# Revision Status Register

<table>
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<tr>
<th>Section/Page/Annexure</th>
<th>Revision Number</th>
<th>Amendment/Addition</th>
<th>Distribution</th>
<th>DP&amp;E Approval Date</th>
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<tr>
<td>All</td>
<td>LW301-303</td>
<td>Original – Draft for Consultation</td>
<td>TransGrid, DRG and DP&amp;E</td>
<td>-</td>
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<tr>
<td>Sections 4.2.3, 7.2 &amp; 9.1 and Tables 6, 9 &amp; 10</td>
<td>LW301-303</td>
<td>Revised – Incorporating Table 9 and updates</td>
<td>TransGrid</td>
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<tr>
<td>Sections 4.2.2 &amp; 9.1, Table 6 and Figure 4</td>
<td>LW301-303</td>
<td>Revised – Incorporating TransGrid edits (email 2 Nov 16)</td>
<td>TransGrid, DRG and DP&amp;E</td>
<td>11 May 2017*</td>
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<td>Section 7.3.2, Tables 2, 8 &amp; 12 and Appendix 3</td>
<td>LW301-303</td>
<td>Revised – Addressing DP&amp;E and DRG requirements</td>
<td>TransGrid</td>
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<td>Section 6.1 and Tables 8 &amp; 11</td>
<td>LW301-303</td>
<td>Revised – Incorporating TransGrid edits (email 26 Jun 17)</td>
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<tr>
<td>All</td>
<td>LW301-303</td>
<td>Revised TARP, Revised for LW 303</td>
<td>TransGrid and DRG</td>
<td>8 November 2018#</td>
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<tr>
<td>All</td>
<td>BFMP_TRA-R01-G</td>
<td>Inclusion of Longwall 304 into BFMP</td>
<td>TransGrid</td>
<td>-</td>
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</table>

* The approval allows for the extraction of Longwalls 301 and 302 only.

# Approval for the extraction of Longwall 303.

April 2019
TABLE OF CONTENTS

1 INTRODUCTION 1
   1.1 PURPOSE AND SCOPE 1
   1.2 STRUCTURE OF THE BFMP-TRA 1
2 BFMP-TRA REVIEW AND UPDATE 6
   2.1 DISTRIBUTION REGISTER 6
3 STATUTORY REQUIREMENTS 7
   3.1 EP&A ACT APPROVAL 7
   3.2 LICENCES, PERMITS AND LEASES 9
   3.3 OTHER LEGISLATION 9
4 REVISED ASSESSMENT OF POTENTIAL ENVIRONMENTAL CONSEQUENCES 10
   4.1 EXTRACTION LAYOUT 10
      4.1.1 TransGrid Assets 10
   4.2 REVISED SUBSIDENCE AND IMPACT PREDICTIONS 12
      4.2.1 Revised Subsidence Predictions 12
      4.2.2 Risk Assessment Meeting 14
      4.2.3 TransGrid Impact Assessment 15
   4.3 UNDERGROUND BLAST VIBRATION IMPACTS 15
5 PERFORMANCE MEASURES AND INDICATORS 16
6 BASELINE DATA 16
   6.1 KEY CONTACTS LIST 17
7 MONITORING 17
   7.1 SUBSIDENCE PARAMETERS 21
   7.2 SPECIFIC MONITORING FOR TOWERS TL11-104 TO TL11-108 21
   7.3 SUBSIDENCE IMPACTS 24
      7.3.1 Towers and Transmission Line 24
      7.3.2 Access Roads/Tracks 24
   7.4 ENVIRONMENTAL CONSEQUENCES 25
8 MANAGEMENT MEASURES 25
9 CONTINGENCY PLAN 26
   9.1 CONTINGENCY MEASURES 27
10 TARP – MANAGEMENT TOOL 28
11 FUTURE EXTRACTION PLANS 32
12 ANNUAL REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE 32
13 INCIDENTS 32
14 COMPLAINTS 33
15 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS 34
16 REFERENCES 35
LIST OF TABLES

Table 1 Management Plan Requirements
Table 2 Provisional Extraction Schedule
Table 3 Transmission Towers Distance to Longwalls 301-304
Table 4 Total Subsidence Predictions for the Transmission Line After Longwalls 301-304
Table 5 Total Subsidence Predictions for the Towers After Longwalls 301-304
Table 6 Program for Implementation of Proposed Risk Control Measures and Procedures
Table 7 List of Key Contacts
Table 8 BFMP-TRA Monitoring Program Overview
Table 9 Monitoring Program Specific to Towers TL11-104 to TL11-108
Table 10 Contingency Measures – Towers and Transmission Lines
Table 11 BFMP-TRA Trigger Action Response Plan

LIST OF PLATES

Plate 1 330 kV Transmission Tower

LIST OF FIGURES

Figure 1 Longwalls 20-27 and Longwalls 301-317 Layout
Figure 2 Longwalls 301-304 Layout
Figure 3 Longwalls 20-27 and Longwalls 301-317 Layout – Aerial Photograph
Figure 4 Environmental Management Structure
Figure 5 TransGrid Assets
Figure 6 Subsidence Monitoring Layout

LIST OF APPENDICES

Appendix 3 Built Features Management Plan – Subsidence Impact Register
Appendix 4 Contingency Plan Procedure and Decision Tree
1 INTRODUCTION

Metropolitan Coal is a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (Peabody). Metropolitan Coal was granted approval for the Metropolitan Coal Project (the Project) under section 75J of the New South Wales (NSW) Environmental Planning and Assessment Act, 1979 (EP&A Act) on 22 June 2009. A copy of the Project Approval is available on the Peabody website (http://www.peabodyenergy.com).

The Project comprises the continuation, upgrade and extension of underground coal mining operations (Longwalls 20-27 and Longwalls 301-317) and surface facilities at Metropolitan Coal. The underground mining longwall layout is shown on Figure 1. Following the completion of Longwall 27 in 2017, Longwalls 301, 302, 303 and 304 define the next mining sub-domains within the Project underground mining area (Figures 1 to 3).

1.1 PURPOSE AND SCOPE

In accordance with Condition 6(f), Schedule 3 of the Project Approval, this Built Features Management Plan – TransGrid (BFMP-TRA) has been developed to manage the potential consequences of longwall extraction on the TransGrid assets.

The relationship of this BFMP-TRA to the Metropolitan Coal Environmental Management Structure and to the Metropolitan Coal Longwalls 301-304 Extraction Plan is shown on Figure 4.

In accordance with Condition 6, Schedule 3 of the Project Approval, the suitably qualified and experienced experts that have prepared this BFMP-TRA, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and Metropolitan Coal were endorsed by the Director-General (now Secretary) of the Department of Planning (DP&E). This BFMP-TRA has been prepared in consultation with TransGrid, including consideration of prior consultation during the development of the previously approved Built Features Management Plans.

1.2 STRUCTURE OF THE BFMP-TRA

The remainder of the BFMP-TRA is structured as follows:

Section 2: Describes the review and update of the BFMP-TRA.
Section 3: Outlines the statutory requirements applicable to the BFMP-TRA.
Section 4: Provides a revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 301-304.
Section 5: Details the performance measures and indicators that will be used to assess the Project.
Section 6: Provides the detailed baseline data.
Section 7: Describes the monitoring program.
Section 8: Describes the management measures that will be implemented.
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.
Figure 1

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Legend:
- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area
- Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
Figure 2

LEGEND
- **Mining Lease Boundary**
- **Woronora Special Area**
- **Project Underground Mining Area**
- **Woronora Notification Area**
- **Existing Underground Access Drive (Main Drift)**
- **Vehicular Track**
- **Longwalls 20-27 and 301-317 Longwall 304 Secondary Extraction**
- **35° Angle of Draw and/or Predicted 20 mm Subsidence Contour**
- **600 m from Secondary Extraction of Longwall 304**

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)
Figure 3
Longwalls 20-27 and Longwalls 301-317 Layout - Aerial Photograph

LEGEND
- Mining Lease Boundary
- Railway
- Project Underground Mining Area
- Longwalls 20-27 and 301-317
- Longwall 304 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwall 304
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Date of Aerial Photography 1998;
Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)
Section 11: Describes the program to collect sufficient baseline data for future Extraction Plans.

Section 12: Describes the annual review and improvement of environmental performance.

Section 13: Outlines the management and reporting of incidents.

Section 14: Outlines the management and reporting of complaints.

Section 15: Outlines the management and reporting of non-compliances with statutory requirements.

Section 16: Lists the references cited in this BFMP-TRA.

2 BFMP-TRA REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, the BFMP-TRA will be reviewed within three months of the submission of:

- an audit under Condition 8 of Schedule 7;
- an incident report under Condition 6 of Schedule 7;
- an annual review under Condition 3 of Schedule 7; and

if necessary, revised to the satisfaction of the Director-General (now 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.

This BFMP will also be reviewed within three months of approval of any Project modification and if necessary, revised to the satisfaction of the DP&E.

The revision status of this plan is indicated on the title page of each copy of the BFMP-TRA. The distribution register for controlled copies of the BFMP-TRA is described in Section 2.1.

Revisions to any documents listed within this BFMP-TRA will not necessarily constitute a revision of this document.

2.1 DISTRIBUTION REGISTER

In accordance with Condition 10, Schedule 7 ‘Access to Information’, Metropolitan Coal will make the BFMP-TRA publicly available on the Peabody website. A hard copy of the BFMP-TRA will also be maintained at the Metropolitan Coal site.

Metropolitan Coal recognises that various regulators have different distribution requirements, both in relation to whom documents should be sent and in what format. An Environmental Management Plan and Monitoring Program Distribution Register has been established in consultation with the relevant agencies and infrastructure owners that indicates:

- to whom the Metropolitan Coal plans and programs, such as the BFMP-TRA, will be distributed;
- the format (i.e. electronic or hard copy) of distribution; and
- the format of revision notification.

Metropolitan Coal will make the Distribution Register publicly available on the Peabody website.
Metropolitan Coal will be responsible for maintaining the Distribution Register and for ensuring that the notification of revisions is sent by email or post as appropriate.

In addition, Metropolitan Coal employees with local computer network access will be able to view the controlled electronic version of this BFMP-TRA on the Metropolitan Coal local area network. Metropolitan Coal will not be responsible for maintaining uncontrolled copies beyond ensuring the most recent version is maintained on Metropolitan Coal’s computer system and the Peabody website.

3 STATUTORY REQUIREMENTS

Metropolitan Coal’s statutory obligations are contained in:

(i) the conditions of the Project Approval;
(ii) relevant licences and permits, including conditions attached to mining leases; and
(iii) other relevant legislation.

These are described below.

3.1 EP&AACT APPROVAL

Condition 6(f), Schedule 3 of the Project Approval requires the preparation of a BFMP as a component of Extraction Plan(s) for second workings. Project Approval Condition 6(f), Schedule 3 states:

SECOND WORKINGS

Extraction Plan

6. The Proponent shall prepare and implement an Extraction Plan for all second workings in the mining area to the satisfaction of the Director-General. This plan must:

... 
(f) include a:

... 
- Built Features Management Plan, which has been prepared in consultation with the owner of the relevant feature, to manage the potential environmental consequences of the Extraction Plan on any built features;

In addition, Condition 2, Schedule 7 and Condition 7, Schedule 3 of the Project Approval outline management plan requirements that are applicable to the preparation of the BFMP-TRA. Table 1 indicates where each component of the conditions is addressed within this BFMP-TRA.
### Table 1
Management Plan Requirements

<table>
<thead>
<tr>
<th>Project Approval Condition</th>
<th>BFMP-TRA Section</th>
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<tbody>
<tr>
<td><strong>Condition 2 of Schedule 7</strong></td>
<td></td>
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<tr>
<td>2. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</td>
<td></td>
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<tr>
<td>a) detailed baseline data;</td>
<td>Section 6</td>
</tr>
<tr>
<td>b) a description of:</td>
<td></td>
</tr>
<tr>
<td>• the relevant statutory requirements (including any relevant approval, licence or lease conditions);</td>
<td>Section 3</td>
</tr>
<tr>
<td>• any relevant limits or performance measures/criteria;</td>
<td>Section 5</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>Section 5</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>Sections 7, 8, 9 and 10</td>
</tr>
<tr>
<td>d) a program to monitor and report on the:</td>
<td>Sections 7, 8 and 12</td>
</tr>
<tr>
<td>• impacts and environmental performance of the project;</td>
<td></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>Section 9 and Appendix 4</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 7 and 12</td>
</tr>
<tr>
<td>g) a protocol for managing and reporting any:</td>
<td>Section 13</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 9 and Appendix 4</td>
</tr>
<tr>
<td>• exceedances of the impact assessment criteria and/or performance criteria; and</td>
<td></td>
</tr>
<tr>
<td>h) a protocol for periodic review of the plan.</td>
<td>Section 2</td>
</tr>
<tr>
<td><strong>Condition 7 of Schedule 3</strong></td>
<td></td>
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<tr>
<td>7. In addition to the standard requirements for management plans (see condition 2 of schedule 7), the Proponent shall ensure that the management plans required under condition 6(f) above include:</td>
<td></td>
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<tr>
<td>a) a program to collect sufficient baseline data for future Extraction Plans;</td>
<td>Section 11</td>
</tr>
<tr>
<td>b) a revised assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;</td>
<td>Section 4</td>
</tr>
<tr>
<td>c) a detailed description of the measures that would be implemented to remediate predicted impacts; and</td>
<td>Section 8</td>
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<tr>
<td>d) a contingency plan that expressly provides for adaptive management.</td>
<td>Section 9 and Appendix 4</td>
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</table>
3.2 LICENCES, PERMITS AND LEASES

In addition to the Project Approval, all activities at or in association with the Metropolitan Coal Mine will be undertaken in accordance with the following licences, permits and leases which have been issued or are pending issue:

- The conditions of mining leases issued by the NSW Division of Resources and Geoscience (DRG), under the NSW Mining Act, 1992 (e.g. Consolidated Coal Lease [CCL] 703, Mining Lease [ML] 1610, ML 1702, Coal Lease [CL] 379 and Mining Purpose Lease [MPL] 320).
- The Metropolitan Coal Mining Operations Plan 1 October 2012 to 30 September 2019 approved by the DRG.
- The conditions of Environment Protection Licence (EPL) No. 767 issued by the NSW Environment Protection Authority (EPA) under the NSW Protection of the Environment Operations Act, 1997. Revision of the EPL will be required prior to the commencement of Metropolitan Coal activities that differ from those currently licensed.
- The prescribed conditions of specific surface access leases within CCL 703 for the installation of surface facilities as required.
- Water Access Licences (WALs) issued by the NSW Department of Primary Industries – Water (now the Department of Industry – Water) under the NSW Water Management Act, 2000, including WAL 36475 under the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 and WAL 25410 under the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011.
- Mining and workplace health and safety related approvals granted by the NSW Resources Regulator and WorkCover NSW.
- Supplementary approvals obtained from WaterNSW for surface activities within the Woronora Special Area (e.g. fire road maintenance activities).

3.3 OTHER LEGISLATION

Metropolitan Coal will conduct the Project consistent with the Project Approval 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 the conduct of the Project (Helensburgh Coal Pty Ltd [HCPL], 2008)1:

- Biodiversity Conservation Act, 2016;
- Biosecurity Act, 2015;
- Contaminated Land Management Act, 1997;
- Crown Land Management Act, 2016;
- Dams Safety Act, 2015;
- Dangerous Goods (Road and Rail Transport) Act, 2008;
- Energy and Utilities Administration Act, 1987;
- Fisheries Management Act, 1994;

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1 The list of potentially applicable Acts has been updated to reflect changes to the Acts that were in force at the time of submission of the Metropolitan Coal Project Environmental Assessment (Project EA) (HCPL, 2008).
Mining Act, 1992;
Protection of the Environment Operations Act, 1997;
Rail Safety (Adoption of National Law) Act, 2012;
Roads Act, 1993;
Water Act, 1912;
Water Management Act, 2000;
Water NSW Act, 2014;
Work Health and Safety Act, 2011; and

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

4 REVISED ASSESSMENT OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

4.1 EXTRACTION LAYOUT

Longwalls 301-304 and the area of land within 600 metres (m) of Longwall 304 secondary extraction are shown on Figures 2 and 3. Longwall extraction occurs from north to south. The longwall layouts include 163 m panel widths (void) with 45 m pillars (solid).

The provisional extraction schedule for Longwalls 301-304 is provided in Table 2.

Table 2
Provisional Extraction Schedule

<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>301</td>
<td>June 2017</td>
<td>6 months</td>
<td>February 2018</td>
</tr>
<tr>
<td>302</td>
<td>March 2018</td>
<td>7 months</td>
<td>October 2018</td>
</tr>
<tr>
<td>303</td>
<td>November 2018</td>
<td>7 months</td>
<td>May 2019</td>
</tr>
<tr>
<td>304</td>
<td>July 2019</td>
<td>6 months</td>
<td>December 2019</td>
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</table>

The future Extraction Plans will consider the cumulative subsidence effects, subsidence impacts and/or environmental consequences. Note that the total cumulative predicted subsidence effects, subsidence impacts and/or environmental consequences at the completion of the Project are considered in the Metropolitan Coal Project Environmental Assessment (Project EA) (HCPL, 2008) and the Preferred Project Report (HCPL, 2009).

4.1.1 TransGrid Assets

Figure 5 illustrates the TransGrid 330 kilovolt (kV) transmission line and towers. The 330 kV transmission line is composed of:

- Transmission (suspension) towers (field numbers TL11-104 to TL11-108) located to the east of the study area for Longwall 304; and
- Dapto to Sydney South 330 kV Transmission Line (Feeder number 11).
There are no tension towers within the Study area for Longwall 304. The transmission line is 670 m from Longwall 304 at its nearest point.

The 330 kV transmission line and towers are located to the east of Longwalls 301-304 and the longwall will not pass beneath these electrical services. There are five towers located near the 35 degree angle of draw and/or predicted 20 mm subsidence line around Longwall 304 as shown on Drawing No. MSEC1013-02 (Figure 5). The distances from the towers to the nearest longwalls are summarised in Table 3 below.

**Table 3**

<table>
<thead>
<tr>
<th>Tower Number</th>
<th>Tower Type</th>
<th>Approximate Distance to Longwall 301 (m)</th>
<th>Approximate Distance to Longwall 304 (m)</th>
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<tr>
<td>TL11-104</td>
<td>Suspension</td>
<td>50</td>
<td>680</td>
</tr>
<tr>
<td>TL11-105</td>
<td>Suspension</td>
<td>50</td>
<td>670</td>
</tr>
<tr>
<td>TL11-106</td>
<td>Suspension</td>
<td>70</td>
<td>680</td>
</tr>
<tr>
<td>TL11-107</td>
<td>Suspension</td>
<td>70</td>
<td>690</td>
</tr>
<tr>
<td>TL11-108</td>
<td>Suspension</td>
<td>195</td>
<td>700</td>
</tr>
</tbody>
</table>

**4.2 REVISED SUBSIDENCE AND IMPACT PREDICTIONS**

**4.2.1 Revised Subsidence Predictions**

Subsidence predictions for Longwalls 20-44 in relation to the TransGrid assets was conducted by MSEC (2008) as part of the Metropolitan Coal Project EA. MSEC (2008) includes a table summarising the incremental systematic subsidence parameters for the extraction of each longwall from Longwalls 20-44. These include:

- maximum predicted incremental subsidence (vertical movement);  
- maximum predicted incremental tilt along alignment;  
- maximum predicted incremental tilt across alignment;  
- maximum predicted incremental tensile strain; and  
- maximum predicted incremental compressive strain.

Revised subsidence and impact predictions for the extraction of Longwalls 301-303 on TransGrid assets were conducted by MSEC and reported in MSEC (2016) (Appendix 1) and again for Longwall 304 MSEC (2019) (Appendix 2). The maximum predicted total systematic subsidence parameters in relation to the transmission lines for the extraction of Longwalls 301-304 is shown in Table 4. The maximum predicted total systematic subsidence parameters at the transmission towers for the extraction of Longwalls 301-304 is shown in Table 5.
Table 4
Total Subsidence Predictions for the Transmission Line After Longwalls 301-304

<table>
<thead>
<tr>
<th>Longwall</th>
<th>Maximum Predicted Total Subsidence (mm)</th>
<th>Maximum Predicted Total Tilt along Alignment (mm/m)</th>
<th>Maximum Predicted Total Tilt across Alignment (mm/m)</th>
</tr>
</thead>
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<tr>
<td>After LW301</td>
<td>60</td>
<td>&lt;0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>After LW302</td>
<td>110</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>After LW303</td>
<td>140</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>After LW304&lt;sup&gt;2&lt;/sup&gt;</td>
<td>140</td>
<td>0.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: Table 3 in MSEC (2016) (Appendix 1) and MSEC (2019).
Mm = millimetres.
Mm/m = millimetres per metre.

Table 5
Total Subsidence Predictions for the Towers After Longwalls 301-304

<table>
<thead>
<tr>
<th>Field Tower</th>
<th>Maximum Predicted Total Subsidence (mm)</th>
<th>Maximum Predicted Total Tilt along Alignment at Base of the Tower (mm/m) [+ve north; -ve south]</th>
<th>Maximum Predicted Total Tilt across Alignment at Base of the Tower (mm/m) [+ve east; -ve west]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>After LW301</td>
<td>After LW302</td>
<td>After LW303</td>
</tr>
<tr>
<td>TL11-104</td>
<td>&lt;20</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>TL11-105</td>
<td>40</td>
<td>100</td>
<td>125</td>
</tr>
<tr>
<td>TL11-106</td>
<td>30</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>TL11-107</td>
<td>30</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>TL11-108</td>
<td>&lt;20</td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: Tables 4 and 5 in MSEC (2016) (Appendix 1) and MSEC (2019).

The maximum predicted subsidence of 125 mm and total tilt of 1.0 mm/m both occur at Tower TL11-105 after the extraction of Longwall 303. The maximum predicted horizontal movement at the top of the towers (i.e. T11-105) is -60 mm orientated to the west (towards the longwalls).

Revised subsidence and impact predictions for the extraction of Longwall 304 on TransGrid assets were conducted by MSEC and reported in MSEC (2019) (Appendix 2). In summary:

- The transmission line is not expected to experience measurable conventional vertical subsidence, tilts or curvatures due to the extraction of Longwall 304.
- The transmission towers could experience low level far-field horizontal movement. The far-field horizontal movements are expected to be similar to those observed for previous longwall mining in the Southern Coalfield, which tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain.
- It is considered unlikely that the transmission lines would experience adverse impacts as a result of predicted movements due to the extraction of Longwall 304.

<sup>2</sup> After Longwall 303 the transmission line is not expected to experience further measurable conventional subsidence, tilts or curvatures due to the extraction Longwall 304.
<sup>3</sup> After Longwall 303 the transmission towers are not expected to experience further measurable conventional subsidence, tilts or curvatures due to the extraction Longwall 304.
### 4.2.2 Risk Assessment Meeting

In accordance with the *Guidelines for the Preparation of Extraction Plans* (DP&E and DRE, 2015) a risk assessment meeting for Longwalls 301-303 was held on 26 August 2016. Attendees at the risk assessment meeting included representatives from Metropolitan Coal, TransGrid, MSEC, Resource Strategies and Axys Consulting (risk assessment facilitator).

The investigation and analysis methods used during the risk assessment included:

- preliminary identification of TransGrid assets;
- review of the revised subsidence predictions and potential impacts on TransGrid assets (including consideration of past experience in the Southern Coalfield); and
- development of a preliminary monitoring plan.

A number of risk control measures and procedures were identified and implemented during the risk assessment which considered the extraction of coal beneath the land within the Study area and in proximity to the TransGrid assets.

The risk control measures and procedures identified during the risk assessment for Longwalls 301-303 will be implemented and continued for the extraction of Longwall 304. The transmission line is not predicted to experience measurable conventional vertical subsidence, tilts or curvatures due to the extraction of Longwall 304.

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

The proposed risk control measures and procedures have been incorporated where relevant in this BFMP and the program for implementation is summarised in Table 6.

#### Table 6

**Program for Implementation of Proposed Risk Control Measures and Procedures**

<table>
<thead>
<tr>
<th>Risk Control Measure / Procedure</th>
<th>BFMP Section</th>
<th>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 / baseline audit of the TransGrid assets (i.e. 330 kV transmission line and towers) in the Study area</td>
<td>Section 6</td>
<td>Complete</td>
</tr>
<tr>
<td>2 Conduct a visual inspection of the access roads/tracks to the TransGrid assets</td>
<td>Section 7.3.2</td>
<td>Complete</td>
</tr>
<tr>
<td><strong>Management / Monitoring / Response Measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Establish key contacts list in the BFMP</td>
<td>Section 6.1</td>
<td>Complete</td>
</tr>
<tr>
<td>4 Include a schedule of times/frequency of communication with TransGrid for the status of mining of Longwalls 301-303 in the BFMP</td>
<td>Sections 7 and 10 / Table 2</td>
<td>Complete</td>
</tr>
<tr>
<td>5 Provide indicative timeframes in the BFMP when the survey monitoring is carried out and information is provided to TransGrid</td>
<td>Section 7.3.1</td>
<td>Complete</td>
</tr>
<tr>
<td>6 Provide an indicative timeframe for the implementation of real-time monitoring for the towers</td>
<td>Section 7.3.1</td>
<td>Complete</td>
</tr>
<tr>
<td>7 Include in the BFMP, increased monitoring frequency to be implemented from the commencement of extraction of Longwall 301 with focus on the first tower(s) that may be affected (TL11-107 and TL11-108)</td>
<td>Section 7 / Table 8</td>
<td>Complete</td>
</tr>
<tr>
<td>8 Include in the TARP triggers for conditions that may need to be actioned by TransGrid</td>
<td>Section 10 / Table 11</td>
<td>Complete</td>
</tr>
<tr>
<td>9 Include in the BFMP relevant details regarding the potential for underground blast vibration impacts at the surface</td>
<td>Section 4.3</td>
<td>Complete</td>
</tr>
</tbody>
</table>
Table 6 (Continued)
Program for Implementation of Proposed Risk Control Measures and Procedures

<table>
<thead>
<tr>
<th>Risk Control Measure / Procedure</th>
<th>BFMP Section</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 TransGrid to confirm if any maintenance activities or capital works are scheduled for the towers within the Study area during the extraction of Longwall 301-303</td>
<td>Section 4.2.3</td>
<td>As required</td>
</tr>
</tbody>
</table>

Contingency Planning

<table>
<thead>
<tr>
<th>Risk Control Measure / Procedure</th>
<th>BFMP Section</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Undertake preliminary design works for contingency measures. This may include the opportunity to purchase/obtain emergency tower structures that could be used as a contingency</td>
<td>Section 9.1 Complete</td>
<td></td>
</tr>
<tr>
<td>12 TransGrid to determine where emergency towers could be installed in the Study area if required as a contingency</td>
<td>Section 9.1 Complete</td>
<td></td>
</tr>
</tbody>
</table>

4.2.3 TransGrid Impact Assessment

TransGrid carried out an assessment of the impacts of the predicted subsidence on the 330 kV transmission line and towers based on MSEC (2016) predictions. In summary:

- Cruciforms are not necessary.
- Conductor sheaves are not necessary.
- Earthwire sheaves are not necessary.
- Survey monitoring is necessary for towers legs.

TransGrid will inform Metropolitan Coal if any maintenance activities and/or capital works are scheduled for the towers within the Study area.

4.3 UNDERGROUND BLAST VIBRATION IMPACTS

Use of explosives is not required for existing or proposed general underground coal mining. Occasionally, geological structures (e.g. dykes) may be encountered underground that have to be broken up using very low mass explosives. This underground blasting would be undertaken at significant depth (e.g. greater than 400 m below the surface).

Ground vibration and airblast levels which cause human discomfort are generally lower than the recommended structural damage limits. Therefore, compliance with the lowest applicable human comfort criteria ensures that the potential to cause structural damage is minimal. Based on the assessment results presented in the Metropolitan Coal Project Noise Impact Assessment (Heggies, 2008), ground vibration levels are predicted to meet the most stringent night-time criteria of 1 mm/s at a distance of 500 m from the blast site. As blasting is conducted at least 400 m below the surface, vibration impacts are likely to be minimal (which is consistent with the existing Metropolitan Colliery blasting practices and experience).
5 PERFORMANCE MEASURES AND INDICATORS

The Project Approval requires Metropolitan Coal not to exceed the subsidence impact performance measures outlined in Table 1 of Condition 1, Schedule 3. The subsidence impact performance measure specified in Table 1 of Condition 1, Schedule 3 in relation to built features is:

Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing.

The performance indicators proposed to ensure that the above performance measure is achieved include:

- the structural integrity of the transmission line and towers is maintained;
- the electrical clearance from vegetation is maintained; and
- the serviceability of the access roads/tracks is maintained.

Section 7 of this BFMP-TRA describes the monitoring that will be conducted to assess the Project against the above performance measure. Section 9 of this BFMP-TRA provides a Contingency Plan in the event the performance measure is exceeded.

6 BASELINE DATA

A photograph of a 330 kV transmission tower is shown in Plate 1.

Plate 1 – 330 kV Transmission Tower (Source: MSEC, 2016)

A site inspection of the 330 kV line was conducted prior to commencement of secondary extraction of Longwall 301 to establish the condition of the line. The inspection included:

- recording of existing structure conditions;
- two dimensional image records of the affected structures; and
- condition of the access road/tracks with specific attention to surface cracks.
6.1 KEY CONTACTS LIST

The list of key contacts for Peabody and TransGrid during the development and implementation of this BFMP are provided in Table 7.

<table>
<thead>
<tr>
<th>Company</th>
<th>Position</th>
<th>Contact</th>
</tr>
</thead>
</table>
| Peabody (Metropolitan Coal) | Manager – Technical Services  
Jon Degotardi | Metropolitan 24hr Control Room  
02 4294 7333 |
| TransGrid                | Proposal Manager  
John Psarologos | Transgrid 24hr Contact  
1800 027 253  
Transgrid General Enquiry  
02 9284 3000 |

If an emergency situation arises and alternative supply is required, the following TransGrid stakeholders would be notified:

- TransGrid System Operation  
  - phone: 02 9620 0102;  
  - email: system.operator@transgrid.com.au
- TransGrid Maintenance Group  
  - phone: 02 9620 0350;  
  - email: TransmissionLinesandEasementsMaintenance@transgrid.com.au

7 MONITORING

A monitoring program has been implemented to monitor the impacts of the Project on the 330 kV transmission line and access roads/tracks as determined in consultation with TransGrid. Table 8 summarises the BFMP-TRA monitoring components.

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

TransGrid or their delegates will conduct the various visual inspections. Metropolitan Coal will be notified of the timing of inspections and accompany TransGrid or delegates if considered necessary. All personnel will complete necessary inductions or orientation relevant to the tasks required.

The frequency of monitoring will be reviewed either:

- in accordance with the Annual Review outlined in Section 12; or
- if triggered as a component of the Contingency Plan as outlined in Section 9 of this BFMP-TRA.
<table>
<thead>
<tr>
<th>Program</th>
<th>Aspect</th>
<th>Method</th>
<th>How</th>
<th>Why</th>
<th>Timing</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Towers (TL11-104 to TL11-108)</td>
<td>Relative Survey</td>
<td>4 x ground points outside each leg for each tower</td>
<td>Establish base conditions</td>
<td>Prior to Longwalls 301 and 304 extraction</td>
<td>Twice</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 x tower leg mounted prisms for each tower</td>
<td>Establish base condition</td>
<td>Prior to Longwalls 301 and 304 extraction</td>
<td>Twice</td>
</tr>
<tr>
<td></td>
<td>Condition Report (recording of existing structure conditions and two-dimensional image records of structures)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Twice</td>
</tr>
<tr>
<td></td>
<td>Transmission Line (between TL11-104 to TL11-108)</td>
<td>Survey</td>
<td>Whole line between TL11-104 to TL11-108</td>
<td>Establish base conditions (including clearance heights for roads, land and vegetation)</td>
<td>Prior to Longwalls 301 and 304 extraction</td>
<td>Twice</td>
</tr>
<tr>
<td></td>
<td>Access roads/tracks</td>
<td>Visual inspection (including notes on general condition of access roads/tracks)</td>
<td></td>
<td>Establish base condition</td>
<td>Prior to Longwall 301 and 304 extraction</td>
<td>Twice</td>
</tr>
<tr>
<td>During Mining</td>
<td>Towers (TL11-104 to TL11-108)</td>
<td>Relative Survey</td>
<td>4 x ground points outside each leg for each tower</td>
<td>Monitor subsidence effects during mining (subsidence, tilt, strain, absolute horizontal translation)</td>
<td>LW301-302</td>
<td>LW301-302 Weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>At each tower within 400 m of the active longwall face until subsidence negligible</td>
<td></td>
<td>LW303-304 Outside 400 m zone at each tower monthly during extraction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 x tower leg mounted prisms for each tower</td>
<td>Monitor subsidence effects during mining (differential leg movement)</td>
<td>LW301-302</td>
<td>LW301-302 Weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>At each tower within 400 m of the active longwall face until subsidence negligible</td>
<td></td>
<td>LW303-304 Outside 400 m zone at each tower monthly during extraction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Earth wire peak point for each tower</td>
<td>Monitor subsidence effects during mining (tilt, absolute horizontal translation)</td>
<td>LW301-302</td>
<td>LW301-302 Weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>At each tower within 400 m of the active longwall face until subsidence negligible</td>
<td></td>
<td>LW303-304 Outside 400 m zone at each tower monthly during extraction</td>
</tr>
</tbody>
</table>
Table 8 (Continued)
BFMP-TRA Monitoring Program Overview

<table>
<thead>
<tr>
<th>Program</th>
<th>Aspect</th>
<th>Method</th>
<th>How</th>
<th>Why</th>
<th>Timing</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>During Mining (Cont.)</td>
<td>Towers (TL11-104 to TL11-108) (Cont.)</td>
<td>Visual inspection</td>
<td>Field notes and observations recorded by surveyors</td>
<td>Monitor for evidence of subsidence effects on Towers including any observable surface deformations (e.g. degradation of foundations/footings) or other subsidence related effects (noted quantitatively in regards width, length, orientation)</td>
<td>At each tower within 400 m of the active longwall face until subsidence negligible</td>
<td>Weekly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LW301-302 Weekly</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LW303-304 End of panel</td>
<td></td>
</tr>
<tr>
<td>Visual inspection</td>
<td>(TransGrid)</td>
<td>Visual check by TransGrid of earth wire/ optical ground wire (OPGW), and for any conductor movement or impact on integrity and function of support clamps.</td>
<td>At any time in case of fault or emergency</td>
<td></td>
<td>LW301-302 Weekly</td>
<td></td>
</tr>
<tr>
<td>Transmission Lines</td>
<td>Survey</td>
<td>± 10 points either side of each tower</td>
<td>Monitor subsidence effects during mining (subsidence, tilt, absolute horizontal translation)</td>
<td>LW301-302 At each tower within 400 m of the active longwall face until subsidence negligible</td>
<td>LW303-304 End of panel</td>
<td></td>
</tr>
<tr>
<td>(between TL11-104 to TL11-108)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LW301-302 Weekly</td>
<td></td>
</tr>
<tr>
<td>Visual inspection</td>
<td>Field notes and observations recorded by surveyors</td>
<td>Visual check by TransGrid of earth wire/ optical ground wire (OPGW), and for any conductor movement or impact on integrity and function of support clamps.</td>
<td>At any time in case of fault or emergency</td>
<td></td>
<td>LW301-302 Weekly</td>
<td></td>
</tr>
<tr>
<td>Access roads/tracks</td>
<td>Visual inspection</td>
<td>Field notes on general condition of access roads/tracks by surveyors</td>
<td>Monitor for surface cracks, buckling and general safety</td>
<td>At the completion of each longwall</td>
<td>Twice (once per Longwall 301 &amp; 302)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LW301-302 At each tower within 400 m of the active longwall face until subsidence negligible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>As per Longwall 304 LMP</td>
<td></td>
</tr>
</tbody>
</table>
Table 8 (Continued)
BFMP-TRA Monitoring Program Overview

<table>
<thead>
<tr>
<th>Program</th>
<th>Aspect</th>
<th>Method</th>
<th>How</th>
<th>Why</th>
<th>Timing</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Mining</td>
<td>Towers (TL11-104 to TL11-108)</td>
<td>Survey</td>
<td>4 x ground points outside each leg for each tower</td>
<td>Determine level of impact of mining</td>
<td>Within 3 months of the completion of Longwalls 302, 303 and 304</td>
<td>Once per longwall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 x tower leg mounted prisms for each tower</td>
<td>Determine level of impact of mining</td>
<td>Within 3 months of the completion of Longwalls 302, 303 and 304</td>
<td>Once per longwall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Earth wire peak point for each tower</td>
<td>Determine level of impact of mining</td>
<td>Within 3 months of the completion of Longwalls 302, 303 and 304</td>
<td>Once per longwall</td>
</tr>
<tr>
<td></td>
<td>Condition Report</td>
<td></td>
<td>Survey ± 10 points either side of each tower</td>
<td>Determine level of impact of mining</td>
<td>Within 3 months of the completion of Longwalls 302, 303 and 304</td>
<td>Once per longwall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Field notes on general condition of access roads/tracks by surveyors</td>
<td>Determine level of impact of mining</td>
<td>Within 3 months of the completion of Longwalls 302, 303 and 304</td>
<td>Once per longwall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Field notes on general condition of access roads/tracks by surveyors</td>
<td>Determine level of impact of mining</td>
<td>Within 3 months of the completion of Longwalls 302, 303 and 304</td>
<td>Once per longwall</td>
</tr>
</tbody>
</table>
7.1 SUBSIDENCE PARAMETERS

Subsidence parameters (i.e. subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation, and differential leg movement) associated with mining will be measured in accordance with the Longwall 304 Subsidence Monitoring Program (Figure 6).

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 the TransGrid 330 kV Transmission Line will be measured by a single survey line along the transmission corridor occupied by the transmission lines, and by survey of each tower (Towers TL11-104 to TL11-108).

The survey line within the transmission line corridor will consist of survey pegs or pins installed every 20 m (subject to terrain constraints) and measured by total station with a survey accuracy of ±20 mm.

7.2 SPECIFIC MONITORING FOR TOWERS TL11-104 TO TL11-108

The specific monitoring program developed in conjunction with TransGrid while mining near towers TL11-100 to TL11-102 has been extended to towers TL11-104 to TL11-108. This is detailed in Table 9.
### Table 9
Monitoring Program Specific to Towers TL11-103 to TL11-108

<table>
<thead>
<tr>
<th>Management Period</th>
<th>Monitoring</th>
<th>Trigger</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline studies prior to mining</td>
<td>• Survey of monitoring lines/points.</td>
<td>• Documentation of base conditions.</td>
<td>• Document and report to: TransGrid; and Principal Subsidence Engineer – Department of Industries.</td>
</tr>
<tr>
<td></td>
<td>• Survey of Tower legs (TL11-104 to TL11-108).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Earth Peaks Monitoring.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LW301-302 Mining within 400 m of towers:</td>
<td>Survey Monitoring</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>TL11-104</td>
<td>For each survey event at each tower carry out the following survey monitoring:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-105</td>
<td>• Survey 4 x ground monitoring points outside each leg.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-106</td>
<td>• Survey 4 x tower leg mounted prisms.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-107</td>
<td>• Survey the earth wire peak point.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-108</td>
<td>• For LW301-302 survey transmission line ± 10 points either side of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>tower being monitored.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Visual Monitoring</strong></td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For each survey event the surveyors will record on their field notes and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>provide in the weekly report the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Any observable surface deformations or other subsidence related effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>at the tower being surveyed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Any observable subsidence effects on the road accessing each tower.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Any observable effects will be noted quantitatively in regards width,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>length, orientation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LW303-304 Mining outside 400 m of towers:</td>
<td>• Separation between tower legs (4-8 mm); and/or</td>
<td>Orange</td>
<td></td>
</tr>
<tr>
<td>TL11-104</td>
<td>• Observable surface deformations at a tower.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-105</td>
<td>• Notify the following key stakeholders, as appropriate, within 24hrs of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-106</td>
<td>becoming aware of the trigger/s:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-107</td>
<td>- TransGrid; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TL11-108</td>
<td>- NSW Principal Subsidence Engineer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Red</strong></td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Separation between tower legs (&gt;8mm); and/or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Observable surface deformations at a tower.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Notify key stakeholders, as appropriate, immediately following awareness</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>of the trigger/s being met:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- TransGrid; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- NSW Principal Subsidence Engineer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Post mining</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Survey of monitoring lines/points.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Survey of Tower legs (TL11-104 to TL11-108).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Earth Peaks Monitoring.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Check against subsidence predictions and baseline survey.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Undertake relative 3D survey and review against predictions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Document actual subsidence against predictions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Report monitoring data to TransGrid.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Report NSW Principal Subsidence Engineer.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.3 SUBSIDENCE IMPACTS

7.3.1 Towers and Transmission Line

Visual inspections will be conducted of the towers and transmission line between Tower TL11-104 to TL11-108 inclusive in accordance with the TransGrid inspection program. This generally includes:

- annual inspection of the structure integrity sites from the ground;
- annual inspection of vegetation growth and electrical clearances from the air;
- six yearly climbing inspection; and
- fault and emergency patrols from either the air or ground at any time.

Audit / baseline inspections will occur prior to commencement of Longwall 301 and Longwall 304, and within three months of the completion of Longwalls 301-303 and Longwall 304. Weekly survey inspections will be conducted at each tower when the active longwall face is within 400 m of the tower until subsidence is negligible*. Monthly survey inspections will be conducted during extraction when greater than 400 m from the active longwall face. Additional observations of subsidence impacts will be conducted during routine works and recorded by surveyors during tower monitoring survey.

Specific details that will be noted and/or photographed include:

- the date of the inspection;
- the location of longwall extraction (i.e. the longwall chainage);
- assessment against the performance indicators and performance measure;
- whether any actions are required (e.g. initiation of the Contingency Plan, incident notification, implementation of appropriate safety controls, review of public safety, etc.); and
- any other relevant information.

The information will be recorded in the Built Features Management Plan - Subsidence Impact Register (Appendix 3) and reported in accordance with the Project Approval conditions.

Real-Time Monitoring Trial

In addition to the above monitoring, Metropolitan Coal is currently trialling the use of real-time survey monitoring at the towers as an additional management tool. Upon completion of the trial and subject to review of the trial outcomes (e.g. survey accuracy, trigger development, etc.), Metropolitan Coal will review and consider the continued use of real-time monitoring during the extraction of Longwalls 301-304.

7.3.2 Access Roads/Tracks

Visual inspection of the access roads/tracks to the TransGrid assets was undertaken prior to the commencement of Longwall 301, and will be conducted following extraction of each longwall panel (i.e. Longwalls 302-304).

Visual observations of access roads/tracks would occur as part of routine works and inspections within 600 m of Longwalls 301-304 secondary extraction as described in the Metropolitan Coal Longwall 304 Land Management Plan (Longwall 304 LMP).

---

* Survey information will be provided to TransGrid as soon as possible following completion of the weekly survey/inspection, and allowing for data entry/download and review (e.g. 24 hours) or as otherwise indicated in Table 9.
Specific details that will be noted and/or photographed that are relevant to the TransGrid access roads/tracks include:

- the location, approximate dimensions (length, width and depth), and orientation of surface tension cracks;
- the location of the surface tension crack in relation to the access road/track to the TransGrid asset;
- whether any actions are required (e.g. implementation of management measures as outlined in the Longwall 304 LMP, initiation of the Contingency Plan as outlined in the Longwall 304 LMP, incident notification, implementation of appropriate safety controls, review of public safety, etc.); and
- any other relevant information.

The date of the observation, details of the observer and the location of longwall extraction will also be documented.

The information obtained will be recorded in the Longwall 304 LMP - Subsidence Impact Register and reported in accordance with the Project Approval conditions.

The information obtained will be used to assess the potential environmental consequences of the subsidence impact (described in the Longwall 304 LMP) and to identify required management measures. Management measures are discussed in the Longwall 304 LMP.

In the event the subsidence impacts are deemed to present a safety hazard (i.e. regardless of the nature or extent of the subsidence impact), actions will be implemented in accordance with the Metropolitan Coal Longwall 304 Public Safety Management Plan.

7.4 ENVIRONMENTAL CONSEQUENCES

Metropolitan Coal and TransGrid will compare the results of the subsidence impact monitoring against the built features performance measure and indicators. In the event the observed subsidence impacts exceed the performance measure or indicators, Metropolitan Coal and TransGrid will assess the consequences of the exceedance in accordance with the Contingency Plan described in Section 9.

8 MANAGEMENT MEASURES

A number of potential management measures in relation to towers and transmission lines are considered to be applicable. These include:

- alteration of conductor tensions;
- install temporary structures;
- modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors; and
- strengthening of tower structures (e.g. through installation of cruciform footings).

The requirement for these management measures will be determined by TransGrid (Section 4.2.3) and if required, constructed prior to mining within 600 m of the towers.
Where significant subsidence impacts on access roads/tracks are detected (e.g. those that affect the serviceability) or at any time Metropolitan Coal, TransGrid or the landholder considers that the integrity of the access roads/tracks may be compromised, the following management measures would be applied. Where significant cracks are detected, the cracks would be repaired as soon as practicable in consultation with the landholder. This may include the use of earthmoving equipment if considered the most appropriate means of repair. Appropriate sedimentation controls will be implemented during repair works. Management measures for access roads/tracks will be implemented in accordance with the Longwall 304 Land Management Plan.

Metropolitan Coal will assess the potential impacts to public safety and where appropriate, implement measures in accordance with the Longwall 304 Public Safety Management Plan.

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

Management measures will be reported in the Annual Review (Section 12).

9 CONTINGENCY PLAN

In the event the subsidence impacts observed exceed the performance measure or indicators detailed in Section 5 of this BFMP-TRA, Metropolitan Coal will implement the following Contingency Plan (Appendix 4):

- The observation will be reported to the Metropolitan Coal Manager - Technical Services within 24 hours.
- With the exception of access roads/tracks, the observation will be recorded in the Built Features Management Plan – Subsidence Impact Register (Appendix 3) consistent with the monitoring program described in Section 7 of this BFMP-TRA.
- If relating to an access road/track, the observation will be recorded in the Metropolitan Coal Longwall 304 Land Management Plan – Subsidence Impact Register.
- Metropolitan Coal will report any exceedance of the performance measure or indicators to the DP&E and TransGrid as soon as practicable after Metropolitan Coal becomes aware of the exceedance.
- Metropolitan Coal will assess public safety and where appropriate implement safety measures in accordance with the Metropolitan Coal Longwall 304 Public Safety Management Plan;
- Metropolitan Coal will conduct an investigation to evaluate the potential contributing factors. The investigation will:
  - include the re-survey of relevant subsidence monitoring lines;
  - compare and critically analyse measured versus predicted subsidence parameters;
  - review measured subsidence parameters against the observed impact; and
  - review the subsidence monitoring program and update the program where appropriate.
- The course of action with respect to the identified impact(s), in consultation with specialists and relevant agencies, will include:
  - a program to review the effectiveness of the contingency measures; and
  - consideration of adaptive management.

Contingency measures are provided in Section 9.1.
• Metropolitan Coal will submit the proposed course of action to the DP&E for approval.
• Metropolitan Coal will implement the approved course of action to the satisfaction of the DP&E.

In accordance with Condition 6, Schedule 6 of the Project Approval, Metropolitan Coal will provide a suitable offset to compensate for the impact to the satisfaction of the Director-General (now Secretary) of DP&E if either the contingency measures implemented by Metropolitan Coal have failed to remediate the impact or the Director-General (now Secretary) determines that it is not reasonable or feasible to remediate the impact.

Metropolitan Coal will comply with the NSW Coal Mine Subsidence Compensation Act, 2017 in the event that property damages occur as a result of mining Longwalls 301-304.

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).

TransGrid designs its network with full redundancy provision (i.e. n-1 capability). In the unlikely event that TL11 became unserviceable due to a subsidence impact, TransGrid can potentially switch around TL11 for a period of time to effect emergency works, continuing to provide power to its customers (unless there are planned outages/faults in other connected parts of the transmission network).

Contingency measures that could be considered in the event the performance measure for the towers and transmission line is exceeded are summarised in Table 10. The decision tree for the contingency measures is shown in Appendix 4.

Preliminary design works for contingency measures (e.g. temporary structures for use in an emergency) has been completed in consultation with TransGrid, including proposed locations for temporary pole towers if required.

<table>
<thead>
<tr>
<th>Environmental Consequence</th>
<th>Contingency Measures</th>
<th>Description</th>
</tr>
</thead>
</table>
| Impact on Towers          | Temporary replacement | • Temporary switching of power to alternate transmission lines to effect repairs to TL11.  
                           |                      | • Installation of temporary emergency tower structures as designed by TransGrid.  
                           |                      | • Emergency structures can be deployed to re-establish line operations within 72hrs (depending on the amount of towers requiring replacement). |
| Rebuilding                 |                      | • Construction of new tower(s) while temporary towers are in operation. |
| Impact on Transmission Wires | Stabilisation techniques | • Sheaving of conductors and/or earth wires. |
|                           | Rebuilding           | • Construction of new transmission lines. |
In the event that contingency measures in Table 10 are still expected to exceed performance measures, adaptive management will be implemented. This includes:

- reduction in extraction height;
- modification to layout; or
- stop mining the longwall.

### 10 TARP – MANAGEMENT TOOL

The framework for the various components of the BFMP-TRA are summarised in the BFMP-TRA TARP shown in Table 11. The BFMP-TRA 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 environmental performance and the implementation of management and/or contingency measures.
Table 11
BFMP-TRA Trigger Action Response Plan

<table>
<thead>
<tr>
<th>TRANSGRID – Towers (T11-104 to T11-108)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk:</strong> Subsidence effect on towers resulting in impact to structural integrity and reduced transmission line clearance.</td>
<td></td>
</tr>
<tr>
<td><strong>TRIGGER LEVEL</strong></td>
<td><strong>RESPONSE</strong></td>
</tr>
<tr>
<td>Level 1 - Normal</td>
<td>Expected subsidence conditions</td>
</tr>
<tr>
<td><strong>Subsidence</strong></td>
<td><strong>Normal Operations</strong></td>
</tr>
<tr>
<td>• less than 100 mm for LW 301 - 302</td>
<td>• Towers are safe and serviceable.</td>
</tr>
<tr>
<td>• less than 125 mm for LW 303 - 304</td>
<td>• Negligible impact to towers.</td>
</tr>
<tr>
<td><strong>Absolute Horizontal Movements</strong></td>
<td>• Continue monitoring activities as planned.</td>
</tr>
<tr>
<td>• less than 80 mm at the base</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile strain</strong></td>
<td></td>
</tr>
<tr>
<td>• less than 0.6 mm/m</td>
<td></td>
</tr>
<tr>
<td><strong>Compressive strain</strong></td>
<td></td>
</tr>
<tr>
<td>• less than 0.6 mm/m</td>
<td></td>
</tr>
<tr>
<td><strong>Differential tower leg movements</strong></td>
<td></td>
</tr>
<tr>
<td>• less than 4.0 mm</td>
<td></td>
</tr>
<tr>
<td>Level 2 - Monitor</td>
<td></td>
</tr>
<tr>
<td><strong>Subsidence elevated up to +15% of predicted but tower leg service condition normal</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Subsidence</strong></td>
<td><strong>Continue operations but report on subsidence anomaly</strong></td>
</tr>
<tr>
<td>• between 100 and 115 mm for LW 301-302</td>
<td>• Towers are safe and serviceable.</td>
</tr>
<tr>
<td>• between 125 and 145 mm for LW 303-304</td>
<td>• Negligible impact to towers.</td>
</tr>
<tr>
<td><strong>Absolute Horizontal Movements</strong></td>
<td><strong>Metropolitan Coal</strong></td>
</tr>
<tr>
<td>• between 80 and 100 mm at the base</td>
<td>• Resurvey subsidence line, ground points, tower leg mounted prisms and earth wire peak points in affected area to confirm results.</td>
</tr>
<tr>
<td><strong>Strain</strong></td>
<td>• Engage subsidence expert to assess results.</td>
</tr>
<tr>
<td>• between 0.6 and 0.8 mm/m</td>
<td>• Confirm results are consistent with other subsidence lines.</td>
</tr>
<tr>
<td><strong>Differential tower leg movements</strong></td>
<td>• Compare and critically analyse measured versus predicted subsidence.</td>
</tr>
<tr>
<td>• less than 4.0 mm</td>
<td>• Inform and provide report to TransGrid and NSW Principal Subsidence Engineer of subsidence results (notify within 24 hours of trigger).</td>
</tr>
<tr>
<td></td>
<td>• Collaboratively share information with TransGrid to monitor situation.</td>
</tr>
<tr>
<td></td>
<td><strong>TransGrid</strong></td>
</tr>
<tr>
<td></td>
<td>• Assess information provided by Metropolitan Coal.</td>
</tr>
</tbody>
</table>
### Table 11 (Continued)
**BFMP-TRA Trigger Action Response Plan**

<table>
<thead>
<tr>
<th>TRANSGRID – Towers (T11-104 to T11-108)</th>
<th>Risk: Subsidence effect on towers resulting in impact to structural integrity and reduced transmission line clearance.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRIGGER LEVEL</strong></td>
<td><strong>RESPONSE</strong></td>
</tr>
<tr>
<td>Level 3 - Cautionary</td>
<td><strong>Investigate &amp; Resolve</strong></td>
</tr>
</tbody>
</table>
| Anomalous differential leg movement or subsidence beyond +15% of predicted | • Towers are safe and serviceable.  
• Indication of impact to towers or reduced transmission line clearance. |
| **TRANSGRID Towers** |                                                                                                  |
| Subsidence | - greater than 115 mm for LW 301-302  
- greater than 145 mm for LW 303-304 |
| Absolute Horizontal Movements | - greater than 100 mm at the base  
- greater than 0.8 mm/m |
| Observable subsidence ground deformations at a tower |                                                                                                 |
| Differential tower leg movements | - between 4.0 and 8.0 mm |
| **Metropolitan Coal** |                                                                                                  |
| | - Steps as per Level 2 event, plus:  
- Inform TransGrid and NSW Principal Subsidence Engineer of subsidence results (immediately following awareness of trigger).  
- Increase frequency of monitoring and subsidence line surveys to weekly in affected area (if not already).  
- Report monitoring data to NSW Principal Subsidence Engineer within 48hrs following collection of data.  
- In conjunction with TransGrid identify impact location and have TransGrid assess tower condition and/or conductor performance.  
- Review the subsidence monitoring program and update the program where appropriate.  
- Provide report on issue to both TransGrid and DP&E. |
| **TransGrid** |                                                                                                  |
| | - In conjunction with Metropolitan Coal identify impact location, inspect tower, assess condition and determine appropriate response. (e.g. greater monitoring data or frequency, or schedule maintenance on the structure).  
- Make determination if other measures necessary to avoid further impact (e.g. deployment of emergency structures). |
### Table 11 (Continued)
**BFMP-TRA Trigger Action Response Plan**

<table>
<thead>
<tr>
<th>TRANSGRID – Towers (T11-104 to T11-108)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RISK</strong></td>
<td><strong>RESPONSE</strong></td>
</tr>
<tr>
<td>Risk: Subsidence effect on towers resulting in impact to structural integrity and reduced transmission line clearance.</td>
<td></td>
</tr>
<tr>
<td><strong>TRIGGER LEVEL</strong></td>
<td><strong>RESPONSE</strong></td>
</tr>
<tr>
<td>Level 4 – Restoration</td>
<td>Implement Contingency Plan</td>
</tr>
<tr>
<td>Exceedance of nominated differential leg movement or fault occurs</td>
<td></td>
</tr>
<tr>
<td>Fault Occurs, or Differential leg movement</td>
<td>Metropolitan Coal</td>
</tr>
<tr>
<td>Greater than 8.0 mm</td>
<td></td>
</tr>
<tr>
<td>TRANSGRID Towers</td>
<td>TransGrid</td>
</tr>
<tr>
<td>Implement Contingency Plan</td>
<td></td>
</tr>
<tr>
<td>As per BFMP Section 9 and Appendix 4.</td>
<td></td>
</tr>
<tr>
<td><strong>Metropolitan Coal</strong></td>
<td></td>
</tr>
<tr>
<td>As per Level 3 event, plus:</td>
<td></td>
</tr>
<tr>
<td>- General Manager to be involved in all decision-making processes.</td>
<td></td>
</tr>
<tr>
<td>- Assess public safety implications and where appropriate implement safety measures in accordance with Metropolitan Coal Longwall 304 Public Safety Management Plan.</td>
<td></td>
</tr>
<tr>
<td>- Report exceedance of the performance measure or indicators to the DP&amp;E and TransGrid as soon as practicable.</td>
<td></td>
</tr>
<tr>
<td>- Update the ‘Built Features Management Plan – Subsidence Impact Register’.</td>
<td></td>
</tr>
<tr>
<td>- Investigate circumstances of the fault and determine requirement for adaptive management of mining operations prior to future operations in vicinity of the towers and transmission lines.</td>
<td></td>
</tr>
<tr>
<td><strong>TransGrid</strong></td>
<td></td>
</tr>
<tr>
<td>As per Level 3 event, plus:</td>
<td></td>
</tr>
<tr>
<td>- For fault - TransGrid to enact fault / emergency response measures including switching around TL11 while service is restored.</td>
<td></td>
</tr>
<tr>
<td>- For greater than 8.0 mm differential leg movement - TransGrid to determine timing of emergency restoration measure.</td>
<td></td>
</tr>
<tr>
<td>- Complete restoration works.</td>
<td></td>
</tr>
<tr>
<td>- Work in conjunction with Metropolitan Coal to investigate root cause of incident and determine appropriate future control measures.</td>
<td></td>
</tr>
</tbody>
</table>
11 FUTURE EXTRACTION PLANS

In accordance with Condition 7, Schedule 3 of the Project Approval, Metropolitan Coal will collect baseline data for the next Extraction Plan (i.e. Longwalls 305-310). The baseline (and post-mining) data collected for Longwalls 301-304 will be used as baseline for Longwalls 305 onward as longwall mining progressively moves further away from the TransGrid 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 BFMP-TRA will inform the appropriate type and frequency of monitoring of the assets relevant to the next Extraction Plan.

12 ANNUAL REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

In accordance with Condition 3, Schedule 7 of the Project Approval, Metropolitan Coal will conduct an Annual Review of the environmental performance of the Project by the end of March each year.

The Annual Review will:

- describe the works carried out in the past year, and the works proposed to be carried out over the next year;
- include a comprehensive review of the monitoring results and complaints records of the Project over the past 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, Preferred Project Report and Extraction Plan;
- 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.

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

13 INCIDENTS

An incident is defined 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 the Project Approval.
The reporting of incidents will be conducted in accordance with Condition 6, Schedule 7 of the Project Approval. Metropolitan Coal will notify the Director-General (now Secretary) of DP&E and any other relevant agencies of any incident associated with the Project as soon as practicable after Metropolitan Coal becomes aware of the incident. Within seven days of the date of the incident, Metropolitan Coal will provide the Director-General (now Secretary) of DP&E and any relevant agencies with a detailed report on the incident.

TransGrid will be notified within 24 hours of any access limitations or restrictions.

14 COMPLAINTS

A protocol for the managing and reporting of complaints has been developed as a component of Metropolitan Coal’s Environmental Management Strategy and is described below.

The Environment & Community Superintendent is responsible for maintaining a system for recording complaints.

Metropolitan Coal will maintain public signage advertising the telephone number on which environmental complaints can be made. The Environment & Community Superintendent is responsible for ensuring that the currency and effectiveness of the service is maintained. Notifications of complaints received are to be provided as quickly as practicable to the Environment & Community Superintendent.

Complaints and enquiries do not have to be received via the telephone line and may be received in any other form. Any complaint or enquiry relating to environmental management or performance is to be relayed to the Environment & Community Superintendent as soon as practicable. All employees are responsible for ensuring the prompt relaying of complaints. All complaints will be recorded in a complaints register.

For each complaint, the following information will be recorded in the complaints register:

- date and time of complaint;
- method by which the complaint was made;
- personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
- nature of the complaint;
- the action(s) taken by Metropolitan Coal in relation to the complaint, including any follow-up contact with the complainant; and
- if no action was taken by Metropolitan Coal, the reason why no action was taken.

The Environment & Community Superintendent is responsible for ensuring that all complaints are appropriately investigated, actioned and that information is fed back to the complainant, unless requested to the contrary.

In accordance with Condition 10, Schedule 7 of the Project Approval, the complaints register will be made publicly available on the website and updated on a monthly basis. A summary of complaints received and actions taken will be presented to the Community Consultative Committee as part of the operational performance review.
15 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 Metropolitan Coal’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 Metropolitan Coal, and will be developed through promotion of Metropolitan Coal ownership under the direction of the General Manager.

The Manager - Technical Services and/or Environment & Community Superintendent 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 13, Metropolitan Coal will notify the Director-General (now Secretary) of the DP&E and any other relevant agencies of any incident associated with Metropolitan Coal as soon as practicable after Metropolitan Coal becomes aware of the incident. Within seven days of the date of the incident, Metropolitan Coal will provide the Director-General (now Secretary) of the DP&E and any relevant agencies with a detailed report on the incident.

A review of Metropolitan Coal’s compliance with all conditions of the Project Approval, 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 Peabody website.

Additionally, in accordance with Condition 8, Schedule 7 of the Project Approval, an independent environmental audit was undertaken by the end of December 2011, and is undertaken a minimum of once every three years thereafter. A copy of the audit report will be submitted to the Director-General (now Secretary) of the DP&E and made publicly available on the Peabody website. The independent audit will be undertaken by an appropriately qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General (now Secretary) of the DP&E.
16 REFERENCES


APPENDIX 1

MSEC (2016) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 301 TO 303 - SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE TRANSGRID 330 KV TRANSMISSION LINE, DATED 7 SEPTEMBER 2016
7th September 2016

Jon Degotardi
Peabody Energy Australia
Metropolitan Colliery
PO Box 402
Helensburgh NSW 2508

Ref: MSEC844-02

Dear Jon,

RE: Metropolitan Colliery – Proposed Longwalls 301 to 303 - Subsidence Predictions and Impact Assessments for the TransGrid 330 kV Transmission Line

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the TransGrid 330 kV transmission line resulting from the extraction of the proposed Longwalls 301 to 303 at Metropolitan Colliery.

The locations of the 330 kV transmission line and the proposed longwalls are shown in the attached Drawing No. MSEC844-02. The transmission line is located to the east of Longwalls 301 to 303 and therefore is not proposed to be directly mined beneath.

The transmission towers and reference numbers are also shown in Drawing No. MSEC844-02. There are six towers that are located within or immediately adjacent to the Study Area for Longwalls 301 to 303. The distances of these towers from the nearest longwall, being Longwall 301, are summarised in Table 1.

Table 1 Distances of the 330 kV Transmission Towers from Longwalls 301 to 303

<table>
<thead>
<tr>
<th>Tower Number</th>
<th>Tower Type</th>
<th>Distance of the Transmission Towers Centrelines from the Longwalls (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL11 103</td>
<td>Suspension</td>
<td>310</td>
</tr>
<tr>
<td>TL11 104</td>
<td>Suspension</td>
<td>50</td>
</tr>
<tr>
<td>TL11 105</td>
<td>Suspension</td>
<td>50</td>
</tr>
<tr>
<td>TL11 106</td>
<td>Suspension</td>
<td>70</td>
</tr>
<tr>
<td>TL11 107</td>
<td>Suspension</td>
<td>70</td>
</tr>
<tr>
<td>TL11 108</td>
<td>Suspension</td>
<td>110</td>
</tr>
</tbody>
</table>

The transmission towers that are located within the Study Area are all suspension towers. The changes in alignment at the transmission towers are in the order of 1 to 3 degrees.

A photograph of one of the 330 kV transmission towers is provided in Figure 1.
The predictions and impact assessments for the 330 kV transmission line are provided in the following sections.

**Predictions of Conventional Subsidence Parameters**

The following provides summaries of the maximum predicted conventional movements for the 330 kV transmission line resulting from the extraction of Longwalls 301 to 303. It is possible that localised and elevated movements could develop as the result of non-conventional ground movements due to geological structures or valley closure effects. Discussions on the potential for non-conventional movements are provided in the following section.

The predicted profiles of transient subsidence, tilt along and tilt across the alignment of the 330 kV transmission line, during the extraction of Longwall 301, are shown in the attached Fig. A.1. The profiles have been shown based on 50 metre advances of the longwall extraction face. The transmission line will initially experience subsidence adjacent to the northern end of Longwall 301 and then subsidence will progressively develop towards the southern end of the longwall during mining.

The predicted profiles of incremental and total conventional subsidence, tilt along and tilt across the alignment of the 330 kV transmission line, resulting from the extraction of Longwalls 301 to 303, are shown in the attached Fig. A.2. The black dashed lines are the incremental profiles that represent the additional movements due to each of the longwalls. The solid blue lines represent the total or accumulated movements after the completion of each longwall.

A summary of the maximum predicted values of incremental subsidence, tilt along and tilt across the alignment of the 330 kV transmission line, due to the extraction of each of the Longwalls 301 to 303, is provided in Table 2. The values are the maxima anywhere along the transmission line (i.e. not necessarily at the tower locations).

### Table 2 Maximum Predicted Incremental Subsidence, Tilt Along and Tilt Across the Alignment of the 330 kV Transmission Line Resulting from the Extraction of Longwalls 301 to 303

<table>
<thead>
<tr>
<th>Longwall</th>
<th>Maximum Predicted Incremental Subsidence (mm)</th>
<th>Maximum Predicted Incremental Tilt Along Alignment (mm/m)</th>
<th>Maximum Predicted Incremental Tilt Across Alignment (mm/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due To LW301</td>
<td>40</td>
<td>&lt; 0.5</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Due To LW302</td>
<td>80</td>
<td>&lt; 0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Due To LW303</td>
<td>30</td>
<td>&lt; 0.5</td>
<td>&lt; 0.5</td>
</tr>
</tbody>
</table>
The maximum predicted incremental subsidence for the 330 kV transmission line, due to the extraction of each of the Longwalls 301 to 303, varies between 30 mm and 80 mm. It is noted, that the maximum predicted incremental subsidence due to Longwall 302 is greater than that due Longwall 301, as it is a second panel in the series and therefore results in higher magnitudes of subsidence above and outside of the mining area. The maximum predicted incremental tilt due to each of the longwalls is 0.5 mm/m (i.e. 0.05 %, or 1 in 2,000) across the alignment.

A summary of the maximum predicted values of total subsidence, tilt along the alignment and tilt across the alignment, resulting from the extraction of Longwalls 301 to 303, is provided in Table 3. The values are the maxima anywhere along the transmission line (i.e. not necessarily at the tower locations).

<table>
<thead>
<tr>
<th>Longwall</th>
<th>Maximum Predicted Total Subsidence (mm)</th>
<th>Maximum Predicted Total Tilt Along Alignment (mm/m)</th>
<th>Maximum Predicted Total Tilt Across Alignment (mm/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After LW301</td>
<td>60</td>
<td>&lt; 0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>After LW302</td>
<td>110</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>After LW303</td>
<td>140</td>
<td>0.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The maximum predicted total subsidence for the 330 kV transmission line, resulting from the extraction of Longwalls 301 to 303, is 140 mm. The greatest subsidence occurs adjacent to the southern end of Longwall 301. The maximum predicted conventional tilt is 1.0 mm/m (i.e. 0.1 %, or 1 in 1,000) and is orientated across the alignment of the transmission line. The maximum predicted conventional tilt along the alignment of the transmission line is 0.5 mm/m (i.e. 0.05 %, or 1 in 2,000).

There are six transmission towers that are located within or immediately adjacent to the Study Area, being Towers TL11 103 to TL11 108. A summary of the predicted values of total subsidence in the locations of the transmission towers, resulting from the extraction of Longwalls 301 to 303, is provided in Table 4.

<table>
<thead>
<tr>
<th>Tower</th>
<th>Maximum Predicted Total Subsidence after LW301 (mm)</th>
<th>Maximum Predicted Total Subsidence after LW302 (mm)</th>
<th>Maximum Predicted Total Subsidence after LW303 (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL11 103</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>TL11 104</td>
<td>&lt; 20</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>TL11 105</td>
<td>40</td>
<td>100</td>
<td>125</td>
</tr>
<tr>
<td>TL11 106</td>
<td>30</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>TL11 107</td>
<td>30</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>TL11 108</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
</tr>
</tbody>
</table>

The transmission towers are predicted to experience vertical subsidence up to 125 mm resulting from the extraction of Longwalls 301 to 303. The highest subsidence is predicted to occur at Tower TL11 105.

A summary of the maximum predicted values of total tilt at the bases of the transmission towers and total horizontal movements at the tops of the towers, resulting from the extraction of Longwalls 301 to 303, is provided in Table 5. The values are the maxima that occur at any time during or after the extraction of these longwalls. The horizontal movements have been based on an overall tower height of 50 metres.
Table 5  Maximum Predicted Total Tilts and Horizontal Movements at the Transmission Towers Resulting from the Extraction of Longwalls 301 to 303

<table>
<thead>
<tr>
<th>Tower</th>
<th>Maximum Predicted Total Tilt Along Alignment at the Base of the Tower (mm, +ve towards north and -ve towards south)</th>
<th>Maximum Predicted Total Tilt Across Alignment at the Base of the Tower (mm, +ve towards east and -ve towards west)</th>
<th>Maximum Predicted Total Horizontal Movement Along Alignment at the Top of Tower (mm, +ve towards north and -ve towards south)</th>
<th>Maximum Predicted Total Horizontal Movement Across Alignment at the Top of the Tower (mm, +ve towards east and -ve towards west)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL11 103</td>
<td>&lt; ±0.5</td>
<td>&lt; ±0.5</td>
<td>&lt; ±20</td>
<td>&lt; ±20</td>
</tr>
<tr>
<td>TL11 104</td>
<td>&lt; ±0.5</td>
<td>&lt; ±0.5</td>
<td>&lt; ±20</td>
<td>&lt; ±20</td>
</tr>
<tr>
<td>TL11 105</td>
<td>&lt; ±0.5</td>
<td>-1.0</td>
<td>&lt; ±20</td>
<td>-60</td>
</tr>
<tr>
<td>TL11 106</td>
<td>&lt; ±0.5</td>
<td>-0.5</td>
<td>&lt; ±20</td>
<td>-50</td>
</tr>
<tr>
<td>TL11 107</td>
<td>&lt; ±0.5</td>
<td>-0.5</td>
<td>&lt; ±20</td>
<td>-50</td>
</tr>
<tr>
<td>TL11 108</td>
<td>&lt; ±0.5</td>
<td>&lt; ±0.5</td>
<td>&lt; ±20</td>
<td>&lt; ±20</td>
</tr>
</tbody>
</table>

The maximum predicted conventional tilt in the locations of the transmission towers is -1.0 mm/m (i.e. 0.1 %, or 1 in 1,000). The maximum predicted horizontal movement at the tops of the towers is -60 mm. The maximum tilt and horizontal movement both occur at Tower TL11 105 and are orientated towards the west (i.e. towards the longwalls).

A summary of the maximum predicted values of total opening and closure between the tops of the transmission towers, resulting from predicted conventional subsidence movements due to the extraction of Longwalls 301 to 303, is provided in Table 6. The values are the maxima that occur at any time during or after the extraction of these longwalls.

Table 6  Maximum Predicted Total Opening and Total Closure between Transmission Towers Resulting from the Extraction of Longwalls 301 to 303

<table>
<thead>
<tr>
<th>Span</th>
<th>Maximum Predicted Opening due to LW301 to LW303 (mm)</th>
<th>Maximum Predicted Closure due to LW301 to LW303 (mm)</th>
<th>Final Predicted Opening (+ve) or Closure (-ve) after LW303 (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL11 103 to TL11 104</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; ±20</td>
</tr>
<tr>
<td>TL11 104 to TL11 105</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; ±20</td>
</tr>
<tr>
<td>TL11 105 to TL11 106</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; ±20</td>
</tr>
<tr>
<td>TL11 106 to TL11 107</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; ±20</td>
</tr>
<tr>
<td>TL11 107 to TL11 108</td>
<td>&lt; 20</td>
<td>&lt; 20</td>
<td>&lt; ±20</td>
</tr>
</tbody>
</table>

The maximum predicted closure and opening between the tops of the transmission towers due to conventional subsidence movement is less than 20 mm.

The 330 kV transmission line is also likely to experience far-field horizontal movements orientated towards the mining area. The far-field horizontal movements are expected to be similar to those observed for previous longwall mining in the Southern Coalfield.

The observed incremental far-field horizontal movements, resulting from the extraction of longwalls in the Southern Coalfield, are provided in Figure 2. The data is based on survey marks located outside of the mining area (i.e. above solid coal).
The transmission towers are located at distances between 50 and 310 metres from Longwalls 301 to 303. At these distances, the towers could experience absolute horizontal movements in the order of 100 mm to 140 mm based on the 95 % confidence level.

Far-field horizontal movements tend to be bodily movements orientated towards the mining area. The potential for impacts does not result from these absolute horizontal movements, but rather the differential horizontal movements. These absolute far-field horizontal movements could result in small changes in the distances between the towers since the directions of these far-field horizontal movements are generally expected to be towards the extracted longwalls and the 330 kV transmission line is oriented approximately perpendicular to the longwalls. The greatest differences would therefore be expected to occur between towers that are located close to the longwalls and those located further from the longwalls, such as towers TL11 103 to TL11 104 and towers TL11 108 to TL11 109. A calculation of relative far field movements between towers based on potential far-field horizontal movements from Figure 2, for the 95% confidence level, indicates a potential maximum closure movement of less than 50 mm between the towers. With increasing distance from the extracted longwalls, the potential relative far-field movement between towers could result in an opening of less than 50 mm.

Predicted Strains

The prediction of strain is more difficult than the predictions of subsidence and tilt. The reason for this is that strain is affected by many factors, including ground curvature and horizontal movement, as well as local variations in the near surface geology, the locations of pre-existing natural joints at bedrock and the depth of bedrock. Survey tolerance can also represent a substantial portion of the measured strain, in cases where the strains are of a low order of magnitude. The profiles of observed strain, therefore, can be irregular even when the profiles of observed subsidence, tilt and curvature are relatively smooth.

In previous MSEC subsidence reports, predictions of conventional strain were provided based on the best estimate of the average relationship between curvature and strain. Similar relationships have been proposed by other authors. The reliability of the strain predictions was highlighted in these reports, where it was stated that measured strains can vary considerably from the predicted conventional values.
Adopting a linear relationship between curvature and strain provides a reasonable prediction for the conventional tensile and compressive strains. In the Southern Coalfield, it has been found that a factor of 15 provides a reasonable relationship between the predicted maximum curvatures and the predicted maximum conventional strains. The locations that are predicted to experience hogging or convex curvature are expected to be net tensile strain zones and locations that are predicted to experience sagging or concave curvature are expected to be net compressive strain zones.

At a point, however, there can be considerable variation from the linear relationship, resulting from non-conventional movements or from the normal scatters which are observed in strain profiles. When expressed as a percentage, observed strains can be many times greater than the predicted conventional strain for low magnitudes of curvature. We have therefore provided a statistical approach to account for the variability, instead of just providing a single predicted conventional strain.

The range of predicted strains for the 330 kV transmission line has been determined using the monitoring data from Metropolitan Colliery and other nearby collieries. 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 transmission towers are located at distances of 50 metres or greater from the proposed longwalls. The database has therefore been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls in the Southern Coalfield, for survey bays that were located outside between zero and 100 metres of the nearest longwall goaf edge, which has been referred to as “above solid coal”.

A histogram of the maximum observed tensile and compressive strains measured in survey bays located above solid coal, for monitoring lines in the Southern Coalfield, is provided in Figure 3. The probability distribution functions, based on a fitted Generalised Pareto Distribution (GPD), have also been shown in this figure.

![Figure 3](I:\Projects\Metropolitan\MSEC844 - LW301 to 303 Stakeholder Consultation\Subsdata\Statistics\Strain Probability Distribution above Solid Coal 0m to 100m.grf)

**Figure 3** Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Solid Coal (0 to 100 metres)
Confidence intervals have been determined from the empirical strain data using the fitted GPDs. In the cases where survey bays were measured multiple times during a longwall extraction, the maximum tensile strain and the maximum compressive strain were used in the analysis (i.e. single tensile strain and single compressive strain measurement per survey bay).

A summary of the probabilities of exceedance for tensile and compressive strains for survey bays located above solid coal, based on the fitted GPDs, is provided in Table 7.

**Table 7 Probabilities of Exceedance for Strain for Survey Bays Located above Solid Coal**

<table>
<thead>
<tr>
<th>Strain (mm/m)</th>
<th>Probability of Exceedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td></td>
</tr>
<tr>
<td>-1.5</td>
<td>1 in 3,100</td>
</tr>
<tr>
<td>-1.0</td>
<td>1 in 630</td>
</tr>
<tr>
<td>-0.5</td>
<td>1 in 40</td>
</tr>
<tr>
<td>-0.3</td>
<td>1 in 10</td>
</tr>
<tr>
<td>Tension</td>
<td></td>
</tr>
<tr>
<td>+0.3</td>
<td>1 in 6</td>
</tr>
<tr>
<td>+0.5</td>
<td>1 in 15</td>
</tr>
<tr>
<td>+1.0</td>
<td>1 in 250</td>
</tr>
<tr>
<td>+1.5</td>
<td>1 in 2,200</td>
</tr>
</tbody>
</table>

The 95 % confidence intervals for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.5 mm/m tensile and 0.4 mm/m compressive. The 99 % confidence intervals for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.8 mm/m tensile and 0.7 mm/m compressive.

**Potential for Non-Conventional Movements**

Non-conventional movements can develop due to the presence of geological structures or valley related effects. In some cases, non-conventional movements can develop with no known cause and these are often referred to as ‘anomalous’ movements.

The locations of the known geological structures are shown in Drawing No. MSEC844-02. The Metropolitan Fault has a north west to south east strike and dips to the north east. This fault crosses the alignment of the 330 kV transmission line outside of the Study Area, in close proximity to Tower TL11 109, at a distance of 0.5 kilometres north of Longwall 301. Faults also cross the alignment of the transmission line in the southern part of the Study Area, in close proximity to Tower TL11 103.

If these faults extend from the seam up to the surface, then localised and elevated compressive strains could develop at their surface expressions. It is also possible that localised and elevated strains could occur elsewhere due to unknown geological structures (i.e. anomalies).

If the surface expressions of the faults are located between the towers, then the predicted parameters for the towers do not change from those summarised in Table 4 to Table 7. However, if the surface expression of a fault is coincident with a tower, then it could experience a compressive strain greater than that predicted based on conventional ground movements.

It is difficult to predict the magnitudes of the non-conventional movements at known geological structures, especially in locations outside of mining. Experience from previous mining in close proximity of known geological structures can be used to provide a guide to the potential ground movements.

The greatest strain that has been measured at a known geological structure that was located outside of mining in the Southern Coalfield occurred in Appin Area 4. The surface expression of a low angle thrust fault was located at a distance of 190 metres from Longwall 407. The measured compressive strain at the surface expression due to mining of this longwall was 3.5 mm/m. The development of compressive strain versus the longwall face advance is illustrated in Figure 4. The rate of change of compressive strain per 10 metre longwall face advance is shown in Figure 5.
The maximum rate of change of compressive strain was 0.076 mm/m per 10 metre longwall face advance. Based on an average extraction rate of 50 metres per week, this equates to a maximum rate of 0.4 mm/m per week. The compressive strain developed over the period when the longwall had an extracted length between 1,300 and 2,200 metres. This equates to a period of approximately 18 weeks based on an average extraction rate of 50 metres per week.

The localised movements that developed at the surface expression of the low angled thrust fault in Appin Area 4 are an extreme case and greater than other known and measured cases in the Southern Coalfield. This case is likely to provide a conservative indication of potential non-conventional movements at surface expressions of geological structures outside of mining.

There are no major streams that cross the alignment of the 330 kV transmission line adjacent to Longwalls 301 to 303. The are some small tributaries along the alignment of the transmission line, which can be seen from the surface profile shown in Figs. A.1 and A.2. Localised and elevated compressive strains could develop in the bases of these small tributaries due to valley closure effects. However, the towers are located away from the bases of these small tributaries and, therefore, are unlikely to experience these valley closure strains.
Impact Assessments for the 330 kV Transmission Line

The cables along the 330 kV transmission line are not directly affected by ground strains, as they are supported by the towers above ground level. The cables can, however, be affected by the changes in bay lengths, i.e. the distances between the towers at the level of the cables, which result from mining induced differential subsidence, horizontal ground movements and lateral movements at the tops of the towers due to differential tilting of the towers. The stability of the transmission towers can be affected by the mining induced tilts, curvatures and ground strains at the tower locations and by changes in the catenary profiles of the cables.

Potential Impacts due to the Predicted Conventional Movements

The transmission towers are predicted to experience vertical subsidence up to 125 mm resulting from the extraction of Longwalls 301 to 303. The transmission line is orientated parallel to the longwalls and therefore the low level vertical subsidence is predicted to be reasonably uniform along its alignment. It is unlikely, therefore, that these magnitudes of vertical subsidence would result in adverse impacts on the cable ground clearances.

The maximum predicted conventional tilt in the locations of the transmission towers is 1.0 mm/m (i.e. 0.1 %, or 1 in 1,000) orientated across the alignment. The predicted mining induced tilts are very small and generally similar to the order of survey tolerance. The mining induced tilts and horizontal movements along the alignment of the transmission line are predicted to result in opening and closure of less than 20 mm between adjacent towers. It is unlikely, therefore, that the conventional movements would result in adverse impacts on the transmission line.

Far-field horizontal movements could result in small changes in the distances between the towers, particularly those located near the ends of the longwalls. Potential maximum predicted shortening movement of 50 mm between the towers and opening of less than 50 mm could occur between towers, due to far-field horizontal movements.

The predicted strains at the locations of the transmission towers are 0.5 mm/m tensile and 0.4 mm/m compressive based on the 95 % confidence level and are 0.8 mm/m tensile and 0.7 mm/m compressive based on the 99 % confidence level. It is recommended that TransGrid review the structural integrity of the towers based on changes in the tower leg spacings (i.e. k-point distances) resulting from the predicted strains.

Potential Impacts due to Possible Non-Conventional Movements

Localised and elevated compressive strains can develop due to the presence of geological structures or valley related effects. There are no significant streams in the locations of the transmission towers and, therefore, it is unlikely that they will be adversely impacted by valley closure effects.

It is possible that the transmission towers could experience compressive strains greater than those predicted based on conventional movements if they were coincident with the surface expression of a fault. The potential for non-conventional movements in the locations of the towers is very low, due to their distances from the longwalls, however, the potential for these irregular movements cannot be discounted.

It is recommended that strategies are developed, in consultation with TransGrid, to manage the potential for non-conventional movements at the transmission tower locations. The strategies should consider the magnitudes and rates of development of strain in locations of known geological structures adjacent to previous longwall mining. The observation at a low angled thrust fault in Appin Area 4 (refer to Figure 4 and Figure 5) is an extreme case and greater than other known and measured cases in the Southern Coalfield. This case is likely to provide a conservative indication of potential non-conventional movements at surface expressions of geological structures outside of mining.

The management strategies should include monitoring of the transmission towers during active subsidence to identify the early development of non-conventional ground movements. It is understood that survey marks have been installed on each of the transmission tower legs and in the ground.

It is recommended that a Trigger Action Response Plan (TARP) is developed outlining the actions required if non-conventional movements were identified at the transmission tower locations. The triggers and actions should be developed and agreed between TransGrid and Peabody Energy.

It is also recommended that preventive measures are developed in case non-conventional movements are identified. The preventive measures could include: installation of timber poles to support the existing tower and/or
the conductors; installation of additional bracing and/or strengthening members to the existing frame; or installation of a prefabricated steel frame to support the tower base.

The appropriate monitoring, management, preventive and remedial measures should be developed in consultation between TransGrid and Peabody Energy.

Summary

The 330 kV transmission line is located to the east of the proposed Longwalls 301 to 303. The transmission towers are located at distances between 50 metres and 310 metres from the longwalls. At these distances, the transmission towers are predicted to experience low levels of vertical subsidence up to 125 mm. The predicted conventional tilts and differential horizontal movements between the towers are very small and unlikely to result in adverse impacts.

However, it is possible that the transmission towers could experience localised and elevated compressive strains due to the presence of geological structures (known or unknown), if the surface expressions of these features are coincident with them. It is recommended that monitoring, management, preventive and remedial measures are developed, in consultation between TransGrid and Peabody Energy, to manage the potential for these irregular movements.

Yours sincerely

Peter DeBono
Mine Subsidence Engineering Consultants

Attachments:

Drawing No. MSEC844-02 – Longwalls 301 to 303 – TransGrid 330 kV Transmission Line

Fig. A.1 Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 330 kV Transmission Line during the Mining of Longwall 301

Fig. A.2 Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 330 kV Transmission Line due to LW301 to LW303
Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 330 kV Transmission Line during the Mining of LW301
Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 330 kV Transmission Line due to LW301 to LW303

- **Predicted Conventional Tilt Across Alignment (mm/m):**
  - LW301 to LW303

- **Predicted Conventional Tilt Along Alignment (mm/m):**
  - LW301 to LW303

- **Subsidence (mm):**
  - LW301 to LW303

- **Surface Level (m AHD):**
  - LW301 to LW303

- **Distance along Transmission Line (m):**
  - LW301 to LW303

- **Legend:**
  - Predicted incremental profiles
  - Predicted total profiles
  - Predicted total profiles after LW303

**Fig. A.2**
APPENDIX 2

Dear Jon,

**RE: Metropolitan Colliery – Proposed Longwall 304 - Subsidence Predictions and Impact Assessments for the TransGrid 330 kV Transmission Line**

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the TransGrid 330 kV transmission line resulting from the extraction of the proposed Longwall 304 at Metropolitan Colliery.

The locations of the 330 kV transmission line and the proposed longwall are shown in the attached Drawing No. MSEC1013-02. A Study Area is shown in Drawing No. MSEC1013-02 and is based on the outer limits of a 35° angle of draw line from Longwall 304 and the predicted 20mm subsidence contour for Longwall 304.

The 330kV transmission line is located outside the Study Area for Longwall 304 and is 670 m from the longwall at its nearest point. Predictions and impact assessments for the TransGrid 330 kV transmission line are provided below.

The transmission towers and reference numbers are also shown in Drawing No. MSEC1013-02. There are five towers that are located immediately adjacent to the Study Area for Longwall 304. The transmission towers that are located adjacent to the Study Area are all suspension towers. The changes in alignment at the transmission towers are in the order of 1 to 3 degrees. A photograph of one of the 330 kV transmission towers is provided in Figure 1.
Predictions of Conventional Subsidence Parameters

The 330 kV transmission line is located 670 m from Longwall 304. At this distance, the transmission line is not expected to experience measurable conventional vertical subsidence, tilts or curvatures due to the extraction of Longwall 304. The transmission towers could experience low level far-field horizontal movement. The far-field horizontal movements are expected to be similar to those observed for previous longwall mining in the Southern Coalfield, which tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain.

It is possible that localised and elevated movements could develop as the result of non-conventional ground movements due to geological structures or valley closure effects. Discussions on the potential for non-conventional movements are provided in the following section.

The observed incremental far-field horizontal movements, resulting from the extraction of longwalls in the Southern Coalfield, are provided in Figure 2. The data is based on survey marks located outside of the mining area (i.e. above solid coal).
The absolute incremental horizontal movements measured at distances greater than 670 m from mining are in the order of 60 mm based on the 95% confidence level. Far-field horizontal movements tend to be bodily movements orientated towards the mining area. The strains associated with these low level horizontal movement are not expected to be measurable. The absolute far-field horizontal movements could result in minor changes in the distances between the towers since the directions of these far-field horizontal movements are generally expected to be towards the extracted longwalls. Monitoring of the transmission towers measured a maximum cumulative differential horizontal movement between towers of approximately 25 mm during the extraction of Longwalls 301 and 302.

**Predicted Strains**

The prediction of strain is more difficult than the predictions of subsidence and tilt. The reason for this is that strain is affected by many factors, including ground curvature and horizontal movement, as well as local variations in the near surface geology, the locations of pre-existing natural joints at bedrock and the depth of bedrock. Survey tolerance can also represent a substantial portion of the measured strain, in cases where the strains are of a low order of magnitude. The profiles of observed strain, therefore, can be irregular even when the profiles of observed subsidence, tilt and curvature are relatively smooth.

In previous MSEC subsidence reports, predictions of conventional strain were provided based on the best estimate of the average relationship between curvature and strain. Similar relationships have been proposed by other authors. The reliability of the strain predictions was highlighted in these reports, where it was stated that measured strains can vary considerably from the predicted conventional values.

Adopting a linear relationship between curvature and strain provides a reasonable prediction for the conventional tensile and compressive strains. In the Southern Coalfield, it has been found that a factor of 15 provides a reasonable relationship between the predicted maximum curvatures and the predicted maximum conventional strains. The locations that are predicted to experience hogging or convex curvature are expected to be net tensile strain zones and locations that are predicted to experience sagging or concave curvature are expected to be net compressive strain zones.
At a point however, there can be considerable variation from the linear relationship, resulting from non-conventional movements or from the normal scatters which are observed in strain profiles. When expressed as a percentage, observed strains can be many times greater than the predicted conventional strain for low magnitudes of curvature. We have therefore provided a statistical approach to account for the variability, instead of just providing a single predicted conventional strain.

The range of predicted strains for the 330 kV transmission line has been determined using the monitoring data from Metropolitan Colliery and other nearby collieries. 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 transmission towers are located at distances of 50 metres or greater from the existing and proposed longwalls. The database has therefore been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls in the Southern Coalfield, for survey bays that were located outside between zero and 100 metres of the nearest longwall goaf edge, which has been referred to as “above solid coal”.

A histogram of the maximum observed tensile and compressive strains measured in survey bays located above solid coal, for monitoring lines in the Southern Coalfield, is provided in Figure 3. The probability distribution functions, based on a fitted Generalised Pareto Distribution (GPD), have also been shown in this figure.

Figure 3  Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Solid Coal (0 to 100 metres)

The 95 % confidence intervals for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.5 mm/m tensile and 0.4 mm/m compressive. The 99 % confidence intervals for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.8 mm/m tensile and 0.7 mm/m compressive.

Potential for Non-Conventional Movements

Non-conventional movements can develop due to the presence of geological structures or valley related effects. In some cases, non-conventional movements can develop with no known cause and these are often referred to as ‘anomalous’ movements.

The locations of the known geological structures at seam level and the major streams are shown in Drawing No. MSEC1013-02. There are no mapped faults located within the Study Area that extend beneath the 330 kV transmission line. It is possible that the transmission line could experience localised and elevated strains due to
unknown geological structures (i.e. anomalies). Non-conventional or anomalous movements have not been identified during the extraction of Longwalls 301 and 302. The range of strains provided in the previous section include those resulting from irregular anomalous movements.

The transmission line does not cross any major streams within the Study Area and, therefore, is not expected to experience any measurable valley closure effects.

**Impact Assessments for the 330 kV Transmission Line**

The cables along the 330 kV transmission line are not directly affected by ground strains, as they are supported by the towers above ground level. The cables can, however, be affected by the changes in bay lengths, i.e. the distances between the towers at the level of the cables, which result from mining induced differential subsidence, horizontal ground movements and lateral movements at the tops of the towers due to differential tilting of the towers. The stability of the transmission towers can be affected by the mining induced tilts, curvatures and ground strains at the tower locations and by changes in the catenary profiles of the cables.

Whilst the 330 kV transmission line could experience low level far-field horizontal movements, the associated tilts, curvatures and strains are not expected to be measurable. It is unlikely that the transmission lines would experience adverse impacts as a result of conventional subsidence movements due to the extraction of Longwall 304.

Far-field horizontal movements could result in small changes in the distances between the towers, particularly those located near the ends of the longwalls. Differential far-field horizontal movements between the transmission towers due to the extraction of Longwall 304 are expected to be less than 20 mm and are not expected to result in adverse impacts to the transmission line.

The predicted strains at the locations of the transmission towers are 0.5 mm/m tensile and 0.4 mm/m compressive based on the 95% confidence level and are 0.8 mm/m tensile and 0.7 mm/m compressive based on the 99% confidence level. Tower leg spacings have been monitored since the commencement of Longwall 301 with observed changes in leg spacings generally within the level of accuracy of survey methods.

Localised and elevated compressive strains can develop due to the presence of geological structures. It is possible that the transmission towers could experience compressive strains greater than those predicted based on conventional movements if they were coincident with the surface expression of a fault. The potential for non-conventional movements in the locations of the towers is very low, due to their distances from the longwalls and observations to date, however, the potential for these irregular movements cannot be discounted.

A monitoring program, including a trigger action response plan, has been in place since the commencement of Longwall 301. Observed subsidence parameters have been within expected levels with no identified non-conventional movements. Based on these results the likelihood of non-conventional movements occurring as a result of the extraction of Longwall 304 is considered to be very low.

It is recommended that monitoring and management strategies developed for the extraction of Longwalls 301 to 303 are updated and continued for Longwall 304, in consultation with Endeavour Energy, to manage the transmission line for potential non-conventional ground movements.

**Summary**

The 330 kV transmission line is located to the east of the proposed Longwall 304 and is located outside the Study Area at distances of 670 m or more from Longwall 304. At this distance, the transmission line is not expected to experience measurable conventional vertical subsidence, tilts or curvatures due to the extraction of Longwall 304. The transmission towers could experience low level far-field horizontal movement. It is considered unlikely that the transmission lines would experience adverse impacts as a result of predicted movements due to the extraction of Longwall 304.

It is possible that the transmission towers could experience localised and elevated strains due to the presence of geological structures (known or unknown), if the surface expressions of these features are coincident with them. Non-conventional subsidence movements have not been observed during the extraction of Longwalls 301 and 302 and the likelihood of non-conventional subsidence movements at the transmission towers due to Longwall 304 is considered to be very low.
It is expected that the potential impacts on the TransGrid infrastructure can be managed with the implementation of the necessary monitoring and management strategies.

Yours sincerely

Peter DeBono
Mine Subsidence Engineering Consultants

Attachments:
Drawing No. MSEC1013-02 – Longwall 304 – TransGrid 330 kV Transmission Line
APPENDIX 3

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER
## Built Features Management Plan - Subsidence Impact Register

<table>
<thead>
<tr>
<th>Impact Register Number(^1)</th>
<th>Built Feature(^2)</th>
<th>Impact Description</th>
<th>Does Impact Exceed the Built Feature Performance Measure/Indicators? (Yes/No)</th>
<th>Management Measures Implemented</th>
<th>Were Management Measures Effective? (Yes/No)</th>
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</table>

Notes:
1: Fill out all details in the Assessment Form and record the register number here.
2: Built feature (e.g. transmission line, tower, etc.).
3: Impacts to access roads/tracks to be included in the Land Management Plan – Subsidence Impact Register.
## Built Feature Management Plan – Subsidence Impact Register
### Assessment Form

**Date:**

---

**Observer (Name and position):**

---

**Register Number (i.e. Number 1, 2, etc.):**

---

**Longwall Number and Chainage:**

---

**Location of Observed Impact:**

*(Examples: location of tower, include GPS co-ordinates and a sketch)*

---

**Description of Observed Impact:**

*(Examples: nature and extent of impact - cracks in road etc any relevant information, attach photographs)*

---

**Person Notified:** Manager - Technical Services

---

**Description of Photographs:**

---

**Actions Required:**

- Contingency Plan Initiated
- Incident Notification
- Safety Measures/Public Safety Management Plan Requirements

---

**Management or Contingency Measures Implemented:**

---

**Effectiveness of Management or Contingency Measures:**

---
APPENDIX 4

CONTINGENCY PLAN PROCEDURE AND DECISION TREE
Subsidence Impact

- Exceeds performance indicator

Notify Technical Services Manager within 24hrs

Public safety risk?

- No
  - Implement public safety measures in accordance with Public Safety Management Plan
  - Record - Subsidence Impact Register

- Yes
  - Implement proposed course of action with asset owner, submit to DP&E for approval
  - TransGrid - see decision trees

Action approved?

- No
  - Implement course of action

- Yes
Towers and Transmission Lines

- **Normal Expected Conditions**
  - up to 4mm differential leg movement
  - Continue monitoring

- **Monitor Subsidence Anomaly**
  - up to 4mm differential leg movement
  - Report on Subsidence anomaly
  - Continue monitoring

- **Caution**
  - Anomalous differential leg movement
  - Tower ground deformation
  - 4 to 8mm differential leg movement
  - Inspect, assess & report

- **Restoration**
  - Transmission Line Failure
  - Significant differential leg movement
  - Power Failure?
    - Y Enact emergency response measures
    - N
      - Greater than 8mm differential leg movement - Inspect, assess & report
      - 4 to 8mm differential leg movement
      - Inspect, assess & report
      - Enact Contingency Plan
      - Planned outage
      - Switch power to alternate line
      - Deploy emergency structures (Reenergise within 72 hours)
      - Are new tower(s) required?
        - Y
          - TransGrid schedule works
          - Continue monitoring
        - N
          - Agree with TransGrid
          - Continue monitoring
      - Are new tower(s) required?
        - Y
          - Enact Contingency Plan
          - Planned outage
          - Switch power to alternate line
          - Deploy emergency structures
          - Return to service
        - N
          - Continue monitoring
      - Enact Contingency Plan
      - Planned outage
      - Switch power to alternate line
      - Deploy emergency structures
      - Return to service
      - Continue monitoring

- **Restoration of Service**
  - Switch power to alternate line
  - Deploy emergency structures (Reenergise within 72 hours)
  - Normal Conditions
    - Continue monitoring
  - Continue monitoring