

METROPOLITAN COAL

LONGWALLS 301-303

BUILT FEATURES MANAGEMENT PLAN OPTUS

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DP&E Approval Date
All	LW301-303 BFMP_OPTUS-R01-A	Original – Draft for Consultation	Optus	-
Sections 1.1, 4.1.1, 6.2, 6.3, 7.2.1, 8 & 9.1, Tables 3, 5, 6 & 8, Figure 4 and Appendices	LW301-303 BFMP_OPTUS-R01-B	Revised – Incorporating updates	Optus	-

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* 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 – Optus (Longwalls 301-303 BFMP-OPTUS) has been developed to manage the potential consequences of Longwalls 301-303 extraction on the Optus assets.

The relationship of this Longwalls 301-303 BFMP-OPTUS to the Metropolitan Coal Environmental Management Structure and to the Metropolitan Coal Longwalls 301-303 Extraction Plan is shown on Figure 4.

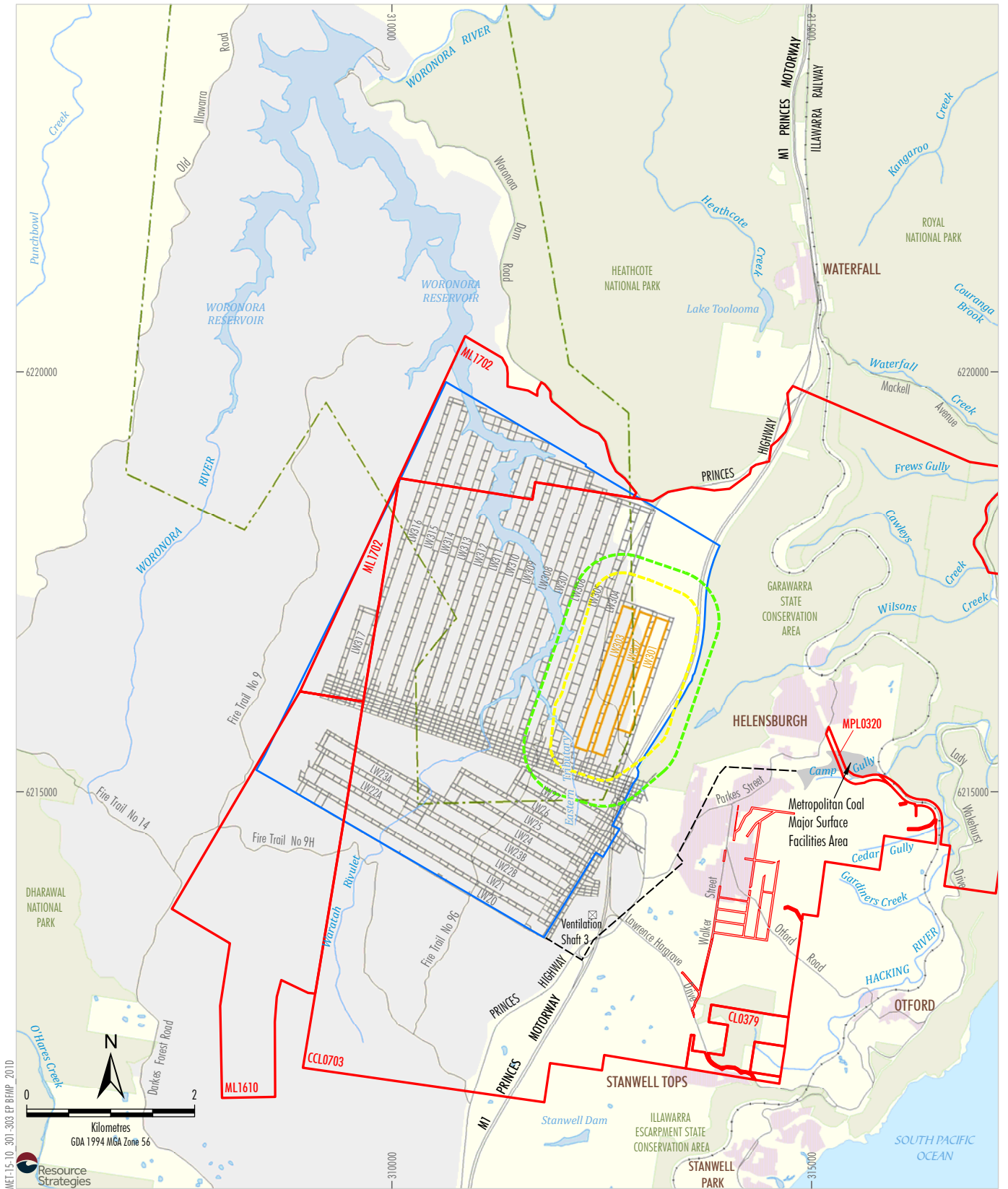
In accordance with Condition 6, Schedule 3 of the Project Approval, the suitably qualified and experienced experts that have prepared this Longwalls 301-303 BFMP-OPTUS, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and Metropolitan Coal were endorsed by the Director-General (now Secretary) of the Department of Planning and Environment (DP&E) on 6 June 2016. This Longwalls 301-303 BFMP-OPTUS has been prepared in consultation with Optus 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-OPTUS

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

- Section 2: Describes the review and update of the Longwalls 301-303 BFMP-OPTUS.
- Section 3: Outlines the statutory requirements applicable to the Longwalls 301-303 BFMP-OPTUS.
- 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-OPTUS.



LEGEND

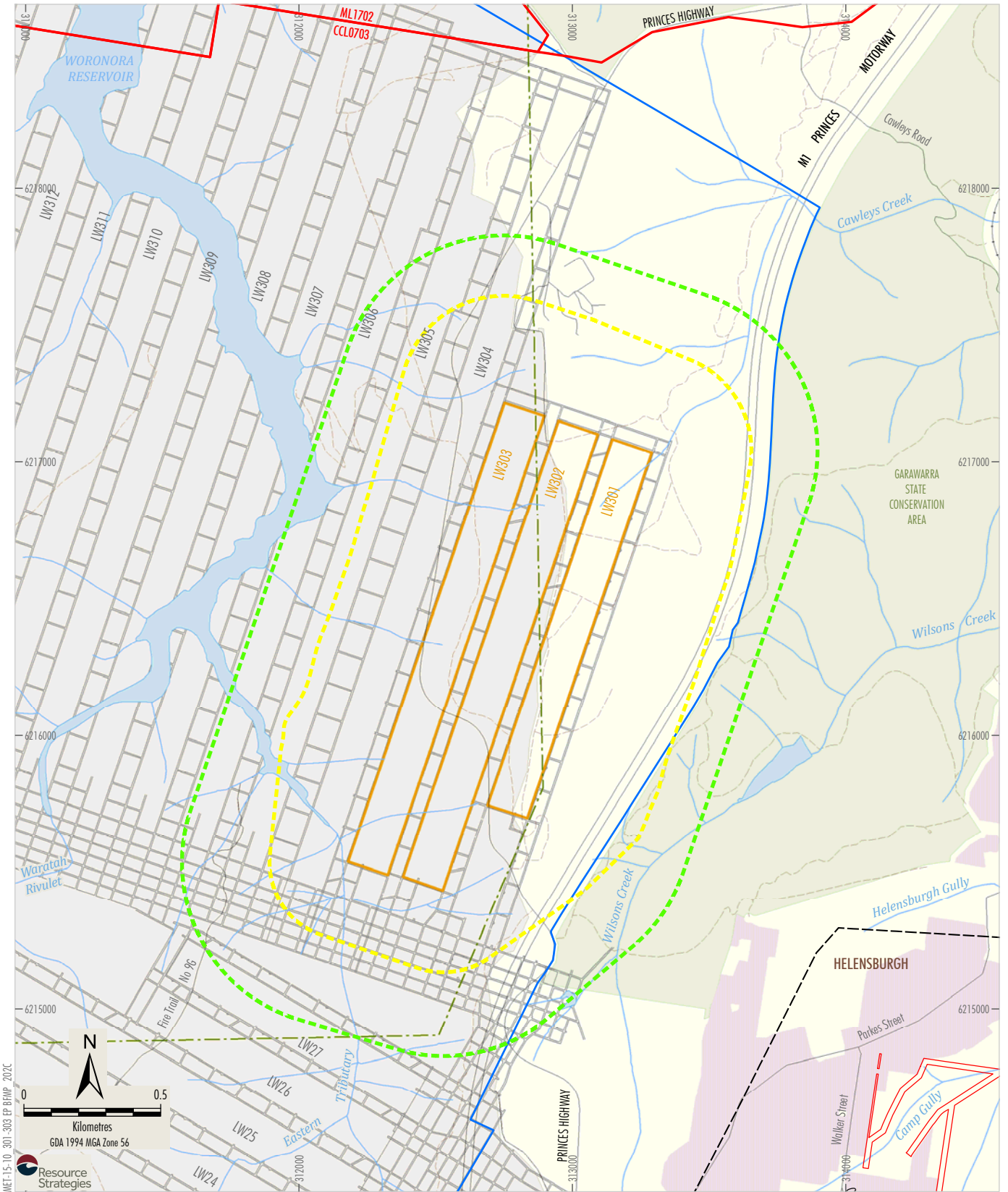
- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area
Longwalls 20-27 and 301-317
- Longwalls 301 - 303 Secondary Extraction
- 35° Angle of Draw and/or Predicted
20 mm Subsidence Contour
- 600 m from Secondary Extraction of
Longwalls 301-303
- Woronora Notification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

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



METROPOLITAN COAL
Project Longwalls 20 - 27 and
Longwalls 301 - 317 Layout

Figure 1



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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)

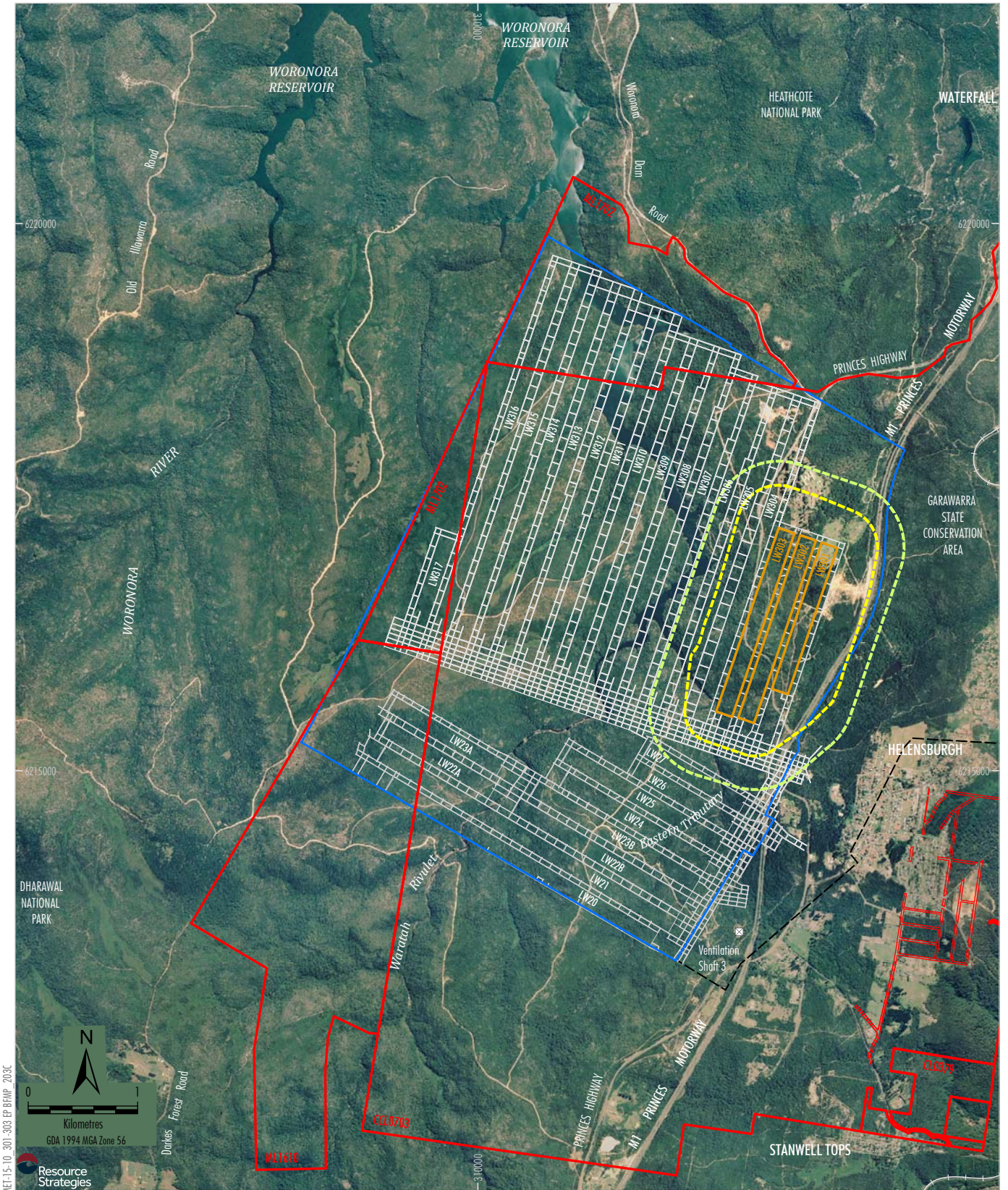
- Road
- Vehicular Track

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



METROPOLITAN COAL
Longwalls 301 - 303 Layout

Figure 2



- 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)

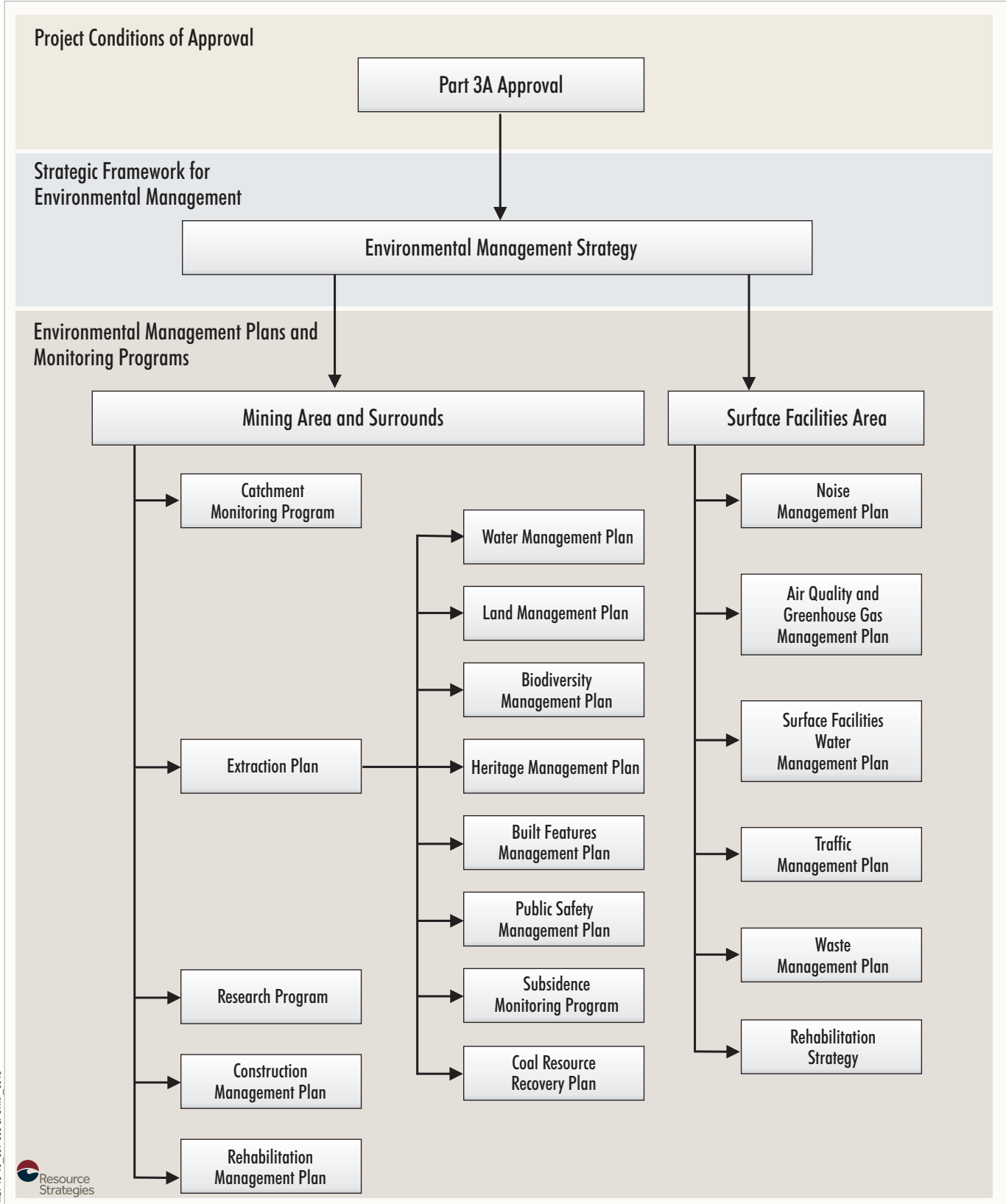
Source: Land and Property Information (2015); Date of Aerial Photography 1998;
Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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

Figure 3



ME1-15-10-301-303 EP BRWP_001B



METROPOLITAN COAL
Environmental Management
Structure

Figure 4

2 LONGWALLS 301-303 BFMP-OPTUS REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, this Longwalls 301-303 BFMP-OPTUS 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 DP&E, to ensure the plan is updated on a regular basis and to incorporate any recommended measures to improve environmental performance.

This Longwalls 301-303 BFMP-OPTUS will also be reviewed within three months of approval of any Project modification and if necessary, revised to the satisfaction of the DP&E.

The revision status of this plan is indicated on the title page of each copy of the Longwalls 301-303 BFMP-OPTUS. The distribution register for controlled copies of the Longwalls 301-303 BFMP-OPTUS is described in Section 2.1.

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

Metropolitan Coal will make the Distribution Register publicly available on the Peabody website.

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

In addition, Metropolitan Coal employees with local computer network access will be able to view the controlled electronic version of this Longwalls 301-303 BFMP-OPTUS 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-OPTUS. Table 1 indicates where each component of the conditions is addressed within this Longwalls 301-303 BFMP-OPTUS.

**Table 1
Management Plan Requirements**

Project Approval Condition	Longwalls 301-303 BFMP-OPTUS Section
Condition 2 of Schedule 7	
<p>2. The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</p> <p>a) detailed baseline data;</p> <p>b) a description of:</p> <ul style="list-style-type: none"> • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures; <p>c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;</p> <p>d) a program to monitor and report on the:</p> <ul style="list-style-type: none"> • impacts and environmental performance of the project; • effectiveness of any management measures (see c above); <p>e) a contingency plan to manage any unpredicted impacts and their consequences;</p> <p>f) a program to investigate and implement ways to improve the environmental performance of the project over time;</p> <p>g) a protocol for managing and reporting any:</p> <ul style="list-style-type: none"> • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and <p>h) a protocol for periodic review of the plan.</p>	<p align="center">Section 6</p> <p align="center">Section 3</p> <p align="center">Section 5</p> <p align="center">Section 5</p> <p align="center">Sections 7, 8, 9 and 10</p> <p align="center">Sections 7, 8 and 12</p> <p align="center">Section 9</p> <p align="center">Sections 7 and 12</p> <p align="center">Section 13</p> <p align="center">Section 14</p> <p align="center">Section 15</p> <p align="center">Section 9</p> <p align="center">Section 2</p>
Condition 7 of Schedule 3	
<p>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:</p> <p>a) a program to collect sufficient baseline data for future Extraction Plans;</p> <p>b) a revised assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;</p> <p>c) a detailed description of the measures that would be implemented to remediate predicted impacts; and</p> <p>d) a contingency plan that expressly provides for adaptive management.</p>	<p align="center">Section 11</p> <p align="center">Section 4</p> <p align="center">Section 8</p> <p align="center">Section 9</p>

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;*

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- *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 trialed 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 Optus Assets

The main Optus assets of relevance for the Longwalls 301-303 extraction include:

- Trunk: IOF SYD-MEL 2. Coastal Inter Office Fibre two sections known as WAT-WOL 2 and WAT-WOL 3.
- Cable: 36S SMOF in leased Telstra Conduit and leased Telstra Manholes/pits, and buried direct. Cable manufacturer, MM Olex. Heavy polyethylene Sheath, manufactured prior to 1993. Installation completed 1993.

The main Optus optical fibre cable is located adjacent to Longwall 301 and above the southern end of Longwall 301 (Figure 5). A second optical fibre cable is located above the northern end of Longwall 303 and above Longwalls 302 and 301 (Optical Fibre Cable 2) (Figure 5). A third optical fibre cable is located south of the longwalls extending from the main Optus optical fibre cable along the alignment of the Old Princes Highway (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 Optus assets was conducted by MSEC (2008) as part of the Metropolitan Coal Project EA. MSEC (2008) includes a table summarising the incremental systematic subsidence parameters for the extraction of each longwall from Longwalls 20-44. These include:

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

Revised subsidence and impact predictions for the extraction of Longwalls 301-303 on Optus assets were conducted by MSEC and reported in MSEC (2016) (Appendix 1).

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

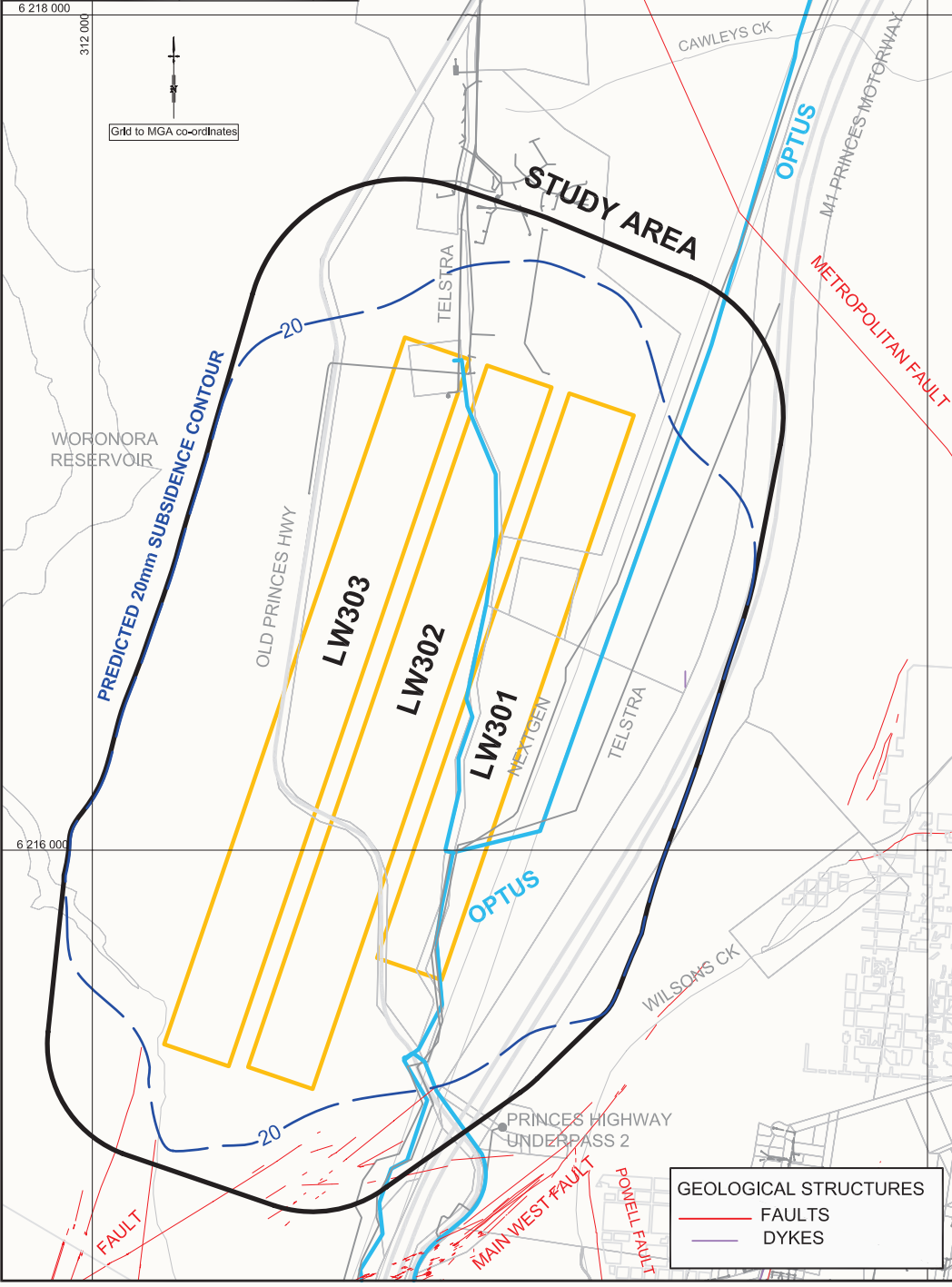
- The optical fibre cables are direct buried and, therefore, will not be impacted by the tilts resulting from the extraction of Longwalls 301-303.
- The buried optical fibre cables are likely to experience curvatures and ground strains resulting from the extraction of Longwalls 301-303.
- The predicted curvatures and strains for the optical fibre cables are similar to those where longwalls in the Southern Coalfield have previously mined directly beneath similar cables.
- It is expected that the optical fibre cables can be maintained in a serviceable condition with the implementation of the appropriate monitoring and management strategies.

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METROPOLITAN COLLIERY
LONGWALLS 301 TO 303
OPTUS INFRASTRUCTURE

DATE: 27 Oct 2016	SCALE: 1:12500	DRAWING No: MSEC844-05	Rev No E
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ME1-15-10_301-303 EP BRWP_Optus_005A



METROPOLITAN COAL
Optus Assets

Figure 5

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 12 August 2016. Attendees at the risk assessment meeting included representatives from Metropolitan Coal, Optus, MSEC, Resource Strategies and Axys Consulting (risk assessment facilitator).

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

- preliminary identification of Optus assets¹;
- review of the revised subsidence predictions and potential impacts on Optus 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 relevant to the fibre optic cable have been identified which considered the extraction of coal beneath the Optus assets, and are summarised as follows:

Baseline Data / Validation

1. Obtain from Optus an audit to confirm that all services, that may be affected by mining of Longwalls 301 to 303 have been identified and documented in the BFMP.¹
2. Carry out an audit of the physical location of the Optic Fibre Cable within the Study area prior to any mining to confirm that physical access is available.
3. Provide survey information on the Optic Fibre Cable run within the Study area for the main cable between Sydney to Melbourne and have Optus confirm that this is correct to validate the current studies and provide a report on the number of surface markers in the section.
4. Metropolitan Coal to carry out further investigation to determine the asset owner of the telecommunications tower and compound.¹
5. Metropolitan Coal to arrange further consultation with relevant personnel (e.g. mobile department) for the telecommunications tower and hut.¹
6. Metropolitan Coal to include a reference to the “management plan process” in the BFMP, similar to the approach adopted for previous Extraction Plans.

Management / Monitoring / Response Measures

7. Develop a Trigger Action Response Plan (TARP) and include a trigger to confirm that the Optical Fibre Cables monitoring is being carried out when the mining of Longwalls 301 to 303 may impact on the main Optic Fibre Cable run between Sydney to Melbourne.
8. Include in the TARP a trigger to conduct physical audits of the Optic Fibre Cable between Sydney to Melbourne when mining is likely to affect the cable so that rectification work can commence if required based on the TARP Conditions.
9. Metropolitan Coal to arrange further consultation with relevant personnel (e.g. damages department) for the fibre optic cable for consideration of specific measures and contingency planning.
10. Include in the BFMP relevant details regarding the potential for underground blast vibration impacts at the surface.

¹ Since the risk assessment meeting was held, Axicom confirmed that the telecommunication tower and compound (initially considered during the Optus risk assessment) is an Axicom asset which is managed separately in the BFMP-Axicom.

Contingency Planning

11. Include in the BFMP contact information from Optus for liaison during implementation of management measures and contingency planning.
12. Obtain an understanding of the time the telecommunication tower and compound systems would operate in the event of a power outage.¹

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 3.

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

Risk Control Measure / Procedure		BFMP Section	Proposed Timing
<i>Baseline Data / Validation</i>			
1	Obtain from Optus an audit to confirm that all services have been identified and documented in the BFMP	Section 6	Prior to LW301
2	Carry out an audit of the physical location of the Optic Fibre Cable within the Study area to confirm that physical access is available	Section 6	Prior to LW301
3	Provide survey information to Optus on the Optic Fibre Cable run for the main cable between Sydney to Melbourne, including surface markers in the section	Section 6	Prior to LW301
4	Carry out further investigation to determine the asset owner of the telecommunications tower and compound	BFMP-Axicom	Complete*
5	Arrange further consultation with relevant personnel (e.g. mobile department) for the telecommunications tower and hut	BFMP-Axicom	Complete*
6	Include a reference to the “management plan process” in the BFMP	All	Complete
<i>Management / Monitoring / Response Measures</i>			
7	Develop a TARP and include a trigger to confirm that the Optical Fibre Cables monitoring is being carried out when mining is likely to affect the main Optic Fibre Cable run between Sydney to Melbourne	Section 10 / Table 8	Complete
8	Include in the TARP a trigger to conduct physical audits of the Optic Fibre Cable between Sydney to Melbourne when mining is likely to affect the cable	Section 10 / Table 8	Complete
9	Arrange further consultation with relevant personnel (e.g. damages department) for the fibre optic cable for consideration of specific measures and contingency planning	Section 6.3	Prior to LW301
10	Include in the BFMP relevant details regarding the potential for underground blast vibration impacts at the surface	Section 4.3	Complete
<i>Contingency Planning</i>			
11	Include contact information from Optus for liaison.	Section 6.3	Complete
12	Obtain an understanding of the time the telecommunication tower and compound systems would operate in the event of a power outage	BFMP-Axicom	Complete*

* Since the risk assessment meeting was held, Axicom confirmed that the telecommunication tower and compound (initially considered during the Optus risk assessment) is an Axicom asset which is managed separately in the BFMP-Axicom.

4.3 UNDERGROUND BLAST VIBRATION IMPACTS

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

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

5 PERFORMANCE MEASURES AND INDICATORS

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

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

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

- negligible transmission loss from mine subsidence impacts;
- the structural integrity of the cable lines and associated facilities is maintained; and
- the serviceability of the access roads/tracks is maintained.

Section 7 of this Longwalls 301-303 BFMP-OPTUS describes the monitoring that will be conducted to assess the Project against the above performance measure and indicators. Sections 8 and 9 of this Longwalls 301-303 BFMP-OPTUS provide management measures and a Contingency Plan in the event the performance indicators or performance measure is exceeded.

6 BASELINE DATA

An audit of the physical location of the optic fibre cables within the Study area will be conducted by Metropolitan Coal to confirm that physical access is available. Survey information will be provided to Optus, including surface markers in the sections.

Baseline data to be obtained prior to mining including:

- the state of the IOF cables;
- amplifier outputs and fibre loss between specified points; and
- inspection of facilities.

The inspections conducted as part of baseline data will include photographic records where appropriate.

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6.1 STATE OF ASSET BEFORE MINING

In consultation with Optus (and similar to the approach adopted for other optical fibre cables), Metropolitan Coal will assess and determine the state of the Optus optical fibre cables before mining Longwall 301.

For example, the state of the IOF cables was previously assessed before mining commenced in Longwall 20. The amplifier outputs and fibre loss between nominated end points O2WF Waterfall CEV and O2WM Wollongong CEV were measured. Measurement points O2WF and O2WM were located on the SM2 IOF at either end of the mining area at the time.

Table 4 below shows the loss measured between O2WF and O2WM from amplifier to amplifier.

Table 4
Measured Loss in O2WF Waterfall – O2WM Wollongong SM-2 IOF Section

Location	Tx Level (dBm)	Rx Level (dBm)	Loss (dBm)
O2WF 1B	14.3		
O2WM 1A		-3.8	18.1
O2WM 2B	14.0		
O2WF 2A		-3.8	17.8

6.2 PRE-MINING INSPECTION

The pre-mining inspection to confirm that physical access is available within the Study area will be completed by Metropolitan Coal prior to commencement of Longwall 301 extraction. An audit from Optus would also be obtained at this time to confirm that all services have been identified and documented in the BFMP.

6.3 KEY CONTACTS LIST

The list of key contacts for Peabody and Optus 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
Optus	Group Leader – Fibre Planning – Fixed Network Core	Ruby Haq
Optus	Senior Network Engineer	Leigh Spence

Further consultation will be undertaken as required prior commencement of extraction of Longwall 301 with other relevant personnel (e.g. damages department) for the fibre optic cable for consideration of specific measures and contingency planning.

7 MONITORING

A monitoring program will be implemented to monitor the impacts of the Project on the Optus assets. Table 6 summarises the Longwalls 301-303 BFMP-OPTUS monitoring components.

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-OPTUS.

Where relevant, inspections of subsidence impacts will include photographic record of the impacts for comparison with baseline photographic records. Optus or their delegates will conduct the visual inspections. Metropolitan Coal will be notified of the timing of inspections and accompany Optus or delegates if considered necessary. All personnel will complete necessary inductions or orientation relevant to the tasks required.

**Table 6
Longwalls 301-303 BFMP-OPTUS Monitoring Program Overview**

Monitoring Component	Locations	Frequency	Parameters
Subsidence Parameters	<ul style="list-style-type: none"> • As described in the Metropolitan Coal Longwalls 301-303 Subsidence Monitoring Program (SMP). This includes subsidence line along the transmission line corridor and M1 Princes Motorway within 600 m of Longwalls 301-303 extraction and the optic / water line (Figure 6). 	<ul style="list-style-type: none"> • Prior to the commencement of Longwall 301 extraction. • As per the Longwalls 301-303 SMP. This includes at the completion of each longwall. • Weekly if the ground strain exceeds 1 millimetre per metre (mm/m) between adjacent survey pegs until movement stabilises. • More frequently (to be determined) if subsidence exceeds 20 mm. 	<ul style="list-style-type: none"> • Monitoring parameters include: subsidence, tilt, tensile strain, compressive strain.
RFMS Monitoring (Fibre Optic Cable Loss Signal)	<ul style="list-style-type: none"> • 1,625 nanometres Optical Time Domain Reflectometer (OTDR) monitoring. 	<ul style="list-style-type: none"> • Continuous (monitoring commencement to occur as longwall face approaches within 400 m of the cables to establish more frequent communications). 	<ul style="list-style-type: none"> • Signal integrity.
Subsidence Impacts - Cable lines and associated pits	<ul style="list-style-type: none"> • Point loss or area of loss within 600 m of Longwalls 301-303 extraction. 	<ul style="list-style-type: none"> • If RFMS records loss event exceeds ± 3.0 dB. 	<ul style="list-style-type: none"> • Movement of conduit, degree of freedom of cable in conduit, ground compression / tension.
Subsidence Impacts - Access Roads/Tracks	<ul style="list-style-type: none"> • Within 600 m of Longwalls 301-303 extraction. 	<ul style="list-style-type: none"> • Prior to the commencement of Longwall 301 extraction. • Opportunistic visual observations as part of routine works and inspections. • Following the completion of extraction of Longwalls 301-303. 	<ul style="list-style-type: none"> • Surface cracks, buckling and general safety.

RFMS – Remote Fibre Monitoring System

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 by Metropolitan Coal 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 Optus assets include the survey lines along optical fibre cable (at the southern end of Longwall 301) and the adjacent 330 kilovolt (kV) and 132 kV transmission line corridor. These surveys will monitor the general movement about the longwalls and the data will allow evaluation of the likely ground movements about the cable line (by comparison between measured and predicted movements).

7.2 SUBSIDENCE IMPACTS

7.2.1 Fibre Optic Cables

Visual inspections will be conducted of the cable lines by Optus as required, in accordance with the Optus inspection system or if triggered by a transmission fault detected by the Optus monitoring system.

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

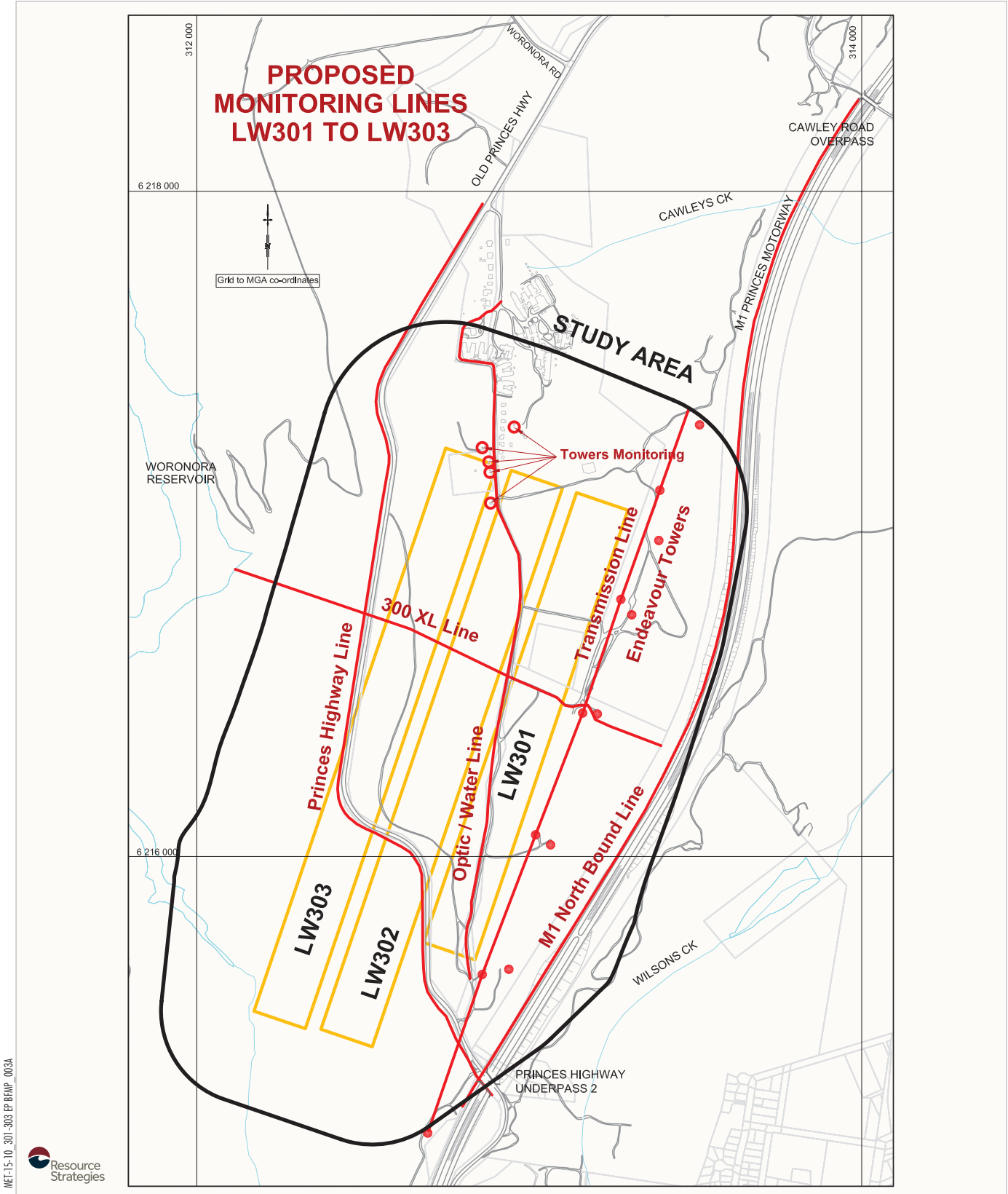
- the date of the inspection;
- the location of longwall extraction (i.e. the longwall chainage);
- assessment against the performance indicators and performance measure;
- whether any actions are required (e.g. initiation of the Contingency Plan, incident notification, implementation of appropriate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

7.2.2 Access Roads/Tracks

Visual inspection of the access roads/tracks will be conducted by Metropolitan Coal prior to the commencement of Longwall 301, and following extraction of Longwalls 301-303.

Opportunistic visual observations of access roads/tracks will also be conducted by Metropolitan Coal 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).



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METROPOLITAN COAL
 Longwalls 301-303 Subsidence Monitoring
 Layout

Figure 6

Specific details that will be noted and/or photographed that are relevant to the Optus 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 access road/track to the Optus 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.

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 Optus will compare the results of the subsidence impact monitoring against the built features performance indicators and performance measure. In the event the observed subsidence impacts exceed the performance indicators or performance measure, Metropolitan Coal and Optus 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 cable lines are considered to be applicable (e.g. stabilisation) and potential contingency measures are summarised in Section 9.1.

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-OPTUS, Metropolitan Coal will implement the following Contingency Plan:

- The observation will be reported to the 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-OPTUS.
- 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 Optus 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).

In the event of unforeseen impacts, potential contingency measures will be developed and may include those summarised in Table 7.

**Table 7
Potential Contingency Measures**

Asset	Contingency Measures / Description	
Fibre Optic Cable	Stabilisation	<ul style="list-style-type: none"> Automatic monitoring detects degradation in signal. Trench fill material is removed from the identified degradation zone, allows fibre to flex, and relieve compression forces.
	Emergency	<ul style="list-style-type: none"> Certain bandwidth is redeployed to other cores within this cable (where available) and/or to other Optus interconnectors between Sydney and Melbourne.
	Rebuilding	<ul style="list-style-type: none"> Fibre heat treatment to soften compression point and return affected cores to operation.

10 TARP – MANAGEMENT TOOL

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

Condition	Baseline Conditions	Predicted Impacts	Restoration/Contingency Phase
Trigger	<ul style="list-style-type: none"> Fibre Optic Cable is safe and serviceable. Access roads/tracks serviceable or as otherwise identified by pre-mining inspection. 	<ul style="list-style-type: none"> Negligible impact to fibre optic cables and associated infrastructure (connection points). Surface cracking developed on access road/track. 	<ul style="list-style-type: none"> Detection of transmission fault or structural integrity or function of connection pits. Tension cracks developed on access roads/tracks.
Action	Establish baseline data. Includes: <ul style="list-style-type: none"> Pre-mining inspection. Pre-extraction subsidence survey as per the Longwalls 301-303 Subsidence Monitoring Program. 	<ul style="list-style-type: none"> Conduct monitoring and physical audits (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). 	<ul style="list-style-type: none"> Implement fault restoration process. Implement measures in relation to maintenance of access roads/ tracks.
Position of Decision-making	<ul style="list-style-type: none"> Manager - Technical Services. Optus Manager Access Engineering Planning. 	<ul style="list-style-type: none"> Manager - Technical Services. Optus Manager Access Engineering Planning. 	<ul style="list-style-type: none"> General Manager. Optus General Manager Access Engineering.

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 fibre optic cable, 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 Optus 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-OPTUS 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, Optus 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 Longwalls 301-303 BFMP-OPTUS 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.

Optus 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 Optus Infrastructure, dated 28 October 2016*.

APPENDIX 1

MSEC (2016) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 301 TO 303
- SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE OPTUS
INFRASTRUCTURE, DATED 28 OCTOBER 2016

Metropolitan Coal – Built Features Management Plan – Optus	
Revision No. LW301-303 BFMP_OPTUS-R01-B	
Document ID : Built Features Management Plan - Optus	

28th October 2016

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

Ref: MSEC844-05

Dear Jon,

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

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

The locations of the Optus infrastructure and the proposed longwalls are shown in the attached Drawing No. MSEC844-05. There is a main optical fibre cable (Optical Fibre Cable 1) within the Study Area that is located above the southern end of Longwall 301 and extends to the north and south in a similar orientation to the Longwall 301. A second optical fibre cable is located above the northern end of Longwall 303 and above Longwalls 302 and 301 (Optical Fibre Cable 2). A third optical fibre cable is located to the south of the longwalls extending from the main optical fibre cable along the alignment of the Old Princes Highway.

The predictions and impact assessments for the Optus infrastructure are provided in the following sections.

Conventional Subsidence Parameters for the Optus Infrastructure

The following provides summaries of the maximum predicted conventional movements for the Optus 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 and curvature along the alignment of Optical Fibre Cable 1 and 2, resulting from the extraction of Longwalls 301 to 303, are shown in the attached Fig. A.1 and Fig. A.2 respectively. 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. The third optical fibre cable is located a minimum distance of 190 m from Longwall 301 and will experience negligible predicted subsidence movements due to the extraction of Longwalls 301 to 303.

A summary of the maximum predicted values of incremental subsidence, tilt and curvature for Optical Fibre Cable 1 and 2, due to the extraction of each of the Longwalls 301 to 303, are provided in Table 1 and Table 2 respectively. The values are the maxima anywhere along the cables at any time during or after the extraction of each longwall.

Table 1 Maximum Predicted Incremental Subsidence, Tilt and Curvature for the Optus Optical Fibre Cable 1 Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Maximum Predicted Incremental Hogging Curvature (km ⁻¹)	Maximum Predicted Incremental Sagging Curvature (km ⁻¹)
Due To LW301	70	< 0.5	< 0.01	< 0.01
Due To LW302	200	1.0	0.04	< 0.01
Due To LW303	60	< 0.5	< 0.01	< 0.01

Table 2 Maximum Predicted Incremental Subsidence, Tilt and Curvature for the Optus Optical Fibre Cable 2 Resulting from the Extraction of Longwalls 301 to 303

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Maximum Predicted Incremental Hogging Curvature (km ⁻¹)	Maximum Predicted Incremental Sagging Curvature (km ⁻¹)
Due To LW301	80	0.5	< 0.01	0.01
Due To LW302	625	3.5	0.03	0.11
Due To LW303	400	2.5	0.06	0.06

The maximum predicted incremental subsidence for the optical fibre cables, due to the extraction of each of the Longwalls 301 to 303, varies from 60 mm to 625 mm. It is noted, that the maximum predicted incremental subsidence due to Longwall 302 is greater than that due to Longwall 301, as it is a second panel in the series and therefore results in higher magnitudes of subsidence above the mining area.

A summary of the maximum predicted values of total subsidence, tilt and curvature for Optical Fibre Cable 1 and 2, resulting from the extraction of Longwalls 301 to 303, are provided in Table 3 and Table 4. The values are the maxima anywhere along the cable at any time during or after the extraction of the longwalls.

Table 3 Maximum Predicted Total Subsidence, Tilt and Curvature for the Optus Optical Fibre Cable 1 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	70	< 0.5	< 0.01	< 0.01
After LW302	275	1.5	0.03	< 0.01
After LW303	325	1.5	0.04	< 0.01

Table 4 Maximum Predicted Total Subsidence, Tilt and Curvature for the Optus Optical Fibre Cable 2 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	80	0.5	< 0.01	0.01
After LW302	675	4.0	0.03	0.11
After LW303	875	4.5	0.04	0.13

The maximum predicted total subsidence for the optical fibre cables, resulting from the extraction of Longwalls 301 to 303, is 875 mm. The maximum predicted conventional tilt for this cable is 4.5 mm/m (i.e. 0.45 %, or 1 in 225). The maximum predicted total conventional curvatures are 0.04 km⁻¹ hogging and 0.13 km⁻¹ sagging, which equate to minimum radii of curvature of 25 kilometres and greater than 8 kilometres, respectively.

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 Optus infrastructure 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 Optus infrastructure is 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 1. The probability distribution functions, based on a fitted *Generalised Pareto Distribution (GPD)*, have also been shown in this figure.

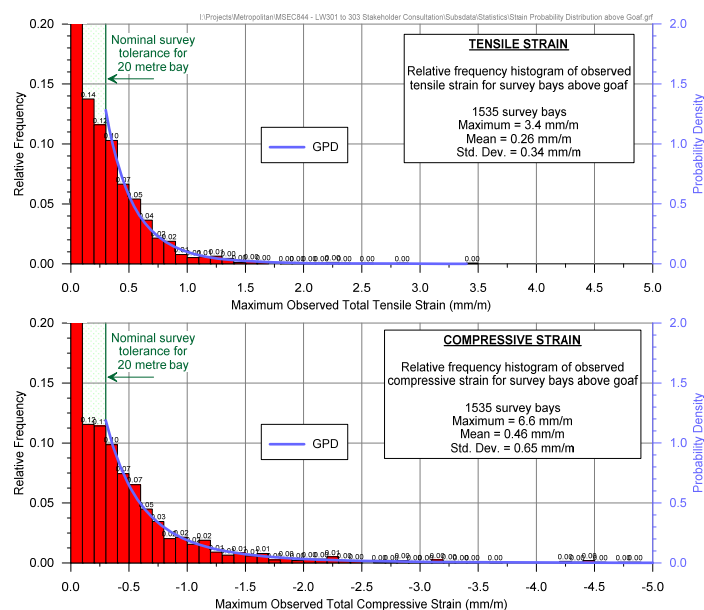


Figure 1 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Goaf

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 5.

Table 5 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. MSEC844-05.

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

Impact Assessments for the Optical Fibre Cables

The optical fibre cables within the Study Area are direct buried and, therefore, will not be impacted by the tilts resulting from the extraction of Longwalls 301 to 303. The cables, however, are likely to experience the curvatures and ground strains resulting from the extraction of these longwalls.

The tensile strains in the optical fibre cable can be higher, however, where the cable connects to the support structures, which may act as anchor points, preventing any differential movements that may have been allowed to occur within the ground. Tree roots have also been known to anchor cables to the ground. The extent to which the anchor points affect the ability of the cable to tolerate the mine subsidence movements depends on the cable size, type, age, installation method and ground conditions.

In addition to this, optical fibre cables contain additional fibre lengths over the sheath lengths, where the individual fibres are loosely contained within tubes. Compression of the sheaths can transfer to the loose tubes and fibres and result in 'micro-bending' of the fibres constrained within the tubes, leading to higher attenuation of the transmitted signal. If the maximum predicted compressive strains were to be fully transferred into the optical fibre cable, they could be of sufficient magnitude to result in the reduction in capacity of the cable or transmission loss.

Localised and elevated curvatures could develop along the optical fibre cable due to non-conventional movements resulting from near surface geological structures (i.e. anomalies). It is possible that these non-conventional movements could be sufficient to result in the attenuation of signal.

The predicted curvatures and strains for the optical fibre cable are similar to those where longwalls in the Southern Coalfield have previously mined directly beneath similar cables. It has been found from this previous experience that the potential impacts on optical fibre cables in the Southern Coalfield can be managed with the implementation of suitable monitoring and management strategies.

Some examples of mining beneath optical fibre cables in the Southern Coalfield are provided in Table 6.

Table 6 Examples of Mining Beneath Optical Fibre Cables in the Southern Coalfield

Colliery and Longwalls	Length of Optical Fibre Cables Directly Mined Beneath (km)	Observed Maximum Movements at Optical Fibre Cables	Pre-Mining Mitigation, Monitoring and Observed Impacts
Appin LW301 and LW302	0.8	650 mm Subsidence 1 mm/m Tensile Strain 3 mm/m Comp. Strain (Measured M & N-Lines)	600 metre aerial cable on standby. Ground survey, visual, OTDR. No reported impacts.
Appin LW703 to LW706	12.7 total for eight cables	1,200 mm Subsidence 2.1 mm/m Tensile Strain 4.5 mm/m Comp. Strain (Measured HW2, ARTC and MPR Lines)	New cable redirection to avoid potential impacts to old optical fibre cable. Ground survey, visual, OTDR. Strain concentrations detected in three cables, attenuation losses were relieved by locally exposing the cables or by building a bypass cable.
Tahmoor LW22 to LW29	1.9	775 mm Subsidence 0.8 mm/m Tensile Strain 3.9 mm/m Comp. Strain	Ground survey, visual, OTDR, SBS. No reported impacts.
Tower LW1 to LW10	1.7	400 mm Subsidence 3 mm/m Tilt 0.5 mm/m Tensile Strain 1 mm/m Comp. Strain	No reported impacts
West Cliff LW5A3, LW5A4 and LW29 to LW38	3.4	1,300 mm Subsidence 1.3 mm/m Tensile Strain 5.5 mm/m Comp. Strain (Measured B-Line)	Survey, visual, OTDR, SBS. No reported impacts.

The strains transferred into the Optus optical fibre cables can be monitored using Optical Time Domain Reflectometry (OTDR). The ground movements can also be monitored using traditional survey lines and visual inspections. These monitoring methods can be used to identify the development of irregular ground movements. If non-conventional movements or signal attenuation are detected during active subsidence, then the cable can be relieved by locally exposing and then reburied the affected section of cable.

It is recommended that monitoring and management strategies are developed, in consultation with Optus, to manage the optical fibre cables for potential irregular ground movements. It is expected that this cables can be maintained in serviceable condition with the implementation of the appropriate monitoring and management strategies.

Summary

The Optus optical fibre cables are located above Longwalls 301 to 303. The previous experience from the Southern Coalfield has found that the potential impacts on optical fibre cables can be managed with the implementation of suitable monitoring and management strategies. These strategies could include Optical Time Domain Reflectometry (OTDR), traditional ground monitoring lines and visual inspections.

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

Yours sincerely



Peter DeBono

Attachments:

Drawing No. MSEC844-05 – Longwalls 301 to 303 – Optus Infrastructure

- Fig. A.1 Predicted Profiles of Conventional Subsidence, Tilt and Curvature for the Optus Optical Fibre Cable 1 due to LW301 to LW303
- Fig. A.2 Predicted Profiles of Conventional Subsidence, Tilt and Curvature for the Optus Optical Fibre Cable 2 due to LW301 to LW303



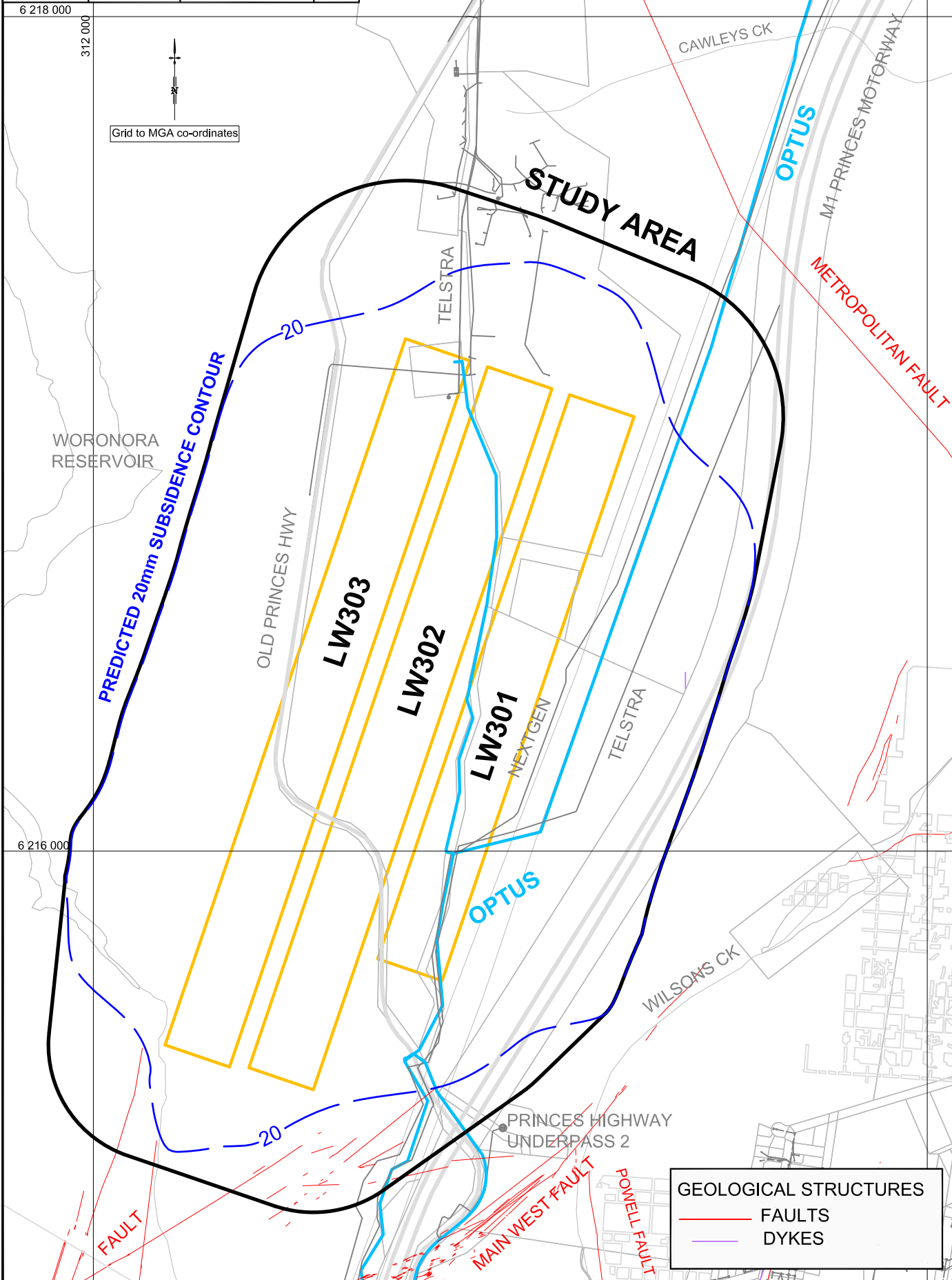
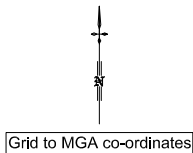
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METROPOLITAN COLLIERY
 LONGWALLS 301 TO 303
 OPTUS INFRASTRUCTURE

DATE: 27 Oct 2016	SCALE: 1:12500	DRAWING No: MSEC844-05	Rev No E
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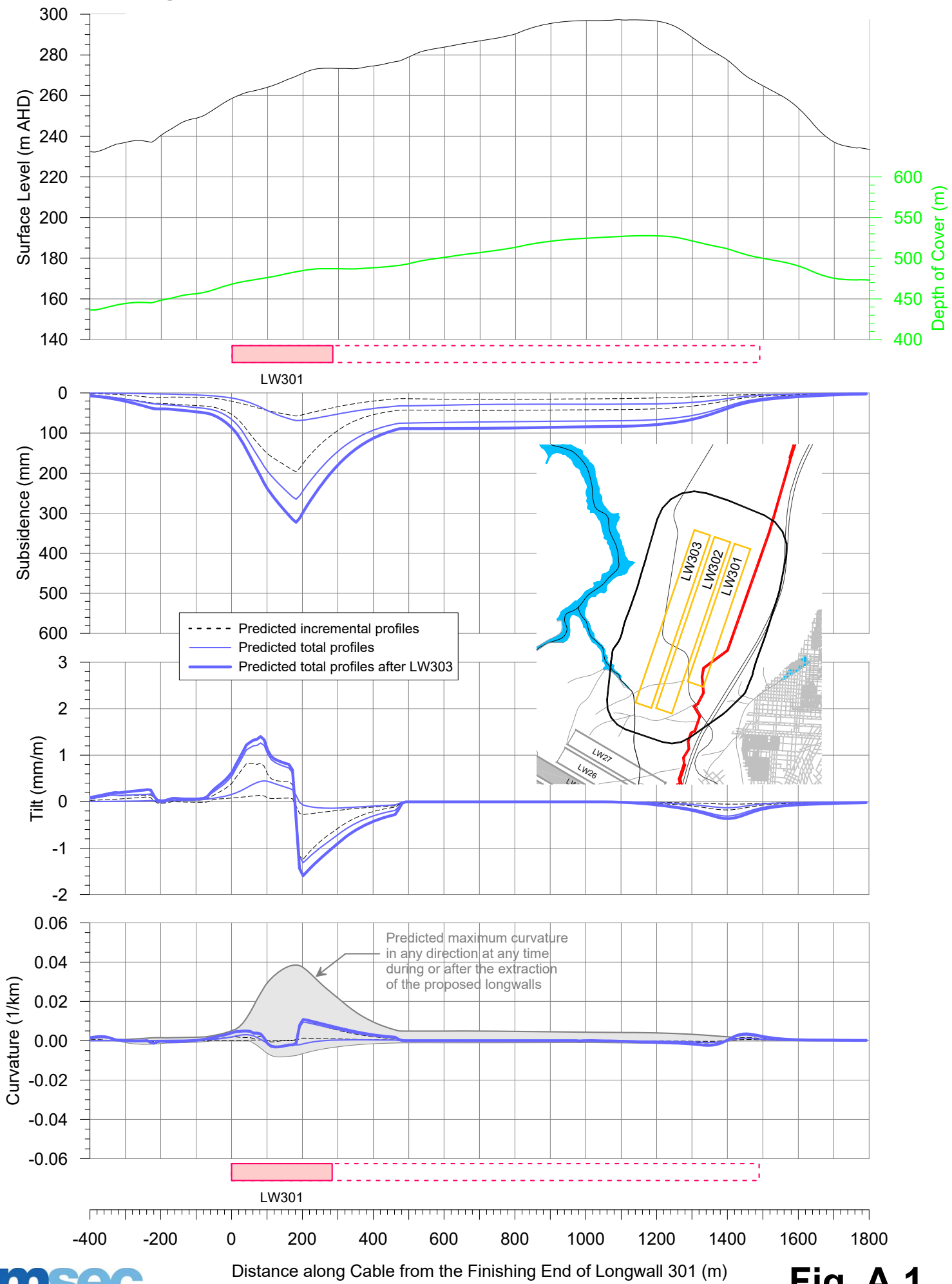
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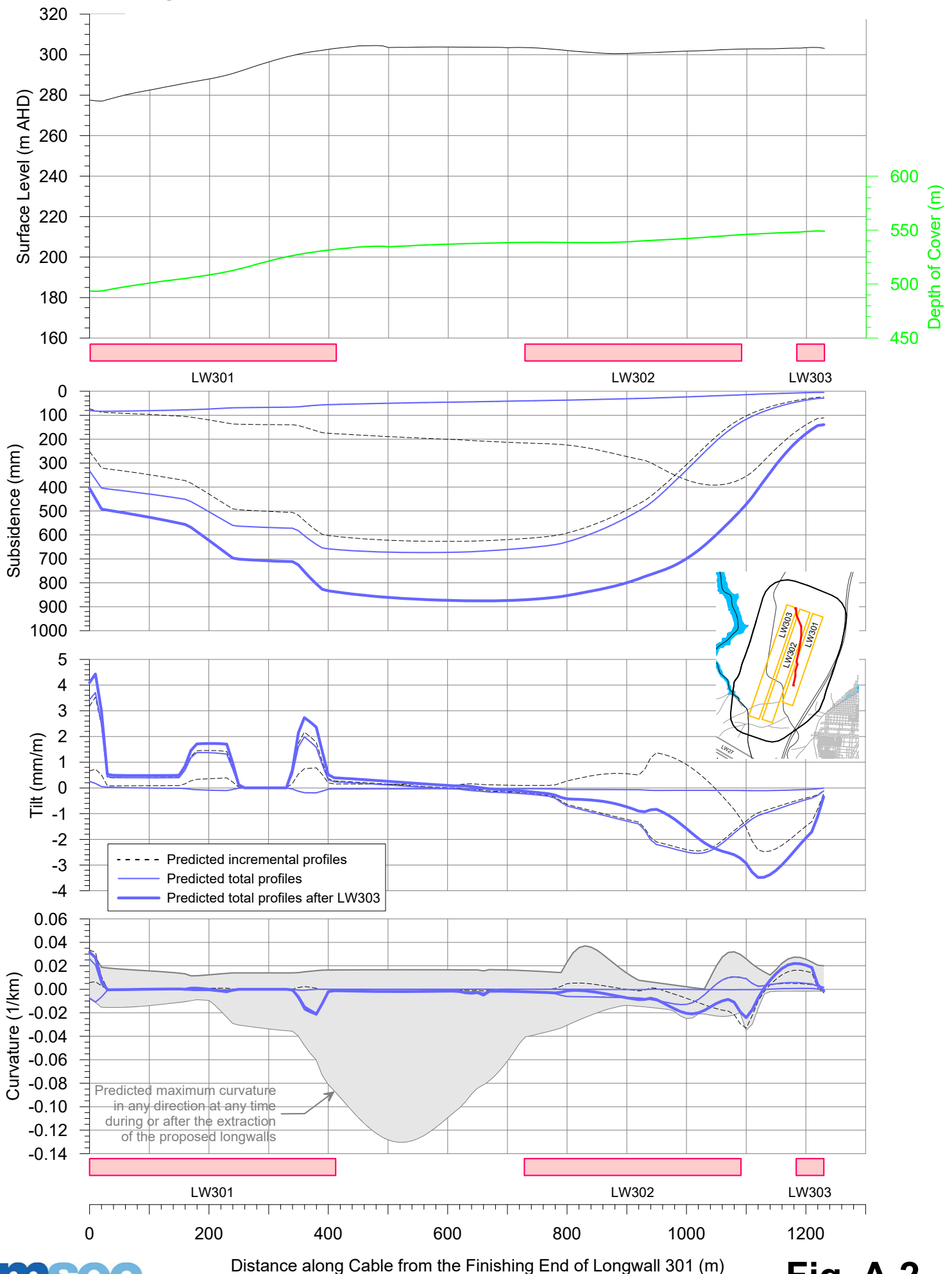
GEOLOGICAL STRUCTURES

- FAULTS
- DYKES

Predicted Profiles of Conventional Subsidence, Tilt and Curvature along Optus Optical Fibre Cable 1 due to LW301 to LW303



Predicted Profiles of Conventional Subsidence, Tilt and Curvature along Optus Optical Fibre Cable 2 due to LW301 to LW303



APPENDIX 2

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER

Metropolitan Coal – Built Features Management Plan – Optus	
Revision No. LW301-303 BFMP_OPTUS-R01-B	
Document ID : Built Features Management Plan - Optus	

**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 cable line, 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	<input type="checkbox"/>
Incident Notification	<input type="checkbox"/>
Safety Measures/Public Safety Management Plan Requirements	<input type="checkbox"/>

Management or Contingency Measures Implemented:

Effectiveness of Management or Contingency Measures: