






UG4 LONGWALLS 409 TO 414 EXTRACTION PLAN

DOCUMENT CONTROL

Applicant	Moolarben Coal Operations Pty Ltd
Mine	Moolarben Coal Complex
Development Consent	Stage 1 Project Approval (05_0117) as modified
Mining Leases	ML 1605 and ML 1628
Title	Moolarben Coal Complex UG4 Longwalls 409 to 414 Extraction Plan
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Date	24 April 2026
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2	April 2026	Updated in response to Comments from the IEAPM	MCO	MCO

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1.0 OVERVIEW OF THE EXTRACTION PLAN

1.1 MOOLARBEN COAL COMPLEX OVERVIEW

The Moolarben Coal Complex is an open cut and underground coal mining operation located approximately 40 kilometres (km) 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. MCO is a wholly owned subsidiary of Yancoal Australia Limited.

The UG4 Underground Mine (UG4) is a component of the approved Moolarben Coal Complex (**Figure 2**). First workings for UG4 commenced in October 2020 (**Figure 3**). Secondary extraction in UG4 of the first Longwall (LW) 401 commenced in July 2022. LW401 to 407 were completed in January 2026. The extraction of LW409 to 414 (hereafter referred to as LW409-414) within UG4 is scheduled to commence in September 2026.

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).

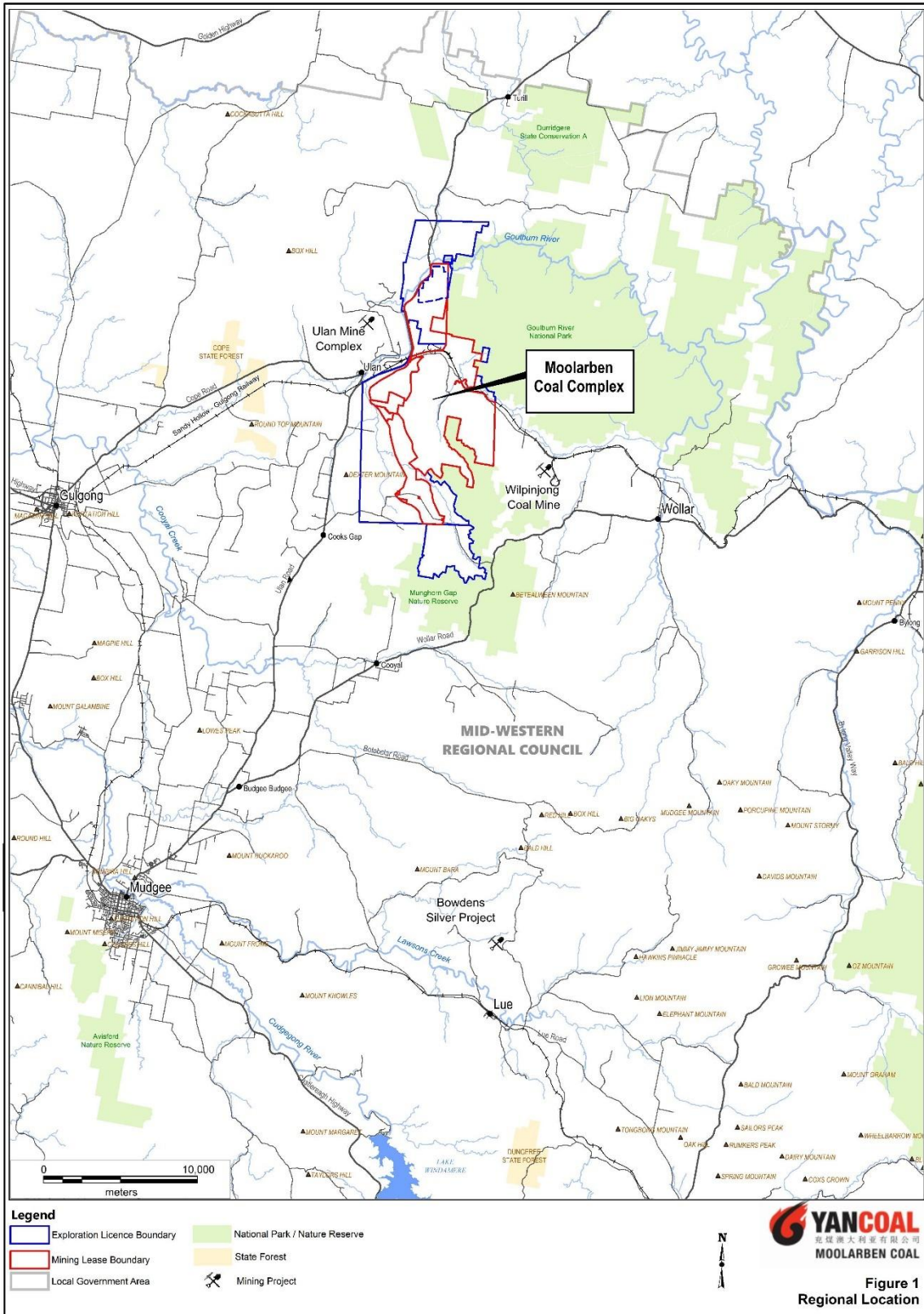
1.2 EXTRACTION PLAN PURPOSE AND SCOPE

This UG4 Longwalls 409 to 414 Extraction Plan (LW409-414 Extraction Plan) outlines the proposed management, mitigation, monitoring and reporting of potential subsidence impacts and environmental consequences in the UG4 mining area during the secondary extraction of LW409-414.

This LW409-414 Extraction Plan has been prepared by MCO with input from suitably qualified experts (i.e. Mine Subsidence Engineering Consultants Pty Ltd [MSEC], Australasian Groundwater and Environment Pty Ltd [AGE], WRM Water and Environment Pty Ltd [WRM] and Niche Environment and Heritage Pty Ltd [Niche]) to satisfy the requirements of Project Approval (05_0117) as modified and the *Extraction Plan Guideline* (Department of Planning and Environment [DPE], 2022).

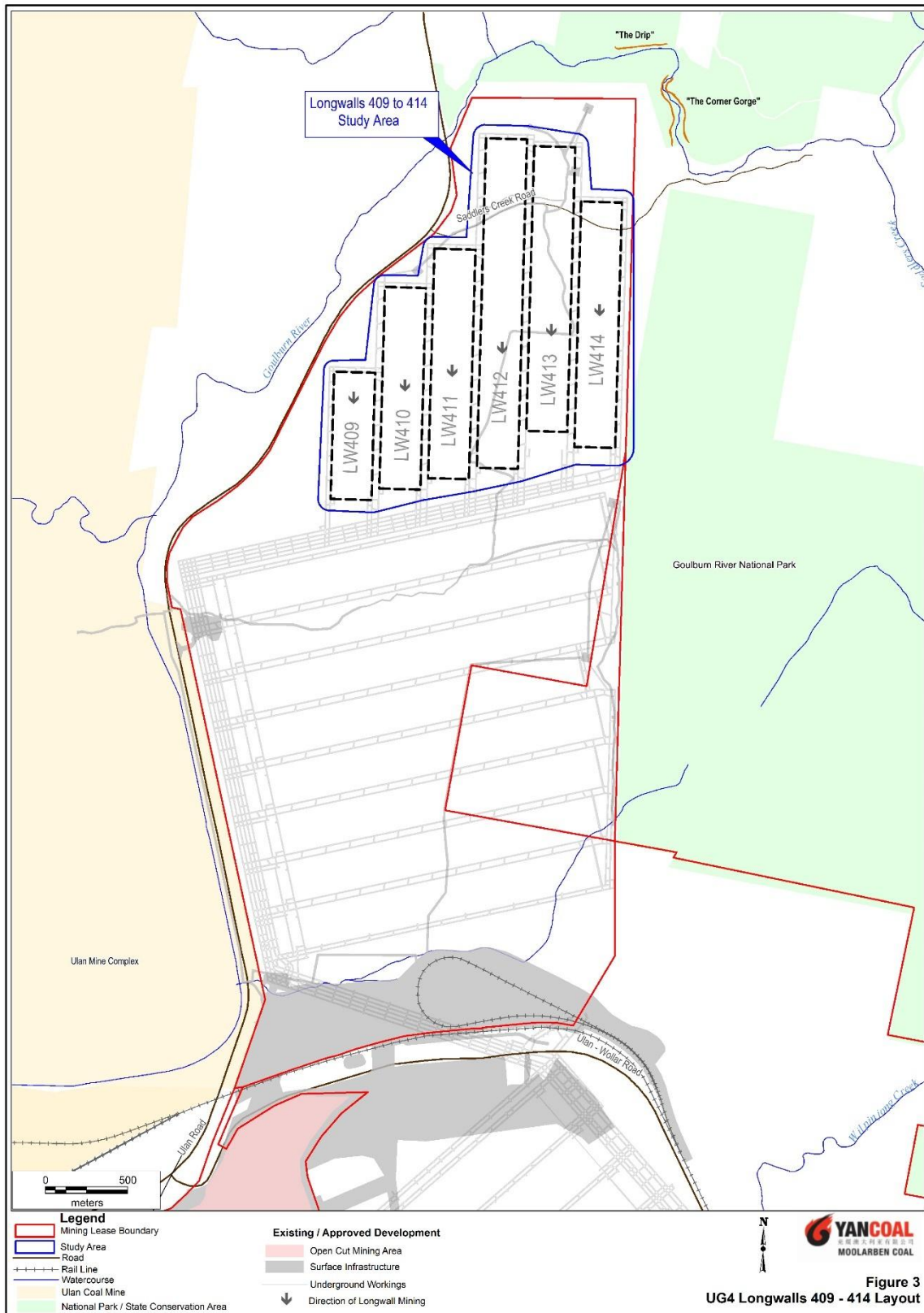
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Figure 1: Regional Location



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Figure 3: UG4 Longwalls 409 to 414 Layout



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The appointment of the suitably qualified and experienced persons (which include representatives of MCO, MSEC, AGE, WRM and Niche) was endorsed by the Secretary of the Department of Planning, Housing and Infrastructure (DPHI) on 9 May 2024 and 28 June 2024 (**Attachment 2**). The objectives of this Extraction Plan are to:

- provide detailed plans of LW409-414;
- outline potential subsidence effects, subsidence impacts and environmental consequences due to the extraction of LW409-414;
- describe the measures that will be implemented to ensure compliance with the subsidence impact performance measures and investigate, mitigate, manage and remediate potential subsidence impacts and environmental consequences; and
- detail a monitoring and contingency plan for potential subsidence impacts and environmental consequences, including detailed performance indicators for subsidence impact performance measures.

This LW409-414 Extraction Plan forms part of MCO’s Environmental Management Strategy (EMS). The relationship of this Extraction Plan to the MCO’s EMS is shown in **Figure 4**.

1.3 THE STUDY AREA

As described in **Section 1.2**, MSEC prepared a subsidence impact assessment report, the *Moolarben Project Stage 1 – Longwalls 409 to 414 – Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Extraction Plan*, to support this LW409-414 Extraction Plan (**Technical Report 1**).

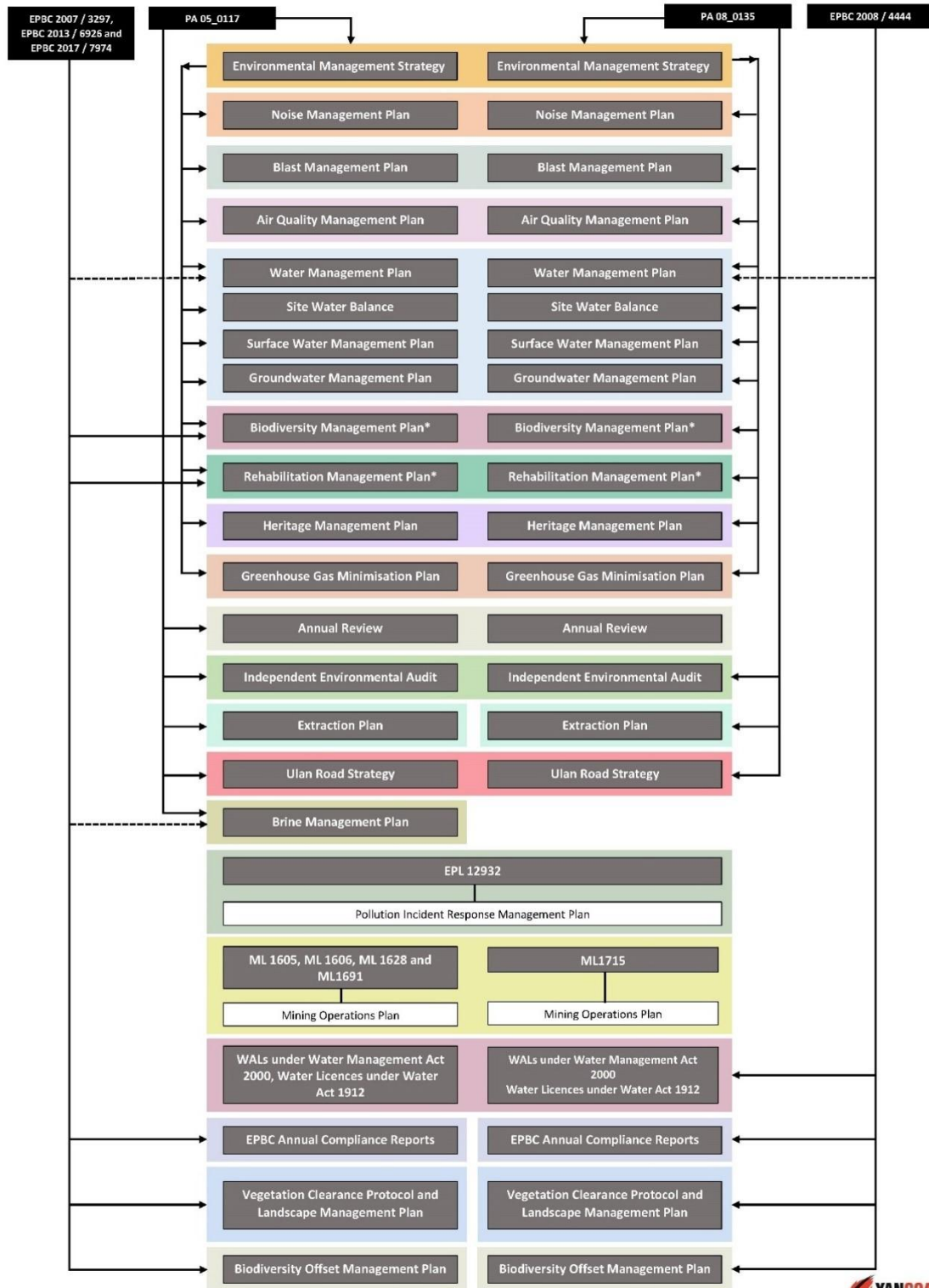
The Study Area (**Figure 3**) for this LW409-414 Extraction Plan is defined as the surface area that is likely to be affected by the proposed mining of LW409-414 (Extraction Plan Layout) in the Ulan Seam. The extent of the LW409-414 Study Area has been calculated by MSEC (2024) combining the areas bounded by the following limits:

- The 26.5 degree (°) angle of draw line; and
- The predicted vertical limit of subsidence, taken as the 20 millimetres (mm) subsidence contour.

As the depth of cover above the longwalls varies between 120 metres (m) and 215 m, the 26.5° angle of draw line has been conservatively determined by drawing a line around the outer edge of the longwall voids at a horizontal distance that varies between 60 m and 108 m.

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Figure 4: Environmental Management System Structure Summary



* To replace Landscape Management Plan



MOOLARBEN COAL COMPLEX
Environmental Management System
Structure Summary

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1.3.1 Statutory Requirements

Project Approval (05_0117)

This LW409-414 Extraction Plan has been prepared in accordance with Conditions 77 and 78, Schedule 3 of Project Approval (05_0117) (as modified). These legislative requirements are summarised in **Table 1**, along with the relevant section(s) of this LW409-414 Extraction Plan in which the requirement is addressed. Further detail on the requirements of Project Approval (05_0117) (as modified) is provided in **Attachment 1**.

Mining Leases

LW409-414 are located within Mining Lease (ML) 1605 and ML 1628 (**Figure 3**). Under the conditions of these MLs, MCO must not commence or undertake underground mining operations that may cause subsidence other than in accordance with an approved Extraction Plan. The approved Extraction Plan must provide for the effective management of risks associated with any subsidence resulting from mining operations.

The requirements of the conditions of the MLs are summarised in **Attachment 1**, along with the relevant section of this LW409-414 Extraction Plan where the requirements are addressed.

Licences, Permits and Leases

In addition to the Stage 1 Project Approval (05_0117) (as modified), and the MLs, all activities at or in association with the Moolarben Coal Complex will be undertaken in accordance with the following licenses, permits and leases:

- The conditions of Commonwealth Approvals (EPBC 2007/3297, EPBC 2013/6926, EPBC 2008/4444 and EPBC 2017/7974).
- The conditions of Environment Protection Licence (EPL) No. 12932 issued by the NSW Environment Protection Authority (EPA) under the *Protection of the Environment Operation Act 1997*. Revision of the EPL may be required prior to the commencement of MCO activities that differ from those currently licensed.
- Water Access Licences issued under the NSW *Water Management Act 2000* and water licences issued under NSW *Water Act 1912*.
- Mining and occupational health and safety related approvals granted by the Resources Regulator (RR) and SafeWork NSW.

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Table 1: Extraction Plan Requirements

Project Approval (05_0117) Condition	Extraction Plan Reference
Condition 77, Schedule 3	
<p>77. The Proponent shall prepare and implement an Extraction Plan for all second workings on site to the satisfaction of the Secretary. Each extraction plan must:</p> <ul style="list-style-type: none"> (a) be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Secretary; (b) be approved by the Secretary before the Proponent carries out any of the second workings covered by the plan; (c) include detailed plans of existing and proposed first and second workings and any associated surface development; (d) include detailed performance indicators for each of the performance measures in Tables 14 and 15; (e) provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings, incorporating any relevant information obtained since this approval; (f) describe the measures that would be implemented to ensure compliance with the performance measures in Tables 14 and 15, and manage or remediate any impacts and/or environmental consequences; (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: <ul style="list-style-type: none"> i. addresses in appropriate detail all items of key public infrastructure and other public infrastructure and all classes of other built features; ii. has been prepared following appropriate consultation with the owner/s of potentially affected feature/s; iii. 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 iv. 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; (h) include a Water Management Plan, which has been prepared in consultation with EPA and DPIE Water, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on watercourses and aquifers, including: <ul style="list-style-type: none"> i. surface and groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse impacts on water resources or water quality; ii. a program to monitor and report stream flows, assess any changes resulting from subsidence impacts and remediate and improve stream stability; iii. a program to monitor and report groundwater inflows to underground workings; iv. a program to predict, manage and monitor impacts on groundwater bores on privately-owned land; (i) include a Biodiversity Management Plan, which has been prepared in consultation with BCD, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species, populations and their habitats; endangered ecological communities; and water dependent ecosystems; 	<p>This Document</p> <p>Section 1.2 and Attachment 2</p> <p>Section 1.3</p> <p>Section 1.5 and Appendix G</p> <p>Section 3 and Appendices A to H</p> <p>Section 2.1 and Technical Reports 1 to 5</p> <p>Section 3 and Appendices A to H</p> <p>Appendix E</p> <p>Appendix A</p> <p>Appendix C</p>

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Table 1 (Continued): Extraction Plan Requirements

Project Approval (05_0117) Condition	Extraction Plan Reference
<p>(j) include a Land Management Plan, which has been prepared in consultation with any affected public authorities, to manage the potential impacts and/or environmental consequences of the proposed second workings on land in general;</p> <p>(k) include a Heritage Management Plan, which has been prepared in consultation with BCD and relevant stakeholders for both Aboriginal and historic heritage, to manage the potential environmental consequences of the proposed second workings on both Aboriginal and non-Aboriginal heritage items, and reflects all requirements under conditions 38-39 of Schedule 3;</p> <p>(l) include a Public Safety Management Plan, which has been prepared in consultation with DRG, to ensure public safety in the mining area;</p> <p>(m) include a Subsidence Monitoring Program, which has been prepared in consultation with Resource Regulator, to:</p> <ul style="list-style-type: none"> i. describe the on-going subsidence monitoring program; ii. provide data to assist with the management of the risks associated with subsidence; iii. validate the subsidence predictions; iv. analyse the relationship between the predicted and resulting subsidence effects and predicted and resulting impacts under the plan and any ensuing environmental consequences; and v. inform the contingency plan and adaptive management process. <p>(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 14 and 15, or where any such exceedance appears likely;</p> <p>(o) proposes appropriate revisions to the Rehabilitation Management Plan required under condition 68 of Schedule 3; and</p> <p>(p) include a program to collect sufficient baseline data for future Extraction Plans.</p> <p>Note: To identify the longwall mining domains referred to in this condition, see Appendix 2.</p>	<p>Appendix B</p> <p>Appendix D</p> <p>Appendix F</p> <p>Appendix G</p> <p>Section 4.1 and Appendices A to F and H</p> <p>Section 3.3</p> <p>Attachment 3 and Appendices A to F</p>
Condition 78A, Schedule 3	
<p>78A Prior to the commencement of second workings in longwall LW12, the Proponent shall:</p> <p>(a) prepare a report:</p> <ul style="list-style-type: none"> i. analysing the subsidence, surface water, and groundwater impacts of the cumulative progress of longwall mining for the project, including consideration of data collected from the previously mined panels up to and including commencement in longwall LW11; ii. updating the predicted impacts based on the available local data and current scientific understanding of these relevant fields (demonstrating compliance with the requirements of this approval); <p>(b) commission suitably qualified subsidence and groundwater experts whose appointment has been approved by the Secretary to review the report, and if necessary recommend changes to the monitoring programs and/or mine plan for subsequent panels; and</p> <p>(c) submit a copy of the report and expert review to the Department, Resources Regulator, BCD and DPIE Water, including a response to any recommendations contained in the expert review; to the satisfaction of the Secretary.</p> <p>Note: The locations of LW9-LW14 are marked in Appendix 7, figure 7.1.</p>	<p>Section 4.3.3</p>
Condition 78, Schedule 3	
<p>78. The Proponent shall ensure that the management plans required under conditions 77(g)-(l) above include:</p> <p>(a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval; and</p> <p>(b) a detailed description of the measures that would be implemented to remediate predicted impacts.</p>	<p>Appendices A to F and H</p>

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1.4 STRUCTURE OF THE LONGWALLS 409 TO 414 EXTRACTION PLAN

This LW409-414 Extraction Plan comprises a main text component (this document) and supporting management plans, monitoring programs and studies, which include **Appendices A through H** and **Technical Reports 1 through 5**. An overview of the main text sections of the LW409-414 Extraction Plan is presented below:

- Section 1** Provides an introduction to the Extraction Plan, including the purpose and scope of the Extraction Plan and a summary of the mine plan and design, subsidence predictions, subsidence impact performance measures and subsidence management approach.
- Section 2** Describes the process of development of the Extraction Plan, including the process of reviewing and updating the predictions of subsidence effects, subsidence impacts and environmental consequences, the risk assessment process for identifying key subsidence management issues and consultation undertaken by the mine with affected agencies and other key stakeholders.
- Section 3** Describes the measures that will be implemented to mitigate, manage, remediate and monitor potential subsidence impacts and environmental consequences on natural and built features.
- Section 4** Addresses key elements of how the plan is going to be implemented, including an adaptive management approach, reporting, regular review and key responsibilities.
- Section 5** Lists the references cited in this Extraction Plan.
- Attachment 1** Outlines the relevant requirements under the Stage 1 Project Approval (05_0117), the *Extraction Plan Guideline* (DPE, 2022) for preparation of an extraction plan, applicable MLs, and provides the relevant section of this Extraction Plan where these requirements are addressed.
- Attachment 2** Provides evidence of MCO’s consultation process for the Extraction Plan.
- Attachment 3** Provides details of a program to collect sufficient baseline data for future Extraction Plans.
- Attachment 4** Provides a consolidated list of key stakeholder contact information.
- Appendices A to H** contain key component management and monitoring plans of the Extraction Plan:
- Appendix A** UG4 Longwalls 409 to 414 Water Management Plan (LW409-414 WMP)
- Appendix B** UG4 Longwalls 409 to 414 Land Management Plan (LW409-414 LMP)
- Appendix C** UG4 Longwalls 409 to 414 Biodiversity Management Plan (LW409-414 BMP)
- Appendix D** UG4 Longwalls 409 to 414 Heritage Management Plan (LW409-414 HMP)
- Appendix E** UG4 Longwalls 409 to 414 Built Features Management Plans (LW409-414 BFMPs)
- Appendix F** UG4 Longwalls 409 to 414 Public Safety Management Plan (LW409-414 PSMP)

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Appendix G UG4 Longwalls 409 to 414 Subsidence Monitoring Program (LW409-414 SMP) (including Plans 1 to 7)

Appendix H UG4 Longwalls 409 to 414 Drip, Corner Gorge and Goulburn River Monitoring and Reporting Program (the Monitoring Program)

This LW409-414 Extraction Plan is informed by a series of technical reports, prepared by the endorsed suitably qualified experts, which contain a review of predictions of subsidence effects, subsidence impacts and environmental consequences. The technical reports are contained in **Technical Reports 1 to 5:**

Technical Report 1 Subsidence Report prepared by MSEC

Technical Report 2 Groundwater Technical Report prepared by AGE.

Technical Report 3 Surface Water Technical Report prepared by WRM.

Technical Report 4 Biodiversity Technical Report prepared by Niche.

Technical Report 5 Aboriginal Cultural Heritage Technical Report prepared by Niche.

1.5 MINE PLANNING AND DESIGN

1.5.1 Geology and Stratigraphy

The Moolarben Coal Complex is located in the northern part of the Western Coalfield, on the north-west margin of the Sydney Basin. Coal occurs in mid to late Permian age (approximately 250 to 275 million years before present) sediments collectively known as the Illawarra Coal Measures (also referred to as Permian coal measures). These units dip between 1 and 2° to the north-east.

The mining of UG4 will extract coal from the Ulan Seam, targeting the low ash D working section (DWS) ply (**Figure 5**). The Ulan Seam occurs toward the base of the Illawarra Coal Measures and the Moolarben Seam is approximately 40 m above the Ulan Seam. The Ulan Seam is considered the equivalent of the Lidsdale Seam, which has been extensively mined further south in the Greater Lithgow District.

The surface geology of most of the areas over the LW409-414 Study Area is predominantly units from the Narrabeen Group Sandstones and Conglomerates. These units overlie areas from the Illawarra Coal Measures. A typical stratigraphic section for the area is shown in **Figure 5**. The major geological units in the LW409-414 Study Area are, from the youngest to oldest:

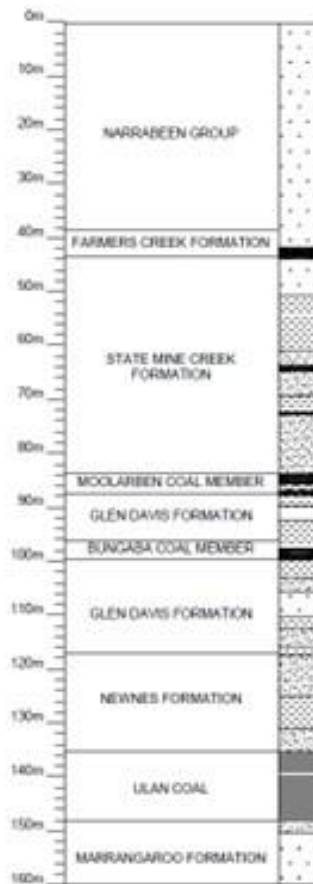
- Triassic-aged sandstones and conglomerates of the Narrabeen Group;
- Permian-aged Illawarra Coal Measures, including the Ulan Seam; and
- Carboniferous aged Ulan Granite.

The Triassic sandstone, known as Wollar Sandstone, is part of the Narrabeen Group and this sandstone unit is the main outcropping rock formation over the UG4 Study Area. Where present, the sandstones are between 14 m and 70 m thick and normally about 60 m with both massive and strongly cross-bedded units of individual thickness in the range of 1.5 m to 3 m.

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The Ulan Seam ranges in thickness from around 6 to 13 m and comprises numerous coal plies separated by partings of tuffaceous claystone and carbonaceous shale. Where the Ulan Seam is fully developed, the upper working section (WS1) ranges in thickness from 5.0 to 7.5 m, and the lower working section (WS2) from 4.9 to 6.2 m. The DWS and overlying D top ply (DTP) are a subset of WS2 occurring in the lower half of the seam. This section is amenable to underground mining, having a recoverable thickness of up to 3.5 m (MSEC, 2024).

Figure 5: Stratigraphic Column



1.5.2 Mining Geometry and Parameters

The LW409-414 Study Area¹ and mine plan is shown in **Figure 3** with key dimensions² summarised in **Table 2**. The depth of cover to the Ulan Seam above these longwalls varies between a minimum of 120 m near the commencing end of LW412, and a maximum of 215 m above the finishing end of LW414. Detailed mine layout drawings are provided in Plans 1 to 7 (**Appendix G**).

Table 2: Key Mining Parameters

Dimension	LW409	LW410	LW411	LW412	LW413	LW414
ROM Coal Extracted (Mt)	0.8	1.3	1.5	2.2	1.9	1.7
Gate Road Width (m)	5.4	5.4	5.4	5.4	5.4	5.4

¹ The LW409-414 Study Area is defined as the area of land within the furthest extent of the 26.5° angle of draw and 20 mm predicted subsidence contour.

² Key dimensions for LW409-414 are based on the revised and approved first workings in **Section 1.6**.

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Dimension	LW409	LW410	LW411	LW412	LW413	LW414
Gate Road Height (m)	3.4	3.4	3.4	3.4	3.4	3.4
MG Chain Pillar Width (m)	34.6	34.6	34.6	34.6	34.6	22.6
TG Chain Pillar Width (m)	19.6	34.6	34.6	34.6	34.6	34.6
Longwall Void Width (m)	260	260	260	260	260	260
Longwall Void Length (m)	787	1241	1411	2022	1750	1509
Extraction Height (m)	3.0	3.0	3.0	3.0	3.0	3.0

Notes: ROM = Run-of-mine, Mt = million tonnes, MG = maingate, TG = tailgate.

1.5.3 Mining Method

Access to LW409-414 is from the Open Cut 1 mine (OC1) highwall. UG4 North Mains head in a northern direction in the Ulan Seam initially within ML 1715 and continues in a northerly direction into ML 1605 within the Ulan Seam (**Figure 3**). The extraction of LW409-414 will occur from the west to east within ML 1605 and ML 1628. LW409-414 will be extracted using retreating longwall mining methods for secondary extraction of panels approximately 260 m wide (void width) and retreat from the north to south for each panel.

The longwall panels will be formed by driving two sets of gate roads (the TG and MG roads). Each gate road requires two roadways (headings) to be driven parallel to each other. The two roadways will be used for ventilation purposes, with one of the roadways used as a transport road and the other roadway used to convey the coal that will be mined back to the main conveyors. Construction of development main headings, MG and TG will be undertaken using continuous miners.

The dimensions of the headings will be approximately 5.4 m wide and 3.4 m in height. The headings will be connected approximately every 150 m by driving a cut-through from one heading to another which forms pillars of coal along the length of the gate road. The longwall layout includes approximately 260 m panel widths (void) with 35 m width pillars (solid). The MG roads and TG roads will then be linked together by driving an installation road and bleeder road at the top end of the longwall panels. ROM coal will be conveyed by the MG conveyor to the main conveyor which will carry coal to the surface of the mine.

1.5.4 Mine Schedule

The Moolarben Coal Complex is approved to operate seven days a week, 24 hours a day. The provisional extraction schedule for LW409-414 is provided in **Table 3** and **Figure 6**.

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Table 3: Provisional Extraction Schedule

Longwall	Estimated Start Date	Estimated Duration (months)	Estimated Completion Date
LW409	September 2026	3	November 2026
LW410	December 2026	3	March 2027
LW411	April 2027	3	July 2027
LW412	August 2027	4	December 2027
LW413	January 2028	4	May 2028
LW414	June 2028	4	September 2028

Note: In June 2026, the extraction timing was administratively updated to ensure consistency with the approved June versions of the WMP and SMP. This update does not otherwise amend the approved April version of this Plan.

1.5.5 Previous and Future Mining

The Moolarben Coal Complex includes four approved open cut mines (known as OC1, Open Cut 2 mine [OC2], Open Cut 3 mine [OC3] and Open Cut 4 mine [OC4]), three approved underground mines (known as Underground Area 1 [UG1], Underground Area 2 and UG4) and the associated infrastructure (**Figure 2**).

Previous mining areas at the Moolarben Coal Complex are located to the south of UG4 and include OC1, OC2, OC3, OC4. Previous underground mining has been completed in UG1 and commenced at the first set of UG4 panels (i.e. LW401-408), which are located in the southern part of the UG4 area.

Previous and future workings in the vicinity of LW409-414 are shown on **Figure 2** and in Plans 1, 3 and 4 (**Appendix G**).

Currently there are no plans for mining other coal seams at UG4.

1.6 SUBSIDENCE PREDICTIONS

Predicted subsidence effects, subsidence impacts and environmental consequences of UG4 were originally assessed, and subsequently approved, in the *Moolarben Coal Project Environmental Assessment Report* (MCM, 2006).

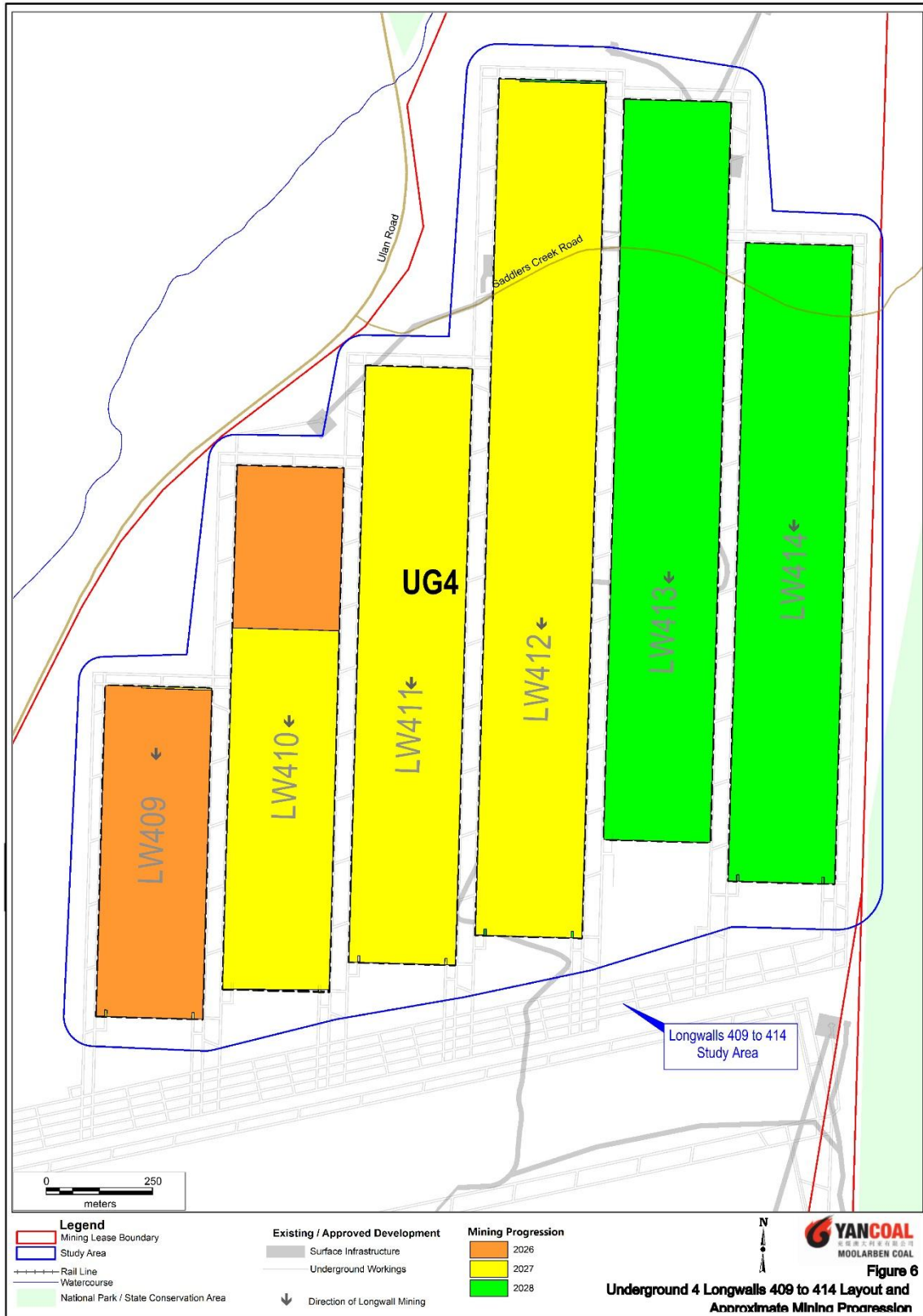
As required by Condition 77(e), Schedule 3 of Project Approval (05_0117), when preparing an Extraction Plan, MCO must revise predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings, incorporating any relevant information obtained since approval. MSEC were engaged by MCO to prepare a revised subsidence report to support the LW409-414 Extraction Plan.

In accordance with Condition 29, Schedule 3 of Project Approval (05_0117), MCO sought approval for the first workings of UG4 in May 2019. On 8 July 2019 the RR approved the first workings for UG4 (**Attachment 2**) as displayed in **Figure 3** (the Extraction Plan Layout).

The original Moolarben Stage 1 Environmental Assessment (MCM, 2006) (Stage 1 EA) proposed a longwall layout for UG4 where mining of LW412-414 would occur at a distance of 250 m to 450 m from the Drip. In response to comments received on the Stage 1 EA by the Independent Hearing and Assessment Panel, MCO revised the UG4 mine plan to increase the minimum setback from the Drip to 645 m. The revised layout also incorporates a setback from the Corner Gorge of 450 m.

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Figure 6: UG4 Longwalls 409 to 414 Layout and Approximate Mining Progression



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The length of LW413 has been reduced by 125 m for the Extraction Layout compared to the Approved Layout to reduce the predicted impacts at Cliff Line 3 (CL3) to achieve the subsidence impact performance measure of ‘minimise subsidence damage’. Further detail is provided in **Section 2.1** and **Appendix B**.

Therefore, the predictions and impact assessments provided in this LW409-414 Extraction Plan are based on the Extraction Plan Layout, which is the same as the Approved Layout, with the exception of LW413, which is shorter at the southern end by 125 m, and LW414, which is 20 m shorter at the northern end (MSEC, 2024).

A summary of the main revised subsidence parameters for the Extraction Plan Layout predicted by MSEC is provided below in **Sections 1.6.1 to 1.6.3**. A summary of the predicted subsidence impacts on natural features and non-MCO built features within and outside of the LW409-414 Study Area is provided in **Section 2.1**.

1.6.1 Predicted Conventional Subsidence Movements

The maximum predicted conventional subsidence parameters resulting from the extraction of LW409-414 were determined using the calibrated Incremental Profile Method. The predicted subsidence contours are irregular due to the shallow depths of cover.

The maximum predicted tilts and curvatures are very localised and therefore do not necessarily represent the overall (i.e. macro) ground movements. Revised standards for reporting adopted by MSEC may result in slight differences in reported values compared with previous reports (MSEC, 2024).

The maximum predicted values of incremental conventional subsidence, tilt and curvature, due to the extraction of each of the longwalls, is summarised in **Table 4**.

Table 4: Maximum Predicted Incremental Conventional Subsidence, Tilt and Curvature Resulting from the Extraction of Each of LW409-414

Longwall	Subsidence ¹ (mm)	Tilt ² (mm/m)	Hogging Curvature ³ (km ⁻¹)	Sagging Curvature ³ (km ⁻¹)
LW409	1800	40	2.0	1.6
LW410	1800	35	1.7	1.1
LW411	1800	30	1.1	0.8
LW412	1800	40	1.8	1.4
LW413	1800	35	1.5	1.1
LW414	1800	35	1.5	1.1

Note: mm/m = millimetre per metre, km⁻¹ = inverse kilometre.

Source: MSEC (2024)

¹ Subsidence refers to vertical displacements of the ground.

² Tilt is the change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the distance between those two points.

³ Curvature is the second derivative of subsidence, 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.

The maximum predicted values of total conventional subsidence, tilt and curvature, after the extraction of each of the longwalls, is summarised in **Table 5**. The predicted tilts provided in this table are the maxima after the completion of each of the longwalls. The predicted curvatures are the maxima at any time during or after the extraction of each of the longwalls. **Figure 7** provides total subsidence contours for LW409-414.

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Table 5: Maximum Predicted Total Conventional Subsidence, Tilt and Curvature after the Extraction of Each of LW409-414

Longwall	Subsidence (mm)	Tilt (mm/m)	Hogging Curvature (km ⁻¹)	Sagging Curvature (km ⁻¹)
LW409	1800	40	2.0	1.6
LW410	1900	40	2.0	1.6
LW411	1900	40	2.0	1.6
LW412	1900	40	2.0	1.6
LW413	1900	40	2.0	1.6
LW414	1900	40	2.0	1.6

Source: MSEC (2024)

The maximum predicted total subsidence parameters based on the Approved Layout are the same as the Extraction Plan Layout for LW409-414.

The maximum predicted subsidence parameters and the predicted subsidence contours provided in this LW409-414 Extraction Plan describe and show the conventional movements and do not include the valley related upsidence and closure movements, nor the effects of faults and other geological structures.

1.6.2 Non-Conventional Ground Movements

MSEC (2024) considers it likely that non-conventional ground movements will occur due to near surface geological conditions and steep topography, which are often accompanied by elevated tilts and curvatures.

In most cases, it is not possible to predict the exact locations or magnitudes of the non-conventional anomalous movements due to near surface geological conditions. For this reason, the strain predictions provided are based on a statistical analysis of measured strains, including both conventional and non-conventional anomalous strains. In addition to this, the impact assessments for the natural and built features include historical impacts resulting from previous longwall mining which have occurred as a result of both conventional and non-conventional subsidence movements (MSEC, 2024).

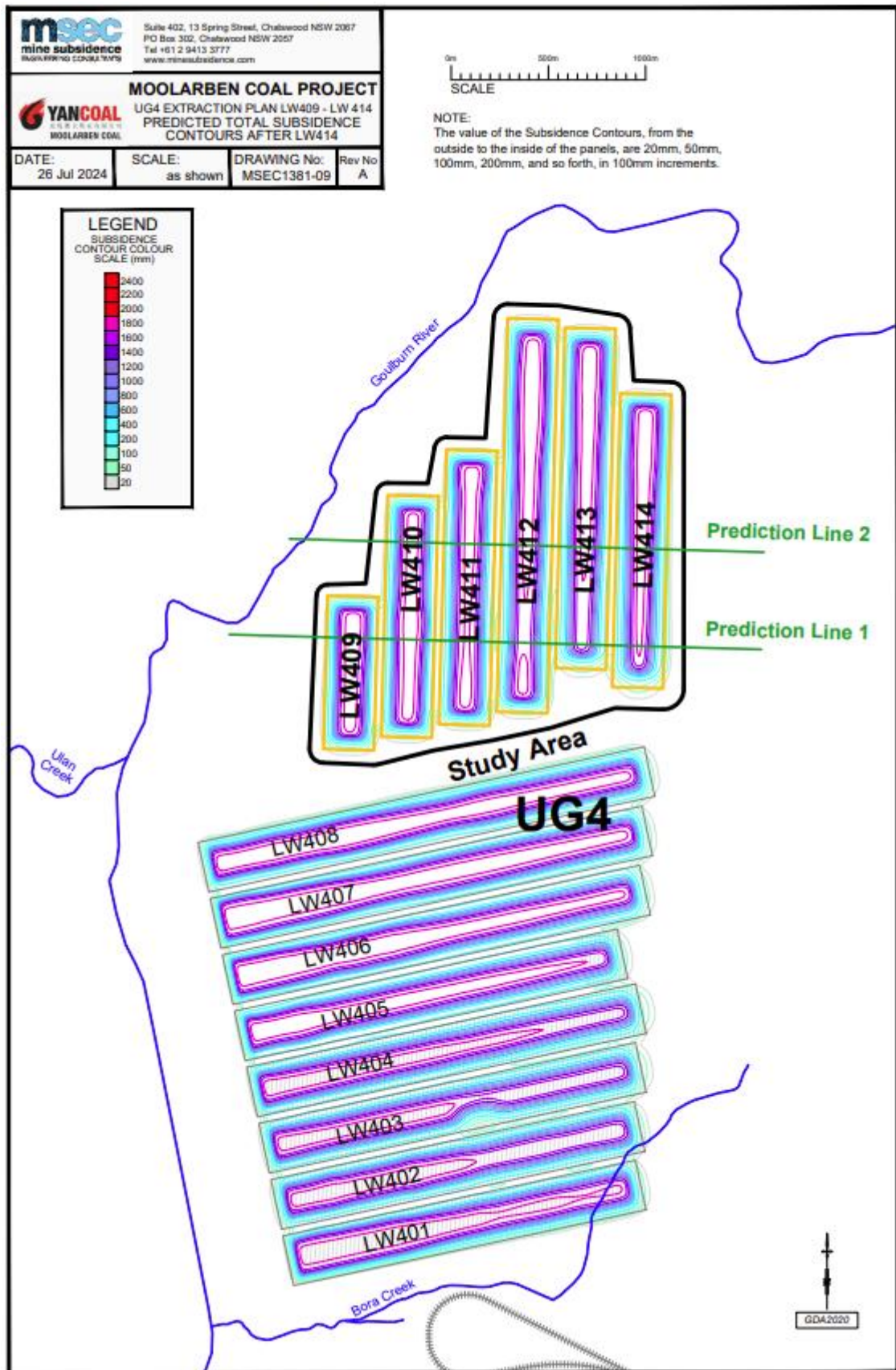
1.6.3 Predicted Far-Field Movements

In addition to the conventional subsidence movements that have been predicted above and adjacent to LW409-414, it is also likely that far-field horizontal movements will be experienced during the extraction of LW409-414 (MSEC, 2024).

In addition to conventional terrestrial survey monitoring lines, MCO has installed several continuous Global Navigation Satellite Systems (GNSS) monitoring sites across the UG4 area. The GNSS units provide continuous positioning with a typical output of one positional data point per day. The result is a much higher positional accuracy compared to conventional terrestrial survey. The quoted accuracy of GNSS positioning is ± 5 mm (MSEC, 2024).

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Figure 7: Predicted Subsidence after Longwalls 409 to 414



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Existing GNSS monitoring data shows that horizontal movements are approximately 10 mm beyond approximately 1,100 m from the extracted longwalls, and gradually increasing with reduced distance from the longwalls. The movement range of up to 10 mm is slightly greater than the typical ± 5 mm accuracy discussed above; however, observation of the movement trends for the GNSS units identified some variation which may be related to seasonal changes, rainfall, and/or atmospheric conditions. With ongoing longwall extraction, additional GNSS monitoring data will be added to form a comprehensive database at the UG4 area. Additional data will also allow formulation of statistical distribution of far-field horizontal movements.

The impacts of far-field horizontal movements on the natural features and items of surface infrastructure within the vicinity of the Study Area are expected to be insignificant, except where they occur at large built features, such as roads and bridges, which may be sensitive to small differential movements and may require monitoring and maintenance to remain in a safe and serviceable condition (MSEC, 2024).

There are additional features that lie outside or partly outside the Study Area that are expected to experience minor far-field movements. The surface features which may be sensitive to such movements have been identified by MSEC (2024) and include:

- Ulan Road.
- Ulan Road Bridge.
- Telstra Copper Cable along Ulan Road.
- The Drip and Corner Gorge.
- The Goulburn River National Park (GRNP) and Goulburn River State Conservation Area (GRSCA), including cliffs and minor cliffs in GRNP and GRSCA.
- Aboriginal heritage sites.
- Building structures on private property.

The LW409-414 LMP (**Appendix B**), LW409-414 HMP (**Appendix D**), LW409-414 BFMPs (**Appendix E**) and the Monitoring Program (**Appendix H**) have been developed to manage the potential impacts of far-field movements on the relevant features as identified by MSEC (2024).

1.7 SUBSIDENCE IMPACT PERFORMANCE MEASURES

Project Approval (05_0117) (as modified) requires MCO to ensure the project does not cause any exceedances of the subsidence impact performance measures for natural and heritage features outlined in Table 14, Condition 73, Schedule 3 and built features as outlined Table 15, Condition 75, Schedule 3. The subsidence impact performance measures are detailed in **Table 6** and **Table 7**.

Not all of the natural, heritage and built features listed in **Table 6** and **Table 7** are relevant to LW409-414. **Table 6** and **Table 7** provide a description of the features relevant to the subsidence impact performance measures for the Project Approval (05_0117).

Natural, heritage and built features relevant to this LW409-414 Extraction Plan are illustrated on **Figure 8** to **Figure 10**.

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Project Approval (05_0117) does not include any specific performance measures for the GRNP and GRSCA. However, a performance indicator has been adopted for cliffs and minor cliffs in the GRNP and GRSCA within 400 m of LW409-414, as developed in consultation with NSW National Parks and Wildlife Service (NPWS) for LW401-408.

Project Approval (05_0117) also does not include any specific performance measures for Aboriginal heritage site S1MC284. However, in consideration of the features associated with S1MC284 (i.e. shelter with art and artefact[s]) and the scientific significance (moderate), it is proposed that the performance measure of “reduce the likelihood of subsidence damage to low” is voluntarily applied to S1MC284.

Table 6: Subsidence Impact Performance Measures – Natural and Heritage Features

Subsidence Impact Performance Measure		Relevance to LW409-414 Extraction Plan
Special Feature		
<i>The Drip and Goulburn River Gorge</i>	<i>Nil impact or environmental consequences</i>	The Drip is located approximately 645 m from LW413 and is approximately 770 m from LW412. The Corner Gorge is located approximately 450 m from LW414 and is approximately 575 m from LW413. Mining-related impacts to the Drip and Corner Gorge due to the extraction of LW409-414 are considered unlikely to occur.
Water Resources		
<i>Goulburn River and the bed of the Goulburn River</i>	<i>Negligible impact or environmental consequences. Remain outside the zone of recorded subsidence damage for longwall mining.</i>	The Goulburn River is located on the north-western side of LW409-412 at distances of 180 m to 440 m from the longwall commencing ends, and to the north and north-east of LW412-414 at distances of 460 m to 500 m and may experience horizontal movements at a valley location. It is considered unlikely that fracturing of the bed of the Goulburn River would occur.
Land		
<i>CL3</i>	<i>Minimise subsidence damage</i>	CL3 is located adjacent to the finishing end of LW413 and is over 165 m to the north of LW408. The length of LW413 has been reduced by 125 m for the Extraction Layout compared to the Approved Layout to reduce the predicted impacts at CL3. The maximum predicted conventional subsidence parameters based on the Extraction Plan Layout are less than those for the Approved Layout.
Heritage Sites		
<i>Aboriginal heritage sites 264, 282, 283, 286 and 287</i>	<i>Reduce the likelihood of subsidence damage to low.</i>	Aboriginal heritage site 264, 282, 283, 284 ³ , 286 and 287 are located outside the 20 mm subsidence contour and subsidence impacts to these sites are considered unlikely to occur.

³ A voluntary performance measure has been proposed for S1MC284 due to the rare site features and moderate significance.

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Table 6 (Continued): Subsidence Impact Performance Measures – Natural and Heritage Features

Subsidence Impact Performance Measure		Relevance to LW409-414 Extraction Plan
<i>Aboriginal Heritage Site 280</i>	<i>Reduce the likelihood of subsidence damage to moderate.</i>	Aboriginal heritage site S1MC280 is located within the LW401-408 Study Area (south of the LW409-414 Study Area) and the likelihood of subsidence impacts to this feature from LW409-414 is considered to be very low. S1MC280 is not discussed further in the LW409-414 Extraction Plan.
<i>Historic heritage sites</i>	<i>No greater subsidence impact or environmental consequences than predicted in the EA⁴</i>	There are no historic heritage sites listed in Project Approval (05_0117) within the Study Area or within the vicinity of the Study Area considered sensitive to subsidence movements.
Mine workings		
<i>First workings under an approved Extraction Plan beneath any feature where performance measures in this table require negligible impacts, negligible consequences or negligible loss</i>	<i>To remain long-term stable and non-subsiding.</i>	First workings have been designed to meet the requirements of Condition 79, Schedule 3 of Project Approval (05_0117). RR confirmed their satisfaction of first workings for UG4 on 8 July 2019.
<i>Second workings</i>	<i>To be carried out only within the longwall mining domains, in accordance with an approved Extraction Plan.</i>	Second workings will be carried out in accordance with an approved Extraction Plan (this Extraction Plan).

⁴ The Moolarben Coal Project Environmental Assessment (2006).

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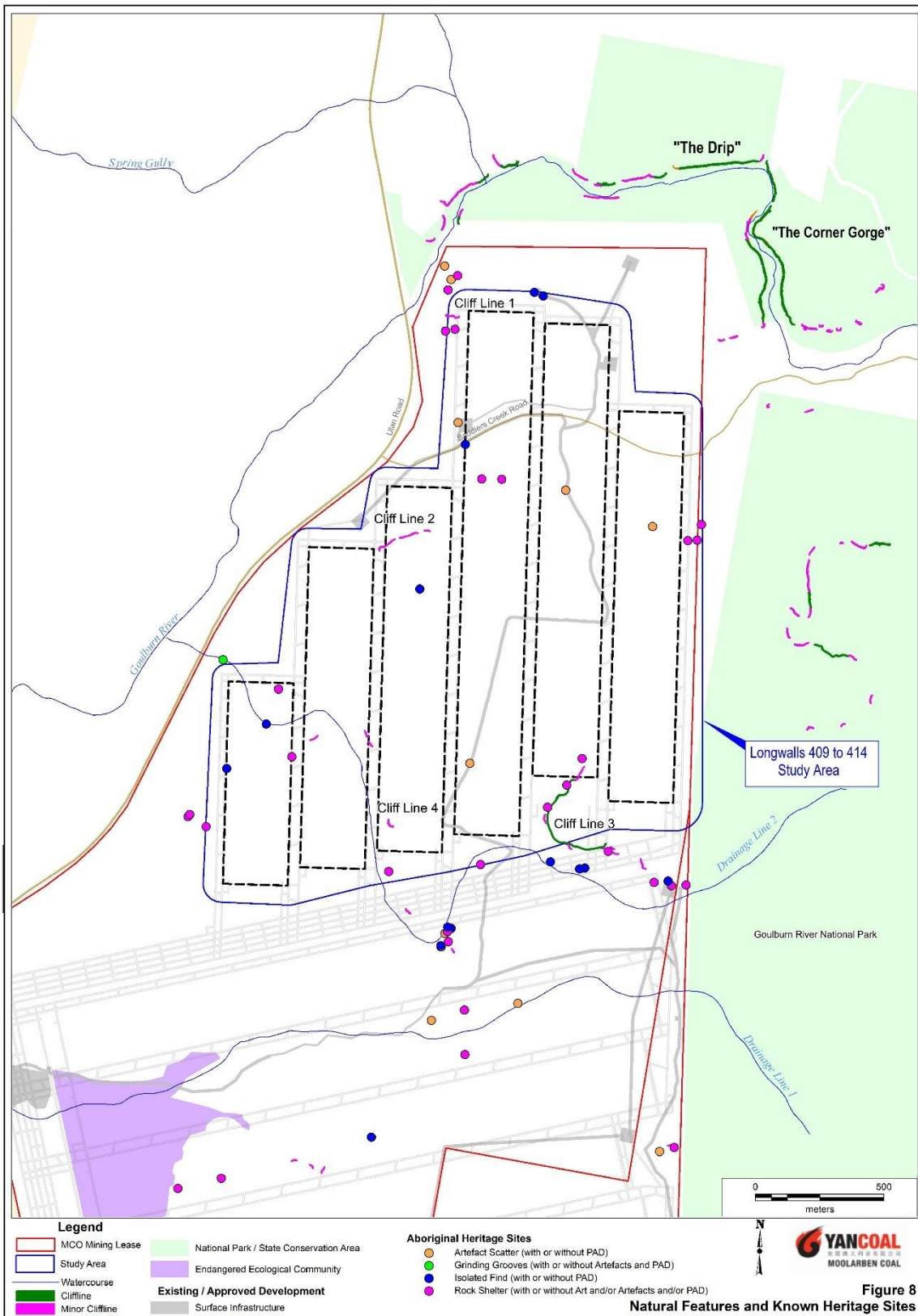
Table 7: Subsidence Impact Performance Measures – Built Features

Subsidence Impact Performance Measure		Relevance to LW409-414 Extraction Plan
Key Public Infrastructure:		
<i>Gulgong-Sandy Hollow Railway Line Wollar-Wellington 330kV Transmission Line</i>	<i>Always safe and serviceable Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.</i>	Gulgong-Sandy Hollow Railway Line and Wollar-Wellington 330kV Transmission Line are located south of LW401-408 and greater than 2.5 km from LW409-414 and therefore well outside of the Study Area. Impacts to these features are considered unlikely to occur.
Other Infrastructure:		
<i>Roads</i>	<i>Safe, serviceable and repairable unless the owner agrees otherwise in writing.</i>	Ulan Road is located to the west of LW409-414 and wholly outside of the Study Area. Features along the road include three cuttings in sandstone and culverts beneath Ulan Road. The Ulan Road Bridge over the Goulburn River is 210 m from LW412 at its nearest point. Ulan Road, the road cuttings and Ulan Road Bridge are all located outside the Study Area and will not be subjected to measurable conventional subsidence, tilts, and curvatures; however, the road, cuttings and bridge may experience far-field horizontal movements. Saddlers Creek Road will be mined beneath by LW412-414 and experience subsidence movements from the extraction of these longwalls including cracking, stepping and rippling of the road surfaces. The road may also experience ponding and redirection of surface flow. However, any subsidence impacts to the road surface can be remediated with earthwork, regrading and releveling the road using standard road maintenance techniques.
<i>Other built features and improvements, including fences</i>	<i>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 replaced or fully compensated.</i>	Telstra-owned copper cables are located along Ulan Road and Saddlers Creek Road. The copper cables along Ulan Road are outside the Study Area and will not be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy); however, the cables are expected to experience far-field horizontal movements. The copper cables along Saddlers Creek Road will be mined beneath by LW412-414. The profiles of predicted subsidence, tilt and curvature along the copper cables will be similar to those predicted for Saddlers Creek Road. It is unlikely that the proposed mining would result in any significant impacts on the copper telecommunications cables within the LW409-414 Study Area.
Public Safety		
<i>Public safety</i>	<i>Negligible additional risk</i>	Public safety is considered in the LW409-414 PSMP.

Note: kV = kilovolt

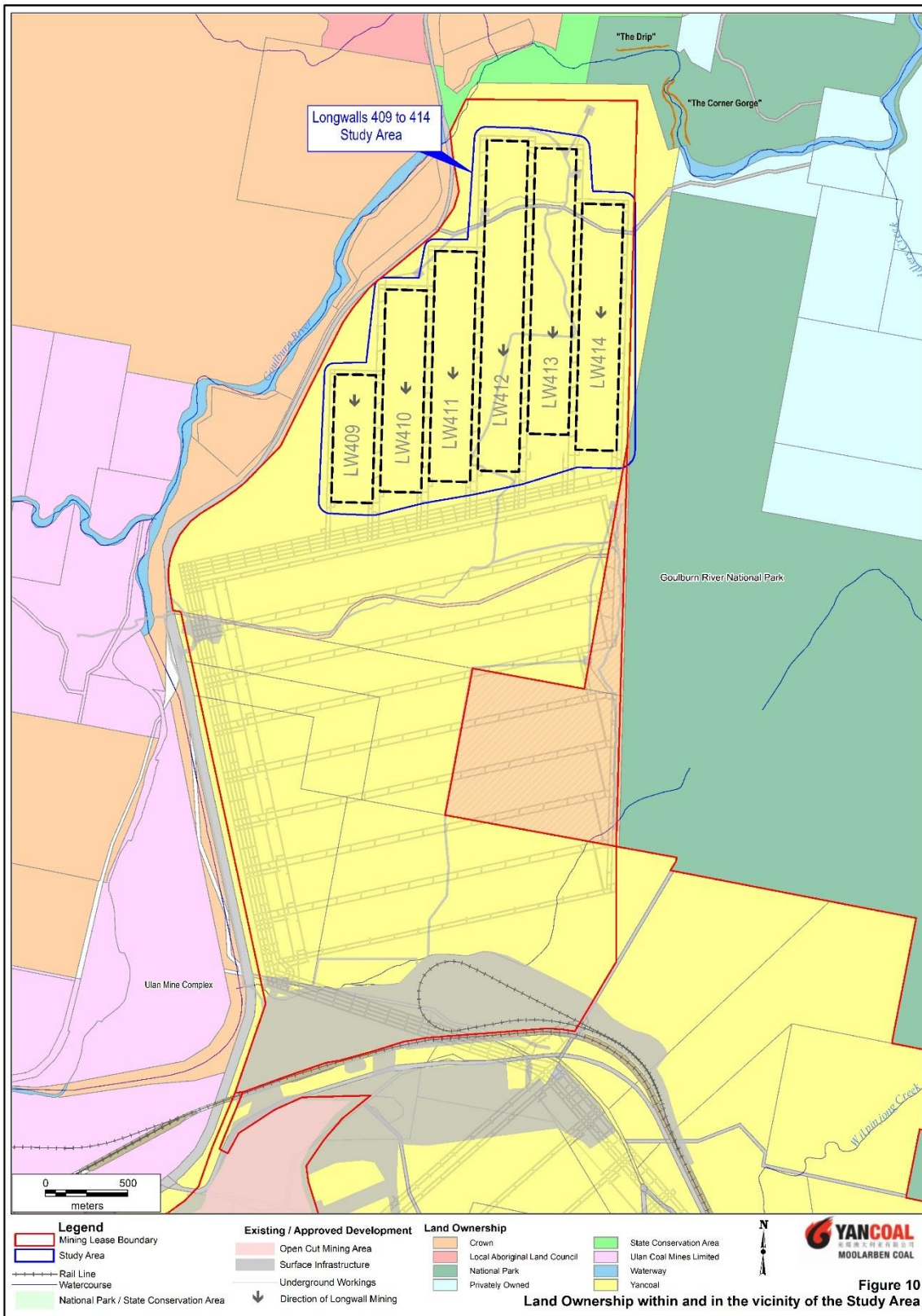
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Figure 8: Natural Features and Heritage Sites Within the Study Area



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Figure 10: Land Ownership Within and in the Vicinity of the Study Area



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1.8 SUBSIDENCE MANAGEMENT APPROACH

Potential environmental consequences during the mining of LW409-414 will be managed in accordance with the relevant requirements of Project Approval (05_0117) and other approvals, through:

- **Mine Design** – the layout of LW409-414 has been developed to meet the subsidence impact performance measures (**Section 1.5**).
- **Subsidence Monitoring** – visual and survey monitoring and reporting will be conducted to confirm predictions of subsidence effects and potential subsidence impacts and environmental consequences (**Section 3.0**).
- **Management Measures and Remediation** – implementation of management measures and/or remediation, as required, to address subsidence impacts and/or environmental consequences (in consideration of the potential impacts of the unmitigated impact [including the potential for self-healing or long-term degradation] and the potential impacts of the remediation) (**Sections 3.1 to 3.4**).
- **Contingency Plans** – implementation of Contingency Plans in the event an exceedance of a subsidence impact performance measure or if an unexpected impact is detected (**Section 4.1**), including consideration of identified potential contingency measures (**Sections 3.1 and 3.2**).
- **Adaptive Management** – adaptive management will be implemented where appropriate by reviewing and evaluating the effectiveness of management strategies, and adjusting management strategies to improve performance, particularly following an exceedance of a subsidence impact performance measure or if an unexpected impact is detected (**Section 4.2**).

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2.0 DEVELOPMENT OF THE EXTRACTION PLAN

2.1 REVIEW OF PREDICTIONS

As discussed in **Section 1.6**, the proposed panel and pillar widths for the Extraction Plan Layout and Approved Layout are unchanged, with the exception of LW413 which has been shortened at the finishing end and LW414 which has been shortened at the commencing end.

A summary of the main subsidence parameters predicted by MSEC is provided in **Sections 1.6.1 to 1.6.3**. A summary of subsidence impacts on natural features, privately owned built features and MCO owned built features within and in the vicinity of the Study Area is provided in **Sections 3.1 and 3.2**.

The previously assessed and approved subsidence impacts and environmental consequences have been reviewed for the Extraction Plan Layout by MSEC (2024), AGE (2024), WRM (2024) and Niche (2024a; 2024b) (**Technical Reports 1 to 5**). This section describes the process of reviewing and updating these subsidence impact predictions.

2.1.1 Predicted Subsidence Effects and Subsidence Impacts

A subsidence assessment review for LW409-414 was prepared in support of this LW409-414 Extraction Plan by MSEC with the outcomes of this assessment incorporated into the management plans in **Appendices A to H** as required.

Review of Subsidence Prediction Methodology

The predicted conventional subsidence parameters for LW409-414 were determined by MSEC using the Incremental Profile Method. The method is an empirical model based on a large database of observed monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of NSW and from mining in the Bowen Basin in Queensland. Empirical models are a common and accepted method of subsidence prediction in NSW (MSEC, 2024).

The database consists of the observed incremental subsidence profiles, which are the additional subsidence profiles resulting from the extraction of each longwall within a series of longwalls. It can be seen from the normalised incremental subsidence profiles within the database, that the observed shapes and magnitudes are reasonably consistent where the mining geometry and local geology are similar (MSEC, 2024).

Subsidence predictions made using the Incremental Profile Method use the database of observed incremental subsidence profiles, the longwall geometries, local surface and seam information and geology. The method has a tendency to over-predict the conventional subsidence parameters (i.e. is slightly conservative) where the mining geometry and geology are within the range of the empirical database. The predictions can be further tailored to local conditions where observed monitoring data is available close to the mining area (MSEC, 2024).

Comparison with Previous Predictions of Subsidence Effects

As discussed, MSEC (2024) prepared a revised subsidence report to support the Extraction Plan for LW409-414. A comparison of the maximum predicted subsidence parameters resulting from the extraction of LW409-414 (based on the Extraction Plan Layout), with those based on the Approved Layout is provided in **Table 8**. The values are the maxima anywhere above the longwall layouts.

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Table 8: Comparison of Maximum Predicted Conventional Subsidence Parameters based on the Approved Layout and the Extraction Plan Layout

Layout	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Conventional Hogging Curvature (km-1)	Maximum Predicted Total Conventional Sagging Curvature (km-1)
Approved Layout	1900	40	2.0	1.6
Extraction Plan Layout	1900	40	2.0	1.6

As displayed in **Table 8**, the maximum predicted total subsidence parameters based on the Approved Layout are the same as those for the Extraction Plan Layout for LW409-414. Whilst the specific values of the maximum curvatures are not shown, due to these representing the localised irregular movements rather than the macro (i.e. overall) movements, these parameters do not change (MSEC, 2024).

Predicted Subsidence Impacts

Longwall mining can result in surface cracking, heaving, buckling, humping and stepping at the surface. The extent and severity of these mining induced ground deformations are dependent on a number of factors, including the mine geometry, depth of cover, overburden geology, locations of natural joints in the bedrock, the presence of near surface geological structures and mining conditions (MSEC, 2024).

2.1.2 Potential Environmental Consequences

Detailed discussion of potential environmental consequences due to the extraction of LW409-414 is provided in the key component management plans in **Appendices A to F and H**. The management of potential environmental consequences is provided in **Section 3**. A summary of potential environmental consequences on natural and built features is provided below.

The suitably qualified experts (endorsed by the Secretary of the DPHI) conducted a review of the potential environmental consequences due to the extraction of LW409-414 for the preparation of each management plan.

The technical reviews concluded that there are no additional potential subsidence impacts or environmental consequences resulting from the extraction of LW409-414 compared to those assessed and approved for the Moolarben Coal Project Stage 1 Approval (05_0117).

Goulburn River

The Goulburn River is located outside the Study Area. The Goulburn River is located on the north-western side of LW409-412 at distances of 180 m to 440 m from the longwall commencing ends, and to the north and north-east of LW412-414 at distances of 460 m to 500 m. At its nearest point of 180 m from LW409-414, the distance to the Goulburn River represents about 1.3 times the depth of cover from LW409-414. Elsewhere, the Goulburn River is two or more times the depth of cover from LW409-414. It is possible that where horizontal movement is observed at a valley location then valley related closure movement could be observed. A prediction of valley closure at the nearest location of the Goulburn River indicates a potential valley closure of 20 mm, which is below the limit of accuracy for the survey data used in the valley closure prediction model. It is considered unlikely that fracturing of the bed of the Goulburn River would occur (MSEC, 2024).

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Further details on the Goulburn River are provided in **Section 3.1** and **Appendix H**.

The Drip and Corner Gorge

The Drip is located approximately 645 m from the commencing end of LW413 and is 770 m from the commencing end of LW412. The distance of 645 m to the Drip represents approximately 4.5 times the depth of cover of 145 m from LW413.

The Corner Gorge is located approximately 450 m from LW414 and is approximately 575 m from LW413. The distance of 450 m to the Corner Gorge represents approximately 3.5 times the depth of cover of 130 m from LW414.

At distances of over 450 m, the Drip and Corner Gorge will not experience measurable conventional tilts, curvatures or strains from the extraction of LW409-414 (MSEC, 2024). Existing GNSS monitoring data has been reviewed by MSEC (2024), which has identified that the Drip and Corner Gorge currently experience a level of baseline natural and tolerance horizontal movements and may experience far-field movements from mining of LW409-414. Due to the significant distance and low magnitude of expected far-field movement at the cliffs, mining-related impacts to the Drip and Corner Gorge due to the extraction of LW409-414 are considered unlikely to occur (MSEC, 2024).

Further details on the Drip and Corner Gorge are provided in **Section 3.1** and **Appendix H**.

Drainage Line

There are no perennial drainage lines within the Study Area. The only drainage line flowing through the Study Area is Drainage Line (DL) 2. A number of other small ephemeral drainage lines have been identified above LW409-414 and within the Study Area. The drainage lines located across the Study Area are likely to be subjected to the full range of predicted systematic subsidence and valley related movements (MSEC, 2024).

Further details on drainage lines are provided in **Section 3.1** and **Appendix A**.

Groundwater

Triassic aged sandstones overly the Permian coal measures and are present over LW409-414. Large extents of the Triassic strata are naturally unsaturated (especially the higher and more permeable upper Triassic quartzose). Data from monitoring point PZ128 Vibrating Wire Piezometer located 20 m north of LW412 show the sensor has been unsaturated for the entire period of monitoring. Where saturated, the Triassic sandstones provide some water supply potential for bores, however the sandstone is generally low yielding (AGE, 2024).

The Triassic sandstone supports a small number of stock and domestic bores on private properties to the north of the Moolarben Coal Complex. Groundwater within the Triassic sandstones north of the Goulburn River also supports the local and culturally sensitive water feature on the Goulburn River known as the Drip, which is located on the northern side of the Goulburn River. The Drip is a perched water table within the Triassic sandstone and effectively disconnected from the underlying regional water table (AGE, 2024).

The Permian aged Illawarra Coal Measures underlie the Triassic Narrabeen Group and comprise interbedded claystones, siltstones, fine to coarse grained sandstones and coal seams, including the Ulan Seam which will be mined at UG4 (AGE, 2024).

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The Permian strata can be categorised into the following hydrogeological sub-units (AGE, 2024):

- very low permeability and very low yielding sandstone and siltstone, that comprises the majority of the Permian interburden/overburden; and
- low to moderately permeable coal seams, which are the principal water bearing strata within the Illawarra Coal Measures.

The Permian coal measures are hydraulically confined to semi-confined within the region. Groundwater levels are locally depressurised due to extensive historic and current mining activities (AGE, 2024)

The Goulburn River is the main watercourse in the vicinity of UG4 and has been heavily modified by the Goulburn River Diversion adjacent to UG4. In November 2023 MCO installed two additional gauging stations, namely SW02 and SW22, and two shallow standpipe monitoring bores PZ237A and PZ234A, to compare surface / groundwater levels at two locations along the Goulburn River. The data collected at these monitoring locations to date indicates both gaining and losing conditions between surface water and groundwater occur along the length of the Goulburn River adjacent to LW409-414 (AGE, 2024).

There is no ‘highly productive’ groundwater, as defined under the *NSW Aquifer Interference Policy* (AIP), mapped in the vicinity of the Moolarben Coal Complex. The aquifers in the vicinity of LW409-414 are “less productive” as per the AIP classification. The nearest ‘highly productive’ groundwater is a portion of the alluvial aquifer associated with Wilpinjong Creek downstream of the Wilpinjong Coal Mine (AGE, 2024).

There are no high priority groundwater dependent ecosystems (GDEs) listed in the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* within or in the vicinity of the Study Area (AGE, 2024).

The Drip is a GDE with local cultural and community significance. The groundwater seepage is observed in a cliff on the northern side of the Goulburn River and is derived from the perching of groundwater in zones that are exposed in the cliff faces. The perching occurs in the Triassic Narrabeen Group sediments and is formed by accumulations of groundwater above less permeable horizons in the Triassic sequence to the north of the Goulburn River. As described above, the perched aquifer is effectively disconnected from the underlying regional water table and therefore depressurisation caused by mining of LW409-414 will not impact the water supply to the Drip (AGE, 2024).

There is one private bore in the vicinity of the Study Area, located to the east of LW414. The bore is a relatively shallow bore (24 m) installed within Triassic strata and connected to the river alluvium. No private bores are predicted to experience greater than minimal impact (i.e. drawdown will be less than the AIP minimal impact definition of greater than 2 m drawdown) due to LW409-414 (AGE, 2024).

Further details on groundwater are provided in **Section 3.1** and **Appendix A and Appendix H**.

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Cliff Line CL3

CL3 is located adjacent to the finishing end of LW413 and is over 165 m to the north of LW408. The length of LW413 has been reduced by 125 m for the Extraction Layout compared to the Approved Layout to reduce the predicted impacts at CL3. The maximum predicted conventional subsidence parameters based on the Extraction Plan Layout are less than those for the Approved Layout (MSEC, 2024).

Further details on cliffs are provided in **Section 3.1** and **Appendix B**.

Cliffs and Minor Cliffs within the GRNP and GRSCA

The nearest minor cliff within the GRNP is located 313 m from the commencing end of LW414. There are no other cliffs or minor cliffs within the GRNP within 400 m of the longwalls. At 313 m or greater from the nearest longwall, the cliffs and minor cliffs are located 2.5 times the depth cover or greater from the longwalls. At distances of 313 m or 2.5 times the depth of cover between the longwalls and the minor cliffs, the maximum expected incremental far-field horizontal movements based on MCO monitoring data is 40 mm (MSEC, 2024).

The nearest minor cliff within the GRSCA is located 300 m from the commencing end of LW412. The nearest cliff within the GRSCA is located 330 m from the commencing end of LW412. At 330 m or greater from the nearest longwall, the cliffs and minor cliffs are located 2.4 times the depth of cover or greater from the longwalls. At distances of 330 m or 2.4 times the depth of cover between the longwalls and the minor cliffs, the maximum expected incremental far-field horizontal movements based on MCO monitoring data is 45 mm (MSEC, 2024).

There is extensive experience of mining adjacent to (i.e. not directly beneath) cliffs in the NSW Coalfields which indicates that the likelihood of impacts on cliffs or minor cliffs outside of the Study Area is very low. There have been no large cliff instabilities where the cliffs have been wholly located outside the extents of mining. It is unlikely, therefore, that the cliffs and minor cliffs within the GRNP and GRSCA would be adversely impacted by the far-field horizontal movements (MSEC, 2024).

Further details on cliffs are provided in **Section 3.1** and **Appendix B**.

Land in General

The depths of cover over the underground mining areas vary from 120 m to 215 m. At the shallow depths of cover above LW409-414, surface cracking is expected to be typically in the order of 150 mm to 200 mm wide, however in some instances could be up to 500 mm wide where the depths of cover are the shallowest. Where the depths of cover are greater, the surface crack widths are expected to be typically in the order of 100 mm to 150 mm wide. The surface crack widths are likely to be smaller where the depths of cover are greater, or where the surface cracks result from the travelling wave.

The surface cracking and deformation within the Study Area could result in safety issues (i.e. trip hazards), affect vehicle access (i.e. large deformations in access tracks), or result in increased erosion (especially along drainage lines and steeper slopes) (MSEC, 2024).

Further details on land in general are provided in **Section 3.1** and **Appendix B**.

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Threatened Species, Threatened Populations, or Endangered Ecological Communities

Niche completed a review for threatened species, populations and their habitats, endangered ecological communities and water dependent ecosystems within the LW409-414 Study Area.

No PCTs within the LW409-414 Study Area are associated with Threatened Ecological Communities.

No threatened flora species have been detected within the LW409-414 Study Area during previous surveys. However, a population of *Androcalva procumbens* (listed as Vulnerable under the BC Act and EPBC Act) is known at a location within the LW409-414 Study Area (Department of Climate Change, Energy, the Environment and Water [DCCEE], 2024), and was identified at that location during the current baseline assessment survey. The population is comprised of five individuals in PCT 3781 and occurs approximately 30 m south of LW413 and approximately 12 m south of the predicted angle of draw (Niche, 2024b).

Previous ecological surveys have identified 17 threatened and/or migratory fauna species, consisting of five mammal species (including five microbat species) and 12 bird species. Opportunistic fauna survey as well as bat acoustic recorder deployment undertaken during this baseline assessment confirmed the presence of habitat for the above species and detected the presence of threatened fauna species including the Glossy Black Cockatoo and three threatened microbat species (i.e. Large-eared Pied Bat, Large Bent-winged Bat and Yellow-bellied Sheathtail Bat) (Niche, 2024b).

Literature reviews and aquatic ecology studies undertaken at the Moolarben Coal Complex indicate that there are no threatened aquatic plants, fish or macroinvertebrate species or populations (as listed under EPBC Act or under the NSW *Fisheries Management Act 1994*) listed or found in the upper Goulburn River (Niche, 2024b).

Predicted subsidence impacts on biodiversity values of the LW409-414 Study Area are expected to be limited to the extent of longwall panels, being localised in nature (MSEC, 2024). It has been determined that secondary extraction at LW409-414 will not significantly impact the biodiversity values within the Study Area (Niche, 2024).

Further details on threatened species and populations are provided in **Section 3.1** and **Appendix C**.

Aboriginal Heritage Sites

Niche completed a review of Aboriginal cultural heritage and an archaeological assessment within the LW409-414 Study Area. A total of 33 Aboriginal heritage sites were identified within or in close proximity (within 100 m) to the LW409-414 Study Area including 23 sites that are recorded within the Study Area and 10 sites which are recorded in proximity to the Study Area (Niche, 2024a) (**Figure 8**).

Of the 23 Aboriginal heritage sites within the Study Area, four sites have been managed (S1MC254, S1MC255, S1MC324 and S1MC461) having been salvaged under existing approvals, the other 19 sites remain in situ). Of the 10 sites in proximity to the Study Area, one site has been managed (S1MC323) (i.e. the other nine sites remain in situ). Another site within the Study Area has been partially managed (S1MC466).

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Of the 19 in situ sites located within the Study Area:

- one site has been assessed as having high archaeological (scientific) significance;
- three sites have been assessed to have moderate archaeological (scientific) significance; and
- 15 sites have been assessed to have low archaeological (scientific) significance.

Among the nine in situ sites located in proximity to the Study Area:

- four sites have been assessed as having high archaeological (scientific) significance;
- one site has been assessed to have moderate archaeological (scientific) significance; and
- four sites have been assessed to have low archaeological (scientific) significance.

The majority of the predicted subsidence parameters based on the Extraction Plan Layout are the same as those based on the Approved Layout. The maximum predicted subsidence, tilt and hogging curvature are unchanged for the Extraction Plan Layout and sagging curvature increases slightly. Based on the similar magnitudes of predicted subsidence parameters, the potential impacts for the Aboriginal heritage sites based on the Extraction Plan Layout are the same as those based on the Approved Layout (MSEC, 2024).

Aboriginal heritage sites with performance measures in accordance with Project Approval (05_0117) (or volunteer performance measure) (i.e. S1MC264, S1MC282, S1MC283, S1MC286, S1MC287 and S1MC284) are located outside the 20 mm subsidence contour. Subsidence impacts to these sites are considered unlikely to occur (MSEC, 2024).

Impacts to open sites containing artefacts and isolated finds and rock shelters located outside the Study Area are considered to be unlikely. Open sites inside the Study Area containing artefacts and isolated finds can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. It is unlikely that the artefacts and isolated finds themselves would be impacted by surface cracking (MSEC, 2024).

Whilst it is unlikely that the artefacts and isolated finds would be impacted by mine subsidence, it is possible that, if remediation works to the surface areas around the Aboriginal heritage sites were required after mining, these works could potentially impact on the Aboriginal heritage sites. All remediation works would be subject to MCO's ground disturbance permit (GDP) process.

Rock shelters and overhangs inside the Study Area are predicted to be subject to similar impacts as described for minor cliffs (i.e. potential for fracturing of sandstone and subsequent rockfalls). These sites could therefore be impacted by rockfalls associated with the rock shelter (MSEC, 2024).

Further details on Aboriginal heritage are provided in **Section 3.1** and **Appendix D**.

Historic Heritage Sites

There are no historic heritage sites listed in Project Approval (05_0117) within the Study Area or within the vicinity of the Study Area considered sensitive to subsidence movements.

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Ulan Road and Bridge

The locations of the roads maintained by Mid-Western Regional Council (MWRC) are shown in **Figure 9**. The roads in the vicinity of the LW409-414 Study Area include Ulan Road, Ulan Road bridge (over the Goulburn River) and Saddlers Creek Road. Saddlers Creek Road is located on Crown Lands but is managed by MWRC, and described below. MWRC also own infrastructure associated with these roads, such as the road pavement, embankments, and culverts.

Ulan Road is a sealed bitumen pavement with no kerb and gutter located to the west of LW409-414 which is wholly outside of the Study Area. The road passes along the north western side of LW409-412 and is 65 m from the commencing end of LW410 at its nearest point, which equates to approximately 0.5 times the depth of cover at this location. Features along the road include three cuttings in sandstone with approximate heights up to 3 m at 400 m west of LW409, 2 m at 175 m west of LW412, and 5 m at 250 m north west of LW412. Culverts beneath Ulan Road are typically 400 mm to 800 mm diameter concrete pipes (MSEC, 2024).

The Ulan Road Bridge (over the Goulburn River) is 210 m from LW412 at its nearest point. The bridge comprises a two span simply supported structure on concrete abutments, with a central headstock supported on three cast piers. The Ulan Road Bridge is approximately 33 m long, 10 m wide and the pavement surface is approximately 7 m above the bed of the Goulburn River.

Ulan Road, the road cuttings and Ulan Road Bridge are all located outside the Study Area and will not be subjected to measurable tilts, curvatures or strains; however, the road, cuttings and bridge may experience far-field horizontal movements (MSEC, 2024).

Further details related to Ulan Road and Bridge are provided in **Section 3.2** and **Appendix E**.

Saddlers Creek Road

Saddlers Creek Road is an unsealed dirt road that will be undermined by LW412-414 and experience subsidence movements from the extraction of these longwalls. The potential subsidence impacts on Saddlers Creek Road are expected to include cracking, stepping and rippling of the road surfaces. The road may also experience ponding and redirection of surface flow (MSEC, 2024).

The expected duration of active subsidence with the extraction of each longwall panel is dependent on the rate of extraction; however, based on rates of extraction at the Moolarben Coal Complex the most active period of vertical subsidence is approximately two weeks. Additional minor subsidence may occur outside this two-week period, with the total period of active subsidence estimated to be a total of four weeks (MSEC, 2024).

It is expected that Saddlers Creek Road can be maintained in serviceable condition with the implementation of the appropriate monitoring and management strategies (MSEC, 2024).

Further details on the roads and bridge are provided in **Section 3.2** and **Appendix E**.

Copper Telecommunications Cables

Telstra owns copper cables in the vicinity of the LW409-414 Study Area. The copper cables follow the general alignment of Ulan Road to the west of LW409-414 and Saddlers Creek Road which is undermined by LW412-414 (MSEC, 2024).

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The copper cables along Ulan Road are not expected to be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy); however, the cables are expected to experience far-field horizontal movements. At a minimum distance of 80 m between the longwalls and the Telstra cables, the maximum expected far-field horizontal movement is 150 mm (MSEC, 2024).

The maximum predicted strains along the Saddlers Creek Road alignment are 20 mm/m but irregular strains are expected to occur and it is possible that the copper cables along Saddlers Creek Road could be impacted as a result of the proposed mining. However, it is unlikely that the proposed mining would result in any significant impacts on the copper telecommunications cables within the LW409-414 Study Area. Any impacts on these cables would be expected to be relatively infrequent and readily repairable (MSEC, 2024).

Further details on the telecommunication tower and cables are provided in **Section 3.2** and **Appendix E**.

Tilt Renewables

The Liverpool Range Wind Farm project proposed by Tilt Renewables is located across three local government areas with wind turbines proposed within the Warrumbungle and Upper Hunter Shire Council areas, with a connecting transmission line proposed on the western side of Ulan Road.

The proposed location of the Tilt Renewables transmission powerline is not yet finalised. It is anticipated that the powerline will be approximately 600 m from LW409 to 840 m from LW411. The depth of cover along the western side of LW409-414 varies from approximately 115 m at LW409 to 125 m at LW411 and the distances to the proposed powerline from these longwalls equates to 5.2 to 6.7 times the depth of cover. The powerlines are not expected to experience measurable subsidence, tilts, curvatures or strains. The powerlines may experience low level far-field horizontal movements (MSEC, 2024).

Goulburn River Stone Cottages

The Goulburn River Stone Cottages are privately owned rental accommodation comprising three rental cottages (River Cottage, Barbara's Cottage and Saddlers Cottage) of stone and brick construction. River Cottage is located 970 m from LW414, and Saddlers Cottage and Barbara's Cottage are greater than 1.5 km from LW414. At distances of over 970 m from LW409-414, the Goulburn River Stone Cottages are not expected to experience measurable conventional mine subsidence ground movements. However, the structures may experience low level far-field horizontal movements which are not expected to result in any impacts to the Cottages (MSEC, 2024).

MCO Built Features

Dewatering infrastructure is located above the Extraction Plan Layout as shown in **Figure 9**. The dewatering infrastructure includes dewatering bores, water pipelines and electrical cables. The polyethylene pipelines and cables are flexible and laid on the ground surface. Potential impacts could occur as a result of irregular movements such as ground heave, stepping, large cracks, rock falls or tree falls. It is expected that impacts to the pipelines and cables could be readily remediated if they occur. Where dewatering bores are located above the extracted panels, it is likely, that fracturing and shearing would occur in the drill holes as the result of mining (MSEC, 2024).

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The locations of the exploration drill holes within the LW409-414 Study Area are shown in **Figure 9**. The drill holes are located directly above and adjacent to the proposed longwalls and, therefore, could experience the full range of predicted subsidence movements. It is likely, therefore, that fracturing and shearing would occur in the drill holes as the result of mining (MSEC, 2024).

Fences are located within the LW409-414 Study Area and are constructed in a variety of ways, generally using either timber or metal materials. All fences are on MCO owned lands. The fences could experience the full range of predicted subsidence movements. The maximum predicted subsidence parameters for the fences, based on the Extraction Plan Layout, therefore, are the same as the maxima based on the Approved Layout. Any impacts on the fences are likely to be of a minor nature and relatively easy to remediate (MSEC, 2024).

There are three farm dams owned by MCO that have been identified within the LW409-414 Study Area (D1, D3 and D4) and their locations are shown in **Figure 9**. The dams are shallow with maximum dimensions of approximately 10 m to 20 m and are no longer in use. The maximum predicted total subsidence parameters for farm dams within the LW409-414 Study Area based on the Extraction Plan Layout are the same as those for the Approved Layout for LW409-414. D1 and D3 are located outside the longwall footprints and are expected to experience negligible predicted subsidence movements. The farm dam (D4) located above the extracted longwalls is expected to experience cracking and leakage of water (MSEC, 2024).

There are a number of MCO owned four wheel drive tracks through the Study Area, some of which are shown on **Figure 9**. These tracks are not publicly accessible. The tracks could experience the full range of predicted subsidence movements. The maximum predicted subsidence parameters for these tracks, based on the Extraction Plan Layout, therefore, are the same as the maxima based on the Approved Layout. Potential impacts are expected to include cracking, stepping and rippling of the track surfaces (MSEC, 2024).

Further details on the MCO's built features are provided in **Section 3.2**.

2.2 RISK ASSESSMENT

In accordance with the *Extraction Plan Guideline* (DPE, 2022), a number of risk assessments have been undertaken for this LW409-414 Extraction Plan to ensure that appropriate consideration was given to risk assessment and risk management in each component management plan. The risk assessments were reviewed for the Extraction Plan Layout and found to be appropriate for the level of predicted impacts.

2.2.1 Environmental Risk Assessment

An Environmental Risk Assessment (ERA) was conducted for the LW409-414 Extraction Plan. The ERA was held on 2 May 2024 to establish potential environmental risks relevant to the Water Management Plan (WMP), Land Management Plan, Heritage Management Plan (HMP) and Biodiversity Management Plan (BMP). The purpose of the ERA was to identify and assess the applicable risks and develop appropriate management measures in accordance with the *Extraction Plan Guideline* (DPE, 2022).

The ERA workshop for LW409-414 was facilitated by independent specialist, AXYS Consulting Pty Ltd (AXYS). A representative of the relevant suitably qualified and experienced experts endorsed by the Secretary of DPHI for the preparation of the LW409-414 Extraction Plan (i.e. MSEC, AGE, WRM and Niche) and relevant MCO personnel participated in the ERA.

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The ERA indicated that risks relevant to water, land, heritage and biodiversity above LW409-414 within the LW409-414 Study Area were in the “Low” to “Medium” category, and it was expected that the risks could be managed with implementation of the appropriate mitigation, management and/or control measures.

2.2.2 Built Features Management Plan Risk Assessment

Built feature risk assessments (BFRAs) were conducted for the LW409-414 Extraction Plan. The BFRAs were held on 1 May 2024 to establish potential risks to BFMPs. The BFRAs workshops were facilitated by AXYS, developed and prepared for each infrastructure owner to inform the development of each respective LW409-414 BFMP (**Appendix E**). A suitably qualified and experienced expert endorsed by the Secretary of DPHI for the preparation of the LW409-414 Extraction Plan (i.e. MSEC) and relevant MCO personnel participated in the BFRAs.

The BFRAs prepared by MCO for each built feature owner utilised an investigation and analysis method for:

- the identification of the infrastructure owner or manager’s assets;
- a review of the revised subsidence predictions and potential impacts on the infrastructure owner’s or manager’s assets;
- a review of the preliminary monitoring plan; and
- the identification of risk control measures and procedures.

MCO considers all risk control measures and procedures to be feasible and appropriate to manage all identified risks, given the predicted impacts for LW409-414 are no greater than that of the Approved Layout (**Section 1.6.3**).

In consultation with each built feature owner, applicable risk control measures and procedures have been incorporated in the relevant LW409-414 BFMPs (**Appendix E**) and issued to all built features infrastructure owners for their records.

2.2.3 Moolarben Coal Operations Assets Risk Assessment

A risk assessment was held for MCO assets within and in the vicinity of the LW409-414 Study Area. The risk assessment for LW409-414 was held on 1 May 2024 and was facilitated by AXYS. The risk assessment assessed the potential impacts on the following MCO assets including:

- general Access Roads and Tracks;
- dewatering Infrastructure (pipelines, buried power and fibre cables, bores); and
- groundwater Piezometers.

A number of risk control and management measures were identified during the risk assessment. With the application of the identified controls, the consensus was that subsidence related impacts from the secondary extraction of LW409-414 were as low as reasonably practicable.

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2.2.4 Public Safety Management Plan Risk Assessment

A risk assessment was held for the LW409-414 PSMP to identify and address potential safety hazards to the public, including:

- potential subsidence impacts on built features;
- potential instability of cliff formations or steep slopes caused by subsidence;
- deformations or fracturing of any land caused by subsidence; and
- any other impacts of subsidence.

The risk assessment was held on 1 May 2024 and was facilitated by AXYS. The outcomes of the risk assessments were incorporated into the LW409-414 PSMP. With the implementation of the identified control strategies, the risks due to the extraction of LW409-414 were in the “Low” and “Medium” category, and it was expected that the risks could be managed with implementation of the appropriate mitigation, management and/or control measures.

2.3 CONSULTATION

Consultation is being conducted for this LW409-414 Extraction Plan in accordance with the requirements of Project Approval (05_0117) and in consideration of the *Extraction Plan Guideline* (DPE, 2022). Details of MCO’s consultation process for the LW409-414 Extraction Plan is provided in **Attachment 2**.

2.3.1 Government Agencies

The following government agencies have been consulted during the preparation of this LW409-414 Extraction Plan:

- DPHI;
- RR;
- DCCEEW – Conservation Programs, Heritage and Regulation (CPHR);
- DCCEEW – Water (including the Natural Resources Access Regulator [NRAR]);
- DPHI – Crown Lands (Crown Lands);
- EPA;
- MWRC;
- Heritage NSW; and
- Transport for NSW – Roads and Maritime Services

Comments received were considered before the LW409-414 Extraction Plan was finalised and lodged with the Secretary of the DPHI for approval.

A summary of the consultation with government agencies and the key issues raised is provided in **Attachment 2 (Table A2-1)**.

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Crown Lands own some portion of land within the LW409-414 Study Area (including a triangle section of Crown Land in the south-east corner and Saddlers Creek Road corridor, which is managed by MWRC) and MWRC owns Ulan Road, including the Ulan Road Bridge (and associated easements) adjacent to the LW409-414 Study Area (**Figure 10**). GRNP and GRSCA, managed by NPWS are adjacent to and partly within the Study Area. As such, MCO has consulted with Crown Lands, NPWS and MWRC as potentially affected public authorities. All other land within the LW409-414 Study Area is owned by MCO.

2.3.2 Public Utilities & Privately Owned Assets

A summary of consultation undertaken with relevant infrastructure owners is provided in **Attachment 2 (Table A2-2)**. Consultation with each built feature owner/manager was generally conducted in accordance with the following protocol:

- Initial contact to confirm the appropriate infrastructure representative and initial briefing.
- Initial risk assessment workshops were held with representatives from MCO and relevant specialists (no asset owners requested a risk assessment be conducted).
- Provision of a specific report prepared by MSEC outlining the subsidence predictions and impact assessment for each infrastructure item⁵.
- Drafts of the LW409-414 BFMPs were distributed for comment to the relevant infrastructure owner.
- Where relevant, MCO funded additional expertise to assist the infrastructure owner to assess appropriate monitoring and management strategies and/or measures.
- Final drafts of the LW409-414 BFMPs were prepared incorporating any comments received from the infrastructure owner.

2.3.3 Landholders

Landholders within the LW409-414 Study Area are MCO and Crown Lands. MCO has consulted with Crown Lands (**Sections 2.3.1 and 2.3.2**). The nearest private property is located outside the LW409-414 Study Area boundary, to the east of LW414. MCO has consulted with this private landholder regarding their property, as well as any other relevant built features (i.e. Saddlers Creek Road and the Telstra cable).

2.3.4 Public Consultation

MCO meets quarterly with its Community Consultative Committee (CCC) to provide updates on operations at the Moolarben Coal Complex, including (but not limited to) community matters, visitors to site, donations, operations and exploration, approvals, underground operations, employment and Emergency Services collaboration.

MCO has provided updates on the development of the Extraction Plan for LW409-414 to the CCC during meetings held in June, September and December of 2024 as well as March, June, September and December of 2025. Minutes from the CCC meetings are provided on Yancoal's website (yancoal.com.au/our-sites/moolarben/moolarben-coal-documents).

The approved Extraction Plan will also be made available on Yancoal's website.

⁵ The reports prepared by MSEC are attached to the relevant LW409-414 BFMPs.

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2.3.5 Consultation with Aboriginal Stakeholders

A draft of the LW409-414 HMP and Aboriginal Cultural Heritage Technical Report (**Technical Report 5**) was provided to Aboriginal stakeholders registered at the Moolarben Coal Complex for their review and comment on 4 October 2024. Comments received were considered before the LW409-414 HMP and Aboriginal Cultural Heritage Technical Report (**Technical Report 5**) were finalised.

A draft of the LW409-414 HMP was also provided to Heritage NSW, for their review and comment on 4 October 2024. Comments received were considered before the LW409-414 HMP was finalised and lodged with the Secretary of DPHI for approval.

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3.0 SUBSIDENCE MANAGEMENT AND MONITORING

Natural and built features within the LW409-414 Study Area (i.e. within the 26.5° angle of draw and 20 mm predicted subsidence contour) have the potential to be impacted by the secondary extraction of LW409-414. Additionally, features that lie outside the LW409-414 Study Area may experience far-field movements.

The surface features which are sensitive to such movements have been identified and included in the subsidence assessments undertaken by MSEC (2024) (**Technical Report 1**) and relevant management plans. Natural and built features within and in the vicinity of the LW409-414 Study Area are listed in **Table 9**.

The management plans detail the management and monitoring of potential environmental consequences resulting from the extraction of LW409-414 and associated subsidence impacts. Descriptions of each of these features are contained within the relevant management plan referenced in **Table 9**.

Table 9: Natural and Built Features Within and in the Vicinity of the Study Area

Feature	Section/Management Plan Reference
Natural Features	
Watercourses and Drainage Lines	Section 3.1 , LW409-414 WMP (Appendix A) and the Monitoring Program (Appendix H)
Land in General	Section 3.1 and LW409-414 LMP (Appendix B)
Cliffs	
The Drip and Corner Gorge	Section 3.1 and the Monitoring Program (Appendix H)
Threatened Species, Populations and their habitats	Section 3.1 and LW409-414 BMP (Appendix C)
Areas of Archaeological and/or Heritage Significance	
Known Aboriginal Heritage Sites	Section 3.1 and LW409-414 HMP (Appendix D)
Public Utilities and Other Infrastructure	
MWRC – Ulan Road and Goulburn River Bridge	Section 3.2 and LW409-414 BFMPs (Appendix E)
MWRC / Crown Lands – Saddlers Creek Road	
Telstra – Copper Telecommunication Cables	
Public Safety	LW409-414 PSMP (Appendix F)

The component management plans to this Extraction Plan form part of MCO’s Environmental Management System for the Moolarben Coal Complex, as shown on **Figure 4**. In order to avoid duplication of existing Environmental Management Plans, the management plans reference components of the following existing complex-wide plans:

- Water Management Plan, including:
 - Surface Water Management Plan; and
 - Groundwater Management Plan.

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- Biodiversity Management Plan.
- Heritage Management Plan.

Where there is any overlap in monitoring or management measures in the management plans with the complex-wide plans, the measures described in these LW409-414 management plans will supersede them (once approved).

The LW409-414 SMP (**Appendix G**) has been prepared to monitor subsidence impacts and validate the subsidence predictions and analyse the relationship between the subsidence effects and subsidence impacts of the LW409-414 Extraction Plan and any ensuing environmental consequences. A summary of the proposed monitoring for the Extraction Plan is provided in **Section 3.4** and on **Figure 11**.

3.1 NATURAL AND HERITAGE FEATURES

3.1.1 Performance Measures and Indicators

Performance measures and indicators relevant to the management of potential environmental consequences resulting from the extraction of LW409-414 and associated potential far-field movements are provided in **Table 10** below, with further detail included in each of the specific component management plans.

Performance measures listed correspond with those in Table 14 of Schedule 4 of Project Approval (05_0117), as they relate to the LW409-414 extent. There are no historic heritage sites listed in Project Approval (05_0117) within the Study Area or within the vicinity of the Study Area considered sensitive to subsidence movements.

A summary of the proposed monitoring is provided on **Figure 11**.

3.1.2 Aspects and Management Measures

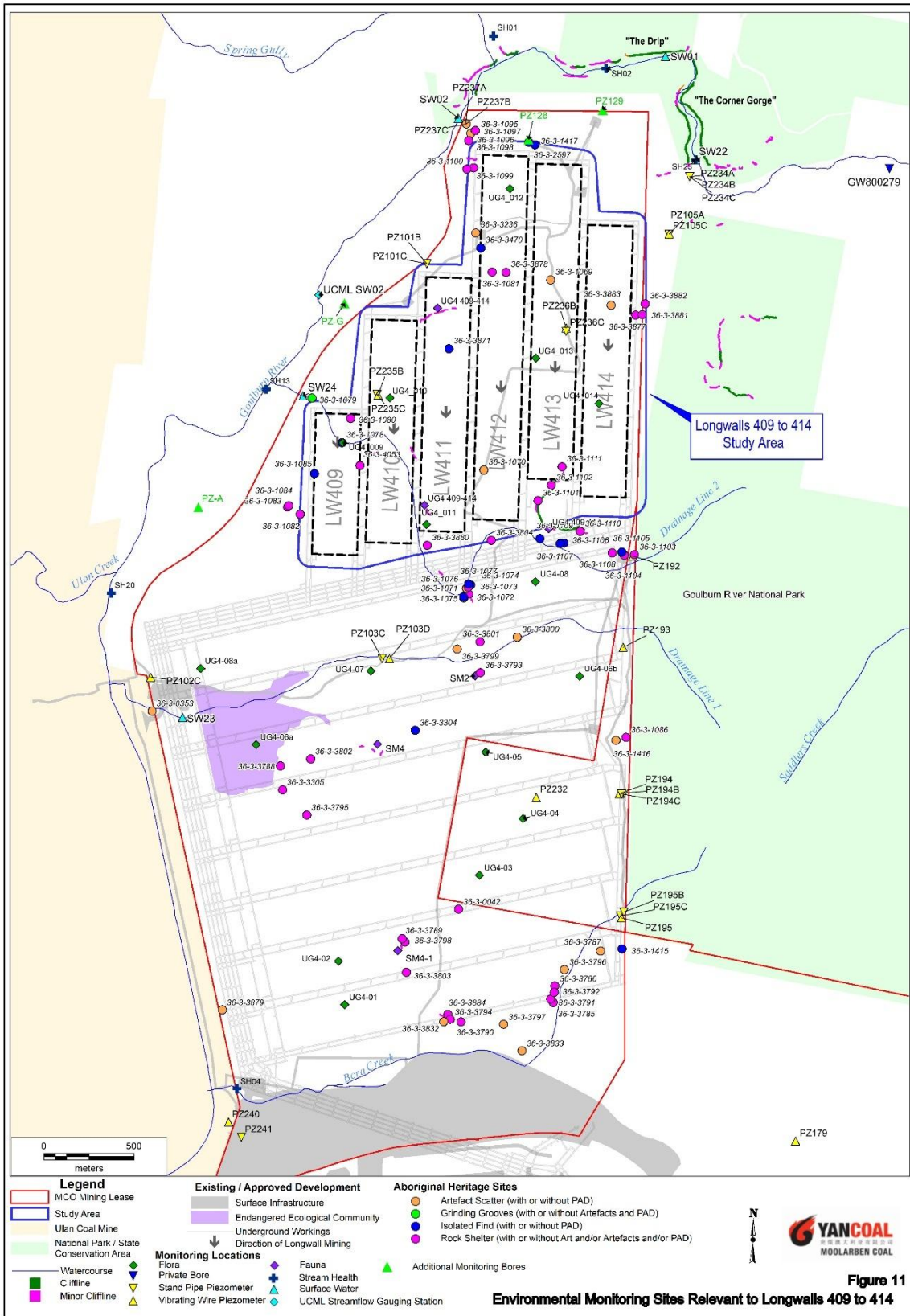
Key aspects and management measures for natural and heritage features have been listed in **Table 11** below. Each aspect has corresponding objectives and management measures in place to manage impacts from the extraction of LW409-414. The component management plans in which these are detailed is also provided for reference.

3.1.3 Contingency Plan

In the event that a subsidence impact performance measure relating to natural and heritage features is considered to have been exceeded, MCO will implement a Contingency Plan as described in detail in the relevant component management plans and summarised in **Section 4.1**.

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Figure 11: Environmental Monitoring Sites Relevant to Longwalls 409 to 414



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Table 10: Natural and Heritage Features Performance Measures and Indicators

Subsidence Impact Performance Measure		Performance Indicators	Management Plan
DL2	<i>Not Applicable.</i>	Unpredicted impacts on DL2 (i.e. noticeable new areas of erosion or expansion of existing erosion, initiation of headcut or noticeable upstream advance of existing headcut or development of new pools or drainage of existing pools).	LW409-414 WMP
Goulburn River and the bed of the Goulburn River	<i>Negligible impact or environmental consequences. Remain outside the zone of recorded subsidence damage for longwall mining.</i>	Unpredicted impacts on Goulburn River.	Monitoring Program
		<i>Surface Water:</i> No significant adverse mining related effects to downstream water quality (when compared to baseline and/or ANZECC limits). Loss of flow in Goulburn River. <i>Groundwater:</i> Negligible impact or environmental consequences at the Goulburn River.	Monitoring Program
The Drip and Goulburn River Gorge	<i>Nil impact on the water supply to The Drip</i>	Unpredicted loss of water supply to the Drip observed during monitoring.	Monitoring Program
	<i>Nil impact or environmental consequences</i>	Observed level of movement at the Drip and/or Corner Gorge greater than predicted, and/or new physical impacts identified.	Monitoring Program
CL3	<i>Minimise subsidence damage</i>	Unpredicted impact to CL3. Note: <i>Minimal damage to CL3 would constitute a mine layout that reduces the risk of impact to minimal or minor impacts. The Project Approval defines minor as "Not very large, important or serious". Impact to a cliff such as cracking, minor rock fall or minor spalling that occur at isolated locations are considered minor impacts.</i>	LW409-414 LMP
Cliffs and minor cliffs in GRNP and GRSCA	<i>Not Applicable.</i>	Negligible impact due to longwall mining for cliffs and minor cliffs in the GRNP and GRSCA.	

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Table 10 (Continued): Natural and Heritage Features Performance Measures and Indicators

Subsidence Impact Performance Measure		Performance Indicators	Management Plan
Aboriginal heritage sites 264, 282, 283, 284⁶, 286 and 287	<i>Reduce the likelihood of subsidence damage to low.</i>	Revised subsidence likelihood reduced to low.	LW409-414 HMP

⁶ S1MC284 is a voluntary performance measure.

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Table 11: Natural and Heritage Features Management Measures

Feature	Objective	Management Measures	Management Plan
The Drip and Corner Gorge	Subsidence impacts from LW409-414 result in nil impacts or environmental consequences. Nil impact on water supply to the Drip.	Where mining-related activities have resulted in exceedances of the trigger levels for the Drip and Corner Gorge (<i>refer to Table A1-1 of the Monitoring Program</i>), undertake further investigation and implement Technical Committee and Steering Committee process.	Monitoring Program
Goulburn River	Subsidence impacts from LW409-414 do not result in impact or environmental consequences beyond negligible.	Where mining-related activities have resulted in exceedances of the trigger levels for the Goulburn River (<i>refer to Table A2-1 of the Monitoring Program</i>), undertake further investigation and implement Technical Committee and Steering Committee process.	Monitoring Program
Surface water quality	Subsidence impacts from LW409-414 do not result in significant adverse water quality impacts to the downstream water quality.	Where mining-related activities have resulted in trigger exceedances (<i>refer to Table 13 of the LW409-414 WMP</i>), implement contingency and remedial measures in consultation with DPHI.	LW409-414 WMP
Groundwater quality and level	Subsidence impacts from LW409-414 do not result in impact or environmental consequences greater than approved.	Where mining-related activities have resulted in trigger exceedances (<i>refer to Table 13 of the LW409-414 WMP</i>), implement contingency and remedial measures in consultation with DPHI.	LW409-414 WMP
DL2	Subsidence impacts from LW409-414 do not result in significant increase in active erosion and/or change in stream character beyond approved.	Where mining-related activities have resulted in trigger exceedances for DL2 (<i>refer to Table 12 of the LW401-408 WMP</i>), implement contingency and remedial measures based on investigation. Potential management strategies may include slope stabilisation, drainage works to restore drainage characteristics, revegetation and bed control using natural materials such as local rock and large woody debris.	LW409-414 WMP

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Table 11 (Continued): Natural and Heritage Features Management Measures

Feature	Objective	Management Measures	Management Plan
CL3	Subsidence impacts and damage from LW409-414 are minimised at CL3 consistent with the Environmental Assessment.	Where mining-related activities have resulted in exceedances of the trigger level for CL3 (<i>refer to Attachment 1 of the LW409-414 LMP</i>), implement management measures in consultation with DPPI (<i>refer to Section 7.0 of the LW409-414 LMP</i>). Potential management strategies may include scaling or dislodgement to remove remaining loose rock, signage and barriers to restrict and warn persons of safety hazards.	LW409-414 LMP
Cliffs and minor cliffs in GRNP and GRSCA	Subsidence impacts from LW409-414 do not result in impact or environmental consequences beyond negligible.	Where mining-related activities have resulted in exceedances of the trigger level relevant to cliffs and minor cliffs in GRNP and GRSCA (<i>refer to Attachment 1 of the LW409-414 LMP</i>), implement management measures in consultation with relevant landholders (NPWS or Crown Lands) (<i>refer to Section 7.0 of the LW409-414 LMP</i>). Potential management strategies may include visual assessments, site access control, signage and stabilisation techniques and remediation of surface tension cracks.	LW409-414 LMP
Land in general	Management of subsidence impacts from LW409-414 on land.	Potential management strategies may include erosion and sediment control, site access control, signage and stabilisation techniques and remediation of surface tension cracks.	LW409-414 LMP
Threatened species, populations and their habitats	Management of subsidence impacts from LW409-414 on threatened species, populations and their habitats.	Where mining-related activities have resulted in exceedances of the trigger level relevant to threatened flora and fauna (<i>refer to Attachment 1 of the LW409-414 BMP</i>), implement management measures in consultation with DPPI (<i>refer to Section 7.0 of the LW409-414 BMP</i>). Potential management strategies may include habitat management (roosting habitat and native vegetation), weed management and additional monitoring.	LW409-414 BMP
Aboriginal Heritage Sites	Likelihood of subsidence impacts and damage from LW409-414 on Aboriginal Heritage Sites 264, 282, 283, 284, 286 and 287 remain low.	Where mining-related activities have resulted in exceedances of the Project Approval performance measures or voluntary performance measures for Site 264, 282, 283, 284, 286 and 287 (<i>refer to Section 5 of the LW409-414 HMP</i>), implement contingency and remedial measures in consultation with DPPI.	LW409-414 HMP

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3.2 BUILT FEATURES AND PUBLIC SAFETY

3.2.1 Overview

The LW409-414 BFMPs are provided in **Appendix E** and include component plans for the individual infrastructure owners. The PSMP is provided in **Appendix F**. The purpose and scope of the LW409-414 BFMPs and PSMP is summarised below:

Purpose: To outline the management of potential subsidence impacts on built features and public safety resulting from the extraction of LW409-414.

Scope: To consider built features as aspects of public safety that could experience subsidence effects during the mining of LW409-414.

3.2.2 Performance Measures, Indicators and Management Measures

Built feature and public safety performance measures, indicators and management measures of potential consequences resulting from the extraction of LW409-414 are provided in **Table 12** and **Table 13** respectively.

Further detail is included in each of the specific component management plans. Performance measures listed correspond with those in Table 14 of Schedule 4 of Project Approval 05_0117, as they relate to the LW409-414 extent.

3.2.3 Contingency Plan

In the event that a subsidence impact performance measure relating to built features and/or public safety is considered to have been exceeded, MCO will implement a Contingency Plan as described in detail in the relevant Management Plan and summarised in **Section 4.1**.

3.3 RECOMMENDATION AND REHABILITATION MEASURES

3.3.1 Potential Subsidence Impacts and Monitoring

The overriding objective for subsidence management is to minimise the potential for, or extent of, the predicted subsidence impacts.

MSEC (2024) presents potential subsidence impacts for LW409-414. Potential subsidence impacts include:

- surface cracking;
- changes in stream bed gradients;
- ponding and changes in stream alignment; and
- slope instability and erosion.

Visual monitoring of potential subsidence impacts will be conducted by MCO in accordance with the LW409-414 LMP, LW409-414 WMP and the Monitoring Program.

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Table 12: Built Features Performance Indicators and Management Measures

Built Feature	Performance Measure	Performance Indicator(s)	Management Measures	Management Plan
Gulgong-Sandy Hollow Railway Line	<i>Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable and must be fully repaired.</i>	Gulgong-Sandy Hollow Railway Line is located to the south of LW401-408 and greater than 2.5 km from LW409-414 and is unlikely to experience subsidence related movements. Therefore, no performance indicators have been developed for LW409-414.	No management measures have been developed.	Not Applicable
Wollar-Wellington 330kV Transmission Line	<i>Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable and must be fully repaired.</i>	The Wollar-Wellington 330kV Transmission Line is located to the south of LW401-408 and greater than 2.5 km from LW409-414 and is unlikely to experience subsidence related movements. Therefore, no performance indicators have been developed for LW409-414.	No management measures have been developed.	Not Applicable

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Table 12 (Continued): Built Features Performance Indicators and Management Measures

Built Feature	Performance Measure	Performance Indicator(s)	Management Measures	Management Plan
Roads Ulan Road Bridge over the Goulburn River	<i>Safe, serviceable and repairable unless the owner agrees otherwise in writing.</i>	The performance indicators proposed to ensure that the performance measures for Ulan Road and the Ulan Road Bridge (over the Goulburn River) in relation to subsidence induced far-field movements are achieved include: <ul style="list-style-type: none"> Ulan Road: Maintain Ulan Road and cuttings in a safe and serviceable manner. Ulan Road drainage structures: No joint displacement or cracking or other defects of the drainage structure (e.g. pipes/culverts) in excess of 5 mm (when compared against baseline condition) due to LW409-414 mining. Ulan Road Bridge (over the Goulburn River): No potential differential movements between span supports in excess of 10 mm (when compared against baseline condition) due to LW409-414 mining. 	Management measures in relation to Ulan Road and the Ulan Road Bridge (over the Goulburn River) include: <ul style="list-style-type: none"> Notification to MWRC prior to and following completion of secondary extraction of LW409-414. Visual inspection and record (baseline) of Ulan Road surface, culverts, bridge and cuttings prior to secondary extraction of LW409. Implement recommended management measures from structural engineer review of baseline condition of Ulan Road Bridge (over the Goulburn River) prior to secondary extraction of LW412. Visual inspection and record of Ulan Road surface, culverts, bridge and cuttings during longwall mining of LW409-414: <ul style="list-style-type: none"> If ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'U Line' or at the Ulan Road Bridge monitoring points. Notification to MWRC during longwall mining of LW409-414: <ul style="list-style-type: none"> If ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'U Line' or at the Ulan Road Bridge monitoring points. If visual monitoring detects subsidence related impacts. Provision of inspection sheets detailing the outcome of the subsidence impact monitoring program to MWRC (unless otherwise agreed with MWRC). <ul style="list-style-type: none"> Following exceedance of the predicted subsidence monitoring parameters and/or subsidence related impact inspections. Implement Trigger Action Response Plans (TARP) during LW409-414 extraction. 	LW409-414 BFMP-MWRC

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Table 12 (Continued): Built Features Performance Indicators and Management Measures

Built Feature	Performance Measure	Performance Indicator(s)	Management Measures	Management Plan
Roads Saddlers Creek Road	<i>Safe, serviceable and repairable unless the owner agrees otherwise in writing.</i>	<p>The performance indicators proposed to ensure that the performance measures for Saddlers Creek Road in relation to subsidence are achieved is:</p> <ul style="list-style-type: none"> Maintain Saddlers Creek Road in a safe, serviceable and accessible condition (i.e. including during active subsidence, with the implementation of management measures). 	<p>Management measures in relation to Saddlers Creek Road include:</p> <ul style="list-style-type: none"> Notification to MWRC and Crown Lands prior to secondary extraction of LW409 and LW412-414 and following completion of mining of LW414. Prior to mining within 100 m of Saddlers Creek Road: <ul style="list-style-type: none"> Notification to Emergency Services of timing of road interruptions. Prepare site setup for monitoring and repairs of Saddlers Creek Road. Publish notices in local newspapers. Notification to MWRC and Crown Lands on the progress of mining in relation to the road by weekly email while Saddlers Creek Road is being directly undermined. Notification to MWRC and Crown Lands during longwall mining of LW409-414: <ul style="list-style-type: none"> If performance indicator for Saddlers Creek Road has not been met (i.e. Saddlers Creek Road is not maintained in a safe, serviceable and accessible condition during active subsidence period) and is not repairable. If ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'SCR Line'. Controlling public access to Saddlers Creek Road to ensure it is safe before allowing traffic to pass while Saddlers Creek Road is being directly undermined and until remediation of Saddlers Creek Road has been completed, and visual inspections confirm no further subsidence impacts. 	LW409-414 BFMP-SCR

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Table 12 (Continued): Built Features Performance Indicators and Management Measures

Built Feature	Performance Measure	Performance Indicator(s)	Management Measures	Management Plan
			<ul style="list-style-type: none"> • Stand-by work crew and equipment to undertake regular visual inspection (i.e. prior to each vehicle passing as at regular intervals during a 24 hour period, informed by location of longwall and observed impacts from previous monitoring) and maintenance as required to maintain a safe, serviceable and accessible condition while Saddlers Creek Road is being directly undermined. • Implement TARP during LW412-414 extraction. • Provision of inspection sheets detailing the outcome of the subsidence impact monitoring program to MWRC and Crown Lands (unless otherwise agreed with MWRC and Crown Lands): <ul style="list-style-type: none"> – If ground surveys identify an exceedance of the predicted subsidence monitoring parameters and/or subsidence related impact inspections. – After completion of secondary extraction of 300 m past Saddlers Creek Road for each of LW412-414. • Remediation of Saddlers Creek Road, including regrading, releveling and crack sealing/repair: <ul style="list-style-type: none"> – During undermining of Saddlers Creek Road for each LW412-414, when subsidence impacts are identified. Additional remediation measures will continue if further visual inspections identify further subsidence impacts. • Post-mining remediation of Saddlers Creek Road, including regrading, releveling and crack sealing/repair: <ul style="list-style-type: none"> – If post-mining visual inspection identifies requirement to implement permanent remediation/repairs. 	

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Table 12 (Continued): Built Features Performance Indicators and Management Measures

Built Feature	Performance Measure	Performance Indicator(s)	Management Measures	Management Plan
<p>Other built features and improvements, including fences Telstra copper telecommunication cables</p>	<p><i>Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated.</i> <i>Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.</i></p>	<p>The performance indicators proposed to ensure that the performance measures for the copper cables are achieved in relation to subsidence movements, include:</p> <ul style="list-style-type: none"> Negligible transmission loss from mine subsidence impacts; and Negligible impacts on structural integrity of the cable lines from mine subsidence. 	<p>Management measures in relation to the copper telecommunication cables include:</p> <ul style="list-style-type: none"> Notification to Telstra prior to secondary extraction of LW409. Notification to Telstra if management measures are considered to be required during secondary extraction of LW409-414. Notification to Telstra during longwall mining of LW409-414: <ul style="list-style-type: none"> If/when ground surveys identify an exceedance of the predicted subsidence monitoring parameters measured along the 'SCR Line' and 'U Line'. If visual monitoring of Ulan Road/ Saddlers Creek Road in accordance with the BFMP-MWRC and/or BFMP-SCR detects subsidence-related impacts. Implement TARP during LW409-414 extraction. Provision of inspection sheets detailing the outcome of the subsidence impact monitoring program to Telstra: <ul style="list-style-type: none"> Following exceedance of the predicted subsidence monitoring parameters and/or subsidence related impact inspections (unless otherwise agreed by Telstra). Notification to Telstra to inform longwall mining of LW409-414 is completed following completion of active mining of LW414 (within 3 months). 	<p>LW409-414 BFMP-Telstra</p>

Note: 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 of Project Approval (05_0117) is to be settled by the Secretary, following consultation with the RR. Any decision by the Secretary shall be final and not subject to further dispute resolution under this approval.

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Table 13: Public Safety Performance Indicators and Management Measures

Feature	Performance Measure	Performance Indicator(s)	Relevant Management Measures	Relevant Management Plan
Public Safety	<i>Negligible additional risk</i>	<p>MCO will assess LW409-414 against the public safety performance measures in the event that any hazard to the general public arising from subsidence impacts becomes evident.</p> <p>Specific performance indicators have also been developed with each asset owner and are described in the individual LW409-414 BFMPs.</p>	<p>Management measures in relation to Public Safety include:</p> <ul style="list-style-type: none"> • Restricted public access into the Study Area: <ul style="list-style-type: none"> – The majority of the Study Area is considered remote undeveloped bushland, with vehicular access points providing entry. – Access to the Study Area via vehicular access points (other than Saddlers Creek Road) will be restricted through locked gates and boundary fencing, with appropriate signage where reasonable. • Potential management measures that will be considered to mitigate/remediate environmental consequences are detailed in the LW409-414 LMP, and include: <ul style="list-style-type: none"> – stabilisation techniques; – erosion and sediment control techniques; – remediation of surface tension cracks; and – site access control and signage. • Potential management measures in relation to subsidence impacts on land include additional signage to warn persons accessing the area of safety hazard, and construction of barriers to restrict access to unsafe areas. • Follow-up inspections will be conducted to assess the effectiveness of implemented management measures and the requirement for any additional management measures. 	LW409-414 PSMP

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3.3.2 Remediation

Several potential management measures will be implemented to mitigate/remediate subsidence impacts on land resulting from underground mining operations. Minor cracks that develop are not expected to require remediation as geomorphologic process will result in natural filling of these cracks over time.

Remediation of typical surface cracks (generally in the order of 150 mm, but up to approximately 500 mm in areas of lower depth of cover) will be undertaken where practicable and accessible using conventional earthmoving equipment (e.g. a backhoe) and will include:

- infilling of surface cracks with soil or other suitable materials; or
- locally re-grading and re-compacting the surface.

Notwithstanding, remediation will be undertaken in the event a crack is identified to present a significant risk to safety of people or livestock and/or presents a long-term degradation or erosion risk.

Areas of surface cracking will be stabilised using erosion protection measures (e.g. vegetation seeding and planting and/or brush matting). Drainage works and rehabilitation of subsidence troughs (i.e. areas of induced ponding) will be conducted as necessary, and may include stabilisation of banks subject to soil slumping.

If surface crack remediation works are required in remnant vegetation areas, compact mobile equipment will be used, where practicable, to minimise damage to surrounding vegetation. If the remediation work requires clearing of remnant vegetation to an extent that would exceed the benefit of the remediation, the requirement for remediation will be reviewed. Vegetation that requires clearance will be subject to MCO's GDP and Vegetation Clearance Protocol (as per the approved complex-wide BMP).

In summary, remediation of surface cracking will be undertaken where practicable and accessible using conventional earthmoving machinery and include infilling of surface cracks with soil and suitable material or locally re-grading and re-compacting the surface.

Visual monitoring of remediated subsidence areas will be conducted quarterly to identify any requirement for maintenance measures and/or remedial works.

3.3.3 Rehabilitation

Rehabilitation associated with subsidence impacts, and any minor disturbance associated with subsidence remediation works or monitoring, will be undertaken in accordance with the management and mitigation measures outlined in this Extraction Plan and the relevant component plans (e.g. the LW409-414 LMP).

Rehabilitation objectives and decommissioning phase performance indicators and completion criteria have been developed for the subsidence area (e.g. overlying LW409-414). The relevant rehabilitation objectives and decommissioning phase performance indicators and completion criteria are:

- Rehabilitation Objectives:
 - Land affected by mine induced subsidence will be safe, stable and non-polluting.
 - Land affected by mine subsidence will not present a risk to achieving final land use options.

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- Decommissioning Phase Performance Indicators and Completion Criteria:
 - No subsidence surface cracks remaining that present a risk to the environment, safety and the final land use objectives.

Rehabilitation performance will be considered to be satisfactory when monitoring data indicates the completion criteria have been met.

3.4 MONITORING PROGRAM SUMMARY

The monitoring program is detailed in both the LW409-414 SMP (**Appendix G**) and the individual management plans (i.e. for the LW409-414 WMP, LW409-414 LMP, LW409-414 BMP, LW409-414 HMP, LW409-414 BFMPs and Monitoring Program).

Monitoring includes flora and fauna, drainage lines, water, heritage sites, built features, and subsidence monitoring lines. Monitoring programs relevant to LW409-414 are presented in **Figure 11**.

Ongoing baseline data collection is described in **Attachment 3** of this Extraction Plan.

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4.0 IMPLEMENTATION

4.1 CONTINGENCY RESPONSE

In the event a subsidence impact performance measure described in **Table 6** and **Table 7** has been exceeded or is likely to be exceeded, MCO will implement the relevant Contingency Plan detailed in the LW409-414 WMP (**Appendix A**), LW409-414 LMP (**Appendix B**), LW409-414 BMP (**Appendix C**), LW409-414 HMP (**Appendix D**), LW409-414 BFMPs (**Appendix E**), the LW409-414 PSMP (**Appendix F**) and the Monitoring Program (**Appendix H**). In general, the Contingency Plans include the following:

- The observation will be reported to the Underground Technical Services Manager and/or the Environment and Community Manager within 24 hours.
- The observation will be recorded consistent with the monitoring programs described in **Section 3**.
- Undertake investigation to confirm if trigger exceedance is mining-related.
- Any exceedance of a subsidence impact performance measure will be reported to the DPPI, relevant agencies and relevant stakeholders as soon as practicable after MCO becomes aware of the exceedance.
- MCO will conduct an investigation to evaluate the potential contributing factors.
- MCO will identify an appropriate course of action with respect to the identified impact(s), in consultation with specialists, relevant agencies and relevant stakeholders, as necessary.
- MCO will submit the proposed course of action to the DPPI for approval.
- MCO will implement the approved course of action to the satisfaction of the DPPI.

In accordance with Condition 74, Schedule 3 of Project Approval (05_0117), MCO will provide a suitable offset to compensate for the impact or environmental consequence to the satisfaction of the Secretary of the DPPI if either the remediation measures implemented by MCO have failed to remediate the impact or environmental consequence or the Secretary of the DPPI determines that it is not reasonable or feasible to remediate the impact or environmental consequence. 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). Relevant management and contingency measures are summarised in **Section 3** and outlined in the component management plans (**Appendices A to H**).

Responsibilities during contingency response are outlined in **Section 4.6**, which is designed to clearly outline actions, levels of responsibility within MCO and reporting requirements where monitoring results indicate that impacts are exceeding (or likely to exceed) predicted or approved limits. This table is designed to support the TARPs provided in the component management plans (**Appendices A to H**). These TARPs will be developed further as this Extraction Plan is reviewed and revised.

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4.2 ADAPTIVE MANAGEMENT

MCO will implement adaptive management in accordance with Condition 2, Schedule 5 of Project Approval (05_0117) to ensure subsidence impact performance measures (**Table 6** and **Table 7**) are achieved for LW409-414. Adaptive management will involve:

- **Planning** – developing management strategies to meet performance measures; identifying performance indicators to assess performance; and establishing monitoring programs to monitor against the performance measures.
- **Implementation** – implementing management strategies and monitoring impacts against performance indicators.
- **Review** – reviewing and evaluating the effectiveness of management strategies by analysis of monitoring data against predicted impacts, performance indicators and performance measures.
- **Contingency Response** – implementing contingency plans where a potential exceedance of a subsidence impact performance measure or an unexpected impact is detected (**Section 4.1**).
- **Adjustment** – adjusting management strategies to improve performance, particularly following an exceedance of a subsidence impact performance measure or detection of an unexpected impact.

Where any exceedance of the subsidence impact performance measures is identified as a result of operations undertaken at LW409-414, MCO will, at the earliest opportunity:

- take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- consider all reasonable and feasible options for remediation (where relevant) and submit a report to DPHI describing those options and any preferred remediation measures or other course of action; and
- implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary.

4.3 REPORTING FRAMEWORK

MCO has developed a reporting framework for the Extraction Plan based on the nature of the predicted subsidence impacts and consequences and streamlining of reporting requirements.

Table 14 provides a summary of the proposed reporting framework, including which stakeholders will receive copies of each report and the distribution method. The subsections below provide further detail on the contents of each reporting mechanism.

Further detail on the review and reporting process for the Drip, Corner Gorge and Goulburn River is provided in the Monitoring Program (**Appendix H**).

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Table 14: Summary of Reporting Framework

Report	Frequency	Distribution	Distribution Method	Responsibility for Preparation	Responsibility for Submission
Incident Report	As required (Section 4.3.1)	DPHI RR EPA (where relevant) Other Relevant Agencies ¹ (where relevant)	Email	Environment and Community Manager	General Manager
Annual Review	Annually	DPHI	Email NSW Planning Portal Website	Environment and Community Manager	General Manager
Report prior to LW412 in accordance with Condition 78A of Project Approval (05_0117)	Prior to the commencement of secondary extraction of LW412	DPHI RR CPHR DCCEEW Water	Email NSW Planning Portal	Technical and Steering Committee	Steering Committee
Reporting for the Drip, Corner Gorge and Goulburn River Monitoring Program	Prior to commencement of secondary extraction of LW410	DPHI	Email NSW Planning Portal	Technical and Steering Committee	Steering Committee
	Prior to commencement of secondary extraction of LW411				
	Prior to commencement of secondary extraction of LW413				
	Prior to commencement of secondary extraction of LW414				
	Following Secondary Extraction of LW414				

Notes: ¹ Other relevant agencies as specified in component management plans

4.3.1 Incident Report

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) (as modified).

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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 MCO's EMS.

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 DPHI and any other relevant agencies of any incident associated with LW409-414 which causes or threatens to cause material harm to the environment immediately after MCO confirms that an incident has occurred. For any other incident associated with mining of LW409-414, 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 the DPHI 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.

4.3.2 Annual Review

In accordance with Condition 4, Schedule 5 of Project Approval (05_0117) (as modified), MCO will conduct an annual review of operations conducted at the Moolarben Coal Complex prior to 31 March for the preceding calendar year, or as otherwise agreed by the Secretary of DPHI.

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 Environmental Assessment.
- 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 Yancoal's website.

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4.3.3 Report Prior to LW412

Prior to commencement of LW412, MCO would prepare a report in accordance with Condition 78A, Schedule 3 of Project Approval (05_0117):

78A. *Prior to the commencement of second workings in longwall LW12, the Proponent shall:*

- (a) *prepare a report:*
 - i. *analysing the subsidence, surface water, and groundwater impacts of the cumulative progress of longwall mining for the project, including consideration of data collected from the previously mined panels up to and including commencement in longwall LW11;*
 - ii. *updating the predicted impacts based on the available local data and current scientific understanding of these relevant fields (demonstrating compliance with the requirements of this approval);*
- (b) *commission suitably qualified subsidence and groundwater experts whose appointment has been approved by the Secretary to review the report, and if necessary recommend changes to the monitoring programs and/or mine plan for subsequent panels; and*
- (c) *submit a copy of the report and expert review to the Department, Resources Regulator, BCS and Water Group, including a response to any recommendations contained in the expert review;*

to the satisfaction of the Secretary.

4.3.4 Reporting for the Drip, Corner Gorge and Goulburn River Monitoring Program

The progressive panel by panel review and reporting process outlines in the Monitoring Program to be undertaken by the Technical and Steering Committees would include (**Appendix H**):

1. Technical Committee reviews monitoring data for relevant period.
2. Technical Committee prepares recommendation.
3. Committee Meeting between Technical and Steering Committee members to present review findings and recommendation.
4. Technical Committee finalises recommendation to Steering Committee and provides a copy to DPHI along with a summary of the supporting monitoring data reviewed.
5. Steering Committee to consider recommendation and decide on any action/s.
6. Steering Committee decision documented and a copy provided to DPHI.
7. Steering Committee to coordinate resources required and implement any action/s, in consultation with Technical Committee.

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4.4 REVIEW OF THE EXTRACTION PLAN

In accordance with Condition 5, Schedule 5 of Project Approval (05_0117), this LW409-414 Extraction Plan will be reviewed within three months of the submission of:

- an Annual Review under Condition 4, Schedule 5;
- an incident report under Condition 7, Schedule 5;
- an audit under Condition 9, Schedule 5; or
- any modification to the conditions of Project Approval (05_0117) (unless the conditions require otherwise); and
- if necessary, revised to the satisfaction of the Secretary of the DPPI to ensure the plan is updated on a regular basis and to incorporate any recommended measures to improve environmental performance.

Where this review leads to revisions to the Extraction Plan, then within four weeks of the review, the revised Extraction Plan will be submitted to the Secretary of the DPPI for approval.

The revision status of this Extraction Plan is indicated on the title page of each copy.

4.5 KEY RESPONSIBILITIES

Key responsibilities of MCO personnel in relation to this LW409-414 Extraction Plan are summarised in **Table 15**. The component management plans provide additional responsibilities under the plans. Responsibilities may be delegated as required.

Table 15: Key Extraction Plan Responsibilities

Responsibility	Task
General Manager	<ul style="list-style-type: none"> • Ensure resources are available to MCO personnel to facilitate the completion of responsibilities under this Extraction Plan. • Ensure the safety of MCO employees and the public in relation to MCO operations. • Approve and instruct implementation of remediation/corrective action/compensation, if necessary.
Underground Technical Services Manager	<ul style="list-style-type: none"> • Liaise with relevant stakeholders regarding environmental management. • Liaise with relevant stakeholders regarding management of built features. • Ensure monitoring and reporting required in accordance with this Extraction Plan are carried out within specified timeframes, are adequately checked and processed and are prepared to the required standard. • Ensure that any Incident Reports are lodged in a timely manner with all available information. • Ensure that reviews of this Extraction Plan and other plans are conducted as described in Sections 4.4 and 4.5. • Liaise with relevant stakeholders regarding subsidence impact management and related public safety hazards.

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Table 15 (Continued): Key Extraction Plan Responsibilities

Responsibility	Task
Environment and Community Manager	<ul style="list-style-type: none"> • Liaise with relevant stakeholders regarding environmental management. • Ensure monitoring and reporting required in accordance with this Extraction Plan are carried out within specified timeframes, are adequately checked and processed and are prepared to the required standard. • Ensure that any Incident Reports are lodged in a timely manner with all available information. • Ensure that reviews of this Extraction Plan and other plans are conducted as described in Sections 4.4 and 4.5.
Registered Mine Surveyor	<ul style="list-style-type: none"> • Undertake all subsidence monitoring to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.

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5.0 REFERENCES

- Australasian Groundwater and Environmental Consultants Pty Ltd (2024) *UG4 LW409 to LW414 Extraction Plan Groundwater Technical Report*.
- Department of Climate Change, Energy, the Environment and Water (2024) *Bionet Atlas*. Available at: https://atlas.bionet.nsw.gov.au/UI_Modules/ATLAS_/AtlasSearch.aspx.
- Department of Planning and Environment (2022) *Extraction Plan Guideline*.
- Mine Subsidence Engineering Consultants Pty Ltd (2024) *Moolarben Coal Complex: Moolarben Project Stage 1, Longwalls 409 to 414 Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Extraction Plan*.
- Moolarben Coal Mines Pty Ltd (2006) *Moolarben Coal Project Stage 1 Environmental Assessment Report*.
- Niche Environment and Heritage Pty Ltd (2024a) *Moolarben Coal Complex, UG4 Longwalls 409-414 Extraction Plan - Aboriginal Cultural Heritage Technical Report*.
- Niche Environment and Heritage Pty Ltd (2024b) *UG4 LW409-414 Biodiversity Technical Report*.
- NSW Department of Planning (2007) *Major Project Assessment - Moolarben Coal Project*.
- WRM Water and Environment Pty Ltd (2024) *UG4 Longwalls 409 to 414 Extraction Plan Surface Water Technical Report*.

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