

METROPOLITAN COAL

LONGWALLS 301-303

BUILT FEATURES MANAGEMENT PLAN WOLLONGONG CITY COUNCIL [OLD PRINCES HIGHWAY]

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DP&E Approval Date
All	LW301-303 BFMP_WCC-R01-A	Original – Draft for Consultation	WCC	-
Tables 3 & 4, Section 6 and Figure 4	LW301-303 BFMP_WCC-R01-B	Revised – Incorporating WCC Comments (15 September 2016) and updates	WCC	-

October 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 – Wollongong City Council (Longwalls 301-303 BFMP-WCC) has been developed to manage the potential consequences of Longwalls 301-303 extraction on the Wollongong City Council assets.

The relationship of this Longwalls 301-303 BFMP-WCC 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-WCC, 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-WCC has been prepared in consultation with Wollongong City Council, including consideration of prior consultation during the development of the previously approved Longwalls 20-22 and Longwalls 23-27 Built Features Management Plans. This 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-WCC

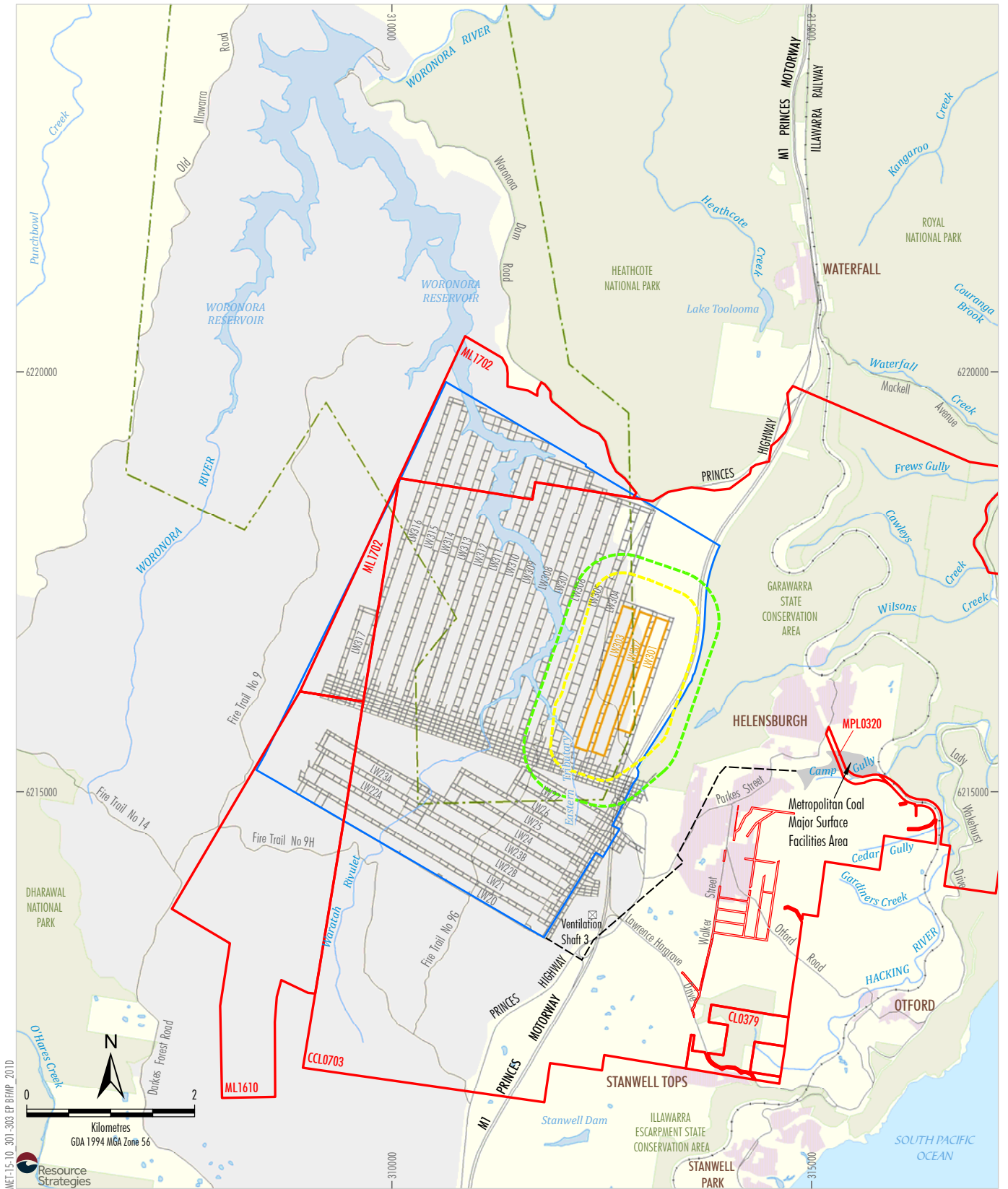
The remainder of the Longwalls 301-303 BFMP-WCC is structured as follows:

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

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- 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-WCC.

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LEGEND

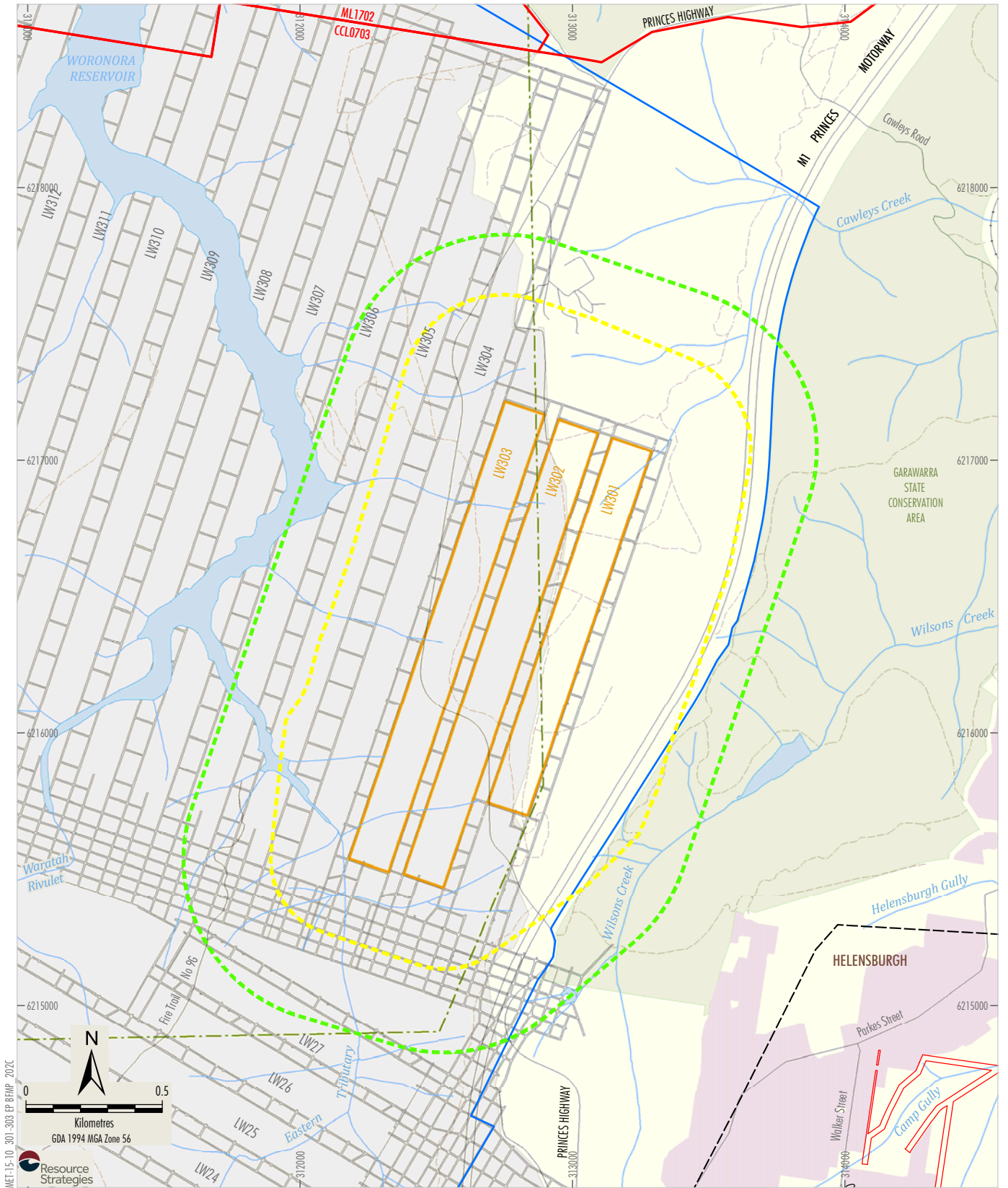
- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area
Longwalls 20-27 and 301-317
- Longwalls 301 - 303 Secondary Extraction
- 35° Angle of Draw and/or Predicted
20 mm Subsidence Contour
- 600 m from Secondary Extraction of
Longwalls 301-303
- Woronora Notification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

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



MEF15-10-301-303 EP BFMP 202C



Resource Strategies

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)

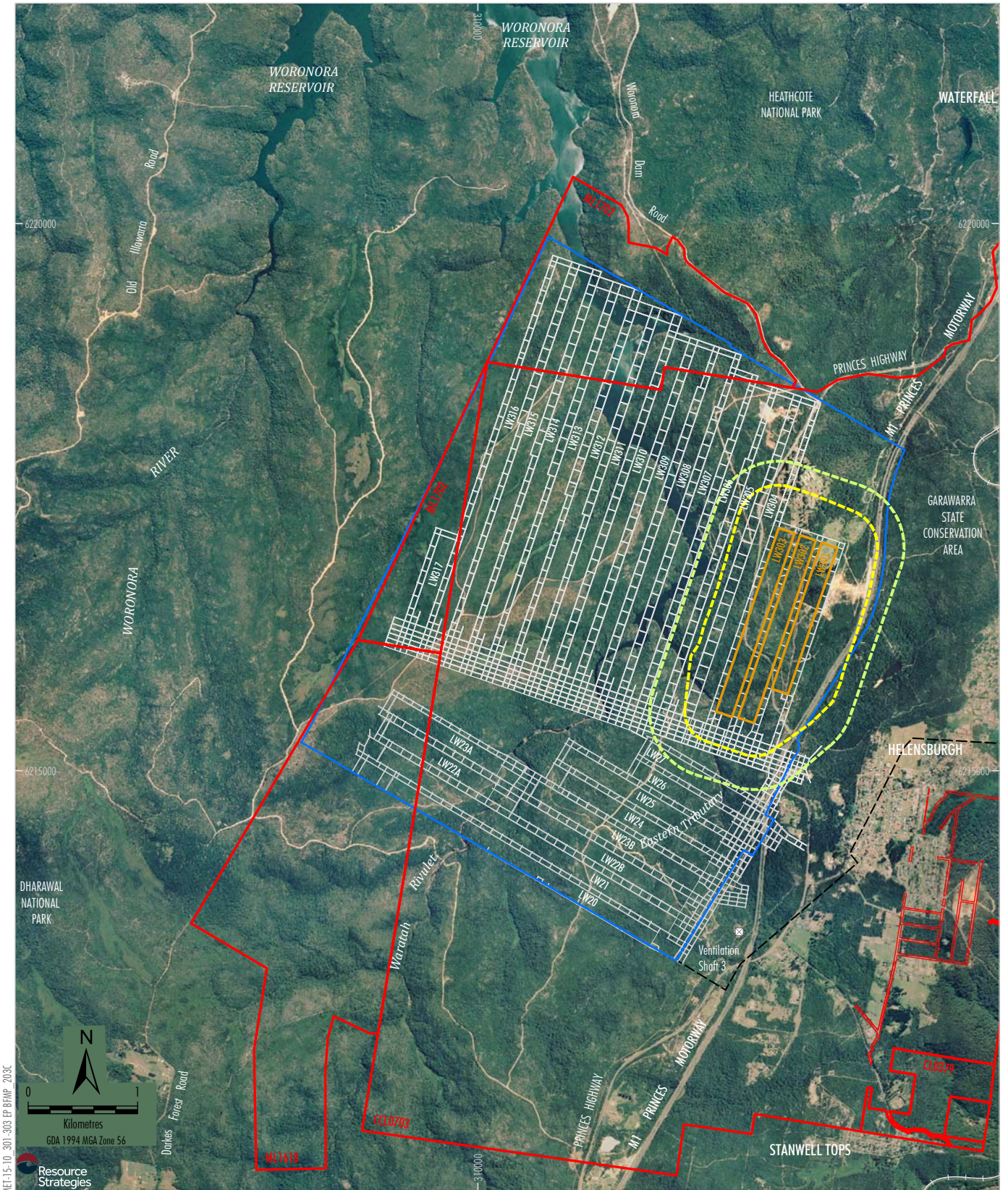
- Road
- Vehicular Track

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)

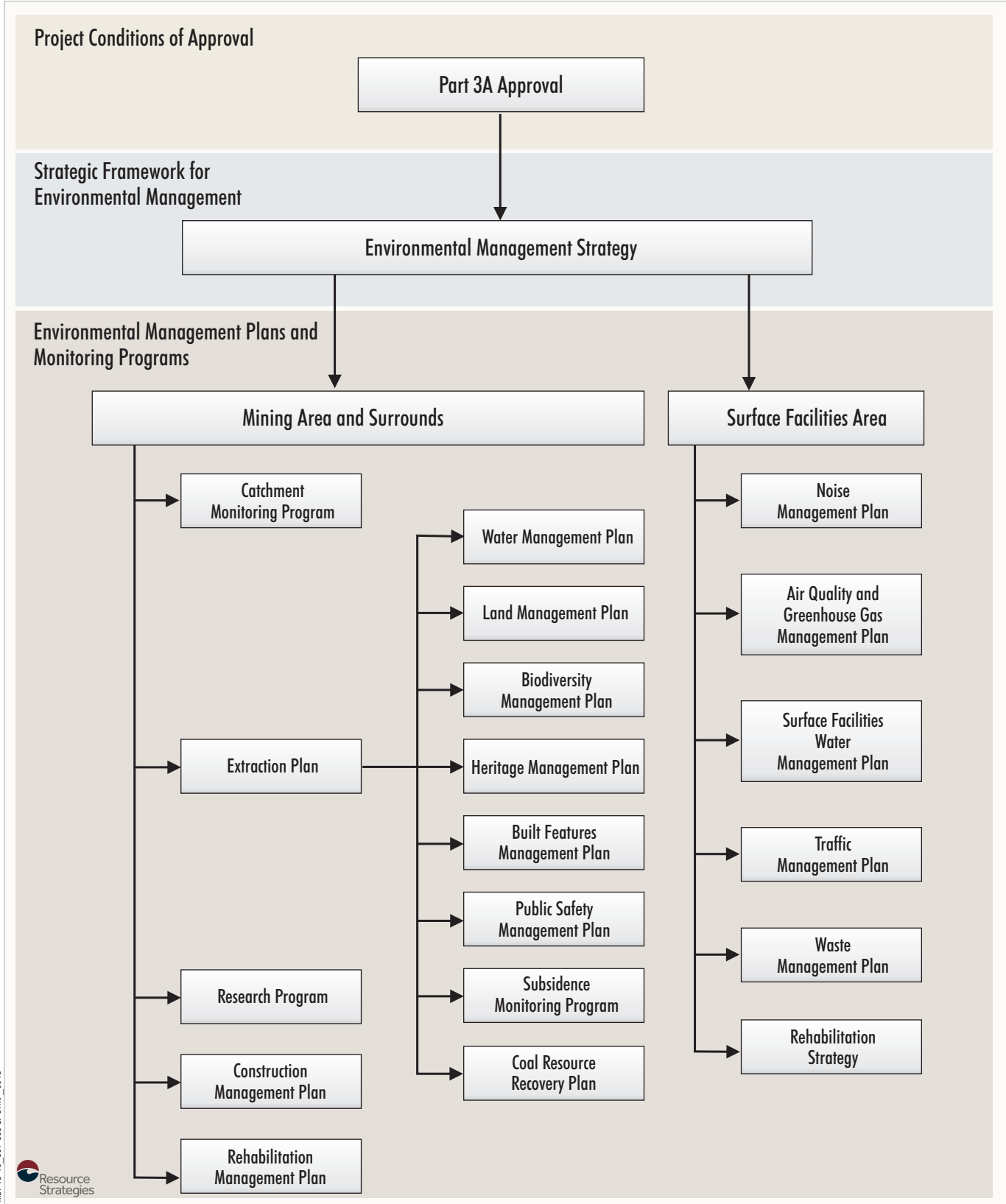
Source: Land and Property Information (2015); Date of Aerial Photography 1998;
Department of Industry (2015); Metropolitan Coal (2016); MSEC (2016)

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ENERGY

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

Figure 3



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METROPOLITAN COAL
Environmental Management
Structure

Figure 4

2 LONGWALLS 301-303 BFMP-WCC REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, this Longwalls 301-303 BFMP-WCC 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-WCC 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-WCC. The distribution register for controlled copies of the Longwalls 301-303 BFMP-WCC is described in Section 2.1.

Revisions to any documents listed within this Longwalls 301-303 BFMP-WCC 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-WCC publicly available on the Peabody website. A hard copy of the Longwalls 301-303 BFMP-WCC 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-WCC, 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-WCC 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.

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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-WCC. Table 1 indicates where each component of the conditions is addressed within this Longwalls 301-303 BFMP-WCC.

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**Table 1
Management Plan Requirements**

Project Approval Condition	Longwalls 301-303 BFMP-WCC Section
<p>Condition 2 of Schedule 7</p> <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>
<p>Condition 7 of Schedule 3</p> <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 the 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 LONGWALLS 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 Wollongong City Council Assets

Figure 5 illustrates the Wollongong City Council assets in relation to Longwalls 301-303 extraction. The assets include:

- Old Princes Highway, including
 - pavement;
 - drainage structures (e.g. pipes, culverts); and
 - guard rails, marker posts and signage.

4.2 REVISED SUBSIDENCE AND IMPACT PREDICTIONS

4.2.1 Revised Subsidence Predictions

Subsidence predictions for Longwalls 20-44 in relation to the Wollongong City Council 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.

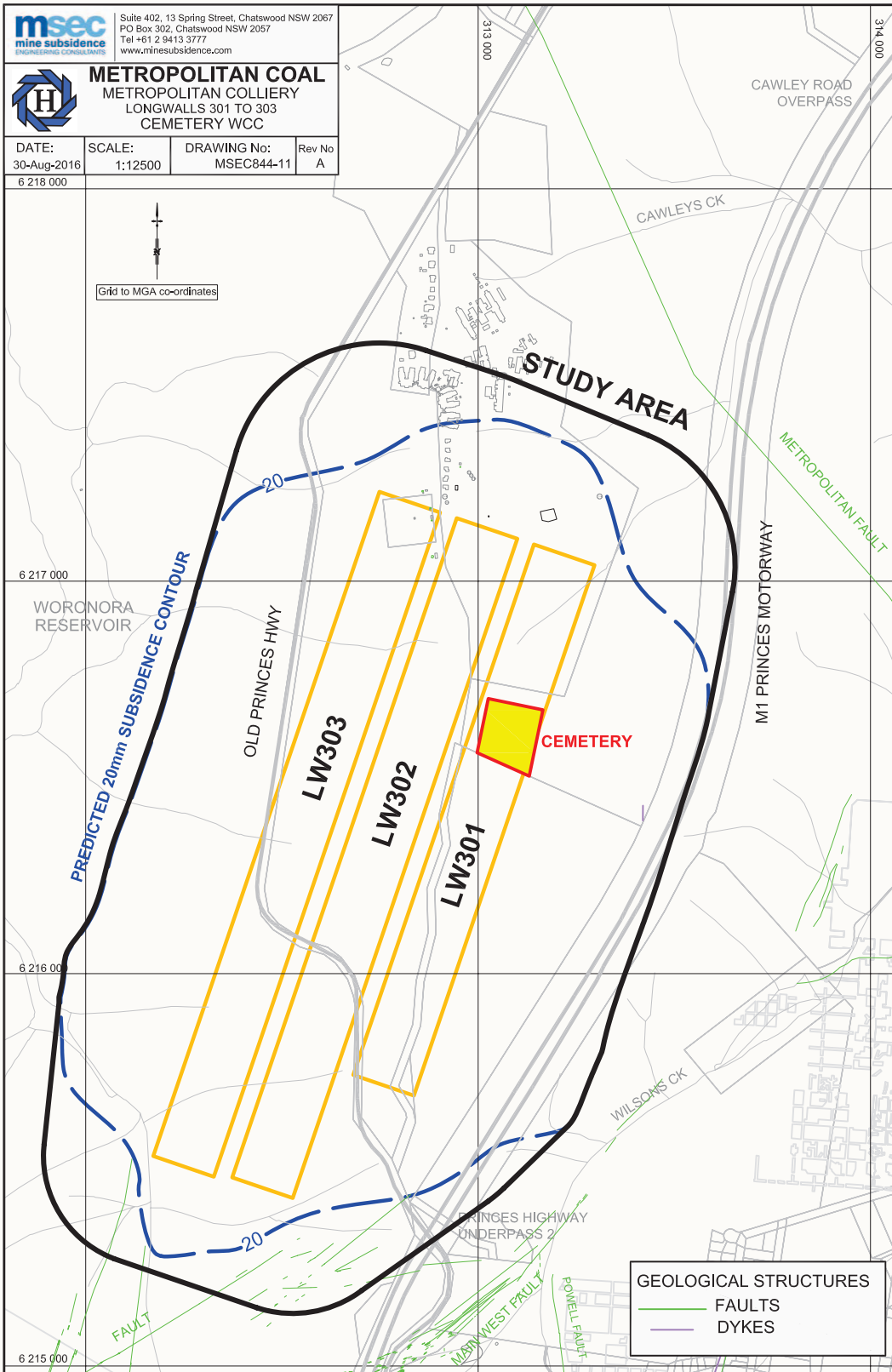
Revised subsidence and impact predictions for the extraction of Longwalls 301-303 on Wollongong City Council assets were conducted by MSEC and reported in MSEC (2016) (Appendix 1).

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

- The section of the Old Princes Highway comprises a single carriageway with a flexible asphalt pavement and grass verges.
- The maximum predicted conventional tilt for the Old Princes Highway is 4.0 mm/m (i.e. 0.4%) and is unlikely to result in adverse impacts on the serviceability or surface water drainage. If additional localised ponding or changes in surface water drainage were to occur, the drainage could be repaired using normal road maintenance techniques.
- The predicted curvatures and strains for the Old Princes Highway are similar to those where longwalls in the Southern Coalfield have previously mined directly beneath similar asphaltic and bitumen pavements.
- The Old Princes Highway Underpass (beneath Bridge 2¹) and Cawleys Road Overpass¹ are located at distances of 330 m and 1.43 km, respectively from the longwalls extracted, and could experience low level far-field horizontal movements (i.e. very small differential horizontal movements in the order of 4 mm and less than those that normally occur due to thermal expansion).

¹ Monitoring and management of the bridge structures (M1 Princes Motorway - Bridge 2 and Cawleys Road Overpass) is addressed separately in the BFMP-RMS (Roads and Maritime Services).

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METROPOLITAN COAL
Waterfall General (Garrawarra)
Cemetery

Figure 5

- Local roads and bridges are located outside the 20 mm subsidence contour and therefore unlikely to experience adverse impacts.
- With the implementation of suitable monitoring (e.g. visual and/or ground survey lines) and management strategies (e.g. repair of highway using normal road maintenance techniques), it is expected that the Old Princes Highway can be maintained in safe and serviceable conditions during and after mining.

It is important to note that the above predictions and conclusions are for total subsidence after extraction of the three Longwalls 301, 302 and 303. Subsidence effects predicted for the Old Princes Highway during initial mining of Longwall 301 alone are minimal to nil as the subsidence profile does not begin to develop until the finishing end of Longwall 301 and the total subsidence profile does not develop until during extraction of Longwall 302 (i.e. from November 2017) and Longwall 303 (i.e. from June 2018).

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

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

- preliminary identification of Wollongong City Council assets²;
- review of the revised subsidence predictions and potential impacts on Wollongong City Council 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 Wollongong City Council assets, and are summarised as follows:

Baseline Data / Validation

1. Confirm the make-up of the roadway structure of the Old Princes Highway (i.e. flexible asphalt) with Wollongong City Council.
2. Carry out a visual audit of the Old Princes Highway (and associated infrastructure) within the Study area.
3. Metropolitan Coal to obtain a copy of the visual audit of the Old Princes Highway (and associated infrastructure) once carried out, and other available baseline records (e.g. deflectograph survey, video, etc.).
4. Metropolitan Coal to engage a third party to conduct a dilapidation survey of the road pavement, guard rails, marker posts and signage in the Study area.

² During the risk assessment meeting, Metropolitan Coal confirmed that the Waterfall General (Garrawarra) Cemetery would be managed separately with Wollongong City Council in the Waterfall General (Garrawarra) Cemetery BFMP (BFMP-CEM).

Management / Monitoring / Response Measures

5. Establish a key contacts list between Peabody and Wollongong City Council to provide a regular update of status of mining activities, and for consultation if any repair works were required to be carried out.
6. Include in the BFMP a schedule of times/frequency of communication with Wollongong City Council for the status of mining of Longwalls 301-303.
7. Develop a Trigger Action Response Plan (TARP) and include a trigger for roadway, pipes/culverts and other furniture conditions that may need to be actioned by Wollongong City Council.
8. Include a monitoring plan in the BFMP to implement visual inspections of the roadway, pipes/culverts and other furniture during active subsidence associated with Longwalls 301-303.
9. Include a schedule for pre and post audits to record conditions of the roadway, pipes/culverts, guard rails, marker posts and signage in the Study area.

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	Confirm the make-up of the roadway structure of the Old Princes Highway (i.e. flexible) with Wollongong City Council	Section 4.2.1	Complete
2	Carry out a visual audit of the Old Princes Highway (and associated infrastructure) in the Study area	Section 6	Prior to LW301 or as otherwise agreed with Wollongong City Council
3	Obtain a copy of the visual audit of the Old Princes Highway (and associated infrastructure) once carried out, and other available baseline records (e.g. deflectograph survey, video)	Section 6	
4	Engage a third party to conduct a dilapidation survey of the road pavement, guard rails, marker posts and signage in the Study area	Section 6	
<i>Management / Monitoring / Response Measures</i>			
5	Establish a key contacts list in the BFMP	Section 6.3 / Table 4	Complete
6	Include a schedule of times/frequency of communication with Wollongong City Council for the status of mining of Longwalls 301-303 in the BFMP	Sections 7 and 10 / Table 2	Complete
7	Include in the TARP a trigger to roadway, pipes/culverts and other furniture conditions that may need to be actioned by Wollongong City Council	Section 10 / Table 7	Complete
8	Include a monitoring plan in the BFMP to implement visual inspections of the roadway, pipes/culverts and other furniture during active subsidence associated with Longwalls 301-303	Table 5	Complete
9	Include a schedule for pre and post audits to record conditions of the roadway, pipes/culverts, guard rails, marker posts and signage in the Study area	Section 7.2	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:

- no pavement cracking exceeding 5 mm, or other defects of the road pavement resulting in deterioration of ride quality;
- no ponding of water on the road surface as a result of changes in grade from subsidence associated with Longwalls 301-303;
- no joint displacement or cracking or other defects of the drainage structure (e.g. pipes/culverts) in excess of 5 mm; and
- serviceability of guard rails, marker posts and signage is maintained.

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

6 BASELINE DATA

The Old Princes Highway is shown on Plate 1.



Plate 1 – Old Princes Highway (Source: MSEC, 2016)

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A site inspection / visual audit of the Old Princes Highway and drainage structure (e.g. pipes/culverts) will occur prior to commencement of secondary extraction of Longwall 301 (or as otherwise agreed with Wollongong City Council) to establish the condition of the roadway and pipes/culverts. The visual audit will be conducted by representatives of Wollongong City Council and include:

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

A copy of the visual audit record will be provided to Metropolitan Coal. Other road pavement baseline records (e.g. deflectograph survey, video) would also be provided to Metropolitan Coal if available.

A third party will be engaged to conduct a dilapidation survey of the guard rails, marker posts and signage. The dilapidation survey reporting will include photo evidence, in addition to notes.

6.1 KEY CONTACTS LIST

The list of key contacts for Peabody and Wollongong City Council during the development and implementation of this BFMP are provided in Table 4.

**Table 4
List of Key Contacts**

Company	Position	Name
Peabody (Metropolitan Coal)	Manager – Technical Services	Jon Degotardi
Wollongong City Council	Civil Asset Management Unit Leader	Murray Davis
Wollongong City Council	Senior Geotechnical Engineer	Peter Tobin

7 MONITORING

A monitoring program will be implemented to monitor the impacts of the Project on the Wollongong City Council assets. Table 5 summarises the Longwalls 301-303 BFMP-WCC monitoring components.

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

Wollongong City Council or their delegates will conduct the various visual inspections. Metropolitan Coal will be notified of the timing of inspections and accompany Wollongong City Council 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-WCC.

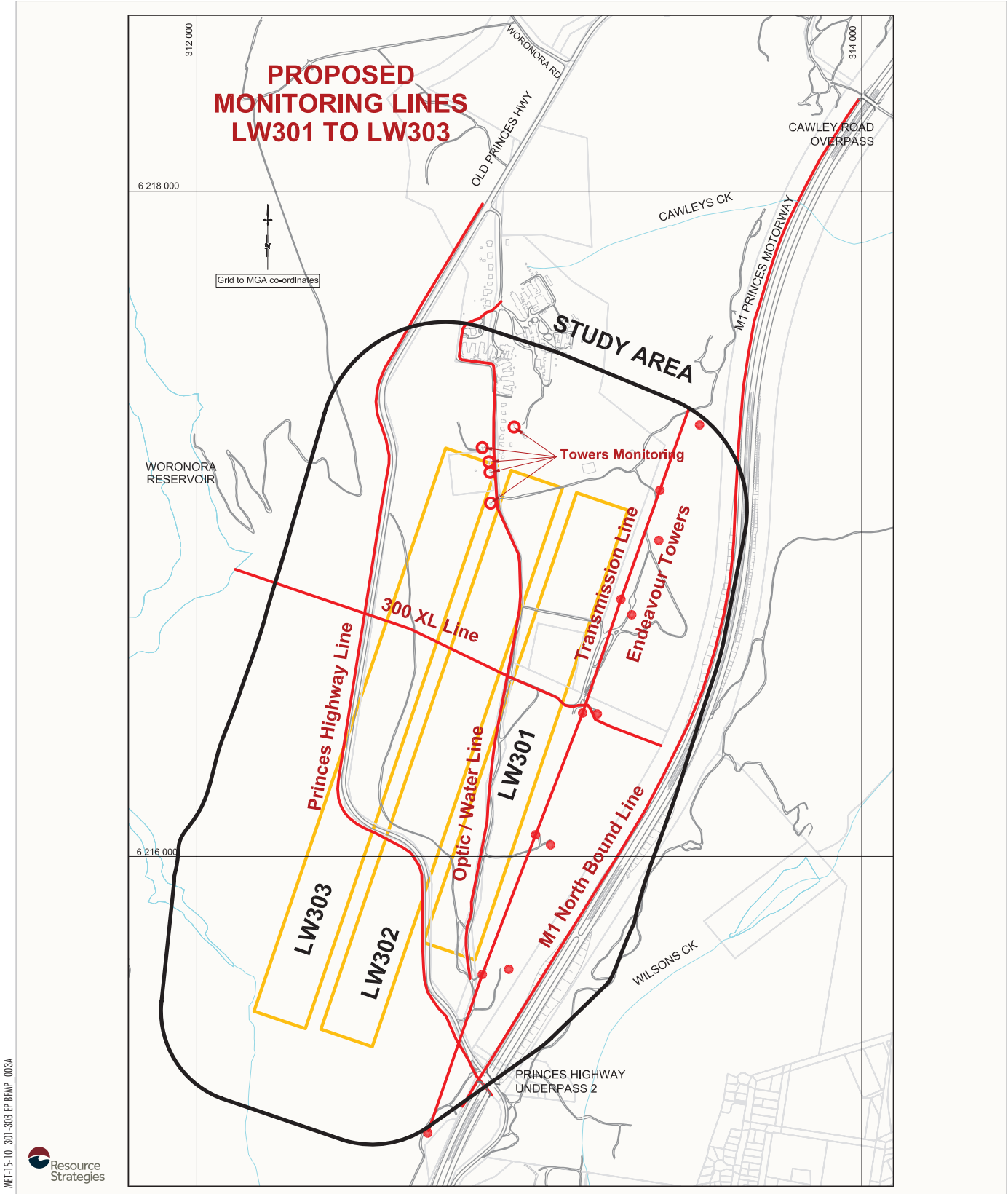
Table 5
Longwalls 301-303 BFMP-WCC Monitoring Program Overview

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. Monitoring of the Old Princes Highway subsidence line. 	<p><i>Baseline</i></p> <ul style="list-style-type: none"> Prior to the commencement of Longwall 301 extraction. <p><i>During Mining</i></p> <ul style="list-style-type: none"> Within 3 months following the completion of each of Longwalls 301, 302 and 303. 	<ul style="list-style-type: none"> Monitoring parameters include: subsidence, tilt, tensile strain, compressive strain.
Subsidence Impacts			
<ul style="list-style-type: none"> Pavement 	As per Figure 6.	<p><i>Baseline</i></p> <ul style="list-style-type: none"> Prior to the commencement of Longwall 301 extraction, or as otherwise agreed with Wollongong City Council. <p><i>During Mining</i></p> <ul style="list-style-type: none"> Progress monitoring (visual inspections) to occur as longwall face approaches within 400 m of asset to establish more frequent communications. Within 3 months following the completion of extraction of each of Longwalls 301, 302 and 303. Routinely as per WCC inspections (quarterly). 	<ul style="list-style-type: none"> Impacts to the surface including cracks, buckling and stepping.
<ul style="list-style-type: none"> Drainage Structures (Pipes/ Culverts) and Other Furniture 	Drainage structures and other furniture within the Study area.	<p><i>Baseline</i></p> <ul style="list-style-type: none"> Prior to the commencement of Longwall 301 extraction, or as otherwise agreed with Wollongong City Council. <p><i>During Mining</i></p> <ul style="list-style-type: none"> Progress monitoring (visual inspections) to occur as longwall face approaches within 400 m of asset to establish more frequent communications. Within 3 months following the completion of extraction of each of Longwalls 301, 302 and 303. Routinely as per WCC inspections. 	<ul style="list-style-type: none"> Impacts to the visible surfaces of pipes/culverts including cracking, buckling, shearing, and collapse. Visible impacts to furniture.

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.



METROPOLITAN COAL
 Longwalls 301-303 Subsidence Monitoring
 Layout

Figure 6

Monitoring of subsidence parameters specific to the Wollongong City Council assets include the survey line along the Old Princes Highway. These surveys will monitor the general movement about the longwalls and the data will allow evaluation of the likely ground movements about the Old Princes Highway (by comparison between measured and predicted movements).

7.2 SUBSIDENCE IMPACTS

7.2.1 Pavement

Road pavement subsidence impacts will be monitored along the pavement using video photography.

Subsidence impacts will be monitored extending from the Old Princes Highway Underpass (Bridge 2) to the entrance to the Garrawarra Centre Complex.

An inspection of the pavement will occur prior to commencement of Longwall 301 (or as otherwise agreed with Wollongong City Council) and within three months of the completion of Longwalls 301-303. Progress monitoring (visual inspections) will occur as the longwall face approaches within 400 m of asset to establish more frequent communications with Wollongong City Council. Additional opportunistic observations of subsidence impacts will be conducted during routine works and WCC's routine (quarterly) road condition inspections.

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 Drainage Structures (Pipes/Culverts)

Inspection using CCTV of the drainage structures (e.g. pipes/culverts) within the Study area will be carried out to provide an assessment of the baseline condition of these features prior to the extraction of Longwall 301 (or as otherwise agreed with Wollongong City Council). The inspection will include:

- recording of existing cracks; and
- recording of other defects such as joint displacement and general condition.

A site inspection of the pipes/culverts will also occur using CCTV following the completion of Longwalls 301-303. The visual assessment will be carried out by representative(s) from the Wollongong City Council following the completion of each longwall and will assess changes to the pipes/culverts from the baseline condition as a result of the extraction of Longwalls 301-303.

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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7.2.3 Guard Rails, Marker Posts and Signage

Pre and post audits of guard rails, marker posts and signage will be conducted using the results of the dilapidation survey described in Section 6 and recorded following the completion of Longwalls 301-303 to assess changes from the baseline condition.

7.3 ENVIRONMENTAL CONSEQUENCES

Metropolitan Coal and Wollongong City Council will compare the results of the subsidence impact monitoring against the built features performance measure and performance indicators. In the event the observed subsidence impacts exceed the performance measure or performance indicators, Metropolitan Coal and Wollongong City Council 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 pavement, drainage structures and other furniture are considered to be applicable and are described below.

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).

8.1 ROAD PAVEMENTS

The potential management measures in relation to the Old Princes Highway pavement include:

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

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

8.2 DRAINAGE STRUCTURES (PIPES/CULVERTS)

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

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

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

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8.3 GUARD RAILS, MARKER POSTS AND SIGNAGE

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

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

9 CONTINGENCY PLAN

In the event the subsidence impacts observed exceed the performance measure or performance indicators detailed in Section 5 of this Longwalls 301-303 BFMP-WCC, 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.
- 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-WCC.
- Metropolitan Coal will report any exceedance of the performance measure or performance indicators to the DP&E and Wollongong City Council 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.

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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 Old Princes Highway is exceeded are summarised in Table 6.

**Table 6
Potential Contingency Measures – Old Princes Highway**

Environmental Consequence	Potential Contingency Measures	
	Measure	Description
Impact on:		
Pavement	Rebuild road.	<ul style="list-style-type: none"> Temporary closure of the road and reconstruction of pavement.
Pipes/Culverts	Replace pipe. Rebuild culvert.	<ul style="list-style-type: none"> Construction of temporary drainage pipe/culvert and reconstruction or replacement of original pipe/culvert.
Other Furniture (Guard Rail, Marker Posts, Signage)	Replace furniture.	<ul style="list-style-type: none"> Replace section of guard rail, marker post or signage.

Temporary road closure procedures would be developed and carried out in consultation with the Wollongong City Council.

10 TARP – MANAGEMENT TOOL

The framework for the various components of the Longwalls 301-303 BFMP-WCC are summarised in the Longwalls 301-303 BFMP-WCC TARP shown in Table 7. The Longwalls 301-303 BFMP-WCC 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 7
Longwalls 301-303 BFMP-WCC Trigger Action Response Plan

Condition	Baseline Conditions	Predicted Impacts	Restoration/Contingency Phase
Trigger	<ul style="list-style-type: none"> Old Princes Highway and associated infrastructure are safe serviceable and repairable (or as otherwise identified by pre-mining inspection). 	<ul style="list-style-type: none"> Repairable impact (using normal road maintenance techniques) to pavement, drainage structures and furniture. Performance indicators in Section 5. 	<ul style="list-style-type: none"> Reduction in serviceability of the roadway. Reduction in serviceability of the drainage structures (e.g. pipes/culverts) or furniture.
Action	Establish baseline data. Includes: <ul style="list-style-type: none"> Pre-mining inspection / audit. Pre-extraction subsidence survey as per the Longwalls 301-303 Subsidence Monitoring Program. 	<ul style="list-style-type: none"> Conduct monitoring as per Table 5. Update the Built Features Management Plan – Subsidence Impact Register. Repair of pavement, drainage structures or furniture where cracks or faults are detected (e.g. those that affect serviceability). 	<ul style="list-style-type: none"> Implement Contingency Plan as per Section 9.
Position of Decision-making	<ul style="list-style-type: none"> Manager - Technical Services. WCC. 	<ul style="list-style-type: none"> Manager - Technical Services. WCC. 	<ul style="list-style-type: none"> General Manager. WCC.

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). The collection of baseline data will be consistent with the baseline data collected for Longwalls 301-303. However for the Old Princes Highway, 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 Wollongong City Council 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-WCC 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, Wollongong City Council 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, the Longwalls 301-303 BFMP-WCC 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) and any relevant agencies with a detailed report on the incident.

Wollongong City Council will be notified within 24 hours of any access limitations or restrictions.

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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.

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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 licences 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.

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 – Subsidence Predictions and Impact Assessments from Proposed Longwalls 301 to 303 for the Wollongong City Council Infrastructure, 8 September 2016*.

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APPENDIX 1

MSEC (2016) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 301 TO 303
– SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE
WOLLONGONG CITY COUNCIL INFRASTRUCTURE, DATED 8 SEPTEMBER 2016

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8th September 2016

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

Ref: MSEC844-10

Dear Jon,

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

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the Wollongong City Council (WCC) infrastructure resulting from the extraction of the proposed Longwalls 301 to 303 at Metropolitan Colliery.

The locations of the WCC infrastructure and the proposed longwalls are shown in the attached Drawing No. MSEC844-10. The Old Princes Highway crosses directly above Longwalls 301 to 303. This section of the highway comprises a single carriageway with a flexible asphalt pavement and grass verges. A photograph of the Old Princes Highway is provided in Figure 1.



Figure 1 Old Princes Highway

There are also local roads and bridges located outside and in the vicinity of the Study Area, within the township of Helensburgh to the south-east of the longwalls and to the north-east of the longwalls. These local roads are located at a minimum distance of 0.9 kilometres from the longwalls. The Princes Highway Underpass and the Cawleys Road Overpass are located at distances of 330 metres and 1.43 kilometres, respectively, from the longwalls.

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

Conventional Subsidence Parameters for the WCC Infrastructure

The following provides summaries of the maximum predicted conventional movements for the WCC 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 the Old Princes Highway, resulting from the extraction of Longwalls 301 to 303, are shown in the attached Fig. A.1. 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 summary of the maximum predicted values of incremental subsidence, tilt and curvature for the Old Princes Highway, due to the extraction of each of the Longwalls 301 to 303, is provided in Table 1. The values are the maxima anywhere along the highway at any time during or after the extraction of each longwall.

Table 1 Maximum Predicted Incremental Subsidence, Tilt and Curvature for the Old Princes Highway 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	40	< 0.5	< 0.01	< 0.01
Due To LW302	625	4.0	0.05	0.06
Due To LW303	650	3.0	0.05	0.06

The maximum predicted incremental subsidence for the Old Princes Highway, due to the extraction of each of the Longwalls 301 to 303, varies between 40 mm to 650 mm.

A summary of the maximum predicted values of total subsidence, tilt and curvature for the Old Princes Highway, resulting from the extraction of Longwalls 301 to 303, is provided in Table 2. The values are the maxima anywhere along the highway at any time during or after the extraction of the longwalls.

Table 2 Maximum Predicted Total Subsidence, Tilt and Curvature for the Old Princes Highway 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	40	< 0.5	< 0.01	< 0.01
After LW302	675	4.0	0.05	0.06
After LW303	900	3.5	0.05	0.06

The maximum predicted total subsidence for the Old Princes Highway, resulting from the extraction of Longwalls 301 to 303, is 900 mm. The maximum predicted conventional tilt for the highway is 4.0 mm/m (i.e. 0.4 %, or 1 in 250). It is noted, that the maximum tilt occurs after the extraction of Longwall 302 and reduces slightly after the extraction of Longwall 303. The maximum predicted conventional curvatures are 0.05 km⁻¹ hogging and 0.06 km⁻¹ sagging, which equate to minimum radii of curvature of 20 kilometres and 17 kilometres, respectively.

The local roads and bridges are located outside the predicted 20 mm subsidence contour. It is unlikely that the features would experience measurable vertical subsidence, tilt, curvatures or strains. These features could experience low level far-field horizontal movement. The far-field horizontal movements are expected to be similar to those observed for previous longwall mining in the Southern Coalfield.

The observed incremental far-field horizontal movements, resulting from the extraction of longwalls in the Southern Coalfield, are provided in Figure 2. The data are based on survey marks located outside of the mining area (i.e. above solid coal).

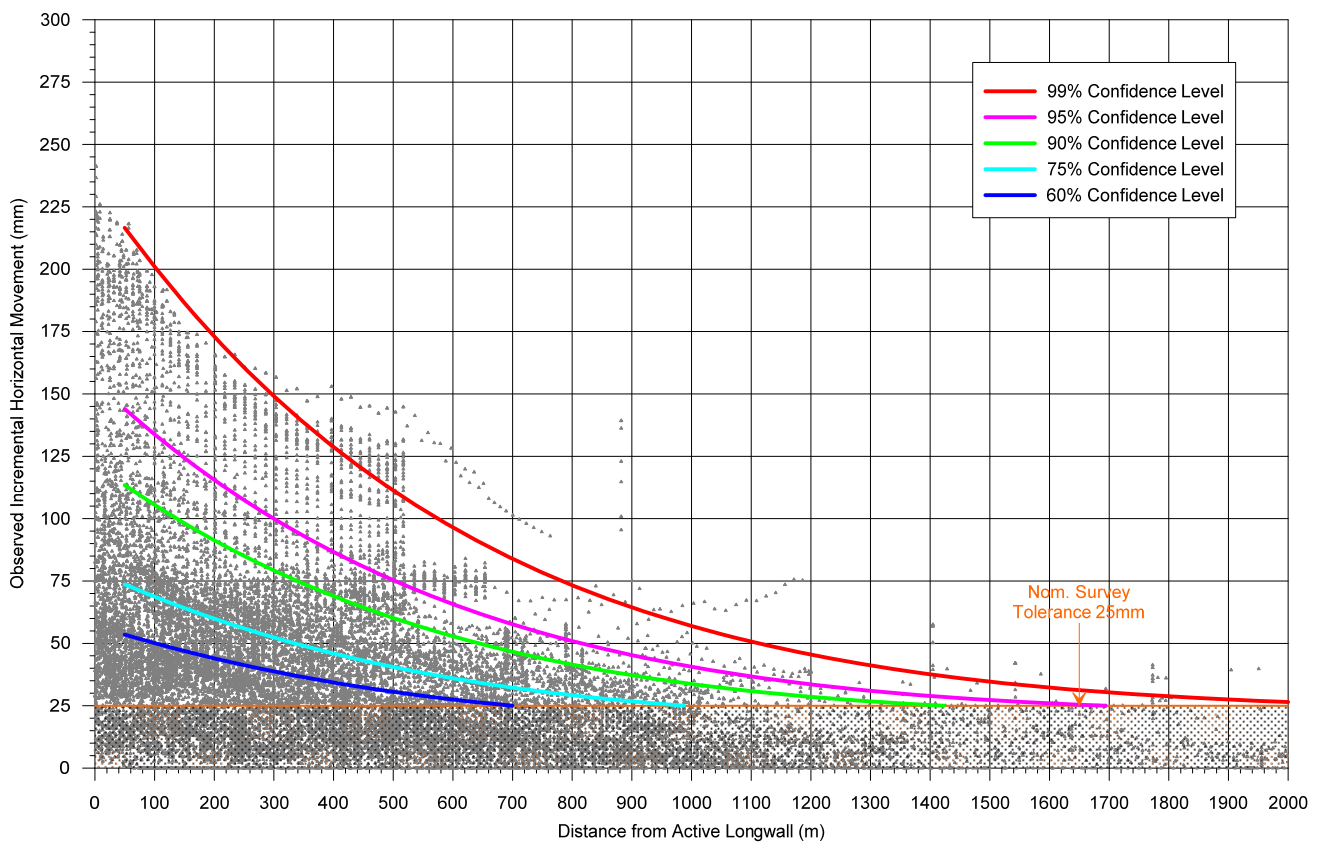


Figure 2 Observed Incremental Far-field Horizontal Movements from the Southern Coalfield (Solid Coal)

The absolute horizontal movements measured at distances greater than 0.9 kilometres from mining are in the order of 40 mm based on the 95 % confidence level. These low level movements comprise a large proportion of survey tolerance. Far-field horizontal movements tend to be bodily movements orientated towards the mining area. The strains associated with these low level horizontal movement are not expected to be measurable.

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 WCC 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 Old Princes Highway is 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 3. The probability distribution functions, based on a fitted *Generalised Pareto Distribution (GPD)*, have also been shown in this figure.

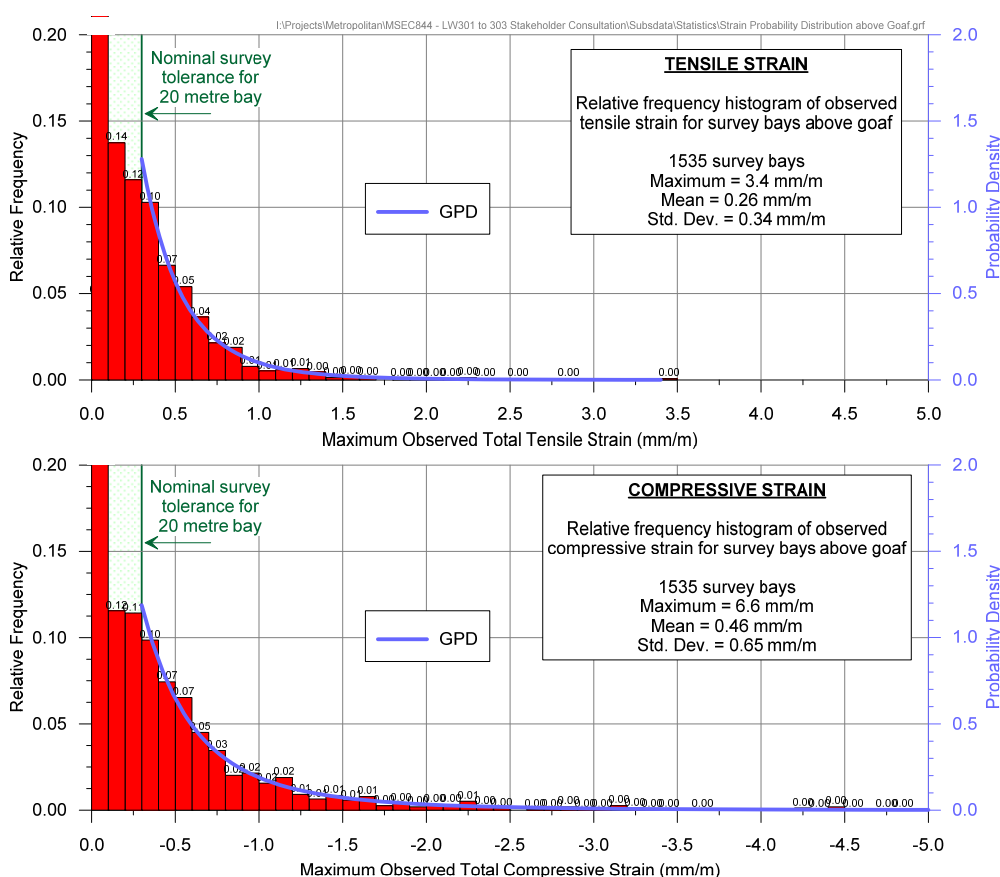


Figure 3 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Goaf

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 3.

Table 3 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. MSEC844-10.

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 Old Princes Highway does not cross any major streams within the Study Area. The highway, therefore, is not expected to experience any measurable valley closure effects.

Impact Assessments for the Old Princes Highway

The maximum predicted conventional tilt for the Old Princes Highway is 4.0 mm/m (i.e. 0.4 %, or 1 in 250). The predicted changes in grade are small, less than 1 %, and therefore are unlikely to result in adverse impacts on the serviceability or surface water drainage for the highway. If additional localised ponding or adverse changes in surface water drainage were to occur as the result of mining, the highway could be repaired using normal road maintenance techniques.

The maximum predicted conventional curvatures for the highway are 0.05 km⁻¹ hogging and 0.06 km⁻¹ sagging, which equate to minimum radii of curvature of 20 kilometres and 17 kilometres, respectively. The 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.

The maximum predicted curvatures and the range of potential strains for the Old Princes Highway are similar to those typically experienced elsewhere in the Southern Coalfield. Longwalls in the Southern Coalfield have been successfully mined directly beneath roads with bitumen and asphaltic pavements.

For example, at Tahmoor Colliery, Longwalls 22 to 27 have mined beneath approximately 24.5 kilometres of local roads. A total of 46 impact sites have been observed and, therefore, this equates to an average of one impact for

every 533 metres of pavement. The impacts were minor and did not present a public safety risk. The potential impacts due to conventional subsidence movements include minor cracking, rippling, bumps and stepping in the road surface. The nature of potential impacts to the pavement are also affected by the type of construction of the road pavement.

The potential impacts on the Old Princes Highway could be managed using monitoring (visual and/or ground survey lines) and remediation of adverse impacts during active subsidence using normal road maintenance techniques. The final repair of the highway would be undertaken at the completion of the longwalls.

It is recommended that monitoring and management strategies are developed, in consultation with WCC, to manage the potential impacts on the Old Princes Highway. It is expected that the highway can be maintained in safe and serviceable conditions with the implementation of the appropriate monitoring and management strategies.

Impact Assessments for the Local Roads and Bridges

The local roads are located outside of the predicted 20 mm subsidence contour. It is unlikely therefore that these roads would experience adverse impacts as a result of Longwalls 301 to 303.

The Princes Highway Underpass and the Cawleys Road Overpass are located at distances of 330 metres and 1.43 kilometres, respectively, from the longwalls. These bridges could experience low level far-field horizontal movements and could be sensitive to these movements. The Princes Highway Underpass and Cawleys Road Overpass are maintained by Roads and Maritime Services (RMS) and therefore the assessments for these bridges are provided in the Report No. MSEC844-08. The monitoring and management of the Princes Highway Underpass and the Cawleys Road Overpass will be incorporated in the Built Features Management Plan for RMS the infrastructure.

Summary

The Old Princes Highway crosses directly above Longwalls 301 to 303. The previous experience from the Southern Coalfield has found that the potential impacts on bitumen seal and asphaltic pavements can be managed with the implementation of suitable monitoring and management strategies.

It is recommended that monitoring and management strategies are developed, in consultation with WCC, to manage the potential impacts on the Old Princes Highway. It is expected that the highway can be maintained in safe and serviceable conditions with the implementation of the appropriate monitoring and management strategies.

The other local roads and bridges are located outside the predicted 20 mm subsidence contour. Whilst these features could experience low level far-field horizontal movements, they are not expected to experience measurable strains or differential horizontal movements. It is unlikely therefore that these features would experience adverse impacts as a result of Longwalls 301 to 303.

Yours sincerely



Peter DeBono

Attachments:

Drawing No. MSEC844-10 – Longwalls 301 to 303 – WCC Infrastructure

Fig. A.1 Predicted Profiles of Conventional Subsidence, Tilt and Curvature for the Old Princes Highway due to LW301 to LW303



Suite 402, 13 Spring Street, Chatswood NSW 2067
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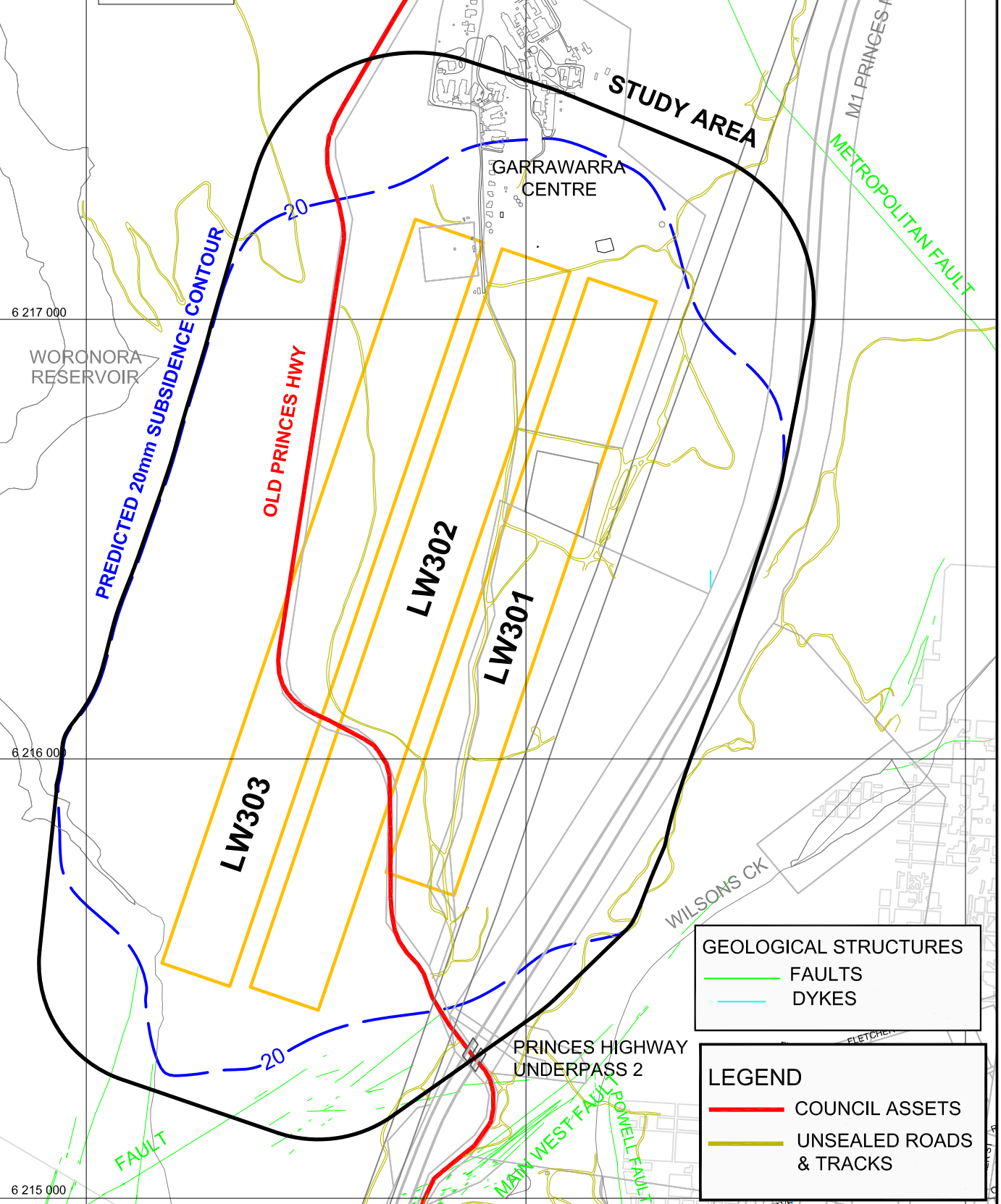
METROPOLITAN COAL
 METROPOLITAN COLLIERY
 LONGWALLS 301 TO 303
 WOLLONGONG CITY COUNCIL

DATE: 30-Aug-2016	SCALE: 1:12500	DRAWING No: MSEC844-10	Rev No D
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6 218 000

312 000

Grid to MGA co-ordinates



GEOLOGICAL STRUCTURES

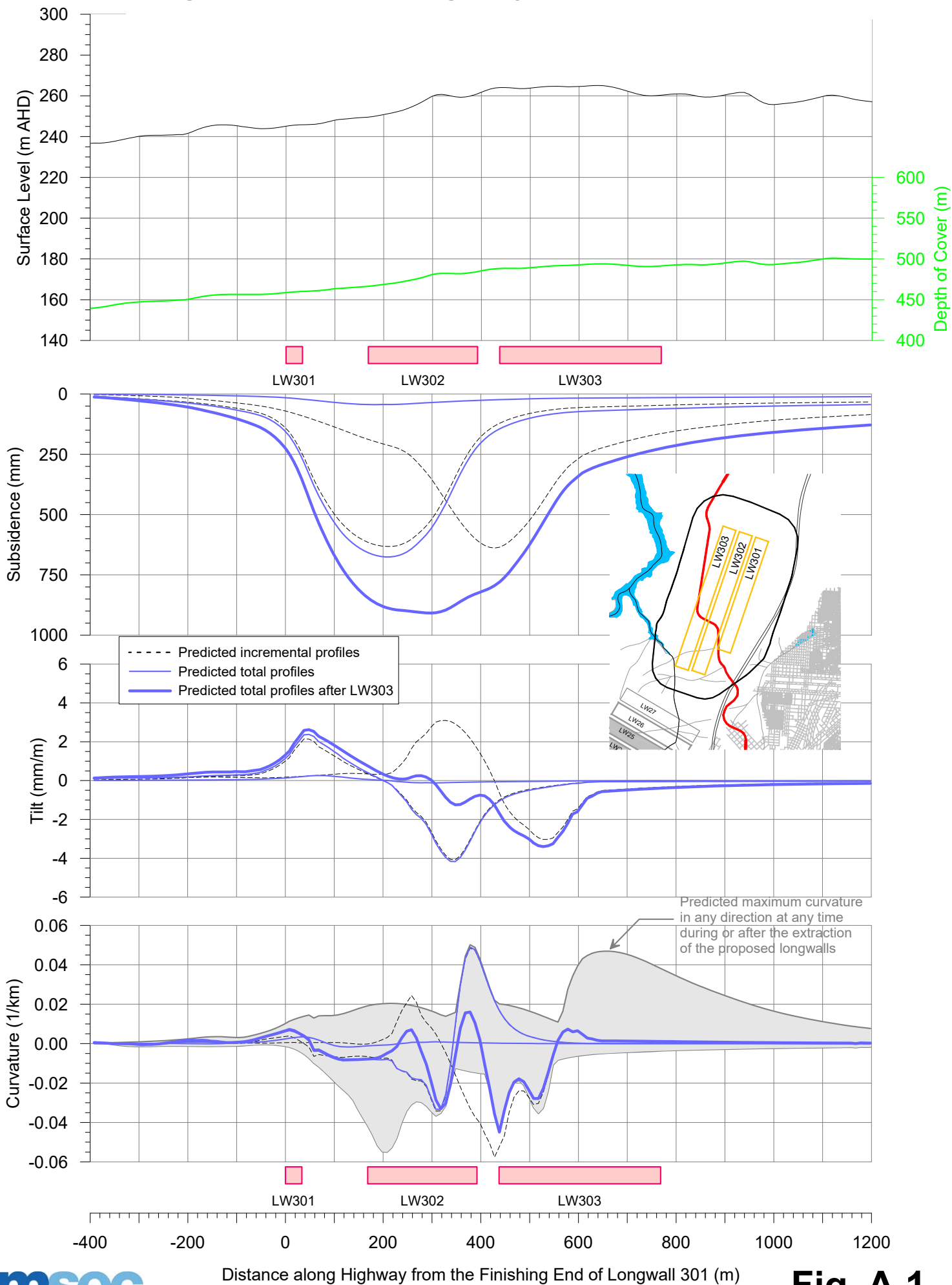
	FAULTS
	DYKES

LEGEND

	COUNCIL ASSETS
	UNSEALED ROADS & TRACKS

6 215 000

Predicted Profiles of Conventional Subsidence, Tilt and Curvature along the Old Princes Highway due to LW301 to LW303



APPENDIX 2

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER

Metropolitan Coal – Built Features Management Plan – Wollongong City Council		
Revision No. LW301-303 BFMP_WCC-R01-B		
Document ID: Built Features Management Plan - WCC		

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. road pavement, guard rail, etc.).

**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 culvert, 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: