METROPOLITAN COAL

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LONGWALLS 301-303

BUILT FEATURES MANAGEMENT PLAN ENDEAVOUR ENERGY

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DP&E Approval Date
All	LW301-303 BFMP_END-R01-A	Original – Draft for Consultation	Endeavour Energy	-
Section 4.2.3 (removed), Table 4 and Figure 4	LW301-303 BFMP_END-R01-B	Revised – including updates	Endeavour Energy	-

November 2016

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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 and surface facilities at Metropolitan Coal. The underground mining longwall layout is shown on Figure 1. Following the anticipated completion of Longwall 27 in 2017, Longwalls 301, 302 and 303 (herein referred to as Longwalls 301-303) define the next mining sub-domain 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 – Endeavour Energy (Longwalls 301-303 BFMP-END) has been developed to manage the potential consequences of Longwalls 301-303 extraction on the Endeavour Energy assets associated with the 132 kV transmission line and towers, and other high voltage powerlines and poles.

The relationship of this Longwalls 301-303 BFMP-END to the Metropolitan Coal Environmental Management Structure and to the Metropolitan Coal Longwalls 301-303 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 Longwalls 301-303 BFMP-END, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and Metropolitan Coal were endorsed by the Director-General (now Secretary) of the Department of Planning and Environment (DP&E) on 6 June 2016. This Longwalls 301-303 BFMP-END has been prepared in consultation with Endeavour Energy, including consideration of prior consultation during the development of the previously approved Longwalls 20-22 and Longwalls 23-27 Built Features Management Plans. The Longwalls 20-22 and Longwalls 23-27 Built Features Management Plans will be superseded by this document consistent with the recommended approach in the draft *Guidelines for the Preparation of Extraction Plans* (DP&E and DRE, 2014).

1.2 STRUCTURE OF THE LONGWALLS 301-303 BFMP-END

The remainder of the Longwalls 301-303 BFMP-END is structured as follows:

Section 2: Describes the review and update of the Longwalls 301-303 BFMP-END.

Section 3: Outlines the statutory requirements applicable to the Longwalls 301-303 BFMP-END.

Section 4: Provides a revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 301-303.

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.

Section 11: Describes the program to collect sufficient baseline data for future Extraction Plans.

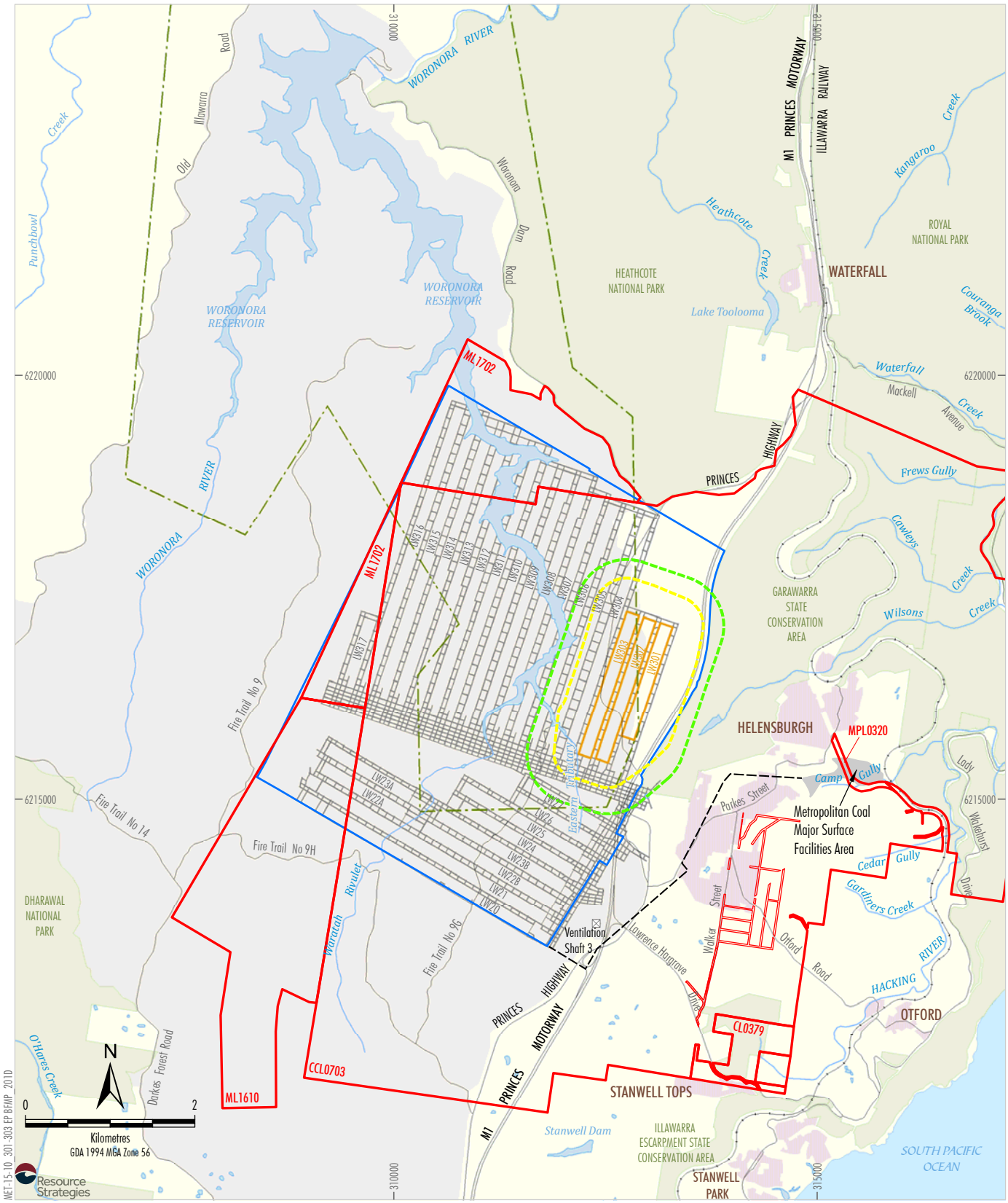
Section 12: Describes the annual review and improvement of environmental performance.

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 Longwalls 301-303 BFMP-END.



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwalls 301 - 303 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwalls 301-303
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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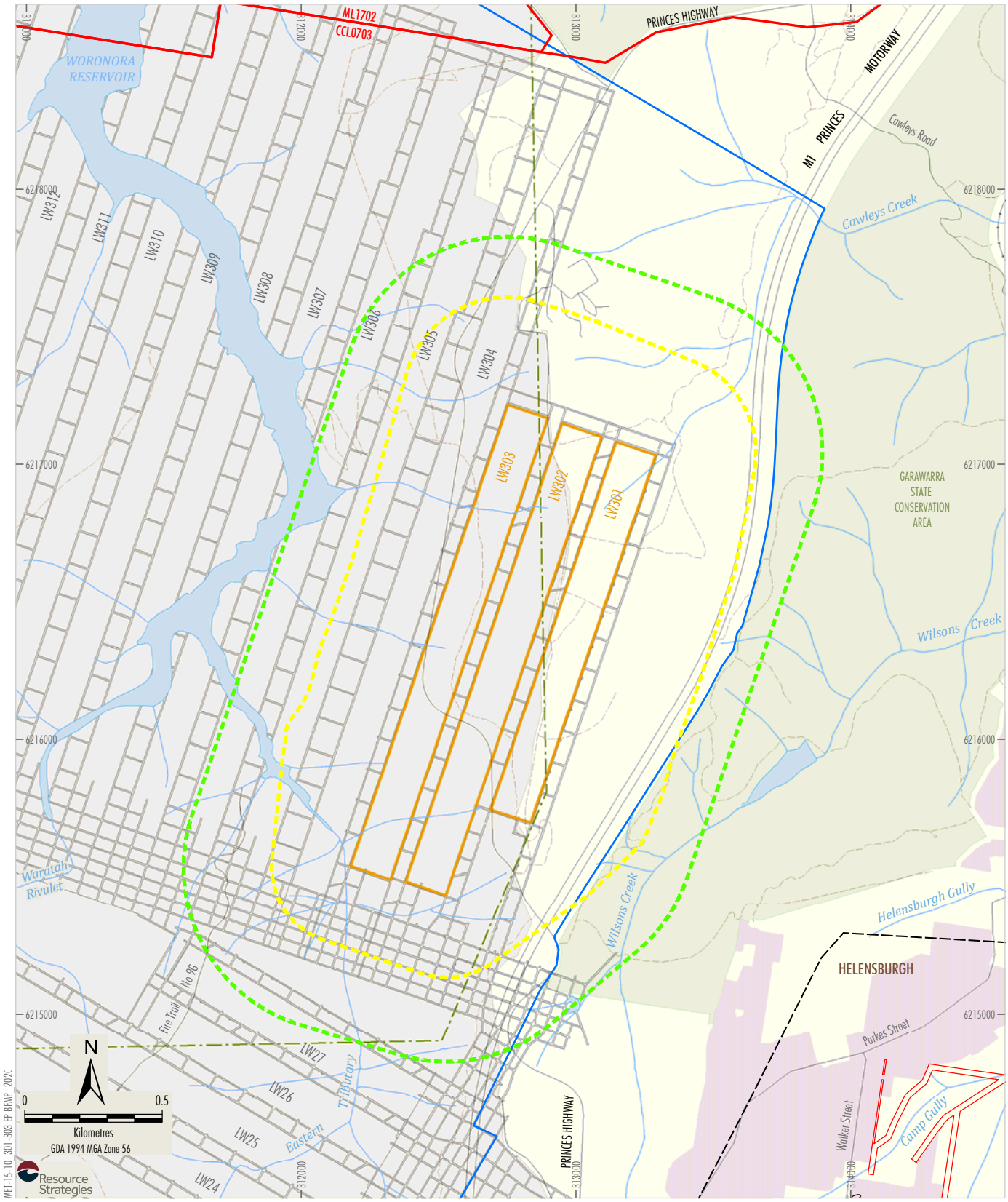
Project Longwalls 20 - 27 and Longwalls 301 - 317 Layout

Figure 1



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwalls 301 - 303 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwalls 301-303
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Road
- Vehicular Track

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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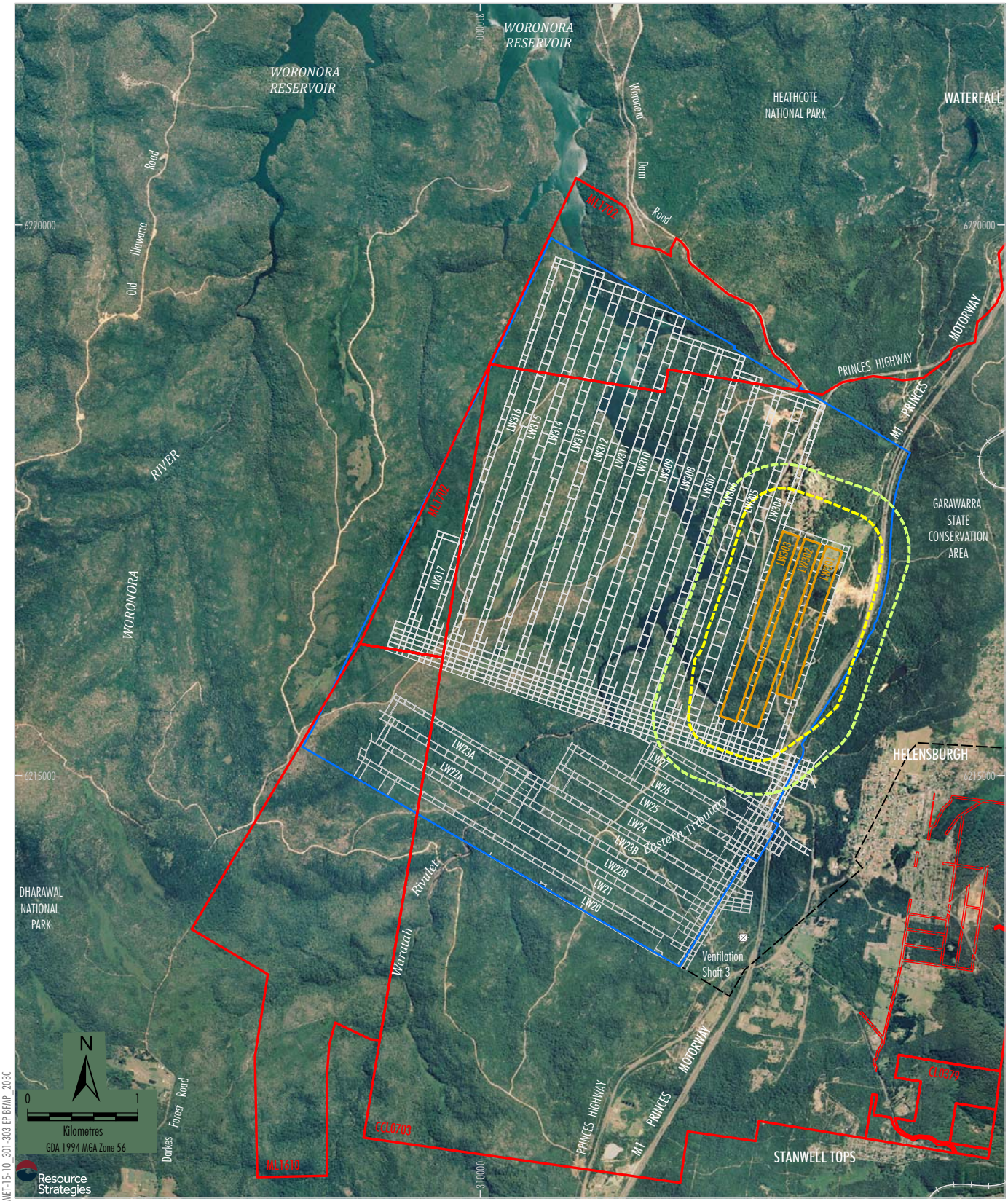
Longwalls 301 - 303 Layout

Figure 2



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LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwalls 301 - 303 Secondary Extraction
- 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Secondary Extraction of Longwalls 301-303
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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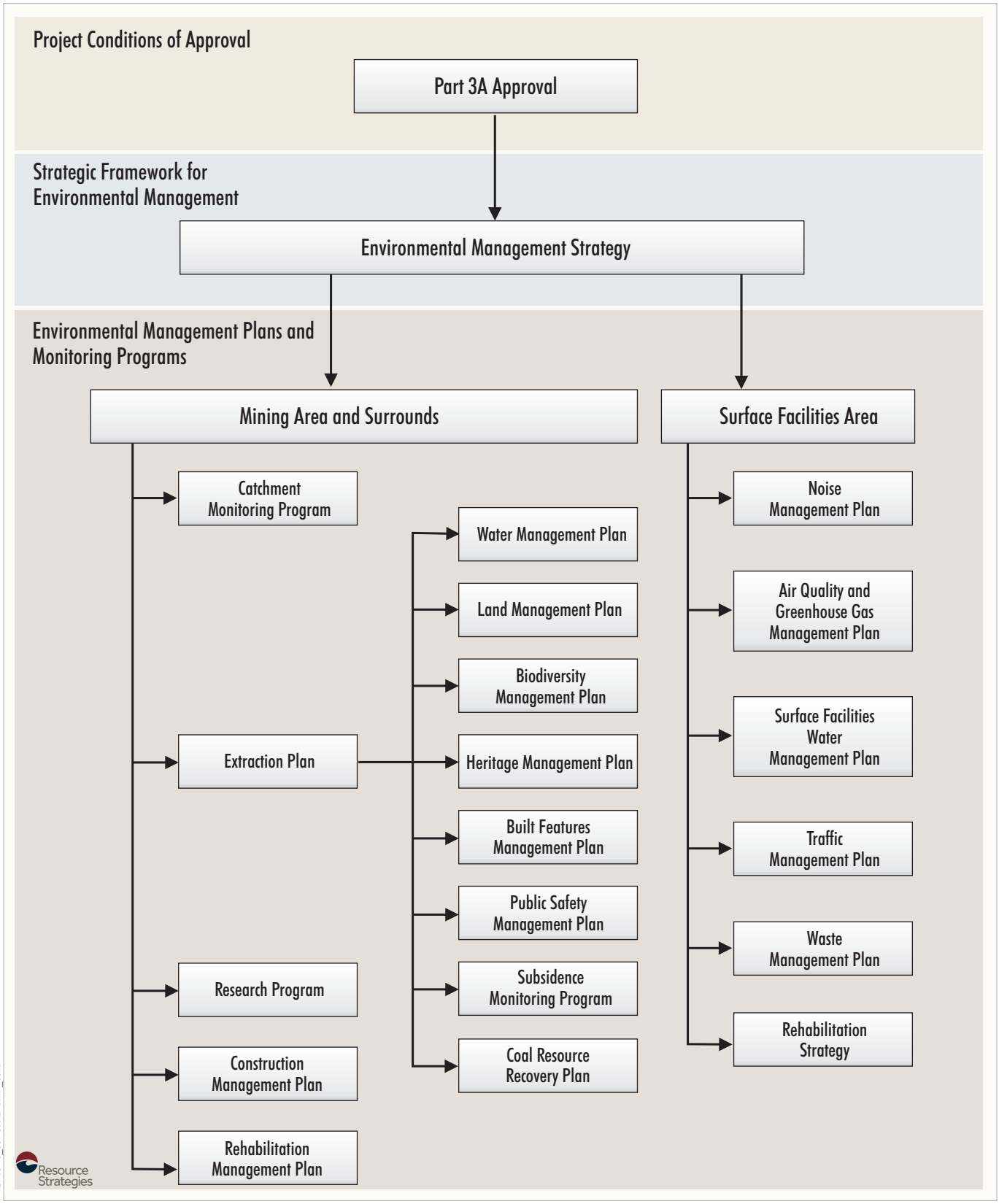
Project Longwalls 20 - 27 and Longwalls 301 - 317 Layout - Aerial Photograph

Figure 3



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Environmental Management Structure

Figure 4

2 LONGWALLS 301-303 BFMP-END REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, this Longwalls 301-303 BFMP-END 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 document is indicated on the title page of each copy of the Longwalls 301-303 BFMP-END. The distribution register for controlled copies of the Longwalls 301-303 BFMP-END is described in Section 2.1.

Revisions to any documents listed within this Longwalls 301-303 BFMP-END 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 Longwalls 301-303 BFMP-END publicly available on the Peabody website. A hard copy of the Longwalls 301-303 BFMP-END 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 Longwalls 301-303 BFMP-END, will be distributed;
- the format (i.e. electronic or hard copy) of distribution; and
- the format of revision notification.

Metropolitan Coal has made 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 Longwalls 301-303 BFMP-END 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&A ACT 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 Longwalls 301-303 BFMP-END. Table 1 indicates where each component of the conditions is addressed within this Longwalls 301-303 BFMP-END.

Table 1
Management Plan Requirements

Project Approval Condition	Longwalls 301-303 BFMP-END Section
Condition 2 of Schedule 7	
2. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:	
a) detailed baseline data;	Section 6
b) a description of:	
• the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 3
• any relevant limits or performance measures/criteria;	Section 5
• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	Section 5
c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	Sections 7, 8, 9 and 10
d) a program to monitor and report on the:	Sections 7, 8 and 12
• impacts and environmental performance of the project;	
• effectiveness of any management measures (see c above);	
e) a contingency plan to manage any unpredicted impacts and their consequences;	Section 9
f) a program to investigate and implement ways to improve the environmental performance of the project over time;	Sections 7 and 12
g) a protocol for managing and reporting any;	
• incidents;	Section 13
• complaints;	Section 14
• non-compliances with statutory requirements; and	Section 15
• exceedances of the impact assessment criteria and/or performance criteria; and	Section 9
h) a protocol for periodic review of the plan.	Section 2
Condition 7 of Schedule 3	
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:	
a) a program to collect sufficient baseline data for future Extraction Plans;	Section 11
b) a revised assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;	Section 4
c) a detailed description of the measures that would be implemented to remediate predicted impacts; and	Section 8
d) a contingency plan that expressly provides for adaptive management.	Section 9

3.2 LICENCES, PERMITS AND LEASES

In addition to the Project Approval, all activities at or in association with Metropolitan Coal 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 Energy (DRE), within the NSW Department of Industry, Skills and Regional Development (NSW Department of Industry) 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 NSW Department of Industry.
- 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 Department of Primary Industries (DPI) 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 NSW Department of Industry and WorkCover NSW.
- Supplementary approvals obtained from WaterNSW (previously the Sydney Catchment Authority [SCA]) 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):

- *Contaminated Land Management Act, 1997;*
- *Crown Lands Act, 1989;*
- *Dams Safety Act, 1978;*
- *Dangerous Goods (Road and Rail Transport) Act, 2008;*
- *Energy and Utilities Administration Act, 1987;*
- *Fisheries Management Act, 1994;*
- *Mining Act, 1992;*
- *Noxious Weeds Act, 1993;*
- *Protection of the Environment Operations Act, 1997;*
- *Rail Safety (Adoption of National Law) Act, 2012;*

- *Roads Act, 1993;*
- *Threatened Species Conservation Act, 1995;*
- *Sydney Water Catchment Management Act, 1998;*
- *Water Act, 1912;*
- *Water Management Act, 2000;*
- *Work Health and Safety Act, 2011; and*
- *Work Health and Safety (Mines and Petroleum Sites) Act, 2013.*

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

4 REVISED ASSESSMENT OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

4.1 LONGWALL 301-303 EXTRACTION LAYOUT

Longwalls 301-303 and the area of land within 600 metres (m) of Longwalls 301-303 secondary extraction are shown on Figures 2 and 3. Longwall extraction occurs from north to south. The longwall layout includes 163 m panel widths (void) with 45 m pillars (solid).

The provisional extraction schedule for Longwalls 301-303 is provided in Table 2.

Table 2
Provisional Extraction Schedule

Longwall	Estimated Start Date	Estimated Duration	Estimated Completion Date
301	April 2017	6 months	September 2017
302	November 2017	7 months	May 2018
303	June 2018	7 months	December 2018

The layout for Longwalls 301-303 (i.e. 163 m panel widths [void] and 45 m pillars [solid]) will be trialled to build on the experience and dataset obtained from Longwalls 20-27. The outcomes of the trial will be used to inform the potential for a similar mine layout to be applied to the next Extraction Plan (i.e. Longwall 304 onwards). The assessment of the trial longwall layout is described in Section 11.1.

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 Endeavour Energy Assets

Figure 5 illustrates the Endeavour Energy 132 kilovolt (kV) transmission line and towers. The Bellambi Heathcote 132 kV double circuit transmission line consists of:

- Circuit OS/98E which is out of service and is used for emergency backup supply to the Bellambi 132/33 kV Transmission Substation; and
- Circuit 7028 which supplies Helensburgh Zone Substation.

The Bellambi Transmission Substations supplies all northern suburbs of Wollongong and the associated major commercial areas, industrial areas and mines including Metropolitan Coal. Circuit 7028 is one of three 33 kV lines which supply Helensburgh Zone Substation which directly supplies Metropolitan Coal.

The 132 kV transmission line and towers are located to the east of the proposed Longwalls 301-303 and the longwalls will not pass beneath these electrical services. There are seven towers located near or within the 35 degree angle of draw line around the proposed longwalls as shown on Drawing No. MSEC844-01 (Figure 5). The distances from the towers to the nearest longwalls are summarised in Table 3 below.

Table 3
Transmission Towers Distance to Proposed Longwalls 301-303

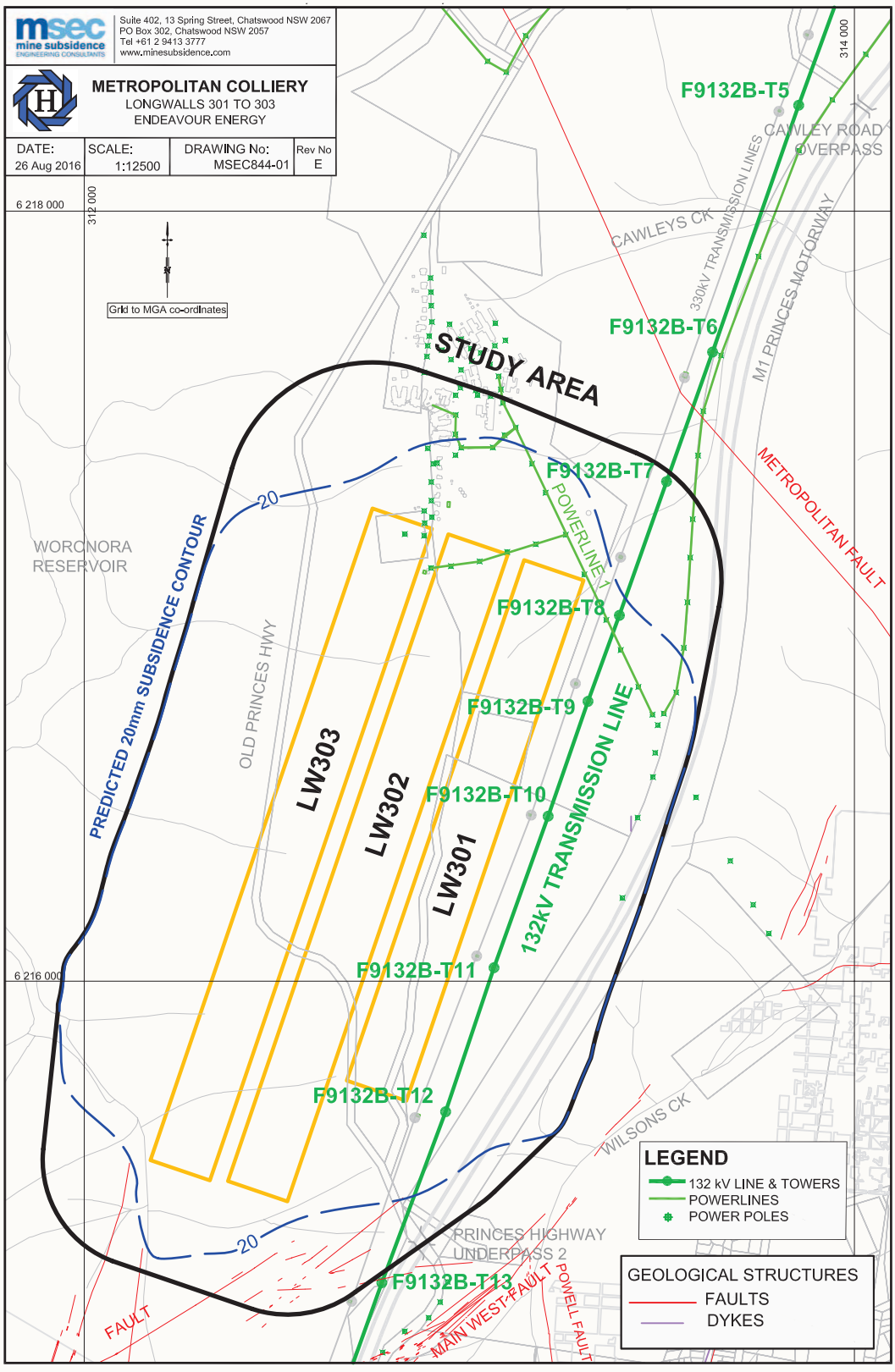
Tower Number	Tower Type	Nearest Longwall	Approximate Distance to Longwall (m)
F9132B – T13	Suspension	Longwall 301	320
F9132B – T12	Suspension	Longwall 301	100
F9132B – T11	Suspension	Longwall 301	100
F9132B – T10	Suspension	Longwall 301	110
F9132B – T9	Suspension	Longwall 301	110
F9132B – T8	Suspension	Longwall 301	120
F9132B – T7	Suspension	Longwall 301	330

Figure 5 also illustrates the Endeavour Energy infrastructure which consists of aerial and buried high voltage powerlines which service the Garrawarra Centre Complex. The feeder aerial powerline that runs between Helensburgh and the Garrawarra Centre Complex is referred in this BFMP as Powerline 1 (Figure 5).

4.2 REVISED SUBSIDENCE AND IMPACT PREDICTIONS

4.2.1 Revised Subsidence Predictions

Subsidence predictions for Longwalls 20-44 in relation to the Endeavour Energy 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.



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Resource Strategies

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Endeavour Energy Assets

Figure 5

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 Endeavour Energy assets were conducted by MSEC and reported in MSEC (2016) (Appendix 1).

In relation to subsidence predictions MSEC (2016) make the following conclusions:

- The 132 kV transmission towers are predicted to experience up to 90 mm subsidence resulting from the extraction of Longwalls 301 to 303.
- The maximum predicted conventional tilts at the 132 kV transmission towers are not measurable, at less than 0.5 mm/m or 1 in 2,000.
- The maximum predicted horizontal movement at the top of the towers (i.e. T11) is -30 mm orientated to the west (towards the longwalls).
- The 95% confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.4 mm/m tensile and 0.4 mm/m compressive. The 99% confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.7 mm/m tensile and 0.6 mm/m compressive.
- The feeder powerline (Powerline 1) is located outside the extents of Longwalls 301-303.
- The aerial conductors are supported by timber poles above the ground and therefore are not expected to experience adverse impacts due to curvature or strain.
- The buried cables located directly above the longwalls could experience the mining induced curvatures and strains.
- Extensive experience of mining beneath aerial and buried powerlines in the Southern Coalfield indicates that the potential mining impacts are rare and generally of a minor nature.

4.2.2 Risk Assessment Meeting

In accordance with the draft *Guidelines for the Preparation of Extraction Plans* (DP&E and DRE, 2014) a risk assessment meeting was held on 19 August 2016. Attendees at the risk assessment meeting included representatives from Metropolitan Coal, Endeavour Energy, MSEC, Resource Strategies and Axys Consulting (risk assessment facilitator).

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

- preliminary identification of Endeavour Energy assets;
- review of the revised subsidence predictions and potential impacts on Endeavour Energy 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 during the risk assessment which considered the extraction of coal beneath the land within the Study area and in proximity to the Endeavour Energy assets, and are summarised as follows:

Baseline Data / Validation

1. Carry out a visual audit of the Endeavour Energy assets (i.e. 132 kV transmission line and high voltage powerlines) within the Study area.
2. Obtain available information from Endeavour Energy regarding the make-up of the 132 kV structures and foundations.
3. Conduct a visual inspection of the access roads/tracks to the Endeavour Energy assets to document the existing condition and serviceability.
4. Carryout an investigation (dial before you dig) to identify the presence and ownership of the 11 kV cables that may be buried underground in the areas that may be affected by Longwalls 301 to 303.

Management / Monitoring / Response Measures

5. Establish a key contacts list between Peabody and Endeavour Energy to provide a regular update of status of mining activities, and for ongoing liaison.
6. Include in the BFMP a schedule of times/frequency of communication with Endeavour Energy for the status of mining of Longwalls 301-303.
7. Develop a Trigger Action Response Plan (TARP) and include triggers for conditions that may need to be actioned by Endeavour Energy.
8. Include in the BFMP relevant details regarding the potential for underground blast vibration impacts at the surface.

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 4.

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).

Table 4
Program for Implementation of Proposed Risk Control Measures and Procedures

	Risk Control Measure / Procedure	BFMP Section	Proposed Timing
Baseline Data / Validation			
1	Carry out a visual audit of the Endeavour Energy assets (i.e. 132kV transmission line and high voltage powerlines) in the Study area	Section 6	Prior to LW301
2	Obtain available information from Endeavour Energy regarding the make-up of the 132 kV structures and foundations	Section 6	Prior to LW301, subject to availability
3	Conduct a visual inspection of the access roads/tracks to the Endeavour Energy assets	Section 7.2.3	Prior to LW301
4	Carryout an investigation (dial before you dig) to identify the presence and ownership of the 11 kV cables that may be buried underground in the areas that may be affected by Longwalls 301 to 303	Appendix 1 / BFMP-Garrawarra	Complete (MSEC)
Management / Monitoring / Response Measures			
5	Establish key contacts list in the BFMP	Section 6.1	Complete
6	Include a schedule of times/frequency of communication with Endeavour Energy for the status of mining of Longwalls 301-303 in the BFMP	Sections 7 and 10 / Table 2	Complete
7	Include in the TARP triggers for conditions that may need to be actioned by Endeavour Energy	Section 10 / Table 8	Complete
8	Include in the BFMP relevant details regarding the potential for underground blast vibration impacts at the surface	Section 4.3	Complete

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 132 kV transmission lines and towers is maintained;
- the structural integrity of the timber poles and high voltage powerlines is maintained;
- the electrical clearance from vegetation is maintained; and
- the serviceability of the access roads/tracks is maintained.

Section 7 of this Longwalls 301-303 BFMP-END describes the monitoring that will be conducted to assess the Project against the above performance measure. Section 9 of this Longwalls 301-303 BFMP-END provides a Contingency Plan in the event the performance measure is exceeded.

6 BASELINE DATA

A photograph of a 132 kV transmission tower is shown in Plate 1.

Plate 1 – 132 kV Transmission Tower (Source: MSEC, 2016)

The powerlines which service the Garrawarra Centre Complex comprise copper conductors supported by timber poles (Plates 2 and 3).

Plates 2 and 3 – Aerial Powerlines (Source: MSEC, 2016)

A visual audit / site inspection of the 132 kV transmission line and towers within the Study area will be conducted prior to commencement of secondary extraction of Longwall 301 to establish the condition of the structures. The inspection will include:

- recording of existing structure conditions;
- two dimensional image records of the potentially affected structures; and
- condition of the access roads/tracks with specific attention to surface cracks.

A site inspection of the timber poles and powerlines within the Study area will also occur to record the existing structure conditions and access roads/tracks prior to commencement of secondary extraction of Longwall 301.

The audits / site inspections will be conducted by representative(s) from Endeavour Energy and Metropolitan Coal.

6.1 KEY CONTACTS LIST

The list of key contacts for Peabody and Endeavour Energy during the development and implementation of this BFMP are provided in Table 5.

Table 5
List of Key Contacts

Company	Position	Name
Peabody (Metropolitan Coal)	Manager – Technical Services	Jon Degotardi
Endeavour Energy	Transmission Manager – Southern Region	Gary Brennan
Endeavour Energy	Senior Engineer – Major Projects B Network Development	Mehran Azimi

7 MONITORING

A monitoring program will be implemented to monitor the impacts of the Project on the 132 kV transmission line and towers, high voltage powerlines and access roads/tracks as determined in consultation with Endeavour Energy. Table 6 summarises the Longwalls 301-303 BFMP-END monitoring components.

Table 6
Longwalls 301-303 BFMP-END Monitoring Program Overview

Monitoring Component	Locations	Frequency	Parameters
Subsidence Parameters	• As described in the Metropolitan Coal Longwalls 301-303 Subsidence Monitoring Program. • Monitoring specific to the 132 kV line includes: - Subsidence line along the transmission line corridor within 600 m of Longwalls 301-303 extraction. - Tower legs (Towers T7 to T13). - T7 to T13 four ground points at each tower. - T7 to T13 top of tower at fixed point.	• Prior to the commencement of Longwall 301 extraction. • Within 3 months following the completion of extraction of each of Longwalls 301, 302 and 303.	• Monitoring parameters include: subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation, and differential leg movement.
Subsidence Impacts			
• 132 kV Towers	• Towers T7 to T13 (refer to Figure 5).	• Prior to the commencement of Longwall 301 extraction. • Within 3 months following the completion of extraction of each of Longwalls 301, 302 and 303. • More frequently (e.g. weekly) at each tower within 400 m of the active longwall face. • Routinely as per Endeavour Energy inspections (annual ground inspection, six yearly climbing inspection). • At any time in case of fault or emergency.	• Degradation of tower structure. • Degradation of tower foundations/footings. • Movement of insulator strings.
• 132 kV Transmission line	• Line from Towers T7 to T13 (refer Figure 5). • Ground survey. • Climbing inspection.	• Prior to the commencement of Longwall 301 extraction. • Within 3 months following the completion of extraction of each of Longwalls 301, 302 and 303. • Routinely as per Endeavour Energy inspections (annual ground inspection, six yearly climbing inspection). • At any time in case of fault or emergency.	• Vegetation clearance. • Land clearance. • Road clearance. • Integrity and function of support clamps or other items.

Table 6 (Continued)
Longwalls 301-303 BFMP-END Monitoring Program Overview

Monitoring Component	Locations	Frequency	Parameters
Subsidence Impacts (Cont.)			
• Poles	• Timber poles (refer to Figure 5).	• Prior to the commencement of Longwall 301 extraction. • Within 3 months following the completion of extraction of Longwalls 301-303. • Routinely as per Endeavour Energy inspections. • At any time in case of fault or emergency.	• Degradation of structure. • Movement of conductors.
• High voltage powerline	• Powerline (refer Figure 5). • Ground survey.	• Prior to the commencement of Longwall 301 extraction. • Within 3 months following the completion of extraction of Longwalls 301-303. • Routinely as per Endeavour Energy inspections. • At any time in case of fault or emergency.	• Vegetation clearance. • Land clearance. • Road clearance. • Integrity and function of support clamps or other items.
• Access roads/tracks	• Within 600 m of Longwalls 301-303 extraction.	• Prior to the commencement of Longwall 301 extraction. • Within 3 months following the completion of extraction of Longwalls 301-303. • Opportunistic visual observations during catchment visits as per the Longwalls 301-303 Land Management Plan. • Routinely as per Endeavour Energy inspections.	• Surface cracks, buckling and general safety.

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

Endeavour Energy or their delegates will conduct the various visual inspections. Metropolitan Coal will be notified of the timing of inspections and accompany Endeavour Energy 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 Longwalls 301-303 BFMP-END.

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 Longwalls 301-303 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 Endeavour Energy 132 kV transmission line and towers will be measured by a single survey line along the transmission corridor occupied by the 132 kV transmission line, and by survey of Towers T7 to T13.

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 ±5 mm.

7.2 SUBSIDENCE IMPACTS

7.2.1 132 kV Transmission Line and Towers

Visual inspections will be conducted of the 132 kV transmission line and towers between Tower T7 and T13 inclusive in accordance with the Endeavour Energy inspection program. This generally includes:

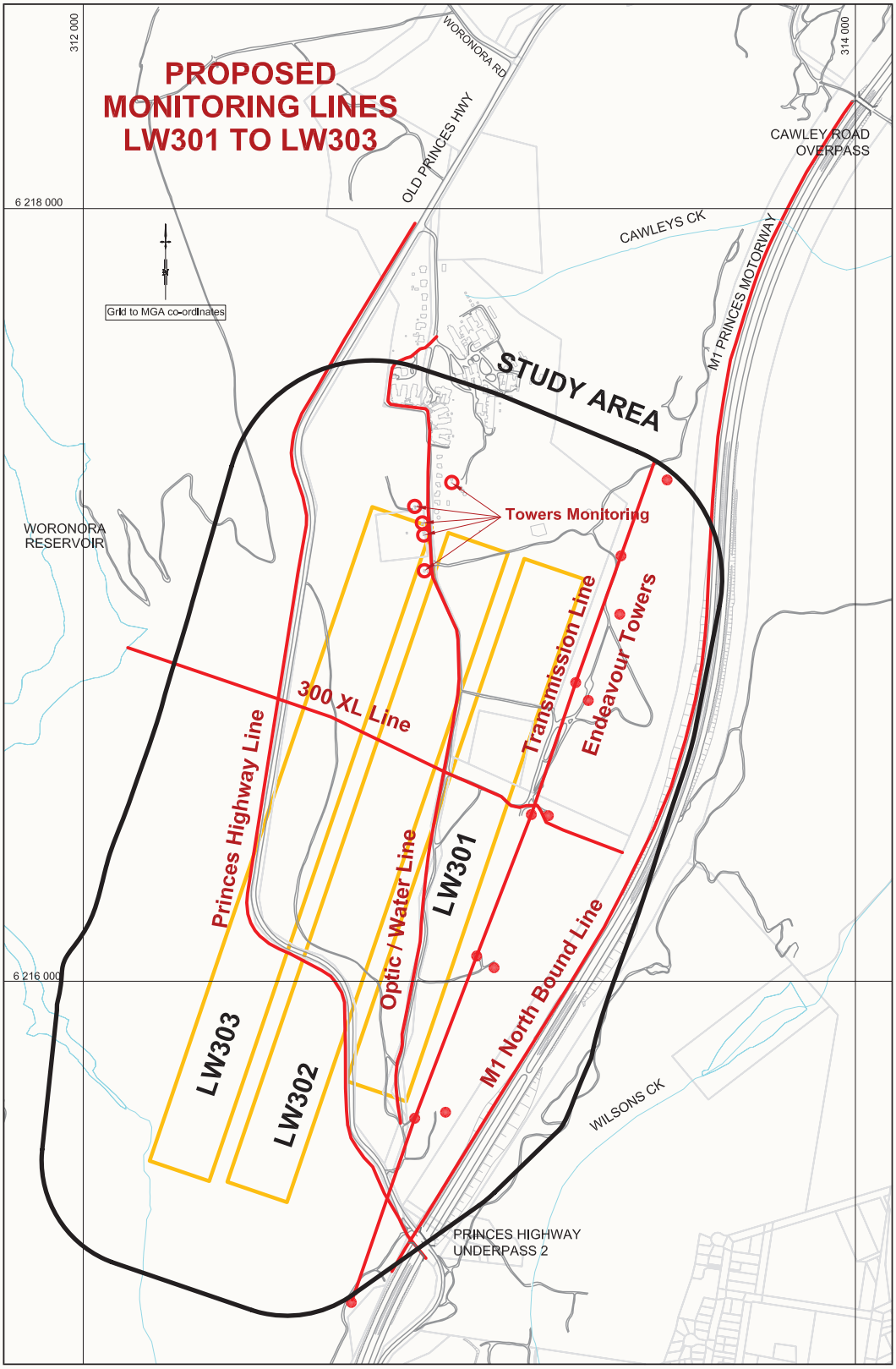
- annual inspection of the structural integrity of sites from the ground;
- annual inspection of vegetation growth and electrical clearances from the air;
- six yearly climbing inspections; and
- fault and emergency patrols from either the air or ground at any time.

A visual inspection will be conducted prior to commencement of Longwall 301. More frequent (e.g. weekly) inspections will be conducted by Metropolitan Coal at each tower within 400 m of the active longwall face. Additional opportunistic 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 2) and reported in accordance with the Project Approval conditions.



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Resource Strategies

Peabody ENERGY

METROPOLITAN COAL

Longwalls 301-303 Subsidence Monitoring
Layout

Figure 6

7.2.2 Timber Poles and High Voltage Powerlines (Aerial and Buried)

A visual inspection of the timber poles[1] and powerlines will be conducted prior to commencement of Longwall 301. Additional opportunistic observations of subsidence impacts will be conducted during routine works and sampling by Metropolitan Coal and its contractors.

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 2) and reported in accordance with the Project Approval conditions.

7.2.3 Access Roads/Tracks

Visual inspection of the access roads/tracks to the Endeavour Energy assets will be conducted prior to the commencement of Longwall 301, and following extraction of each longwall panel.

Opportunistic visual observations of access roads/tracks would occur as part of routine works and inspections as well as during catchment visits within 600 m of Longwalls 301-303 secondary extraction as described in the Metropolitan Coal Longwalls 301-303 Land Management Plan (Longwalls 301-303 LMP).

Specific details that will be noted and/or photographed that are relevant to the Endeavour Energy 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 Endeavour Energy asset;
- whether any actions are required (e.g. implementation of management measures as outlined in the Longwalls 301-303 LMP, initiation of the Contingency Plan as outlined in the Longwalls 301-303 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 Longwalls 301-303 LMP - Subsidence Impact Register and reported in accordance with the Project Approval conditions.

[1] For example, where a timber pole lean of greater than 15 degrees from vertical is identified.

The information obtained will be used to assess the potential environmental consequences of the subsidence impact (described in the Longwalls 301-303 LMP) and to identify required management measures. Management measures are discussed in the Longwalls 301-303 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 Longwalls 301-303 Public Safety Management Plan.

7.3 ENVIRONMENTAL CONSEQUENCES

Metropolitan Coal and Endeavour Energy 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 Endeavour Energy 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 132 kV towers and transmission lines, and other high voltage powerlines and poles are considered to be applicable. These include:

- alteration of conductor tensions;
- modification to attachment points such as placement of stringing sheaves to earth wires and/or phase conductors;
- strengthening of tower structures through installation of cruciform footings; and
- strengthening of timber poles footings.

The requirement for these management measures will be determined by Endeavour Energy and if required, constructed prior to mining within 600 m of the structure.

Where significant subsidence impacts on access roads/tracks are detected (e.g. those that affect the serviceability) or at any time Metropolitan Coal, Endeavour Energy or the landholder considers that the integrity of the access roads/tracks may be compromised, the following management measures will be implemented. 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 Longwalls 301-303 Land Management Plan.

Metropolitan Coal will assess the potential impacts to public safety and where appropriate, implement measures in accordance with the Longwalls 301-303 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 Longwalls 301-303 BFMP-END, Metropolitan Coal will implement the following Contingency Plan:

- The observation will be reported to the Metropolitan Coal Manager - Technical Services or the Manager – Safety & Environmental 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 2) consistent with the monitoring program described in Section 7 of this Longwalls 301-303 BFMP-END.
- If relating to an access road/track, the observation will be recorded in the Metropolitan Coal Longwalls 301-303 Land Management Plan – Subsidence Impact Register.
- Metropolitan Coal will report any exceedance of the performance measure or indicators to the DP&E and Endeavour Energy 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 Longwalls 301-303 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.

  Potential 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 *Mine Subsidence Compensation Regulation, 2002* in the event that property damages occur as a result of mining Longwalls 301-303.

9.1 CONTINGENCY MEASURES

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

Potential contingency measures that could be considered in the event the performance measure for the 132 kV towers and transmission lines or the timber poles and high voltage powerlines is exceeded are summarised in Table 7.

Table 7
Potential Contingency Measures

Environmental Consequence	Potential Contingency Measures	
	Measure	**Description**
Impact on:		
Towers	Stabilisation techniques	Installation of tower supports such as cruciform elements.
	Rebuilding	Construction of new tower(s) or emergency structures.
Transmission Wires	Stabilisation techniques	Sheaving of conductors and/or earth wires.
	Rebuilding	Construction of new transmission lines.
Timber Poles	Stabilisation techniques	Installation of supports.
	Rebuilding	Construction of new pole(s) or emergency structures.
Powerline Wires	Stabilisation techniques	Sheaving of conductors and/or earth wires.
	Rebuilding	Construction of new powerlines.

10 TARP – MANAGEMENT TOOL

The framework for the various components of this Longwalls 301-303 BFMP-END are summarised in the Longwalls 301-303 BFMP-END TARP shown in Table 8. The Longwalls 301-303 BFMP-END 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 8
Longwalls 301-303 BFMP-END Trigger Action Response Plan

Condition	Baseline Conditions	Predicted Impacts	Restoration/Contingency Phase
Trigger	• 132 kV towers and transmission line is safe serviceable and repairable or as otherwise identified by pre-mining inspection. • Timber poles and high voltage powerlines are safe serviceable and repairable or as otherwise identified by pre-mining inspection. • Access roads/tracks serviceable.	• Negligible impact to 132 kV towers and transmission lines. • Negligible impact to timber poles and high voltage powerlines. • Surface cracking developed on access road/track.	• Reduction in structural integrity or function of towers and/or transmission line. • Reduction in structural integrity or function of poles and/or high voltage power line. • Tension cracks developed on access roads/tracks.
Action	Establish baseline data. Includes: • Pre-mining inspection. • Pre-extraction subsidence survey as per the Longwalls 301-303 Subsidence Monitoring Program.	• Conduct monitoring as per Table 6. • Update the 'Built Features Management Plan – Subsidence Impact Register'. • For access roads/tracks, update the 'Land Management Plan – Subsidence Impact Register'. • Repair of access roads/tracks where significant cracks are detected (e.g. those that affect serviceability).	• Implement Contingency Plan as per Section 9.
Position of Decision-making	• Manager - Technical Services. • Endeavour Energy – Transmission Manager.	• Manager - Technical Services. • Endeavour Energy – Transmission Manager.	• General Manager. • Endeavour Energy – Transmission Manager.

11 FUTURE EXTRACTION PLANS

In accordance with Condition 7, Schedule 3 of the Project Approval, Metropolitan Coal will collect baseline data for the future Extraction Plan (e.g. Longwall 304 onward). However for the 132 kV transmission lines and towers and other high voltage powerlines, the baseline (and post-mining) data collected for Longwalls 301-303 will be used as baseline for Longwalls 304 onward as longwall mining progressively moves further away from the Endeavour Energy 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 Longwalls 301-303 BFMP-END will inform the appropriate type and frequency of monitoring of the assets relevant to the next Extraction Plan.

11.1 ASSESSMENT OF TRIAL LONGWALL LAYOUT FOR LONGWALLS 301-303

As described in Section 4.1, the layout for Longwalls 301-303 (i.e. 163 m panel widths [void] and 45 m pillars [solid]) will be trialled to build on the experience and dataset obtained from Longwalls 20 to 27. The outcomes of the trial will be used to inform the potential for a similar mine layout to be applied to the next Extraction Plan (i.e. Longwall 304 onwards).

Following the completion of Longwall 301, and during the mining of Longwall 302, Metropolitan Coal will review the available subsidence monitoring results and assess the changes to, and impacts on, Endeavour Energy assets.

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.

Endeavour Energy 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 Manager – Safety & Environmental Services 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 Manager – Safety & Environmental Services 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 Manager – Safety & Environmental Services.

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 Manager – Safety & Environmental Services 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 Manager – Safety & Environmental Services 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 Manager – Safety & Environmental Services 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

Department of Planning & Environment and Division of Resources and Energy (2014) *Guidelines for the Preparation of Extraction Plans*. Draft.

Heggies (2008) *Metropolitan Coal Project Noise Impact Assessment.* Appendix J in the Metropolitan Coal Project Environmental Assessment.

Helensburgh Coal Pty Ltd [HCPL] (2008) *Metropolitan Coal Project Environmental Assessment*.

Helensburgh Coal Pty Ltd [HCPL] (2009) *Metropolitan Coal Project Preferred Project Report.*

Mine Subsidence Engineering Consultants (2008) *Subsidence Assessment Report on the Prediction of Subsidence Parameters and the Assessment of Mine Subsidence Impacts on Natural Features and Surface Infrastructure Resulting from the Proposed Extraction of Longwalls 20 to 44 at Metropolitan Colliery in Support of a Part 3A Application.*

Mine Subsidence Engineering Consultants (2016) *Metropolitan Colliery – Proposed Longwalls 301 to 303 - Subsidence Predictions and Impact Assessments for the Endeavour Energy Infrastructure.*

APPENDIX 1

MSEC (2016) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 301 TO 303 - SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE ENDEAVOUR ENERGY INFRASTRUCTURE, DATED 7 SEPTEMBER 2016

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7th September 2016

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

Ref: MSEC844-01

Dear Jon,

RE: Metropolitan Colliery – Proposed Longwalls 301 to 303 - Subsidence Predictions and Impact Assessments for the Endeavour Energy Infrastructure

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the Endeavour Energy Infrastructure resulting from the extraction of the proposed Longwalls 301 to 303 at Metropolitan Colliery.

The locations of the infrastructure and the proposed longwalls are shown in the attached Drawing No. MSEC844-01. The infrastructure includes a 132kV transmission line and low voltage powerlines located to the north and east of Longwalls 301 to 303. The 132kV transmission line therefore is located to the east and not proposed to be directly mined beneath. Parts of the low voltage powerline pass above the Longwalls 302 and 303. Predictions and impact assessments for the Endeavour Energy infrastructure are provided below

132 kV Transmission Line

The transmission towers and reference numbers are also shown in Drawing No. MSEC844-01. There are seven 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 132 kV Transmission Towers from Longwalls 301 to 303

Tower Number	Tower Type	Distance of the Transmission Towers Centrelines from the Longwalls (m)
F9132B-T13	Suspension	320
F9132B-T12	Suspension	100
F9132B-T11	Suspension	100
F9132B-T10	Suspension	110
F9132B-T9	Suspension	110
F9132B-T8	Suspension	120
F9132B-T7	Suspension	330

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 2 degrees.

A photograph of one of the 132 kV transmission towers is provided in Figure 1.

Figure 1 Photograph of a 132 kV Transmission Tower

The predictions and impact assessments for the 132 kV transmission line are provided in the following sections.

Conventional Subsidence Parameters

The following provides summaries of the maximum predicted conventional movements for the 132 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 132 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 132 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 132 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 132 kV Transmission Line Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt Along Alignment (mm/m)	Maximum Predicted Incremental Tilt Across Alignment (mm/m)
Due To LW301	30	< 0.5	< 0.5
Due To LW302	60	< 0.5	< 0.5
Due To LW303	< 20	< 0.5	< 0.5

The maximum predicted incremental subsidence for the 132 kV transmission line, due to the extraction of each of the Longwalls 301 to 303, varies from less than 20 mm to 60 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 tilts due to each of the longwalls are less than 0.5 mm/m (i.e. less than 0.05 %, or 1 in 2,000).

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 3 Maximum Predicted Total Subsidence, Tilt Along and Tilt Across the Alignment of the 132 kV Transmission Line Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt Along Alignment (mm/m)	Maximum Predicted Total Tilt Across Alignment (mm/m)
After LW301	30	< 0.5	< 0.5
After LW302	80	< 0.5	< 0.5
After LW303	90	< 0.5	0.5

The maximum predicted total subsidence for the 132 kV transmission line, resulting from the extraction of Longwalls 301 to 303, is 90 mm. The greatest subsidence occurs adjacent to the southern end of Longwall 301. The maximum predicted conventional tilt is 0.5 mm/m (i.e. 0.05 %, or 1 in 2,000) and is orientated across the alignment of the transmission line. The predicted conventional tilts along the alignment of the transmission line are less than 0.5 mm/m.

There are seven transmission towers that are located within or immediately adjacent to the Study Area, being Towers F9132B-T7 to F9132B-T13. 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 4 Predicted Total Subsidence in the Locations of the Transmission Towers Resulting from the Extraction of Longwalls 301 to 303

Tower	Maximum Predicted Total Subsidence after LW301 (mm)	Maximum Predicted Total Subsidence after LW302 (mm)	Maximum Predicted Total Subsidence after LW303 (mm)
F9132B-T13	< 20	< 20	< 20
F9132B-T12	< 20	40	50
F9132B-T11	30	80	90
F9132B-T10	30	70	90
F9132B-T9	30	70	80
F9132B-T8	< 20	20	30
F9132B-T7	< 20	< 20	< 20

The transmission towers are predicted to experience vertical subsidence up to 90 mm resulting from the extraction of Longwalls 301 to 303. The highest subsidence is predicted to occur at Towers F9132B-T10 and F9132B-T10.

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 40 metres.

Table 5 Maximum Predicted Total Tilts and Horizontal Movements at the Transmission Towers Resulting from the Extraction of Longwalls 301 to 303

Tower	Maximum Predicted Total Tilt Along Alignment at the Base of the Tower (mm, +ve towards north and -ve towards south)	Maximum Predicted Total Tilt Across Alignment at the Base of the Tower (mm, +ve towards east and -ve towards west)	Maximum Predicted Total Horizontal Movement Along Alignment at the Top of Tower (mm, +ve towards north and -ve towards south)	Maximum Predicted Total Horizontal Movement Across Alignment at the Top of the Tower (mm, +ve towards east and -ve towards west)
F9132B-T13	< ±0.5	< ±0.5	< ±20	< ±20
F9132B-T12	< ±0.5	< ±0.5	< ±20	< ±20
F9132B-T11	< ±0.5	< ±0.5	< ±20	-30
F9132B-T10	< ±0.5	< ±0.5	< ±20	-20
F9132B-T9	< ±0.5	< ±0.5	< ±20	-20
F9132B-T8	< ±0.5	< ±0.5	< ±20	< ±20
F9132B-T7	< ±0.5	< ±0.5	< ±20	< ±20

The maximum predicted conventional tilt in the locations of the transmission towers is less than 0.5 mm/m (i.e. less than 0.05 %, or 1 in 2,000). The maximum predicted horizontal movement at the tops of the towers is -30 mm 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

Span	Maximum Predicted Opening due to LW301 to LW303 (mm)	Maximum Predicted Closure due to LW301 to LW303 (mm)	Final Predicted Opening (+ve) or Closure (-ve) after LW303 (mm)
F9132B-T13 to F9132B-T12	< 20	< 20	< ±20
F9132B-T12 to F9132B-T11	< 20	< 20	< ±20
F9132B-T11 to F9132B-T10	< 20	< 20	< ±20
F9132B-T10 to F9132B-T9	< 20	< 20	< ±20
F9132B-T9 to F9132B-T8	< 20	< 20	< ±20
F9132B-T8 to F9132B-T7	< 20	< 20	< ±20

The maximum predicted opening and closure between the tops of the transmission towers are less than 20 mm.

The 132 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).

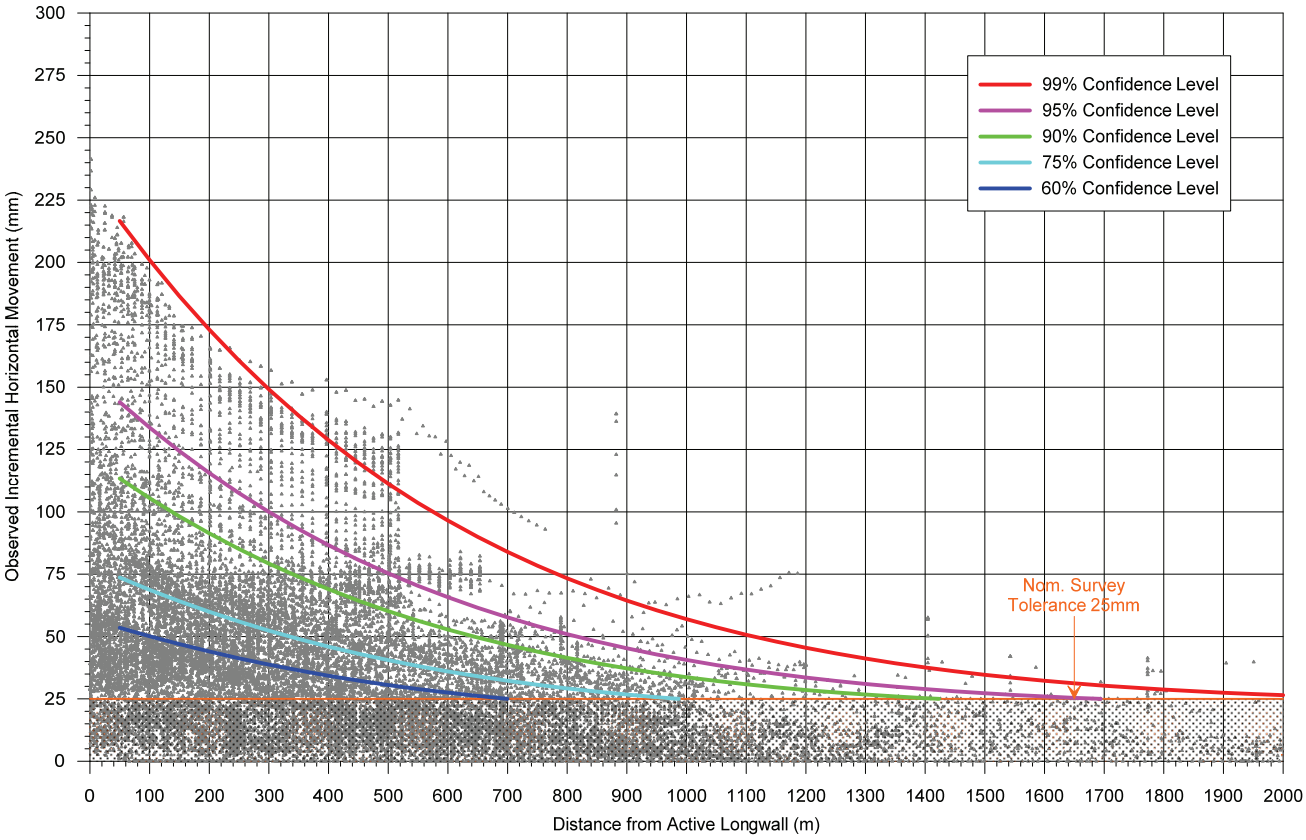

Figure 2 Observed Incremental Far-field Horizontal Movements from the Southern Coalfield (Solid Coal)

The transmission towers are located at distances between 100 and 330 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 132 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 F9132B-T12 to F9132B-T13 and towers F9132B-T7 to F9132B-T8. 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 50 mm to 100 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 132 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 100 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 and within 100 metres to 250 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.

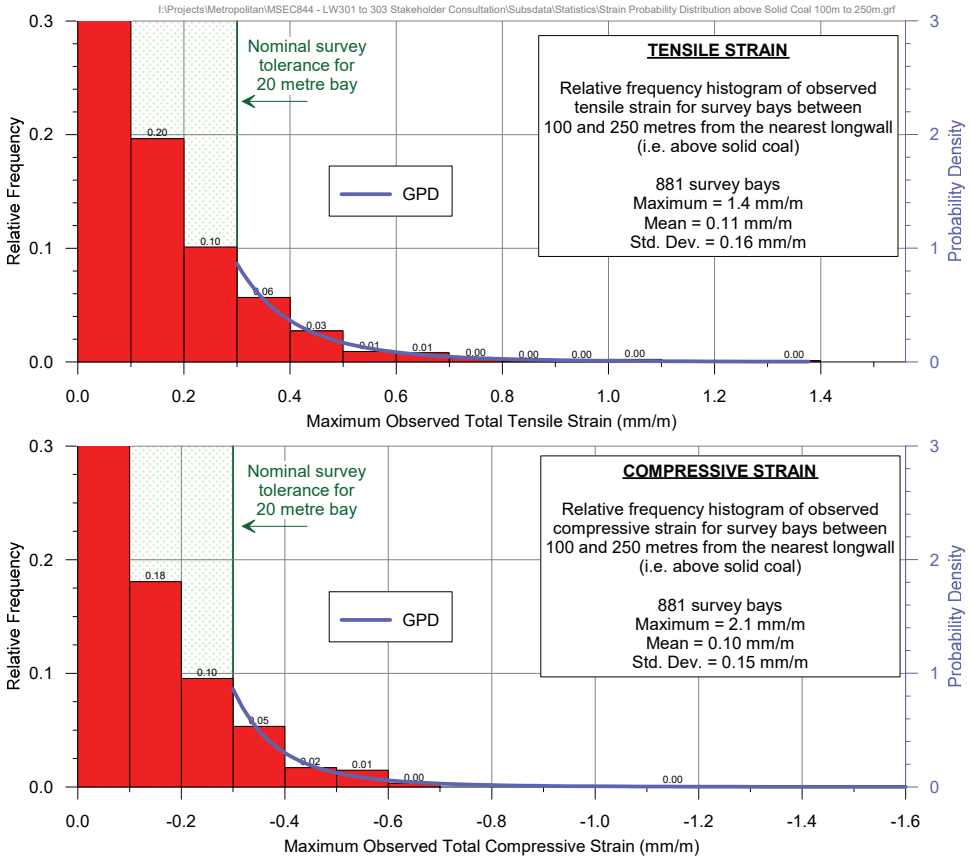

Figure 3 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Solid Coal (100 to 250 metres)

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

Strain (mm/m)		Probability of Exceedance
Compression	-1.5	1 in 3,100
	-1.0	1 in 630
	-0.5	1 in 50
	-0.3	1 in 10
Tension	+0.3	1 in 10
	+0.5	1 in 35
	+1.0	1 in 400
	+1.5	1 in 2,200

The 95 % confidence intervals for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining are 0.4 mm/m tensile and 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 0.7 mm/m tensile and 0.6 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 mapped geological structures are shown in Drawing No. MSEC844-01. The Metropolitan Fault has a north west to south east strike and dips to the north east. This fault crosses the alignment of the 132 kV transmission line outside of the Study Area, 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 F9132B-T13.

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.

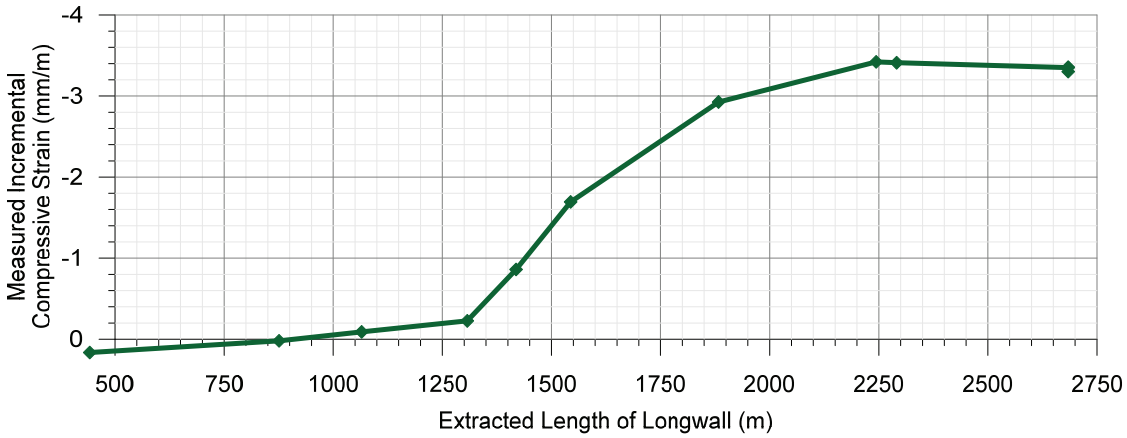

Figure 4 Development of Compressive Strain at the Surface Expression of the Low Angle Thrust Fault due to the Extraction of Appin Longwall 407

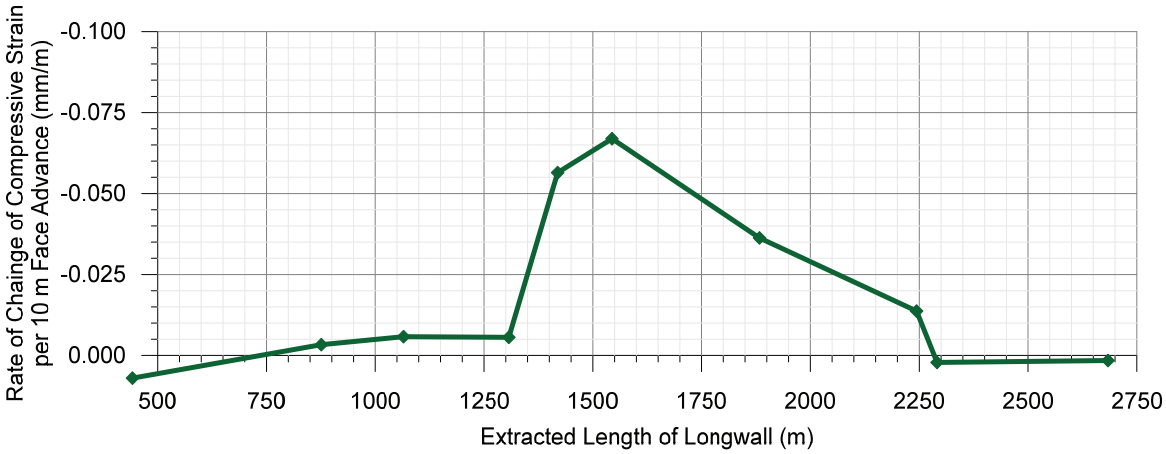

Figure 5 Rate of Change of Compressive Strain at the Surface Expression of the Low Angle Thrust Fault due to the Extraction of Appin Longwall 407

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 132 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 132 kV Transmission Line

The cables along the 132 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 distance between the towers, 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 90 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 less than 0.5 mm/m (i.e. less than 0.1 %, or 1 in 2,000). The predicted mining induced tilts are very small and in the order of survey tolerance (i.e. not measurable). The mining induced tilts and horizontal movements due to conventional subsidence movements are predicted to result in opening and closures 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 to 100 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 0.4 mm/m tensile and compressive based on the 95 % confidence level and are 0.7 mm/m tensile and 0.6 mm/m compressive based on the 99 % confidence level. It is recommended that Endeavour Energy 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 Endeavour Energy, 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 are proposed to be 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 Endeavour Energy 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 Endeavour Energy and Peabody Energy.

Low Voltage Powerlines

The locations of the low voltage infrastructure and the proposed longwalls are shown in the attached Drawing No. MSEC844-01. Aerial and buried low voltage powerlines service the Garrawarra Complex in the northern part of the Study Area and above the northern ends of Longwalls 302 and 303. The feeder aerial powerline that runs between Helensburgh and the Garrawarra Complex is referred to as Powerline 1 and it is located north of the commencing ends of Longwalls 301 and 302.

Photographs of the aerial powerlines within the Study Area are provided in Figure 6. These powerlines comprise copper conductors supported by timber poles.

Figure 6 Aerial Powerlines

Conventional Subsidence Parameters

The following provides summaries of the maximum predicted conventional movements for the Endeavour Energy infrastructure 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 this letter report.

The predicted profiles of incremental and total conventional subsidence, tilt along and tilt across the alignment of Powerline 1, resulting from the extraction of Longwalls 301 to 303, are shown in the attached Fig. A.3. 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. The range of predicted curvatures in any direction at any time during or after the extraction of the longwalls is shown by the grey shading.

A summaries of the maximum predicted values of incremental subsidence and tilt for Powerline 1, due to the extraction of each of the Longwalls 301 to 303, is provided in Table 8. The values are the maxima anywhere along the powerline at any time during or after the extraction of each longwall.

Table 8 Maximum Predicted Incremental Subsidence and Tilt for Powerline 1 Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt Along Alignment (mm/m)	Maximum Predicted Incremental Tilt Across Alignment (mm/m)
Due To LW301	< 20	< 0.5	< 0.5
Due To LW302	30	< 0.5	< 0.5
Due To LW303	< 20	< 0.5	< 0.5

The maximum predicted incremental subsidence for Powerline 1, due to the extraction of each of the Longwalls 301 to 303, varies from less than 20 mm to 30 mm. Only low levels of vertical subsidence are predicted for this powerline since it is located outside the extents of the longwalls.

A summary of the maximum predicted values of total subsidence and tilt for Powerline 1, resulting from the extraction of Longwalls 301 to 303, is provided in Table 9. The values are the maxima anywhere along the cables at any time during or after the extraction of the longwalls.

Table 9 Maximum Predicted Total Subsidence and Tilt for Powerline 1 Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt Along Alignment (mm/m)	Maximum Predicted Total Tilt Across Alignment (mm/m)
After LW301	< 20	< 0.5	< 0.5
After LW302	40	< 0.5	< 0.5
After LW303	50	< 0.5	0.5

The maximum predicted total subsidence for Powerline 1, resulting from the extraction of Longwalls 3301 to 303, is 50 mm after the completion of Longwall 303. The maximum predicted conventional tilts for this powerline are less than 0.5 mm/m (i.e. less than 0.05 %, or 1 in 2,000) along the alignment and 0.5 mm/m (i.e. 0.05 %, or 1 in 2,000) across the alignment (i.e. towards the longwalls).

The aerial powerlines that service the Garrawarra Complex are located above the northern ends of Longwalls 302 and 303. A summary of the maximum predicted values of total subsidence, tilt and curvature for these powerlines, resulting from the extraction of Longwalls 301 to 303, is provided in Table 10.

Table 10 Maximum Predicted Total Subsidence, Tilt and Curvature for the Aerial and Buried Powerlines on the Garrawarra Complex Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Hogging Curvature (km^{-1})	Maximum Predicted Total Sagging Curvature (km^{-1})
After LW301	30	< 0.5	< 0.01	< 0.01
After LW302	375	3.0	0.03	0.04
After LW303	500	4.0	0.03	0.05

The maximum predicted conventional tilt for the powerlines located directly above the longwalls is 4.0 mm/m (i.e. 0.4 %, or 1 in 250). The maximum predicted conventional curvatures are 0.03 km^{-1} hogging and 0.05 km^{-1} sagging, which equate to minimum radii of curvature of 33 kilometres and 20 kilometres, respectively.

Predicted Strains

The low voltage Powerlines are partially located above Longwalls 301 to 303. A histogram of the maximum tensile and compressive strains measured in survey bays located above previously extracted longwalls in the Southern Coalfield is provided in Figure 7. The probability distribution functions, based on a fitted *Generalised Pareto Distribution (GPD)*, have also been shown in this figure.

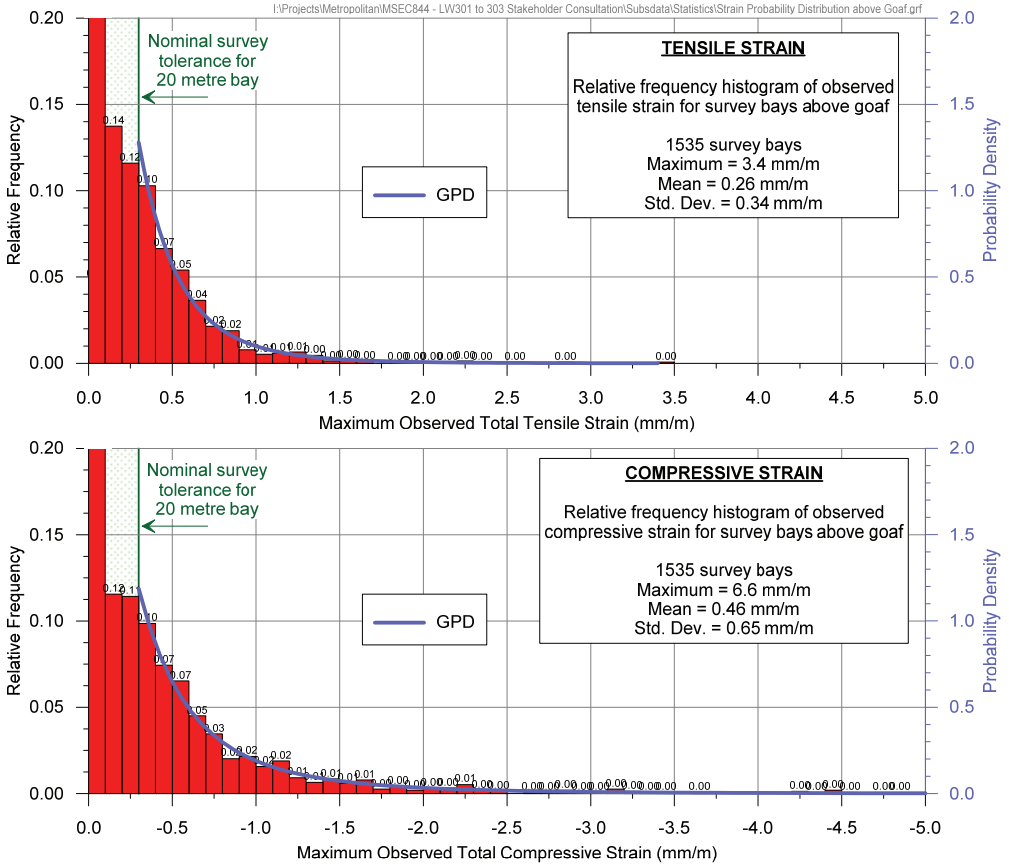

Figure 7 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Goaf

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 goaf, based on the fitted GPDs, is provided in Table 11.

Table 11 Probabilities of Exceedance for Strain for Survey Bays Located above Goaf

Strain (mm/m)		Probability of Exceedance
Compression	-8.0	1 in 1,300
	-6.0	1 in 570
	-4.0	1 in 185
	-2.0	1 in 35
	-1.0	1 in 9
	-0.5	1 in 3
	-0.3	1 in 2
Tension	+0.3	1 in 3
	+0.5	1 in 6
	+1.0	1 in 30
	+2.0	1 in 300
	+3.0	1 in 1,800

The 95 % confidence intervals for the maximum total strains that the individual survey bays above goaf experienced at any time during mining are 0.9 mm/m tensile and 1.6 mm/m compressive. The 99 % confidence intervals for the maximum total strains that the individual survey bays above goaf experienced at any time during mining are 1.5 mm/m tensile and 3.2 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 and the streams are shown in Drawing No. MSEC844-01.

There are no mapped faults located within the extents of Longwalls 301 to 303. It is possible that the infrastructure located above the longwalls could experience localised and elevated strains due to unknown geological structures (i.e. anomalies). The range of strains provided in the previous section include those resulting from irregular anomalous movements.

The powerlines do not cross any major streams within the Study Area. These cables, therefore, are not expected to experience any measurable valley closure effects.

Impact Assessments for the Powerlines

The feeder powerline (i.e. Powerline 1) is located outside the extents of Longwalls 301 to 303. The maximum predicted tilt for this powerline is 0.5 mm/m across its alignment (i.e. towards the longwalls). The maximum predicted tilt for the powerlines that are located directly above the longwalls is 4.0 mm/m.

The aerial conductors are supported by the timber poles above the ground and, therefore, are not expected to experience adverse impacts due to curvature and strain. The maximum predicted curvature is 0.05 km^{-1} sagging, which represents a minimum radius of curvature of 20 km. The maximum predicted strains are 0.9 mm/m tensile and 1.6 mm/m compressive based on the 95 % confidence level and 1.5 mm/m tensile and 3.2 mm/m compressive based on the 99 % confidence level.

Extensive experience of mining beneath aerial powerlines in the Southern Coalfield indicates that the potential impacts are rare and generally of a minor nature. Some remedial measures have been required, which include adjustments to cable catenaries, pole tilts and consumer cables which connect between the poles and building structures. The incidence of these impacts, however, was very low.

It is recommended that monitoring and management strategies are developed, in consultation with Endeavour Energy, to manage the potential impacts on the powerlines. It is expected that these cables can be maintained in serviceable condition with the implementation of the appropriate monitoring and management strategies.

Summary

The 132 kV transmission line is located to the east of the proposed Longwalls 301 to 303. The transmission towers are located at distances between 100 metres and 330 metres from the longwalls. At these distances, the transmission towers are predicted to experience low levels of vertical subsidence up to 90 mm. The predicted conventional tilts and differential horizontal movements between the towers are 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.

The aerial low voltage powerlines are located in the northern part of the Study Area and above the northern ends of Longwalls 302 and 303. Experience of mining beneath these types of cables in the Southern Coalfield indicates that the potential impacts on these types of cables are rare and generally of a minor nature.

It is recommended that monitoring, management, preventive and remedial measures are developed, in consultation between Endeavour Energy and Peabody Energy, to manage the potential impacts for the Endeavour Energy infrastructure.

Yours sincerely

Peter DeBono
Mine Subsidence Engineering Consultants

Attachments:

Drawing No. MSEC844-01 – Longwalls 301 to 303 – Endeavour Energy 132 kV Transmission Line

Fig. A.1 Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 132 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 132 kV Transmission Line due to LW301 to LW303
Fig. A.3 Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of Powerline 1 due to LW301 to LW303

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METROPOLITAN COLLIERY
LONGWALLS 301 TO 303
ENDEAVOUR ENERGY

DATE:	SCALE:	DRAWING No:	Rev No
26 Aug 2016	1:12500	MSEC844-01	E

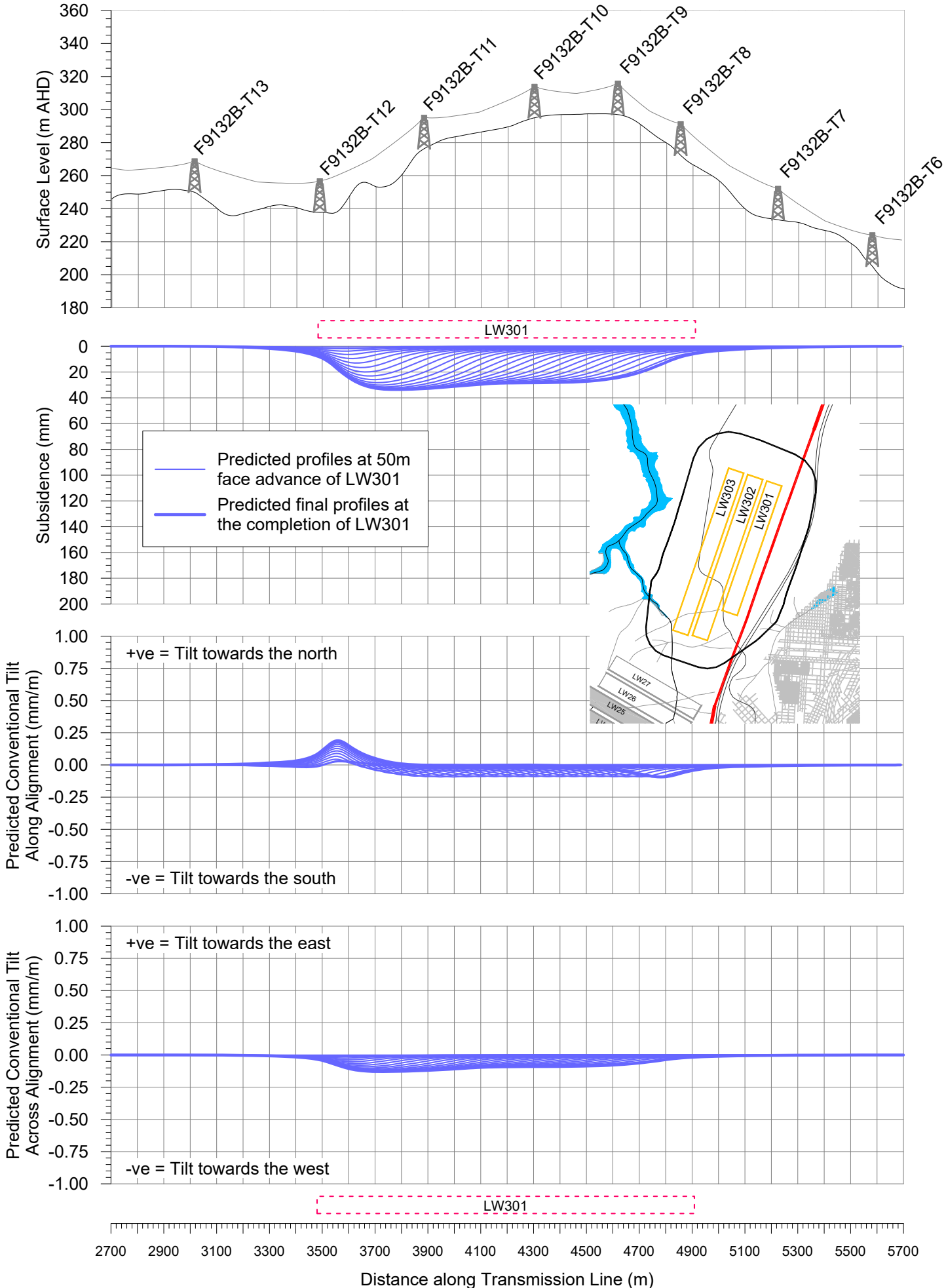
6 218 000
312 000
314 000
6 216 000
Grid to MGA co-ordinates

STUDY AREA
PREDICTED 20mm SUBSIDENCE CONTOUR
20
LW303
LW302
LW301
F9132B-T5
F9132B-T6
F9132B-T7
F9132B-T8
F9132B-T9
F9132B-T10
F9132B-T11
F9132B-T12
F9132B-T13
CAWLEY ROAD OVERPASS
CAWLEYS CK
330kV TRANSMISSION LINES
M1 PRINCES MOTORWAY
METROPOLITAN FAULT
POWERLINE 1
132kV TRANSMISSION LINE
WORONORA RESERVOIR
OLD PRINCES HWY
WILSONS CK
PRINCES HIGHWAY UNDERPASS 2
FAULT
MAIN WEST FAULT
POWELL FAULT

LEGEND
- 132 kV LINE & TOWERS
- POWERLINES
- POWER POLES

GEOLOGICAL STRUCTURES
- FAULTS
- DYKES

Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 132 kV Transmission Line during the Mining of LW301



msec

Fig. A.1

Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of the 132 kV Transmission Line due to LW301 to LW303

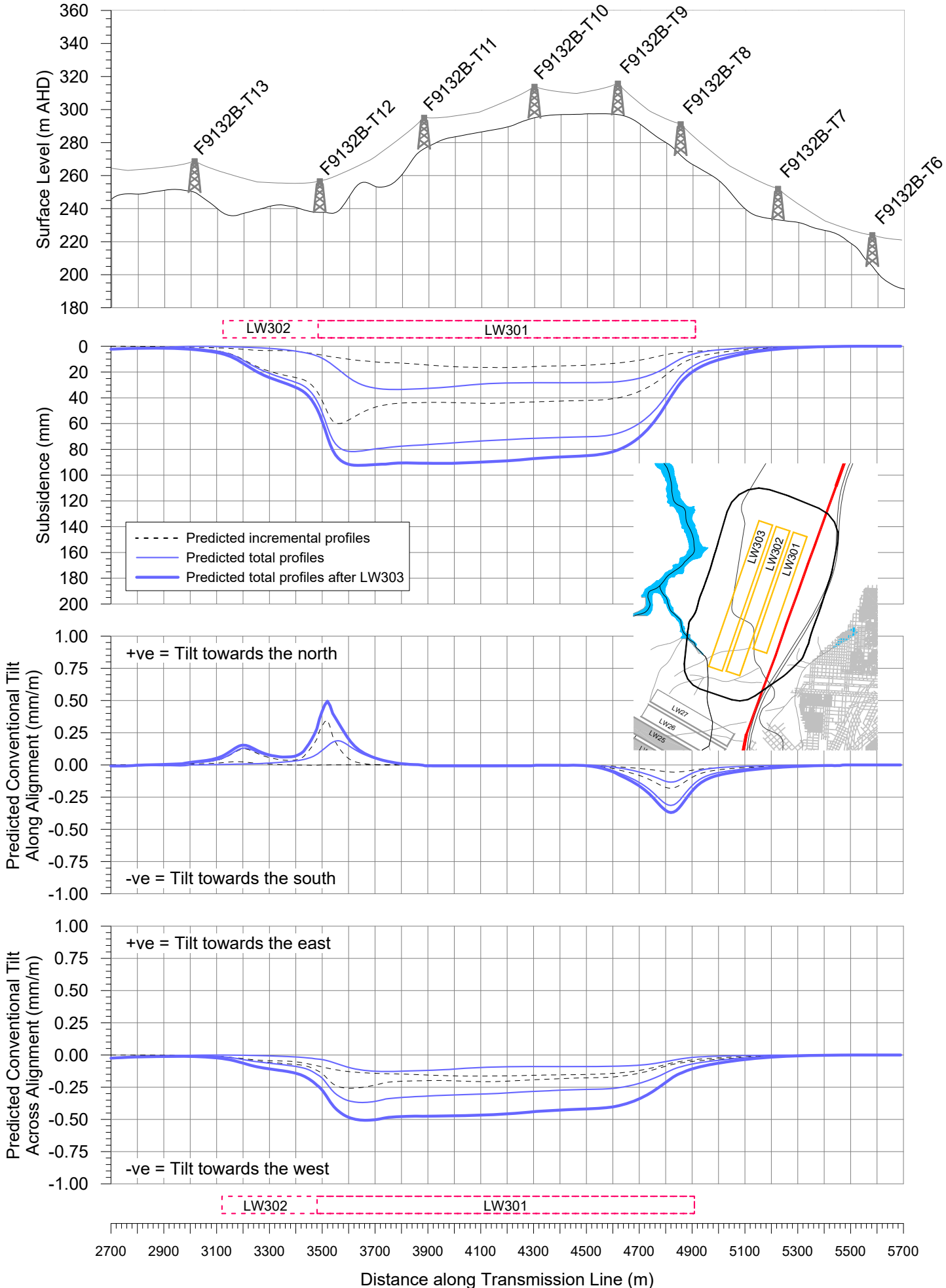


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Fig. A.2

Predicted Profiles of Conventional Subsidence, Tilt Along and Tilt Across the Alignment of Powerline 1 due to LW301 to LW303

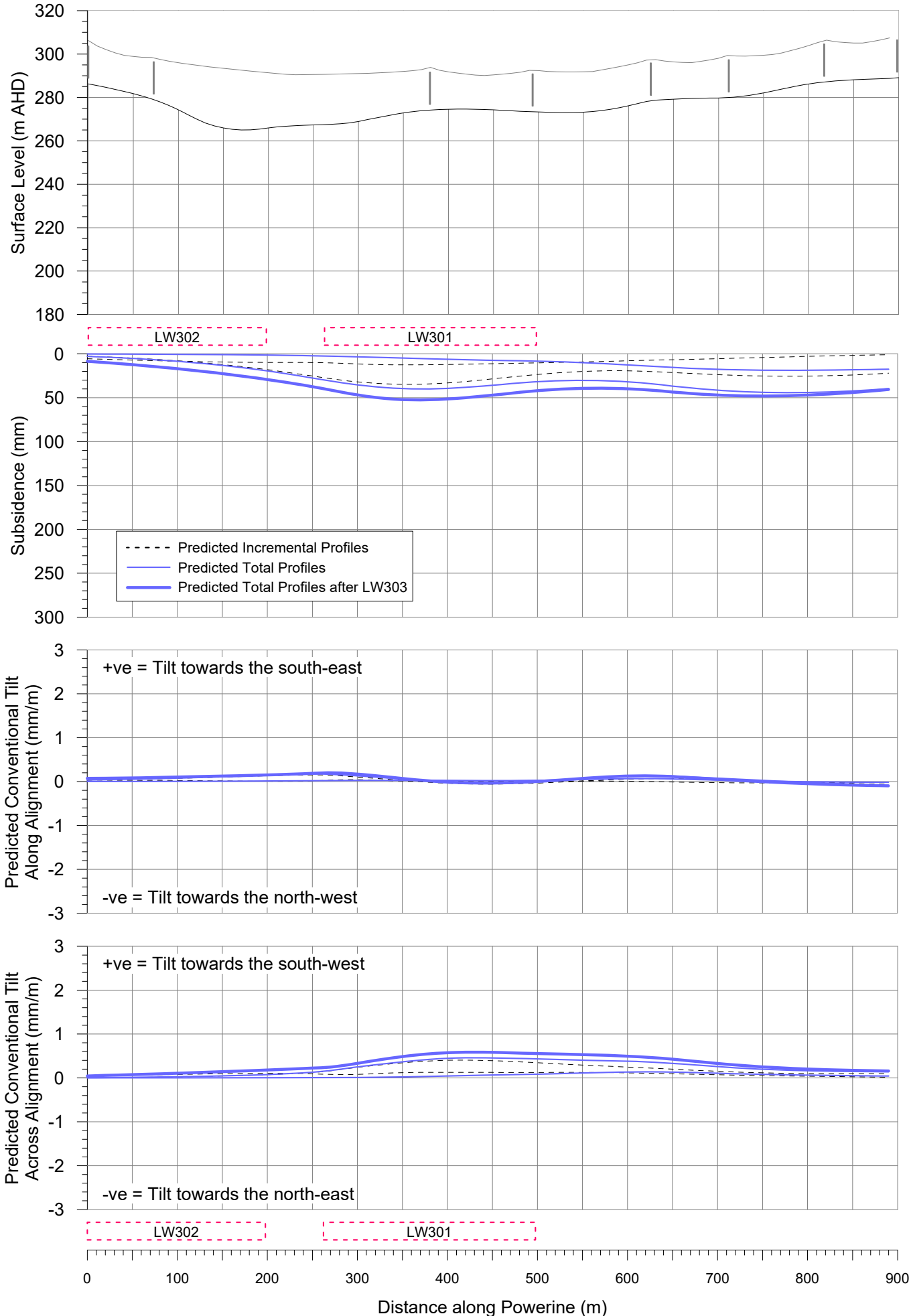

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Fig. A.3

APPENDIX 2

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER

Built Features Management Plan - Subsidence Impact Register

Impact Register Number[1]	Built Feature[2]	Impact Description	Does Impact Exceed the Built Feature Performance Measure/Indicators? (Yes/No)	Management Measures Implemented	Were Management Measures Effective? (Yes/No)

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: