree is still alive. The scar is now closed over by overgrowth (Plate 4.2).

Table 3.1 provides an overview of all the identified Aboriginal sites within the Study Area. Further information about the sites can be found in the ACHA reports (EMM 2019a; Niche 2014) and a summary of archaeological significance of the sites is attached as Appendix B.

iii Ongoing monitoring

An AHTR (EMM 2019b) was prepared to support the Extraction Plan for LW W1–W2. It outlined adaptive management strategies and a TARP using the performance indicators for the management of Aboriginal sites.

The grinding groove site (#52-2-2068) has been monitored during the period of active subsidence for extraction of LW W1–W2 will continue to be monitored during extraction of LW W3–W4, through Global Navigation Satellite System (GNSS) units, monthly ground surveys of rock bar and additional provisions provided in the SCRMP.

No subsidence related impacts to the grinding groove site have been observed during the monitoring program to date.

See Section 5.3 for more detailed information about the monitoring program.

4 Predicted subsidence impacts and environmental consequences

4.1 Potential subsidence impacts and environmental consequences

4.1.1 Longwall mining

Longwall mining is a method of underground coal mining that involves the extraction of large panels of coal by progressively shaving slices of coal from the longwall face under the protection of hydraulic roof supports. As coal is excavated the weight of the overlying ground, originally supported by the coal, becomes supported only by the remaining pillars or walls. This causes the mine void walls to compress and the overlying rock to crack and tilt into the void.

Subsidence at the ground surface occurs as underlying strata collapse into the void, which is called the goaf. The ground at the surface subsides vertically and at the edges of the subsidence zone it tilts and moves horizontally towards the centre of the goaf (IESC 2014). These horizontal movements result in tensile strains, leading to cracking of the ground surface, and compressive strains when the distance between two points decreases, potentially pushing the ground upwards.

The prediction of impacts to Aboriginal heritage is determined first by adequate surveys to determine the existence and significance of Aboriginal sites within the Study Area. Archaeological sites which are most susceptible to subsidence-induced damage are rock shelters in caves or overhangs, generally associated with cliff lines (DoP 2008, p.84). Streams and valleys are the natural surface features most sensitive to subsidence movements. Axe grinding groove sites and rockshelters are located along the valleys of streams and therefore could experience valley related movements of upsidence and valley closure movements.

Impacts to open sites, such as open artefact scatters and scarred trees, depending on the level of subsidence, are limited to cracking in the surface soils which could lead to erosion channels if left untreated. It is unlikely that the artefacts or trees themselves would be impacted by surface cracking (MSEC 2021, p.202).

4.1.2 Overview

There are eight Aboriginal sites recorded in the Study Area, comprising one grinding groove site, six open artefact sites and one modified tree (refer Figure 3.1 and Table 3.1). The potential subsidence impacts on different Aboriginal sites depend on a number of factors including longwall geometry, depth of cover, extracted seam thickness and geology.

Mine Subsidence Engineering Consultants (MSEC) prepared a subsidence impact assessment for the Aboriginal sites within the Study Area. The likelihood of damage occurring at the sites was assessed on criteria which considers theoretical cracking limits caused by strains and tilts. Impact assessment findings for all sites are summarised in Table 4.1. As discussed in the SCRMP, monitoring across Stonequarry Creek during the mining of LW W1-W2 has found that observed valley closure movements and strains have been consistently less than predictions. A summary of subsidence predictions and probability ratings for impacts for Aboriginal sites within the Study Area is presented at the end of this chapter in Table 4.2.

Tahmoor Coal has developed and will implement the TARP (Appendix A) and site specific TARP for grinding groove site Stonequarry Creek 1. The TARPs include commitments to monitor ground movements and changes at the sites, with response actions planned to be implemented if observations exceed defined trigger levels. In the event of any subsidence impact, appropriate management, remediation and mitigation measures will be undertaken in

accordance with relevant approvals, including any AHIP requirements, in consultation with Heritage NSW and RAPs (see Section 6). The following sections describe the different types of Aboriginal sites and the predicted subsidence impacts to these sites within the Study Area based on site type.

Table 4.1 Predicted subsidence effects for Aboriginal artefact sites within the Study Area

AHIMS number	Site type	Distance from LW W3–W4 (m)	Total vertical subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km ²)	Maximum predicted total sagging curvature (km ²)	Upsidence (mm)	Closure (mm)	Predicted strains (mm/m)
52-2-2069	Isolated find	Above LW W3	700	4.0	0.04	0.09	N/A	N/A	1.0 (tensile) 1.7 (compressive)
52-2-2070	Isolated find	Above LW W3	275	4.0	0.04	0.09	N/A	N/A	2.0 (tensile) 1.7 (compressive)
52-2-2071	Isolated find	170 m north of LW W3	40-60	4.0	0.04	0.09	N/A	N/A	<0.5
52-2-2072	Isolated find	200 m north of LW W3	40-60	4.0	0.04	0.09	N/A	N/A	<0.5
52-2-2073	Isolated find	40 m north of LW W3	40-60	4.0	0.04	0.09	N/A	N/A	<0.5
52-2-4549	Artefact scatter	118 m north of LW W3	40-60	4.0	0.04	0.09	N/A	N/A	<0.5
52-2-2068	Grinding grooves	140 m north of LW W3	40	<0.5	<0.01	<0.01	70	70	<2 (compressive)
52-2-2100	Modified tree	250 m west of LW W3	900	4.0	0.04	0.09	N/A	N/A	<0.5

4.1.3 Open artefact sites

There are six identified open artefact sites within the Study Area (Figure 3.1), comprising one artefact scatter and five isolated finds. Two sites (isolated finds) are located directly above LW W3. The other sites are all located within 200 m of the longwall footprints. Predicted subsidence effects for open artefact sites are provided in Table 4.1.

The potential for impacts to artefact sites, particularly to sites directly above LW W3, would be limited to cracking in the surface soils which could lead to erosion channels if left untreated. However, the depths of cover (the depth the mine) within the Study Area ranges from a minimum of 470 m above the commencing end of LW W3 to a maximum of 550 m above the commencing end of LW W4. Cracking in the surface soils as the result of conventional subsidence movements are not commonly observed at these depths of cover in areas away from valleys and steep slopes. Surface cracking that has been observed as the result of conventional subsidence movements has generally been relatively isolated and of a minor nature (MSEC 2021, p.202). Furthermore, it is unlikely that the artefacts themselves would be impacted by any potential surface cracking.

Therefore, subsidence movements are not expected to have observable effect on artefact scatters and isolated finds in open terrain, and this is very unlikely to constitute 'harm' as defined by the NPW Act. While these sites could experience low-level vertical subsidence of up to 700 mm, they are not expected to experience significant tilts, curvatures or strains. Total predicted tilts for all the recorded open artefact sites are 4 mm/m which is considered low for cracking and subsequent erosional damage to open artefact sites.

Overall, the predicted subsidence impacts on the open artefact sites within the Study Area are considered to be negligible and are unlikely to constitute the definition of harm under the NPWS Act. The predicted likelihood of impact on artefact sites is considered to be *very unlikely*.

4.1.4 Grinding grooves

A substantial grinding groove site (with 120 grinding grooves) is located near a vehicle crossing in Stonequarry Creek (#52-2-2068) approximately 140 m north of the commencement end of LW W3 (Plate 4.1, Figure 3.1). This site is assessed as having high significance (EMM 2019a). Tahmoor Coal has prepared the SCRMP to specifically monitor and manage this site.

The proposed extraction of LW W3–W4 is predicted to result in minor additional increases in subsidence, valley closure and upsidence along Stonequarry Creek. No measurable valley closure was measured across the grinding groove site during the mining of LW W1 and W2.

No impacts to the grinding grooves were observed during the end of panel monitoring following the extraction of LW W1 and W2.

Fracturing of exposed bedrock as the result of mining subsidence has historically been observed in the Southern Coalfield, with more significant fracturing tending to occur near the bases of rivers, creeks and valleys, as the result of valley related movements:

Faults and joints in bedrock develop during the formation of the strata and from subsequent destressing associated with movement of the strata. Longwall mining can result in additional fracturing in the bedrock, which tends to occur in the tensile zones, but fractures can also occur due to buckling of the surface beds in the compressive zones. The incidence of visible cracking at the surface is dependent on the pre-existing jointing patterns in the bedrock as well as the thickness and inherent plasticity of the soils that overlie the bedrock (MSEC 2021, p.54).

As the grinding groove site (#52-2-2068) is located within a stream bed, it could potentially experience valley related effects of up to 70 mm upsidence and 70 mm valley closure. The compressive strains due to valley closure effects could be sufficient to result in fracturing of the rock in the base of Stonequarry Creek. Minor and isolated fracturing has been observed up to approximately 400 m outside of previously extracted longwalls in the Southern Coalfield.

monitoring across Stonequarry Creek during the mining of LW W1-W2 has found that observed valley closure movements and strains have been consistently less than predictions. As discussed in SCRMP, the rockbar is expected to experience between 10 mm of ground extension and 10 mm closure due to the extraction of LW W3.

The grinding groove site is predicted to experience 40 mm vertical subsidence, but it is not expected to experience significant tilts, curvatures or conventional strains.

MSEC has assessed that it is possible though unlikely that fracturing could occur in the rock platform due to its large size. They noted that:

One group of approximately 120 grooves are located on both sides of an existing natural crack in the bedrock, which has formed as part of the weathering and erosion process. The grooves generally avoid the crack, though the end of one or two grooves appear to cross over it. If differential movements develop at the rockbar, it is possible that some changes could be observed at existing joints and cracks that are present in the rockbar. It is, therefore, possible that the existing crack that runs through the group of grooves could open up or close due to mining (MSEC 2021, p.202).

Tahmoor Coal has prepared the SCRMP to reduce the probability of the grinding groove experiencing potential impacts to the heritage value of the site. The SCRMP includes a commitment to stop mining and relocated the longwall if observed ground movements approach magnitudes that have the potential to result in fracturing of the rockbar. With the measures provided in the SCRMP, the probability of exceeding negligible loss of heritage value for this site is determined to be *extremely unlikely*.

See Section 5.2.1iii for recommendations around further assessment of potential impacts to this site and Section 6 for recommendations on management of this site.



Plate 4.1 Grinding groove site (AHIMS #52-2-2068) on a rock platform within Stonequarry Creek (view west). Note the pre-existing crack mentioned in the MSEC assessment (2021, p.202).

4.1.5 Modified tree

A single modified tree (#52-2-2100) is located directly above LW W2 (Figure 3.1) and approximately 250 m from LW W3, where the maximum predicted total vertical subsidence during the extraction of LW W3-W4 is 900 mm.

The tree, which is approximately 100 m from the LW W1 footprint (ie closer than to LW W3), was assessed following the completing of LW W1. No impacts to the tree were observed. Experience from the Southern Coalfield is that the impact of longwall mining on trees is very low (MSEC 2021). Impacts generally only occur at very shallow depths of cover, in the order of 50 m, or on very steeply sloping terrain, in the order of 1 in 1 or greater (MSEC 2021). The depth of cover for the modified tree is over 490 m and the natural surface slopes are less than 1 in 3. As cracking in surface soils above longwall mining tends to be isolated and minor, typically in the top few metres of the surface soils, mediation is therefore not generally required.

The likelihood of impact is therefore assessed to be *very unlikely* (MSEC 2021).



Plate 4.2 **Left: Overgrown scar on the modified tree above LW W2 (#52-2-2100). View north-west.**
Right: Modified tree in surrounding landscape. View west.

4.2 Summary of subsidence impacts and environmental consequences

A summary of the predicted impacts of subsidence on Aboriginal site types is summarised in Table 4.2.

Table 4.2 Heritage subsidence performance indicators and likelihood of impact

Aboriginal sites	Possible environmental consequences	Probability of impact rating
Isolated finds/artefact scatters	Negligible environmental consequences.	Extremely unlikely
Scarred tree	Negligible environmental consequences.	Extremely unlikely
Grinding grooves	Subsidence impacts include cracking of rock platform due to upsidence and valley movement. Environmental consequences unknown.	Extremely unlikely (with the measures provided in the SCRMP)

5 Subsidence monitoring program

5.1 Performance measures and indicators

Performance measures for heritage are provided in Table 1 of Condition 13A of DA 67/98 and summarised in relation to Aboriginal sites Table 5.1.

Table 5.1 Heritage subsidence performance measures and performance indicators

Aboriginal sites	Subsidence performance measures	Probability of subsidence impact	Performance indicators
Isolated finds/ artefact scatters	Negligible subsidence impacts or environmental consequences	Very unlikely	No performance indicators are currently established as impacts are predicted to be negligible.
Scarred tree	Negligible subsidence impacts or environmental consequences	Very unlikely	This performance indicator will be considered to be triggered if: • subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or • subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage.
Grinding grooves	Negligible subsidence impacts or environmental consequences	Extremely unlikely with SCRMP in place	This performance indicator will be considered to be triggered if: • subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking or movement of the grinding groove features; and • these subsidence impacts result in impacts to the heritage values of the site.

For the purpose of this AHTR, negligible as referred to in this section is defined as being ‘so small and insignificant as to not be worth considering’. Negligible impacts would not constitute harm under the NPW Act. Based on the predicted subsidence impacts (MSEC 2021), it is predicted that the performance measures (negligible subsidence impacts and environmental consequences) for the Aboriginal sites within the Study Area will be achieved. The SCRMP contains further definitions concerning heritage values and negligible impacts relating specifically to Stonequarry Creek 1 (#52-2-2068).

A monitoring program will be implemented to confirm if impacts remain within predictions and identify any management or mitigation measures as required. With the measures provided in the SCRMP, impacts to the grinding groove sites located in Stonequarry Creek (#52-2-2068) are considered extremely unlikely. Impacts to this site will be reassessed after partial extraction of LW W2 as outlined in Table 5.2. To establish compliance with the performance measures, a TARP has been developed (Appendix A and the SCRMP Appendix A) outlining adaptive management where monitoring indicates that any performance measures have been exceeded or if exceedance seems likely.

5.2 Subsidence monitoring program

A monitoring program to monitor the subsidence impacts and environmental consequences of subsidence effects on known Aboriginal sites during extraction of LW W1–W2 has been implemented and will continue during the

extraction of LW W3–W4. The monitoring program will specifically target known Aboriginal sites within the Study Area.

The monitoring program recorded the condition of the relevant sites before mining (baseline survey and baseline check). Monitoring the condition of the relevant sites after the completion of mining of LW W1 was undertaken in November 2020 (post mining initial condition and post mining secondary condition check) and no impacts were observed. Monitoring will be conducted after the conclusion of each longwall (LW W2–W4).

Baseline recording (see Section 5.2.1) carried out by EMM in March 2019 will continue to be used to assist with monitoring and assessment of whether impacts from mining have occurred to Aboriginal sites within the Study Area. Further specific monitoring measures are proposed for Stonequarry Creek 1 which is detailed in the SCRMP.

Table 5.2 Monitoring program for Aboriginal heritage

Aboriginal sites	Monitoring component	Monitoring		
		Prior to extraction	During extraction	Post mining
Isolated finds/ artefact scatters	Monitoring not required.	N/A	N/A	N/A
Scarred tree	Recording and photography.	Baseline monitoring to record the condition of the tree was undertaken prior to the commencement of LW W1 (completed). Monitoring at the completion of LW W1–W2 (prior to commencement of LW W3) to be completed.	N/A	Visual inspection conducted by an archaeologist at the completion of each longwall.
Grinding grooves	Recording – drone photography/ photogrammetry, plan drawing.	Baseline monitoring to record the site before mining and note any existing cracks or damage (completed).	Refer to the SCRMP.	Refer to the SCRMP

5.2.1 Baseline recording of Aboriginal sites within the Study Area

i Overview

EMM conducted baseline recording of Aboriginal sites within the Study Area in March 2019, prior to the extraction of LW W1–W2. The data collected prior to the extraction of LW W1–W2 will be used as baseline data for the sites during extraction of LW W3–W4.

ii Purpose

The results of the baseline recording will be used for comparisons to determine any impact from mining. To this end, the baseline recording will:

- mitigate the risk of potential impact through more detailed archival recording; and

- provide a set of baseline records for the monitoring program.

iii Method

The recording of Aboriginal heritage sites involved photography of the grinding groove site in order to show:

- the wider context of the site – landscape and setting at long range and medium scales; and
- details of the site’s features.

In addition, the following site-specific recording of the sites was undertaken.

a Grinding groove site (#52-2-2068):

Photogrammetry using drone photography to record the grinding groove site (#52-2-2068) has provided an archival record of the site prior to mining as well as a comprehensive record against which to monitor the site. An example is shown in Plate 5.1 and a full record is provided in the appendices to the ACHA (EMM 2019a). Photogrammetric photography was initially completed at the site on 11 September 2019 and after 1,000 m of extraction from LW W1, on 19 August 2021. An end of panel inspection was undertaken at the site at the completion of LW W1 in November 2020 and will be completed at the completion of each subsequent longwall (LW W2–W4).

Given its location in the creek bed and the size of the rock platform, impacts to the grinding groove site (#52-2-2068) have been assessed as possible, though unlikely. This site was re-assessed after approximately 1,000 m of extraction from LW W1 and at the end of LW W1 extraction by quantifying the subsidence impacts on Cedar Creek and extrapolating the impacts on the grinding groove rock platform during extraction from LW W2. In this way a more accurate prediction of possible impact to the grinding groove site could be made. No impacts were observed during these two inspections. Ongoing and regular monitoring will ensure that any potential impacts are observed, and appropriate mitigation (if required) are completed.

b Scarred tree (#52-2-2100):

Photographs of the scarred tree and a visual inspection to record the tilt of the tree, the location of the cultural scar and overall condition of the tree was initially completed for this site on 11 September 2019 and again, at the end of LW W1 extraction on 23 November 2020. No impacts were observed.



Plate 5.1 Example of 3D photogrammetric model perspective of part of the grinding groove site

5.3 Monitoring undertaken during the extraction of LW W1–W2 and implications for LW W3–W4

5.3.1 Overview

5.3.2 The grinding groove site AHIMS #52-2-2068 has been monitored during the period of active subsidence for extraction of LW W1 and LW W2 and will continue to be monitored during extraction of W3–W4, through the GNSS units and provisions set out in the SCRMP. Adaptive Management Review after 1,000 m of extraction from LW W1

A review of observations was undertaken after approximately 1000 m of extraction from LW W1. This was considered a sufficient distance to observe the majority of mining-induced movements. If impacts on Cedar and Stonequarry Creek near the commencing end of LW W1 had been greater than anticipated, Tahmoor Coal would have considered amending the commencing position of LW W2 to further reduce the potential for impacts on Stonequarry Creek. However, the review in July 2020 (MSEC, 2021) found that observations were consistent with the findings of the subsidence impact assessment that was provided in support of the Extraction Plan for LW W1–W2 and that subsidence impact performance measures for LW W1–W2 were not likely to be exceeded. Accordingly, it was not recommended to change the start position of LW W2.

DPIE reviewed the findings of the adaptive management report and approved the start position of LW W2, subject to a requirement that Tahmoor Coal conducted higher frequency downloading of data and visual inspections of the

gas bubble impact site at Pool MR45 and higher frequency downloading of data of groundwater levels (MSEC 2021, p.143).

In addition, on 19 August 2020, an EMM archaeologist and RAP representatives from Cubbitch Barta and TLALC completed an interim archaeological monitoring inspection at the 1000 m extraction point for LW LW1. The focus of the 1,000 m monitoring fieldwork was to inspect and photogrammetrically record grinding groove site (#52-2-2068). No evidence of subsidence or subsidence related impact were observed on the grinding groove site at the end of the 1,000 m extraction point.

5.3.3 Archaeological monitoring

Following the completion of panel extraction of LW W1, an EMM archaeologist and RAP representative from Cubbitch Barta conducted archaeological monitoring of Aboriginal sites within the Study Area for LW W1–W2 (EMM 2020b). Archaeological monitoring fieldwork took place over two days on 23 and 24 November 2020. Of the 25 Aboriginal sites recorded in the study area for LW W1, there are 17 rockshelters, one grinding groove site and one modified tree which required subsidence monitoring, as well as six open artefact sites which did not require monitoring.

No subsidence related impacts were observed to any of the Aboriginal sites inspected as part of the monitoring program and therefore no additional management strategies were required. The photogrammetry recording completed for AHIMS #52-2-2068 is kept on record by Tahmoor Coal.

5.4 Monitoring of newly identified Aboriginal heritage items

In the event of discovery of new Aboriginal sites within the Study Area prior to or during the extraction period, Tahmoor Coal may need to implement monitoring for these additional Aboriginal heritage sites depending on their site type, location and predicted level of impact. Assessment and monitoring measures will be developed in consultation with an archaeologist and with relevant members of the Aboriginal community. Monitoring requirements may be subject to compliance with any AHIP conditions. This AHTR will be updated with information about the find, and any new sites must be registered in the AHIMS database and appended to an inventory in this AHTR.

6 Subsidence management strategies

6.1 Adaptive management

A TARP has been developed using the performance indicators for management of Aboriginal sites (Appendix A). The TARP applies only to the Extraction Plan Study Area for LW W3–W4. Additionally, detailed monitoring and management measures for Stonequarry Creek 1 are provided in the SCRMP which includes a site-specific Trigger Action Response Plan (TARP).

The TARP outlines the assigned level of risk for each performance indicator:

- Level 1: Normal;
- Level 2: Within Prediction; and
- Level 3: Exceeds Prediction.

Where performance indicators indicate that a level of risk has been triggered (Levels 1 to 3 with escalating corresponding risk), a response, or a contingency plan that outlines the adaptive management measures for each level of risk, is required as outlined in the TARP.

In the event of any exceedance of performance indicators, Tahmoor Coal will, at the earliest opportunity:

- investigate to determine if the exceedance is related to non-mining factors or is a consequence of mining activities;
- consider all reasonable and feasible options for remediation (where relevant) in consultation with local Aboriginal groups and Heritage NSW;
- submit a report to the relevant Government authority describing those options and any preferred remediation measures or other course of action; and
- implement remediation measures.

6.1.1 Remediation measures

If an impact to Aboriginal heritage occurs, the type of remediation that is undertaken will be dependent on:

- the location of the site (eg open paddock, creek bed);
- the site type (eg rockshelter, grinding grooves);
- the nature of the damage and its location within the site (eg rockshelter roof or wall; proximity to art);
- the impact on the heritage values of the site (eg loss of art works, a crack across grinding grooves);
- cultural advice from the local Aboriginal community to the proposed remediation measures (eg sealants used on cracks or introducing supports or scaffolding into rockshelters); and
- compliance with relevant AHIP conditions, if granted for the activity.

Therefore, remediation measures, if needed, will be assessed on a case-by-case basis in the light of these considerations in order to ensure that performance measures are met.

6.2 Trigger Action Response Plan

The TARP provides a description of performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to sites of Aboriginal heritage and considers the management or remediation of any impacts and/or environmental consequences relating to Aboriginal heritage sites.

The purpose of the TARP is to provide:

- appropriate triggers to warn of increased risk of exceedance of any performance measures;
- specific actions to respond to high-risk exceedance of any performance measure to ensure that the measure is not exceeded;
- an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and
- adaptive management where monitoring indicates that there has been an exceedance of any performance measure, or where any such exceedance appears likely.

The TARP is attached as Appendix A.

6.3 Unexpected finds procedures

6.3.1 Discovery of Aboriginal objects

Under Section 89A of the NPW Act, it is a requirement that Heritage NSW is notified of the existence of Aboriginal objects as soon as practicable after they are first identified. This is done through the completion of a Site Card which is submitted to the Registrar of AHIMS for inclusion on the Aboriginal site database. Information regarding AHIMS and site recording forms can be downloaded from the Heritage NSW website located at <http://www.environment.nsw.gov.au/licences/DECCAHIIMSSiteRecordingForm.htm>.

Under s85A of the NPW Act, Aboriginal objects remain the property, and under the protection of, the Crown until formal transfer to a person or persons of a class prescribed by the regulations occurs.

6.3.2 Reporting impact to Aboriginal sites

An Aboriginal Site Impact Recording Form must be completed following impacts to AHIMS sites that are:

- a) a result of test excavation carried out in accordance with the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW*;
- b) authorised by an AHIP issued by Heritage NSW;
- c) undertaken for the purpose of complying with Secretary's environmental assessment requirements issued by DPIE for:
 - i) State Significant Development,
 - ii) State Significant Infrastructure, or

- iii) a major project, or
- d) authorised by a State Significant Development/State Significant Infrastructure/former Part 3A consent/approval under the NSW *Environmental Planning and Assessment Act 1999*.

Completed forms must be submitted to the AHIMS Registrar at
www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm

Aboriginal Site Impact Recording Forms can be downloaded from the Heritage NSW website located at
<https://www.environment.nsw.gov.au/resources/cultureheritage/aboriginal-site-recording-form-180307.pdf>

i. **Discovery of human skeletal remains**

In the event that known or suspected human skeletal remains are encountered within the Study Area, the following procedure must be followed:

- the immediate vicinity will be secured to protect the find and the find will be immediately reported to the work supervisor who will immediately advise the site supervisor or other nominated senior staff member;
- the environmental manager or other nominated senior staff member will notify the police and the state coroner on the same day of the find (as required for all human remains discoveries);
- the environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material;
- if it is determined that the skeletal material is ancestral Aboriginal remains, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains;
- the site will be recorded in accordance with the NPW Act and Heritage NSW guidelines;
- if the remains are historical and not of Aboriginal origin, Heritage NSW will be notified for further instruction; and
- works will not recommence until written approval is received.

7 Review and improvement

7.1 Overview

This section of the AHTR describes the key elements of implementation, including reporting requirements, reviews and key responsibilities specifically relevant to this AHTR.

Further details of the general reporting and review requirements, and key responsibilities are provided in Section 6 of the Extraction Plan main document.

7.1.1 Reporting requirements

In accordance with DA 67/98 Condition 48 or as triggered by the TARP, if an incident occurs relating to heritage material whereby performance measures are exceeded and harm to Aboriginal heritage is threatened or caused, a letter report will be issued within one week of the event, notifying DPIE, Heritage NSW, and RAPs of the TARP trigger.

The detailed report that will be provided to DPIE will be sent within seven days of the incident including details of the actions being undertaken to prevent recurrence.

7.2 Review and auditing

Changes to this AHTR will be made in the following circumstances:

- where new Aboriginal sites are discovered, they must be added to the inventory in this AHTR within three months of the find; and
- where an AHIP is issued, this AHTR will be reviewed and updated where necessary to comply with the requirements of any AHIP conditions.

Where changes are made to the AHTR, a draft of the modified plan will be provided to RAPs (once identified) for their review. RAPs will not be required to review the AHTR for minor plan updates. This comprises:

- when a new Aboriginal site is discovered and is at no risk of impact by the project. In this instance, the inventory of the AHTR will be updated to acknowledge the site, but RAPs will not be required to review the AHTR; and
- when the status of a site needs to be updated on the inventory of the AHTR. For example, once a site has been salvaged the AHTR will be updated to reflect the site's status. However, RAPs will not be required to review this action.

Although RAPs are not required to review the AHTR for minor plan updates, they will be notified if new sites are identified and of updates relating to the status of Aboriginal sites.

Matters raised in consultation which are specific to the changes in the plan will be acknowledged and addressed in the modified plan.

Any changes made to this AHTR will be made in consultation with the DPIE, and a copy of the revised management plan will be supplied to the Secretary of the DPE for approval.

Abbreviations

Abbreviation	
ACHA	Aboriginal Cultural Heritage Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AHTR	Aboriginal Heritage Technical Report
Cubbitch Barta	Cubbitch Barta Native Title Claimants
DoP	Department of Planning
DPIE	Department of Planning, Industry and Environment
DECCW	Department of Environment Climate Change and Water
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Limited
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
GNSS	Global Navigation Satellite System
IESC	Independent Expert Scientific Committee
km	Kilometre
LW	Longwalls
LW W1-W2	Longwalls West 1 and West 2
LW W1	Longwall West 1
LW W2	Longwall West 2
LW W3-W4	Longwalls West 3 and West 4
LW W3	Longwall West 3
LW W4	Longwall West 4
ML	Mining Lease
m	Metre
mm	Millimetre
MSEC	Mining Subsidence Engineering Consultants
Niche	Niche Environment and Heritage
NPW Act	<i>NSW National Parks and Wildlife Act 1974</i>
NPW Regulation	<i>NSW National Parks and Wildlife Regulation 2009</i>
NSW	New South Wales
OEH	Office of Environment and Heritage
PAD	Potential Archaeological Deposit
RAPs	Registered Aboriginal Parties
RMZ	Risk management zone
SMP	Subsidence Management Plan

Abbreviation

SCRMP	Stonequarry Creek Rockbar Management Plan
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TLALC	Tharawal Local Aboriginal Land Council
WSC	Wollondilly Shire Council

Glossary

Term	Definition
35 degree angle of draw	Used to define the limits of the subsidence trough. It is the angle between two lines drawn from the edge of the mine workings, one a vertical line and the other a line to the limit of vertical displacement.
20 mm subsidence contour	A limiting value for vertical displacement which is attributable to mining.
Closure	The reduction in the horizontal distance between the valley sides. The magnitude of closure, which is typically expressed in the units of millimetres (mm), is the greatest reduction in distance between any two points on the opposing valley sides.
Curvature	Rate of change of tilt and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections.
Far field movements	The measured horizontal movements at pegs that are located beyond the longwall panel edges and over solid unmined coal areas.
Riparian zone	Area of land adjacent to a river or stream
Strain	Determined by calculating the horizontal change in length of a section of subsidence profile and dividing this by the initial horizontal length of the section. It includes both tensile strains over the sides of the panel and compressive strains towards the bottom of the subsidence trough
Study Area	The surface area enclosed by a 35 degree angle of draw from the limit of the proposed longwall mining extension (LW W1–W2) and by the predicted 20 mm subsidence contour resulting from the extraction of the proposed longwalls (MSEC 2021). The Study Area is shown in Figure 1.2.
Subsidence	The deformation of the ground mass surrounding a mine due to the mining activity, including all mining-induced ground movements, vertical and horizontal displacement, tilt, strain and curvature.
Tilt	Calculated as the change in subsidence between two points divided by the distance between those points. The maximum tilt occurs at the point of inflection in the subsidence trough where the subsidence is roughly equal to one half of the predicted maximum subsidence.
Upsidence	Mining-induced relative upward vertical displacement of the ground surface or subsurface strata, generally observable at the bottom of valleys.

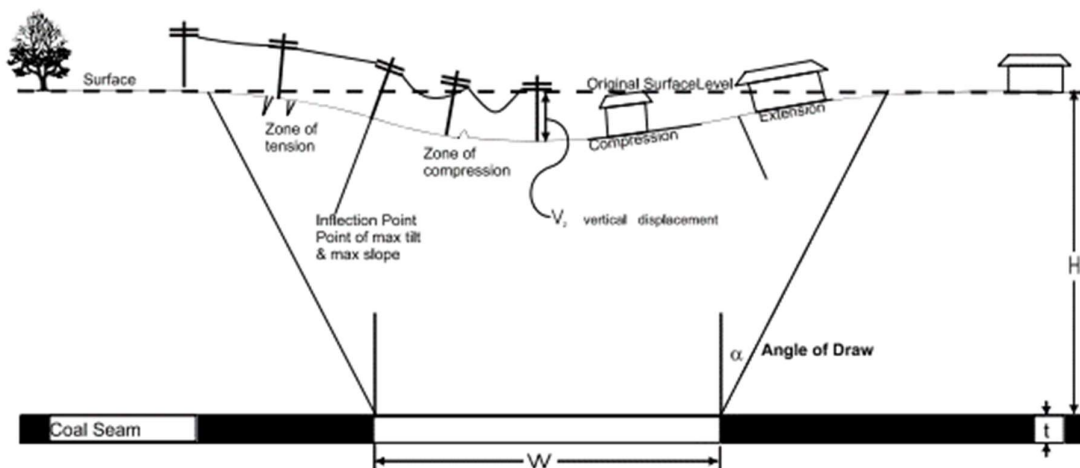


Plate 7.1 Angle of draw and surface subsidence in flat topography (NSW DoP 2008 p.48)

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EMM Consulting

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Appendix A

Trigger Action Response Plan

A.1.1 TARP

The following TARP outlines performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to the Aboriginal modified tree within the Study Area, Clearview (#52-2-2100) and considers the management or remediation of any impacts and/or environmental consequences relating to this Aboriginal heritage site.

A site-specific TARP for Stonequarry Creek 1 is included in the SCRMP which comprises a sub-plan of the HMP for the Extraction Plan for LW W3-W4.

Table A.1 Trigger Action Response Plan

Feature	Management		
	Trigger	Action	Response
Aboriginal heritage	Level 1		
	Aboriginal heritage site monitoring indicates no detectable environmental consequences.	Continue monitoring as per monitoring program.	No response required.
	Level 2		
	Aboriginal heritage site monitoring indicates no detectable environmental consequences.	Continue monitoring as per monitoring program.	No response required.
	Level 3		
	Aboriginal heritage site monitoring indicates environmental consequences to heritage site(s).	- Continue monitoring as per monitoring program. - Convene Tahmoor Coal Environmental Response Group to review response. - Investigate exceedance of subsidence prediction. - Review mine design/predictions against mine criteria. - Review monitoring program and modify if necessary.	- Notify RAPs within one week of the event and co-ordinate a site inspection with RAPs. - Notify DPIE and Heritage NSW within one week of the event. - Investigate and implement any additional management measures (Section 6) as required in consultation with RAPs, Heritage NSW and DPIE.

Appendix B

Aboriginal sites in the LW W3–W4 Study Area – assessment of archaeological significance

B.1 Aboriginal sites within the Study Area - assessment of archaeological significance

B.1.1 Scientific value

The following scientific values are identified as 'low', 'moderate' or 'high' for each identified Aboriginal site with an overall rating identified based on the results of each individual assessment. In the overall assessment of significance, research potential is generally weighted higher because it encompasses other values such as the site's archaeological integrity and influences the types of research questions that can be addressed.

- *Research potential:* The potential of a site to contribute to the present understanding of society and the human past.
- *Rarity and representativeness:* The frequency of a site type and how the sites relate to the wider archaeological record. The significance may be due to sites being uncommon because of the related activity that created them, or preservation, or they are uncommon now because of ongoing site destruction through development and change.
- *Integrity:* The level of disturbance or intactness of a site and how this may affect research potential.
- *Educational value:* The potential of a site to be used as an educational tool. This usually includes sites with easily identifiable and accessible characteristics that are good representative examples.

Table B.1 **Summary of scientific values**

AHIMS	Site type	Research potential	Rarity and representativeness	Integrity	Educational value	Overall significance	Significance rating
52-2-2068	Grinding groove site	High: Extensive grinding groove site (120 grooves) on a platform in a creek bed. High frequency of grooves available for comparative analysis with other grinding grooves in the region. Potential to answer questions of site formation, ie multiple events over time, indicating longstanding use or created in a short timespan. Potential to answer questions relating to broader landscape occupation models around landscape use and its relationship to other sites such as rockshelters and open camping landscapes.	High: Grinding grooves occur in the local area but are rare in the study area. This is one of the most extensive local examples.	High: Grooves are distinct and easily distinguishable. Sandstone bedrock is intact.	High: Good example of extensive grinding groove site with easily identifiable features in an easily accessible location.	High: Rare <i>and</i> extensive site type with high integrity.	High
52-2-2069	Isolated find	Low: Common type, isolated silcrete flake identified on grazing land on a lower hillslope.	Low: May be part of a wider artefact distribution but artefact is a common material and type.	Low: Site is disturbed from clearing and pastoral grazing	Low: The site is a common site type and may be difficult to re-locate.	Low: Common type, sparse assemblage. on a typical landform in a disturbed context.	Low
52-2-2070	Isolated find	Low: Common type, isolated stone artefact identified on grazing land on a lower hillslope.	Low: May be part of a wider artefact distribution but artefact is a common material and type.	Low: Site is disturbed from clearing and pastoral grazing.	Low: The site is a common site type and may be difficult to re-locate.	Low: Common type, sparse assemblage. on a typical landform in a disturbed context.	Low

Table B.1 **Summary of scientific values**

AHIMS	Site type	Research potential	Rarity and representativeness	Integrity	Educational value	Overall significance	Significance rating
52-2-2071	Isolated find	Low: Common type, isolated quartz flake identified near a tributary to Stonequarry Creek on grazing land on a lower hillslope.	Low: May be part of a wider artefact distribution but artefact is a common material and type.	Low: Site is disturbed from clearing and pastoral grazing.	Low: The site is a common site type and may be difficult to re-locate.	Low: Common type, sparse assemblage. on a typical landform in a disturbed context.	Low
52-2-2072	Isolated find	Low: Common type, isolated chert flake identified near a tributary to Stonequarry Creek on grazing land on a lower hillslope.	Low: May be part of a wider artefact distribution but artefact is a common material and type.	Low: Site is disturbed from clearing and pastoral grazing.	Low: The site is a common site type and may be difficult to re-locate.	Low: Common type, sparse assemblage. on a typical landform in a disturbed context.	Low
52-2-2073	Isolated find	Low: Common type, isolated retouched silcrete flake identified on grazing land on a lower hillslope.	Low: May be part of a wider artefact distribution but artefact is a common material and type.	Low: Site is disturbed from clearing and pastoral grazing.	Low: The site is a common site type and may be difficult to re-locate.	Low: Common type, sparse assemblage. on a typical landform in a disturbed context	Low:
52-2-2100	Modified tree	Moderate Demonstrates the change over time (30 years) to the scar and may assist with the identification of other scarred trees of a similar age where the scars are obscured by overgrowth.	Moderate Rare site type in the local area due to development, vegetation clearance and pastoral use. Scar is obscured by overgrowth but representative of the size, shape and location of cultural bark removal.	Low Overgrowth of scar tissue has hidden the scar. The tree is alive although suffering from termite infestation.	Moderate The type of tree and the shape of the scar are an example of how trees were used in the local area.	Moderate Although the scar is obscured, the tree is a rare surviving example in the local landscape and indicates the potential for similar scarred trees to exist.	Moderate

Table B.1 Summary of scientific values

AHIMS	Site type	Research potential	Rarity and representativeness	Integrity	Educational value	Overall significance	Significance rating
52-2-4548	Open artefact scatter	Moderate: Common site type but likely to be part of a larger area of PAD on the banks of Stonequarry Creek	Low Common materials and artefact types	Moderate Artefacts are exposed in the eroding bank, high potential for subsurface deposit	Moderate The site contains easily identifiable artefact types of good quality raw materials	Moderate The site is a common open artefact scatter on a typical landform. Proximity to the creek indicates high archaeological potential.	Moderate

Appendix C

Consultation with the local Aboriginal community

Pamela Chauvel

From: April Hudson <April.Hudson@simecgfg.com>
Sent: Friday, 27 March 2020 7:36 AM
To: daruglandobservations@gmail.com; didgengunawalclan@yahoo.com.au; yurrandaali_cs@hotmail.com; yulayculturalservices@gmail.com; barrabyculturalservices@gmail.com; barkingowlcorp@gmail.com; cazadirect@live.com; kgchalker@bigpond.com; informationofficer@tharawal.com.au; Amandahickey@live.com.au; Goodradigbee1@outlook.com; koori@ozemail.com.au; Ngambaaculturalconnections@hotmail.com
Cc: Zina Ainsworth; Ryan Desic; Pamela Chauvel
Subject: Tahmoor Coal - AHIP for Longwalls West 1 and West 2
Attachments: AHIP C0005707 - AHIMS 4584 - Tahmoor North Western Domain Longwalls West 1 and West 2 - 16 March 2020.pdf

Dear Registered Aboriginal Party,

Please be advised that Tahmoor Coal have received an Aboriginal Heritage Impact Permit (AHIP C0005707) from the Department of Planning, Industry and Environment on 16 March 2020 for the potential harm to certain Aboriginal objects through the longwall coal mining works for the Longwalls West 1 and West 2. Please find a copy of the AHIP attached for your records.

Tahmoor Coal would also like to advise you that we are still intending to extract Longwalls West 3 and West 4. These longwalls will be within the Study Area as previously presented during the preparation of the Aboriginal Cultural Heritage Assessment (ACHA) for Longwalls West 1 and 2. As part of the preparation for Longwalls West 3 and West 4, a separate ACHA document will be prepared to support an AHIP application for the additional two longwalls. Additional Aboriginal heritage technical reports will also be prepared for the extraction plan for Longwalls West 3 and West 4. We will be in contact with you further regarding this.

In the meantime, if you have any queries please do not hesitate to contact myself or Ryan Desic from EMM Consulting (rdesic@emmconsulting.com.au).

Kind regards,

April Hudson

Approvals Coordinator

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14 July 2020

Registered Aboriginal Party
Tahmoor Coal Mine: Longwalls West 1-4

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www.emmconsulting.com.au

**Re: Archaeological monitoring inspection: 1000 m extraction point of Long Wall West 1.
Notice of continued consultation for proposed Long Walls West 3-4.**

Dear Registered Party,

Thank you for your continued participation in Aboriginal consultation for the Tahmoor Coal Mine: Study Area Longwalls West 1 to 4 (LW W1–W4) Aboriginal Cultural Heritage Assessment (ACHA). EMM Consulting on behalf of Tahmoor Coal wish to advise registered Aboriginal parties (RAPs) about upcoming archaeological monitoring for Longwall West 1 (LW W1) which has now reached the 1000 m extraction point (Figure 1). In line with this milestone, EMM plan to complete a site inspection with participation from Cubbitch Barta Native Title Claimants and Tharawal Aboriginal Local Aboriginal Land Council, as per existing RAP fieldwork arrangements with Tahmoor Coal.

The purpose of the archaeological monitoring will be to visually observe if subsidence impacts have occurred to Aboriginal rock shelters and grinding groove sites within the project Aboriginal heritage impact permit (AHIP) boundary. Inspection of the grinding groove site AHIMS #52-2-2068 will be possible but it is expected that inspection of rockshelters may only be completed from the valley floor at a safe distance from any potential subsidence movements.

The inspection will focus on grinding groove site AHIMS #52-2-2068 and photos will be taken of the site to document its condition. These will not be archival photographs but will be taken to compare them against photographs that were taken prior to extraction of LW W1. Drone aerial photography will also be completed during the site inspection of the grinding groove site. This imagery will be stored by EMM and will be processed into orthographic photogrammetry at a later date (in conjunction with the end of long wall monitoring report). The rockshelters will be inspected as best we can from a safe distance and, where possible, cross-referenced with the photographs taken prior to extraction of LW W1.

Subsidence monitoring and inspections have been completed at monthly intervals by subsidence specialists and no impacts to Aboriginal sites have been documented. Hydrogeologists from GeoTerra Pty Limited have routinely inspected creek beds and cliffs lines of Stonequarry, Cedar and Matthews creeks from a safe distance where Aboriginal rock shelters occur. Additionally, geotechnical engineers from Douglas Partners Pty Limited have inspected the cliff lines of Cedar Creek and Matthews Creek (mostly from the valley floor as safety permits, but also some cliff terraces) and have not observed any discernible signs of distress. Mining Subsidence Engineering Consultants (MSEC) have also conducting monthly reviews of subsidence movements along the creeks during mining of LW W1 as part of the project adaptive management strategy. This has included detailed monitoring at 'Rockbar SR17' which is also where grinding groove site AHIMS #52-2-2068 occur. To date, no damage to the grinding groove site or the rock bar has been observed and no subsidence related rock face cracking or spalling has been observed along the cliff lines where the Aboriginal rock shelters occur.

EMM will document the findings of the archaeological monitoring in a short report and provide it to RAPs and Heritage NSW. As no impacts are currently anticipated, no further action is likely to be required at this stage. If impacts are observed, Tahmoor Coal will follow protocols and requirements in line with the project Trigger Action Response Plan (TARP) and the conditions of the AHIP.

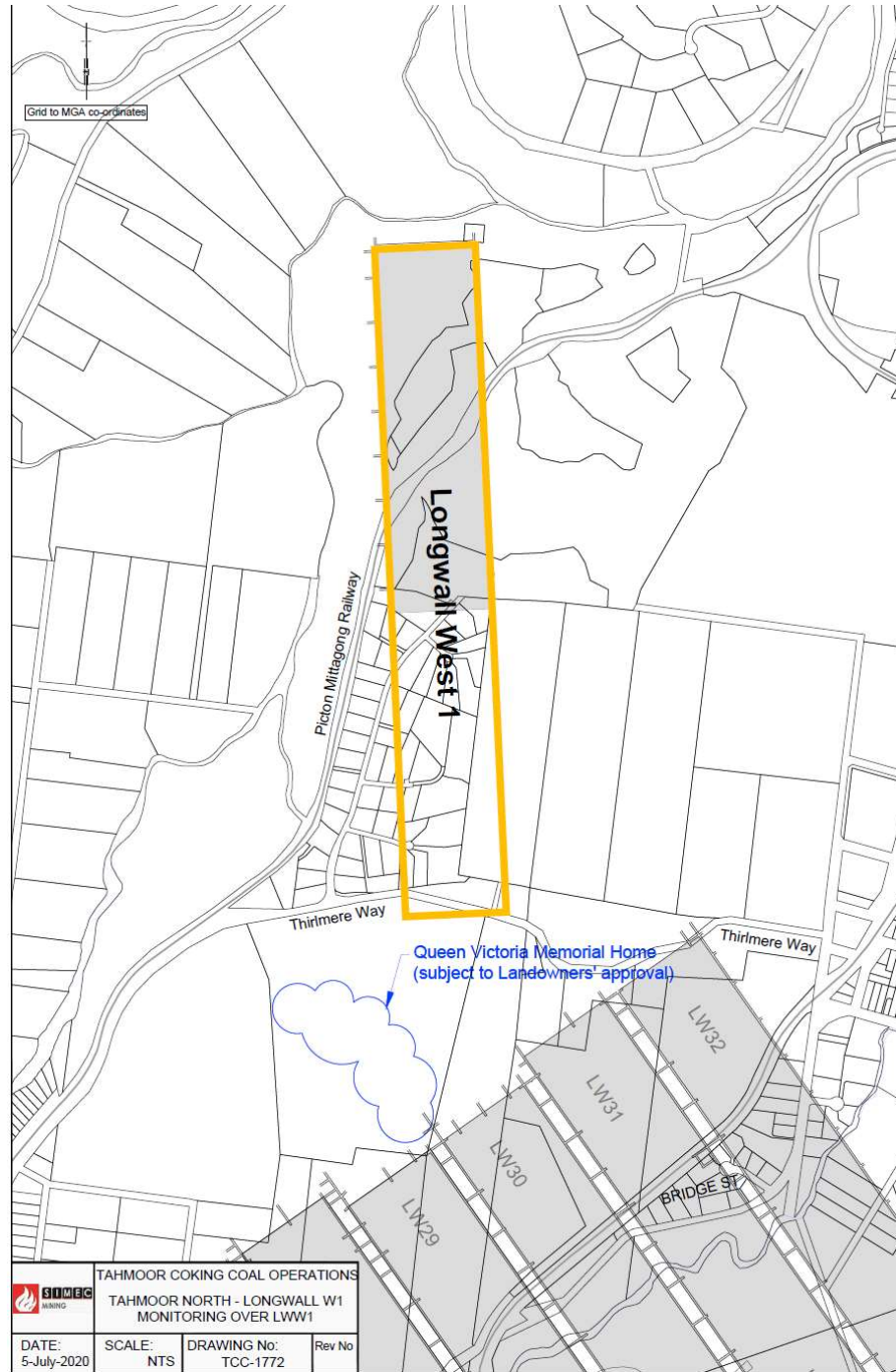


Figure 1 Figure showing extraction progress of Longwall West 1: grey area represents the extracted area as of 5 July 2020.

Tahmoor Coal has committed to review their subsidence impacts to the grinding groove site at 1000 m extraction of LW W1. If it is predicted that subsidence performance indicators may be exceeded during the extraction of Longwall West 2 (LW W2), Tahmoor Coal will reassess the commencing position for LW W2 using the adaptive management process. RAPs will be notified if any changes are made to the LW W2 commencing position.

On a separate note, would also like to remind you that Tahmoor Coal is still intending to extract Longwalls West 3 and West 4 (LW W3-W4). These longwalls will be within the Study Area as previously presented during the preparation of the Aboriginal Cultural Heritage Assessment (ACHA) for LW W1-W2. As part of the preparation for LW W3-W4, a separate ACHA document will be prepared to support an AHIP application for the additional two longwalls. Additional Aboriginal heritage technical reports will also be prepared for the extraction plan for LW W3-W4. We will be in contact with you further regarding this.

Thank you for your time.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Ryan Desic', with a stylized flourish at the end.

Ryan Desic

Associate Archaeologist - Heritage Team Leader

rdesic@emmconsulting.com.au

Pamela Chauvel

From: Pamela Chauvel
Sent: Thursday, 22 October 2020 11:27 AM
To: Pamela Chauvel
Cc: Ryan Desic
Subject: Aboriginal heritage monitoring report - Tahmoor Mine update
Attachments: J190120_1000_m_Monitoring_v1.pdf

Hi all,

Thank you for your ongoing involvement in consultation for the Tahmoor Coal Mine project.

We're writing to let you know that an interim archaeological monitoring inspection was completed at the 1000 m extraction point for Longwall (LW) W1 at Tahmoor Mine. Aboriginal sites associated with LW W1 -W2 are managed through the provisions of the *Tahmoor Mine Extraction Plan Longwall West 1 – West 2 Aboriginal Heritage Technical Report* (AHTR) (EMM 2019), which was also adopted as Condition 8 of Aboriginal Heritage Impact Permit (AHIP) C0005707 that applies to the area.

A report of the findings of the monitoring inspection is included with this email.

In summary, an EMM archaeologist and a representative of Cubbitch Barta Native Title Claimants completed a site inspection on 19 August 2020. The focus of the fieldwork was the grinding groove site on Stonequarry Creek (AHIMS #52-2-2068) and the rockshelters located on the cliff lines of Matthews Creek and Stonequarry Creek (where it was safe to access). The purpose of the inspection was to observe if any subsidence impacts have occurred. Areas observed during the site inspection revealed no evidence of subsidence and as such, no additional management strategies are required. During the inspection, five additional grinding grooves were identified at AHIMS #52-2-2068 and will be included in all future monitoring programs.

If you have any questions, please don't hesitate to get in touch.

Kind regards,
Pamela

Pamela Chauvel

Consultant Archaeologist



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26 October 2020

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Re: Tahmoor Mine: ACHA LW W1-W4 update: Impact assessment LW W-W4

Dear Registered Party,

1 Introduction

Thank you for your ongoing participation in consultation on Aboriginal cultural heritage matters for the extraction of Longwalls West 1 – West 4 (LW W1W4) at Tahmoor Mine (the project).

In 2019, EMM Consulting prepared an Aboriginal Cultural Heritage Assessment (ACHA) for the project for Tahmoor Coal Pty Ltd (Tahmoor Coal). The ACHA assessed a study area covering the predicted extent of potential subsidence impacts from LW W1–W4, with a specific focus on the potential impacts to Aboriginal cultural heritage from the mining of LW W1–W2. EMM are now preparing a separate ACHA document to support an AHIP application for LW W3–W4.

Condition 13H of the Conditions of Consent for DA 67/98 states that negligible subsidence impacts or environmental consequences and negligible loss of heritage value are required for Aboriginal and historical heritage items. To address this, an Aboriginal heritage technical report (AHTR) outlining potential impacts, monitoring and management measures will be prepared for the Extraction Plan for LW W3–W4. The AHTR will be provided to RAPs separately for review.

The aims of this letter are to:

- provide an overview of the project and approval pathways;
- outline the purpose and aims of the Aboriginal consultation process;
- provide your party with an opportunity to inform EMM about any Aboriginal cultural heritage values associated with the project and how they may affect, inform or refine the project and/or assessment methods;
- identify any culturally appropriate protocols that registered parties wish to be adopted during the information gathering process (eg handling of culturally sensitive information); and
- present a draft of the intended ACHA methods for your review and comment.

This document is provided in accordance with sections 4.2 and 4.3 of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*, which sets out the Aboriginal consultation requirements for the project.

2 Project information

The proponent is Tahmoor Coal, and the project contact is:

Tahmoor Coal proposes to extend underground coal mining at the Tahmoor Colliery in the Western Domain which will include LW W3-W4. Under Condition 13H of DA 67/98 (as modified) an Extraction Plan is required for all second workings from LW33 (now known as LW W1) onward. An Extraction Plan for LW W1-W2 was approved by the NSW Department of Planning Industry and Environment (DPIE, now Heritage NSW) on 8 November 2019. On 16 March 2020, Tahmoor Coal received an Aboriginal Heritage Impact Permit (AHIP C0005707) for the potential harm to certain Aboriginal objects through the longwall coal mining works for LW W1-W2.

Mining of LW W1 commenced in November 2019. Subsidence monitoring and inspections have been completed at monthly intervals by subsidence specialists and no impacts to Aboriginal sites have been documented. The creek beds and cliffs lines of Stonequarry, Cedar and Matthews Creeks where Aboriginal rockshelters occur have been inspected regularly by hydrogeologists from GeoTerra. The cliff lines of Cedar Creek and Matthews Creek have been inspected by geotechnical engineers from Douglas Partners. No subsidence related rock face cracking or spalling has been observed along the cliff lines where the Aboriginal rockshelters occur.

Mining Subsidence Engineering Consultants (MSEC) have conducted monthly reviews of subsidence movements along the creeks during mining of LW W1 as part of the project adaptive management strategy. This has included detailed monitoring at the rockbar where the grinding groove site (AHIMS #52-2-2068) is located. To date, no damage to the grinding groove site or the rock bar has been observed.

In addition, archaeological monitoring was undertaken after LW W1 reached the 1000 m extraction point by Ryan Desic (EMM archaeologist) with participation from Cubbitch Barta Native Title Claimants Aboriginal Corporation (Cubbitch Barta) and the Tharawal Local Aboriginal Land Council (TLALC), as per existing RAP fieldwork arrangements with Tahmoor Coal. The inspection focused on grinding groove site AHIMS #52-2-2068 and photos (close up and from a drone) were taken of the site to document its condition. Inspection of the rockshelters was undertaken where it was safe to do so. No new cracking or damage was observed during the site inspection.

Tahmoor Coal is now proposing to extract LW W3-W4. These longwalls will be within the same study area as previously presented during the preparation of the ACHA for LW W1-W4 (EMM 2019). This ACHA included an assessment of the potential impacts to LW W1-W2. The updated and separate ACHA will now assess the potential impacts to Aboriginal sites from the extraction of LW W3-W4. Tahmoor Coal will be consulting RAPs previously identified in April 2019 for the LW W1-W4 study area presented in Figure 1.

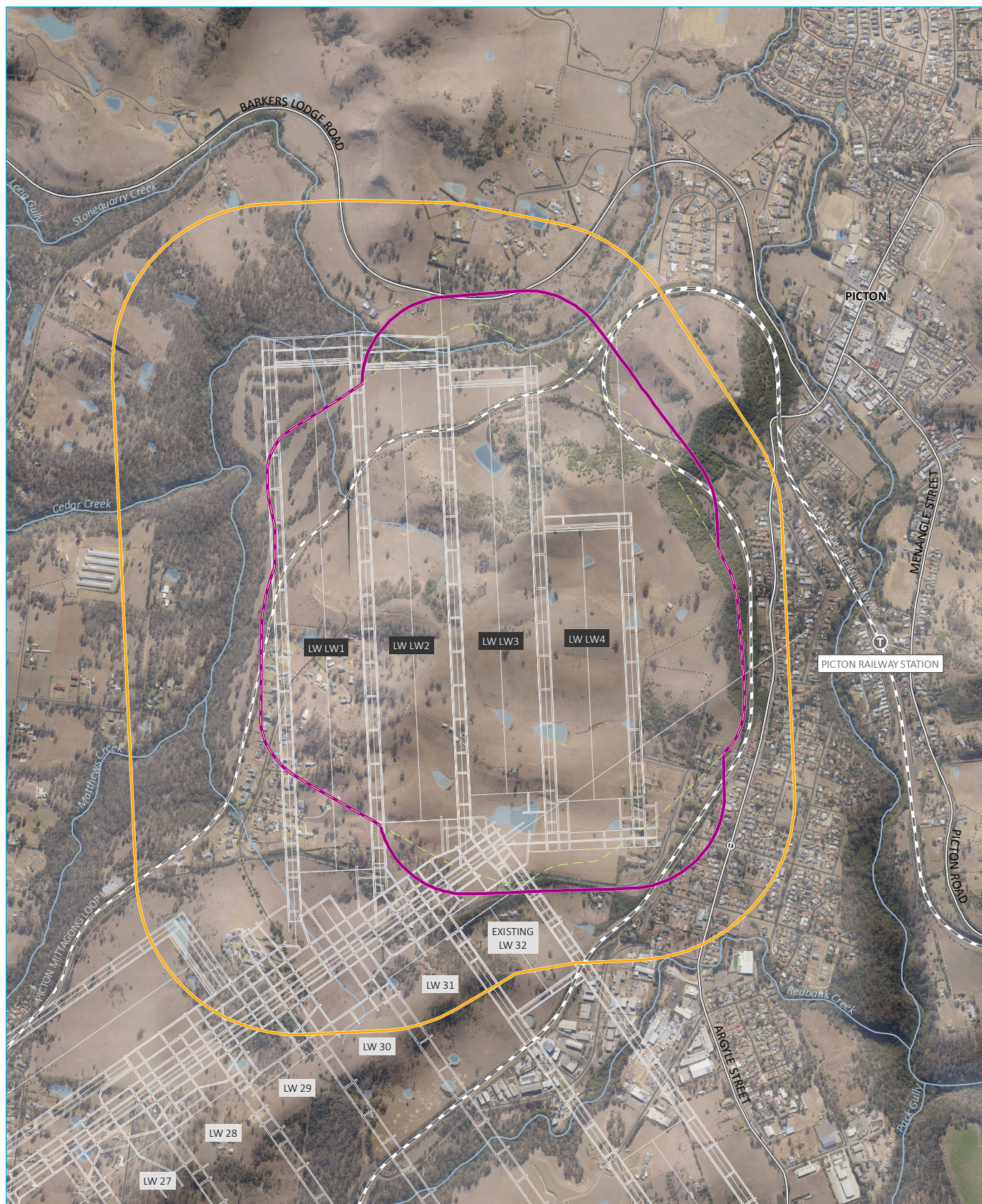
2.1 The study area

The **project area** has been defined as the surface area that could be affected by the mining of LW W3-W4 (Figure 1). The extent of the project area has been calculated by combining the areas bound by the following limits:

- a 35-degree angle of draw from the extents of LW W1–W4; and
- the predicted limit of vertical subsidence, taken as the 20 mm total subsidence contour resulting from the extraction of the proposed longwalls.

The **study area** is defined by a 600 m longwall buffer around LW W1-W4 that encompasses an area wider than the project area.

Longwall mining of LW W1 - W4 will involve subsurface activity only. Surface construction related activities are not anticipated.



Source: EMM (2020); DFSI (2017); GA (2011)

KEY

Study area

Project area

Predicted 20 mm subsidence contour

Train station

Rail line

Mine plan

Major road

Minor road

Vehicular track

Named watercourse

Waterbody

Study area

Tahmoor Coal Mine
Aboriginal cultural heritage assessment
Figure 1

EMM
creating opportunities

3 Archaeological background

3.1.1 Aboriginal sites within the study area

A search of the AHIMS database on 17 September 2020 identified 30 registered AHIMS sites within the study area, of which eight are within the project area. A summary of the sites within the project area is presented in Table 3.1 and shown in Figure 2. Please note that there are Aboriginal burial sites in the vicinity (removed from the map) but they are outside the study area.

The rockshelter sites along Matthews Creek and Cedar Creek that have the potential to be impacted by the mining of LW W1-W2 (AHIP C0005707), are outside the project area for LW W3-W4.

3.1.2 Aboriginal sites within the project area

Six of the registered sites within the project area are artefact sites (isolated finds or scatters) and one is a modified tree. These types of sites are less likely to be impacted by the effects of longwall mining, with impacts generally limited to cracking in the surface soils which could lead to erosion channels if left untreated. It is unlikely that the artefacts or tree would be impacted by surface cracking.

Archaeological sites which are most susceptible to subsidence-induced damage from longwall mining are rockshelters, generally associated with cliff lines, and grinding groove sites on rock platforms within streams and valleys. Stonequarry Creek 1 (#52-2-2068) is a significant grinding groove site within the project area. It is currently being monitored during the extraction of LW W1-W2, and no impacts have been observed to date. Nevertheless, the ACHA for LW W3-W4 will assess the potential impacts to the site from ongoing longwall mining.

Table 3.1 Aboriginal sites within the project area

AHIMS number	Site name	Site type	Description	Landform
52-2-2068	Stonequarry Creek 1	Grinding groove site	Two clusters of axe grinding grooves on a stone platform in the bed of Stonequarry Creek. A total of approximately 115 grooves.	Creek bed
52-2-2069	Isolated Finds 5	Isolated find	Silcrete flake identified in a paddock used as grazing pasture.	Lower slope
52-2-2070	Isolated Finds 9	Isolated find	Stone artefact identified on pastoral grazing land.	Lower slope
52-2-2071	Isolated Finds 2	Isolated find	Flaked piece of white quartz, near a small tributary of Stonequarry Creek.	Lower slope
52-2-2072	Isolated Finds 1	Isolated find	Chert flake near a small tributary of Stonequarry Creek.	Lower slope
52-2-2073	Isolated Finds 3	Isolated find	Retouched silcrete flake with possible use-wear in a paddock.	Lower slope
52-2-2100	Clearview	Modified tree	White mahogany tree with scar 0.3x 0.75 cm, on pastoral land.	Lower slope
52-2-4549	SQC 1	Artefact scatter	Eleven flakes (silcrete, chert and IMT) found within a 20 m ² area of eroding bank beside Stonequarry Creek.	Creek bank

3.2 Previous assessment of the study area

EMM prepared an ACHA for Tahmoor Coal Mine: Study Area LW W1-W4 in September 2019. The impact assessment in the 2019 report focused on LW W1-W2 as they were the first two longwall panels to be extracted. RAP representatives from Cubbitch Barta and TLALC assisted in AHIMS site reconnaissance during Stage 1 of the fieldwork (28 March 2019) and assisted with archaeological survey during Stage 2 of the fieldwork (4 July 2019). Cubbitch Barta and TLALC also assisted EMM on 11 September 2019 during the photogrammetry exercise for grinding groove site #52-2-2068 and in monitoring of the site, following extraction of 1000 m from LW W1, on 23 July 2020.

4 Proposed assessment methodology

4.1 Overview

The ACHA currently being prepared will update the findings of the 2019 ACHA, to include the results of monitoring to date, and will assess the potential impacts from the proposed mining of LW W3-W4.

EMM will base the impact assessment off subsidence predictions provided by Tahmoor Coal and MSEC, along with detailed predictions on potential subsidence impacts to cliffs lines and other rock features supporting Aboriginal heritage values.

Based on the outcomes of the impact assessment an AHIP application may be required to address potential impacts arising from underground mining of LW W3-4.

The findings of the archaeological survey of the study area undertaken in 2019 will be used to inform the ACHA. It is not anticipated that further fieldwork will be required as the study area of LW W1-W4 remains unchanged.

4.2 Relevant documents

This assessment will be completed in accordance with the following documents in accordance with SEARs:

- *Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW* (the Code) (DECCW 2010a);
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (DECCW 2010b); and
- *Aboriginal Consultation Requirements for Proponents 2010* (DECCW 2010c).

4.3 ACHA assessment methods

The purpose of the assessment is to identify and manage the Aboriginal cultural heritage values of all areas that will be affected by the study. In summary, this will involve.

- consultation with Registered Aboriginal Parties (RAPs) to identify socio-cultural values of the project area and places of special significance that should be considered;
- a search of the AHIMS register for records of previously registered Aboriginal sites;
- a review of past Aboriginal heritage reports covering the study area;
- environmental landscape analysis to identify past Aboriginal resources and suitable occupation areas;

- synthesis of background research to develop a predictive model of Aboriginal site location;
- an assessment of significance for Aboriginal cultural heritage values in the project area (with input from RAPs);
- an impact assessment of how the project will affect Aboriginal cultural heritage values in the project area; and
- development of management recommendations based on the results of the ACHA and input from RAPs during the consultation process and particularly from the draft ACHA review period.

4.4 Aboriginal technical heritage report (AHTR): LW W3-W4

The AHTR will address the potential impacts to Aboriginal cultural sites within the project area and their management. RAPs will receive a copy of the AHTR to review in December 2020.

The AHTR will include:

- statutory requirements and relevant legislation;
- an overview of the heritage sites and existing heritage management plans;
- inclusion of the potential subsidence related impacts to Aboriginal heritage items identified in the heritage assessment;
- management measures;
- a Trigger Action Response Plan (TARP); and
- reporting requirements, review and improvement measures.

5 Timeline

EMM Heritage proposes the following indicative timeframes for the ACHA and AHTR:

- Distribution of this document to RAPs: late October 2020.
- End of review period for the proposed methodology: late November 2020 (28 day review period).
- Distribution of draft AHTR: December 2020.
- Distribution of the draft ACHA report: January 2021.
- End of review period for the draft ACHA report: February 2021 (28 day review period, excluding Christmas/New Year period).

6 Roles, functions and responsibilities

EMM Heritage propose the following general roles, functions and responsibilities for EMM and RAPs.

EMM Heritage is responsible for the following:

- conducting the Aboriginal cultural heritage assessment;
- facilitating the Aboriginal consultation process; and

- considering the cultural perspectives, views, knowledge and advice of the RAPs in assessing cultural significance and developing management measures.

Registered Aboriginal parties are responsible for the following:

- providing cultural perspectives, views, knowledge and advice to EMM Heritage;
- indicating areas of cultural significance (if known and relevant to the study area);
- having an awareness and understanding of the commercial environment and constraints in which the Code operates; and
- demonstrating awareness and understanding of the opportunities to input into the ACHA and management recommendations.

We recommend that you refer to the document *Aboriginal Consultation Requirements for Proponents 2010* (DECCW 2010) for further information about the consultation process. This can be downloaded at <https://www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf>

7 Request for information

Aboriginal heritage incorporates a wide range of values such as stories, traditions and cultural practices. EMM welcomes advice from the Aboriginal community about Aboriginal cultural values (which might include archaeological sites or other types of values) relevant to the study area and its surrounds.

EMM Heritage is relying on the Aboriginal community for advice on non-archaeological, including intangible, Aboriginal values for the study area. We are happy to discuss any information which you are willing to share and will respect confidentiality where requested. Email is our preferred method of communication (see contact details at the end of this letter) but we will also accept letters and faxes and telephone calls to discuss relevant Aboriginal cultural heritage information. Please contact us at your earliest opportunity.

EMM would appreciate your feedback on the above methodology proposed for the investigation and assessment of the project area. In returning your answers, please include the following where appropriate:

- any protocols that you would like adopted during the project;
- identification of any Aboriginal objects of cultural significance and/or importance that you are aware of within the project area, and how you wish them to be dealt with during the project;
- identification of any places of cultural significance and/or importance that you are aware of within the activity area, and how you wish them to be dealt with during the project;
- guidance on the protocols, sensitivity, use and/or distribution of any cultural information that you provide to EMM Heritage;
- whether you require any further information prior to EMM Heritage proceeding with the project.

Note that EMM will use any relevant cultural information previously supplied for the ACHA covering the LW W1–4 study area.

8 Closing

We look forward to receiving any response your organisation wishes to make about the proposed method by **23 November 2020**. Your response will be documented and considered in the assessment. Most

importantly, your cultural information is also welcome within this timeframe; but it can also be submitted up until the completion of the draft ACHA.

Please feel free to contact me with any questions.

Yours sincerely

A handwritten signature in black ink, reading 'P Chauvel'. The 'P' is large and stylized, with a loop at the top. The 'Chauvel' is written in a cursive script.

Pamela Chauvel

Consultant Archaeologist

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Appendix C – Historical Heritage Technical Report



Tahmoor Mine Extraction Plan: Longwalls West 3 - West 4

Historical heritage technical report

Prepared for Tahmoor Coal Pty Ltd
March 2021





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Tahmoor Mine Extraction Plan: Longwalls West 3 - West 4

Historical heritage technical report

Report Number

J200551 RP4

Client

Tahmoor Coal Pty Ltd

Date

15 March 2021

Version

v2 Final

Prepared by



Pamela Chauvel
Consultant Archaeologist
15 March 2021

Approved by



Pamela Kottaras
Associate Archaeologist, National Technical Lead, Historical
Heritage
15 March 2021

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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Executive Summary

This Historical Heritage Technical Report (HHTR) has been prepared by EMM Consulting Pty Limited (EMM) to support an Extraction Plan for the secondary extraction of coal from Longwalls West 3 and West 4 (LW W3–W4). The objectives of the HHTR are to identify historical (non-Aboriginal) heritage values within the LW W3–W4 Study Area and to provide for the monitoring and management of potential subsidence related environmental impacts on historical heritage sites to demonstrate that the relevant performance measures are met.

The proposed LW W3–W4 will be operating in the Tahmoor North mining area under Development Consent DA 57/93 granted on 7 September 1994 and DA 67/98 granted on 25 February 1999. This HHTR has been developed in accordance with the conditional planning approval framework for mining activities in the area to the north-west of the Main Southern Railway (the Western Domain) within the Tahmoor North mining area.

There are six listed heritage sites within the Study Area. Three items are listed on the Wollondilly Local Environment Plan: the Mushroom Tunnel (I144), Weatherboard Cottage (WLEP I211) and Redbank Uniting Church (I146). Three items are listed on S170 registers: Picton Tunnel (ARTC S170 Register, as part of the Picton Railway Deviation Works), Antill Street Underbridge (ARTC S170 Register) and Rural Landscape (Thirlmere Way) (Department of Health S170 Register). In addition, three listed heritage sites, Picton Viaduct (State Heritage Register), Argyle Street Underbridge (Hole in the Wall) (I149) and a pedestrian overbridge at 86.1 km (ARTC S170 Register) have been included in this report as they may be sensitive to far field horizontal movements during extraction of W3–W4.

Items of railway infrastructure that are not listed on heritage registers but have collective local significance have also been considered in this report. Six culverts on the Picton-Mittagong Loop Line, of which two are directly above LW W3, have been inspected and recorded (EMM 2019). In addition, a number of items of railway infrastructure within the Study Area will require a heritage assessment and are included in this management plan. The items that require inspection are seven culverts on the Main Southern Railway, the subway at 88.133, the Bridge on Matthews Lane, a high retaining wall, Prince Street Overbridge, Connellan Crescent Overbridge and any other bridges or items of historical interest that are located on the Main Southern Railway within the Study Area.

The probability of subsidence impacts to most of the historical heritage items is predicted by MSEC (2019) to be *unlikely*. The exception is the two culverts above LW W3 where impacts are predicted to be *possible* (MSEC 2019).

ES1 Management measures

To ensure that performance measures are met, an ongoing monitoring program will be implemented to confirm if impacts remain within predictions and identify if any mitigation measures are triggered. To establish compliance with the performance measures, a Trigger Action Response Plan (TARP) has been developed (Appendix A) outlining subsidence monitoring measures feedback and improvement where monitoring indicates that any performance measures have been exceeded or if exceedance seems likely.

The monitoring program, which was put in place to monitor the impacts and consequences of subsidence effects on known historical heritage sites during the extraction of LW W1–W2, will continue during the extraction of LW W3–W4. Additional historical heritage items within the W3–W4 Study Area will undergo a similar process.

Monitoring measures to control the risk of impacts to all heritage items will be continuously reviewed during the extraction of LW W3–W4. As each longwall progresses, it will be possible to introduce additional controls if required in the event that unexpected adverse changes are observed.

Picton Viaduct (SHR 01051) is a State heritage listed item and if required, works covered under Standard Exemption 19 (safety and security) do not require approval under subsection 57(1) of the Heritage Act 1977 (Heritage NSW 2020b). The specified activities/works are to be undertaken in accordance with each of the relevant prescribed standards.

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1 Introduction

1.1 Introduction

Tahmoor Coal Mine (Tahmoor Mine) is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney between the towns of Tahmoor and Bargo, New South Wales (NSW) (Figure 1.1). Tahmoor Mine produces up to three million tonnes of Run of Mine coal per annum from the Bulli Coal Seam. Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Product coal is transported via rail to Port Kembla and Newcastle for Australian domestic customers and export customers.

The Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced in 1979 using bord and pillar mining methods, and via longwall mining methods since 1987. Tahmoor Coal is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group.

Tahmoor Coal has previously mined 33 longwalls to the north and west of the Tahmoor Mine's current pit top location (refer to Figure 1.2) in accordance with Development Consents and Subsidence Management Plan Approval.

Tahmoor Coal is now extending underground coal mining to the north-west of the Main Southern Railway at Picton and Thirlmere (referred to as the 'Western Domain') within Mining Lease (ML) 1376 and ML 1539. An Extraction Plan for the first two longwalls to be mined, Longwall West 1 – West 2 (LW W1-W2) was approved by the NSW Department of Planning, Industry and Environment (DPIE) on 8 November 2019. Extraction of LW W1 commenced on 15 November 2019 and was completed on 6 November 2020. LW W2 commenced on 7 December 2020. Tahmoor Coal is proposing to mine a further two longwalls in the Western Domain - Longwall West 3–West 4 (LW W3–W4).

The extraction of the next two longwalls, Longwall West 3–West 4 (collectively referred to as LW W3–W4), are the subject of this technical report.

1.2 Purpose

This Historical Heritage Technical Report (HHTR) has been prepared by EMM Consulting Pty Ltd (EMM) to support an Extraction Plan for the secondary extraction of coal from LW W3–W4. The objectives of the HHTR are to identify historical heritage items within the LW W3–W4 Study Area and to provide for the monitoring and management of potential subsidence related environmental impacts on historical heritage sites within the Study Area in order to demonstrate that the relevant performance measures are met.

Personnel responsible for the implementation of this document and effective implementation of the TARP (refer to Appendix A) are included in the Extraction Plan.

1.3 Scope

This HHTR:

- addresses specific requirements set by DA 67/98 Condition 13H(vii)(f) (refer to Section 2.1);
- addresses related regulatory requirements (refer to Section 2.3);
- addresses the monitoring and management of potential subsidence-related impacts to historical heritage values resulting from the extraction of LW W3–W4 (refer to Section 5 and 6);

- provides a Trigger Action Response Plan (TARP) to be implemented to manage and protect known heritage values within the Study Area (refer to Section 6.1; Appendix A); and
- Identifies a process of review and improvement (refer to Section 7).

The HHTR is primarily informed by the following:

- an Aboriginal and European Heritage Assessment prepared for LW 31–37, which was a previous mine plan and study area for longwalls in the Western Domain, and included the current Study Area for LW W3–W4 (Niche, 2014);
- archaeological survey of the Picton Mittagong Loop Line (Loop Line) within the Study Area completed by EMM in March 2019; and
- subsidence data provided by Mining Subsidence Engineering Consultants (MSEC 2021) to measure subsidence impacts and associated environmental consequences.

The HHTR applies to all sites within the Study Area as shown in Figure 1.2.

1.4 Study Area

The Study Area has been defined as the surface area that could be affected by the mining of LW W3–W4 (Figure 1.2). The extent of the Study Area has been calculated by combining the areas bound by the following limits:

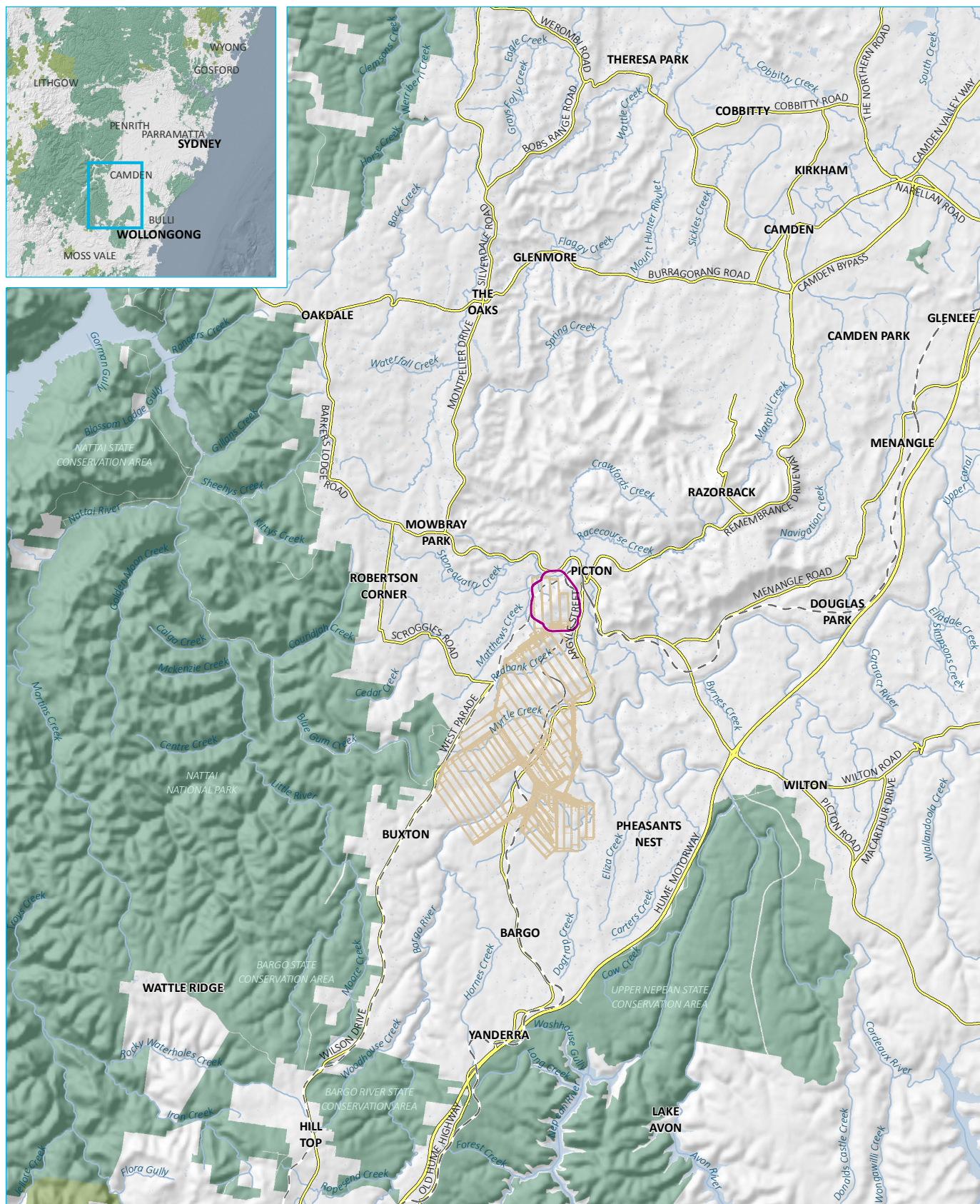
- a 35-degree angle of draw from the extents of LW W3–W4;
- the predicted limit of vertical subsidence, taken as the 20-millimetre (mm) subsidence contour resulting from the extraction of the proposed longwalls; and
- features that could experience far field or valley-related movements and could be sensitive to such movements.

There are additional features (railway infrastructure) that are located outside the Study Area which could experience either far field horizontal movements or valley-related movements. Heritage items that could be sensitive to such movements have been identified and included in the assessments provided in this report (see Table 3.3).

The Study Area is shown in Figure 1.2

1.5 Report authors

EMM was commissioned by Tahmoor Coal to prepare this HHTR to support an Extraction Plan for Tahmoor Mine LW W3–W4. This HHTR was prepared by Pamela Chauvel (Archaeologist) with review and input from Pamela Kottaras (Associate Archaeologist, National Technical Lead – Historical Heritage).



KEY

- Study area
- Mine plan
- Rail line
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

Regional location

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Historical Heritage Technical Report
Figure 1.1



KEY

- Study area
- Predicted 20 mm subsidence contour
- Completed longwall
- Mine plan
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

The study area

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Historical Heritage Technical Report
Figure 1.2

2 Statutory framework

2.1 Project approval

2.1.1 Developmental consent

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety, and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database.

The proposed LW W3–W4 will be operating in the Tahmoor North mining area DA 57/98 and DA 67/98 approved by DPIE.

DA 67/98 provides the conditional planning approval framework for mining activities in the Western Domain of the Tahmoor North mining area to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to the HHTR from DA 67/98 are detailed in Table 2.1 and performance measures (as described in Table 1 of DA 67/98 Condition 13A) are detailed separately in Table 2.2.

Table 2.1 Key conditions of DA 67/98 relating to historical heritage

Condition	Condition requirement	Section(s) addressed
SUBSIDENCE		
Performance Measures – Natural and Heritage Features etc		
13A	The Applicant must ensure that extraction of Longwall 33 and subsequent longwalls does not cause any exceedances of the performance measures in Table 1. <i>Note: The Applicant will be required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent.</i>	Section 5 and 6
Table 1	Feature	Performance Measure
	Heritage Sites	
	Heritage sites show in the figures in Appendix 7 ¹	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.
	Other Aboriginal and heritage sites	Negligible subsidence impacts or environmental consequences.
13B	Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.	Section 5
Extraction Plan		
13H	The Applicant must prepare an Extraction Plan for all second workings in Longwall 33 and subsequent longwalls to the satisfaction of the Secretary. Each Extraction Plan must:	Extraction Plan Main Document

Table 2.1 Key conditions of DA 67/98 relating to historical heritage

Condition	Condition requirement	Section(s) addressed
13H(vi)	describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 1 and Table 2, and manage or remediate any impacts and/or environmental consequences;	Section 5.1, 5.2 and 6
13H(vii)(f)	include a Heritage Management Plan which has been prepared in consultation with Heritage NSW and relevant stakeholders for heritage items which provides for the management of potential environmental consequences of the proposed second workings on heritage items;	This document and the Heritage Management Plan
13H(vii)(h)	include a Trigger Action Response Plan/s addressing all features in Table 1 and Table 2, which contains:	Appendix A (TARP)
	appropriate triggers to warn of increased risk of exceedance of any performance measure; and	Appendix A (TARP)
	specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded;	Appendix A (TARP); Section 6
	an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	Section 6.3
	adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 1 or Table 2, or where any such exceedance appears likely; and	Section 6.2
13H(vii)(i)	Contingency Plan that expressly provides for:	
	adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 1 and Table 2, or where any such exceedance appears likely; and	Section 6.2
	an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures; and	Section 6.3, 6.1, Appendix A (TARP)
	includes a program to collect sufficient baseline data for future Extraction Plans.	Section 5

Note: 1 As there is no Appendix 7 in DA 67/98 Modification 5, it is interpreted that this refers to Aboriginal heritage sites listed on the Aboriginal Heritage Information Management System, Wollondilly Local Environmental Plan 2011, State Heritage Register, and the Australian Heritage Database.

2.2 Subsidence performance measures

Performance measures for historical heritage sites are provided in Table 1 of Condition 13A of DA 67/98 and summarised in Table 2.2. Definitions and discussion around what constitute negligible impacts is presented in Section 5.

Table 2.2 Heritage performance measures

Heritage item	Subsidence performance measures
Heritage sites shown in the figures in Appendix 7 ¹	Negligible subsidence impacts or environmental consequences; Negligible loss of heritage value.
Other Aboriginal and heritage sites	Negligible subsidence impacts or environmental consequences.

Note: 1 As there is no Appendix 7 in DA 67/98 Modification 5, it is interpreted that this refers to heritage sites listed on the Wollondilly Local Environmental Plan 2011, State Heritage Register, and the Australian Heritage Database.

2.3 Relevant legislation and guidelines

This HHTR has been prepared in accordance with the principles of the Australia ICOMOS *Burra Charter*, 2013 (*Burra Charter*). The *Burra Charter* provides guidance for the conservation and management of places of cultural significance and sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians.

Items of heritage significance in NSW are protected by a series of Acts whose purpose it is to ensure that change is appropriately managed to ensure that significance is not lost. In NSW, the *Heritage Act 1977* (the Heritage Act), and the *Environmental Planning and Assessment Act 1979* (EP&A Act) are the primary statutory controls protecting historical heritage and archaeology within NSW. Listing on statutory registers provides legal protection for heritage items. Further details regarding these Acts are included in Appendix B.

2.4 Consultation

On 28 January 2020, a letter via email was sent to Heritage NSW introducing the Extraction Plan for LW W3-W4 and providing a figure of the Extraction Plan Study Area and an overview of the longwalls. No response to the letter of consultation has been received from Heritage NSW.

On 16 September 2020, a letter via email was sent to NSW Department of Planning, Industry and Environment – Environment, Energy and Science (EES) Group introducing the Extraction Plan for LW W3-W4. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. An email response was received from EES on 21 September 2020 with a list of data requests. Tahmoor provided the data to EES on 25 September 2020 and 15 January 2021. While preliminary comments were received from EES on 29 January 2021, none of these comments concerned heritage.

3 Existing environment

3.1 Landscape

The Study Area is located immediately to the west of the Main Southern Railway Line in Picton, NSW. The topography is generally hilly and undulating in a rural landscape that has been largely cleared for pastoral grazing.

The southern and eastern portions of the Study Area are characterised by a broad ridgeline that is generally on a north-east/south-west axis. At its highest point, the ridge is 286 metres Australian Height Datum (m AHD), sloping down to Matthews, Cedar and Stonequarry Creeks to the north and west. Stonequarry Creek (a fifth order creek) flows west to east across the north of the Study Area. The surrounding landscape is cleared pastoral land with a riparian corridor beside the creek.

The Picton-Mittagong Loop Line (Loop Line) traverses the Study Area from the south-west to the north-east on a series of embankments and cuttings. Infrastructure constructed c1867 for the Loop Line includes heritage items such as the Mushroom Tunnel, Picton Viaduct and sandstone culverts.

The Main Southern Railway runs south to north along the east of the Study Area before looping around to the east and heading south outside the eastern extent of the Study Area. This railway line was constructed in 1919 as a deviation to the Loop Line and could carry much heavier loads. The Main Southern Railway is the main line between Melbourne and Sydney and in continuous use. Infrastructure within the Study Area on this line includes Antill Street Underbridge, Picton Tunnel and a series of brick culverts, while outside the Study Area but susceptible to far field movements are a number of unlisted bridges that are part of the original construction of the railway line.

A brief history of the railway lines and the listed heritage items are included in Appendix D.

3.2 Heritage sites within the Study Area

A summary of all registered and non-registered heritage items is included in Table 3.1 and shown on Figure 3.1 (registered sites) and Figure 3.2 (non-registered sites). Appendix D provides further detailed information about the heritage sites that are within the Study Area or which may experience impacts from underground mining of LW W3-W4.

In addition, Appendix C provides a summary of previous historical heritage assessments of the Study Area that have informed the findings of this report.

Table 3.1 **Heritage items**

Within the Study Area		Abutting the Study Area		Outside the Study Area but may experience far field movements	
Registered	Non-registered	Registered	Non-registered	Registered	Non-registered
• Mushroom Tunnel • Railway Deviation Works – Picton Tunnel • Rural Landscape – Thirlmere Way • Redbank Uniting Church • Weatherboard Cottage • Antill Street Underbridge	• Loop Line culverts – 88.980 – 88.400 – 87.850 – 87.630 – 87.330 – 87.300			• Picton Viaduct • Argyle Street Underbridge (Hole in the Wall) • Pedestrian overbridge 86.1 km	
Items that require inspection					
	• Main Southern Railway culverts – 87.331 – 87.918 – 89.216		• Main Southern Railway culverts – 88.091 – 88.232 – 88.496 – 88.698 • Pedestrian subway (88.133 km) • Connellan Crescent Overbridge		• High retaining wall 84.687 km¹ • Bridge on Matthews Lane • Prince Street Overbridge

¹ This item may be within the curtilage of SHR item: Picton Railway Station Group (01224)

3.2.1 Registered heritage sites

Listing on statutory registers provides a basis under which the item or place is protected, and change is managed through project approval. Statutory listings provide legal protection for heritage items under the legislation outlined in Appendix B.

A review of the following databases was undertaken in December 2020:

- Commonwealth Heritage List (CHL);
- National Heritage List (NHL);
- State Heritage Register (SHR);
- Wollondilly Local Environment Plan (WLEP 2011), schedule 5;
- Wingecarribee LEP (2010) schedule 5;
- NSW Department of Health s170 register;
- Rail Corp s170 register;
- Australian Rail Track Corporation (ARTC) s170 register; and
- National Trust register.

There are no heritage items within the Study Area that are listed on the CHL, NHL, SHR or National Trust registers. However, although it is outside the Study Area, Picton Viaduct (SHR 01051), which is listed on the SHR, has been included in this assessment as it may be sensitive to far field horizontal movements during extraction of LW W3–W4.

There are no listed heritage items directly above the footprint of the longwalls. On the WLEP (2011), the ‘Hole in the Wall’ Railway Bridge (I149) is shown as a polygon which encompasses the entire Main Southern Railway Loop between approximately, chainage 86.2 to 88.2, although the bridge itself is outside the Study Area. Therefore, while the curtilage of the ‘Hole in the Wall’ Railway Bridge overlaps with the footprint of LW W3 in the north-east corner, the listing on the State Heritage Inventory (SHI) identifies only the bridge, which is outside the Study Area, as the significant item: “railway bridge over old Great South Road/Hume Hwy, where the road makes a sharp right-hand turn under the bridge to Picton Village”. It has been included in this assessment as it may be susceptible to far field movements.

Within the Study Area, six heritage items are listed on the WLEP (2011), ARTC S170 Register, or the Department of Health S170 register. The Picton-Mittagong Loop Line Railway Line (Loop Line) is listed on the Wingecarribee LEP (2010) (I473) for the section of the line between Buxton and Mittagong, but the section of the Loop Line within the Wollondilly Shire LGA (and within the Study Area) is not listed on the WLEP. Rural landscape - Thirlmere Way is linked to the Department of Health S170 group record for The Queen Victoria Memorial Hospital Precinct.

‘Picton Railway Deviation Works’ (85.500–88.00 km on the Main Southern Railway) is listed on the Australian Rail Track Corporation (ARTC) s170 Register and incorporates a number of heritage items within the 1919 deviated section of the Main Southern Railway line. The listing for the deviation works begins at the country end of the viaduct over Stonequarry Creek [Picton Viaduct] where the duplication works were moved to a new alignment that crossed Argyle Street (Hume Highway) by a high brick arch bridge [‘Hole in the Wall’ railway bridge]; then by a circular alignment through cuttings around the hill to cross the original railway line at the western end of the original single line tunnel [Mushroom Tunnel]; then through a new double track tunnel from 87.667 km to 87.88 km [Picton

Tunnel]; continuing south by another brick arch overbridge at Connellan Crescent and then over Antill Road [Antill Road Underbridge] towards Tahmoor (SHI 4280323).

The Antill Street Underbridge is incorrectly listed on the ARTC S170 Register as located at 88.133 km on the Main Southern Railway. It is located at 89.326 on Thirlmere Way (Antill Street becomes Thirlmere Way, west of the roundabout intersection with Argyle Street/Old Hume Highway) and is therefore within the Study Area.

A summary of these heritage items is provided in Table 3.2 and Table 3.3. Heritage items are shown on Figure 3.1 and Figure 3.2.

Table 3.2 Registered heritage sites within the Study Area

WLEP	Department of Health S170 Register	ARTC S170 Register	Address	Distance from Longwalls	Significance
Mushroom Tunnel (former Mainline Railway Tunnel) (I144)			229 Argyle Street, Picton	380 m north-east of LW W4	Local
		Picton Railway Deviation Works (Chainage 85.500–88.000 km Main Southern Railway)	Argyle Street, Picton	The curtilage for the item is 240 m from LW W4 at its closest point; however, the bridge itself is 720 m north-east of LW W4 and outside the Study Area.	Local
Cottage (weatherboard) (I211)			796-800 Thirlmere Way, Picton	80 m south of LW W4	Local
Redbank Uniting Church (I146)			385 Argyle Street, Picton	330 m north-west of LW W4 (abuts the Study Area)	Local
		Picton Railway Deviation Works (incorporating the Picton Tunnel)	Chainage 85.500–88.000 km Main Southern Railway	240 m north-east of LW W4 north-east at its closest point	Local
		Picton Antill Street Underbridge	88.133 km Main Southern Railway	430 m east of LW W4	Local
	Rural Landscape – Thirlmere Way		Thirlmere Way, Picton	Partially within the southern boundary of the Study Area.	Local

Table 3.3 Registered heritage sites also considered in this report

SHR	WLEP	ARTC S170 Register	Address	Distance from Longwalls	Significance
Picton Railway Viaduct over Stonequarry Creek (01051)		Picton Stonequarry Creek Underbridge	Main Southern Railway	850 m east of LW W4	State
	Railway Bridge (Hole in the Wall) (I149)	Picton Argyle Street Underbridge	Argyle Street, Picton 86.160 km Main Southern Railway	720 m north-east of LW W4	Local
		Picton Pedestrian Overbridge	86.1 km Main Southern Railway	650 m north-east of LW W4	Local

Table 3.4 **Registered heritage sites in the vicinity of the Study Area**

SHR	WLEP	Department of Health S170 Register	ARTC S170 Register	Address	Distance from Longwalls	Significance
	Industry Housing Group (I130)			15-23 Antill Street, Picton	520 m south-east of LW W4	Local
	Anglican Rectory (I142)			223 Argyle Street, Picton	550 m north-east of LW W4	Local
	Picton Loopline Level Crossing (I143)			229 Argyle Street, Picton	580 m east of LW W4	Local
	Gatehouse and Tollkeepers Cottage (I145)			236 Argyle Street, Picton	600 m east of LW W4	Local
	Redbank Uniting Church (I146)			385 Argyle Street, Picton	330 m north-west of LW W4 (partially within Study Area)	Local
	James Cottage (I147)			404 Argyle Street, Picton	520 m south-east of LW W4	Local
	Industry Housing Group – Cowper Street and Dunlop Place (I170)			14, 16, 18 and 20 Cowper Street; 4, 6, 8, 10, 16; and 18 Dunlop Place, Picton	430 m east of LW W4	Local
	Rogers Stone Cottage (I174)			41G Hill Street, Picton	490 m south-west of LW W4	Local
	Picton Uniting Church (I176)			2-4 Lumsdaine Street, Picton	590 m east of LW W4	Local
	Picton General Cemetery (I222)			Wild Street, Picton	570 m east of LW W4	Local
	Mill Hill, Millers House and archaeological relics (I210)			675 Thirlmere Way, Picton	450 m south-west of LW W3	Local
	Picton Conservation area (C2)			Picton	490 m east of LW W4	Local

Table 3.4 **Registered heritage sites in the vicinity of the Study Area**

SHR	WLEP	Department of Health S170 Register	ARTC S170 Register	Address	Distance from Longwalls	Significance
	Queen Victoria Hospital (I265)	Queen Victoria Hospital Precinct. S170 register individually lists the following items: • Chalets (seven items); • Cultural landscape; • Daycare Centre; • Goodlet House; • Library and Diversional Therapy; • Nursing Administration; • Polyclinic; • Remnant native landscape; • Repatriation Chalet; • Tennis Court; • The Grove; • Visitors Chalet; and • Workshop and stores.		Thirlmere Way, Picton	500 m south-west of LW W3	Local
	Harmony House Archaeological site (A14)	Artefacts		220 Bridge St, Thirlmere (Thirlmere Way, Picton)	450 m south west of LW W3	Local
Picton Railway Station Group (01224)			Picton Railway Precinct	Picton, NSW	970 m east of LW W4	Local

3.2.2 Non-registered heritage sites

i Loop Line culverts

The Loop Line crosses directly above the northern ends of LW W3–W4. Two sandstone and three brick culverts are situated along the section of this railway line within the Study Area. An additional brick culvert (87.300) is situated beneath the disused embankment for the original railway alignment.

The sandstone culverts are likely to date to the construction of the original line in 1863, and the brick culverts to additional works in 1919. The location of the culverts is shown on Figure 3.1 and a summary of each culvert is provided in Table 3.5.

During a site inspection by EMM on 29 March 2019, the culverts were found to be generally in fair to good condition. While cracking of the brick culverts along the Loop Line was mostly confined to the mortar, the brick culvert at chainage 87.300 under the disused embankment displayed additional cracking to the bricks themselves around the entrance to the culvert Plate 3.1. See EMM (2019) for additional details about the site inspection and assessment of significance, and Section 5.3.3 for the results of monitoring inspections undertaken to date.

Table 3.5 Loop Line culverts within the Study Area

Chainage	Item	Construction date	Notes	Diameter (m)	Distance from the longwalls
87.300	Brick culvert	c.1919	Located beneath the disused embankment for the original railway alignment. Bricks cracked at northern headwall. Not in association with a creek line.	1.2	150 m east of LW W3
87.330	Brick culvert	c.1919	Drainage channels of rendered brick have been constructed on either side of the embankments to funnel water into the culvert. Cracking is along the mortar only and the condition of the bricks is good.	1.2	230 m north-east of LW W3
87.630	Brick culvert	c.1919	Concrete skin on base and rubble at the mouth. Mortar tuck pointed. Headwall and abutment in good condition. Recent embankment to the south-east means water is largely diverted away from the culvert.	1.2	Directly above LW W3
87.850	Brick culvert	c.1919	Missing some bricks above the arch. Multiple existing cracks along the mortar.	1.5	Directly above LW W3
88.400	Sandstone culvert	c.1867	Integrity of structure and condition of the sandstone is good. Weeds that impeded initial inspection have subsequently been removed.	2.5	400 m west of LW W3
88.980	Sandstone culvert	c.1867	Poorly “restored” as part of the Stonequarry Estate Development, resulting in exfoliation of sandstone blocks particularly on the roof of the culvert.	2.5	



Plate 3.1 Brick culvert (chainage 87.300) beneath disused embankment. View east.



Plate 3.2 Culvert 87.330 km. View north-west.



Plate 3.3 Brick culvert (chainage 87.630). View north-west.



Plate 3.4 Brick culvert (chainage 87.850). View north-west.



Plate 3.5 Sandstone culvert 88.400 with RCP sleeve
(The RCP is a mitigation measure for subsidence, refer to Table 6.1).



Plate 3.6 Sandstone culvert 88.980 with RCP sleeve.

ii Non-registered items to be inspected

A number of non-registered items on the Main Southern Railway require inspection to assess their potential for heritage significance. This report should be updated with the results of the inspection. The items within the Study Area are:

- Main Southern Railway culverts: three culverts within the Study Area.

Items on the Main Southern Railway associated with the 1919 deviation works that are outside the Study Area, but which may be susceptible to far field movement and require inspection are:

- Main Southern Railway culverts: four culverts adjacent to the Study Area;
- Subway (88.133 km) adjacent to the study area;
- High retaining wall (84.687 km);
- Bridge on Matthews Lane (84.55.1 km);
- Connellan Crescent Overbridge (89.080 km); and
- Prince Street Overbridge (85.17 km).



Source: EMM (2021); DFSI (2017); GA (2011); DPE (2017)

KEY

- | | | |
|--|--|---|
| Study area | Historic heritage items | Train station |
| Predicted 20 mm subsidence contour | State Heritage Act | Rail line |
| Completed longwall | Conservation Area - General | Major road |
| Proposed longwall | Item - General | Minor road |
| Mine plan | Item - Archaeological | Vehicular track |
| | | Named watercourse |
| | | Waterbody |

Historical heritage items (registered sites)

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Historical Heritage Technical Report
Figure 3.1



Source: EMM (2021); DFSI (2017); GA (2011); DPE (2017)

0 250 500
m
GDA 1994 MGA Zone 56

KEY

- | | | |
|--|--|--|
| Study area | Historic heritage items | ● Heritage items - not listed |
| Predicted 20 mm subsidence contour | State Heritage Act | T Train station |
| Completed longwall | Conservation Area - General | Rail line |
| Proposed longwall | Item - General | Major road |
| Mine plan | Item - Archaeological | Minor road |
| | | Vehicular track |
| | | Named watercourse |
| | | Waterbody |

Historical heritage items
(unregistered sites)

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Historical Heritage Technical Report
Figure 3.2

4 Predicted subsidence impacts and environmental consequences

4.1 Potential subsidence impacts and environmental consequences

4.1.1 Longwall mining

Longwall mining is a method of underground coal mining that involves the extraction of large rectangular panels of coal approximately 450-500 m underground by progressively shaving slices of coal from the longwall face under the protection of hydraulic roof supports. As coal is excavated, the weight of the overlying ground originally supported by the coal becomes supported only by the remaining pillars or walls. This causes the mine void walls to compress and the overlying rock to crack and tilt into the void.

Subsidence at the ground surface occurs as underlying strata collapse into the void, which is called the goaf. The ground at the surface subsides vertically and at the edges of the subsidence zone it tilts and moves horizontally towards the centre of the zone (IESC 2014). These horizontal movements result in subsidence and subsidence induced movements at the ground surface caused by tensile strains, leading to cracking of the ground surface, and compressive strains when the distance between two points decreases, pushing the ground upwards. Although less likely, far valley movements and non-conventional subsidence movements that are more difficult to predict, have potential to harm structures within the limits of subsidence (shown on Figure 3.1). The potential for impacts on railway bridges and tunnels outside the Study Area does not result from absolute far field horizontal movements, but rather from differential horizontal movements over the lengths of the structure. A more detailed discussion of the probability of far-valley impacts and the methodology behind these predictions is contained in MSEC (2021).

The prediction of impacts to heritage sites is determined first by adequate surveys to determine the existence and significance of heritage sites within the Study Area. The design and configuration of buildings and the materials of which they are built will determine the effects which mining subsidence will have upon them. In addition, the levels of impact due to curvature and strain will vary considerably throughout the longwall area (EIS 1998: p.85-6). Structures which are most susceptible to subsidence-induced damage are those with more rigid foundations or built directly on bedrock.

4.1.2 Heritage overview

There are six listed heritage sites within the Study Area comprising the Mushroom Tunnel, Picton Tunnel, Weatherboard Cottage, Antill Street Underbridge, Rural Landscape (Thirlmere Way), and Redbank Uniting Church. In addition, three listed heritage sites have been included in this report as they may be sensitive to far-field horizontal movements during extraction of W3–W4 - Picton Viaduct, Argyle Street Underbridge (Hole in the Wall), and a pedestrian overbridge at 86.1 km

A number of items of railway infrastructure that are not listed on heritage registers but have collective local significance have also been considered in this report. Six culverts on the Picton-Mittagong Loop Line, of which two are directly above LW W3, have been inspected and recorded (EMM 2019). In addition, the following items of railway infrastructure require a heritage inspection - seven culverts on the Main Southern Railway, a high retaining wall at 84.687 km, a subway at 88.133 km the Bridge on Matthews Lane, Prince Street Overbridge and Connellan Crescent Overbridge. The location of the high retaining wall in relation to the SHR curtilage of the Picton Railway Station Group (SHR 01224) will need to be confirmed during the site inspection.

Subsidence predictions for the existing and proposed longwalls and impact assessments for the heritage items within the Study Area, prepared by Mining Consultant Engineering Consultants (MSEC 2021), have informed the impact assessment and management measures outlined in this report (Table 5.1). The likelihood of damage occurring at the sites was assessed on criteria which consider theoretical cracking limits caused by strains and tilts.

As the proposed longwalls do not mine directly beneath the Main Southern Railway and given that the predicted conventional subsidence movements along the Main Southern Railway due to the extraction of the proposed LW W3-W4 are very small and well within operational tolerances for the railway, impacts to most heritage items associated with the railway are deemed to be *unlikely* or *very unlikely*. The exception is the two brick culverts above LW W3 where impacts are predicted to be *possible* (MSEC 2019).

Non-railway related heritage items including the Weatherboard Cottage, Redbank Uniting Church and Rural Landscape (Thirlmere Way) are *very unlikely* to experience impacts.

Table 4.1 summarises the predicted probability of impact for each of the heritage sites and section 4.2 provides an overview of the predicted subsidence impacts to each historical heritage sites within the Study Area.

If the subsidence impact performance measures are exceeded, Tahmoor Coal will implement the TARP (Appendix A). In the event of any subsidence impact, appropriate management, remediation and mitigation measures will be undertaken in accordance with relevant approvals.

Table 4.1 **Historical heritage sites and predicted probability of impact**

Site name	Location in relation to LWs	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)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)	Predicted probability of impact
<i>Listed heritage sites within the Study Area</i>								
Mushroom Tunnel (former Mainline Railway Tunnel) (I144)	500m east of LW W3 370 m north-east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely
Picton Tunnel (part of the Picton Deviation Works)	430-585 m east of LW W3. 295-320 m north-east of LW W4	30	<0.5	<0.01	<0.01	-	-	Very unlikely
Cottage (weatherboard) (I211)	180 m south-east of LW W4	20	<0.1	<0.1	<0.1	-	-	Very unlikely
Redbank Uniting Church	330 m south-east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely
Rural Landscape – Thirlmere Way	Partially within the southern boundary of the Study Area.	N/A	N/A	N/A	N/A	N/A	N/A	Very unlikely
Picton Antill Street Underbridge (Thirlmere Way)	250 m south-east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Unlikely
<i>Additional listed heritage sites considered within this report</i>								
Picton Viaduct	1200 east of LW W3 850 m east of LW W4.	<20	<0.5	<0.5	<0.5	<5	<5	Very unlikely
Picton Argyle Street Underbridge (Hole in the Wall)	720 m north-east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely
Picton pedestrian overbridge 86.1	650 m north-east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely
<i>Non-registered heritage sites within the Study Area</i>								
Loop Line brick culvert 87.300	150 m east of LW W3	50	0.5	<0.01	<0.01			Unlikely
Loop Line brick culvert 87.330	230 m north-east of LW W3	<20	0.5	<0.01	<0.01	60	90	Unlikely

Table 4.1 **Historical heritage sites and predicted probability of impact**

Site name	Location in relation to LWs	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)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)	Predicted probability of impact
Loop Line brick culvert 87.630	Directly above LW W3	150	2.0	0.02	<0.01	50	70	Possible
Loop Line brick culvert 87.850	Directly above LW W3	600	3.0	<0.01	0.03	300	450	Possible
Loop Line sandstone culvert 88.400	400 m west of LW W3	800	1.0	0.02	0.02	100	150	Unlikely
Loop Line sandstone culvert 88.980	700 m west of LW W3	150	1.0	0.01	<0.01	70	100	Unlikely
<i>Non-registered items – to be inspected</i>								
Main Southern Railway brick culvert 87.331	290 m east of LW W3	<20	<0.5	<0.01	<0.01	60	90	Unlikely
Main Southern Railway brick culvert 87.918	330 m north-east of LW W4	<20	<0.5	<0.01	<0.01	No valley	No valley	Very unlikely
Main Southern Railway brick culvert 89.216	260 m east of LW W4	<20	<0.5	<0.01	<0.01	<20	<5	Very unlikely
Main Southern Railway brick culvert 88.091	410 m east of LW W4	<20	<0.5	<0.01	<0.01	<5	<5	Very unlikely
Main Southern Railway brick culvert 88.232	460 m east of LW W4	<20	<0.5	<0.01	<0.01	<5	<5	Very unlikely
Main Southern Railway brick culvert 88.496	460 m east of LW W4	<20	<0.5	<0.01	<0.01	<5	<5	Very unlikely
Main Southern Railway brick culvert 88.698	450 m east of LW W4	<20	<0.5	<0.01	<0.01	<5	<5	Very unlikely
Subway, Main Southern Railway 88.133	410 m east of LW W4	<20	<0.5	<0.01	<0.01	No valley	No valley	Very unlikely
High retaining wall, Main Southern Railway 84.687 km	1 km east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely

Table 4.1 **Historical heritage sites and predicted probability of impact**

Site name	Location in relation to LWs	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)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)	Predicted probability of impact
Bridge on Matthews Lane	1,040 m east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely
Prince Street Overbridge	960 m east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely
Connellan Crescent Overbridge	400 m east of LW W4	<20	<0.5	<0.5	<0.5	-	-	Very unlikely

4.2 Predicted impacts to historical heritage sites

4.2.1 Mushroom Tunnel

The Mushroom Tunnel is predicted to experience less than 20 mm of subsidence and negligible tilts. MSEC advises that while the likelihood is considered low, the Mushroom Tunnel could experience differential far field movements which may result in cracks developing.

Impacts to the Mushroom Tunnel are predicted by MSEC (2021) to be *very unlikely*.

4.2.2 Picton Tunnel

The brick arch tunnel is supported by short height unreinforced concrete pedestal walls along most of its length apart from full brick arches at both portals. Subsidence is predicted to be higher at the northern portal (30 mm) than the southern portal (15 mm). Therefore, the potential for impacts on the Tunnel is greatest from differential horizontal movements. This risk has been assessed by MSEC by statistically analysing the available 3D monitoring data from the Southern Coalfields. Specifically, the experiences observed at Redbank Tunnel have provided a case study for the mining of LW W3-W4 adjacent to the Picton Tunnel. Results demonstrated overall low levels of subsidence (<40 mm) and very small rotation of rockmass and horizontal sheers. For more detail, see MSEC 2021, p.110-112.

The likelihood of impacts to Picton Tunnel are considered to be *very unlikely*.

4.2.3 Weatherboard Cottage

As the weatherboard cottage sits on brick piers, it is less prone to subsidence impact than if it were constructed on a less flexible foundation (such as bedrock). MSEC predicts that it will experience up to 20 mm of vertical subsidence due to the proposed extraction of W3–W4. Potential impacts are likely to be limited to the external cladding or internal finishes rather than to the structural integrity of the building.

Overall impacts to the weatherboard cottage are predicted by MSEC (2021) to be *very unlikely*.

4.2.4 Redbank Uniting Church

The property curtilage for Redbank Uniting Church is partly inside the Study Area; although the sandstone church building is located just outside the Study Area. It is therefore predicted to experience less than 20 mm of vertical subsidence and is *very unlikely* to experience impacts from the extraction of LW W3-W4 (MSEC 2021).

4.2.5 Rural Landscape, Thirlmere Way

Variations in vertical subsidence of around 200-300 mm occur over distances of 320 m and, therefore, are not visually perceptible.

Curvatures and strains could result in cracking or heaving in the surface soils. Due to the high depths of cover however, any surface deformations are expected to be isolated and of a minor nature, with crack widths typically less than 25 mm. Any significant surface deformations could be remediated by locally regrading and recompacting the surface soils. No large-scale slope failures are anticipated, as none have been observed in the Southern Coalfield as a result of longwall mining. It is unlikely, therefore, that the mining induced curvatures or strains would reduce the visual aesthetics or the heritage value of the land.

The likelihood of adverse impact on the rural landscape is therefore considered to be *unlikely*.

4.2.6 Picton Antill Street Underbridge

The closest points between Antill Street Underbridge and both LW W3 and W4 is at a longwall corner, where subsidence movements are typically greater than those observed to the sides and beyond the ends of longwall panels (MSEC 2021, p.122). While the bridge is predicted to experience very low levels of subsidence, it may experience incremental far field horizontal movement whereby the potential for impacts results from differential horizontal movements between the abutments of the bridge rather than from absolute far-field horizontal movements. Overall, the probability of impacts is considered *very unlikely*.

4.2.7 Picton Viaduct

Picton Viaduct is a State significant heritage item and therefore the Heritage NSW's (2020) material threshold policy must be considered.

The "material threshold is reached when State heritage significance is considered to be "materially affected/effected". (Heritage NSW 2020a). For example, adverse impacts to State heritage significance occur when proposed changes, in this case cracking due to far field movement caused by longwall mining, adversely impact on the item's ability to demonstrate the listed criteria. The listed criteria for Picton Viaduct are outlined in Appendix F and include historical, associative, aesthetic and social significance, and research potential. Picton Viaduct is rare as it is "the only double track stone arch viaduct" and "is a magnificent representative example of a class of railway bridge built during 1862-69" (SHR 01051).

MSEC (2021) has predicted that Picton Viaduct could experience far field horizontal movements resulting from the proposed mining. The potential for impacts on the Viaduct does not result from absolute far field horizontal movements, but rather from differential horizontal movements over the lengths of the structure. Differential horizontal movements along the alignments of the viaduct could result in differential horizontal movements between the piers. In practical terms, 30 mm of valley closure, for example, would result in a 1 in 600 probability of a 10 mm crack. A more detailed discussion of the probability of far-valley impacts and the methodology behind these predictions is contained in MSEC (2021).

In summary, the likelihood of adverse impact on Picton Viaduct is considered *very unlikely*. Therefore, as minor adverse impacts to State heritage significance are anticipated, the material threshold is not reached.

4.2.8 Argyle Street Underbridge (Hole in the Wall)

While the bridge is predicted to experience very low levels of subsidence, it may experience incremental far field horizontal movement whereby the potential for impacts results from differential horizontal movements between the abutments of the bridge rather than from absolute far-field horizontal movements. Overall, the probability of impacts is considered *very unlikely*.

4.2.9 Pedestrian Overbridge 86.1 km

The pedestrian overbridge is outside the Study Area and will therefore experience less than 20 mm subsidence. While far field movements may be experienced, the potential for impacts on the bridge do not result from absolute far field horizontal movements, but rather from differential horizontal movements. However, as the bridge is constructed on bearings on concrete footings it is likely to slide on these bearings in response to opening or closure of the abutments and impacts are predicted to be *very unlikely*.

4.2.10 The Loop Line culverts (not listed)

The Loop Line crosses directly above the northern and western ends of LW W3–W4. Two sandstone and four brick culverts are situated along the section of this railway line within the Study Area. The brick culverts at 87.850 km and 87.630 km are located directly above proposed LW W3 and are therefore assessed to be at higher risk than the other culverts within the Study Area.

It is possible that the culverts may experience some cracking and spalling of the masonry as a result of the extraction of LW W3–W4. Cracking may occur in the masonry arch or in the headwalls.

The maximum predicted total tilt at the loop line culverts is 3.0 mm/m (ie 0.3 %). It is not expected that mining-induced conventional tilts would have adverse impacts on the drainage flows in the culverts, as the changes in grade are predicted to be less than 1%.

No mining-induced impacts were observed to the culverts during the mining of LW W1. Minor hairline cracks were observed in the exposed bedrock at the inlet and outlet of the Culvert at 88.400 km, with no impacts observed to the culvert itself. A pre-existing crack in the Culvert at 89.629 km was observed to open slightly during the mining of LW W1. The crack is less than 1 mm wide and there are no immediate concerns.

The likelihood of adverse impact on the brick and sandstone culverts is considered *unlikely* for most of the culverts and *possible* for the culverts at 87.850 km and 87.630 km.

4.2.11 Main Southern Railway culverts (not listed)

The eastern boundary of the Study Area includes or traverses closely, the Main Southern Railway. A series of railway brick culverts located beneath the railway embankment are yet to be inspected. They range in diameter from 0.6 m (87.918, 88.232 and 88.698) to 2.5 m (89.216 km).

MSEC have identified the main risk of impacts to the brick arch culverts is the potential for physical impacts such as cracking and spalling of the masonry as a result of mining the proposed longwalls. Cracking may occur in the masonry arch or in the headwalls. The predicted movements are not considered likely to result in collapse of the culvert (MSEC 2021).

While the risk of impact to most of the culverts is *very unlikely*, culvert 88.331 to the east of LW W3 is at a higher risk of impacts because it is set within a deeply incised valley, although potential for harm is still deemed *unlikely*. This culvert is currently infested with weeds which will need to be removed to ascertain the condition of the structure.

4.2.12 Subway 88.133 km (not listed)

The pedestrian subway beneath the Main Southern Railway at 88.133 km is just outside the Study Area. The brick structure with a concrete ballast top is not in a drainage line and therefore the risk of impacts is *very unlikely*.

4.2.13 High retaining wall 84.687 km (not listed but may be within the SHR curtilage for the Picton Railway Station Group)

The wall is 1 km from the LW W4 and as is not within a valley or stream channel. It is therefore *very unlikely* to experience impacts due to far field movement.

4.2.14 Bridge on Matthews Lane 84.551 km (not listed)

The single lane timber bridge over the Main Southern Railway is supported by timber trestles upon concrete upstand beams. In addition to being located over a kilometre from the proposed longwalls, as the bridge is constructed with timber, it can accommodate significantly more differential subsidence movements than masonry bridges and impacts to the bridge are predicted to be *very unlikely*.

4.2.15 Prince Street Overbridge (not listed)

Prince Street Overbridge is a steel framed bridge supported by concrete headstocks over brick arched piers. The bridge is located a long distance from the proposed longwalls and while it may experience far field horizontal movement resulting from differential horizontal movements between the abutments of the bridge; overall, the probability of impacts is considered *very unlikely*.

4.2.16 Connellan Crescent Underbridge (not listed)

Connellan Crescent Overbridge is supported by a reinforced concrete arch and has brick masonry walls either side of the road. The bridge may experience far field horizontal movement resulting from differential horizontal movements between the abutments of the bridge; overall, the probability of impacts is considered *very unlikely*.

5 Subsidence monitoring program

5.1 Performance measures and indicators

Performance measures for heritage are provided in Table 1 of Condition 13A of DA 67/98 and summarised in relation to historical heritage sites in Table 5.1.

For the purpose of this HHTR, negligible is defined as being so small and insignificant as to not be worth considering. Based on the predicted subsidence impacts (MSEC 2019) the performance measures (negligible subsidence impacts) for the listed historical heritage sites within the Study Area will be achieved. Two of unlisted heritage sites, the Loop Line brick culverts (at chainage 87.630 and 87.850) are at possible risk of subsidence impacts; however, with appropriate mitigation measures, negligible loss of heritage values will be achieved.

Table 5.1 Historical heritage subsidence performance measures and performance indicators

Historical sites	Significance	Subsidence performance measures	Probability of subsidence impact	Performance indicator triggers
Mushroom Tunnel (former Mainline Railway Tunnel) (I144) Sandstone construction	Local	Negligible subsidence impacts or environmental consequences Negligible loss of heritage value.	Very unlikely	subsidence monitoring identifies cracking of external brick work or other physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.
Picton Tunnel Brick construction	Local	Negligible subsidence impacts or environmental consequences.	Unlikely	subsidence monitoring identifies cracking of external brick work or other physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.
Cottage (weatherboard) (I211)	Local	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Very unlikely	subsidence monitoring identifies damage to external cladding or internal finishes.
Redbank Uniting Church Brick construction	Local	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Very unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.

Table 5.1 Historical heritage subsidence performance measures and performance indicators

Historical sites	Significance	Subsidence performance measures	Probability of subsidence impact	Performance indicator triggers
Antill Street Underbridge Brick construction	Local	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Very unlikely	subsidence monitoring identifies physical impacts to the historical heritage values of the bridge, measurable tilt or visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Rural landscape – Thirlmere Way	Local	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Unlikely	Visible subsidence, surface cracks.
Picton Viaduct (SHI 01051) Sandstone construction	State	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Unlikely	subsidence monitoring identifies physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking or spalling².
Argyle Street Underbridge (Hole in the Wall) (I149) Brick construction	Local	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Unlikely	subsidence monitoring identifies physical impacts to the historical heritage values of the bridge, measurable tilt or visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Pedestrian overbridge 86.1 km	Local	Negligible subsidence impacts or environmental consequences. Negligible loss of heritage value.	Very unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking.
Loop Line sandstone culverts	Local and contributory	Negligible subsidence impacts or environmental consequences.	Unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, spalling, block movement or block fall.

² Spalling is a condition of masonry whereby outer layers begin to break off or peel away in parallel layers (Grimmer 1984).

Table 5.1 Historical heritage subsidence performance measures and performance indicators

Historical sites	Significance	Subsidence performance measures	Probability of subsidence impact	Performance indicator triggers
Loop Line brick culverts	Local and contributory	Negligible subsidence impacts or environmental consequences.	Impacts to the culverts at chainage 87.850 km and 87.630 km are possible. Impacts to the other culverts are unlikely.	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Main Southern Railway culverts Brick construction	Local and contributory	Negligible subsidence impacts or environmental consequences.	Impacts to the culvert at chainage 88.331 km is unlikely. Impacts to the other culverts are very unlikely.	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
High retaining wall 84.687 km	Local and contributory	Negligible subsidence impacts or environmental consequences.	Very unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Bridge on Matthews Lane	Local and contributory	Negligible subsidence impacts or environmental consequences.	Very unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Prince Street Overbridge	Local and contributory	Negligible subsidence impacts or environmental consequences.	Very unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.
Connellan Crescent Overbridge	Local and contributory	Negligible subsidence impacts or environmental consequences.	Very unlikely	subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.

5.2 Subsidence monitoring program - overview

A monitoring program will be implemented to confirm if impacts remain within predictions and identify if any mitigation measures are triggered. To establish compliance with the performance measures, a TARP has been developed (Appendix A) outlining subsidence monitoring measures feedback and improvement where monitoring indicates that any performance measures have been exceeded or if exceedance seems likely.

The monitoring program, which was put in place to monitor the impacts and consequences of subsidence effects on known historical heritage sites during the extraction of LW W1-W2, will continue during the extraction of LW W3-W4. Additional historical heritage items within the W3-W4 Study Area will undergo a similar process.

In addition, Picton Viaduct (SHR 01051), while outside the limits of subsidence as assessed by MSEC (2021) which means that subsidence is predicted to be less than 20 mm, is being monitored. Monitoring will continue until approximately 12 months after the completion of longwall mining in the Western Domain (estimated by the end of

2022). Other listed heritage items that are outside the Study Area but considered to be at risk of far field movement and will be or will continue to be monitored include the Argyle Street Underbridge (Hole in the Wall); and the pedestrian overbridge (86 km).

A number of non-registered items on the Main Southern Railway require inspection to assess their potential for heritage significance (Section 5.4.2). Monitoring will be implemented for non-registered and additional historical heritage sites identified prior to or during extraction of LW W3–W4, which are determined to be at risk of subsidence impacts. Assessment and monitoring measures will be developed in consultation with a heritage consultant or archaeologist.

While the extraction of LW W3–W4 may result in impacts on historical sites, these can be managed through early detection via monitoring and early response through the implementation of the TARP (Appendix A).

Each monitoring component is outlined in Table 5.2. The following sections (5.3.1–5.4.2) provide more specific details relevant to each site and a summary is provided in Table 5.3.

Table 5.2 **Description of management measures**

Management measures	Description
Baseline recording	Baseline recording of the culverts will be carried out prior to the commencement of mining in order to assist with ongoing monitoring and assessment of whether impacts from mining have occurred. This will be achieved through survey control points. A final assessment and recording will be completed at the completion of subsidence. The results of the baseline recording will be used for comparisons to determine any impact from mining. To this end, the baseline recording will: • assess the structure’s pre-mining condition; • mitigate the risk of potential impact through more detailed archival recording; and • provide a set of baseline records for the monitoring program.
Photography	Photographs will be taken with the appropriate scale and will include: • the wider context of the site, showing the landscape and setting at long range and medium scales; • details of the structure’s features; and • close up photographs of pre-existing cracks and damage, and their location noted on the plan drawings.
Survey control points	A surveyor will be appointed by Tahmoor Coal to record survey control points on heritage items where needed. The number, type and location of the survey points will provide sufficient points of reference to later monitor the extent and effects of subsidence.
Visual inspection	Heritage items will be inspected prior to extraction of each longwall and as part of end of panel monitoring.

Table 5.3 Monitoring program for historical heritage

Item	Monitoring component	Monitoring		
		Prior to extraction	During extraction	Post mining
Mushroom Tunnel (former Mainline Railway Tunnel) (I144)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Picton Tunnel	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Cottage (weatherboard) (I211)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment. Baseline recording of the site before mining, noting any existing cracks or damage.	Regular monitoring.	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Antill Street Underbridge	Survey control points. Structural assessment. Visual inspection.	Pre-mining condition and structural assessment. Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Rural Landscape, Thirlmere Way	None required	Not required.	Not required.	Not required.
Redbank Uniting Church	Survey control points. Structural assessment. Visual inspection.	Pre-mining condition and structural assessment. Baseline recording of the site before mining, noting any existing cracks or damage.	Regular monitoring.	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Picton Viaduct	Survey control points. Structural assessment. Visual inspection.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Argyle Street Underbridge (Hole in the Wall)	Visual inspection. Survey control points. Structural assessment.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.

Table 5.3 Monitoring program for historical heritage

Item	Monitoring component	Monitoring		
		Prior to extraction	During extraction	Post mining
Pedestrian overbridge (86 km)	Survey control points. Structural assessment. Visual inspection.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection; and • structural assessment.
Loop Line sandstone culverts	Visual inspection. Baseline recording: • photographs. Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a system, which will monitor ground movements on and around the culverts (completed). Reinforcement (in place).	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Loop Line brick culverts	Visual inspection. Baseline recording: • photographs; and Survey control points. Structural assessment of culverts, with particular attention given to 87.850 and 87.630.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a monitoring system, which will monitor ground movements on and around the culverts (completed). Reinforcement of culvert 87.630.	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Main Southern Railway culverts	Visual inspection. Baseline recording: • photographs; and Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage. Install a monitoring system, which will monitor ground movements on and around the culverts.	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Subway 88.133 km	Survey control points. Structural assessment Visual inspection. Baseline recording • photographs	Baseline recording of the site before mining, noting any existing cracks or damage.	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection.
High retaining wall 84.687 km	Structural assessment Visual inspection. Baseline recording • photographs	Baseline recording of the site before mining, noting any existing cracks or damage.	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: • visual inspection.

Table 5.3 Monitoring program for historical heritage

Item	Monitoring component	Monitoring		
		Prior to extraction	During extraction	Post mining
Bridge on Matthews Lane	Survey control points. Structural assessment Visual inspection.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	Conducted at the completion of LW W4: visual inspection.
Prince Street Overbridge	Survey control points. Structural assessment Visual inspection.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	
Connellan Crescent Overbridge	Survey control points. Structural assessment Visual inspection.	Pre-mining condition and structural assessment (completed). Install a monitoring system (completed).	Regular monitoring as per the LW W3-W4 Main Southern Railway Plan (to be prepared by MSEC and Tahmoor Coal).	

5.3 Subsidence monitoring program – known heritage items

5.3.1 Mushroom Tunnel (WLEP I144)

As the Mushroom Tunnel is not in active use as a railway tunnel, reinforcement for operational reasons is not necessary. Regular monitoring during active subsidence should be sufficient and, if subsidence related impacts are observed, remediation measures will be considered according to what is appropriate in order to preserve the heritage values of this item (EMM 2020a), and in consultation with a heritage consultant and Wollondilly Shire Council.

As part of ongoing monitoring, Tahmoor Coal have installed survey marks every 20 m inside the Tunnel on both sides to monitor differential movements along and across the Tunnel. In addition, results from absolute 3D surveys and the Global Navigation Satellite System (GNSS) unit above the Picton Tunnel can be applied to the Mushroom Tunnel.

Detailed technical information will be provided in the Main Southern Railway Management Plan for LW W3-W4.

5.3.2 Picton Tunnel (ARTC S170 register as part of Picton Railway Deviation Works)

Monitoring measures to date have included (MSEC 2021, p.112):

- kinematic envelope study at the portals;
- engineering inspections;
- hazard identification assessment by structural engineer JMA Solutions;

- ground penetrating radar (GPR) was conducted by GHD Geotechnics to detect the volume of voids behind the brick arches during the mining of LW W1. No large overbreak sections were identified;
- detailed mapping of geological structures by SCT (2020). Field observations found no indication of disturbance of the strata immediately surrounding the tunnel; and
- absolute 3D survey of the position above the Tunnel (installed during LW31).

Ongoing monitoring of Picton Tunnel will include:

- continuous, automated GNSS monitoring above the Tunnel (installed during LW31);
- absolute 3D surveys of prisms every 20 m inside the Tunnel with a 7-prism array covering the base, mid-height of concrete wall, spring points and crown (installed prior to commencement of LW W1);
- continuous automated laser distance meters every 20 m across the base and spring point of the Tunnel (installed during the mining of LW W1);
- vertical inclinometer borehole to the side of the Tunnel (installed prior to the commencement of LW W2); and
- dilapidation inspection of Picton Tunnel (completed).

5.3.3 Weatherboard Cottage (WLEP I211)

The Weatherboard Cottage has local heritage significance. It will need to be inspected and assessed prior to the commencement of mining of LW W3.

Impacts to the Weatherboard Cottage are likely to be limited to the external cladding or internal finishes, rather than to the structural integrity of the building.

Monitoring of the Weatherboard Cottage should include an assessment by a structural engineer, the installation of survey control points and baseline recording by a heritage consultant.

A management plan for the Weatherboard Cottage will be prepared and submitted to Wollondilly Council for approval.

5.3.4 Redbank Uniting Church (WLEP I146)

Redbank Uniting Church has local heritage significance. It will need to be inspected and assessed prior to the commencement of mining of LW W3.

Impacts to Redbank Uniting Church are likely to be limited to the external cladding or internal finishes, rather than to the structural integrity of the building.

Monitoring of the Redbank Uniting Church should include an assessment by a structural engineer, the installation of survey control points and baseline recording by a heritage consultant.

5.3.5 Rural Landscape, Thirlmere Way (Department of Health S170 register)

The rural landscape – Thirlmere Way was assessed by Niche (2014) and, as subsidence impacts were deemed unlikely, no management measures were recommended during the mining of LW 31–32. Similarly, the risk of impact from the extraction of LW W1-W2 is deemed to be negligible to the heritage value of this rural landscape. Therefore, no monitoring is required.

5.3.6 Picton Antill Street Underbridge (ARTC SW170 register)

Tahmoor Coal has monitored movements at the Antill Street Underbridge since the extraction of LW 31. Results of monitoring to date indicate that the Underbridge has not experienced any measurable changes in horizontal distances between the abutments during the mining of LW W1 and no impacts have been observed to date.

Ongoing monitoring measures to date include (MSEC 2021 p.123):

- engineering inspections by structural engineer JMA Solutions and ARTC appointed structural engineers;
- dilapidation inspection of the bridge;
- geotechnical investigations near the Sydney abutment on the Up side during the mining of LW W1, which verified the level and extent of concrete backing above the brick arch;
- targeted structural analyses of the arch by structural engineer JMA Solutions;
- absolute 3D survey of the position of the bridge; and
- local 3D surveys of survey marks at the base and top of the abutment walls across the arch, and at the ends of the wingwalls.

Detailed technical information will be provided in the Main Southern Railway Management Plan for LW W3-W4.

5.3.7 Picton Viaduct (SHR 01051)

Tahmoor Coal has monitored movements at the Picton Viaduct since the extraction of LW 31. Results of monitoring to date indicate that the Viaduct has not experienced any measurable differential vertical movements.

In summary, monitoring has been informed by historical design drawings, previous geotechnical investigations commissioned by ARTC, inspections by structural engineer JMA Solutions and ARTC appointed structural engineers, detailed mapping of geological structures by SCT (2020) and numerical analysis of potential impact probabilities.

Ongoing monitoring measures to date include (MSEC 2021 p.118):

- absolute 3D survey of the position of each end of the Viaduct (installed during LW31);
- continuous, automated GNSS monitoring at each end of the Viaduct (installed during LW31);
- local 3D surveys of prisms mounted at the base of the intermediate piers and abutments and along the tops of the arches below the low height parapet walls (installed during LW31 and LW W1);
- local 3D surveys of ground survey pegs along a monitoring line that is located upstream of the Viaduct (installed prior to LW W1);

- 2D horizontal distance surveys between two marks that are located across the tops of the valley sides on the downstream side of the Viaduct (installed prior to LW W1); and
- dilapidation inspection of Picton Viaduct (completed).

In addition, approval has been granted by Heritage NSW to conduct three vertical investigation boreholes in the ground adjacent to the Viaduct (within the SHR curtilage) and to install laser distometers to monitor changes in spans along the Viaduct (see EMM 2020b). Once inclinometer casings have been installed in the boreholes, this structure will be monitored on a regular (monthly) basis during the mining of LW W2-W4.

Measures to control risks to the Picton Viaduct will be continuously reviewed during the extraction of LW W2 to LW W4 and the mine plan amended if required in the event that unexpected adverse changes are observed, and it is considered that it is no longer feasible to manage potential hazards to the Viaduct at the planned offset distances from it (MSEC 2021). Detailed technical information will be provided in the Main Southern Railway Management Plan for LW W3-W4.

Should any movement with adverse implication occur, works covered under Standard Exemption 19 (safety and security) do not require approval under subsection 57(1) of the *Heritage Act 1977* (Heritage NSW 2020b). The specified activities/works are to be undertaken in accordance with each of the relevant standards prescribed below.

Specified activities/works:

- The erection of temporary security fencing, scaffolding, hoardings or surveillance systems to prevent unauthorised access, or to secure public safety.
- Emergency stabilisation activities/works necessary to secure safety where a structure or landscape feature (such as a tree) has been irreparably damaged or destabilised and poses a safety risk to its users or the public.

Relevant standards:

- Installation and operation of any temporary equipment specified in a) and b) above must not impact on significant fabric (including landscape or archaeological features) and the item's overall heritage significance.
- Any temporary security fencing, scaffolding, hoardings or surveillance systems must not be erected for more than 180 calendar days (inclusive of setup and pack down).
- No further temporary fencing, scaffolding, hoardings or surveillance may be erected again on the site, under this exemption within a period of 365 calendar days.
- Activities/work must not permanently change or alter the structure such as the configuration of the floor space, or any architectural or landscape features.
- Any new penetrations must be:
 - limited in number; and
 - made through non-significant fabric or mortar joints only.
- Activities/work must not result in an increase in the floor space of any building or structure.

5.3.8 Picton Argyle Street Underbridge (Hole in the Wall) (ARTC S170 register and WLEP I149)

Tahmoor Coal has monitored movements at Argyle Street Underbridge since the extraction of LW 31. Results of monitoring to date indicate that the Underbridge has not experienced any measurable changes in horizontal distances between the abutments during the mining of LW W1 and no impacts have been observed to date.

Ongoing monitoring measures include (MSEC 2021 p.123):

- engineering inspections by structural engineer JMA Solutions and ARTC appointed structural engineers;
- dilapidation inspection of the bridge (completed);
- targeted structural analyses of the arch by structural engineer JMA Solutions;
- absolute 3D survey of the position of the bridge; and
- local 3D surveys of survey marks at the base and top of the abutment walls across the arch, and at the ends of the wingwalls.

In addition, laser distometers will be +installed across the base of the arch.

Detailed technical information will be provided in the Main Southern Railway Management Plan for LW W3-W4.

5.3.9 Pedestrian overbridge 86.1 km (ARTC S170 register)

Tahmoor Coal has been monitoring differential movements at the pedestrian overbridge since the extraction of LW W1 and will continue to monitor this structure under the Main Southern Railway Management Plan. To date, no impacts have been observed to the bridge.

5.4 Subsidence monitoring program – items not listed

5.4.1 Loop Line culverts

In their impact assessment for LW W1-W2, MSEC (2019) advised that that potential impacts on the Loop Line culverts could be managed during the extraction of the longwalls with an appropriate management plan in place, even if actual subsidence movements were to be greater than the predictions provided by MSEC, or if substantial non-conventional movements occurred (MSEC 2019; p85-6). To date, no impacts from longwall mining in the Western Domain have been observed.

Tahmoor Mine Extraction Plan Longwall West 1 – West 2 Historical Heritage Technical Report (HHTR) (EMM 2019), which informs the LW W1-W2 Heritage Management Plan, was put in place to monitor the impacts and consequences of subsidence effects on known historical heritage sites during the extraction of LW W1-W2. In accordance with the HHTR, the following monitoring has been undertaken:

- The condition of the relevant historical heritage sites was assessed and recorded prior to the extraction of LW W1 (baseline recording and baseline check).
- Survey control points have been installed on each of the Loop Line culverts to provide sufficient points of reference for monitoring the extent and effects of subsidence.
- Continuous weekly monitoring has been undertaken by Mark Delaney, principal engineering geologist at Newcastle Geotech, who has recorded no subsidence impacts to the culverts to date.

- After completion of LW W1 panel extraction, monitoring for movement of the five historical brick and sandstone culverts within the LW W1-W2 Study Area was undertaken by EMM archaeologist Ryan Desic over two days on 23 and 24 November 2020. This was in accordance with the requirements of the LW W1-W2 Heritage Management Plan (Tahmoor Coal 2019). No subsidence related impacts were observed at any of the inspected heritage sites as part of the monitoring program.

MSEC (2021) has assessed that the extraction of LW W3–W4 may result in impacts on the culverts, but that the potential risk to track safety can be managed through early detection via monitoring and early response through the implementation of triggered response plans.

During extraction of LW W3–W4, the following monitoring measures will be implemented (MSEC 2021 P.132):

- assessment of the culverts prior to extraction of LW W3-W4;
- check and maintain the RCP within the culverts at 87.850 km, 88.400 km and 88.980 km;
- install a monitoring system, which includes monitoring of ground movements on and around culvert 87.630, and track geometry above the culvert;
- regularly review and assess the monitoring data;
- continue to conduct regular visual inspections of the culverts; and
- repair culvert 87.630 if required.

5.4.2 Items that require heritage inspection

A number of non-registered items on the Main Southern Railway require inspection to assess their heritage significance. This report should be updated with the results of the inspection. In addition, the section of the Main Southern Railway that is within the Study Area should be subject to inspection to ensure that all items of potential heritage significance have been identified and assessed.

The known items within the Study Area that require heritage inspection are:

- Main Southern Railway culverts - three culverts within the Study Area four adjacent to the Study Area along the eastern boundary.

Items on the Main Southern Railway associated with the 1919 deviation works that are outside the Study Area, but which may be susceptible to far field movement and require heritage inspection are:

- Main Southern Railway culverts - four culverts adjacent to the Study Area;
- Subway (88.133 km) adjacent to the study area;
- High retaining wall (84.687 km), outside the study area but may be susceptible to far field horizontal movements;
- Bridge on Matthews Lane (84.55.1 km), outside the study area but may be susceptible to far field horizontal movements;
- Connellan Crescent Overbridge (89.080 km); and
- Prince Street Overbridge (85.17 km).

Engineering inspections by structural engineer JMA Solutions have been carried out at the Matthews Lane, Prince Street and Connellan Crescent Overbridges, and Tahmoor Coal has been monitoring movements of the bridges with survey pegs since the extraction of LW W1. To date, no impacts on the bridges have been observed during the mining of LW W1-W2.

Baseline recording of the items that are assessed as having historical significance will be carried out prior to the commencement of LW W3 mining in order to assist with ongoing monitoring and assessment of whether impacts from mining have occurred. A final assessment and recording will be conducted at the completion of mining.

The results of the baseline recording will be used for comparisons to determine any impact from mining.

Photographs will be taken with the appropriate scale and will include:

- the wider context of the site, showing the landscape and setting at long range and medium scales;
- details of the structure's features; and
- close up photographs of pre-existing cracks and damage, and their location noted on the plan drawings.

It is likely that the culverts will need to be cleared of vegetation and debris prior to mining, and weeds removed carefully where roots are growing out of the structure.

6 Subsidence management strategies

6.1 Trigger Action Response Plan

A TARP has been developed using the performance indicators for management of historical heritage items (Appendix A). The TARP applies only to the Extraction Plan Study Area for LW W3–W4. The purpose of the TARP is to provide:

- appropriate triggers to warn of increased risk of exceedance of any performance measures;
- specific actions to respond to high-risk exceedance of any performance measure to ensure that the measure is not exceeded;
- an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and
- where monitoring indicates that there has been an exceedance of any performance measure, or where any such exceedance appears likely.

The TARP (Appendix A) provides a description of performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to sites of historical heritage and considers the management or remediation of any impacts and/or environmental consequences relating to historical heritage sites.

The TARP outlines the assigned level of risk for each performance indicator:

- Level 1: Normal;
- Level 2: Within Prediction; and
- Level 3: Exceeds Prediction.

Where performance indicators trigger a level of risk (Levels 1 to 3 with escalating corresponding risk), a response, or a contingency plan that outlines subsidence monitoring measures feedback and improvement for each level of risk, is required as outlined in the TARP.

In the event of any exceedance of performance indicators, Tahmoor Coal will, at the earliest opportunity:

- investigate to determine if the nature of the exceedance (mining or non-mining factors);
- consider all reasonable and feasible options for remediation;
- submit a report to the relevant Government authority describing those options and any preferred remediation measures or other course of action; and
- implement remediation measures.

6.2 Subsidence monitoring measures feedback and improvement

Monitoring measures to control the risk of impacts to all heritage items will be continuously reviewed during the extraction of LW W3- W4. As each longwall progresses, it will be possible to introduce additional controls if required in the event that unexpected adverse changes are observed.

6.3 Remediation measures

If an impact to a historical heritage item occurs, the type of remediation that is undertaken will be dependent on:

- the nature of the damage;
- the scale of the damage;
- the impact on the historical heritage values of the site; and
- expert advice regarding practical and historically sympathetic remediation measures.

Therefore, remediation measures, if needed, will be assessed on a case-by-case basis in the light of these considerations in order to ensure that performance measures are met and that there are no negative outcomes to historical heritage values.

Mitigation measures should follow best practice principles of heritage management. Any mitigation measures should be visually inconspicuous and preserve the appearance of the heritage item in its setting. Any attachments to the fabric of the structure should be designed to be reversible and to do no harm to the fabric of the heritage item.

Table 6.1 outlines specific remediation measures for the registered heritage items.

Table 6.1 Specific remediation

Item	Measures
Listed heritage Items	
Picton Tunnel	The implementation of planned responses, if triggered by monitoring results at Picton Tunnel may include: • detailed inspections by structural engineer; • repair of cracked brickwork and/or spalled concrete; and/or • mesh installed to the underside of the arch to prevent spalled brickwork falling onto the track. Mitigation measures to Picton Tunnel should follow best practice principles of heritage management. Any mitigation measures should be visually inconspicuous from the outside and preserve the appearance of the heritage item in its setting. Any attachments to the fabric of the tunnel should be designed to be reversible and to do no harm to the fabric of the tunnel (EMM 2020a). It is possible that some face brickwork at the portals may be cracked and if so, the brickwork and mortar can be strengthened without adversely impacting the fabric of the tunnel portals.
Mushroom Tunnel	If steel bar reinforcement is required in order to provide structural support to the tunnel, fixtures and holes should be made into the mortar joints and not into sandstone. Mitigation measures should follow best practice principles of heritage management. Any mitigation measures and/or remediation should be visually inconspicuous from the outside and preserve the appearance of the heritage item in its setting. Any attachments to the fabric of the tunnel should be designed to be reversible and to do no harm to the fabric of the tunnel (EMM 2020a).
Picton Viaduct	Picton Viaduct is a State significant heritage item. As stated by Heritage NSW (2020) the “material threshold is triggered by the degree of impact to significance [to the State heritage significance of an SHR listed place]” (Heritage NSW 2020) (See Section 4.2.7). MSEC predict that impacts to the Picton Viaduct are <i>very unlikely</i>. Therefore, minor adverse impacts to State heritage significance are anticipated. This level of impact is below the material threshold. Remediation, if required, should be in line with ARTC requirements for maintenance and safety and in accordance with Section 118 of the Heritage Act (Appendix B.4.1) and Standard Exemption 19 (see Section 5.3.7).

Table 6.1 Specific remediation

Item	Measures
	As such, if the TARP is triggered by monitoring results, the following responses will be undertaken: • report these changes to the heritage consultant; • detailed inspections by a structural engineer; • repair cracked stonework in consultation with a heritage consultant; and • if required by structural engineer, provide additional support to the arch and parapet walls in consultation with a heritage consultant.
Weatherboard Cottage	If impacts occur to the Weatherboard Cottage, the structure will be repaired in accordance with the <i>Coal Mine Subsidence Compensation Act 2017</i> (MSEC 2021 p.165).
Redbank Uniting Church	If impacts occur to Redbank Uniting Church, the structure will be repaired in accordance with the <i>Coal Mine Subsidence Compensation Act 2017</i> (MSEC 2021 p.205).
Rural Landscape – Thirlmere Way	None needed
Antill Street Underbridge	The implementation of planned responses, if triggered by monitoring results at Antill Street Underbridge may include: • detailed inspections by structural engineer; • repair of cracked brickwork and/or spalled concrete; • additional support to the arch, spandrel walls and/or wingwalls; • mesh installed to the underside of the arch to prevent spalled brickwork falling onto the road; and/or Any attachments to the fabric of the tunnel should be designed to be reversable and to do no harm to the fabric of the bridge.
Hole in the Wall (Argyle Street Underbridge)	The implementation of planned responses, if triggered by monitoring results at Argyle Street Underbridge may include: • detailed inspections by structural engineer; • repair of cracked brickwork and spalled concrete; • provide additional support to the arch, spandrel walls and/or wingwalls; • mesh installed to the underside of the arch to prevent spalled brickwork falling onto the road; and/or • install laser distancemeters across the base of the arch as recommended by structural engineer. Any attachments to the fabric of the tunnel should be designed to be reversable and to do no harm to the fabric of the bridge.
Pedestrian overbridge	The implementation of planned responses, if triggered by monitoring results at the pedestrian overbridge may include: • detailed inspections by a structural engineer; and/or • repair cracks to approach slabs, relevee decs, saw cut additional gaps between the bridge decs and approach slabs, adjust handrails.
Non- listed items	
Loop Line culverts	Management strategies for the culverts were put in place to maintain their integrity during active subsidence during the extraction of LW W1-W2. This involved the installation of a reinforced concrete pipe (RCP) within the culvert opening of culverts 87.850, 88.400 and 88.980 (Plate 3.5, Plate 3.6). The RCPs should all but fill the culvert, with a gap sufficient to allow some movement without cracking either the culvert or the pipe. The purpose of this approach is to minimise harm, should there be any block movement or collapse when a train passes overhead or as a result of subsidence from underground mining, the culvert would be somewhat supported. From a safety point of view, reinforcement is necessary. From a heritage point of view, this method of reinforcement offers a reversible solution that would result in minimal harm to the fabric of the culverts.

Table 6.1 **Specific remediation**

Item	Measures
	If cracking or spalling does occur, repairs should be carried out in consultation with a heritage specialist.
Main Southern Railway culverts	Mitigation measures are unlikely to be required on account of the large offset distance from the proposed longwalls (MSEC 2021 p.123). If cracking or spalling does occur, repairs should be carried out in consultation with a heritage specialist.
Pedestrian subway (88.133 km)	Mitigation measures are unlikely to be required on account of the large offset distance from the proposed longwalls (MSEC 2021 p.123). If cracking or spalling does occur, repairs should be carried out in consultation with a heritage specialist.
High retaining wall 84.687 km	Mitigation measures are unlikely to be required on account of the large offset distance from the proposed longwalls (MSEC 2021 p.123). If cracking or spalling does occur, repairs should be carried out in consultation with a heritage specialist.
Bridge on Matthews Lane	The implementation of planned responses, if triggered by monitoring results at Argyle Street Underbridge may include: • detailed inspections by structural engineer; • re-level bridge deck if required by structural. • repair damage to timber and/or connections; and/or • apply a load limit or temporarily vehicle traffic over the bridge (in accordance with a traffic management plan).
Prince Street Overbridge	The implementation of planned responses, if triggered by monitoring results at Argyle Street Underbridge may include: • detailed inspections by structural engineer; • adjust brick bearings and handrails; and/or • repair damage to bridge.
Connellan Crescent Overbridge	The implementation of planned responses, if triggered by monitoring results at Argyle Street Underbridge may include: • detailed inspections by structural engineer; • adjust brick bearings and handrails; and/or • repair damage to bridge.

6.4 Unexpected finds procedures

Additional historical heritage assessments are not recommended at this point as impacts are not anticipated to historical heritage items in the vicinity. Due to the nature of the extraction activities, it is unlikely relics will be uncovered however, if they are, the following steps will be taken:

- no further harm to the object;
- immediately cease all work at the particular location;
- secure the area so as to avoid further harm to the relic; and
- contact an archaeologist for further information and advice.

6.4.1 Discovery of human skeletal remains

In the event that known or suspected human skeletal remains are encountered within the Study Area, the following procedure must be followed:

- the immediate vicinity will be secured to protect the find and the find will be immediately reported to the work supervisor who will immediately advise the site supervisor or other nominated senior staff member;
- the environmental manager or other nominated senior staff member will notify the police and the state coroner on the same day of the find (as required for all human remains discoveries);
- the environmental manager or other nominated senior staff member will contact Heritage NSW for advice on identification of the skeletal material as Aboriginal and if so, management of the material;
- if it is determined that the skeletal material is ancestral Aboriginal remains, the Aboriginal community will be contacted, and consultative arrangements will be made to discuss ongoing care of the remains;
- the site will be recorded in accordance with the NPW Act and Heritage NSW guidelines;
- if the remains are historical and not of Aboriginal origin, Heritage NSW will be notified for further instruction; and
- works will not recommence until written approval is received.

7 Review and improvement

7.1 Overview

This section of the HHTR describes the key elements of implementation, including reporting requirements, reviews and key responsibilities specifically relevant to this Historical Heritage Technical Report.

Further details of the general reporting and review requirements, and key responsibilities are provided in Section 6 of the Extraction Plan main document.

7.1.1 Reporting requirements

In accordance with DA 67/98 Condition 48 or as triggered by the TARP (including those not on a statutory list but included in this report), where performance measures are exceeded and harm to historical heritage is threatened or caused, a letter report will be issued within one week of an awareness of the event, notifying DPIE, Wollondilly Shire Council, Heritage NSW and any other relevant agencies.

The detailed report that will be provided to DPIE will be sent within seven days of awareness of the event including details of the actions being undertaken to prevent recurrence.

7.2 Review and auditing

New historical heritage sites identified during extraction of LW W3–W4, which are determined to be at risk of subsidence impact, will require monitoring. Assessment and monitoring measures will be developed in consultation with a heritage consultant or archaeologist and this HHTR updated accordingly.

Where new historical heritage sites are discovered, they must be added to the inventory in this HHTR within one month of the find, including an assessment of potential impacts from subsidence.

Any changes made to this HHTR will be made in consultation with DPIE, and a copy of the revised management plan will be supplied to DPIE for approval.

Abbreviations

Abbreviation

CHL	Commonwealth Heritage List
DCP	Development control plan
DoP	Department of Planning
DPE	Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
Heritage NSW	Heritage NSW of the Office of Premier and Cabinet
HHTR	Historical Heritage Technical Report
LEP	Local Environment Plan
LW	longwalls
MSEC	Mining Subsidence Engineering Consultants
Niche	Niche Environment and Heritage
NHL	National Heritage List
NPW Act	National Parks and Wildlife Act 1974
OEH	Office of Environment and Heritage
SHR	State Heritage Register
SIMEC	SIMEC Mining Division
SMP	Subsidence Management Plan
TCCO	Tahmoor Coking Coal Operations
TARP	Trigger Action Response Plan
WLEP	Wollondilly Local Environment Plan
WSC	Wollondilly Shire Council

Glossary

Term	Definition
35-degree angle of draw	Used to define the limits of the subsidence trough. It is the angle between two lines drawn from the edge of the mine workings, one a vertical line and the other a line to the limit of vertical displacement.
20 mm subsidence contour	A limiting value for vertical displacement which is attributable to mining
Closure	The reduction in the horizontal distance between the valley sides. The magnitude of closure, which is typically expressed in the units of millimetres (mm), is the greatest reduction in distance between any two points on the opposing valley sides.
Curvature	The rate of change of tilt and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections.
Far field movements	The measured horizontal movements at pegs that are located beyond the longwall panel edges and over solid unmined coal areas.
Riparian zone	Area of land adjacent to a river or stream
Strain	Determined by calculating the horizontal change in length of a section of subsidence profile and dividing this by the initial horizontal length of the section. It includes both tensile strains over the sides of the panel and compressive strains towards the bottom of the subsidence trough.
Study Area	Surface area enclosed by a 35-degree angle of draw from the limit of the proposed longwall mining extension (LW W3–W4) and by the predicted 20 mm subsidence contour resulting from the extraction of the proposed longwalls (MSEC, 2019 in draft). The Study Area is shown in Figure 1.1
Subsidence	Deformation of the ground mass surrounding a mine due to the mining activity, including all mining-induced ground movements, vertical and horizontal displacement, tilt, strain and curvature.
Tilt	Calculated as the change in subsidence between two points divided by the distance between those points. The maximum tilt occurs at the point of inflection in the subsidence trough where the subsidence is roughly equal to one half of the predicted maximum subsidence.
Upsidence	Mining-induced relative upward vertical displacement of the ground surface or subsurface strata, generally observable at the bottom of valleys.

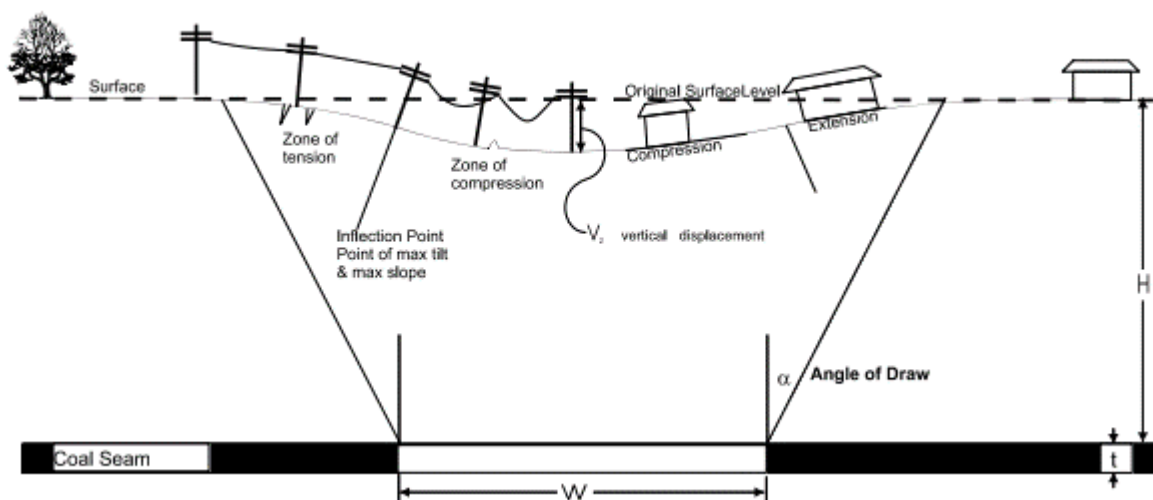


Plate 7.1 Angle of draw and surface subsidence in flat topography (NSW DoP 2008 p.48)

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- 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*, draft report for SIMEC Mining.

Niche Environment and Heritage (Niche) 2014 *Tahmoor North Longwalls 31 to 37: Aboriginal and European Heritage Assessment* report for Tahmoor Coal.

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Wollondilly Local Environment Plan (WLEP) 2011 <https://www.legislation.nsw.gov.au/#/view/EPI/2011/85>



Appendix A

Trigger Action Response Plan



Table A.1 **Trigger Action Response Plan**

Feature	Management		
	Trigger	Action	Response
Historical heritage	Level 1		
	Historical heritage site monitoring indicates no detectable environmental consequences	Continue monitoring as per monitoring program.	No response required.
	Level 2		
	Historical heritage site monitoring indicates potential detectable environmental consequences but with negligible impacts to heritage sites.	Continue monitoring as per monitoring program.	No response required
	Level 3		
	Historical heritage site monitoring indicates environmental consequences to heritage site(s).	- Continue monitoring program as per monitoring program. - Convene Tahmoor Coal Environmental Response Group to review response. - Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect. - Investigate exceedance of subsidence prediction. - Review mine design/predictions against mine criteria. - Review monitoring program and modify if necessary.	- Notify DPIE and Heritage NSW within one week of awareness of the event. - Investigate and implement any additional management measures (Section 6) as required in consultation with Heritage NSW and DPIE.



Appendix B

Relevant heritage legislation



B.1 Legislation

In NSW, heritage items and relics, that is archaeological sites assessed to be of local or State significance, are protected by two main pieces of legislation: the EP&A Act and the NSW *Heritage Act 1977*. An additional layer of protection is added, in certain circumstances, by the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

B.2 Environmental Planning and Assessment Act 1979

The EP&A Act establishes the framework for formally assessing cultural heritage values as part of the development application process. The EP&A Act requires that environmental impacts be considered before development and that appropriate measures to avoid, mitigate or ameliorate impacts are developed; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits.

Under the EP&A Act local governments are directed to prepare planning instruments, such as LEPs and Development Control Plans (DCPs). These documents provide guidance on the level of environmental assessment and the acceptable level of change in their jurisdiction. This includes identification of heritage items, as listed on the heritage schedules of an LEP. Where a project is being assessed as SSD, approval by the relevant council is not required but the items require assessment and management if they are affected by a proposal.

B.3 Wollondilly Local Environmental Plan 2011

Part 5, Section 5.10 of the Wollondilly Local Environment Plan (WLEP 2011) addresses the conservation of heritage significance within the LGA. The objectives of the LEP in relation to heritage are:

- a) to conserve the environmental heritage of Wollondilly;
- b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views;
- c) to conserve archaeological sites; and
- d) to conserve Aboriginal objects and Aboriginal places of heritage significance.

To achieve these objectives, development consent is required to demolish, move, alter, disturb or excavate a heritage item, an Aboriginal object or a building, work, relic or tree within a heritage conservation area. Schedule 5 of the LEP provides a list of heritage items, conservation areas and archaeological sites within the LGA.

B.4 Heritage Act 1977

The Heritage Act is keystone State legislation that protects and manages items of environmental heritage that are listed on the State Heritage Register (SHR) and/or are assessed as 'relics'.

Items listed on the SHR are given automatic protection, under the Heritage Act, against any activities that may damage an item or affect heritage significance.

Section 170 of the Heritage Act establishes the *Heritage and Conservation Register* that government agencies must keep that includes all items of environmental heritage that have been identified by the agency, or that are listed on the SHR, an environmental planning instrument, or which may be subject to an interim heritage order that are owned, occupied or managed by that government body. These registers provide a list of known heritage items to be considered during this assessment.

Part 6 of the Heritage Act provides protection for 'relics', regardless of their listing status. It applies to all land in NSW that is not included in the SHR. Section 4(1) of the Heritage Act (as amended 2009) defines a 'relic' as follows:

A "relic" means any deposit, artefact, object or material evidence that:

- a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
- b) is of State or local heritage significance.

Section 139(1) of the Heritage Act states that:

A person must not disturb or excavate any land knowingly or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit.

Approval under the Heritage Act is not applicable for projects assessed as SSD under the SRD SEPP, in accordance with Division 4.7, section 4.41(1)(c) of the EP&A Act.

However, where unanticipated relics are discovered, notification to the Heritage Council is regulated under Section 146 of the Heritage Act.

Section 146 Notification of discovery of relic:

A person who is aware or believes that he or she has discovered or located a relic (in any circumstances, and whether or not the person has been issued with a permit) must:

- c) *within a reasonable time after he or she first becomes aware or believes that he or she has discovered or located that relic, notify the Heritage Council of the location of the relic, unless he or she believes on reasonable grounds that the Heritage Council is aware of the location of the relic, and*
- d) *within the period required by the Heritage Council, furnish the Heritage Council with such information concerning the relic as the Heritage Council may reasonably require.*

The Heritage Act identifies the category of 'works', which refers to historical infrastructure, and is viewed as separate to that of archaeological 'relics' under the Heritage Act. 'Works' may be buried, and are therefore archaeological in nature, but exposing a 'work' does not trigger reporting obligations under the Heritage Act unless it is of demonstrable significance

B.4.1 Heritage Act 1977 – Section 118

Section 118 of the Heritage Act (1977) allows for a minimum standard of maintenance and repair within the following conditions:

1. The regulations may impose minimum standards with respect to the maintenance and repair of a work (other than a ruin) or a relic that is listed or within a precinct that is listed on the State Heritage Register, but those standards can only relate to the following matters:
 - a) the protection of the building, work or relic from damage or deterioration due to weather (including such matters as the weatherproofing of roof, doors and windows);
 - b) the prevention of and the protection of the building, work or relic from damage or destruction by fire;
 - c) security (including fencing and surveillance measures to prevent vandalism); and/or

- d) essential maintenance and repair (being maintenance and repair necessary to prevent serious or irreparable damage or deterioration).
- 2. The regulations may make provision for or with respect to minimum standards that may be listed on the State Heritage Register for the maintenance of a ruin or a moveable object that is listed on that Register, but those standards can only relate to the following matters:
 - a) the protection of the ruin or moveable object from damage or destruction by fire;
 - b) security (including fencing and surveillance measures to prevent vandalism);
 - c) essential maintenance of a moveable object (being maintenance necessary to prevent serious or irreparable damage or deterioration).
- 3. Without limiting subsection (2), the regulations referred to in that subsection may make provision for or with respect to:
 - a) the means by which the minimum standards may be listed, amended or revoked, and
 - b) the enforcement of the minimum standards (including by extending the operation of sections 119, 120 and 121 and associated provisions, with any necessary modification, to the minimum standards).
- 4. In this section "ruin" means a building or work that is listed, and identified as a ruin, on the State Heritage Register.



Appendix C

Previous assessments of the Study Area



C.1 Heritage assessment (Niche 2014)

Niche Environment and Heritage (Niche) completed an Aboriginal and European Heritage Assessment for a previous mine plan and study area for longwalls in the Western Domain, which included the current Study Area for LW W3–W4 (Niche 2014).

In addition to the historical sites listed on the heritage registers, Niche identified a sandstone culvert associated with the historic Picton Mittagong Loop Line (chainage 88.980 km) as part of their European Heritage Assessment (Niche 2014).

C.2 Historical heritage technical report: LW W1-W2 (EMM 2019)

EMM prepared a historical heritage technical report to support an Extraction Plan for the secondary extraction of coal from LW W1-W2 and which outlined management measures (EMM 2020).

The report identified four listed heritage sites with local significance located partially within the LW W1-W2 Study Area: the Queen Victoria Memorial Hospital (QVMH); Mill Hill Millers House and archaeological relics; Harmony House archaeological site, which are located outside the Study Area for LW W3–W4; and Thirlmere Way rural landscape which is located partly within the Study Area. Impacts to the listed heritage sites were assessed as *unlikely to very unlikely*.

As part of the assessment, EMM conducted a survey of the LW W1–W4 Study Area in March 2019. The focus of the site visit was inspection of the Loop Line directly above the northern ends of LW W1–W2 as the listed heritage items within the Study Area had been previously inspected (Niche 2014). EMM inspected the Loop Line on 29 March 2019 accompanied by a representative of Heritage Rail.

During the inspection, a series of culverts associated with the historic Picton Mittagong Loop were identified (Figure 3.1). Details of each culvert were recorded with digital tablets using site recording forms created by EMM on the Survey123 application for ArcGIS (Esri© software). Where access permitted, both sides of each culvert were inspected, and additional photographs were taken of the culverts with a scale rod, as well as close-up photographs of existing damage to the structures. Weeds and overgrown vegetation prevented a full inspection of some of the culverts.

Of relevance to this report are two sandstone and four brick culverts within the Study Area for LW W3–W4. These structures are not heritage listed but have local significance on an individual and collective basis. The probability of subsidence impacts to most of the culverts was predicted by MSEC (2019) as *unlikely*, with the exception of culvert 88.400 which is directly above LW W1. Impacts to this culvert were predicted to be *possible* (MSEC 2019).

Results of the ongoing program to monitor the subsidence impacts and environmental consequences of subsidence effects during extraction of LW W1 (completed) and LW W2 (ongoing) on known heritage sites within the Study Area are outlined in Section 5.

C.3 Historical heritage assessment: Mod 5 (EMM 2020a)

EMM prepared a historical heritage assessment (HHA) to assist the preparation of the DA 67/98 Mod 5 Application that was required when mine plan updates resulted in an expansion of the 20 mm total subsidence contour for LW W1-W4 and increased the subsidence area that intersects with the rail corridor.

There are two listed historical heritage sites located within the Mod 5 study area: The Mushroom Tunnel (WLEP I144) and Picton Railway Deviation Works (incorporating the Picton Tunnel) (ARTC s170). Three unlisted heritage items (brick culverts) that are located in the vicinity of the study area were also considered in the assessment. These items are all within the current study area for LW W3–W4.

C.4 Statement of Heritage Impact: Picton Railway Viaduct over Stonequarry Creek (EMM 2020b)

EMM prepared a letter report assessing the potential impacts of proposed monitoring works by Tahmoor Coal to the Picton Railway Viaduct over Stonequarry Creek (Picton Viaduct), to accompany an exemption notification for standard exemption 7, to the Heritage Council. Picton Viaduct is listed on the State Heritage Register (SHR) as an item of State significance (SHR 01051).

While Picton Viaduct is outside the limits of subsidence and mining related impacts are not anticipated, it is a requirement, as per the *Main Southern Railway Management Plan* (MSEC 2019), that controls be put in place to monitor inadvertent impacts from subsidence due to longwall mining. The report assessed the proposed monitoring measures including the installation of distometers and geotechnical works.

The report concluded that as the proposed monitoring works inside the curtilage of Picton Viaduct (SHR 01051) are minor in nature and will have little or no adverse impact on the item's heritage significance, an exemption notification would be required under subsection 57(1) of the Act.

On 31 July 2021, an exemption under section 57(2) of the *Heritage Act 1977* was granted. Exemption was endorsed on the basis that all fixtures and holes would be made into the mortar joints and not into sandstone.



Appendix D

Historical context



D.1 Picton

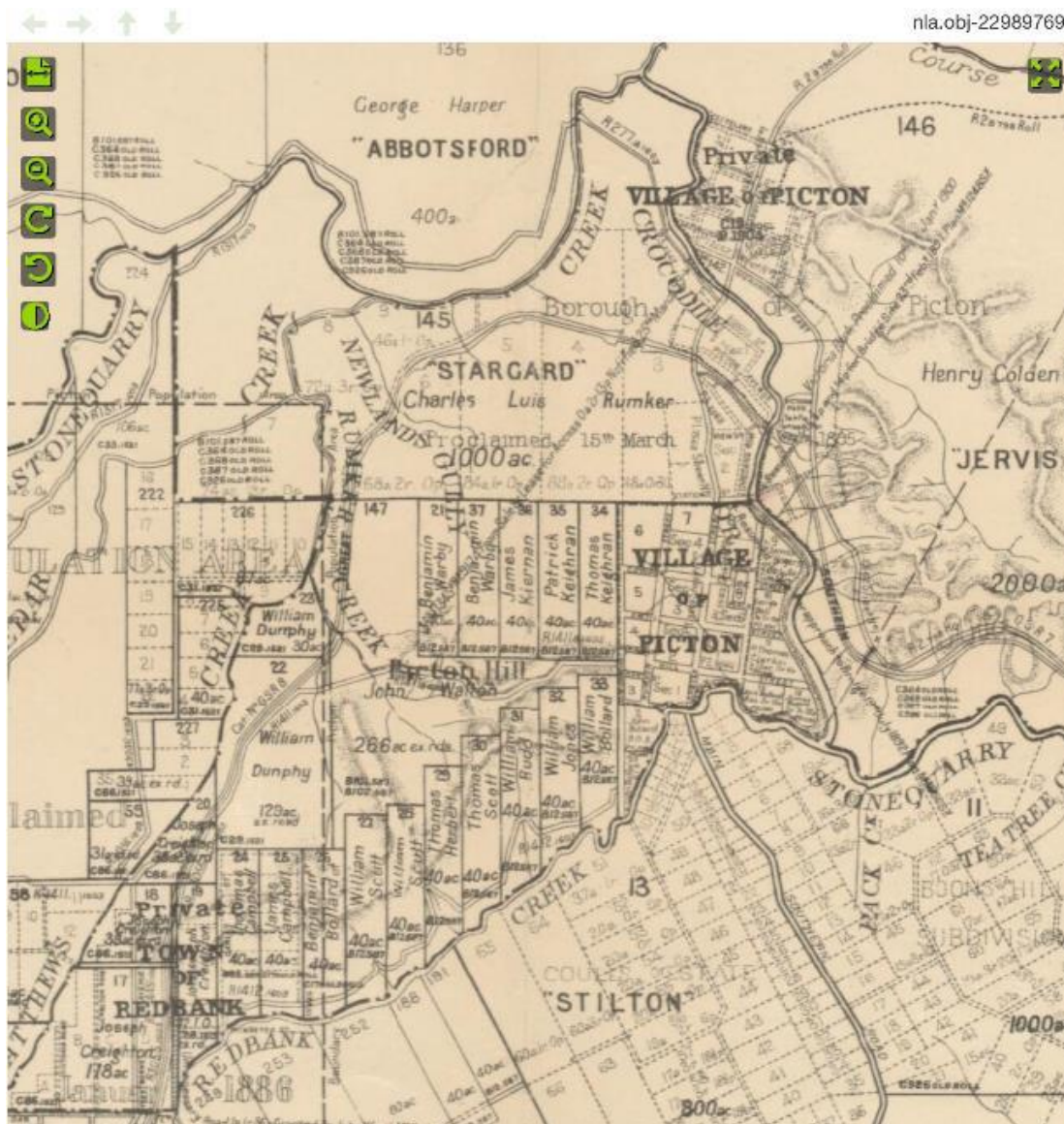
The Picton area was surveyed into small land grants in 1821. The Great South Road between Sydney and the Southern Highlands opened the area to settlers, and the arrival of the railway in the 1860s led to a boom in the local economy. Picton developed as two separate towns: a private village established by Major Antill, and Upper Picton to the south. The two towns eventually united (Plate D.1).

Henry Antill was granted an estate near Picton in 1825 which he named Jarvisfield (Antill 1966). In 1841 Antill subdivided the part of his estate on the north side of Stonequarry Creek and called it the Village of Picton, after Sir Thomas Picton, one of the Duke of Wellington's generals at the Battle of Waterloo.

The success of Antill's village led the government to lay out its own town to the immediate south of Antill's village. It too was called Picton, and lots were offered for sale in 1847. However, it was the private village of Lower Picton that thrived and became the centre for trade and business, and by the end of the nineteenth century Argyle Street was the commercial hub.

Picton Conservation area (Wollondilly LEP 2011) encompasses houses and commercial buildings that represent the development of Picton as a township from the mid nineteenth to early twentieth century. Heritage buildings in the vicinity of the study area include a number of churches. The Anglican rectory, a two-storey Victorian residence (c.1860) was originally built for Mr Fieldhouse to cater for workers on the old railway tunnel. It was converted into a rectory and later, a school for girls. A rectory built in 1878 on the other side of the road was demolished in 1915 for the railway deviation. Picton Presbyterian (now Uniting) Church was built c.1886 in the simplified gothic tradition of the time.

Plate D.1 shows the Private Village of Picton and the Village of Picton to the south, with the early railway alignment and what is now the Mushroom Tunnel.



Source: NSW Department of Lands

Plate D.1 Detail from Parish map, *Parish of Picton, County of Camden, 1900*

D.2 Railways

D.2.1 Picton Mittagong Loop Line

Picton railway station opened in 1863 and was the terminus of the Main South Line until the line was extended and the Picton-Mittagong Line was opened in February 1867. It was built under the supervision of John Whitton, Engineer in Charge for the New South Wales Railways from 1856 to 1898. The line was a single track with steep gradients up to 1 in 30. The Victorian Georgian style station building at Picton is also attributed to Whitton.

Construction of the Main South Line resulted in the construction of the first railway tunnel in NSW. Much of the infrastructure, such as the viaduct on Stonequarry Creek at Picton (c.1862-69) which cost £10,437 (Plate D.2) and the culverts of “beautifully cut stone” (Bayley 1974), was constructed from sandstone. A contract plan for a standard culvert design on the line shows that the culverts were constructed of sandstone blocks and were to be almost circular in shape with wing walls (Niche 2014, p.36).

The original alignment, which became known as the “Picton to Mittagong Loop Line”, passed through the Mushroom Tunnel (east of the study area) and along an embankment (now disused) forming a triangular wedge of land that is bounded by three embankments. A brick culvert is located beneath the old embankment (87.300 km).



Source: State Library of Victoria H15184

Plate D.2 **Picton Viaduct Great Southern Railway, c.1866 by William Hetzer**

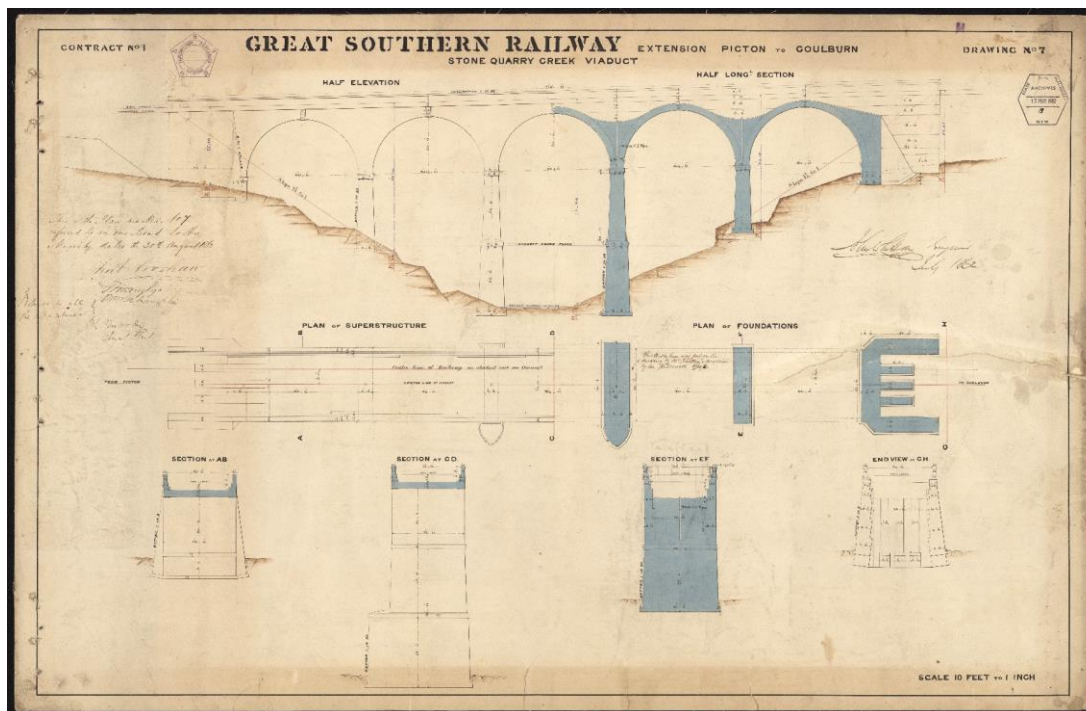


Plate D.3 Plan drawings of Picton Viaduct



Source: State Library of Victoria H15173

Plate D.4 The Mushroom Tunnel, "Picton Tunnel Great Southern Railway, New South Wales, 1866", by William Hetzer

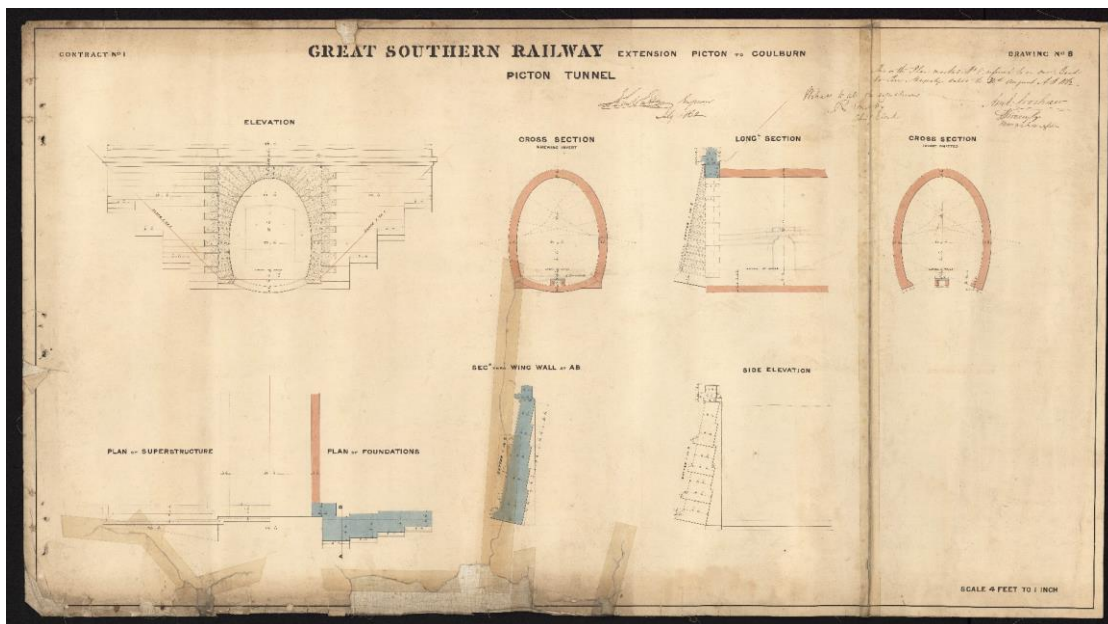


Plate D.5 Plan drawings of the Mushroom Tunnel, previously known as “Picton Tunnel”

D.2.2 The Main Southern Line

In 1919, the Picton to Mittagong deviation line was constructed to the east of the original line which now became known as the “Picton to Mittagong Loop Line” (Loop Line). The purpose of the new alignment was to avoid the steep gradients between Picton and Mittagong and lower the gradient to 1 in 75. The deviation was a double line and capable of carrying much heavier loads.

The line ran through the newly constructed Picton Tunnel, a brick arched tunnel, 600 feet (183 m) in length. It then curved sharply around to the east. The tight railway line loop of the new Main Southern Railway allowed the railway to descend from Upper Picton to the valley of Stonequarry Creek. The railway bridge crossed over the old Great South Road/Hume Highway, now Argyle St, where the road makes a sharp right-hand turn under the bridge to Picton Village, known as the ‘Hole in the Wall’.

To the south, “Tollgate Lodge” a Victorian rustic gothic cottage (c1867), was built as a gatehouse for the railway level crossing on the Old Hume Highway (now Argyle St). The gatekeeper would stop traffic to allow trains to cross. After use of the toll bar on the Great Southern Road ceased in 1867, the gate-keeper’s residence became a place to pay tolls until coach traffic ceased in 1872.

D.3 Summary of listed heritage sites

This section provides a brief summary of each of the listed heritage items that have been considered within this assessment, either because they are within, or immediately adjacent to, the Study Area or because they may be subject to far field horizontal movements. Heritage items relate to the following phases of historical development in the local area:

- establishment and early settlement of Thirlmere Way c.1840 on the outskirts of ‘Stonequarry’ (Picton) on Stonequarry Creek;
- construction of the Picton-Mittagong Railway line c.1867;
- provision of private health services for tuberculosis patients c.1880;

- late nineteenth century and early twentieth century subdivision and occupation of Thirlmere Way, Picton and the Old Hume Highway, Tahmoor; and
- duplication of the Southern Railway Line between Picton and Mittagong via Bargo c.1919.

D.3.1 Mushroom Tunnel (WLEP I144)

The Mushroom Tunnel (formerly called the Redbank Range Railway Tunnel) was opened in 1867 and was the first tunnel used by NSW Railways. Originally known as Picton Tunnel (as shown in a photograph from c.1866 ()). The tunnel was closed when the double track tunnel on the main line was opened in 1919. During WWII, the tunnel was used to store ammunition and military supplies and after 1950, was used for commercial mushroom growing.



Plate D.6 Mushroom Tunnel, southern entrance. Dressed sandstone blocks radiate from the portal. View north-west.

D.3.2 Picton Tunnel – part of Picton Railway Deviation Works (ARTC S170 register)

Picton Tunnel is situated on the 1919 double track deviation of the Main Southern Line. The horseshoe arch tunnel has five heading courses surrounding the arch and a sandstone keystone (Plate D.7). The opening is approximately 6.3m high and 8.3m long (MSEC 2020, p.32). Brick wing walls on either side of the entrance provide support. The brick work is English bond with a string course and cornice towards the top. The tunnel is an operational rail asset and well maintained.



Source: JMA (2017)

Plate D.7 Picton Tunnel, northern portal

D.3.3 Weatherboard Cottage (WLEP I211)

The weatherboard cottage located on Thirlmere Way, likely dates to the late nineteenth century. It has twin brick chimneys and a hipped tin roof (restored). It has significance for its aesthetic contribution to the street and to the historical landscape of Picton.



Source: JMA

Plate D.8 Weatherboard cottage

D.3.4 Picton Antill Street Underbridge (ARTC S170 register)

The Antill Street Underbridge is listed on the ARTC S170 Register. The listing incorrectly gives its location as 88.133 km. The Antill Street Underbridge is located at 89.326 on Thirlmere Way (Antill Street becomes Thirlmere Way, west of the roundabout intersection with Argyle St/Old Hume Highway). The single span arch bridge is formed with six, rowlock brick courses supported by brick abutments and angled wingwalls. The underbridge serves as a road bridge for cars passing below the Main Southern Railway. It was possibly constructed in the early twentieth century as part of the railway deviation works. Antill Street Underbridge is a single span brick road underbridge on Thirlmere Way.



Source: Google Maps

Plate D.9 Antill Street Underbridge

D.3.5 Rural Landscape, Thirlmere Way (Department of Health S170 register)

The rural landscape provides the picturesque setting for the QVMH precinct. As the setting for the early hospital, it formed the basis, and an integral part, of the patient's treatment at the hospital. It is a good example of pasture improvement on a working farm, providing food for the hospital (Tropman & Tropman 2004). The site dates from c.1882 with a dam added in 1910 and further modifications between 1920-1930. The boundary of this item is defined as the setting for the QVMH.

D.3.6 Picton Viaduct (SHR 01051 and ARTC S170 register)

Designed by John Whitton, Chief Engineer and architect of the NSW Government Railway, the Picton Viaduct spans Stonequarry Creek on the main Sydney - Melbourne railway line, just north of Picton Station. The sandstone viaduct was constructed between 1863-1867 as part of the Picton-Mittagong Loop Line.

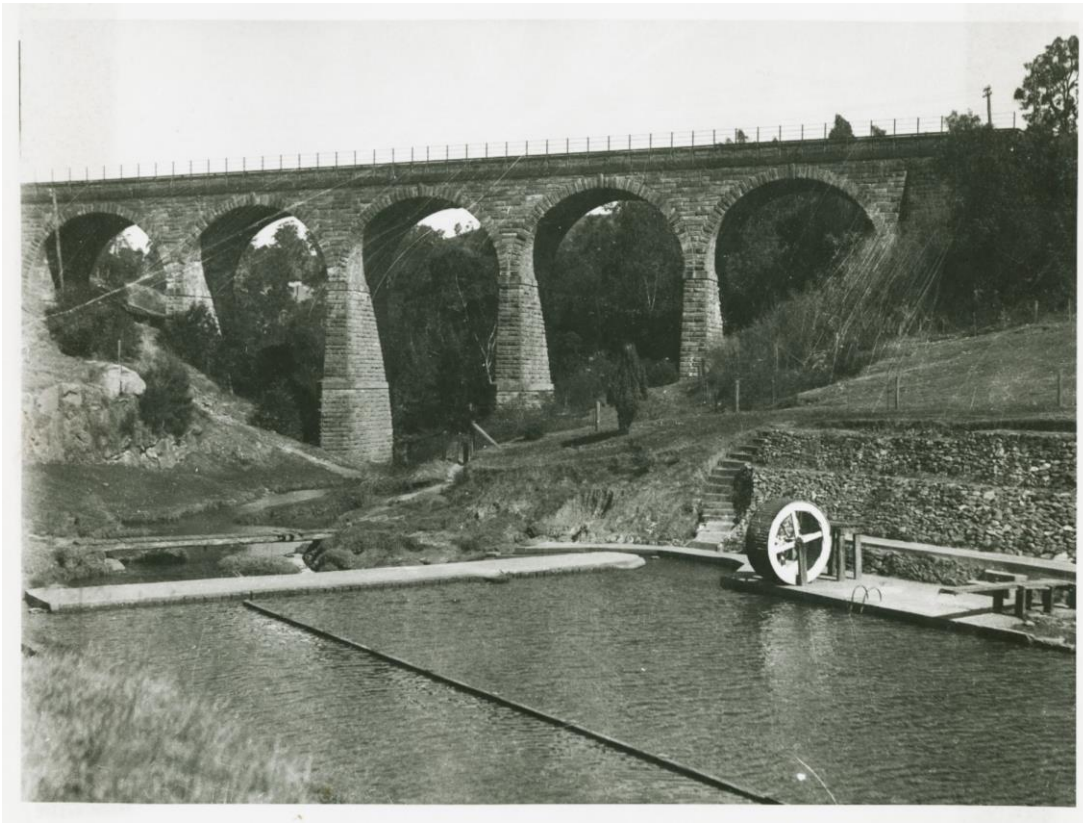
The viaduct is comprised of five arches, each span is 12 m wide and the highest is 23.8 m. The total length of the viaduct is 84.1 m with a rising gradient of 1 in 40 against southbound trains. While the viaduct is similar to many other viaducts in the Blue Mountains designed by John Whitton, it is unique in that it accommodates two railway lines.

The piers are solid stone, founded at shallow depth into rock. The internal 'V' formed above each pier is filled with stone rubble (to about 5 m) and dished to form a drain. A drainpipe down the middle of the 'V' discharges at the springing level (the level at which the arch starts). This prevents the tracks from becoming waterlogged. There is a low stone parapet wall on each side of the viaduct. Abutments are U-shaped in plan with three internal buttresses.

The viaduct is still in use by all trains on the main line between Sydney and Melbourne.



Plate D.10 Looking south-west towards Picton Viaduct from Stonequarry Creek.



Source: NRS17420_2-20 photo 636_8

Plate D.11 **Picton Viaduct with swimming pool (weir)**

D.3.7 **Railway Bridge (Hole in the Wall) (WLEP I149)**

The “Hole in the Wall” is a high brick arch railway bridge over the old Great South Road/Argyle Street (now the Hume Highway) to the south of Picton Village. It is also referred to as the Argyle Street Underbridge (ARTC S170 register). The railway bridge was constructed in 1918-19 as part of the railway development to replace the Picton Mittagong line. A photograph of the Dunlop cycle race taken in 1930 (Plate D.13) looks up the hill away from Picton Village towards the bridge.

While the curtilage of this item is within the Study Area—encompassing the section of railway line between approximately, chainage 86.2 to 88.2—the bridge itself is outside the Study Area.



Source: Surveyor

Plate D.12 **Railway bridge (Hole in the Wall) on Argyle Street with Picton Village behind. View east.**



Plate D.13 **‘A line of cyclists coming through the arch of the railway bridge at Picton’, Sam Hood, 1930 (SLNSW *Home and Away* 2473). View west.**

D.3.8 Pedestrian overbridge 86.1 km (ARTC S170 register)

The pedestrian overbridge that crosses the Main Southern Railway at 86.1 km is a single span steel deck with concrete abutments above a sandstone cutting.

To be inspected.

D.3.9 Redbank Uniting Church (WLEP I146)

Redbank Uniting Church was built as a Wesleyan Chapel in 1849 by James Rogers, a local builder and storekeeper, using stone quarried in Stonequarry Creek. It is the earliest intact building remaining of the original village reserve established to the south of Stonequarry Creek by Surveyor G A Harper. The building is a modest representative example of an early to mid-Victorian country church, erected by the non-conformists of that period.

The original church building was constructed of ashlar sandstone. The gabled roof has a small stone bellcote at the east end. The original church had a packed earth floor was packed earth and shingled roof. In the cemetery of the Church grounds, the earliest known burial is that of Henry Rogers, the 14 year old son of James Rogers and his first wife, who died in 1851.

As the congregation grew, the chapel needed to be enlarged. James Rogers extended the rear of the church by 3 m and added a porch in 1865. Timber flooring and an iron roof were added in 1895. A hall was added in 1965.

The church was sold in 1997 and is now a private residence.



Source: Heritage Office/Wollondilly Council

Plate D.14 Redbank Uniting Church



Appendix E

Picton Viaduct SHR listing



Picton railway viaduct over Stonequarry Creek

Item details

Name of item:

Picton railway viaduct over Stonequarry Creek

Other name/s:

Stonequarry Creek Railway Viaduct

Type of item:

Built

Group/Collection:

Transport - Rail

Category:

Railway Bridge/ Viaduct

Location:

Lat: -34.1776600646 Long: 150.6118253520

Primary address:

Main Southern Railway, Picton, NSW 2571

Local govt. area:

Wollondilly

Local Aboriginal Land Council:

Tharawal

Boundary:

The listing boundary commences at the north end of the Picton Viaduct and runs parallel to the viaduct on each side. On the western side of the station the boundary follows the top of the embankment, crossing the road bridge and then turning across the tracks, returning north at the back of the platform then turning towards the east to include the parking area and following the property boundary until reaching the viaduct.

All addresses

Street Address	Suburb/town	LGA	Parish	County	Type
Main Southern Railway	Picton	Wollondilly			Primary Address
Menangle Road	Picton	Wollondilly			Alternate Address

Owner/s

Organisation Name	Owner Category	Date Ownership Updated
Transport Asset Holding Entity	State Government	05 Nov 98

Statement of significance:

This 1867 viaduct is significant because it is the oldest stone arch railway bridge in New South Wales. It is associated with John Whitton the 'father of new South Railways', it is an imposing sandstone structure, a landmark for the historic town of Picton, its construction contributed significantly to the subsequent railway extension to Albury in 1883 to link with the Victorian line and to the development of Southern Western new South Wales and when John Whitton was denied funds to continue with the expensive wrought iron girder bridges he chose the stone arch viaduct for his major bridge works. It has proved to be a most cost-effective structure. It is unique being the first double track stone arch viaduct and retains its original fabric and function. It represents a major technological achievement in the construction of the Great Southern Railway line by John Whitton.

Date significance updated: 15 Mar 06

Note: The State Heritage Inventory provides information about heritage items listed by local and State government agencies. The State Heritage Inventory is continually being updated by local and State agencies as new information becomes available. Read the Department of Premier and Cabinet [copyright](#) and [disclaimer](#).

Description

Designer/Maker:

John Whitton, Engineer-in-Chief for Railways

Builder/Maker:

Murnin and Brown

Construction years:

1863-1867

Physical description:

A sandstone viaduct carrying the double track Main South Railway (was great Southern Railway) over Stonequarry Creek just south of Picton Railway Station.

There are five arches of 40 feet clear span which together with pier widths and abutments gives the viaduct a total length of 276 feet. The middle arch is the highest above the creek bed at 78 feet.

The piers are solid stone, founded at shallow depth into rock, tapering to the springing levels of the arches which are solid semi-circular, 20 feet radius and 2 feet 6 inches thick.

At the piers, the internal 'V' formed by the adjoining arches is filled by stone rubble to about 15 feet and dished to form a drain. There is a pipe drain down the middle which discharges at the springing level. By this arrangement the ballasted tracks are drained and do not get water logged.

There is a low stone parapet wall on each side of the viaduct supplemented by a timber fence for the safety of train shunters.

The abutments are U-shaped in plan with 3 internal buttresses.

Physical condition and/or**Archaeological potential:**

The viaduct is in excellent condition and carries rail traffic that is considerably heavier and faster than when built. No strengthening works or modification have been necessary.

Date condition updated: 15 Mar 06

Modifications and dates:

There have been only minor railway attachments to suit changing operations over the years, but those that remain do not detract from the significance of the bridge.

Current use:

Viaduct that carries the double track Main South Railway line

Former use:

Aboriginal land, Viaduct that carries the double track Main South Railway

History

Historical notes:

This area was the traditional land of the Gandangara people (Garran, 1978, 530). The area is home to the Tharawal and Gundungurra people (Robinson, 2008).

Camden & the Cow Pastures:

The area is associated with the early history of the colony of New South Wales. Governor Hunter named it 'The Cowpastures' after cattle which had strayed from the Farm Cove settlement were discovered there in 1795. Due to the early European settlers, namely the Macarthurs, who established flourishing wool, wine and wheat industries here, the area is said to be 'the birthplace of the nation's wealth' (ibid, 2008).

Picton:

The town of Picton was named by Major Antill after Sir Thomas Picton in 1841. The location was previously known as 'Stonequarry'. The Duke of Wellington described Picton as a 'rough foul-mouthed devil as ever lived' but very capable. He was 'respected for his courage and feared for his irascible temperament'. He was chiefly remembered for his exploits under Wellington in the Iberian Peninsular War displaying great bravery and persistence. He was killed at the battle of Waterloo and was the most senior officer to die there. He was buried in the family vault at St. George's, Hanover Square in London. In 1859 Picton was re-interred in St. Paul's Cathedral, London, lying close to the body of the Duke of Wellington (Wheeldon, 2015, 3).

Great Southern Railway:

Picton is located on the Main South line. The 'Great Southern Railway' originally opened from Picton to Mittagong via a loop line in 1867.

Picton Railway Viaduct:

The Stonequarry Creek railway viaduct was built for the Picton to Goulburn railway extension, 1862-1869.

John Whitton signed the plans in July 1862 but the first contractor failed so Murnin and Brown took over the contract in December 1863. The work was supervised by George Cowdery (a future Engineer-in-Chief for Existing Lines) and was opened for traffic on 28 February 1867 for the first section of extension to Mittagong. It cost (Pounds)10,437.

It is the oldest railway arch bridge in New South Wales and the first one built for two tracks, the second is over James Street, Lithgow. Economic constraints forced Whitton to build the others for single track. They were progressively bypassed by double track brick arch bridges whereas Stonequarry Creek viaduct continues its original function.

The viaduct is accessible from Menangle Road.

Historic themes

Australian theme (abbrev)	New South Wales theme	Local theme
1. Environment-Tracing the evolution of a continent's special environments	Environment - naturally evolved-Activities associated with the physical surroundings that support human life and influence or shape human cultures.	Other open space-
1. Environment-Tracing the evolution of a continent's special environments	Environment - naturally evolved-Activities associated with the physical surroundings that support human life and influence or shape human cultures.	Changing the environment-
1. Environment-Tracing the evolution of a continent's special environments	Environment - naturally evolved-Activities associated with the physical surroundings that support human life and influence or shape human cultures.	Cultural: Rivers and waterbodies important to humans-
3. Economy-Developing local, regional and national economies	Environment - cultural landscape-Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	Developing local, regional and national economies-National Theme 3
3. Economy-Developing local, regional and national economies	Environment - cultural landscape-Activities associated with the interactions between humans, human societies and the shaping of their physical surroundings	Landscapes of institutions - productive and ornamental-
3. Economy-Developing local, regional and national economies	Technology-Activities and processes associated with the knowledge or use of mechanical arts and applied sciences	Technologies of bridge building-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Building the railway network-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Building and maintaining the public railway system-
3. Economy-Developing local, regional and national economies	Transport-Activities associated with the moving of people and goods from one place to another, and systems for the provision of such movements	Bridging rivers-
4. Settlement-Building settlements	Accommodation-Activities associated with the provision of accommodation	Building settlements, towns

ettlements, towns and cities	tion, and particular types of accommodation – does not include architectural styles – use the theme of Creative Endeavour for such activities.	ns and cities-National Theme 4
4. Settlement-Building settlements, towns and cities	Accommodation-Activities associated with the provision of accommodation, and particular types of accommodation – does not include architectural styles – use the theme of Creative Endeavour for such activities.	A Picturesque Residential Suburb-
4. Settlement-Building settlements, towns and cities	Land tenure-Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal	Early land grants-
4. Settlement-Building settlements, towns and cities	Land tenure-Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal	Townships-
4. Settlement-Building settlements, towns and cities	Land tenure-Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal	Early farming (Cattle grazing)-
4. Settlement-Building settlements, towns and cities	Land tenure-Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal	Administering and alienating Crown lands-
4. Settlement-Building settlements, towns and cities	Land tenure-Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal	Changing land uses - from rural to suburban-
4. Settlement-Building settlements, towns and cities	Land tenure-Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal	Resuming private lands for public purposes-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Developing suburbia-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Beautifying towns and villages-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Developing private towns -
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Shaping inland settlements-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Creating landmark structures and places in regional settings-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	19th Century Infrastructure-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Impact of railways on suburban development-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Impacts of railways on rural development-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Railway Suburbs-
4. Settlement-Building settlements, towns and cities	Towns, suburbs and villages-Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Roadside Villages-
4. Settlement-Building settlements, towns and cities	Utilities-Activities associated with the provision of services, especially on a communal basis	Building Bridges-
4. Settlement-Building settlements, towns and cities	Utilities-Activities associated with the provision of services, especially on	Railways to inland settle

ettlements, towns and cities	a communal basis	ments-
4. Settlement-Building settlements, towns and cities	Utilities-Activities associated with the provision of services, especially on a communal basis	Public Transport - suburban railway lines-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	State government-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Developing roles for government - administration of land-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Developing roles for government - building and administering rail networks-
7. Governing-Governing	Government and Administration-Activities associated with the governance of local areas, regions, the State and the nation, and the administration of public programs - includes both principled and corrupt activities.	Developing roles for government - conserving cultural and natural heritage-
9. Phases of Life-Marking the phases of life	Persons-Activities of, and associations with, identifiable individuals, families and communal groups	Associations with Murnin and Brown, builders-

Assessment of significance

SHR Criteria a)

[Historical significance]

This viaduct is the oldest stone arch railway bridge in New South Wales. It is still in use without any restriction on railway operations.

SHR Criteria b)

[Associative significance]

It is associated with John Whitton the 'father of New South Wales railways'.

SHR Criteria c)

[Aesthetic significance]

The viaduct is an imposing sandstone structure, a landmark for the historic town of Picton and a photo stop for tourist.

SHR Criteria d)

[Social significance]

Its construction contributed significantly to the railway extension to Albury to link with the Victorian line and to the development of South Western New South Wales. It continues as a major item of railway infrastructure for the commercial and social wellbeing of that region and for land transport to Melbourne.

SHR Criteria e)

[Research potential]

When John Whitton was denied funds to continue with the expensive wrought iron girder bridges he chose the stone arch viaduct for his major bridge works. The former at Menangle cost £94,562 whereas the Stonequarry Creek viaduct cost £10,437. It has proved to be a most cost-effective structure.

This viaduct was a prelude to his extensive use of stone arch viaducts across the Blue Mountains to Lithgow.

SHR Criteria f)

[Rarity]

The only double track stone arch viaduct.

SHR Criteria g)

[Representativeness]

It is a magnificent representative example of a class of railway bridge built during 1862-69.

Integrity/Intactness:

The viaduct retains its original fabric and function.

Assessment criteria:

Items are assessed against the  [State Heritage Register \(SHR\) Criteria](#) to determine the level of significance. Refer to the Listings below for the level of statutory protection.

Recommended management:

Recommendations

Management Category	Description	Date Updated
Recommended Management	Produce a Conservation Management Plan (CMP)	
Recommended Management	Prepare a maintenance schedule or guidelines	
Recommended Management	Carry out interpretation, promotion and/or education	

Procedures /Exemptions

Section of act	Description	Title	Comments	Action date
57(2)	Exemption to allow work	Standard Exemptions	ORDER UNDER SECTION 57(2) OF THE HERITAGE ACT 1977 Standard exemptions for engaging in or carrying out activities / works otherwise prohibited by section 57(1) of the Heritage Act 1977. I, Donald Harwin, the Special Minister of State pursuant to subsection 57(2) of the Heritage Act 1977, on the recommendation of the Heritage Council of New South Wales do by this Order, effective 1 December 2020: 1. revoke the order made on 11 July 2008 and published on pages 91177 to 9182 of Government Gazette Number 110 of 5 September 2008 and varied by notice published in the Government Gazette on 5 March 2015; and 2. grant the exemptions from subsection 57(1) of the Heritage Act 1977 that are described in the attached Schedule. Donald Harwin Special Minister of State Signed this 9th Day of November 2020. To view the standard exemptions for engaging in or carrying out activities / works otherwise prohibited by section 57(1) of the Heritage Act 1977 click on the link below.	Nov 13 2020

 [Standard exemptions](#) for engaging in or carrying out activities / works otherwise prohibited by section 57(1) of the *Heritage Act 1977*

Listings

Heritage Listing	Listing Title	Listing Number	Gazette Date	Gazette Number	Gazette Page
Heritage Act - State Heritage Register		01051	02 Apr 99	27	1546
Heritage Act - s.170 NSW State agency heritage register					
Register of the National Estate			28 Sep 82		

References, internet links & images

Type	Author	Year	Title	Internet Links
Tourism		2007	Picton Railway Viaduct over Stonequarry Creek	View details
Tourism	Attraction Homepage	2007	Picton railway viaduct over Stonequarry Creek	View details
Written	Wheeldon, Paul	2015	(Picton section, in) 'Waterloo - those who left their mark on Australia - Part 2'	View details

Note: internet links may be to web pages, documents or images.



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Appendix D – Main Southern Railway Inspection Report

24 August 2021

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Re: Tahmoor LW W3-W4: Main Southern Railway Inspection

Dear April,

Tahmoor Coal has engaged EMM Consulting (EMM) to undertake an inspection of non-registered heritage items on the Main Southern Railway to assess their heritage significance. This letter memo will be appended to the Heritage Management Plan that supplements the Extraction Plan for Longwalls West 3 – West 4.

This letter includes:

- a brief exploration of the historical context of the study area and heritage context; and
- details of the site inspection and an assessment of the condition of the heritage items; and
- an assessment of heritage significance.

Should you have any questions or concerns please do not hesitate to contact me on (02) 9493 9500.

Yours sincerely



Jessica Horton
Heritage Consultant | Archaeologist
jhorton@emmconsulting.com.au

1 Background

The Tahmoor Coal Mine (Tahmoor Mine) is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney between the towns of Tahmoor and Bargo, New South Wales (NSW). The Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced operation in 1979 using bord and pillar mining methods, and via longwall mining methods since 1987. Tahmoor Coal is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group.

Tahmoor Coal is extending underground coal mining to the north-west of the Main Southern Railway at Picton and Thirlmere (referred to as the 'Western Domain') within Mining Lease (ML) 1376 and ML 1539. An Extraction Plan for the first two longwalls to be mined, Longwall West 1 – West 2 (LW W1-W2) was approved by the NSW Department of Planning, Industry and Environment (DPIE) on 8 November 2019. Extraction of LW W1 commenced on 15 November 2019 and was completed on 6 November 2020. LW W2 extraction was completed on 17 June 2021. Tahmoor Coal is proposing to mine a further two longwalls in the Western Domain – Longwall West 3-West 4 (LW W3-W4).

1.1 Purpose of report

A Historical Heritage Technical Report (HHTR) was prepared by EMM Consulting Pty Ltd (EMM) in March 2021 as part of the Extraction Plan for LW W3-W4. The objectives of the HHTR were to identify historical heritage items within the LW W3-W4 study area and to provide for the monitoring and management of potential subsidence related environmental impacts on historical heritage sites within the study area to demonstrate that the relevant performance measures are met. As part of this report, several non-registered heritage items were identified requiring inspection and assessment. A complete list of heritage items in and within the vicinity of the study area is provided within Appendix A.

The known items within the study area that required heritage inspection and assessment are:

- Main Southern Railway culverts - three culverts within the study area and four adjacent to the study area along the eastern boundary.

Items on the Main Southern Railway associated with the 1919 deviation works that are outside the study area, but which may be susceptible to far field movement and require heritage inspection are:

- Main Southern Railway culverts - four culverts adjacent to the study area;
- Subway (88.133 km) adjacent to the study area;
- High retaining wall (84.687 km), outside the study area but may be susceptible to far field horizontal movements;
- Bridge on Matthews Lane (84.551 km), outside the study area but may be susceptible to far field horizontal movements;
- Connellan Crescent Overbridge (89.080 km); and
- Prince Street Overbridge (85.17 km).

This letter memo will be appended to the HHTR, providing a baseline recording of the non-registered heritage items identified. This will assist with ongoing monitoring and assessment of whether impacts from mining have occurred. A final assessment and recording will be conducted at the completion of mining works.

It is noted that engineering inspections by structural engineer JMA Solutions have been carried out at the Matthews Lane, Prince Street and Connellan Crescent Overbridges, and Tahmoor Coal has been monitoring

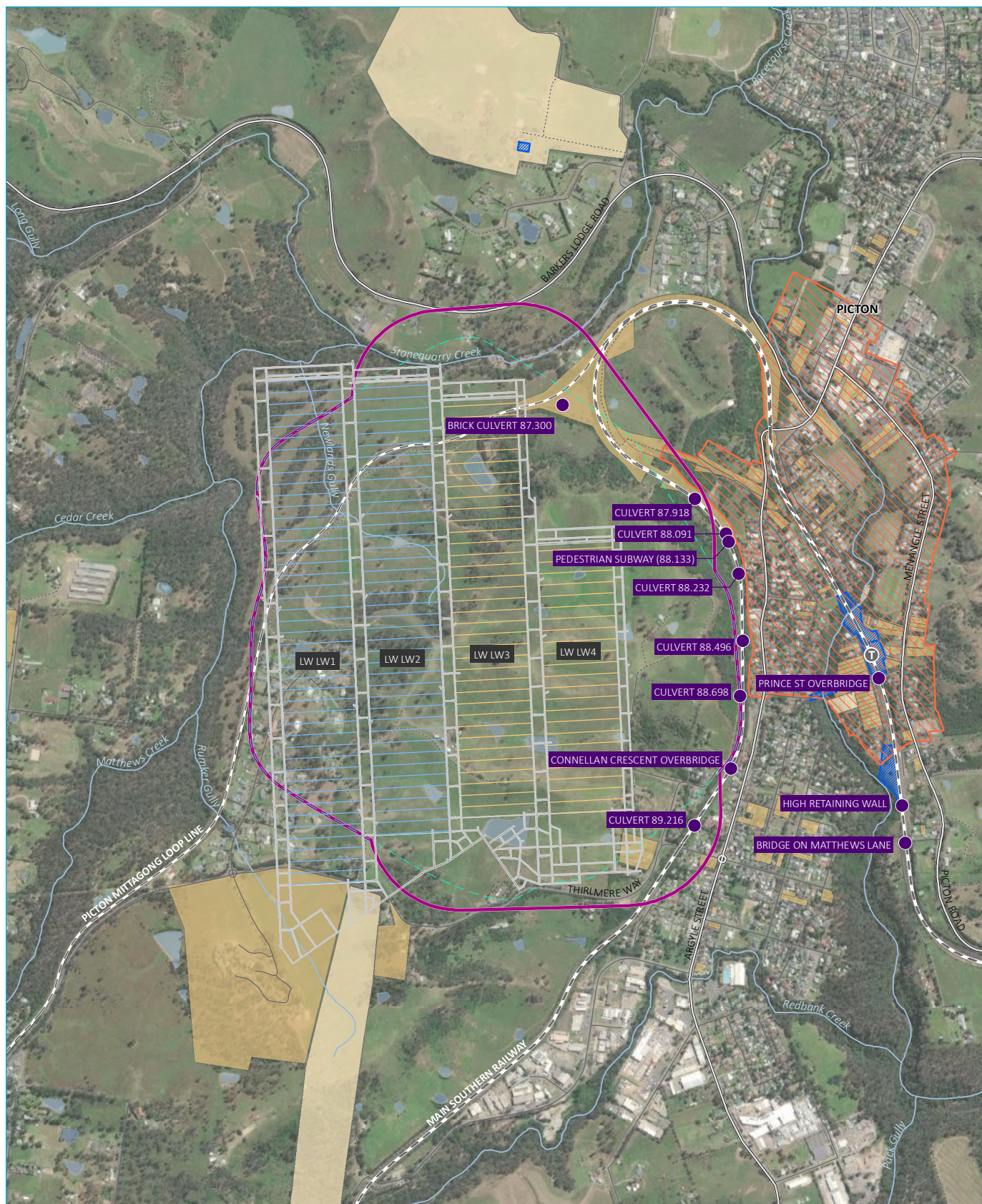
movements of the bridges with survey pegs since the extraction of LW W1. To date, no impacts on the bridges have been observed during the mining of LW W1-W2.

1.2 Study area

The study area has been defined as the surface area that could be affected by the mining of LW W3–W4. The extent of the study area has been calculated by combining the areas bound by the following limits:

- a 35-degree angle of draw from the extents of LW W3–W4;
- the predicted limit of vertical subsidence, taken as the 20-millimetre (mm) subsidence contour resulting from the extraction of the proposed longwalls; and
- features that could experience far field or valley-related movements and could be sensitive to such movements.

The study area is outlined in Figure 1.1.



Source: EMM (2021); DFSI (2017); GA (2011); DPE (2017)

KEY

Study area

Predicted 20 mm subsidence contour

Completed longwall

Proposed longwall

Mine plan

Historic heritage items

State Heritage Act

Conservation Area - General

Item - General

Item - Archaeological

Heritage items - not listed

Train station

Rail line

Major road

Minor road

Vehicular track

Named watercourse

Waterbody

Historical heritage items
(unregistered sites)

Tahmoor Longwalls W3-W4
Main Southern Railway Inspection
Figure 1.1

EMM
creating opportunities

DRAFT

\\Emmsvr1\emms3\2020\200551 - LW W3 W4 Extraction Plan Tahmoor Heritage\GIS\02_Maps\G004_HHUnlisted_20210810_02.mxd 10/08/2021

1.3 Assessment guidelines and requirements

This baseline recording of non-registered heritage items has been prepared in accordance with the relevant government assessment requirements, guidelines, and policies. The report and field survey were undertaken using the principles of the *Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (the *Burra Charter*, Australia ICOMOS 2013) and the New South Wales (NSW) *Heritage Manual* (Heritage Office 1996 with regular additions).

The *Burra Charter* defines the concept of cultural significance as ‘aesthetic, historic, scientific, social, or spiritual value for past, present, or future generations’ (Australia ICOMOS 2013, Article 1.2). It identifies that conservation of an item of cultural significance should be guided by the item’s level of significance.

The *Heritage Manual* comprises the following guidance documents:

- *Statements of Heritage Impact Guidelines* (Heritage Office 2006);
- *Investigating Heritage Significance* (Heritage Office 2004);
- *Assessing Heritage Significance* (Heritage Office 2001); and
- *Assessing Significance for Historical Archaeological Sites and ‘Relics’* (Heritage Branch Department of Planning 2009).

1.3.1 NSW heritage assessment criteria

The heritage significance assessment criteria are as follows:

Table 1.1 NSW heritage assessment criteria

Criteria	Description
A – Historical significance	An item is important in the course or pattern of NSW’s cultural or natural history.
B – Associative significance	An item has strong or special associations with the life or works of a person, or group of persons, of importance in the NSW’s cultural or natural history.
C – Aesthetic significance	An item is important in demonstrating aesthetic characteristics and/or high degree of creative or technical achievement in NSW.
D – Social significance	An item has strong or special association with a particular community or cultural group in NSW for social, cultural, or spiritual reasons.
E – Research potential	An item has potential to yield information that will contribute to an understanding of NSW’s cultural or natural history.
F - Rarity	An item possesses uncommon, rare, or endangered aspects of NSW’s cultural or natural history.
G – Representativeness	An item is important in demonstrating the principal characteristics of a class of NSW’s cultural or natural places; or cultural or natural environments.

2 Statutory Historical context

The following historical context has largely been drawn from the *Tahmoor Mine Extraction Plan: Longwalls West 3 – West 4 Historical heritage technical report* prepared by EMM in March 2021.

2.1 Picton

2.1.1 Early exploration

Exploration into the Picton region occurred shortly following the landing of the First Fleet at Sydney Cove in 1788. Two bulls and five cows brought upon the First Fleet had escaped Sydney Cove, only to be found in 1795 south of the Nepean River at the Cowpastures (Camden). A small number of stockmen are thought to have resided within the Picton region during the 1790s, tending to these cattle (Back to Picton, 1954).

By 1798, disillusioned convicts had begun cultivating a hopeful vision that there was an inland Utopia, or as Governor Hunter worded: ‘a colony of [European] people at no very great distance in the back country – 150 or 200 miles – where there was an abundance of every sort of provision without the necessity of so much labour’ (Hunter, 1798). To convince this group there was no such ‘New World,’ Hunter commissioned a party of convicts lead by emancipist John Wilson westwards. The expedition reached Mittagong, proceeding to the junction of the Wollondilly and Wingecarribee Rivers at which point the search was abandoned (Back to Picton, 1954).

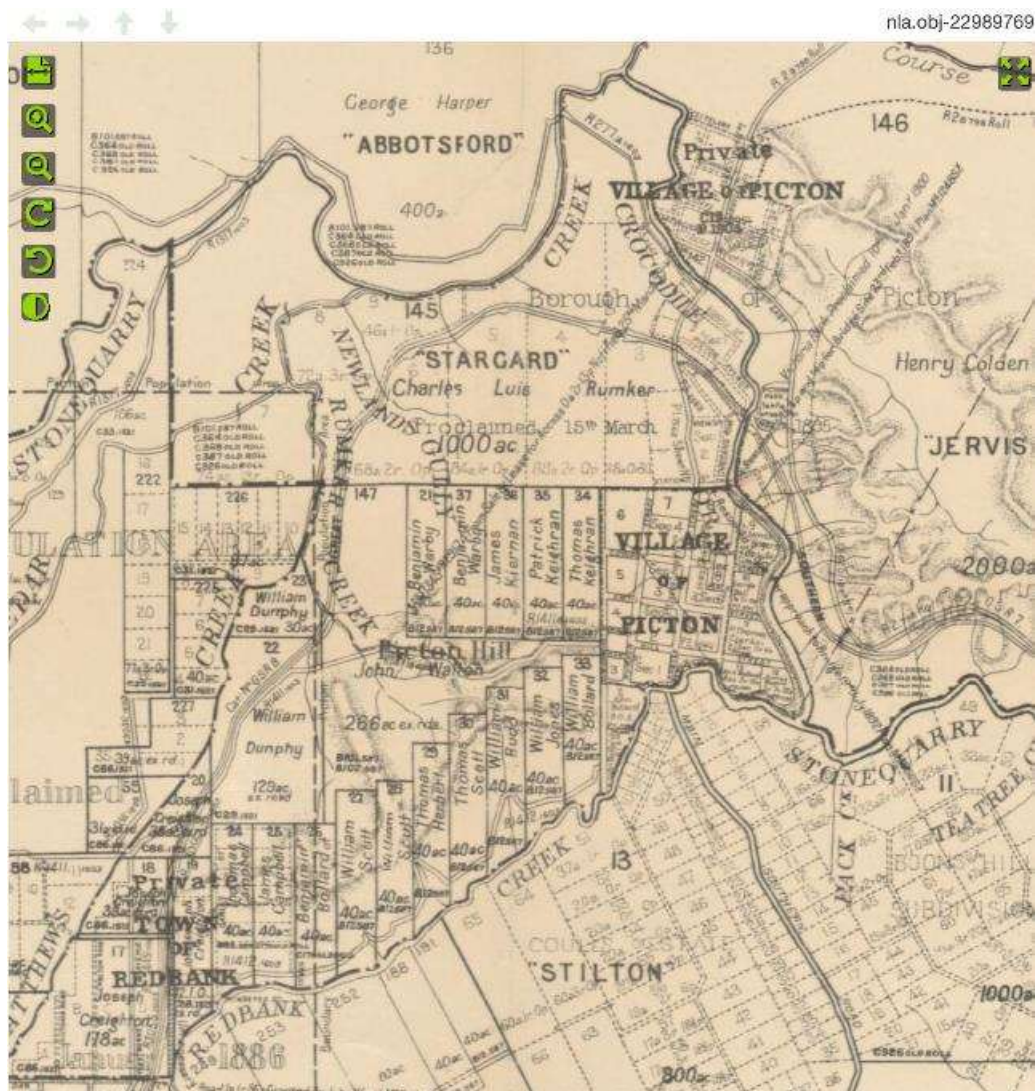
In 1802, a party was led west by Ensign Francis Barrallier from Parramatta in an attempt to cross the Blue Mountains. Barrallier travelled towards the Nepean, passing close to the present site of Picton, following the Nattai and Kowmung Rivers until abandoning their attempt at the Kanangra Falls (Back to Picton, 1954).

Exploration continued in 1804, with Governor King naming the area encompassing the present site of Picton ‘Stonequarry Creek.’ A government stockyard was established at the site for herding wild cattle. In 1820, Governor Macquarie identified the land as being suitable for a township (Maloney & Weaver, 1983).

2.1.2 Township

The construction of the Great South Road between Sydney and the Southern Highlands in 1819 had opened the region to settlers, with small land grants made at Picton from c1821. The coming of the railway during the 1860s led to an economic boom within the region.

Picton developed as two separate towns: a private village established by Major Henry Antil, and Upper Picton to the south. Antil had been granted an estate near Picton in 1825, named Jarvisfield (Antil 1966). In 1841, Antil subdivided a portion of his estate on the northern side of Stonequarry Creek, named the Village of Picton after Sir Thomas Picton. Due to the success of Antil’s village, the Government established its own town to the immediate south, also called Picton, with lots offered for sale in 1847. The two towns eventually merged (Plate 2.1).



Source: NSW Department of Lands

Plate 2.1 Detail from Parish map, *Parish of Picton, County of Camden, 1900*

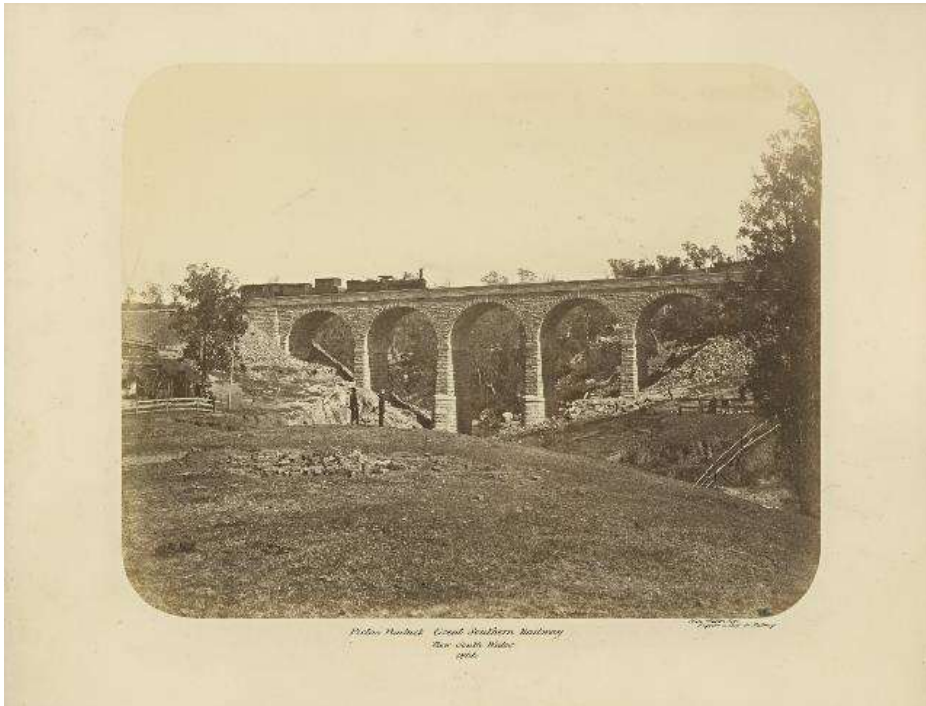
2.1.3 Railways

i Picton Mittagong Loop Line

Picton railway station opened in 1863 and was the terminus of the Main South Line until the line was extended and the Picton-Mittagong Line was opened in February 1867. It was built under the supervision of John Whitton, Engineer in Charge for the New South Wales Railways from 1856 to 1898. The line was a single track with steep gradients up to 1 in 30. The Victorian Georgian style station building at Picton is also attributed to Whitton.

Construction of the Main South Line resulted in the construction of the first railway tunnel in NSW. Much of the infrastructure, such as the viaduct on Stonequarry Creek at Picton (c.1862-69) which cost £10,437 (Plate 2.2 - Plate 2.3) and the culverts of "beautifully cut stone" (Bayley 1974), was constructed from sandstone. A contract plan for a standard culvert design on the line shows that the culverts were constructed of sandstone blocks and were to be almost circular in shape with wing walls (Niche 2014, p.36).

The original alignment, which became known as the “Picton to Mittagong Loop Line”, passed through the Mushroom Tunnel (east of the study area) and along an embankment (now disused) forming a triangular wedge of land that is bounded by three embankments (Plate 2.4 - Plate 2.5). A brick culvert is located beneath the old embankment (87.300 km).



Source: State Library of Victoria H15184

Plate 2.2 Picton Viaduct Great Southern Railway, c.1866 by William Hetzer

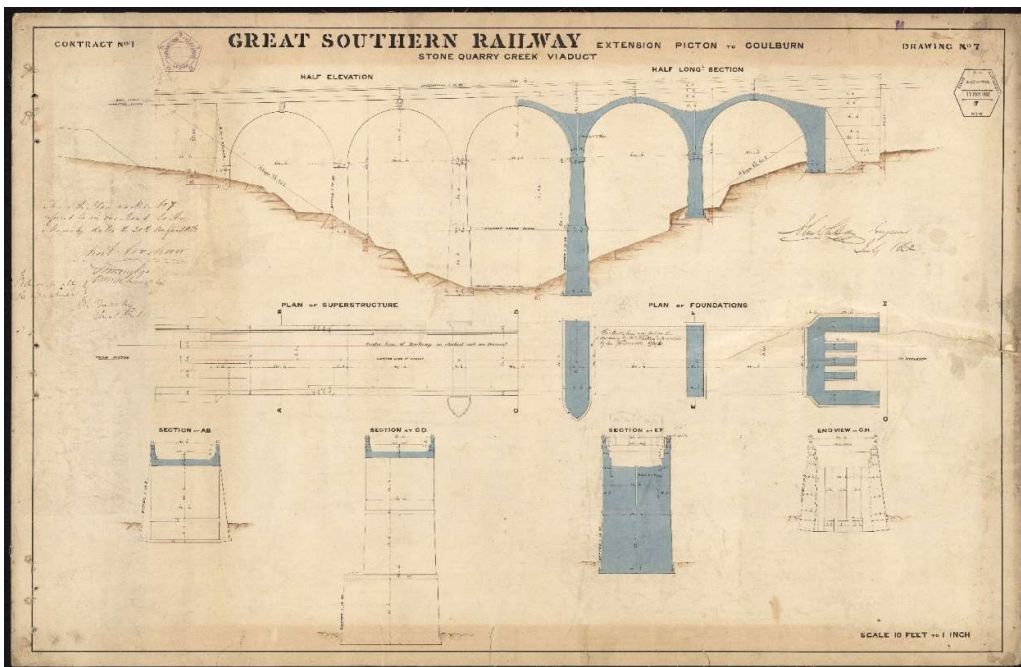


Plate 2.3 Plan drawings of Picton Viaduct



Source: State Library of Victoria H15173

Plate 2.4 The Mushroom Tunnel, “Picton Tunnel Great Southern Railway, New South Wales, 1866”, by William Hetzer

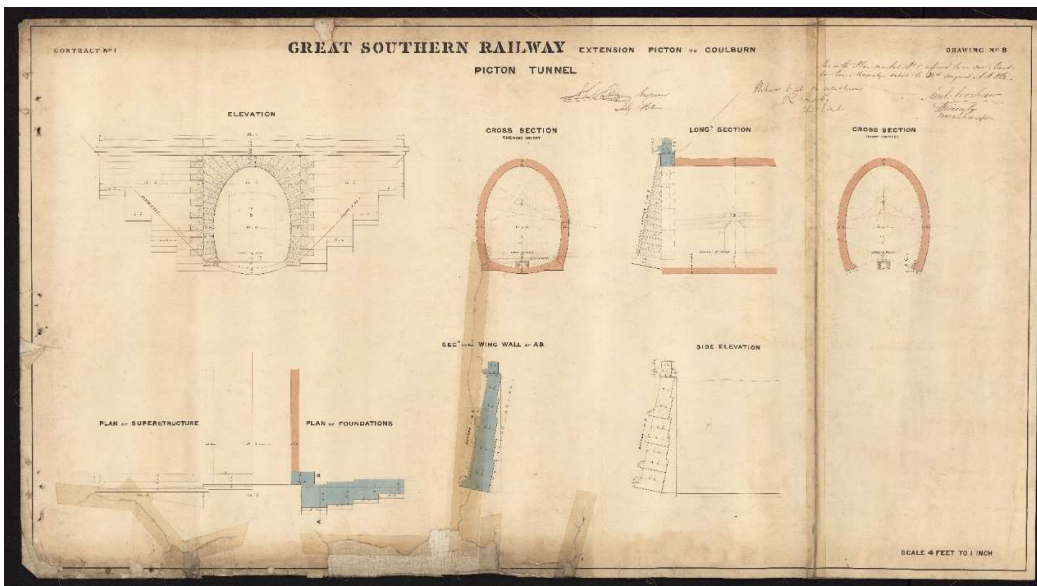


Plate 2.5 Plan drawings of the Mushroom Tunnel, previously known as “Picton Tunnel”

ii Main Southern Line

In 1919, the Picton to Mittagong deviation line was constructed to the east of the original line which now became known as the “Picton to Mittagong Loop Line” (Loop Line). The purpose of the new alignment was to avoid the steep gradients between Picton and Mittagong and lower the gradient to 1 in 75. The deviation was a double line and capable of carrying much heavier loads.

The line ran through the newly constructed Picton Tunnel, a brick arched tunnel, 600 feet (183 m) in length. It then curved sharply around to the east. The tight railway line loop of the new Main Southern Railway allowed the railway to descend from Upper Picton to the valley of Stonequarry Creek. The railway bridge crossed over the old Great South Road/Hume Highway, now Argyle St, where the road makes a sharp right-hand turn under the bridge to Picton Village, known as the 'Hole in the Wall'.

To the south, "Tollgate Lodge" a Victorian rustic gothic cottage (c1867), was built as a gatehouse for the railway level crossing on the Old Hume Highway (now Argyle St). The gatekeeper would stop traffic to allow trains to cross. After use of the toll bar on the Great Southern Road ceased in 1867, the gate-keeper's residence became a place to pay tolls until coach traffic ceased in 1872.

2.2 Bridges

i Timber beam bridges

The sustained growth of the Sydney settlement largely depended on effective use of roads, and later railways. Bridges formed part of this growth, often taking the timber beam form. The first bridge within the colony was a log bridge built across the Tank Stream in October 1788, replaced in 1803 with a stone arch bridge, lending its name to present-day Bridge Street. A timber bridge was constructed across the Duck River in 1797, and in 1805 the Governor's Road Committee listed 10 bridges along Parramatta Road from Annandale to Parramatta. Timber beam bridges can be defined into two design phases: pre-1894 traditional design and post-1894 when the design was improved, making them cheaper, stronger, and requiring less maintenance (RTA, 2006).

The pre-1894 bridge construction largely comprised a series of timber trestles, each with 3 to 5 piles (360-460mm) driven into the bed of the waterway or opening. Piles were capped directly by a 300 x 300mm headstock, which was a single piece of timber. The piles were braced on the outside by 250 x 100mm planks, forming cross bracing. Supported on the headstock, at right angles, would be a set of short timber corbels, matching the number and location as the main longitudinal beams. On top of the main beams were thick transverse deck planks. Railway bridges spanning over 11 metres would utilise compound beams, one above the other, locked together with bolts and wooden keys in pre-cut slots. In 1894, timber beam bridges were redesigned by Percy Allan who simplified construction and maintenance, minimising timber used (RTA, 2006).

ii Masonry bridges

During the early years of the colony, there was no expert bridge builder. The introduction of modern bridge engineering technology to NSW was marked by Sub-Inspector of Roads David Lennox's arrival to the colony in 1832. Lennox's first major project was the Horseshow Bridge on Mitchell's Pass, near Lapstone, resulting in NSW earliest extant masonry bridge (RTA, 2006).

The colonial application of bridge construction techniques was based on knowledge from England. Bridge construction in NSW prior to 1833 largely comprised single span structures, however these were only suitable for bridging short distances. To bridge greater distances, supports from the base of an opening, such as piers, upright props or timber shores were implemented. These were supported on piles where appropriate. The method was not recommended for deep openings, or across rapid watercourses. In these situations, bolsters, struts, or a straining piece was used (TRA, 2006).

In Britain, technical bridge design was reaching new levels of sophistication with the use of mathematics and physics, spurred by desires to construct record spans. Masonry arch bridge design was further developed with the use of pier foundations, providing more stable and durable designs. Lennox was able to utilise these developments within NSW (RTA, 2006).

2.3 Culverts

The development of the Sydney settlement depended on effective use of roads, and later railways. Culverts have been installed within roadways and railways since point of development, allowing natural water courses to flow freely beneath or through a new structure.

Early culverts were largely constructed from sandstone, however, by the late nineteenth and early twentieth centuries, brick and concrete were the preferred material. The culverts identified within this report are brick and concrete, likely dating to the 1919 Main Southern Railway modification. Culverts of this nature remain essential to the operation of the railway, presenting a demonstration of the skill set of engineers, builders, and bricklayers of the era.

3 Baseline recording site inspection

On 12 July 2021, a site inspection of non-registered heritage items located within the study area was undertaken by Jessica Horton (Heritage Consultant, EMM Consulting) and Anthony Dakhoul (Heritage Consultant, EMM Consulting) on foot, and with the use of a vehicle, using GPS survey. The results of the baseline recording will be used for comparisons to determine any impact from mining.

During the site inspection, photographs were taken with the appropriate scale and include:

- the wider context of the site, showing the landscape and setting at long range and medium scales;
- details of the structure's features; and
- close up photographs of pre-existing cracks and damage, and their location noted on the plan drawings.

The results of the site inspection are outlined in Table 3.1 – 3.12

Table 3.1 Main Southern Railway culverts

Location	87.331 km, Main Southern Railway, Picton
Listing	Not listed on local, State, or National heritage registers
Site description	Brick and concrete culvert, multiple outlets.
Assessment of significance	a) Historical significance – culvert 87.331km maintains local contributory significance within the Main Southern Railway representing development and ongoing maintenance of the rail line from point of construction. The culvert presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – culvert 87.331km does not meet the threshold for local significance under this criterion. c) Aesthetic significance - culvert 87.331km maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance - culvert 87.331km does not meet the threshold for local significance under this criterion. e) Research significance - culvert 87.331km has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity - culvert 87.331km is not considered rare and does not meet the threshold for local significance under this criterion.

Table 3.1 Main Southern Railway culverts

Location	87.331 km, Main Southern Railway, Picton
	g) Representativeness – culvert 87.331km is representative of brick culverts positioned along the 1919 section of the Main Southern Railway.
Statement of significance	Culvert 87.331km maintains local contributory significance individually and as part of a group of brick culverts positioned along the 1919 section of the Main Southern Railway. Although culverts represent a minor part of the infrastructure of the Main Southern Railway, they demonstrate the technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century.
Site condition	The brick and concrete culvert is in good condition. There is a minor amount of vegetation growth, however, this does not appear to have impacted the feature.
Photographs	 Northern view of the brick and concrete culvert, showing northern outlet.  Southern view of brick and concrete culvert, showing southern outlet.

Table 3.2 Main Southern Railway culverts

Location	87.918 km, Main Southern Railway, Picton
Listing	Not listed on local, state, or national heritage registers
Site description	A brick culvert was not identified at chainage 87.918 km; however, a concrete drain was visible.
Significance	The concrete drain would not reach the threshold for local contributory significance.
Site condition	N/A
Photographs	 Southwestern view of concrete drain at chainage 87.918 km.

Table 3.3 Main Southern Railway culverts

Location	89.216 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers
Site description	Brick culvert. Currently in use over a tributary to Matthews Creek.
Assessment of significance	a) Historical significance – culvert 89.216km maintains local contributory significance within the Main Southern Railway representing development and ongoing maintenance of the rail line from point of construction. The culvert presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – culvert 89.216km does not meet the threshold for local significance under this criterion. c) Aesthetic significance - culvert 89.216km maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance - culvert 89.216km does not meet the threshold for local significance under this criterion. e) Research significance - culvert 89.216km has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity - culvert 89.216km is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – culvert 89.216km is representative of brick culverts positioned along the 1919 section of the Main Southern Railway.
Statement of significance	Culvert 89.216km maintains local contributory significance individually and as part of a group of brick culverts positioned along the 1919 section of the Main Southern Railway. Although culverts represent a minor part of the infrastructure of the Main Southern Railway, they demonstrate the

Table 3.3 Main Southern Railway culverts

Location	89.216 km, Main Southern Railway, Picton
	technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century.
Site condition	The brick culvert is in good condition despite a moderate amount of graffiti.
Photographs	 Western view of brick culvert at 89.216 km chainage.  Western view within the brick culvert at 89.216 km chainage.

Table 3.4 Main Southern Railway culverts

Location	88.091 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers
Site description	Brick culvert. Currently in use over tributary creek to Stonequarry Creek.
Assessment of significance	a) Historical significance – culvert 88.091km maintains local contributory significance within the Main Southern Railway representing development and ongoing maintenance of the rail line from point of construction. The culvert presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – culvert 88.091km does not meet the threshold for local significance under this criterion.

Table 3.4 Main Southern Railway culverts

Location	88.091 km, Main Southern Railway, Picton
	c) Aesthetic significance - culvert 88.091km maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance - culvert 88.091km does not meet the threshold for local significance under this criterion. e) Research significance - culvert 88.091km has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity - culvert 88.091km is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – culvert 88.091km is representative of brick culverts positioned along the 1919 section of the Main Southern Railway.
Statement of significance	Culvert 88.091km maintains local contributory significance individually and as part of a group of brick culverts positioned along the 1919 section of the Main Southern Railway. Although culverts represent a minor part of the infrastructure of the Main Southern Railway, they demonstrate the technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century.
Site condition	The brick culvert is in good condition, despite a moderate amount of vegetation overgrowth.
Photographs	 Southwestern view of brick culvert at chainage 88.091 km.  Southwestern view of brick culvert at chainage 88.091 km.

Table 3.5 Main Southern Railway culverts

Location	88.496 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers
Site description	Brick culvert. Currently in use over tributary creek Stonequarry Creek. The site inspection revealed a terracotta pipe outlet, the brick portion of culvert was not identified.
Assessment of significance	a) Historical significance – culvert 88.496km maintains local contributory significance within the Main Southern Railway representing development and ongoing maintenance of the rail line from point of construction. The culvert presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – culvert 88.496km does not meet the threshold for local significance under this criterion. c) Aesthetic significance - culvert 88.496km maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance - culvert 88.496km does not meet the threshold for local significance under this criterion. e) Research significance - culvert 88.496km has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity - culvert 88.496km is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – culvert 88.496km is representative of brick culverts positioned along the 1919 section of the Main Southern Railway.
Statement of significance	Culvert 88.496km maintains local contributory significance individually and as part of a group of brick culverts positioned along the 1919 section of the Main Southern Railway. Although culverts represent a minor part of the infrastructure of the Main Southern Railway, they demonstrate the technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century.
Site condition	The outlet pipe was in good condition.
Photographs	 View of terracotta culvert located at chainage 88.496 km.

Table 3.6 Main Southern Railway culverts

Location	88.232 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers
Site description	Brick culvert. No longer in use.
Assessment of significance	a) Historical significance – culvert 88.232km maintains local contributory significance within the Main Southern Railway representing development and ongoing maintenance of the rail line from point of construction. The culvert presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – culvert 88.232km does not meet the threshold for local significance under this criterion. c) Aesthetic significance - culvert 88.232km maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance - culvert 88.232km does not meet the threshold for local significance under this criterion. e) Research significance - culvert 88.232km has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity - culvert 88.232km is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – culvert 88.232km is representative of brick culverts positioned along the 1919 section of the Main Southern Railway.
Statement of significance	Culvert 88.232km maintains local contributory significance individually and as part of a group of brick culverts positioned along the 1919 section of the Main Southern Railway. Although culverts represent a minor part of the infrastructure of the Main Southern Railway, they demonstrate the technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century.
Site condition	The brick culvert is in good condition, despite a moderate amount of vegetation overgrowth.
Photographs	

Table 3.7 Main Southern Railway culverts

Location	88.698 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers
Site description	Brick culvert. Currently in use over tributary creek to Stonequarry Creek.
Assessment of significance	a) Historical significance – culvert 88.698km maintains local contributory significance within the Main Southern Railway representing development and ongoing maintenance of the rail line from point of construction. The culvert presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – culvert 88.698km does not meet the threshold for local significance under this criterion. c) Aesthetic significance - culvert 88.698km maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance - culvert 88.698km does not meet the threshold for local significance under this criterion. e) Research significance - culvert 88.698km has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity - culvert 88.698km is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – culvert 88.698km is representative of brick culverts positioned along the 1919 section of the Main Southern Railway.
Statement of significance	Culvert 88.698km maintains local contributory significance individually and as part of a group of brick culverts positioned along the 1919 section of the Main Southern Railway. Although culverts represent a minor part of the infrastructure of the Main Southern Railway, they demonstrate the technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century.
Site condition	The brick culvert is in good condition. The cement sandbag shoring may indicate previous conservation works.
Photographs	 View of brick culvert at chainage 88.698 km. Note the cement sandbag shoring.

Table 3.8 Pedestrian subway

Location	88.133 km, Main Southern Railway, Picton
Listing	Not listed on local, state, or national heritage registers
Site description	A pedestrian walkway providing passage underneath the railway line.
Assessment of significance	a) Historical significance – the pedestrian subway maintains local contributory significance within the Main Southern Railway representing a period of development along the rail line. The pedestrian subway presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – the pedestrian subway does not meet the threshold for local significance under this criterion. c) Aesthetic significance – the pedestrian subway maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance – the pedestrian subway does not meet the threshold for local significance under this criterion. e) Research significance – the pedestrian subway has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment. f) Rarity – the pedestrian subway has potential to reach the threshold for this criterion as a subway not associated with a station. g) Representativeness – the pedestrian subway is representative of pedestrian subways positioned along the 1919 section of the Main Southern Railway.
Statement of significance	The pedestrian subway maintains local contributory significance as an element positioned along the 1919 section of the Main Southern Railway. The pedestrian subway demonstrates the technical skill, quality in design, and standards applied to Government infrastructure within NSW during the early twentieth century. It maintains rarity as a subway not associated with a railway station.
Site condition	The pedestrian subway is in good condition, despite a number of superficial cracks and minimal graffiti.
Photographs	

View of pedestrian subway at chainage 88.133 km along the Main Southern Railway, Picton.

Table 3.8 Pedestrian subway

Location	88.133 km, Main Southern Railway, Picton
	
Detail view of pedestrian subway, showing cracks and graffiti.	

Table 3.9 Connellan Crescent Overbridge

Location	12 Connellan Crescent, Picton, 89.080 km, Main Southern Railway
Listing	Not listed on local, state, or national heritage registers
Site description	An overbridge crossing the Great Southern Railway Line supported by reinforced concrete arch and has brick masonry walls either side of the road.
Assessment of significance	a) Historical significance – the Connellan Crescent Overbridge maintains local contributory significance within the Main Southern Railway representing a period of development along the rail line. The Connellan Crescent Overbridge presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. The bridge is a typical example of rail bridges erected in the 1890-1920 period and is an important component within the surrounding cultural landscape. b) Associative significance – the Connellan Crescent Overbridge does not meet the threshold for local significance under this criterion. c) Aesthetic significance – the Connellan Crescent Overbridge maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. It is a good example of an early twentieth century rail bridge and a prominent landmark within the surrounding area. d) Social significance – the Connellan Crescent Overbridge does not meet the threshold for local significance under this criterion. e) Research significance – the Connellan Crescent Overbridge maintains local significance though its ability to provide information concerning early twentieth century engineering techniques and the construction of the Main Southern Railway line. f) Rarity – the Connellan Crescent Overbridge is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – the Connellan Crescent Overbridge is representative of early twentieth century railway bridges positioned along the 1919 section of the Main Southern Railway.
Statement of significance	The Connellan Crescent Overbridge maintains local contributory significance for its association with the construction of the Main Southern Railway line. It is a typical example of rail bridges constructed in the 1890-1920 period built to an established model by the NSW Government Railways.

Table 3.9 Connellan Crescent Overbridge

Location	12 Connellan Crescent, Picton, 89.080 km, Main Southern Railway
Site condition	The Connellan Crescent Overbridge is in good overall condition, despite a moderate amount of graffiti.
Photographs	 Southwest facing view of the Connellan Crescent Overbridge from within the Main Southern Railway corridor.  Southwest facing view of the Connellan Crescent Overbridge from within the Main Southern Railway corridor showing graffiti. Note the evidence of timber formwork on the concrete arch.

Table 3.10 High retaining wall

Location	84.687 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers but may be within the SHR curtilage for the Picton Railway Station Group
Site description	A retaining wall adjacent to the Main Southern Railway that is not within a valley or stream channel. The retaining wall was identified by EMM consultants, however due to access restrictions, photos have been provided by SIMEC Mining.
Assessment of significance	a) Historical significance – the high retaining wall maintains local contributory significance within the Main Southern Railway representing a period of development along the rail line from point of construction. The high retaining wall presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line.

Masonry retaining walls are common along NSW rail lines, however, the size and location form an important landscape element.

- b) Associative significance – the high retaining wall does not meet the threshold for local significance under this criterion.
- c) Aesthetic significance – the high retaining wall maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. The retaining wall is an important element within the surrounding cultural landscape due to its size and location.
- d) Social significance – the high retaining wall does not meet the threshold for local significance under this criterion.
- e) Research significance – the high retaining wall has the potential to provide information regarding early twentieth century construction methods. These construction methods varied on local, regional, and state level scales and were tailored to meet the requirements of a diverse environment.
- f) Rarity – the high retaining wall is not considered rare and does not meet the threshold for local significance under this criterion.
- g) Representativeness – the high retaining wall is representative of retaining walls positioned along the 1919 section of the Main Southern Railway.

Statement of significance The high retaining wall maintains local contributory significance as an element positioned along the 1919 section of the Main Southern Railway. The high retaining wall demonstrates the technical skill and standards applied to Government infrastructure within NSW during the early twentieth century. The retaining wall is an important element within the surrounding cultural landscape due to its size and location.

Site condition The high retaining wall is in good condition.

Photographs



East facing view of high retaining wall from Stonequarry Creek.



East facing view of high retaining wall from Stonequarry Creek.

Table 3.11 Bridge on Mathews Lane

Location	84.551 km, Main Southern Railway, Picton
Listing	Not listed on local, state or national heritage registers
Site description	A single lane timber beam bridge over the Main Southern Railway supported by timber trestles on concrete upstand beams
Assessment of significance	a) Historical significance – the bridge on Mathews Lane maintains local contributory significance within the Main Southern Railway representing a period of development along the rail line from point of construction. The bridge on Mathews Lane presents changing construction techniques in the early twentieth century as part of the range of works undertaken for the deviation works (1919) to overcome the steep gradients and limitations of the rail line. b) Associative significance – the Bridge on Mathews Lane does not meet the threshold for local significance under this criterion. c) Aesthetic significance – the bridge on Mathews Lane is indicative of early twentieth century timber bridge technology and its use in the development of railway infrastructure within the local region. d) Social significance – the bridge on Mathews Lane does not meet the threshold for local significance under this criterion. e) Research significance – the bridge on Mathews Lane has the potential to yield information relating to the use, development, and modification of timber beam technology in the local region as part of the continued use of the railway network. f) Rarity – the bridge on Mathews Lane is not considered rare and does not meet the threshold for local significance under this criterion. g) Representativeness – the bridge on Mathews Lane is representative in its use of timber beam technology in the construction of railway bridges in the local region.
Statement of significance	The bridge on Mathews Lane maintains local contributory significance individually as an element positioned along the 1919 section of the Main Southern Railway. The Bridge on Mathews Lane demonstrates the use, development, and modification of timber beam technology into the early twentieth century.
Site condition	The Bridge on Mathews Lane is in good condition.

Photographs



East facing view of Bridge on Mathews Lane showing timber decking, metal guard rails and modern signage.



East facing view of underside of Bridge on Mathews Lane showing timber cross bracing and concrete foundations.

Table 3.12 Prince Street Overbridge

Location	85.171 km, Main Southern Railway, Picton
Listing	Not listed on local, State or National heritage registers.
Site description	The Prince Street Overbridge is a steel framed bridge with steel guard rails supported by concrete headstocks over brick arched piers that crosses over the Main Southern Railway at Picton Station.
Assessment of significance	a) Historical significance – the Prince Street Overbridge maintains local contributory significance for its association with the Main Southern Railway representing a period of development along the rail line (1919). The bridge is typical of rail bridges constructed in the 1890-1920 period, built to an established model by NSW Government Railways. b) Associative significance – the Prince Street Overbridge does not meet the threshold for local significance under this criterion. c) Aesthetic significance – the Prince Street Overbridge maintains local contributory significance presenting brickwork demonstrating technical skill and standards applied to Government infrastructure programs during the early twentieth century. d) Social significance – the Prince Street Overbridge does not meet the threshold for local significance under this criterion.

-
- e) Research significance – the Prince Street Overbridge has local significance through its ability to provide information regarding early twentieth century engineering techniques and the construction of the southern rail line.
 - f) Rarity – the Prince Street Overbridge is not considered rare and does not meet the threshold for local significance under this criterion.
 - g) Representativeness – the Prince Street Overbridge is representative of early twentieth century rail bridges positioned along the 1919 section of the Main Southern Railway.

Statement of significance The Prince Street Overbridge maintains local contributory significance individually as an element positioned along the 1919 section of the Main Southern Railway. The Prince Street Overbridge demonstrates the technical skill and standards applied to Government infrastructure within NSW during the early twentieth century. It is a good representative example of an early twentieth century rail bridge.

Site condition The Prince Street Overbridge is in good condition, despite a moderate amount of graffiti.

Photographs



Southeast facing view of the Prince Street Overbridge from within the Main Southern Railway corridor showing brick piers and pedestrian access staircase.



WSW facing view of Prince Street Overbridge showing brick arched piers and railway cutting (into sandstone bedrock).

4 Discussion and conclusion

Twelve unlisted heritage features were located and surveyed during the site inspection undertaken by EMM on 12 July 2021:

- Main Southern Railway Culverts:
 - 87.331 km
 - 87.918 km
 - 89.216 km
 - 88.091 km
 - 88.232 km
 - 88.496 km
 - 88.698 km
- Pedestrian subway (88.133 km)
- Connellan Crescent Overbridge
- High retaining wall 84.687 km¹
- Bridge on Matthews Lane
- Prince Street Overbridge

Eleven of the features were confirmed as holding local contributory significance within the area as individual items and as a group. They maintain historical significance as part of the works and structures constructed along the Main Southern Railway. However, the concrete drain culvert identified at chainage 87.918 does not appear to reach the threshold for local contributory significance. The brick culverts, pedestrian subway, Prince Street Overbridge and Connellan Crescent Overbridge are likely to date to 1919, during a period of modification works along the railway line, whilst the bridge on Mathews Lane, as a timber beam bridge has potential to maintain an earlier construction date, although modified.

The features were found to be in generally good condition, despite areas of graffiti and vegetative growth. However, this appears to have been superficial, not resulting in substantial structural damage to the heritage items.

The unlisted heritage features are located outside the study area and are therefore not expected to maintain direct (physical) or indirect (visual) impacts as a result of the project works. However, there is potential for indirect vibration impacts to occur as a result of the proposed works. As such, it is recommended that the eleven features identified within the report be included within the ongoing subsidence monitoring program currently undertaken for the project.

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Appendix A

Heritage items

A.1 Heritage items

Table 5.1 Heritage items

Within the study area		Abutting the study area		Outside the study area but may experience far field movements	
Registered	Non-registered	Registered	Non-registered	Registered	Non-registered
• Mushroom Tunnel • Railway Deviation Works – Picton Tunnel • Rural Landscape – Thirlmere Way • Redbank Uniting Church • Weatherboard Cottage • Antill Street Underbridge	• Loop Line culverts – 88.980 – 88.400 – 87.850 – 87.630 – 87.330 – 87.300			• Picton Viaduct • Argyle Street Underbridge (Hole in the Wall) • Pedestrian overbridge 86.1 km	
Items that require inspection					
	• Main Southern Railway culverts – 87.331 – 87.918 – 89.216		• Main Southern Railway culverts – 88.091 – 88.232 – 88.496 – 88.698 • Pedestrian subway (88.133 km) • Connellan Crescent Overbridge		• High retaining wall 84.687 km² • Bridge on Matthews Lane • Prince Street Overbridge

² This item may be within the curtilage of SHR item: Picton Railway Station Group (01224).

Appendix B

Site inspection photographs

B.1 Site inspection photographs



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



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Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Culvert 87.331km



Concrete drain at chainage 87.918km



Concrete drain at chainage 87.918km



Concrete drain at chainage 87.918km



Culvert 89.216km



Culvert 89.216km



Culvert 89.216km



Culvert 89.216km



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Culvert 89.216km



Culvert 88.091km



Culvert 88.091km



Culvert 88.091km



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Culvert 88.091km



Culvert 88.232km



Culvert 88.232km



Culvert 88.232km



Culvert 88.496km



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Pedestrian subway



Pedestrian subway



Pedestrian subway



Pedestrian subway



Pedestrian subway



Pedestrian subway



Pedestrian subway



Connellan Crescent Overbridge



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High retaining wall



High retaining wall



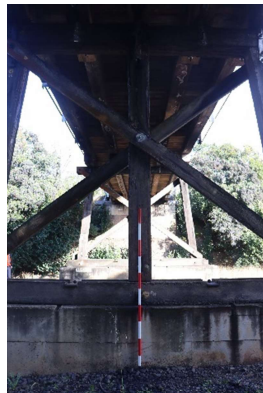
High retaining wall



Bridge on Mathews Lane



Bridge on Mathews Lane



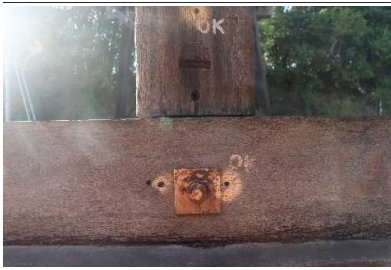
Bridge on Mathews Lane



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Prince Street Overbridge



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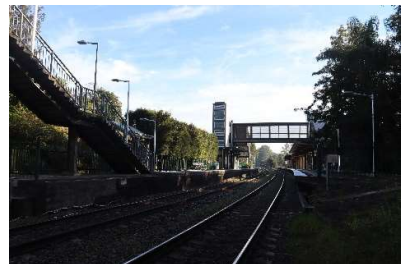
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