UG1 LONGWALLS 101 TO 103 BUILT FEATURES
MANAGEMENT PLAN
MID-WESTERN REGIONAL COUNCIL

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<th>Approval Date</th>
<th>Description</th>
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<td>MCO and MSEC</td>
<td>Environmental Department</td>
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Approved: [Signature]
Date: 21/9/2017
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Attachment 2  UG1 Longwalls 101 to 103 Built Features Management Plan – Mid-Western Regional Council Trigger Action Response Plan
Attachment 3  UG1 Longwalls 101 to 103 Built Features Management Plan – Mid-Western Regional Council Subsidence Impact Register
1.0 INTRODUCTION

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 (Moolarben Coal Mines Pty Ltd [MCM], Sojitz Moolarben Resources Pty Ltd and a consortium of Korean power companies). MCO and MCM are wholly owned subsidiaries of Yancoal Australia Limited.

The UG1 Underground Mine is a component of the approved Moolarben Coal Complex (Figure 2). The UG1 Underground Mine commenced first workings in May 2016 and is scheduled to commence secondary workings (longwall extraction) in October 2017 by longwall mining methods from the Ulan Seam within Mining Lease (ML) 1605, ML 1606, ML 1628, ML 1691 and ML 1715 (Figure 3).

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and would 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, granted under the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act).

This UG1 Longwalls 101 to 103 Built Features Management Plan – Mid-Western Regional Council (LW101-103 BFMP-MWRC) forms a part of the Extraction Plan being developed for Longwalls 101 to 103 (herein referred to as Longwalls 101-103) of the approved UG1 Underground Mine.

1.1 PURPOSE AND SCOPE

Purpose: This LW101-103 BFMP-MWRC outlines the management of potential subsidence impacts of the proposed secondary workings described in the Extraction Plan on the existing Ulan-Wollar Road.

Scope: This LW101-103 BFMP-MWRC covers the section of the Ulan-Wollar Road within and proximal to the Study Area\(^1\) and immediate surrounds, which relates to the extent of subsidence effects resulting from the secondary extraction of Longwalls 101-103 (Figure 4). This LW101-103 BFMP-MWRC will be reviewed and updated, prior to the secondary extraction of Longwalls 104 and 105.

\(^1\) Longwalls 101-103 and the area of land within the furthest extent of the 26.5 degree (°) angle of draw and 20 millimetres (mm) predicted subsidence contour.

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<td>Sept 2017</td>
<td>Sept 2017</td>
<td>Sept 2018</td>
<td>MCO</td>
<td>S. Archinal</td>
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</tbody>
</table>
Figure 1

Source: NSW Land & Property Information (2015); NSW Department of Industry (2016); Office of Environment and Heritage NSW (2016)
LEGEND
- Exploration Licence Boundary
- Mining Lease Boundary
- Haul Road
- Approved Road Realignment
  (not yet constructed)
- Existing/Approved Development
- Open Cut Mining Area
- Out-of-pit Emplacement
- Surface Infrastructure Area
- Underground Longwall Layout
- Direction of Longwall Mining
- Longwalls 101 to 103 Study Area

Source: MCO (June 2016); NSW Dept of Industry (2016)

Moolarben Coal Complex Layout

Figure 2
1.2 SUITABLY QUALIFIED AND EXPERIENCED PERSONS

In accordance with Condition 5(a), Schedule 4 of Project Approval (08_0135), the suitably qualified and experienced persons that have prepared this LW101-103 BFMP-MWRC, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and MCO, were endorsed by the Secretary of the Department of Planning and Environment (DP&E).

This LW101-103 BFMP-MWRC has been prepared in consultation with the Mid-Western Regional Council (MWRC) (Section 4.4).

A list of the key responsibilities of MCO personnel in relation to this LW101-103 BFMP-MWRC, and a list of key contacts is provided in Section 11.

1.3 STRUCTURE OF THE LONGWALLS 101-103 BFMP-MWRC

The remainder of the LW101-103 BFMP-MWRC is structured as follows:

Section 2: Describes the review and update of the LW101-103 BFMP-MWRC.
Section 3: Outlines the statutory requirements applicable to the LW101-103 BFMP-MWRC.
Section 4: Provides baseline data, extraction schedule, revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 101-103, as well as the outcomes of the risk assessment.
Section 5: Details the performance measures relevant to MWRC assets.
Section 6: Describes the monitoring program.
Section 7: Describes the management measures that will be implemented.
Section 8: Details the performance indicators that will be used to assess against the performance measures.
Section 9: Provides a contingency plan to manage any unpredicted impacts and their consequences.
Section 10: Describes the Trigger Action Response Plan (TARP) management tool.
Section 11: Describes the roles and responsibilities for MCO personnel and key contacts.
Section 12: Describes the program to collect sufficient baseline data for future Extraction Plans.
Section 13: Describes the Annual Review, audits, regular reporting and improvement of environmental performance.
Section 14: Outlines the management and reporting of incidents.
Section 15: Outlines the management and reporting of complaints.
Section 16: Outlines the management and reporting of non-compliances with statutory requirements.
Section 17: Lists the references cited in this LW101-103 BFMP-MWRC.
2.0 LONGWALLS 101 TO 103 BFMP-MWRC REVIEW AND UPDATE

In accordance with Condition 5, Schedule 6 of Project Approval (08_0135), this LW101-103 BFMP-MWRC will be reviewed within three months of the submission of:

- an Annual Review under Condition 4, Schedule 6;
- an incident report under Condition 7, Schedule 6;
- an audit under Condition 9, Schedule 6; or
- any modification to the conditions of Project Approval (08_0135) or Project Approval (05_0117) (unless the conditions require otherwise); and

if necessary, revised to the satisfaction of the Secretary of the DP&E 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 LW101-103 BFMP-MWRC, then within four weeks of the review, the revised LW101-103 BFMP-MWRC will be submitted to the Secretary of the DP&E for approval.

2.1 ACCESS TO INFORMATION

In accordance with Condition 11, Schedule 6 ‘Access to Information’, MCO will make the approved LW101-103 BFMP-MWRC publicly available on the MCO website.
3.0 STATUTORY REQUIREMENTS

MCO’s statutory obligations are contained in:

- the conditions of the NSW Project Approval (05_0117) (as modified) and NSW Project Approval (08_0135) (as modified);
- the conditions of Commonwealth Approvals (EPBC 2007/3297, EPBC 2013/6926 and EPBC 2008/4444);
- relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL) No. 12932 and MLs (i.e. ML 1605, ML 1606, ML 1628, ML 1691 and ML 1715); and
- other relevant legislation.

Obligations relevant to this LW101-103 BFMP-MWRC are described below.

3.1 EP&A ACT APPROVAL

Condition 5(g), Schedule 4 of Project Approval (08_0135) requires the preparation of a Built Features Management Plan as a component of the Extraction Plan. In addition, Conditions 3, 5(n), 5(p) and 6, Schedule 4 and Condition 3, Schedule 6 of Project Approval (08_0135) outline general management plan requirements that are applicable to the preparation of this LW101-103 BFMP-MWRC.

Table 1 presents these requirements and indicates where they are addressed within this LW101-103 BFMP-MWRC.
Table 1: Management Plan Requirements

<table>
<thead>
<tr>
<th>Condition 3, Schedule 4</th>
<th>Notes:</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>• The Proponent will be required to define more detailed performance indicators for each of these performance measures in Built Features Management Plans or Public Safety Management Plan (see condition 5 below).</td>
</tr>
<tr>
<td></td>
<td>• Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.</td>
</tr>
<tr>
<td></td>
<td>• Requirements under this condition may be met by measures undertaken in accordance with the Mine Subsidence Compensation Act 1961.</td>
</tr>
<tr>
<td></td>
<td>...</td>
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<tr>
<td>Condition 5(g), Schedule 4</td>
<td>(g) include a Built Features Management Plan, which has been prepared in consultation with DRE and the owners of affected public infrastructure, to manage the potential subsidence impacts and/or environmental consequences of the proposed second workings, and which:</td>
</tr>
<tr>
<td></td>
<td>• addresses in appropriate detail all items of key public infrastructure and other public infrastructure and all classes of other built features;</td>
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<tr>
<td></td>
<td>• has been prepared following appropriate consultation with the owner/s of potentially affected feature/s;</td>
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<tr>
<td></td>
<td>• 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</td>
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<td></td>
<td>• 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;</td>
</tr>
<tr>
<td>Condition 5(n), Schedule 4</td>
<td>(n) include a contingency plan that expressly provides for adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Tables 18 and 19, or where any such exceedance appears likely; ...</td>
</tr>
<tr>
<td>Condition 5(p), Schedule 4</td>
<td>(p) include a program to collect sufficient baseline data for future Extraction Plans.</td>
</tr>
<tr>
<td>Condition 6, Schedule 4</td>
<td>6. The Proponent shall ensure that the management plans required under conditions 5(g)–(p) above include:</td>
</tr>
<tr>
<td></td>
<td>a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval; and</td>
</tr>
<tr>
<td></td>
<td>b) a detailed description of the measures that would be implemented to remediate predicted impacts.</td>
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<td>Sept 2018</td>
<td>MCO</td>
<td>S. Archinal</td>
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</table>
3. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:
   a) detailed baseline data;
   b) a description of:
      • the relevant statutory requirements (including any relevant approval, licence or lease conditions);
      • the relevant limits or performance measures/criteria;
      • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;
   c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
   d) a program to monitor and report on the:
      • impacts and environmental performance of the project;
      • effectiveness of any management measures (see c above);
   e) a contingency plan to manage any unpredicted impacts and their consequences;
   f) a program to investigate and implement ways to improve the environmental performance of the project over time;
   g) a protocol for managing and reporting any:
      • incidents;
      • complaints;
      • non-compliances with statutory requirements; and
      • exceedances of the impact assessment criteria and/or performance criteria; and
   h) a protocol for periodic review of the plan.

<table>
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<tr>
<th>Condition 3, Schedule 6</th>
<th>LW101-103 BFMP-MWRC Section</th>
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<tr>
<td>3. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</td>
<td>Sections 3 &amp; 4.4</td>
</tr>
<tr>
<td>a) detailed baseline data;</td>
<td>Section 3</td>
</tr>
<tr>
<td>b) a description of:</td>
<td>Section 5</td>
</tr>
<tr>
<td>• the relevant statutory requirements (including any relevant approval, licence or lease conditions);</td>
<td>Section 8</td>
</tr>
<tr>
<td>• the relevant limits or performance measures/criteria;</td>
<td>Sections 7 &amp; 9</td>
</tr>
<tr>
<td>• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;</td>
<td></td>
</tr>
<tr>
<td>c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;</td>
<td></td>
</tr>
<tr>
<td>d) a program to monitor and report on the:</td>
<td>Sections 6, 8 &amp; 13</td>
</tr>
<tr>
<td>• impacts and environmental performance of the project;</td>
<td>Section 9</td>
</tr>
<tr>
<td>• effectiveness of any management measures (see c above);</td>
<td></td>
</tr>
<tr>
<td>e) a contingency plan to manage any unpredicted impacts and their consequences;</td>
<td></td>
</tr>
<tr>
<td>f) a program to investigate and implement ways to improve the environmental performance of the project over time;</td>
<td>Sections 6 &amp; 13</td>
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<tr>
<td>g) a protocol for managing and reporting any:</td>
<td></td>
</tr>
<tr>
<td>• incidents;</td>
<td>Section 14</td>
</tr>
<tr>
<td>• complaints;</td>
<td>Section 15</td>
</tr>
<tr>
<td>• non-compliances with statutory requirements; and</td>
<td>Section 16</td>
</tr>
<tr>
<td>• exceedances of the impact assessment criteria and/or performance criteria; and</td>
<td>Section 9</td>
</tr>
<tr>
<td>h) a protocol for periodic review of the plan.</td>
<td>Section 2</td>
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3.2 OTHER LEGISLATION

MCO will operate the Moolarben Coal Complex consistent with Project Approval (08_0135) and any other legislation that is applicable to an approved Part 3A Project under the EP&A Act.

The following Acts may be applicable to, but are not limited to, the conduct of the Moolarben Coal Complex:

- Crown Lands Act, 1989;
- Fisheries Management Act, 1994;
- Heritage Act, 1977;
- Mine Subsidence Compensation Act, 1961;
- Mining Act, 1992;
• National Parks and Wildlife Act, 1974;
• Biodiversity Conservation Act, 2016;
• Protection of the Environment Operations Act, 1997;
• Roads Act, 1993;
• Water Act, 1912;
• Water Management Act, 2000;
• Work Health and Safety Act, 2011; and

Relevant licences or approvals required under these Acts will be obtained as required.
4.0 MID-WESTERN REGIONAL COUNCIL INFRASTRUCTURE

4.1 BASELINE DATA

MWRC infrastructure in the vicinity of Longwalls 101 to 103 includes (Figure 4):

- Ulan Road;
- Ulan Road bridge (over the Sandy Hollow Gulgong Railway);
- publicly accessible sections of Ulan-Wollar Road (on land owned by MWRC and on land owned by MCO);
- publicly inaccessible (i.e. closed) sections of Ulan-Wollar Road (on land owned by MWRC); and
- other roads closed to the public (on land owned by MWRC) including Murragamba Road and Carrs Gap Road.

The MWRC also owns infrastructure associated with these roads, such as the road pavement, embankments, tunnels and culverts.

Ulan-Wollar Road runs adjacent to the Sandy Hollow Gulgong Railway at distances of 250 metres (m) or more from Longwalls 101-103 (Figure 4). The route of Ulan-Wollar Road from the intersection with Ulan Road and around the northern end of Longwalls 101-103 has recently been realigned. The former road alignment (located closer to the northern ends of Longwalls 101-103) has been closed to the public at both ends. These changes to the Ulan-Wollar Road alignment are currently under application to be officially gazetted, and at this stage, the realigned section of the public road is located on land owned by MCO.

Ulan Road is located to the north west of Longwalls 101 to 103, more than 1 km from the nearest longwall with an open cut pit between the road and the longwalls. A road bridge is located along Ulan Road, over the Sandy Hollow Gulgong Railway line, and is 1.2 km from Longwall 101.

The nearest publicly accessible sections of Ulan-Wollar Road to the proposed longwalls are approximately 250 m from Longwall 101 and 335 m from Longwall 103. The nearest closed sections of Ulan-Wollar Road are approximately 100 m from Longwall 103. Additionally, sections of the other closed roads, Murragamba Road and Carrs Gap Road, directly overlie Longwalls 101 to 103. As these roads are closed to the public, they have not been considered further.

The nearest drainage culvert on Ulan-Wollar Road is located approximately 1.2 km to the south east at Murragamba Creek. An embankment and twin tunnels have also been constructed beneath the road along the alignment of the conveyor, approximately 720 m from Longwall 101.
4.2 **LONGWALLS 101-103 EXTRACTION SCHEDULE**

Ulan-Wollar Road is located to the north and north-east of the Study Area for Longwalls 101-103 (Figure 4) and will not be subject to measurable conventional subsidence effects, however, may experience small far-field horizontal movements.

Longwalls 101-103 and the area of land within the furthest extent of the 26.5° angle of draw and 20 mm predicted subsidence contour (i.e. the Longwalls 101-103 Study Area) are shown on Figures 3 and 4. Longwall extraction will occur from the west to the east. The longwall layout includes approximately 311 m panel widths (void) with 20 m pillars (solid).

The provisional extraction schedule for Longwalls 101-103 is provided in Table 2.

<table>
<thead>
<tr>
<th>Longwall</th>
<th>Estimated Start Date</th>
<th>Estimated Duration</th>
<th>Estimated Completion Date</th>
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<tr>
<td>101</td>
<td>October 2017</td>
<td>10 months</td>
<td>August 2018</td>
</tr>
<tr>
<td>102 (A+B)</td>
<td>October 2018</td>
<td>12 months</td>
<td>October 2019</td>
</tr>
<tr>
<td>103</td>
<td>November 2019</td>
<td>10 months</td>
<td>September 2020</td>
</tr>
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</table>

Following approval of the UG1 Optimisation Modification in April 2016, MCO has delineated a geological feature in Longwall 102 that prevents economic mining of this section, and has subsequently revised the longwall layout to incorporate a barrier pillar around this feature. The barrier pillar separating Longwalls 102A and 102B is approximately 140 m in length. In addition, following further detailed design, Longwalls 101-103 have been shortened by approximately 70 m to provide safe operational conveyor distance between the end of the longwalls and main headings. With the exception of these changes, the longwall geometry is the same as that for the approved UG1 Optimisation Modification, and MSEC (2017a) concludes that the overall impact assessments for the natural and built features are unchanged or reduced.

4.3 **REVISED SUBSIDENCE AND IMPACT PREDICTIONS**

Subsidence and impact predictions for Longwalls 101-105 in relation to the MWRC assets was conducted by MSEC (2015) as part of the Moolarben Coal Complex UG1 Optimisation Modification Environmental Assessment (EA).
Revised subsidence and impact predictions specifically for the extraction of Longwalls 101-103 on MWRC assets were conducted by MSEC and reported in MSEC (2017b) (Attachment 1). Subsequent to the preparation of MSEC (2017b), the longwall layout was revised to incorporate a reduced longwall length and shorter barrier pillar (Section 4.2). MSEC (2017a) includes updated subsidence predictions for the revised layout. As the asset is located further from Longwalls 101-103, a reduced impact is predicted by MSEC (2017a) compared to MSEC (2017b).

In relation to subsidence predictions for Longwalls 101-103, MSEC (2017a; 2017b) make the following conclusions:

- The predicted levels of conventional vertical mine subsidence along the publicly accessible section of Ulan-Wollar Road are likely to be negligible, however the road may be subject to low level far field horizontal movements less than 80 mm.
- The effects of the predicted subsidence and the differential far field movements due to the proposed extraction of the UG1 longwalls on the Ulan-Wollar Road are unlikely to adversely impact on the road.
- However, Ulan-Wollar Road should be inspected on a regular basis as the Longwalls 101-103 are mined, to confirm that the observed ground movements and impacts are consistent with the predictions and assessments. In this way, the road can be maintained in a safe and serviceable condition throughout the mining period.

It is expected that any subsidence impacts affecting the serviceability of Ulan-Wollar Road could be managed using typical mitigation and management techniques (Section 7).

### 4.4 RISK ASSESSMENT

At a meeting on 16 February 2017, MCO presented to representatives of the MWRC the predicted subsidence impacts and proposed monitoring programs, controls and contingencies relating to MWRC infrastructure within the vicinity of the Study Area. The MWRC was satisfied that a formal risk assessment workshop was not required for the LW101-103 BFMP-MWRC. Notwithstanding, the MWRC would review the LW101-103 BFMP-MWRC documentation when provided.

In accordance with the Guidelines for the Preparation of Extraction Plans (DP&E and DRE, 2015), risk control measures and procedures have been identified which consider the extraction of coal beneath the land within the Study Area and in proximity to the MWRC assets, and are summarised as follows:

**Baseline Data / Validation**

1. Carry out a visual inspection of the Ulan-Wollar Road (and associated infrastructure) within 400 m of Longwalls 101 to 103.
2. Provide MWRC with a copy of the visual inspection of the Ulan-Wollar Road (and associated infrastructure) once carried out, and obtain other available baseline records (where available).

3. Installation of the subsidence monitoring program.

Management / Monitoring / Response Measures

4. Establish a key contacts list between MCO and MWRC to provide a regular update of status of mining activities, and for ongoing liaison.

5. Include in the LW101-103 BFMP-MWRC a schedule of times/frequency of communication with MWRC for the status of mining of Longwalls 101-103.

6. Develop a TARP and include triggers for conditions that may need to be actioned by MCO and/or MWRC.

7. Include a monitoring plan in the LW101-103 BFMP-MWRC to implement visual inspections of the roadway, pipes/culverts and other furniture during active subsidence associated with Longwalls 101-103.

The proposed risk control measures and procedures have been incorporated where relevant in this LW101-103 BFMP-MWRC and the program for implementation is summarised in Table 3.

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

<table>
<thead>
<tr>
<th>Risk Control Measure / Procedure</th>
<th>LW101-103 BFMP-MWRC Section</th>
<th>Proposed Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Data / Validation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Carry out a visual inspection of the Ulan-Wollar Road (and associated infrastructure) within 400 m of Longwalls 101 to 103.</td>
<td>Section 6.2</td>
<td>Prior to Longwall 101</td>
</tr>
<tr>
<td>2 Provide MWRC with a copy of the visual inspection of the Ulan-Wollar Road (and associated infrastructure) once carried out, and obtain other available baseline records (where available).</td>
<td>Section 6.2</td>
<td>Prior to Longwall 101, subject to availability</td>
</tr>
<tr>
<td>3 Installation of the subsidence monitoring program.</td>
<td>Section 6</td>
<td>Prior to Longwall 101</td>
</tr>
<tr>
<td><strong>Management / Monitoring / Response Measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Establish key contacts list in the LW101-103 BFMP-MWRC.</td>
<td>Section 11.1</td>
<td>Complete</td>
</tr>
<tr>
<td>5 Include a schedule of times/frequency of communication with MWRC for the status of mining of Longwalls 101-103 in the LW101-103 BFMP-MWRC.</td>
<td>Section 7 and Table 6</td>
<td>Complete</td>
</tr>
<tr>
<td>6 Include in the TARP triggers for conditions that may need to be actioned by MCO and/or MWRC.</td>
<td>Section 10 and Attachment 2</td>
<td>Complete</td>
</tr>
<tr>
<td>7 Include a monitoring plan in the LW101-103 BFMP-MWRC to implement visual inspections of the roadway, pipes/culverts and other furniture during active subsidence associated with Longwalls 101-103.</td>
<td>Table 5</td>
<td>Complete</td>
</tr>
</tbody>
</table>

MCO considers all risk control measures and procedures to be feasible to manage all identified risks relating to public safety and predicted impacts to MWRC infrastructure.

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Issue</th>
<th>Effective</th>
<th>Review</th>
<th>Author</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCO_BFMP_MWRC</td>
<td>1</td>
<td>Sept 2017</td>
<td>Sept 2017</td>
<td>Sept 2018</td>
<td>MCO</td>
<td>S. Archinal</td>
</tr>
</tbody>
</table>
5.0 PERFORMANCE MEASURES

The performance measures specified in Table 19, Schedule 4 of Project Approval (08_0135) relevant to the Ulan-Wollar Road, as a built feature, are listed in Table 4.

Table 4: Built Features Subsidence Impact Performance Measures

<table>
<thead>
<tr>
<th>Feature</th>
<th>Subsidence Impact Performance Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key public infrastructure:</strong></td>
<td></td>
</tr>
<tr>
<td>Ulan-Wollar Road</td>
<td>Always safe and serviceable. Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.</td>
</tr>
<tr>
<td><strong>Other infrastructure:</strong></td>
<td></td>
</tr>
<tr>
<td>Murragamba Road1</td>
<td>Always safe. 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.</td>
</tr>
</tbody>
</table>

Source: Table 19 of Condition 3, Schedule 4 of Project Approval (08_0135).

1 Murragamba Road is closed to the public, and as such, has not been considered further.

In accordance with Condition 3, Schedule 4 of Project Approval (08_0135), MCO must ensure that there is no exceedance of the performance measures listed in Table 19, to the satisfaction of the Secretary of the DP&E.

Section 6 outlines the monitoring that will be undertaken to assess the impact of Longwalls 101-103 against the performance measures in relation to the Ulan-Wollar Road. Management measures for the Ulan-Wollar Road are outlined in Section 7 and performance indicators for the performance measures are summarised in Section 8.
6.0 MONITORING

A monitoring program will be developed in order to monitor the impacts of the extraction of Longwalls 101-103 on the Ulan-Wollar Road to identify unsafe conditions or loss of serviceability during or after mining. Key components of the monitoring program are summarised in Table 5.

### Table 5: Ulan-Wollar Road Monitoring Program Overview

<table>
<thead>
<tr>
<th>Monitoring Component</th>
<th>Parameter</th>
<th>Timing/Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-mining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulan-Wollar Road – Visual inspection.</td>
<td>Condition of road pavements, culverts and other furniture.</td>
<td>Prior to commencement of Longwall 101 extraction.</td>
<td>Underground Technical Manager and representative of asset owner if required</td>
</tr>
<tr>
<td>UG1 subsidence monitoring lines as described in the UG1</td>
<td>Ground survey of ‘FF Line’ (along alignment of Ulan-Wollar Road) – baseline.</td>
<td>Prior to commencement of Longwall 101 extraction.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
<tr>
<td>Longwalls 101 to 103 Subsidence Monitoring Program (LW101-103 SMP).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>During and After Mining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG1 subsidence monitoring lines as described in the LW101-103 SMP.</td>
<td>Ground survey of ‘FF Line’ (along alignment of Ulan-Wollar Road). Monitoring parameters include:</td>
<td>Prior to secondary extraction within 400 m of the longwall take-off positions. At 100 m intervals determined by the longwall chainage marks while the active mining face is within 400 m of the longwall take-off positions. [Inspection sheets provided to MWRC unless otherwise agreed] At any time in case of an emergency and requested by MWRC.</td>
<td>Underground Technical Manager / Registered Mine Surveyor</td>
</tr>
<tr>
<td></td>
<td>subsidence; tilt; tensile strain; compressive strain; and absolute horizontal translation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulan-Wollar Road – Subsidence impact inspection.</td>
<td>Subsidence impact inspections will target the identification of:</td>
<td>If/when ground movement (in excess of survey accuracy) is detected during monitoring of the FF Line. Opportunistic visual observations during routine works by MCO and its contractors. At any time in case of an emergency and requested by MWRC.</td>
<td>Underground Technical Manager</td>
</tr>
<tr>
<td></td>
<td>impacts to the surface including cracks, buckling and stepping; impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing, and collapse; and visible impacts to furniture.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>As per MWRC inspections.</td>
<td>Routinely as per MWRC inspections.</td>
<td>MWRC</td>
</tr>
</tbody>
</table>
Table 5 (Continued): Ulan-Wollar Road Monitoring Program Overview

<table>
<thead>
<tr>
<th>Monitoring Component</th>
<th>Parameter</th>
<th>Timing/Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Post-Mining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG1 subsidence</td>
<td>Ground</td>
<td>Within three</td>
<td>Underground</td>
</tr>
<tr>
<td>monitoring lines</td>
<td>monitoring lines (along alignment of UG1 subsidence monitoring)</td>
<td>months following</td>
<td>Technical</td>
</tr>
<tr>
<td>as described in the</td>
<td>including tilt;</td>
<td>completion of longwall recovery</td>
<td>Manager /</td>
</tr>
<tr>
<td>LW101-103 SMP.</td>
<td>tensile strain;</td>
<td>from each of Longwalls 101, 102 and 103.</td>
<td>Registered Mine</td>
</tr>
<tr>
<td></td>
<td>compressive strain;</td>
<td></td>
<td>Surveyor</td>
</tr>
<tr>
<td></td>
<td>and absolute horizontal translation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulan-Wollar Road –</td>
<td>Condition of road pavements, culverts and other furniture</td>
<td>Following completion of active mining at UG1.</td>
<td>Underground</td>
</tr>
<tr>
<td>Visual inspection.</td>
<td>post-mining.</td>
<td></td>
<td>Technical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Manager and representative of asset owner if required</td>
</tr>
</tbody>
</table>

The frequency of monitoring will be reviewed either:

- in accordance with the Annual Review; or
- if triggered as a component of the Contingency Plan as outlined in Section 9 of this LW101-103 BFMP-MWRC.

6.1 SUBSIDENCE PARAMETERS

Subsidence parameters (i.e. subsidence, tilt, tensile strain, compressive strain and absolute horizontal translation) associated with mining will be measured in accordance with the LW101-103 SMP.

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

Monitoring of subsidence parameters specific to Ulan-Wollar Road will be measured by a single survey line (‘FF Line’) located along the alignment of Ulan-Wollar Road in the vicinity of Longwalls 101-103. Surveys along the FF Line will be undertaken prior to extraction of Longwall 101, prior to mining within 400 m of the longwall take-off positions and at 100 m intervals based on longwall chainage marks when mining is within 400 m of the longwall take-off positions. Surveys will also be conducted within three months of the completion of longwall recovery.
Unless otherwise agreed with MWRC, inspection sheets detailing the outcome of the subsidence impact monitoring program will be provided to MWRC following confirmation of the results.

6.2 SUBSIDENCE IMPACTS

A visual inspection of Ulan-Wollar Road will be conducted prior to commencement of Longwall 101 to establish the condition of the roadway and pipes/culverts.

The visual inspection will be conducted by MCO and include:

- recording of existing defects using detailed road surface photography (video), i.e. one photograph every 2 m; and
- recording of existing pipe/culvert condition.

A copy of the visual inspection report will be provided to MWRC. Other road pavement baseline records (where available) would be provided to MCO.

In the event monitoring identifies ground movement (in excess of survey accuracy) MCO will undertake an inspection of the road for any impacts caused by subsidence movements. Opportunistic observations of subsidence impacts will be conducted during routine works by MCO (and its contractors) and MWRC’s routine road condition inspections.

Information will be recorded in the LW101-103 BFMP-MWRC Subsidence Impact Register (Attachment 3) and reported in accordance with Project Approval (08_0135) (Section 13).

6.3 ENVIRONMENTAL CONSEQUENCES

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

The potential management measures in relation to the Ulan-Wollar Road pavement include:

- mill and/or replace pavement layers; and
- crack sealing/repair.

In the event that repairs are required, traffic control measures such as contra-flow of traffic or partial carriageway closures may be used to divert traffic off one carriageway, lane or shoulder. Repairs would be carried out as soon as practicable in consultation with the MWRC.

The potential management measures in relation to drainage structures (pipes/culverts) include:

- point repairs;
- replace sections of pipe/culvert; and
- grouting/sealing of cracks.

The potential management measures in relation to guard rails, marker posts and signage include repairs and/or replacement of furniture.

Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures.

A summary of management measures will be reported in the Annual Review.

Key management actions and timing is summarised in Table 6.
<table>
<thead>
<tr>
<th>Management Measure</th>
<th>Timing/Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-mining</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notification to MWRC prior to commencement of secondary extraction.</td>
<td>Prior to secondary extraction of Longwall 101.</td>
<td>Underground Technical Manager</td>
</tr>
<tr>
<td>Visual inspection and record of Ulan-Wollar Road pavement, including culverts and other furniture.</td>
<td>Prior to secondary extraction of Longwall 101.</td>
<td>Underground Technical Manager</td>
</tr>
<tr>
<td><strong>During Mining</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notification to MWRC prior to subsidence effects on Ulan-Wollar Road.</td>
<td>Prior to mining within 400 m of the longwall take-off positions.</td>
<td>Underground Technical Manager</td>
</tr>
<tr>
<td>Provision of inspection sheets detailing the outcome of the subsidence impact monitoring program to MWRC (unless otherwise agreed with MWRC).</td>
<td>During Longwall 101-103 extraction.</td>
<td>Underground Technical Manager</td>
</tr>
<tr>
<td>Implement TARP (Attachment 2).</td>
<td>During Longwall 101-103 extraction.</td>
<td>Underground Technical Manager</td>
</tr>
<tr>
<td><strong>Post-mining</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Inspection of Ulan-Wollar Road to identify any post-mining remediation works required.</td>
<td>Following completion of active mining at UG1.</td>
<td>Underground Technical Manager</td>
</tr>
</tbody>
</table>
8.0 ASSESSMENT OF PERFORMANCE INDICATORS AND MEASURES

In accordance with Condition 5(d), Schedule 4 of Project Approval (08_0135), performance indicators have been developed for the performance measures listed in Table 4 (Section 5).

The performance indicators proposed to ensure that the performance measures for Ulan-Wollar Road are achieved include:

- no additional visible pavement cracking or other defects of the road pavement (when compared against baseline conditions and sections of road outside the Study Area) resulting in deterioration of road quality;
- no ponding of water on the road surface as a result of changes in grade from subsidence associated with Longwalls 101-103;
- no joint displacement or cracking or other defects of the drainage structure (e.g. pipes/culverts) in excess of 5 mm; and
- serviceability of guard rails, marker posts and signage is maintained.

Monitoring conducted to inform the assessment of secondary extraction of Longwalls 101-103 against the performance indicators (for the performance measures relevant to the Ulan-Wollar Road as a built feature) is outlined in Section 6.

Assessment of monitoring results against the performance indicators and performance measure would include comparison against the baseline visual inspection to confirm any changes were not present prior to the commencement of mining at UG1, and review of FF Line monitoring data to confirm if ground movements in excess of survey accuracy have occurred.

If a performance measure is considered to have been exceeded, the Contingency Plan outlined in Section 9 of this LW101-103 BFMP-MWRC will be implemented.
9.0 CONTINGENCY PLAN

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

- The observation will be reported to the Underground Technical Manager or the Environmental and Community Manager within 24 hours.
- The observation will be recorded in the Subsidence Impact Register (Attachment 3).
- The likely exceedance will be reported in an Incident Report (refer to the Extraction Plan).
- MCO will provide the Incident Report to relevant stakeholders (i.e. DP&E, DRE and MWRC).
- MCO will conduct an investigation to identify and evaluate contributing factors to the exceedance, including re-survey of the relevant subsidence monitoring lines, analysis of predicted versus observed subsidence parameters and a review of the subsidence monitoring program with updates to the program where appropriate.
- An appropriate course of action will be developed in consultation with relevant stakeholders and government agencies including proposed contingency measures (Section 9.1), and a program to review the effectiveness of the contingency measures.
- The course of action will be approved by, and implemented to the satisfaction of, MWRC and DRE.
- This LW101-103 BFMP-MWRC and the performance indicators will be reviewed to adequately manage future potential impacts within the limits of Project Approval (08_0135).

MCO will comply with the NSW Mine Subsidence Compensation Act, 1961 in the event that property damages occur as a result of mining Longwalls 101-103.

9.1 CONTINGENCY MEASURES

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

Potential contingency measures that could be considered in the event the performance measure for the Ulan-Wollar Road is exceeded are summarised in Table 7.

Temporary road closure procedures if required would be developed and carried out in consultation with the MWRC.
### Table 7: Potential Contingency Measures

<table>
<thead>
<tr>
<th>Environmental Consequence</th>
<th>Potential Contingency Measures</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement</td>
<td>Repair road.</td>
<td>Temporary closure of the road and repair of pavement.</td>
</tr>
<tr>
<td>Pipes/Culverts</td>
<td>Repair or replace pipe.</td>
<td>Construction of temporary drainage pipe/culvert (if required) and repair or replacement of original pipe/culvert.</td>
</tr>
<tr>
<td></td>
<td>Repair or rebuild culvert.</td>
<td></td>
</tr>
<tr>
<td>Other Furniture (Guard Rail, Marker Posts, Signage)</td>
<td>Repair or replace furniture.</td>
<td>Repair/replace section of guard rail, marker post or signage.</td>
</tr>
</tbody>
</table>
10.0 TRIGGER ACTION RESPONSE PLAN – MANAGEMENT TOOL

The framework for the various components of this LW101-103 BFMP-MWRC are summarised in the TARP shown in Attachment 2. The TARP illustrates how the various predicted subsidence impacts, monitoring components, performance measures, and responsibilities are structured to achieve compliance with the relevant statutory requirements, and the framework for management and contingency actions.

The TARP comprises:

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

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

Key responsibilities of MCO personnel in relation to this LW101-103 BFMP-MWRC are summarised in Table 8. Responsibilities may be delegated as required.

Table 8: Longwalls 101 to 103 Built Features Management Plan – Mid-Western Regional Council Responsibility Summary

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Manager</td>
<td>• Ensure resources are available to MCO personnel to facilitate the completion of responsibilities under this LW01-103 BFMP-MWRC.</td>
</tr>
<tr>
<td>Underground Technical Manager</td>
<td>• Ensure the LW101-103 SMP is implemented.</td>
</tr>
<tr>
<td></td>
<td>• Ensure monitoring required under this LW101-103 BFMP-MWRC is carried out within specified timeframes, adequately checked and processed and prepared to the required standard.</td>
</tr>
<tr>
<td></td>
<td>• Undertake relevant monitoring and implementation of management measures summarised in Tables 5 and 6 respectively.</td>
</tr>
<tr>
<td>Environmental and Community Manager</td>
<td>• Ensure the LW101-103 BFMP-MWRC is implemented.</td>
</tr>
<tr>
<td></td>
<td>• Liaise with relevant stakeholders regarding subsidence impact management and related environmental consequences.</td>
</tr>
<tr>
<td>Registered Mine Surveyor</td>
<td>• Undertake all subsidence monitoring to the required standard within the specified timeframes and ensure data are adequately checked, processed and recorded.</td>
</tr>
</tbody>
</table>

11.1 KEY CONTACTS

The details of key contacts and phone numbers in relation to this LW101-103 BFMP-MWRC are summarised in Table 9.

Table 9: Longwalls 101 to 103 Built Features Management Plan – Mid-Western Regional Council Key Personnel Contact Details

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Position</th>
<th>Contact Name</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCO</td>
<td>Underground Technical Manager</td>
<td>Mr Shane Pegg</td>
<td>02 6376 1656</td>
</tr>
<tr>
<td></td>
<td>Environmental and Community Manager</td>
<td>Mr Graham Chase</td>
<td>02 6376 1407</td>
</tr>
<tr>
<td></td>
<td>Moolarben Coal Hotline</td>
<td></td>
<td>1800 556 484</td>
</tr>
<tr>
<td>MWRC</td>
<td>General Manager</td>
<td>Brad Cam</td>
<td>02 6378 2850</td>
</tr>
<tr>
<td></td>
<td>Works Manager</td>
<td>Sally Mullinger</td>
<td>02 6378 2850</td>
</tr>
</tbody>
</table>
12.0 FUTURE EXTRACTION PLANS

In accordance with Condition 5(p), Schedule 4 of Project Approval (08_0135), MCO will collect baseline data for the future Extraction Plan (e.g. Longwalls 104-105). However, for the Ulan-Wollar Road, the baseline (and post-mining) data collected for Longwalls 101-103 will be used as baseline for Longwalls 104-105 as longwall mining progressively moves further south of the MWRC assets.

In addition to the baseline data collection, consideration of the environmental performance and management measures, in accordance with the review(s) conducted as part of this LW101-103 BFMP-MWRC, will inform the appropriate type and frequency of monitoring of the assets relevant to the next Extraction Plan.
13.0 ANNUAL REVIEW, REGULAR REPORTING AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

In accordance with Condition 4, Schedule 6 of Project Approval (08_0135), MCO will conduct an Annual Review of the environmental performance of the Project by the end of March each year, or as otherwise agreed by the Secretary of the DP&E.

The Annual Review will:

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

In accordance with Condition 11, Schedule 6 of Project Approval (08_0135), the Annual Review will be made available on the MCO website.

As described in Section 2, this LW101-103 BFMP-MWRC will be reviewed within three months of the submission of an Annual Review, and revised where appropriate.

In accordance with Condition 8, Schedule 6 of Project Approval (08_0135), MCO will also provide regular reporting on the environmental performance of the Project on the MCO website.
13.1 AUDITS

In accordance with Condition 9, Schedule 6 of Project Approval (08_0135), an independent environmental audit was conducted by the end of December 2015, and will be undertaken every three years thereafter. A copy of the independent environmental audit will be provided to the Secretary of the DP&E and made available on the MCO website.

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

The independent environmental audit will assess the environmental performance of the Project and assess whether it is complying with the requirements of Project Approval (08_0135), and any other relevant approvals, and recommend measures or actions to improve the environmental performance of the Project.
14.0 INCIDENTS

An incident is defined in Project Approval (08_0135) 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 (08_0135).

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

The reporting of incidents will be conducted in accordance with Condition 7, Schedule 6 of Project Approval (08_0135).

MCO will notify the Secretary of DP&E and any other relevant agencies of any incident associated with the UG1 Underground Mine immediately after MCO confirms that an incident has occurred. Within seven days of the date of the incident, MCO will provide the Secretary of DP&E and any relevant agencies with a detailed report on the incident. The report will:

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

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

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

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

- the nature of complaint;
- method of the complaint;
- relevant monitoring results and meteorological data at the time of the complaint;
- site investigation outcomes;
- any necessary site activity and activity changes;
- any necessary actions assigned; and
- communication of the investigation outcome(s) to the complainant.

In accordance with Condition 11, Schedule 6 of Project Approval (08_0135), the complaints register will be updated monthly and made available on the MCO website.
16.0 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS

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

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

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

As described in Section 14, MCO will notify the Secretary of the DP&E, and any other relevant agencies, of any incident associated with MCO immediately after MCO becomes aware of the incident. Within seven days of the date of the incident, MCO will provide the Secretary of the DP&E, and any relevant agencies, with a detailed report on the incident.

A review of MCO’s compliance with all conditions of Project Approval (08_0135), mining leases and all other approvals and licenses will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on the MCO website.

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


ATTACHMENT 1

MSEC (2017b) MOOLARBEN COAL OPERATIONS –LONGWALLS 101 TO 103
- SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE
  MID-WESTERN REGIONAL COUNCIL INFRASTRUCTURE
17th January 2017

Shane Pegg
Underground Technical Manager
Moolarben Coal Operations Pty Ltd
Locked Bag 2003
Mudgee NSW 2850

Ref: MSEC877-02

Dear Shane,

RE: Moolarben Coal Operations – Longwalls 101 to 103 - Subsidence Predictions and Impact Assessments for the Mid-Western Regional Council Infrastructure

Moolarben Coal Operations is preparing an Extraction Plan to support the commencement of longwall mining operations in the 4th quarter of 2017, and this letter has been prepared to detail potential subsidence impacts on infrastructure owned and operated by the Mid-Western Regional Council (MWRC).

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the MWRC infrastructure resulting from the extraction of Longwalls 101 to 103 at the Moolarben Coal Complex. In doing so this letter considers potential subsidence induced mechanisms of impact and concludes with a summary of the impact assessment. The potential subsidence impacts are consistent with those previously assessed and approved for the Moolarben Coal Complex UG1 Optimisation Modification Environmental Assessment.

The locations of the MWRC infrastructure and Longwalls 101 to 103 are shown in the attached Drawing No. MSEC877-02.

The MWRC infrastructure in the vicinity of Longwalls 101 to 103 includes:

- Ulan Road;
- Ulan Road bridge (over the Sandy Hollow Gulgong Railway);
- publicly accessible sections of Ulan-Wollar Road (on land owned by MWRC and on land owned by Moolarben Coal Operations);
- publicly inaccessible (i.e. closed) sections of Ulan-Wollar Road (on land owned by MWRC); and
- other roads closed to the public (on land owned by MWRC) including Murragamba Road and Carrs Gap Road.

MWRC also own infrastructure associated with these roads, such as the road pavement, embankments, tunnels and culverts.

The current route of Ulan-Wollar Road from the intersection with Ulan Road and around the northern end of Longwalls 101 to 103 has been realigned as shown in Drawing No. MSEC877-02 by construction of a new road pavement. The former road alignment (located closer to the northern ends of Longwalls 101 to 103 on MWRC owned land) has been closed to the public at both ends. It is understood these changes to the Ulan-Wollar Road alignment are under application to be officially gazetted and at this stage, the realigned section of the public road is located on land owned by Moolarben Coal Operations. Other closed roads include the unsealed roads Murragamba Road and Carrs Gap Road as shown in Drawing No. MSEC877-02 which are located on MWRC owned land.
This letter report considers the realigned Ulan-Wollar Road which is the current public access route through the area and will be in use during the extraction of Longwalls 101 to 103, notwithstanding that a section of the realigned road is located on land owned by Moolarben Coal Operations. This letter also considers other existing publicly accessible roads located on MWRC owned land (Ulan Road and Ulan-Wollar Road) and closed roads located on MWRC owned land.

Ulan Road is located to the north west of Longwalls 101 to 103, more than 1 km from the nearest longwall with an open cut pit between the road and the longwalls. A road bridge is located along Ulan Road, over the Sandy Hollow – Gulgong Railway line, and is 1.2 km from Longwall 101.

The nearest publicly accessible sections of Ulan-Wollar Road to the proposed longwalls are approximately 190 m from Longwall 101 and 260 m from Longwall 103. At these locations the depths of cover range from 110 m to 130 m and at the minimum distance of 190 m the road is 1.5 times the depths of cover from the longwalls.

The nearest closed sections of Ulan-Wollar Road are approximately 50 m from Longwall 103. Additionally, sections of the other closed roads, Murragamba Road and Carrs Gap Road, directly overly Longwalls 101 to 103. As these roads are closed to the public, detailed subsidence predictions have not been provided.

Ulan-Wollar Road is a sealed asphaltic concrete pavement with no kerb and gutter. The nearest drainage culvert is located approximately 1.2 km to the south east at Murragamba Creek. An embankment and twin tunnels have also been constructed beneath the road along the alignment of the conveyor, at 720 m from Longwall 101.

**Conventional Subsidence Parameters**

At distances of 190 m or more between the longwalls and the publicly accessible sections of Ulan-Wollar Road and based on depths of cover of 110 m to 130 m, Ulan-Wollar Road will not be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy); however, the road may experience far-field horizontal movements which are discussed below. Ulan Road is located 1 km or more from Longwall 101 and is separated from the longwalls by the open cut pit. Ulan Road will not be subjected to measurable conventional mine subsidence ground movements (i.e. less than limits of survey accuracy) and far-field horizontal movements are not expected due to the presence of the open cut pit, which is discussed below.

**Far-Field Movements**

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

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

In some cases, higher levels of far-field horizontal movements have been observed where steep slopes or surface incisions exist nearby, as these features influence both the magnitude and the direction of ground movement patterns. Similarly, increased horizontal movements are often observed around sudden changes in geology or where blocks of coal are left between longwalls or near other previously extracted series of longwalls. In these cases, the levels of observed vertical subsidence and horizontal movement can be slightly higher than normally predicted, but these increased movements are generally accompanied by very low levels of tilt and strain.

An empirical database of observed incremental far-field horizontal movements has been compiled using available monitoring data from the NSW and Queensland Coalfields, but this database predominately comprises measurements from the Southern Coalfield. The far-field horizontal movements are generally observed to be orientated towards the extracted longwall. At very low levels of far-field horizontal movements, however, there is a higher scatter in the orientation of the observed movements.
The observed incremental far-field horizontal movements, resulting from the extraction of each longwall within a series, are shown in Figure 1. The observed directions of these far-field horizontal movements were generally observed to be orientated towards the extracted longwall.

This plot of far-field horizontal movements includes some multi-seam mining cases and some sites where it is known that the plotted movements include components from valley closure effects. The confidence levels, based on fitted Generalised Pareto Distributions (GPDs), have also been shown in this figure to illustrate the spread of the data. The magnitude of these movements decrease with distance from the mined edges however, there have been cases where the observed far-field horizontal movements beyond the edges of the mined panels have approached 400 mm. The highest observed far-field horizontal movements are multi seam cases that are located close to large valleys.

This data includes some of the available observed far-field horizontal movements that have been measured at Ulan Coal Mine and other observed data from other regions where the depths of cover are also relatively shallow compared to the Southern Coalfield of NSW. The available far-field incremental horizontal movement data has therefore been replotted, as shown in Figure 2, against the distances from the nearest edge of the incremental panel divided by the depth of cover.

Figure 1  Observed Incremental Far-field Horizontal Movements (mm) from Many Regions in NSW Plotted Against the Distance to the Nearest Edge of the Mined Panel (m)
Figure 2  Observed Incremental Far-Field Horizontal Movements (mm) from Many Regions in NSW Versus the Distance to the Nearest edge of the Mined Panel Divided by the Depth of Cover (m/m)

Figure 2 replots the available far-field horizontal movement data that is shown in Figure 1 to allow for varying depths of cover and this plot is more appropriate for use at the Moolarben Coal Complex. This plot still includes those many cases where higher movements occurred because of multi-seam mining and valley closure effects.

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

Figure 2 shows the upper limit of previously observed absolute far-field horizontal movements at Ulan Coal Mine for the sites located 1.5 times the depths of cover from longwalls, was less than 140 mm, (however this data includes the H-Line case and the F-Line case where high valley closure movements were observed). Ignoring sites with high valley closure movements and the multi seam cases, Figure 2 shows the upper limit of previously observed absolute far-field horizontal movements for sites located 1.5 times the depths of cover from longwalls, is less than 100 mm.

Ulan Road is located over nine times the depth of cover from Longwall 101 and, based on Figure 2, is not expected to experience far-field horizontal movements.

Ulan-Wollar Road, therefore, is predicted to experience incremental far-field horizontal movements in the order of 100 mm due to the extraction of each of Longwalls 101 to 103. These low level horizontal movements are not expected to be associated with measurable tilts, curvatures or strains.
Influence of Unconsolidated Tertiary Sediments on Horizontal Far-field Movements

There are unconsolidated Tertiary sediments, with a maximum thickness of 40-50 m, to the north and east of the Longwalls 101 to 103 as shown in Drawing No. MSEC877-02. These unconsolidated sediments are remnants of inactive river or stream channels that have been later filled in or buried by younger sediment that can be stronger or weaker than the original strata.

At Moolarben Coal Complex the unconsolidated sediments to the north and east of Longwalls 101 to 103 were formed when Permian strata layers were replaced with infill sediments consisting of poorly-sorted semi-consolidated quartzose sands and gravels in a clayey matrix, i.e. including unsaturated alluvium and low permeability clays. The presence of these materials can modify the subsidence ground movements beyond the end of the longwalls, (depending on the depth of the channels, and its location with respect to the panel edges).

Since these unconsolidated sediments are located away from the edges of the longwalls, then, their presence should result in less subsidence within these areas and reduced far-field movements at the road.

Influence of the Existing Open Cut (OC1) on Horizontal Far-field Movements

An open cut mining area (OC1) currently in operation is located to the north west of the longwalls as shown in Drawing No. MSEC877-02. Access to the longwalls will be via the OC1 pit. An open cut mining area is also located to the south east (OC4) and will be extracted as part of future operations.

The open cut pits extract the overburden material and the target coal seam, i.e. down to the seam floor level of the longwalls. The effect of the removal of this material is to relieve or redistribute much of the in situ stress in the overburden strata adjacent to the pit. With the removal of the overburden material, the potential for far-field effects to develop in the vicinity of the pit are significantly reduced.

With rehabilitated open cut mine areas, the overburden material has been replaced, typically with other stripped material which is compacted by vehicle tracking during the emplacement process. Potential for far-field movements where the open cut pit has been fully rehabilitated between the longwalls and the outer natural overburden is expected to be significantly reduced, similar to the open cut pit, as the emplaced material is unlikely to support any significant stress redistribution.

Potential for Non-Conventional Movements

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

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

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

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

The range of potential strains associated with non-conventional movements has been assessed using monitoring data from previously extracted panels in the NSW Coalfields, for single-seam conditions, where the width-to-depth ratios and extraction heights were similar to those of Longwalls 101 to 103. The data used in the analysis of observed strains included those resulting from both conventional and non-conventional anomalous movements, but did not include those resulting from valley related movements. The strains resulting from damaged or disturbed survey marks have also been excluded. The survey database has been analysed to extract the maximum tensile
and compressive strains that have been measured at any time during mining for survey bays that were located beyond the goaf edges of the mined panels and positioned on unmined areas of coal between 200 m and 600 m of the nearest longwall goaf edge.

The 95% confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 1.6 mm/m tensile and 1.5 mm/m compressive. The 99% confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 2.9 mm/m tensile and 3.0 mm/m compressive. The 75% confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 0.5 mm/m both tensile and compressive, which is the typical limit of accuracy of strain measurement by conventional survey methods. It is noted that these results comprise a component of survey tolerance and have also been affected by disturbed survey marks and survey errors.

Impact Assessments for MWRC Infrastructure

The Ulan-Wollar Road conveyor tunnels and embankment, and the culvert at Murragamba Creek are located about six and nine times the depth of cover respectively from the longwalls and far-field horizontal movements would not be expected at this distance. Similarly, Ulan Road and the bridge over the Sandy Hollow-Gulgong Railway are located beyond OC1 at greater than nine times the depth of cover from the longwalls and far-field horizontal movements would not be expected at this distance, even without the presence of OC1. Adverse impacts to these features resulting from the extraction of Longwalls 101 to 103 are considered to be unlikely to occur.

The publicly accessible section of Ulan-Wollar Road is not expected to be subject to measurable conventional vertical subsidence, tilt, curvature or strain. However, the road may experience low level far-field horizontal movements. The upper limit of previously observed absolute far-field horizontal movements for sites located 1.5 times the depths of cover from longwalls, is in the order of 100 mm. The presence of unconsolidated sediments should result in reduced far-field movements at the road.

The predicted far-field horizontal movements of less than 100 mm at the road are expected to be bodily movements that are directed across the general alignment of the road towards the extracted goaf area and should be accompanied by very low levels of strain that are in the order of survey tolerance. Adverse impact to the road resulting from these potential far-field horizontal movements are considered to be unlikely to occur.

There is the potential for measurable ground strains to occur resulting from non-conventional movements. The statistical analysis of observed strain data between 200 m and 600 m from extracted longwalls shows a 25% probability of exceedance of 0.5 mm/m tensile and compressive, and a 5% probability of exceedance of approximately 1.5 mm/m tensile and compressive.

With the publicly accessible sections of Ulan-Wollar Road located 190 m or more from Longwalls 101 to 103 and the low probability of significant observed strains developing based on statistical analysis, the development of adverse impacts to the road due to the extraction of Longwalls 101 to 103 is considered to be unlikely to occur.

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

It is recommended that monitoring and management strategies are developed, in consultation with MWRC, to manage the road for potential irregular ground movements. It is expected that the road can be maintained in a safe and serviceable condition with the implementation of the appropriate monitoring and management strategies.
Recommendations

In order to manage the predicted impacts on MWRC infrastructure, the following is recommended:

   a) Implement a program of monitoring for potential far-field horizontal movements and non-conventional movement.

   b) Develop and implement monitoring and management strategies for dealing with potential impacts on MWRC infrastructure.

Summary

Ulan-Wollar Road is located 190 m or more from Longwalls 101 to 103 and is not expected to experience measurable conventional vertical subsidence movements resulting from the extraction of these longwalls. Predicted far-field horizontal movements at the location of the road are likely to be less than 100 mm.

There is a low probability that significant strains could develop at the location of the road due to non-conventional movements and as a result, the development of adverse impacts to the road due to the extraction of Longwalls 101 to 103 is considered to be unlikely to occur.

Ground monitoring and visual monitoring is recommended for the road for each longwall to check for the potential development of irregular subsidence movements.

It is expected that the potential impacts on the MWRC infrastructure can be managed with the implementation of the necessary monitoring and management strategies.

Yours sincerely

Peter DeBono

Attachments:

Drawing No. MSEC877-02 – Longwalls 101 to 103 – Mid-Western Regional Council Infrastructure
ATTACHMENT 2

UG1 LONGWALLS 101 TO 103
BUILT FEATURES MANAGEMENT PLAN – MID-WESTERN REGIONAL COUNCIL
TRIGGER ACTION RESPONSE PLAN
## Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline Conditions</th>
<th>Predicted Impacts</th>
<th>Implement Management Measures</th>
<th>Restoration/Contingency Phase</th>
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<td>Trigger</td>
<td>Ulan-Wollar Road and associated infrastructure is safe, serviceable and repairable or as otherwise identified by pre-mining inspection.</td>
<td>Subsidence effects on Ulan-Wollar Road.</td>
<td>Monitoring identifies impacts that are greater than predicted, but the performance measure has not been exceeded and is not likely to be exceeded.</td>
<td>If the Performance Measure relevant to Ulan-Wollar Road has been exceeded, or is likely to be exceeded (i.e. unsafe or loss of serviceability).</td>
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| Action    | Establish baseline data, including:  
- Pre-mining visual inspection.  
- Pre-extraction subsidence survey as per the UG1 Longwalls 101 to 103 Subsidence Monitoring Program. | Conduct monitoring as described in Section 6, including:  
- Ground survey.  
- Subsidence impact inspections, targeting the identification of:  
  - impacts to the surface including cracks, buckling and stepping;  
  - impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing and collapse; and  
  - visible impacts to furniture.  
- Visual inspection of the condition of road pavements, culverts and other furniture. | Management measures implemented as described in Section 7 (with regard to the specific circumstances of the subsidence impact [e.g. the nature and extent of the impact]). Follow-up inspections will be conducted to assess the effectiveness of the management measures implemented and the requirement for any additional management measures. | Contingency Plan implemented (with regard to the specific circumstances of the subsidence impact). In summary:  
- The observation will be reported to the Underground Technical Manager or the Environmental and Community Manager within 24 hours.  
- The observation will be recorded in the Subsidence Impact Register.  
- The exceedance or likely exceedance will be reported in an incident report.  
- An investigation will be conducted to identify and evaluate contributing factors to the exceedance.  
- An appropriate course of action will be developed in consultation with relevant stakeholders and government agencies.  
- The course of action will be approved by, and implemented to the satisfaction of, relevant stakeholders and government agencies.  
- The Built Features Management Plan – Mid-Western Regional Council and the performance indicators will be reviewed to adequately manage future potential impacts. |
| Frequency | Prior to commencement of extraction of Longwall 101. | | To be implemented as required (i.e. if monitoring identifies impacts that are greater than predicted, but the performance measure has not been exceeded and is not likely to be exceeded). | To be implemented following identification of an exceedance of the performance measure, or if the performance measure is likely to be exceeded (i.e. unsafe or loss of serviceability). |
MWR – General Manager (or delegate). | Underground Technical Manager.  
MWR – General Manager (or delegate). | Underground Technical Manager.  
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MWR – General Manager (or delegate). |
ATTACHMENT 3

UG1 LONGWALLS 101 TO 103
BUILT FEATURES MANAGEMENT PLAN – MID-WESTERN REGIONAL COUNCIL
SUBSIDENCE IMPACT REGISTER
# UG1 Longwalls 101 to 103 Built Features Management Plan – Mid-Western Regional Council

## Subsidence Impact Register

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## Document Information

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