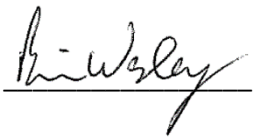
YANCOAL
兖煤澳大利亚有限公司
MOOLARBEN COAL

UG4 LONGWALLS 401 TO 408 BUILT FEATURES MANAGEMENT PLAN ULAN COAL MINES PTY LIMITED

Document	Version	Issue	Effective	Author	Approved
MCO_BFMP_UCMPL	1	June 22	July 22	MCO	B. Wesley

Version	Issue Date	Approval Date	Description	Author(s)	Review Team
1	June 2022	July 2022	Approved	MCO and MSEC	MCO

Approved:  Date: 15/07/2022

Document	Version	Issue	Effective	Author	Approved
MCO_BFMP_UCMPL	1	June 22	July 22	MCO	B. Wesley

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

The Moolarben Coal Complex (MCP) is an open cut and underground coal mining operation located approximately 40 kilometres north of Mudgee in the Western Coalfield of New South Wales (NSW) (Figure 1).

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben [YM] Pty Ltd and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited.

The UG4 Underground Mine (UG4) is a component of the approved Moolarben Coal Complex (**Figure 2**). First workings for UG4 North Mains commenced in October 2020 (**Figure 3**). Secondary extraction in UG4 of the first Longwall LW401 is scheduled to commence in 2022 (**Table 2**).

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and continue to be carried out in accordance with Project Approval (05_0117) (Moolarben Coal Project Stage 1) (as modified) and Project Approval (08_0135) (Moolarben Coal Project Stage 2) (as modified).

The UG4 Longwalls 401 to 408 Built Features Management Plan – Ulan Coal Mines Pty Limited (LW401-408 BFMP-UCMPL) forms a part of the Extraction Plan for Longwalls 401 to 408 (herein referred to as Longwalls 401-408) of the approved UG4 Underground Mine.

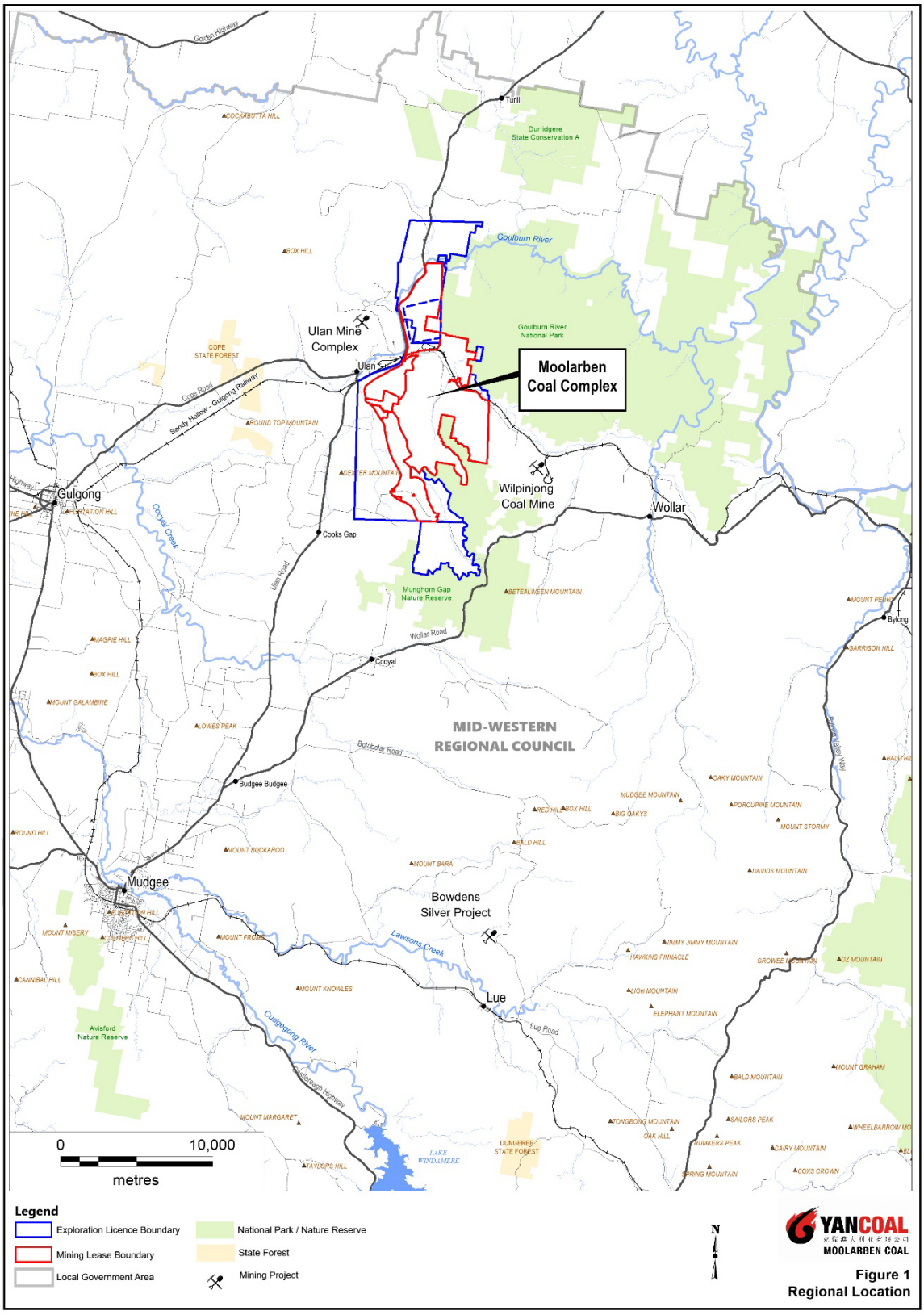
1.1 PURPOSE AND SCOPE

Purpose: This LW401-408 BFMP-UCMPL outlines the management of potential subsidence impacts of the proposed secondary workings described in the Extraction Plan on UCMPL infrastructure.

Scope: This LW401-408 BFMP-UCMPL covers UCMPL infrastructure within and proximal to the Study Area[1] and immediate surrounds, which relates to the extent of subsidence effects resulting from the secondary extraction of Longwalls 401-408 (**Figure 4**).

[1] Longwalls 401-408 and the area of land within the furthest extent of the 26.5 degree (°) angle of draw and 20 millimetres (mm) predicted subsidence contour. UCMPL infrastructure assets are not located within the Study Area, however may be subject to far field movements (**Section 4.3**).

Figure 1 Locality



Document	Version	Issue	Effective	Author	Approved
MCO_BFMP_UCMPL	1	June 22	July 22	MCO	B. Wesley

Figure 2 Moolarben Coal Complex Layout

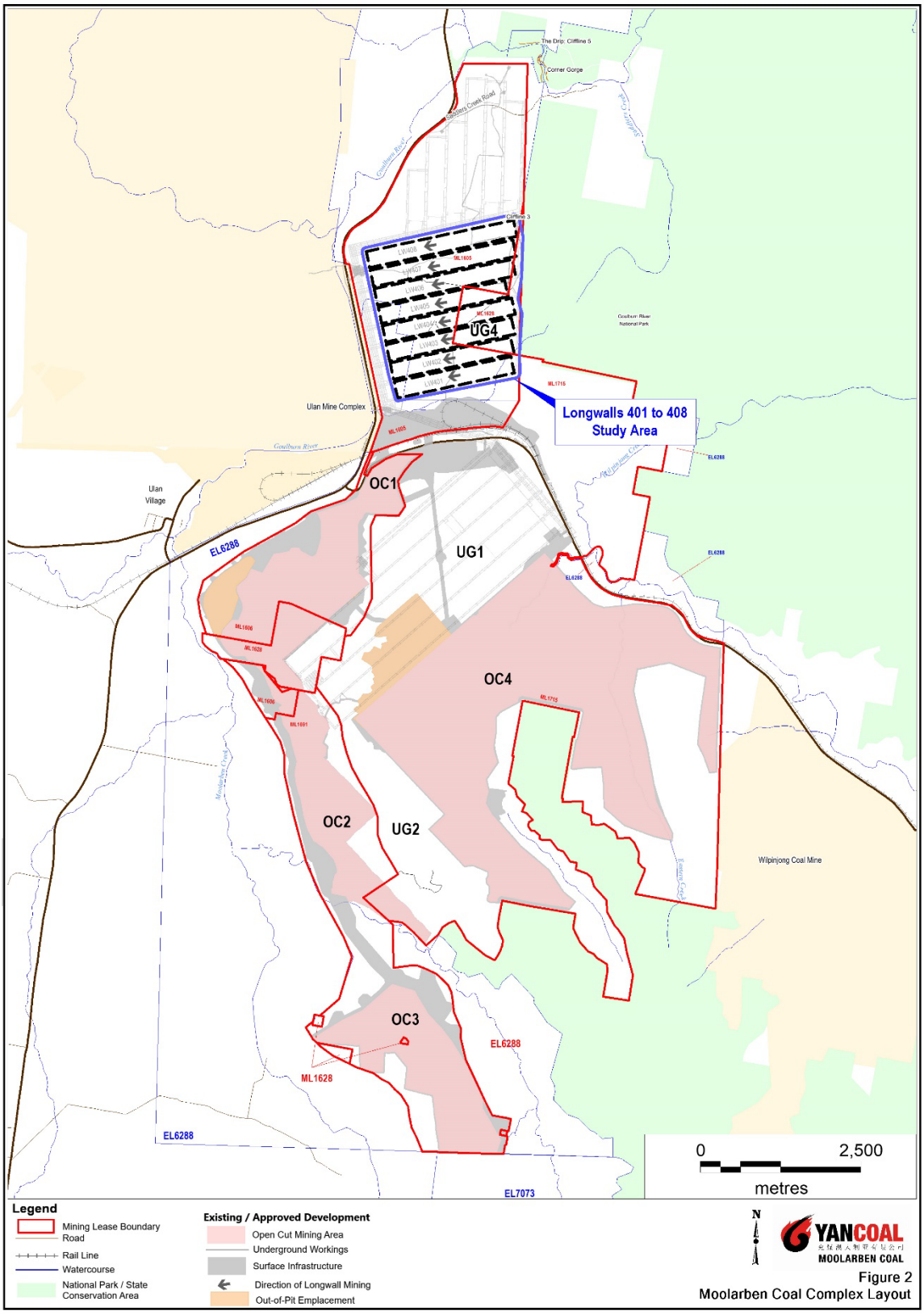


Figure 3 UG4 Longwalls 401 to 408 Layout

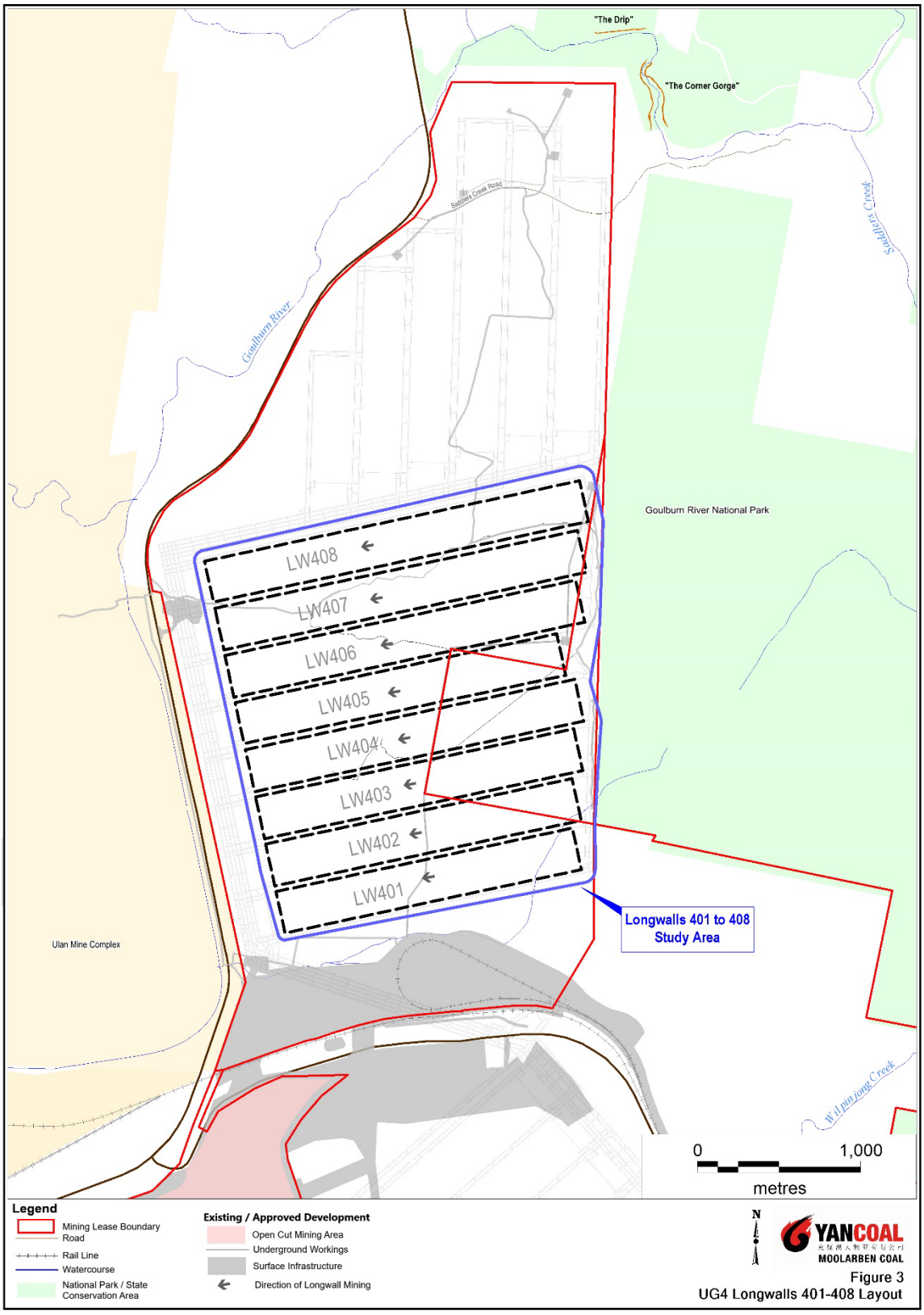
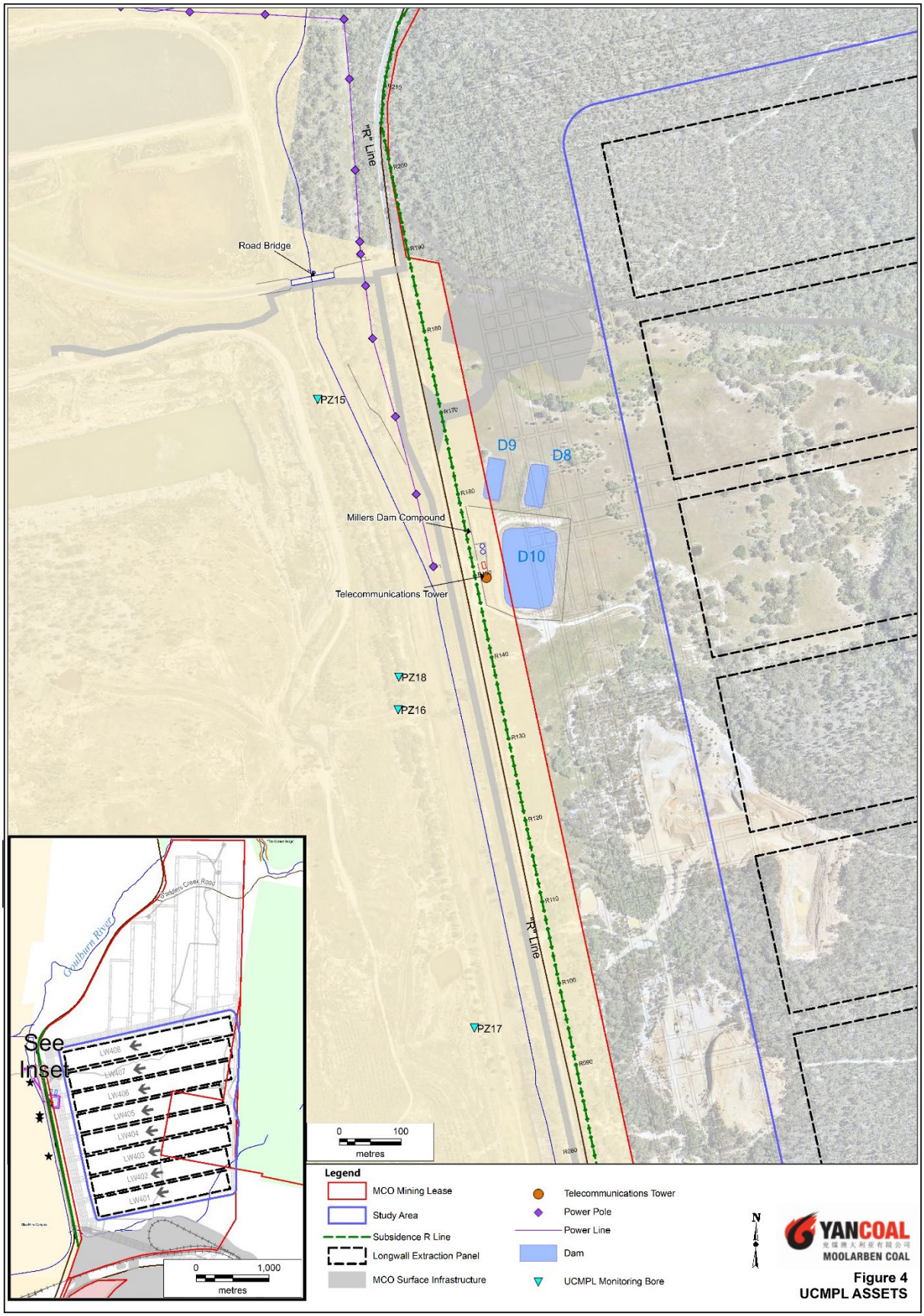


Figure 4 UCMPL Assets



Document	Version	Issue	Effective	Author	Approved
MCO_BFMP_UCMPL	1	June 22	July 22	MCO	B. Wesley

1.2 SUITABLY QUALIFIED AND EXPERIENCED PERSONS

In accordance with Condition 77(a), Schedule 3 of Project Approval (05_0117), the suitably qualified and experienced persons that have prepared this LW401-408 BFMP-UCMPL, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and MCO, were endorsed by the Secretary of the Department of Planning, Industry and Environment (DPIE).

This LW401-408 BFMP-UCMPL has been prepared in consultation with Ulan Coal Mines Pty Limited (UCMPL) (**Section 4.4**).

A list of the key responsibilities of MCO personnel in relation to this LW401-408 BFMP-UCMPL, and a list of key contacts is provided in **Section 11**.

1.3 STRUCTURE OF THE LONGWALLS 401-408 BFMP-UCMPL

The remainder of the LW401-408 BFMP-UCMPL is structured as follows:

Section 2: Describes the review and update of the LW401-408 BFMP-UCMPL.

Section 3: Outlines the statutory requirements applicable to the LW401-408 BFMP-UCMPL.

Section 4: Provides baseline data, extraction schedule, revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 401-408, as well as the outcomes of the risk assessment.

Section 5: Details the performance measures relevant to UCMPL assets.

Section 6: Describes the monitoring program.

Section 7: Describes the management measures that will be implemented.

Section 8: Details the performance indicators that will be used to assess against the performance measures.

Section 9: Provides a contingency plan to manage any unpredicted impacts and their consequences.

Section 10: Describes the Trigger Action Response Plan (TARP) management tool.

Section 11: Describes the roles and responsibilities for MCO personnel and key contacts.

Section 12: Describes the program to collect sufficient baseline data for future Extraction Plans.

Section 13: Describes the Annual Review, audits, regular reporting and improvement of environmental performance.

Section 14: Outlines the management and reporting of incidents.

Section 15: Outlines the management and reporting of complaints.

Section 16: Outlines the management and reporting of non-compliances with statutory requirements.

Section 17: Lists the references cited in this LW401-408 BFMP-UCMPL.

2.0 LONGWALLS 401 TO 408 BFMP-UCMPL REVIEW AND UPDATE

In accordance with Condition 5, Schedule 5 of Project Approval (05_0117), this LW401-408 BFMP-UCMPL will be reviewed as follows:

> *5. Within 3 months of the submission of:*
>
> *(a) the submission of annual review under condition 4 above;*
>
> *(b) the submission of an incident report under condition 7 below;*
>
> *(c) the submission of an audit under condition 9 below; or*
>
> *(d) any modification to the conditions of this approval (unless the conditions require otherwise),*
>
> *the Proponent shall review and, if necessary, revise the strategies, plans, and programs required under this approval to the satisfaction of the Secretary. Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted to the Secretary for approval*

2.1 ACCESS TO INFORMATION

In accordance with Condition 11, Schedule 5 of Project Approval (05_0117), MCO will make the approved LW401-408 BFMP-UCMPL publicly available on the MCO website.

3.0 STATUTORY REQUIREMENTS

MCO's statutory obligations are contained in:

- the conditions of the NSW Project Approval (05_0117) (as modified)
- the conditions of Commonwealth Approvals (EPBC 2007/3297, EPBC 2013/6926, EPBC 2008/4444 and EPBC 2017/7974);
- relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL) No. 12932 and MLs (i.e. ML 1605, ML 1606, ML 1628, ML 1691 and ML 1715); and
- other relevant legislation.

Obligations relevant to this LW401-408 BFMP-UCMPL are described below.

3.1 EP&A ACT PROJECT APPROVAL

Condition 77(g), Schedule 4 of Project Approval (05_0117), requires the preparation of a Built Features Management Plan as a component of the Extraction Plan. In addition, Conditions 75, 76, 77(n), 77(p) and 79, Schedule 4 and Condition 3, Schedule 5 of Project Approval (05_0117) outline general management plan requirements that are applicable to the preparation of this LW401-408 BFMP-UCMPL.

Table 1 presents these requirements and indicates where they are addressed within this LW401-408 BFMP-UCMPL.

Table 1 Management Plan Requirements

Project Approval (05_0117) Condition	LW401-408 BFMP-UCMPL Section
Condition 75, Schedule 3	
Notes: *...* • *The Proponent will be required to define more detailed performance indicators for each of these performance measures in Built Features Management Plans or Public Safety Management Plan (see condition 74 below).* • *Measurement and/or monitoring of compliance with performance measures and performance indicators 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. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.* *...* • *Requirements under this condition may be met by measures undertaken in accordance with the Mine Subsidence Compensation Act 1961.* *...*	**Section 7** **Sections 6** **Section 9**
Condition 76, Schedule 3	
Any dispute between the Proponent and the owner of any built feature over the interpretation, application or implementation of the performance measures in Table 15 is to be settled by the Secretary, following consultation with the Resources Regulator. Any decision by the Secretary shall be final and not subject to further dispute resolution under this approval.	**Section 8**
Condition 77(g), Schedule 3	
(g) include a Built Features Management Plan, which has been prepared in consultation with Resources Regulator and the owners of affected public infrastructure, to manage the potential subsidence impacts and/or environmental consequences of the proposed second workings, and which: • *addresses in appropriate detail all items of key public infrastructure and other public infrastructure and all classes of other built features;* • *has been prepared following appropriate consultation with the owner/s of potentially affected feature/s;* • *recommends appropriate remedial measures and includes commitments to mitigate, repair, replace or compensate all predicted impacts on potentially affected built features in a timely manner; and* • *in the case of all key public infrastructure, and other public infrastructure except roads, trails and associated structures, reports external auditing for compliance with ISO 31000 (or alternative standard agreed with the infrastructure owner) and provides for annual auditing of compliance and effectiveness during extraction of longwalls which may impact the infrastructure;*	**Section 4.1** **Section 4.4** **Sections 7 & 9** **Section 13.1**
Condition 77(n), Schedule 3	
(n) include a contingency plan that expressly provides for adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Tables 18 and 19, or where any such exceedance appears likely;.	**Section 9**
Condition 77(p), Schedule 3	
(p) include a program to collect sufficient baseline data for future Extraction Plans.	**Section 12**

Table 1 (Continued): Management Plan Requirements

Project Approval (05_0117) Condition	LW401-408 BFMP-UCMPL Section
Condition 78, Schedule 3	
6. The Proponent shall ensure that the management plans required under conditions 77(g)-(l) above include:	
a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval; and	**Section 4**
b) a detailed description of the measures that would be implemented to remediate predicted impacts.	**Section 7**
Condition 3, Schedule 5	
3. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:	
a) detailed baseline data;	**Section 4.1**
b) a description of:	
• *the relevant statutory requirements (including any relevant approval, licence or lease conditions);*	**Section 3**
• *the relevant limits or performance measures/criteria;*	**Section 5**
• *the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;*	**Section 8**
c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	**Sections 7 & 9**
d) a program to monitor and report on the:	**Sections 6, 8 & 13**
• *impacts and environmental performance of the project;*	
• *effectiveness of any management measures (see c above);*	
e) a contingency plan to manage any unpredicted impacts and their consequences;	**Section 9**
f) a program to investigate and implement ways to improve the environmental performance of the project over time;	**Sections 6 & 13**
g) a protocol for managing and reporting any:	
• *incidents;*	**Section 14**
• *complaints;*	**Section 15**
• *non-compliances with statutory requirements; and*	**Section 16**
• *exceedances of the impact assessment criteria and/or performance criteria; and*	**Section 9**
h) a protocol for periodic review of the plan.	**Section 2**

3.2 OTHER LEGISLATION

The Acts which may be applicable to the conduct of the Moolarben Coal Complex includes, but is not limited to, the:

- *Crown Lands Act, 1989;*
- *Fisheries Management Act, 1994;*
- *Heritage Act, 1977;*
- *Coal Mine Subsidence Compensation Act, 2017;*
- *Mining Act, 1992;*
- *National Parks and Wildlife Act, 1974;*
- *Biodiversity Conservation Act, 2016;*
- *Protection of the Environment Operations Act, 1997;*
- *Roads Act, 1993;*

- *Water Act, 1912;*
- *Water Management Act, 2000;*
- *Work Health and Safety Act, 2011;* and
- *Work Health and Safety (Mines and Petroleum Sites) Act, 2013.*

Relevant licences or approvals required under these Acts will be obtained as required.

4.0 ULAN COAL MINES PTY LIMITED INFRASTRUCTURE

4.1 BASELINE DATA

UCMPL infrastructure assets are not located within the Study Area, however may be subject to far field movements.

UCMPL infrastructure in the vicinity of Longwalls 401 to 408 includes (**Figure 4**):

- A bridge over the Goulburn River;
- A groundwater bore (PB1C) and water pipelines;
- Monitoring bores PZ15-18 adjacent to the East Pit
- powerlines;
- Telecommunications tower; and
- Millers Dam with associated water treatment facility, concrete tanks and security fencing.

The Millers Dam Compound is located to the west of Longwalls 406 and 407. There are three dams 200 m to 310 m from the longwalls. Two of the dams have plan dimensions of approximately 70 m x 30 m and one larger dam has plan dimensions of approximately 85 m x 130 m. Embankments surrounding the dams are up to approximately 2 m height. Other features located 320 m to 350 m from the longwalls include a reverse osmosis plant, two above ground concrete storage tanks, telecommunications tower, cyclone fencing, and pipes and power lines (MSEC, 2021). UCMPL intend to decommission the Millers Dam Compound prior to extraction of Longwall 406.

The overhead powerlines are supported on timber poles and are located on the western side of Ulan Road at approximately 400 m from the longwalls. The depth of cover at the finishing ends of Longwalls 406 and 407 is approximately 85 m. The Millers Dam Compound infrastructure are therefore located at 2.4 to 4 times the depth of cover from the longwalls (MSEC, 2021).

The nearest groundwater bore (PB1C) is located 430 m from Longwall 408, which represents 3.3 times the depth of cover at this location. Groundwater levels at PB1C have been influenced by past and continuing mining operations in the region. Monitoring piezometers PZ15 to PZ18 are located between the UCML East Pit to the west and the Goulburn River Diversion to the East. The bridge over the Goulburn River diversion is located 470 m from Longwall 408, which represents 3.6 times the depth of cover at this location. (MSEC, 2021) (**Figure 4**).

4.2 LONGWALLS 401-408 EXTRACTION SCHEDULE

Longwalls 401-408 and the area of land within Study Area are shown on **Figures 3** and **4**. Longwall extraction will occur from the east to the west. The longwall layout includes approximately 260 m panel widths (void) with 35 m width pillars (solid). The provisional extraction schedule for Longwalls 401-408 is provided in **Table 2**.

Table 2 Provisional Extraction Schedule

Longwall	Estimated Start Date	Estimated Duration (months)	Estimated Completion Date
LW401	June 2022	4	October 2022
LW402	November 2022	4	March 2023
LW403	April 2023	4	August 2023
LW404	August 2023	5	January 2024
LW405	February 2024	4	June 2024
LW406	July 2024	5	December 2024
LW407	January 2025	4	May 2025
LW408	June 2025	4	November 2025

4.3 REVISED SUBSIDENCE AND IMPACT PREDICTIONS

Revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings have been prepared by MSEC, incorporating any relevant information obtained since approval.

The LW401-408 BFMP-UCMPL for UG4 has incorporated the revised subsidence predictions and impacts as they relate to far field movements on UCMPL infrastructure from Longwalls 401-408. A summary of the subsidence impacts and prediction is provided in **Section 4.3.1**, and **Attachment 1**.

4.3.1 UG4 Revised Subsidence Impacts & Predictions

A summary of the subsidence predictions (MSEC, 2021) is provided below:

- The Ulan Coal Mine infrastructure is located outside the Study Area boundary and is not expected to be subjected to measurable conventional vertical subsidence, tilt, curvature or strain. Observed far-field horizontal movements at the location of the infrastructure are expected to be less than 70 mm.

- There is a low probability that significant strains could develop at the location of the infrastructure due to non-conventional movements, and as a result, the development of adverse impacts to the infrastructure due to the extraction of Longwalls 401 to 408 are considered unlikely to occur.

- With the location of the infrastructure outside the longwall footprint and the low probability of significant observed strains developing based on statistical analysis, the development of adverse impacts to the infrastructure due to the extraction of Longwalls 401 to 408 is considered to be unlikely to occur.

It is expected that UCMPL infrastructure can be maintained in serviceable condition with the implementation of the appropriate monitoring and management strategies (**Sections 6** and **7**).

4.4 RISK ASSESSMENT

In accordance with the draft *Guidelines for the Preparation of Extraction Plans* (DP&E and DRE, 2015), potential risks and potential risk control measures and procedures have been considered for the UCMPL infrastructure in the vicinity of Longwalls 401-408.

The investigation included:

- Confirmation of relevant UCMPL assets.
- Review of the revised subsidence predictions and potential impacts on UCMPL assets (including consideration of past experience in for UG1 and in the Western Coalfield).
- Consideration of the proposed monitoring program, management measures and contingency measures.

The following potential risks were identified during the risk assessment (AXYS, 2021):

- Longwall mining causes impacts to UCMPL Infrastructure and MCO are required to compensate UCMPL to make repairs.

A number of risk control measures and procedures were identified. The proposed risk control measures and procedures have been incorporated where relevant in this LW401-408 BFMP-UCMPL and the program for implementation is summarised in **Table 3**.

MCO considers all risk control measures and procedures to be feasible to manage all identified risks.

Table 3 Program for Implementation of Proposed Risk Control Measures and Procedures

	Risk Control Measure / Procedure	LW401-408 BFMP-UCMPL Section	Proposed Timing
Baseline Data / Validation			
1	Carry out pre mining condition assessments of the UCMPL infrastructure within 400 m of Longwalls 401 to 408 (this may include visual, and survey assessments)	**Section 6.2**	Prior to Longwall 404
2	Provide UCMPL with a copy of the pre mining condition assessments of the UCMPL infrastructure within 400 m of Longwalls 401 to 408	**Section 6.2**	Prior to Longwall 404
3	Installation of UG4 subsidence effect monitoring line and commencement of the subsidence monitoring program for Longwalls 401 - 408.	**Section 6**	Prior to Longwall 401
Management / Monitoring / Response Measures			
4	Establish key contacts list in the LW401-408 BFMP-UCMPL.	**Section 11.1**	Complete
5	Include a schedule of times/frequency of communication with UCMPL for the status of mining of Longwalls 401-408 in the LW401-408 BFMP-UCMPL.	**Section 7 and Table 6**	Complete
6	Include in the TARP triggers for conditions that may need to be actioned by MCO and/or UCMPL.	**Section 10 and Attachment 1**	Complete
7	Include a monitoring plan in the LW401-408 BFMP-UCMPL to implement visual inspections of UCMPL infrastructure with 400m of Longwalls 401-408 during active subsidence.	**Table 5**	Complete

5.0 PERFORMANCE MEASURES

The performance measures specified in Table 15, Schedule 4 of Project Approval (05_0117) relevant to UCMPL infrastructure, as other built features, are listed in **Table 4**.

Table 4 Built Features Subsidence Impact Performance Measures

Feature	Subsidence Impact Performance Measure
Other infrastructure:	
Other built features and improvements, including fences	Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else fully replaced or fully compensated.

Source: Table 15 in Schedule 3 of Project Approval (05_0117).

In accordance with Condition 75, Schedule 4 of Project Approval (05_0117), MCO must ensure that there is no exceedance of the performance measures listed in Table 15, Schedule 3 of Project Approval (05_0117), to the satisfaction of the Secretary of the DPIE.

Section 6 outlines the monitoring that will be undertaken to assess the impact of Longwalls 401-408 against the performance measures in relation to the UCMPL Infrastructure. Management measures for the UCMPL infrastructure are outlined in **Section 7** and performance indicators for the performance measures are summarised in **Section 8**.

6.0 MONITORING

A monitoring program will be developed in order to monitor the impacts of the extraction of Longwalls 401-408 on UCMPL infrastructure to identify loss of serviceability during or after mining. Key components of the monitoring program are summarised in **Table 5**.

Table 5 UCMPL Infrastructure Monitoring Program Overview

Monitoring Component	Parameter	Timing/Frequency	Responsibility
Pre-mining			
Visual inspection of UCMPL Infrastructure within 400m of Longwalls 401-408	Inspect and record condition of bridge, pipelines, powerlines, dams, water treatment facility, concrete slabs and tanks, security fencing and telecommunications tower.	Prior to the secondary extraction of Longwall 404	Underground Technical Manager and representative of asset owner if required
Survey power poles, Goulburn River Diversion Bridge and telecommunications tower within 400m of Longwalls 401-408	Baseline survey – monitoring points at each timber pole, Goulburn River Diversion Bridge and at the telecommunications tower	Prior to the secondary extraction for Longwall 404	Underground Technical Manager / Registered Mine Surveyor
Pre-mining			
UG4 subsidence monitoring lines, as described in the UG4 Longwalls 401 to 408 Subsidence Monitoring Program (LW401- 408 SMP).	Installation of survey monitoring program and initial ground survey ('R Line'). Monitoring parameters include: • Easting; • Northing ; • Vertical Subsidence; • tilt; • tensile strain; and • compressive strain;	Prior to the secondary extraction of Longwall 401	Underground Technical Manager / Registered Mine Surveyor
Goulburn River	Undertake a baseline inspection at access points along Goulburn River adjacent to LW401 - 408, noting the condition of vegetation in the channel and any areas of active erosion, sediment deposition, water ponding or streambed cracking. Collect photographic record of channel condition.	Prior to completion of LW401	Environment and Community Manager

Monitoring Component	Parameter	Timing/Frequency	Responsibility
During and After Mining			
Visual inspection of UCMPL Infrastructure within 400m of Longwalls 401-408	Inspect and record condition of bridge, pipelines, powerlines, dams, water treatment facility, concrete slabs and tanks, security fencing and telecommunications tower.	If/when ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'R Line' within 400m of UCMPL infrastructure Opportunistic visual observations during routine works by MCO and its contractors or UCML. Provide a copy of the results of the visual inspections after each Longwall 401 to 408 to UCMPL	Underground Technical Manager
UG4 subsidence monitoring lines, as described in the UG4 Longwalls 401 to 408 Subsidence Monitoring Program (LW401- 408 SMP).	Survey monitoring program for subsidence parameters measured along the 'R Line', including: • Easting; • Northing ; • Vertical Subsidence; • tilt; • tensile strain; and • compressive strain.	At the completion of each Longwall 401-408	Underground Technical Manager / Registered Mine Surveyor
During and After Mining			
Survey power poles, Goulburn River Diversion Bridge, and telecommunications tower within 400m of Longwalls 401-408	Baseline survey – monitoring points at each timber pole, Goulburn River Diversion Bridge and at the telecommunications tower	If/when ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'R Line' within 400m of UCMPL infrastructure At any time in case of fault or emergency and where requested by UCMPL.	Underground Technical Manager / Registered Mine Surveyor
Goulburn River	Undertake periodic visual inspection and update photographic record	6 monthly until 1 year after completion of Longwall 408 extraction	Environment and Community Manager

The frequency of monitoring will be reviewed either:

- In accordance with the Annual Review; or
- If monitoring determines there has been less impact to the UCMPL Infrastructure than predicted, in consultation with UCMPL; or
- If triggered as a component of the Contingency Plan as outlined in **Section 9** of this LW401-408 BFMP-UCMPL.

6.1 SUBSIDENCE PARAMETERS

Subsidence parameters measured by a survey line 'R Line' (i.e. Easting, Northing, Vertical Subsidence, tilt, tensile strain, and compressive strain) associated with mining will be measured in accordance with the UG4 Longwalls 401 to 408 Subsidence Monitoring Program (LW401-408 SMP).

In summary, surveys will be conducted to measure subsidence movements in three dimensions using a total station survey instrument. Subsidence movements (i.e. subsidence, tilt, tensile strain and compressive strain) will be measured along subsidence lines that have been positioned across the general landscape.

Monitoring of subsidence parameters will be measured by a single survey line 'R Line'. Surveys along the 'R Line' will be undertaken prior to extraction of Longwall 401 and at the completion of each Longwall 401-408.

Unless otherwise agreed with UCMPL, inspection sheets detailing the outcome of the subsidence impact monitoring program will be provided to UCMPL following confirmation of the results.

6.2 SUBSIDENCE IMPACTS

A baseline visual inspection of UCMPL Infrastructure within the vicinity of Longwalls 401-408 will be conducted prior to commencement of Longwall 404 to establish the condition of a bridge, pipelines, powerlines, dams, water treatment facility, concrete slabs and tanks, security fencing and telecommunications tower within 400m of Longwalls 401 to 408.

The baseline visual inspection will be conducted by MCO and include:

- recording of existing defects, cracking, tilting, surface condition of infrastructure using photography; and
- survey power poles and telecommunications tower.

Where relevant, inspections of subsidence impacts will include photographic record of the impacts from nominated photo points for comparison with baseline photographic records.

A copy of the visual inspection report will be provided to UCMPL. In the event monitoring identifies ground movement greater than the predicted subsidence monitoring parameters for UG4 and those predictions described in **Section 4.3,** MCO will undertake an inspection of UCMPL infrastructure within 400m of Longwalls 401-408 for any potential impacts caused by subsidence movements. Opportunistic observations of subsidence impacts will be conducted during routine works by MCO (and its contractors).

Information will be recorded in the LW401-408 BFMP-UCMPL Subsidence Impact Register (**Attachment 2**) and reported in accordance with Project Approval (05_0117) (**Section 13**).

MCO will compare the results of the subsidence impact monitoring against the built features performance measure and indicators (**Sections 5 and 8**). In the event the observed subsidence impacts from the Moolarben Coal Complex exceed the performance measure or indicators, MCO and UCMPL will assess the consequences of the exceedance in accordance with the Contingency Plan described in **Section 9**.

7.0 MANAGEMENT MEASURES

A number of potential management measures in relation to the UCMPL Infrastructure are considered to be applicable.

The implementation of management measures will be considered with regard to the specific circumstances of the subsidence impact (e.g. the location, nature and extent of the impact) and the assessment of environmental consequences. The implementation of management measures will be related to the scale of subsidence impact due to LW401-408 and the ability to, and value in, undertaking mitigation measures on a case by case basis. The implementation of any stabilisation measures, repairs supplementary supply or compensation will be conducted in consultation UCMPL where required.

Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures. Key management actions and timing is summarised in **Table 6**.

Table 6 UCMPL Infrastructure Key Management Actions

Management Measure	Timing/Frequency	Responsibility
Pre-mining		
Subsidence Impact Assessment provided to UCMPL	Prior to the commencement of Longwall 401 secondary extraction	Underground Technical Manager
Notification to UCMPL prior to commencement of secondary extraction.	Prior to secondary extraction of each Longwall 401 to 408	Underground Technical Manager
Visual inspection and record (baseline) of UCMPL infrastructure within 400m of Longwalls 401-408	Prior to secondary extraction of Longwall 404	Underground Technical Manager
During Mining		
Notification to UCMPL during longwall mining of Longwalls 401-408	If/when ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'R Line'	Underground Technical Manager
Notification to MCO during longwall mining of Longwalls 401-408	If/when visual monitoring detects subsidence related impacts	UCMPL– General Manager (or delegate).
Provision of **inspection sheets** detailing the outcome of the subsidence impact monitoring program to UCMPL (unless otherwise agreed with UCMPL).	Following exceedance of the predicted subsidence monitoring parameters and/or subsidence related impact inspections.	Underground Technical Manager
Provision of supplementary water supply for PB1C or compensation for impacts. Supplementary supply to be of comparable quality and quantity to PB1C when impacted by UG4 LW401-408,	If PB1C is in use and LW401-408 subsidence has demonstrated impacted on PB1C.	Underground Technical Manager

Management Measure	Timing/Frequency	Responsibility
Repair of (or compensation for) damage to UCML Infrastructure due to UG4 LW401-408 subsidence.	If LW401-408 subsidence has resulted in damage to UCML infrastructure.	Underground Technical Manager
Implement TARP (**Attachment 2**).	During Longwall 401 to 408 extraction.	Underground Technical Manager
Post Mining		
Visual Inspection of UCMPL infrastructure within 400m of Longwalls 401-408 to identify any post-mining remediation works (if) required.	Following completion of mining Longwall 408	Underground Technical Manager
Notification to UCMPL to inform longwall mining of Longwalls 401-408 is completed	Following completion of mining Longwall 408	Underground Technical Manager

8.0 ASSESSMENT OF PERFORMANCE INDICATORS AND MEASURES

In accordance with Condition 77(d), Schedule 4 of Project Approval (05_0117), performance indicators have been developed for the performance measures listed in **Table 4** (**Section 5**).

The performance indicators proposed to ensure that the performance measures for UCMPL infrastructure within 400m of Longwalls 401-408 in relation to subsidence induced far field movements, include:

- Subsidence monitoring indicates subsidence is consistent with approved impacts.

Monitoring conducted to inform the assessment of secondary extraction of Longwalls 401-408 against the performance indicators (for the performance measures relevant to UCMPL infrastructure as a built feature) is outlined in **Section 6**.

Assessment of monitoring results against the performance indicators and performance measure would include comparison against the baseline visual inspection to confirm any changes were not present prior to the commencement of mining at UG4, and review of 'R Line' monitoring data to confirm if ground movements in excess of survey accuracy have occurred.

If a performance measure is considered to have been exceeded, the Contingency Plan outlined in **Section 9** of this LW401-408 BFMP-UCMPL will be implemented.

Any dispute between MCO and the UCMPL over the interpretation, application or implementation of the performance measures is to be referred to the DPIE to be settled by the Secretary, following consultation with the Resources Regulator. Any decision by the Secretary shall be final and not subject to further dispute resolution under this approval.

9.0 CONTINGENCY PLAN

In the event the performance measures relevant to UCMPL infrastructure as a built feature, summarised in **Table 4**, are considered to have been exceeded or are likely to be exceeded, MCO will implement the following Contingency Plan:

- The observation will be reported to the Underground Technical Manager or the Environmental and Community Manager within 24 hours.
- The observation will be recorded in the Subsidence Impact Register (**Attachment 3**).
- The likely exceedance will be reported in an Incident Report (refer to the Extraction Plan).
- MCO will provide the Incident Report to relevant stakeholders (i.e. DPIE, DPIE-RR and UCMPL).
- MCO will conduct an investigation to identify and evaluate contributing factors to the exceedance, including re-survey of the relevant subsidence monitoring lines, analysis of predicted versus observed subsidence parameters and a review of the subsidence monitoring program with updates to the program where appropriate.
- An appropriate course of action will be developed in consultation with relevant stakeholders and government agencies including proposed contingency measures (**Section 9.1**), and a program to review the effectiveness of the contingency measures.
- The course of action will be approved by, and implemented to the satisfaction of, UCMPL and DPIE-RR. Any dispute will be referred to the secretary of the DPIE for resolution.
- This LW401-408 BFMP-UCMPL and the performance indicators will be reviewed to adequately manage future potential impacts within the limits of Project Approval (05_0117).

MCO will comply with the NSW *Coal Mine Subsidence Compensation Act, 2017* (formerly *Mine Subsidence Compensation Act, 1961)* in the event that property damages occur as a result of mining Longwalls 401-408.

9.1 CONTINGENCY MEASURES

Contingency measures will be developed in consideration of the specific circumstances of the feature (e.g. the location, nature and extent of the impact, and the assessment of environmental consequences).

Potential contingency measures that could be considered in the event the performance measure for the UCMPL is exceeded includes repairs to infrastructure or compensation.

10.0 TRIGGER ACTION RESPONSE PLAN – MANAGEMENT TOOL

The framework for the various components of this LW401-408 BFMP-UCMPL are summarised in the TARP shown in **Attachment 2**. The TARP illustrates how the various predicted subsidence impacts, monitoring components, performance measures, and responsibilities are structured to achieve compliance with the relevant statutory requirements, and the framework for management and contingency actions.

The TARP comprises:

- baseline conditions;
- predicted subsidence impacts;
- trigger levels from monitoring to assess performance; and
- triggers that flag implementation of contingency measures.

The TARP system provides a simple and transparent snapshot of the monitoring of performance and the implementation of management and/or contingency measures.

11.0 ROLES AND RESPONSIBILITIES

Key responsibilities of MCO personnel in relation to this LW401-408 BFMP-UCMPL are summarised in **Table 7**. Responsibilities may be delegated as required.

Table 7 Responsibility Summary

Responsibility	Task
General Manager	• Ensure resources are available to MCO personnel to facilitate the completion of responsibilities under this LW401-408 BFMP-UCMPL.
Underground Technical Manager	• Ensure the LW401- 408 SMP is implemented. • Ensure monitoring required under this LW401-408 BFMP-UCMPL is carried out within specified timeframes, adequately checked and processed and prepared to the required standard. • Undertake relevant monitoring and implementation of management measures summarised in **Tables 5** and **6** respectively.
Environmental and Community Manager	• Liaise with relevant stakeholders regarding subsidence impact management and related environmental consequences.
Registered Mine Surveyor	• Undertake all subsidence monitoring to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.

11.1 KEY CONTACTS

The details of key contacts and phone numbers in relation to this LW401-408 BFMP-UCMPL are summarised in **Table 8.**

Table 8 Key Personnel Contact Details

Organisation	Position	Contact Name	Phone Number
MCO	Underground Technical Manager	Mr Liam Mildon	**02 6376 1614**
	Environmental and Community Manager	Mr Trent Cini	**02 6376 1436**
	Moolarben Coal Hotline		**1800 556 484**
UCMPL	General Manager	Mr Charlie Allan	**6372 5300**

12.0 FUTURE EXTRACTION PLANS

In accordance with Condition 77(p), Schedule 4 of Project Approval (08_0117), MCO will collect baseline data for the future Extraction Plans. In addition to the baseline data collection, consideration of the environmental performance and management measures, in accordance with the review(s) conducted as part of this LW401-408 BFMP-UCMPL, will inform the appropriate type and frequency of monitoring of the assets relevant to the next Extraction Plan.

13.0 ANNUAL REVIEW, REGULAR REPORTING AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

In accordance with Condition 4, Schedule 5 of Project Approval (05_0117), MCO will conduct an Annual Review of the environmental performance of the Project by the end of March each year, or as otherwise agreed by the Secretary of the DPIE. The Annual Review will:

- describe the works carried out in the previous calendar year, and the development proposed to be carried out over the current calendar year;
- include a comprehensive review of the monitoring results and complaints records of the Project over the previous calendar year, including a comparison of these results against the:
  - relevant statutory requirements, limits or performance measures/criteria;
  - monitoring results of previous years; and
  - relevant predictions in the EA;
- identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
- identify any trends in the monitoring data over the life of the Project;
- identify any discrepancies between the predicted and actual impacts of the Project, and analyse the potential cause of any significant discrepancies; and
- describe what measures will be implemented over the next year to improve the environmental performance of the Project.

In accordance with Condition 11, Schedule 5 of Project Approval (05_0117), the Annual Review will be made available on the MCO website. As described in **Section 2**, this LW401-408 BFMP-UCMPL will be reviewed within three months of the submission of an Annual Review and revised where appropriate. In accordance with Condition 8, Schedule 5 of Project Approval (05_0117), MCO will also provide regular reporting on the environmental performance of the Project on the MCO website.

13.1 AUDITS

In accordance with Condition 9, Schedule 5 of Project Approval (05_0117), an independent environmental audit was conducted by the end of December 2015 and every three years thereafter. A copy of the independent environmental audit will be provided to the Secretary of the DPIE and made available on the MCO website.

The independent environmental audit will be conducted by suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary of the DPIE.

The independent environmental audit will assess the environmental performance of the Project and assess whether it is complying with the requirements of Project Approval (05_0117), and any other relevant approvals, and recommend measures or actions to improve the environmental performance of the Project.

14.0 INCIDENTS

An incident is defined in Project Approval (05_0117) as a set of circumstances that:

- causes or threatens to cause material harm to the environment; and/or
- breaches or exceeds the limits or performance measures/criteria in Project Approval (05_0117).

In the event that an incident which causes, or threatens to cause, material harm to the environment occurs, the incident will be managed in accordance with the Pollution Incident Response Management Plan.

The reporting of incidents will be conducted in accordance with Condition 7, Schedule 5 of Project Approval (05_0117).

MCO will notify the Secretary of the DPIE, and any other relevant agencies immediately after MCO becomes aware of the incident which causes or threatens to cause material harm to the environment. For any other incident associated with the project, MCO will notify the Secretary and any other relevant agencies as soon as practicable after becoming aware of the incident.

Within seven days of the date of the incident, MCO will provide the Secretary of DPIE and any relevant agencies with a detailed report on the incident. The report will:

- describe the date, time and nature of the exceedance/incident;
- identify the cause (or likely cause) of the exceedance/incident;
- describe what action has been taken to date; and
- describe the proposed measures to address the exceedance/incident.

15.0 COMPLAINTS

MCO maintains a Community Complaints Line (Phone Number: 1800 556 484) that is dedicated to the receipt of community complaints. The Community Complaints Line is publicly advertised and operates 24 hours per day, seven days a week, to receive any complaints from neighbouring residents or other stakeholders.

MCO has developed a Community Complaints Procedure which details the process to be followed when receiving, responding to and recording community complaints. The Community Complaints Procedure is supported by a Complaints Database.

The Community Complaints Procedure is a component of the MCO Environmental Management Strategy which requires the recording of relevant information including:

- the nature of complaint;
- method of the complaint;
- relevant monitoring results and meteorological data at the time of the complaint;
- site investigation outcomes;

- any necessary site activity and activity changes;
- any necessary actions assigned; and
- communication of the investigation outcome(s) to the complainant.

In accordance with Condition 11, Schedule 5 of Project Approval (05_0117), the complaints register will be updated monthly and made available on the MCO website.

16.0 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS

A protocol for the managing and reporting of non-compliances with statutory requirements has been developed as a component of MCO's Environmental Management Strategy and is described below.

Compliance with all approvals, plans and procedures will be the responsibility of all personnel (staff and contractors) employed on or in association with the Moolarben Coal Complex.

The Environmental and Community Manager (or delegate) will undertake regular inspections, internal audits and initiate directions identifying any remediation/rectification work required, and areas of actual or potential non-compliance.

As described in **Section 14**, MCO will notify the Secretary of the DPIE, and any other relevant agencies, of any incident associated with MCO.

A review of MCO's compliance with all conditions of Project Approval (05_0117), mining leases and all other approvals and licenses will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on the MCO website.

As described in **Section 13.1**, an independent environmental audit was conducted by the end of December 2015 and undertaken every three years thereafter. A copy of the audit report will be submitted to the Secretary of the DPIE and made publicly available on the MCO website.

17.0 REFERENCES

Department of Planning and Environment and NSW Trade & Investment – Division of Resources and Energy (2015) *Guidelines for the Preparation of Extraction Plans Required under Conditions of Development Consents, Project Approvals and Mining Lease Conditions for Underground Coal Mining*. Version 5. Draft.

Mine Subsidence Engineering Consultants (2021) *Moolarben Coal Operations – Longwalls 401 to 408 Subsidence predictions and impact assessments for the Ulan Coal Mine Infrastructure*

ATTACHMENT 1

MOOLARBEN COAL OPERATIONS – LONGWALLS 401 TO 408 SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENT FOR THE ULAN COAL MINE INFRASTRUCTURE

Suite 402, Level 4, 13 Spring Street
Chatswood NSW 2067
PO Box 302
Chatswood NSW 2057
Tel +61 2 9413 3777
enquiries@minesubsidence.com
www.minesubsidence.com

21st June 2021

Liam Mildon
Underground Technical Services Manager
Moolarben Coal Operations Pty Ltd
Locked Bag 2003
Mudgee NSW 2850

Ref: MSEC1166-06

Dear Liam,

RE: Moolarben Coal Operations – Longwalls 401 to 408
Subsidence predictions and impact assessments for Ulan Coal Mine Infrastructure

Moolarben Coal Operations Pty Limited (MCO) operates the Moolarben Coal Complex (MCC), which is located approximately 40 kilometres north east of Mudgee in New South Wales (NSW). MCO has been granted approval to develop Stages 1 and 2 of the Moolarben Coal Project (MCP) under the *Environmental Planning and Assessment Act 1979*. Approval for Stage 1 of the MCP (05_0117) was granted by the Minister for Planning on 6 September 2007. The Stage 1 approval is based on a Preferred Mine Plan General Layout (*Approved Layout*) for Underground Area 4 (UG4).

MCO is currently preparing an Extraction Plan for the extraction of Longwalls 401 to 408 within UG4 as shown in Drawing No. MSEC1166-07. The layout of Longwalls 401 to 408 that incorporates minor shortening of the lengths of the Approved Layout is referred to as the *Extraction Plan Layout* in this report.

This letter details potential subsidence impacts on infrastructure owned and operated by the Ulan Coal Mine. Ulan Coal Mine is located to the west and north west of UG4. The Extraction Plan Layout has been overlaid on an orthophoto of the area in Figure 1. Many of the surface features at Ulan Coal Mine can be seen in this figure. The majority of the surface infrastructure at Ulan Coal Mine is located over 1 km from Longwalls 401 to 408 and is not anticipated to experience any adverse impact from extraction of the longwalls. The surface features nearer to the Extraction Plan Layout include rehabilitated land and settlement ponds on the western side of Ulan Road, a bridge over the Goulburn River diversion at the mine entry road, powerlines, groundwater bore and the Millers Dam Compound on the eastern side of Ulan Road. It is understood that the Dams and plant will be decommissioned in 2021.

The Millers Dam Compound is located to the west of Longwalls 406 and 407. There are three dams 200 m to 310 m from the longwalls. Two of the dams have plan dimensions of approximately 70 m x 30 m and one larger dam has plan dimensions of approximately 85 m x 130 m. Embankments surrounding the dams are up to approximately 2 m height. Other features located 320 m to 350 m from the longwalls include a reverse osmosis plant, two above ground concrete storage tanks, telecommunications tower, cyclone fencing, and pipes and power lines. The detailed features at the Millers Dam Compound are shown in Figure 2 and photographs are shown in Figure 3 to Figure 5. The overhead powerlines are supported on timber poles and are located on the western side of Ulan Road at approximately 400 m from the longwalls.

The depth of cover at the finishing ends of Longwalls 406 and 407 is approximately 85 m. The Millers Dam Compound infrastructure are therefore located at 2.4 to 4 times the depth of cover from the longwalls.

The nearest groundwater bore is located 430 m from Longwall 408, which represents 3.3 times the depth of cover at this location. The bridge over the Goulburn River diversion is located 470 m from Longwall 408, which represents 3.6 times the depth of cover at this location.

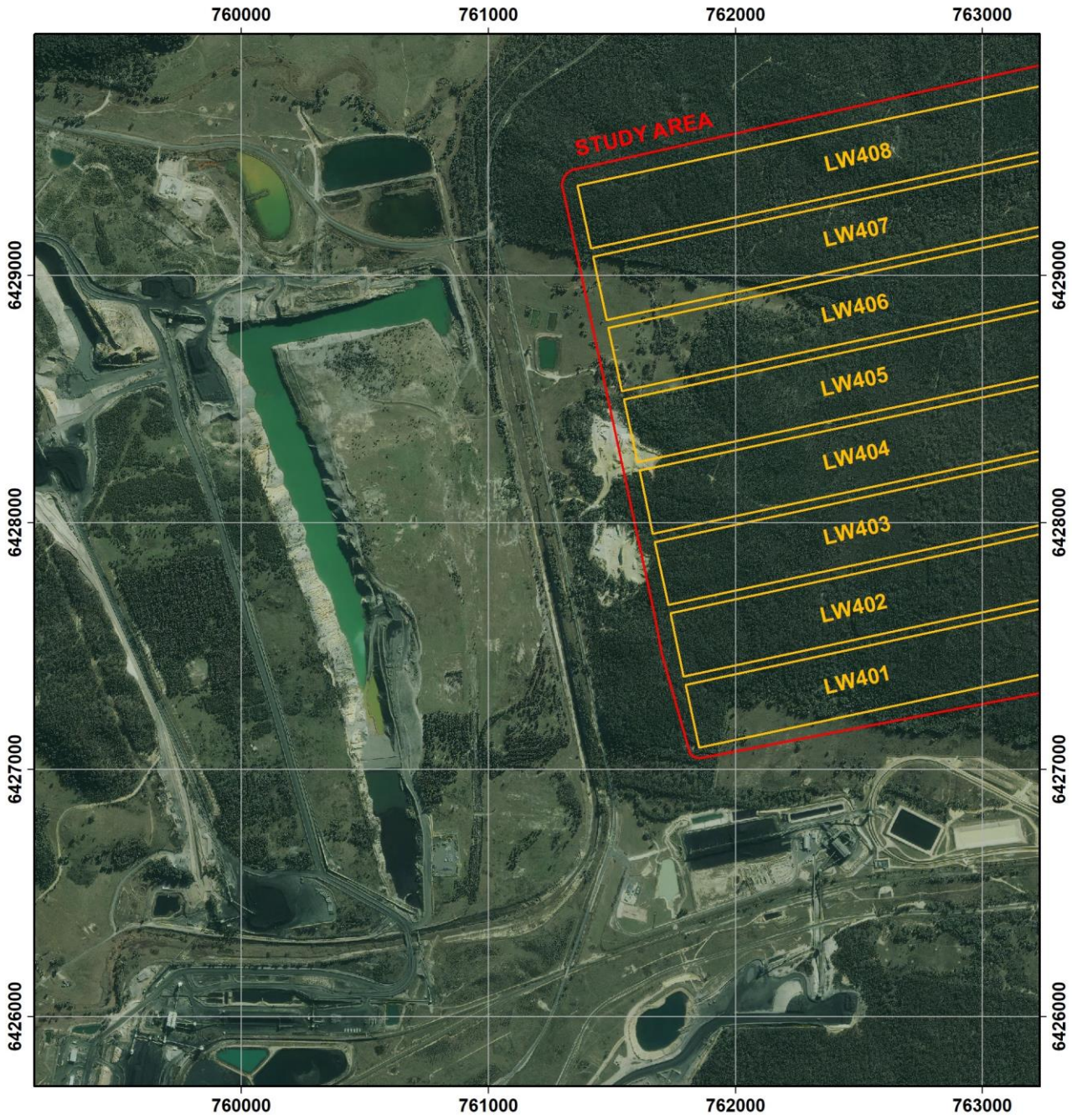


Figure 1 Aerial Photograph Showing Location of Extraction Plan Layout

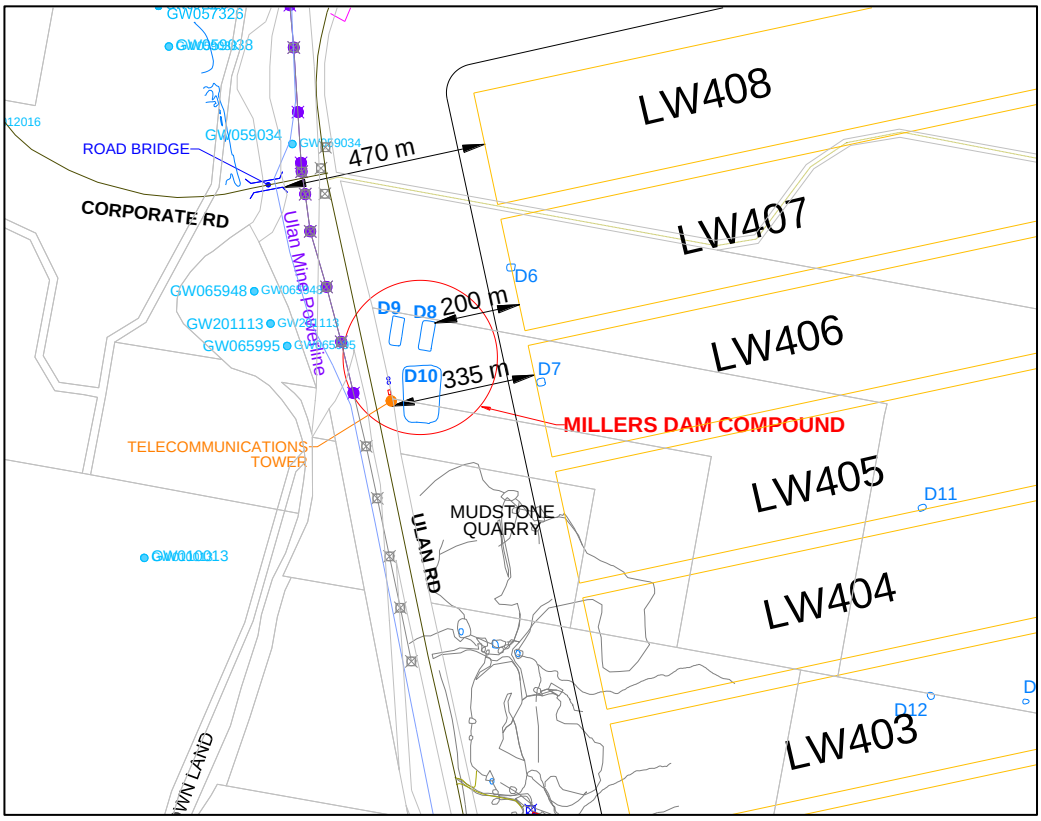


Figure 2 Ulan Coal Mine Infrastructure

Figure 3 Millers Dam Plant

Figure 4 telecommunications tower and dam embankment

Figure 5 concrete tanks

Study Area

A Study Area is defined around the longwall layout as the surface area that is likely to be affected by the proposed mining of Longwalls 401 to 408. The extent of the Study Area is calculated by the further extent of a 26.5° angle of draw line and the predicted vertical limit of subsidence, taken as the 20 mm subsidence contour. The Study Area boundary is shown in MSEC1166-07, Figure 1 and Figure 2.

Conventional Subsidence Parameters

At distances of 200 m or more between the longwalls and the Millers Dam Compound, the site features will not be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy); however, the site features may experience far-field horizontal movements which are discussed below.

Far-Field Movements

The measured horizontal movements at locations beyond the longwall goaf edges and over solid unmined coal areas are often greater than the observed vertical movements at those marks. These movements are often referred to as *far-field horizontal movements*.

Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain. These movements generally do not result in impacts on natural or built features, except where they are experienced by large structures which are very sensitive to differential horizontal movements.

In some cases, higher levels of far-field horizontal movements have been observed where steep slopes or surface incisions exist nearby, as these features influence both the magnitude and the direction of ground movement patterns.

An empirical database of observed incremental far-field horizontal movements has been compiled using available monitoring data from the NSW and Queensland Coalfields, but this database predominately comprises measurements from the Southern Coalfield. The far-field horizontal movements are generally observed to be orientated towards the extracted longwall. At low levels of far-field horizontal movements, however, there is a higher scatter in the orientation of the observed movements.

This database includes available observed far-field horizontal movements that have been measured at Ulan Coal Mine, Moolarben Mine and observed data from other regions where the depths of cover are also relatively shallow compared to the Southern Coalfield of NSW. The observed far-field horizontal movements in the database represent large variations in depth of cover from less than 50 m to greater than 600 m. In order to utilise the observed far-field horizontal data at the Moolarben Coal Complex where depth of cover is relatively shallow, the data has been plotted, as shown in Figure 6, against the distances from the nearest edge of the incremental panel divided by the depth of cover. This plot excludes those cases where higher movements occurred because of multi-seam mining and valley closure effects as these are not applicable to extraction of Longwalls 401 to 408.

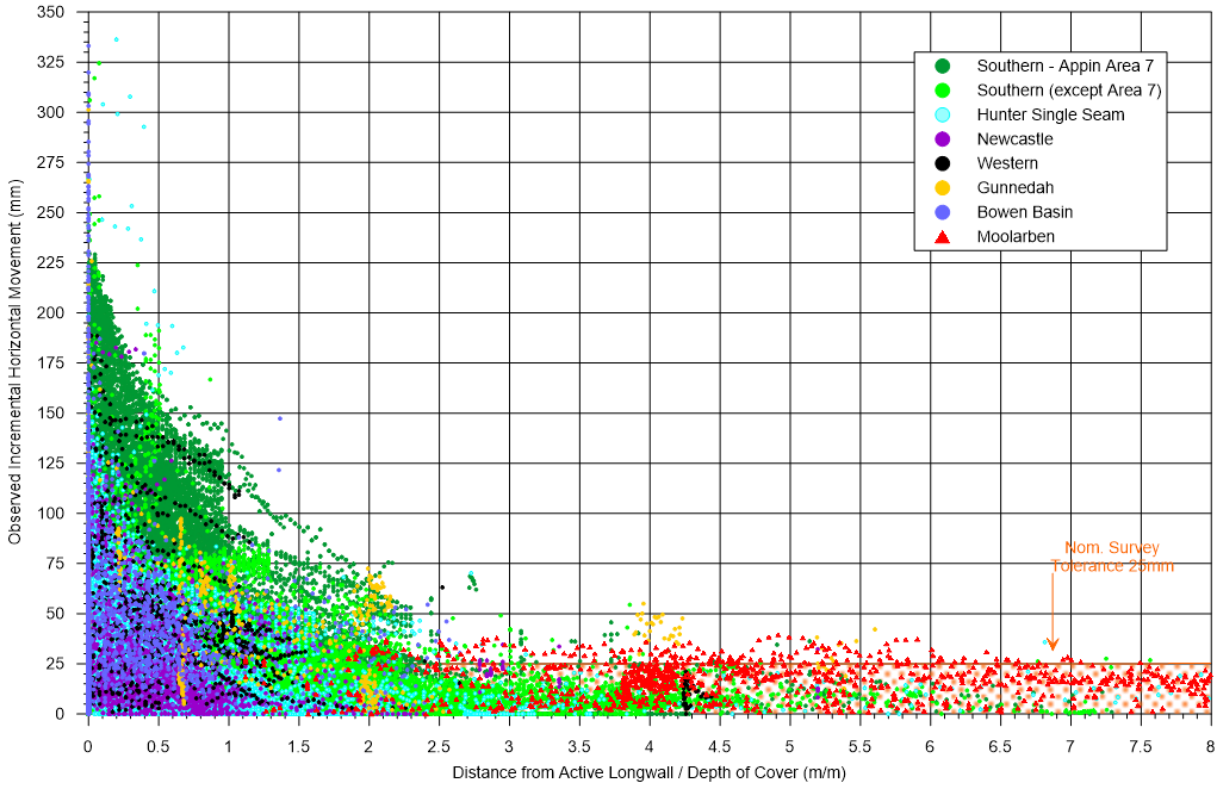


Figure 6 Observed incremental far-field horizontal movements (mm) from many regions in NSW versus the distance to the nearest edge of the mined panel divided by the depth of cover (m/m)

As successive longwalls within a series of longwall panels are mined, the magnitudes of the incremental far-field horizontal movements decrease. This is possibly due to the fact that once the in situ stresses in the strata within the collapsed zones above the first few extracted longwalls has been redistributed, the potential for further movement is reduced. The total far-field horizontal movement is not, therefore, the sum of the incremental far-field horizontal movements for the individual longwalls.

Figure 6 shows the upper limit of previously observed absolute far-field horizontal movements for the sites located greater than 2.4 times the depth of cover from longwalls, to be less than 70 mm.

These far-field horizontal movements are expected to be bodily, accompanied by very low levels of strain, and generally do not result in impacts at structures unless they are very sensitive to differential horizontal movements.

Potential for Non-Conventional Movements

It is believed that most non-conventional ground movements are the result of the reaction of near surface strata to increased horizontal compressive stresses due to mining operations. Some of the geological conditions that are believed to influence these irregular subsidence movements are the blocky nature of near surface sedimentary strata layers and the possible presence of unknown faults, dykes or other geological structures, cross bedded strata, thin and brittle near surface strata layers and pre-existing natural joints. The presence of these geological features near the surface can result in a localised bump in an otherwise smooth subsidence profile and these bumps are usually accompanied by locally increased tilts and strains.

Even though it may be possible to attribute a reason behind most observed non-conventional ground movements, there remains some observed irregular ground movements that still cannot be explained with the available geological information. The term “anomaly” is therefore reserved for those non-conventional ground movement cases that were not expected to occur and cannot be explained by any of the above possible causes.

It is not possible to predict the locations and magnitudes of non-conventional anomalous movements. In some cases, approximate predictions for the non-conventional ground movements can be made where the underlying geological or topographic conditions are known in advance.

The likelihood of non-conventional anomalous movements reduces with increasing distance away from the longwall panels.

Predicted Strains

The range of potential strains associated with non-conventional movements has been assessed based on statistical analyses of strains measured in the NSW Hunter, Newcastle and Western Coalfields, for single-seam conditions, where the longwall width-to-depth ratios and extraction heights were similar to those of the Extraction Plan layout.

The data used in the analysis of observed strains included those resulting from both conventional and non-conventional anomalous movements, but did not include those resulting from valley related movements. The strains resulting from damaged or disturbed survey marks have also been excluded.

The surface features are located greater than 200 m from the Longwalls 401 to 408. The survey database has therefore been analysed to extract the maximum tensile and compressive strains that have been measured at any time during mining for survey bays that were located beyond the goaf edges of the mined panels and positioned on unmined areas of coal between 200 m and 600 m of the nearest longwall goaf edge.

The histogram of the maximum observed tensile and compressive strains measured in survey bays above solid coal is provided in Figure 7. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

The 95 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* (beyond 200 m) experienced at any time during mining are 1.6 mm/m tensile and 1.5 mm/m compressive. The 99 % confidence levels for the maximum total strains that the individual survey bays above solid coal (beyond 200 m) experienced at any time during mining are 2.9 mm/m tensile and 3.0 mm/m compressive. The 75 % confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.5 mm/m both tensile and compressive, which is the typical limit of accuracy of strain measurement by conventional survey methods. It is noted that these measured strains also include components of survey tolerance.

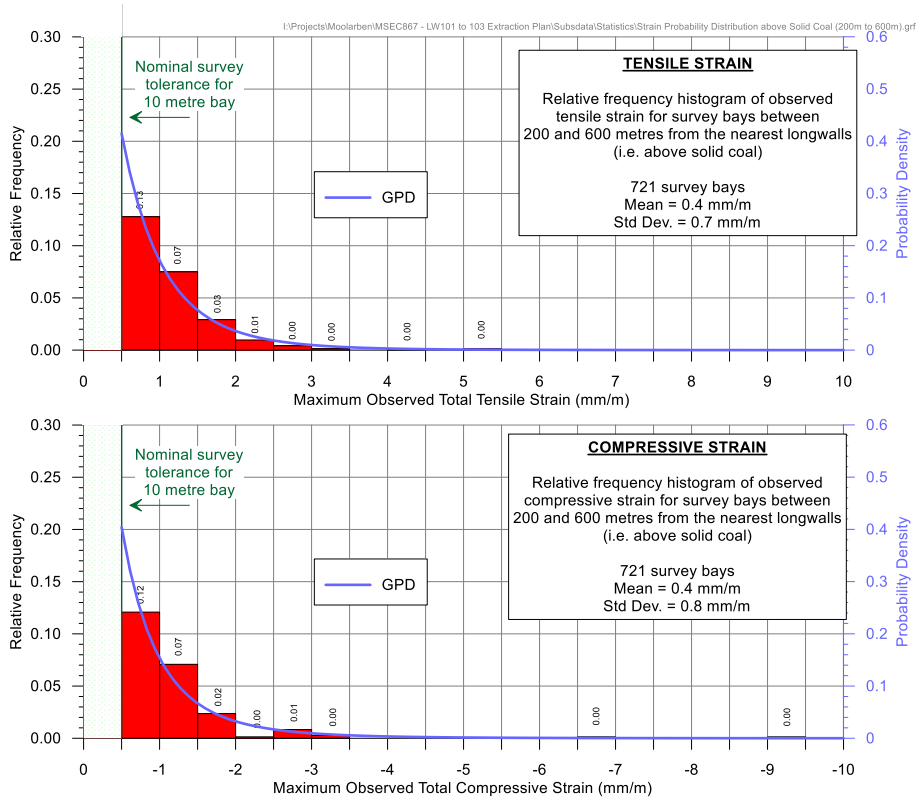


Figure 7 Distributions of the Measured Maximum Tensile and Compressive Strains in the Hunter, Newcastle and Western Coalfields for Survey Bays located above Solid Coal between 200 m and 600 m of the nearest longwall

Impact Assessments for Ulan Coal Mine infrastructure

The Ulan Coal Mine infrastructure is located outside the 26.5° angle of draw from both the Extraction Plan Layout and the Approved Layout. The potential impacts for the infrastructure based on the Extraction Plan Layout, therefore, are the same as or lower than those assessed based on the Approved Layout.

The Ulan Coal Mine infrastructure is located outside the Study Area boundary and is not expected to be subjected to measurable conventional vertical subsidence, tilt, curvature or strain. However, the surface features at the Millers Dam Compound, powerlines and bridge may experience far-field horizontal movements of up to 70 mm.

The statistical analysis of observed strain data between 200 m and 600 m from extracted longwalls shows a 25% probability of exceedance of 0.5 mm/m tensile and compressive, and a 5% probability of exceedance of approximately 1.5 mm/m tensile and compressive.

With the location of the infrastructure outside the longwall footprint and the low probability of significant observed strains developing based on statistical analysis, the development of adverse impacts to the infrastructure due to the extraction of Longwalls 401 to 408 is considered to be unlikely to occur.

Recommendations

The ground movements can be monitored using survey marks and visual inspections. These monitoring methods can be used to identify the development of irregular ground movements.

It is recommended that monitoring and management strategies are developed, in consultation with Ulan Coal Mine, to monitor far-field horizontal movements and potential non-conventional movements and manage potential impacts to infrastructure. It is expected that the infrastructure can be maintained in serviceable condition with the implementation of the appropriate monitoring and management strategies.

Summary

At distances of 200 m or more from the longwalls, the Ulan Coal Mine infrastructure is outside the Study Area and is predicted to experience less than 20 mm vertical subsidence resulting from the extraction of the extraction of Longwalls 401 to 408. Whilst the infrastructure could experience very low levels of vertical subsidence, it is not expected to experience measurable tilts, curvatures or strains. Observed far-field horizontal movements at the location of the infrastructure are expected to be less than 70 mm.

There is a low probability that significant strains could develop at the location of the infrastructure due to non-conventional movements, and as a result, the development of adverse impacts to the infrastructure due to the extraction of Longwalls 401 to 408 are considered unlikely to occur.

Ground monitoring and visual monitoring is recommended for the infrastructure to check for the potential development of non-conventional subsidence movements.

It is expected that the potential impacts on the Ulan Coal Mine infrastructure can be managed with the implementation of suitable monitoring and management strategies.

Yours sincerely

Peter DeBono

Attachments:
Drawing No. MSEC1166-07 – Longwalls 401 to 408 – Ulan Coal Mine Infrastructure

I:\Projects\Moolarben\MSEC1166 - UG4 Extraction Plan - LW401 to 408 Stakeholder Consultation\MSEC1166-07 Ulan\MSEC1166-07 Built Features.dwg

msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

MOOLARBENCOAL

MOOLARBEN COAL PROJECT

UG4 LW401 - LW 408

ULAN COALMINE INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
21 Jun 2021	as shown	MSEC1166-07	A

0m 500m 1000m
SCALE

GDA2020

LEGEND
- BUILDINGS
- DAMS
- GROUNDWATER BORES
- TELECOMMUNICATION TOWER
- ROADS
- TRACKS
- BRIDGES
- CULVERTS
- CUTTINGS
- RAILWAY

6 432 000
762 000
764 000
6 430 000
6 428 000
6 426 000

ULAN RD
SADDLERS CREEK RD
Goulburn River
Ulan Creek
CORPORATE RD
ROAD BRIDGE
TRACK
Ulan Mine Powerline
TELECOMMUNICATIONS TOWER
MUDSTONE QUARRY
CROWN LAND
ULAN COAL MINE
Bora Creek
ULAN WOLLAR RD
SANDY HOLLOW GULGONG RAILWAY
HAUL RD
MILLERS DAM COMPOUND
470 m
200 m
335 m

UG4
LW408
LW407
LW406
LW405
LW404
LW403
LW402
LW401
Study Area

EXTENT OF UNCONSOLIDATED MATERIAL

UG1

ATTACHMENT 2

UG4 LONGWALLS 401 TO 408
BUILT FEATURES MANAGEMENT PLAN – ULAN COAL MINES PTY LIMITED
TRIGGER ACTION RESPONSE PLAN

Condition	Normal		Level 1	Level 2
	Baseline Conditions	**Predicted Impacts**	**Implement Management Measures**	**Restoration/Contingency Phase**
Trigger	UCMPL infrastructure is safe, serviceable and repairable or as otherwise identified by pre-mining inspection.	Subsidence impacts as per Moolarben Coal Operations – Longwalls 401 to 408 Subsidence predictions and impact assessments for UCMPL (MSEC,2021)	Monitoring identifies impacts that are greater than predicted, but the performance measure has not been exceeded and is not likely to be exceeded.	If Performance Measure relevant to UCMPL Infrastructure has been exceeded, or is likely to be exceeded (i.e. loss of serviceability).
Action	Establish baseline data, including: • Pre-mining visual inspection. • Pre-extraction subsidence survey as per the UG4 Longwalls 401 to 408 Subsidence Monitoring Program.	Conduct monitoring as described in **Section 6**, including: • Ground survey of the subsidence effects monitoring 'R Line' • Visual Inspections	Management measures implemented as described in **Section 7** (with regard to the specific circumstances of the subsidence impact due to LW401-408 [e.g. the nature and extent of the impact]). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.	Contingency Plan implemented (with regard to the specific circumstances of the subsidence impact). In summary: • The observation will be reported to the Underground Technical Manager or the Environmental and Community Manager within 24 hours. • The observation will be recorded in the Subsidence Impact Register. • The exceedance or likely exceedance will be reported in an incident report. • An investigation will be conducted to identify and evaluate contributing factors to the exceedance. • An appropriate course of action will be developed in consultation with relevant stakeholders and government agencies. • The course of action will be approved by, and implemented to the satisfaction of, relevant stakeholders and government agencies. • The Built Features Management Plan – UCMPL and the performance indicators will be reviewed to adequately manage future potential impacts.
Frequency	Prior to commencement of extraction of Longwall 401 (Survey) and LW404 (visual inspections).	• Ground survey of the subsidence effects monitoring 'R Line' – Prior to secondary extraction of Longwall 401 – At the completion of each Longwall 401-408. – At any time in case of fault or emergency and where requested by UCMPL • Visual inspection: – Following completion of active mining after Longwall 408.	To be implemented as required (i.e. if monitoring identifies impacts that are greater than predicted, but the performance measure has not been exceeded and is not likely to be exceeded).	To be implemented following identification of an exceedance of the performance measure, or if the performance measure is likely to be exceeded (loss of serviceability). Subsidence impact inspection: • If/when ground movement exceeds the predicted subsidence monitoring parameters for UG4 during monitoring of the 'R Line'
Position of Decision Making	• Underground Technical Manager. • UCMPL– General Manager (or delegate).	• Underground Technical Manager. • UCMPL– General Manager (or delegate).	• Underground Technical Manager. • UCMPL– General Manager (or delegate).	• Underground Technical Manager. • UCMPL– General Manager (or delegate).

ATTACHMENT 3

UG4 LONGWALLS 401 TO 408
BUILT FEATURES MANAGEMENT PLAN – ULAN COAL MINES PTY LIMITED
SUBSIDENCE IMPACT REGISTER TEMPLATE

UG4 Longwalls 401 to 408 Built Features Management Plan – UCMPL
Subsidence Impact Register Template

Impact Register Number	Built Feature	Impact Description	Does Impact Exceed the Built Feature Performance Measure/Indicators? (Yes/No)	Management Measures Implemented	Were Management Measures Effective? (Yes/No)