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LONGWALLS 301-303

BUILT FEATURES MANAGEMENT PLAN
WATERFALL GENERAL [GARRAWARRA] CEMETERY

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DP&E Approval Date
All	LW301-303 BFMP_CEM-R01-A	Original – Draft for Consultation	Wollongong City Council	-
Tables 3 & 5, Figure 4	LW301-303 BFMP_CEM-R01-B	Revised – Incorporating updates	Wollongong City Council	-

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 – Cemetery (Longwalls 301-303 BFMP-CEM) has been developed to manage the potential consequences of Longwalls 301-303 extraction on the Waterfall General [Garrawarra] Cemetery.

The relationship of this Longwalls 301-303 BFMP-CEM 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 of Schedule 3, the suitably qualified and experienced experts that have prepared this Longwalls 301-303 BFMP-CEM, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and Metropolitan Coal were endorsed by the Secretary of the NSW Department of Planning and Environment (DP&E) on 6 June 2016. This Longwalls 301-303 BFMP-CEM has been prepared in consultation with Wollongong City Council.

1.2 STRUCTURE OF THE LONGWALLS 301-303 BFMP-CEM

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

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

Section 3: Outlines the statutory requirements applicable to the Plan.

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.

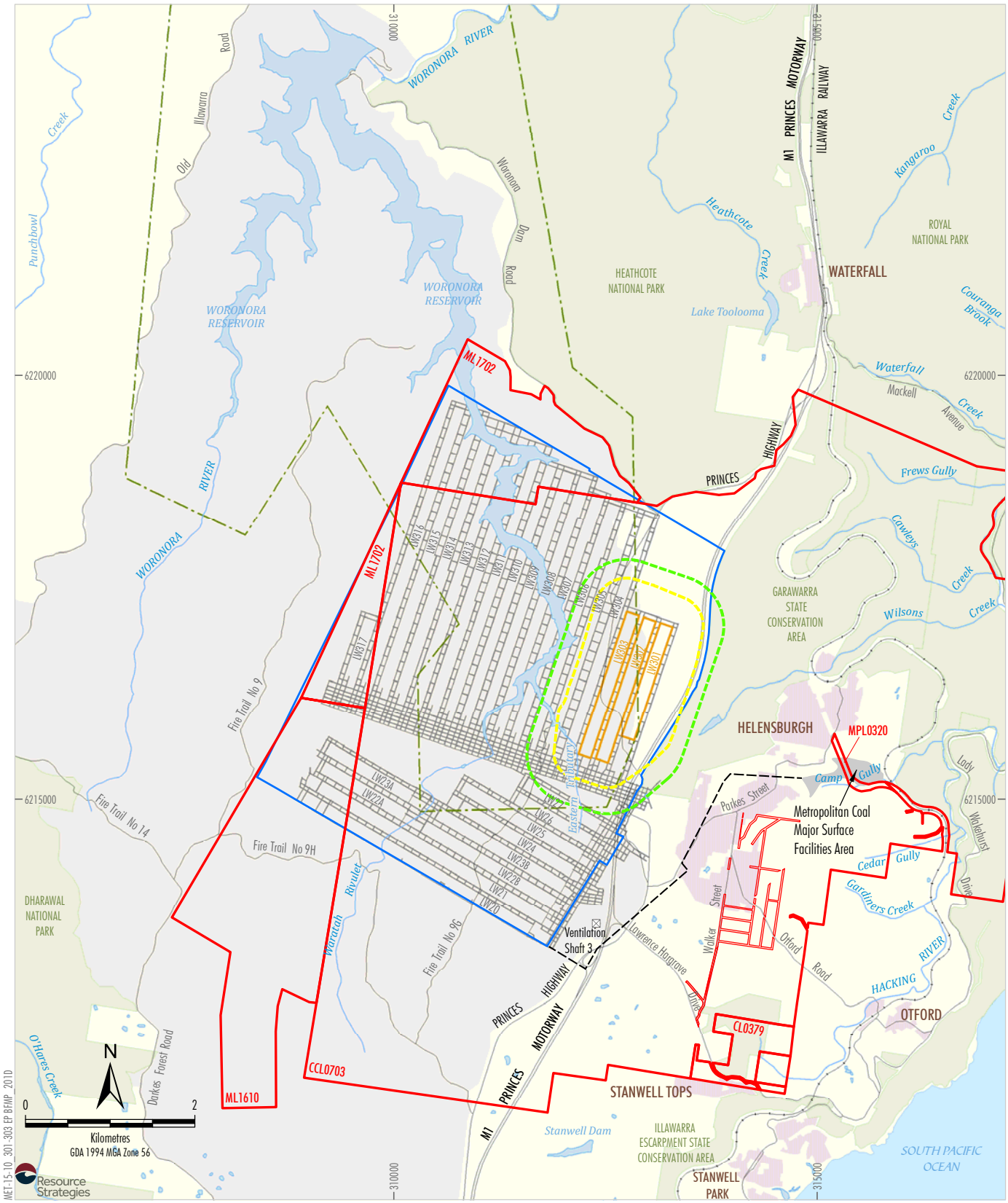
Section 12: Describes the annual review and improvement of environmental performance.

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-CEM.



LEGEND

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

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

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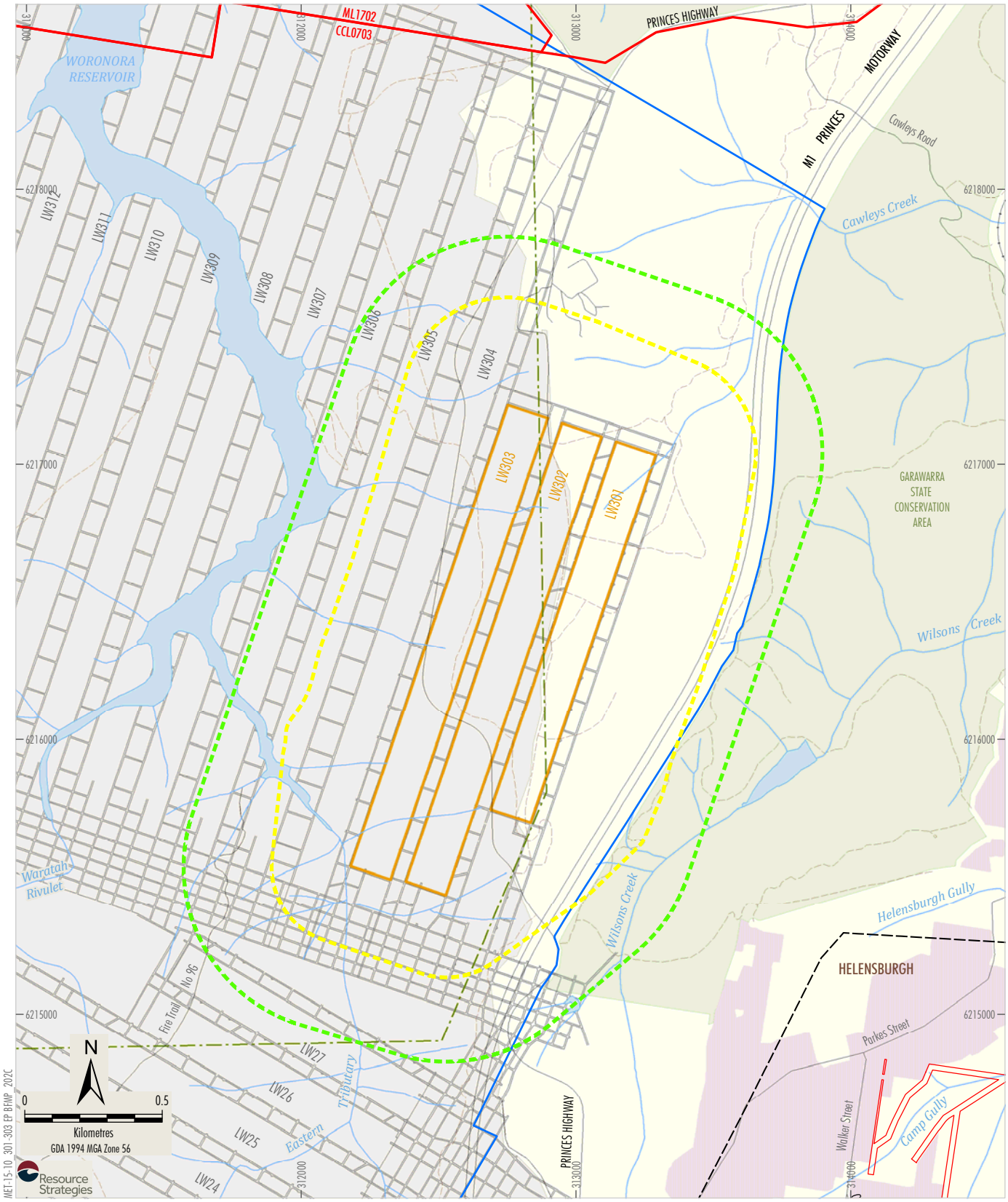
Project Longwalls 20 - 27 and Longwalls 301 - 317 Layout

Figure 1



LEGEND

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

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

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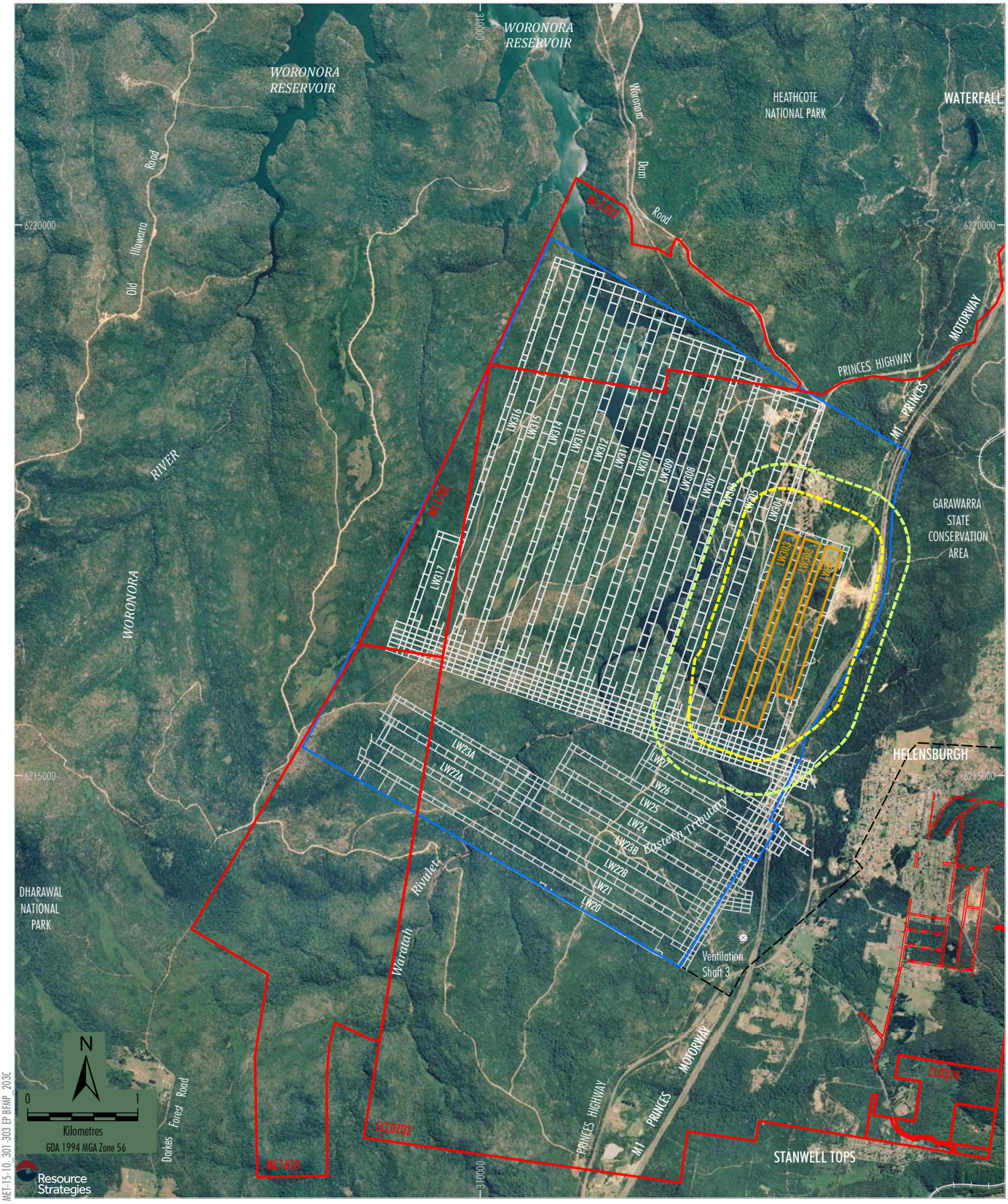
Longwalls 301 - 303 Layout

Figure 2



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LEGEND

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

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

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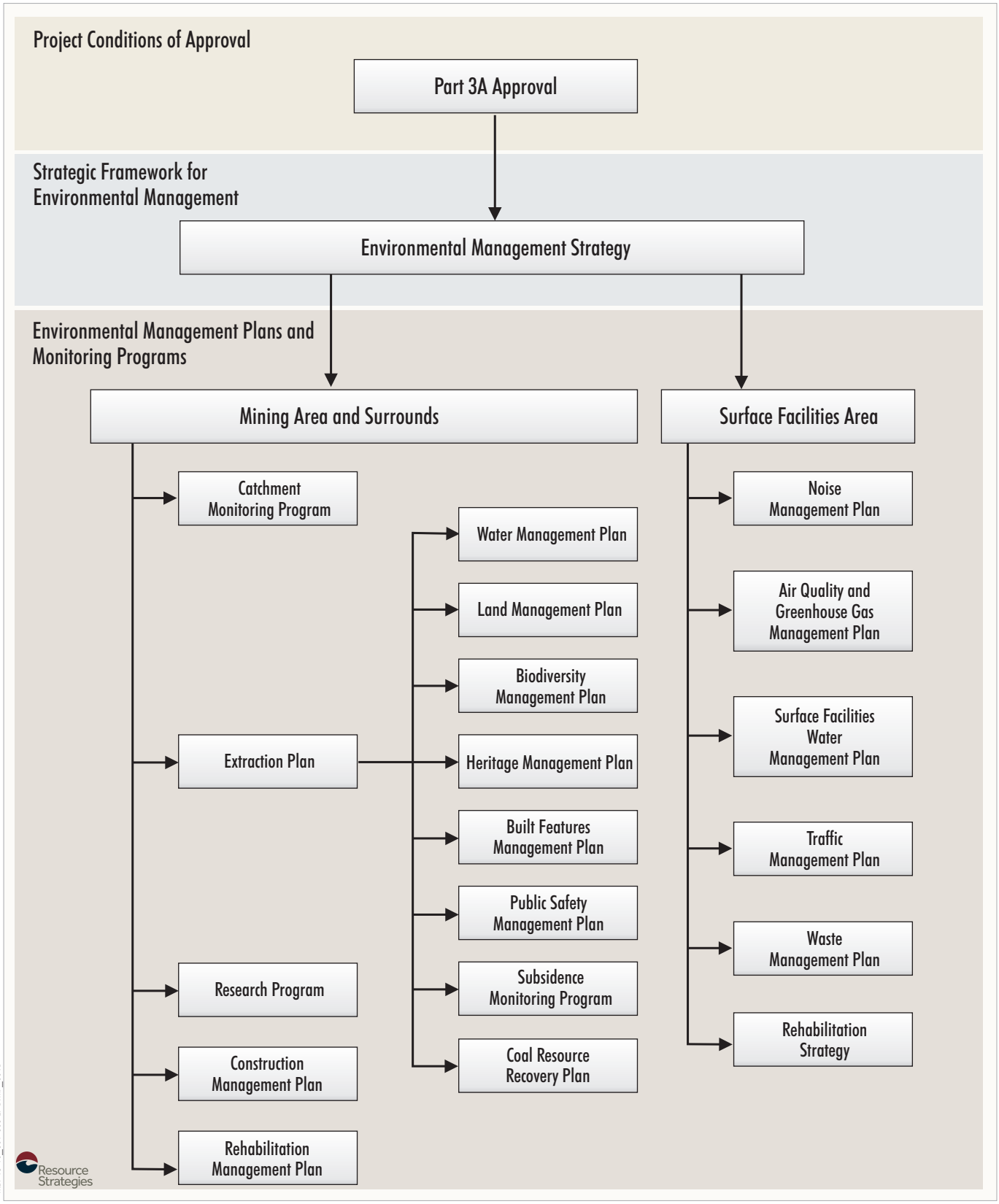
Project Longwalls 20 - 27 and Longwalls 301 - 317 Layout - Aerial Photograph

Figure 3



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Environmental Management Structure

Figure 4

2 LONGWALLS 301-303 BFMP-CEM REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, this Longwalls 301-303 BFMP-CEM 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 BFMP will also be reviewed within three months of approval of any Project modification and if necessary, revised to the satisfaction of the DP&E.

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

Revisions to any documents listed within this Longwalls 301-303 BFMP-CEM 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-CEM publicly available on the Peabody website. A hard copy of the Longwalls 301-303 BFMP-CEM 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-CEM, 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-CEM 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-CEM. Table 1 indicates where each component of the conditions is addressed within this Longwalls 301-303 BFMP-CEM.

Table 1
Management Plan Requirements

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

3.2 LICENCES, PERMITS AND LEASES

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

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

3.3 OTHER LEGISLATION

Metropolitan Coal will conduct the Project consistent with the Project Approval and any other legislation that is applicable to an approved Part 3A Project under the EP&A Act.

The following Acts may be applicable to the conduct of the Project (Helensburgh Coal Pty Ltd [HCPL], 2008):

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

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

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

4 REVISED ASSESSMENT OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

4.1 LONGWALL 301-303 EXTRACTION LAYOUT

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

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

Table 2
Provisional Extraction Schedule

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

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

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

4.1.1 Waterfall General [Garrawarra] Cemetery

The Waterfall General [Garrawarra] Cemetery, also referred as the Garrawarra Hospital Cemetery or Waterfall Cemetery, is currently listed as an item of local significance under the *Wollongong Local Environmental Plan, 2009* (item 6505).

The Subsidence Assessment prepared by MSEC in 2008 (Appendix A to the Metropolitan Coal Project EA) included an assessment of impacts on the Waterfall Cemetery, and noted that:

> *It is unlikely that existing headstones or fencing, if any, would be affected by the predicted maximum tilt of 5.3 mm/m.*
>
> *It is possible that some minor cracking of the surface soils in the cemetery could occur as a result of the extraction of the proposed Longwalls 20 to 44, but it is unlikely that surface cracks in the soil would exceed 20 mm in width... If these cracks eventuate they can be identified by regular survey inspections and surface cracking can be readily overcome by infilling with soil or other suitable materials, or by locally regrading and compacting the surface.*

The Waterfall Cemetery site is under the management of the Wollongong City Council. A photographic index of identifiable graves was produced by the Wollongong City Council in September 2013 (Wollongong City Council, 2013). A Conservation Management Plan was developed and endorsed by the Wollongong City Council on 14 July 2014.

A draft Planning Proposal was also exhibited from 24 August 2015 to 11 September 2015 to amend the property description and expand the conservation area boundary of Garrawarra Hospital Heritage Conservation Area (item 61028) to include the Waterfall General [Garrawarra] Cemetery.

4.2 REVISED SUBSIDENCE AND IMPACT PREDICTIONS

4.2.1 Revised Subsidence Predictions

Subsidence predictions for Longwalls 20-44 in relation to the Waterfall Cemetery 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 the Waterfall Cemetery were conducted by MSEC and reported in MSEC (2016) (Appendix 1).

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

- The Waterfall Cemetery site is located directly above Longwall 301 in an area of relatively flat topography at a topographical high point.

- The maximum predicted incremental subsidence (600 mm) for the Waterfall Cemetery site however occurs due to the extraction of Longwall 302.
- The maximum predicted total subsidence for the Waterfall Cemetery site resulting from the extraction of Longwalls 301-303 is 800 mm.
- The maximum predicted conventional tilt for the Waterfall Cemetery site is 5.0 mm/m, which is a very small change in grade (i.e. 0.5%) and therefore is unlikely to result in adverse impacts on any features including headstones or fencing.
- The maximum predicted curvatures and the range of potential strains for the Waterfall Cemetery site are similar to those typically experienced elsewhere in the Southern Coalfield directly above extracted longwalls.
- It is possible that some minor cracking of the surface soils or exposed bedrock in the Waterfall Cemetery could occur as a result of the extraction of Longwalls 301-303, however identification may be difficult given the overgrown nature of the site (refer Section 6).
- If minor surface cracks eventuate, and can be identified, they can be readily repaired by infilling with soil or other suitable materials.

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:

- identification of the asset managed by Wollongong City Council (i.e. Waterfall General [Garrawarra] Cemetery), including recognition of the Conservation Management Plan and draft Planning Proposal for the site;
- 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 Waterfall Cemetery, and are summarised as follows:

Baseline Data / Validation

1. Prepare a pre-mining audit of all marked grave sites to document a baseline of the condition of each grave site. The pre-mining audit to include photographs and commentary.

Management / Monitoring / Response Measures

2. 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 (refer Point 4 below).
3. Prepare a post mining audit of all marked grave sites to report on any changes or impacts to the graves sites from the mining of Longwalls 301 to 303.

Contingency Planning

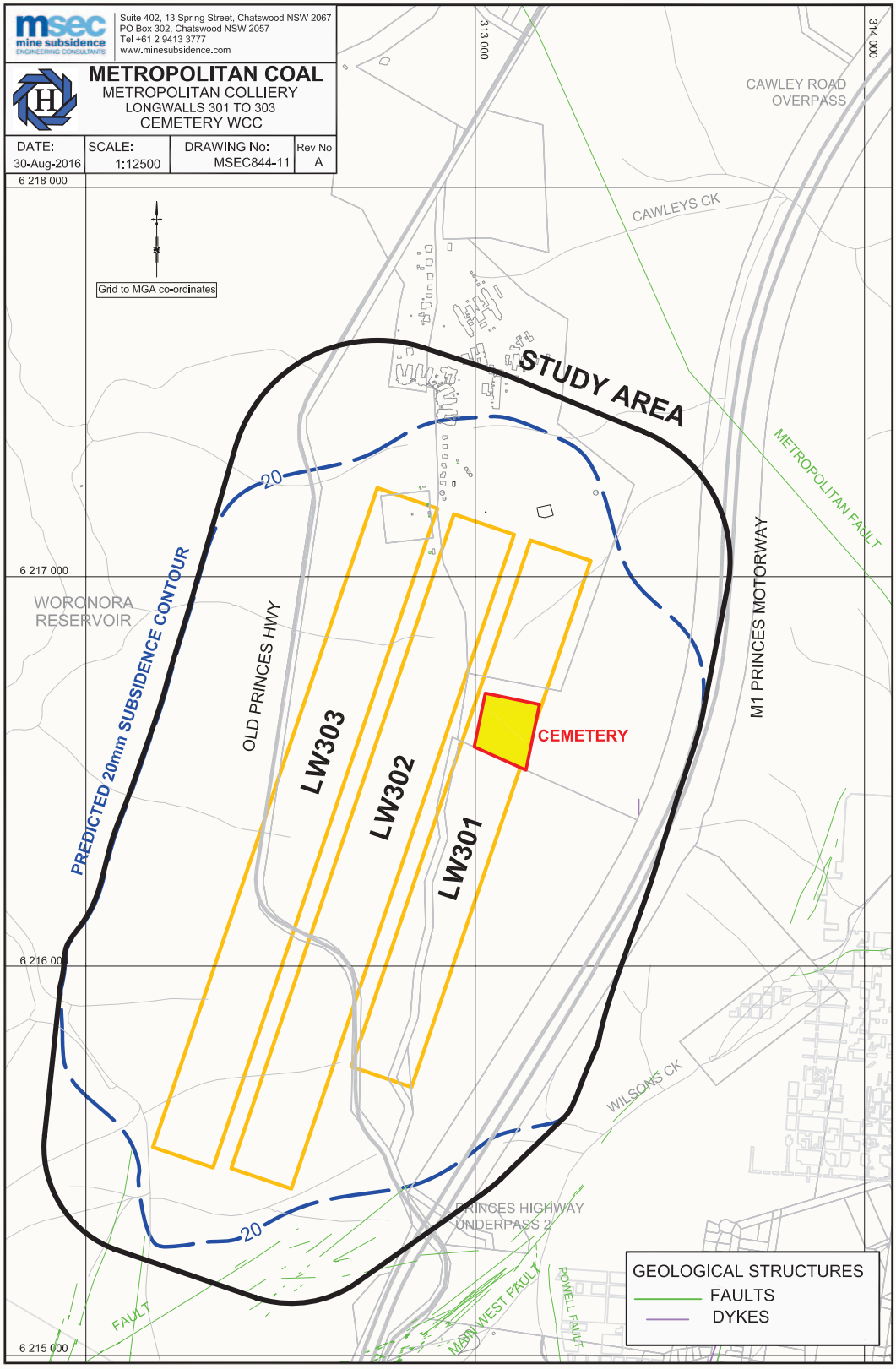
4. Develop a rectification plan/protocol to describe how potentially affected grave sites can be repaired and returned to the pre-audit report condition taking into account the Wollongong City Council endorsed Conservation Management Plan.
5. Establish mechanisms to address a possible change in the classification of the cemetery from current local listing to a state listed heritage site.

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
Baseline Data / Validation			
1	Pre-mining audit of all marked grave sites	Section 6.1	Prior to LW301
Management / Monitoring / Response Measures			
2	Establish key contacts list in the BFMP	Section 6.3	Complete
3	Prepare a post mining audit of all marked grave sites	Section 7.2.1	Post LW301-LW303
Contingency Planning			
4	Develop a rectification plan/protocol	Section 9.1	Complete
5	Establish mechanisms for possible changes to the heritage listing classification	Section 9.2	Complete



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Waterfall General (Garrawarra) Cemetery

Figure 5

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 defects to the structural integrity of headstones or fencing (beyond the baseline [pre-mining] conditions – refer Section 6); and
- the land in general is expected to experience minor cracking consistent with that observed during the extraction of previous longwalls at Metropolitan Coal (i.e. no more than minor cracking).

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

6 BASELINE DATA

The Waterfall Cemetery is understood to have received some 2,000 burials between 1909 and the 1950s. The Waterfall Cemetery was closed when the Waterfall State Sanatorium was closed in 1957 (which is now the Garrawarra Centre Complex). In 1967, the Wollongong City Council was handed responsibility to manage the Waterfall Cemetery site.

The Waterfall Cemetery site is described in the *Conservation Plan for the Garrawarra Centre for Aged Care* (Howard Tanner & Associates, 1993) as:

> *"Mounds in ground, some broken pieces of marble. Overgrown with Eucalyptus haemastoma, ...and other indigenous vegetation. ...*
>
> [Condition is] *poor – little remains to identify this area as the Cemetery"*

A summary of the notes reported following an inspection of the Waterfall Cemetery site by the Wollongong City Council in March 2012 and referred in the minutes of the Wollongong City Council ordinary meeting held on 27 August 2012 is provided below:

- Little maintenance has occurred at the site since hand over to Wollongong City Council in 1967.
- Surrounding bush has encroached onto the site making it unrecognisable as a cemetery.
- Many graves were damaged by overgrown vegetation, vandalism and grave subsidence.
- Bushfires are believed to have resulted in the loss of much of the evidence of the cemetery including timber grave markers.
- More than 40 graves were identifiable during the inspection[1].
- Evidence of fencing, roadways and entry gates remain.

[1] A subsequent photographic index of identifiable graves was published in September 2013 (Wollongong City Council, 2013).

6.1 STATE OF ASSET BEFORE MINING

A pre-mining audit (including photographic record and commentary) will be completed by Metropolitan Coal to establish the state of the Wollongong City Council asset prior to commencement of Longwall 301.

6.2 PRE-MINING INSPECTION

The pre-mining inspection will be undertaken prior to the commencement of Longwall 301.

6.3 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	Commercial Business Manager	Jenny Towers
Wollongong City Council	Heritage Officer	Joel Thompson

7 MONITORING

A monitoring program will be implemented to monitor the impacts of the Project on the Waterfall Cemetery as determined in consultation with Wollongong City Council.

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 may conduct opportunistic 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.

Table 5 summarises the Longwalls 301-303 BFMP-CEM monitoring components.

The frequency of monitoring will be further 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-CEM.

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

Monitoring Component	Locations	Frequency	Parameters
Subsidence Parameters	• As described in the Metropolitan Coal Longwalls 301-303 Subsidence Monitoring Program (SMP). This includes: - 300XL Line. - Transmission Line.	*Baseline* • Prior to the commencement of Longwall 301 extraction. *During Mining* • As per the Longwalls 301-303 SMP.	• Monitoring parameters include: subsidence, tilt, tensile strain, compressive strain.
Subsidence Impacts - Waterfall Cemetery site	• Within 600 m of Longwalls 301-303 extraction.	*Baseline* • Prior to the commencement of Longwall 301 extraction. *During Mining* • Following the completion of extraction of Longwalls 301-303.	• Pre and post mining audits (photographic record and commentary). • Surface cracks, buckling and general safety.
Subsidence Impacts - Access roads/tracks	• Within 600 m of Longwalls 301-303 extraction.	*Baseline* • Prior to the commencement of Longwall 301 extraction. *During Mining* • Following the completion of extraction of Longwalls 301-303. • Opportunistic visual observations during catchment visits as per the Longwalls 301-303 Land Management Plan.	• Surface cracks, buckling and general safety.

7.1 SUBSIDENCE PARAMETERS

Subsidence parameters (i.e. subsidence, tilt, tensile strain, compressive strain, absolute horizontal translation, and differential leg movement) associated with mining will be measured in accordance with the Longwalls 301-303 Subsidence Monitoring Program (Figure 6).

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

Monitoring of subsidence parameters specific to the Waterfall Cemetery include the survey lines along the adjacent transmission line corridor and the 300 XL subsidence monitoring line (Figure 6). The surveys will monitor the general movement about the longwalls and the data will allow evaluation of the likely ground movements about the site (by comparison between measured and predicted movements).

7.2 SUBSIDENCE IMPACTS

7.2.1 Waterfall General [Garrawarra] Cemetery

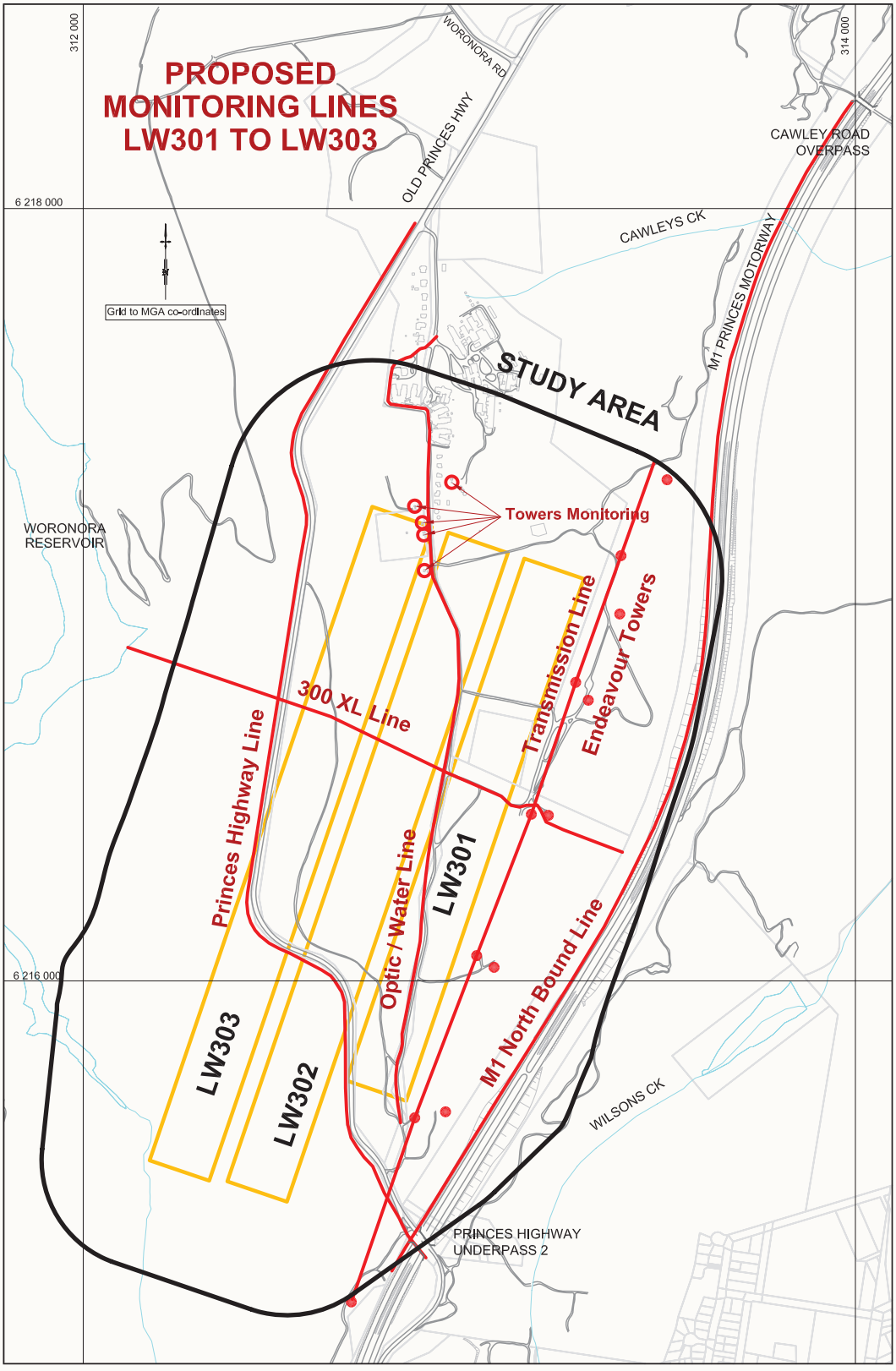
A post mining audit will be conducted following completion of Longwalls 301-303 for comparison with the pre-mining audit records.

Visual inspections will be conducted by Metropolitan Coal at the Waterfall Cemetery opportunistically in consultation with Wollongong City Council.

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

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

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



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Resource Strategies

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Longwalls 301-303 Subsidence Monitoring
Layout

Figure 6

7.2.2 Access Roads/Tracks

Visual inspection of the access roads/tracks will occur 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).

Specific details that will be noted and/or photographed that are relevant to the Waterfall Cemetery 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 Waterfall Cemetery;
- 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 Wollongong City Council 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 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 the Waterfall Cemetery are considered to be applicable (e.g. if minor surface cracks eventuate, and can be identified, they can be readily repaired by infilling with soil or other suitable materials) and further measures are summarised in the rectification plan/protocol (Section 9.1.1).

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 BFMP, 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 3) consistent with the monitoring program described in Section 7 of this Longwalls 301-303 BFMP-CEM.
- If relating to an access road/track, the observation will be recorded in the Metropolitan Coal LW301-303 Land Management Plan – Subsidence Impact Register.
- Metropolitan Coal will report any exceedance of the performance measure or 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.

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).

A rectification plan/protocol has been developed for the Waterfall General [Garrawarra] Cemetery and is described in Section 9.1.1 below. Possible changes resulting if and when heritage listing of the cemetery was to change from local to state is also detailed below in Section 9.1.2.

9.1.1 Rectification Plan/Protocol

In the event that impacts associated with mining activities are observed at the Waterfall General [Garrawarra] Cemetery (during post-mining audits and subsidence monitoring activities), the following rectification plan/protocol will be implemented:

1. Metropolitan Coal will determine the extent of the impacts to the Waterfall General [Garrawarra] Cemetery, including the nature of the impacts (i.e. cracking of headstones, collapse of grave monuments etc.) and the grave site(s) and/or monument(s) affected.
2. Metropolitan Coal will notify the Wollongong City Council (including the Wollongong Heritage Advisory Committee if requested by the Wollongong City Council) of the extent and nature of the impacts to the Waterfall General [Garrawarra] Cemetery.
3. Based on the nature and extent of the impacts, Metropolitan Coal (in consultation with a suitably qualified archaeologist) will develop suitable rectification/repair methods for each grave site/monument. In accordance with the *Waterfall General (Garrawarra) Cemetery Conservation Management Plan* (Biosis, 2013) any repairs and/or rectification works will reflect the appearance around the time of active operation of the cemetery (i.e. 1909-1949) where possible.

   The methods proposed may include (but are not limited to) the following:

   - Re-bedding of fallen monuments using porous fill (e.g. light gravel and sand).
   - Re-setting broken portions of gravestone bases (using pinning or epoxy resin adhesive).
   - Installation of backing plate (in same material where appropriate) for cracked gravestones or grave monuments.
   - Installation of steel fixing pins and epoxy resin adhesive to repair cracked marble headstones and minor cracks in concrete bases/slabs.
   - Back filling of any collapsed graves with local ironstone gravel fill (where available).
   - Replacement of fallen lettering (e.g. re-hammering by a relevant mason).

4. In the event that impacts to an identified grave site are observed, Metropolitan Coal will (with assistance from the Wollongong City Council and the Wollongong Heritage Advisory Committee if required) seek to notify and consult with any relatives/descendants in relation to the proposed repair and/or rectification works (as determined in consultation with the Wollongong City Council).
5. In the event impacts are observed at an unidentified grave site, or if the relatives/descendants are unknown, un-contactable or decline to be consulted, the Wollongong City Council will be the relevant party for consultation.
6. Following consultation with the relatives/descendants and Wollongong City Council as described in (4), and prior to the commencement of any repair and/or rectification works, Metropolitan Coal will submit the proposed course of action to the DP&E for approval.
7. Following DP&E approval of the repair and/or rectification works, Metropolitan Coal will engage suitably qualified experts to undertake the works[2].
8. Following completion of the repairs and/or rectification works, Metropolitan Coal will notify the relatives/descendents, Wollongong City Council and the DP&E of the completion of the works.
9. In the event that the damage observed is unable to be repaired and/or restored to a similar condition to that noted in the pre-mining baseline audit, Metropolitan Coal will provide a suitable offset to compensate for the impact to the satisfaction of the Director-General (now Secretary) of DP&E, in accordance with Condition 6, Schedule 6 of the Project Approval.

The above rectification plan/protocol has been developed in consideration of the *Waterfall General (Garrawarra) Cemetery Conservation Management Plan* prepared for the Wollongong City Council (Biosis, 2013).

As described in Section 4.1.1, a draft Planning Proposal has been prepared to amend the property description and expand the conservation area boundary of Garrawarra Hospital Heritage Conservation Area to include the Waterfall General [Garrawarra] Cemetery. In the event that the Conservation Area is amended, the BFMP will be reviewed and if necessary, revised to reflect the expanded boundary.

9.1.2 Possible Changes to Heritage Listing

The *Waterfall General (Garrawarra) Cemetery Conservation Management Plan* prepared for the Wollongong City Council (Biosis, 2013) recommended the Cemetery (and the associated Waterfall State Sanatorium [now the Garrawarra Aged Care Centre]) be nominated to the State Heritage Register for listing as a site of state heritage significance.

In the event the Waterfall General [Garrawarra] Cemetery is listed on the State Heritage Register, additional consultation may also be required with the Heritage Council of NSW and Cemeteries and Crematoria NSW. Should this occur, the above described rectification plan/protocol will be reviewed and revised if necessary.

[2] Note that prior to commencement of any works, NSW Department of Primary Industries – Land and/or WaterNSW will be notified in the event access through Crown Land and/or the Woronora Special Area is required.

10 TARP – MANAGEMENT TOOL

The framework for the various components of the Longwalls 301-303 BFMP-CEM are summarised in the Longwalls 301-303 BFMP-CEM TARP shown in Table 6. The Longwalls 301-303 BFMP-CEM 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 6
Longwalls 301-303 BFMP-CEM Trigger Action Response Plan

Condition	Baseline Conditions	Predicted Impacts	Restoration/ Contingency Phase
Trigger	• Buildings and structures are safe, serviceable and repairable (or as otherwise determined during pre-mining audit/inspection). • Access roads/tracks serviceable.	• Negligible impact to assets. • Minor cracking to access roads/tracks.	• Defects to the structural integrity of headstones or fencing (beyond the baseline [pre-mining] conditions. • Significant cracking beyond that observed during the extraction of previous longwalls at Metropolitan Coal.
Action	Establish baseline data. Includes: • Pre-mining audit/inspection. • Pre-extraction subsidence survey as per the Longwalls 301-303 Subsidence Monitoring Program.	• Conduct monitoring of subsidence lines (Section 7.1). • Post mining audit (Section 7.2). • Update the 'Built Features Management Plan – Subsidence Impact Register'. • For access roads/tracks, update the 'Land Management Plan – Subsidence Impact Register'. • Repair of access roads/tracks where significant cracks are detected (e.g. those that affect serviceability).	• Implement Rectification Plan/Protocol (Section 9.1.1). • Implement measures in relation to maintenance of access roads/ tracks.
Position of Decision-making	• Manager - Technical Services. • Wollongong City Council – Heritage Officer	• Manager - Technical Services. • Wollongong City Council – Heritage Officer	• General Manager. • Wollongong City Council – Commercial Business Manager

11 FUTURE EXTRACTION PLANS

In accordance with Condition 7, Schedule 3 of the Project Approval, Metropolitan Coal will collect baseline data for the future Extraction Plan (e.g. Longwall 304 onward). However for the Waterfall Cemetery, 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 Waterfall Cemetery.

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-CEM will inform the appropriate type and frequency of monitoring 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, the Waterfall General [Garrawarra] Cemetery.

12 ANNUAL REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

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

The Annual Review will:

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

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

13 INCIDENTS

An incident is defined as a set of circumstances that causes or threatens to cause material harm to the environment, and/or breaches or exceeds the limits or performance measures/criteria in the Project Approval.

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

Wollongong City Council 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

Biosis (2013) *Waterfall General (Garrawarra) Cemetery Conservation Management Plan*. Prepared for Wollongong City Council. 7 June 2013.

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.*

Howard Tanner & Associates (1993) *Conservation Plan for the Garrawarra Centre for Aged Care.*

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 Waterfall General [Garrawarra] Cemetery – Wollongong City Council*, 31 August 2016.

Wollongong City Council (2013) *Waterfall General [Garrawarra] Cemetery: A Photographic Index of Identifiable Graves.* September 2013.

APPENDIX 1

MSEC (2016) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 301 TO 303 - SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE WATERFALL GENERAL [GARRAWARRA] CEMETERY – WOLLONGONG CITY COUNCIL, DATED 31 AUGUST 2016

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31st August 2016

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

Ref: MSEC844-11

Dear Jon,

RE: Metropolitan Colliery – Proposed Longwalls 301 to 303 - Subsidence Predictions and Impact Assessments for the Waterfall General (Garrawarra) Cemetery - Wollongong City Council

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the Waterfall General (Garrawarra) Cemetery (the Cemetery) resulting from the extraction of the proposed Longwalls 301 to 303 at Metropolitan Colliery.

The Wollongong City Council (WCC) LEP 2009 identifies the cemetery as an item of heritage significance (Item 6486 within Schedule 5 Part 1. A Conservation Plan for the Garrawarra Centre for Aged Care (Howard Tanner & Associates, 1993) provides the following information on the cemetery:

- The cemetery was closed when the Sanatorium closed (i.e. now the Garrawarra Complex), which was in 1957;
- No maintenance has been carried out since it closed;
- The cemetery has been recolonised by neighbouring bushland;
- The cemetery is described as “Mounds in ground, some broken pieces of marble. Overgrown with Eucalyptus haemastoma,…. and other indigenous vegetation”;
- The condition is described as “poor – little remains to identify this area as the Cemetery”

In 1967, Wollongong City Council was handed responsibility for maintenance and control of the Cemetery. Details of the cemetery and future recommendations are outlined in a report published in the Wollongong City Council minutes of ordinary meeting on Monday 27 August 2012. A summary of points from the report is as follows:

- The Cemetery is understood to have received some 2000 burials between 1909 and mid 1950’s
- Little maintenance of the cemetery has occurred since the hand over in 1967
- Surrounding bush has encroached onto the site making it unrecognisable as a cemetery
- A site inspection was undertaken by WCC in March 2012 which found:
    - Many graves were damaged by overgrown vegetation, vandalism and grave subsidence.
    - Bush fires are believed to have resulted in the loss of much of the evidence of the Cemetery including timber grave markers
    - 43 identifiable graves were located during the site inspection
    - Clearing of the site would likely reveal further evidence of burials
    - Some evidence of fencing, roadways and entry gates remains on site
- A staged process is proposed for working towards further options for the future management, conservation and potential public accessibility

The location of the Cemetery and the proposed longwalls are shown in the attached Drawing No. MSEC844-11. The Cemetery is located directly above Longwall 301. The cemetery is located in an area of relatively flat topography at a topographical high point. The area is approximately 22 hectares and has average dimensions of approximately 156 metres by 142 metres.

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

Conventional Subsidence Parameters for the Cemetery

The following provides summaries of the maximum predicted conventional movements for the Cemetery 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. Discussions on the potential for non-conventional movements are provided in this letter report.

A summary of the maximum predicted values of incremental subsidence, tilt and curvature for the Cemetery, due to the extraction of each of the Longwalls 301 to 303, is provided in Table 1. The values are the maxima anywhere within the Cemetery and within 20 metres of the cemetery boundary at any time during or after the extraction of each longwall.

Table 1 Maximum Predicted Incremental Subsidence, Tilt and Curvature for the Cemetery 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	75	< 0.5	< 0.01	0.01
Due To LW302	600	4.0	0.04	0.1
Due To LW303	150	1.0	< 0.01	< 0.01

The maximum predicted incremental subsidence for the Cemetery of 600 mm, occurs due to the extraction of Longwall 302.

A summary of the maximum predicted values of total subsidence, tilt and curvature for the Cemetery, resulting from the extraction of Longwalls 301 to 303, is provided in Table 2. The values are the maxima anywhere within the Cemetery and within 20 metres of the cemetery boundary at any time during or after the extraction of each longwall.

Table 2 Maximum Predicted Total Subsidence, Tilt and Curvature for the Cemetery 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	75	< 0.5	< 0.01	0.01
After LW302	650	4.0	0.03	0.1
After LW303	800	5.0	0.04	0.1

The maximum predicted total subsidence for the Cemetery, resulting from the extraction of Longwalls 301 to 303, is 800 mm. The maximum predicted conventional tilt for the Cemetery is 5.0 mm/m (i.e. 0.5 %, or 1 in 200). The maximum predicted conventional curvatures are 0.04 km^{-1} hogging and 0.1 km^{-1} sagging, which equate to minimum radii of curvature of 25 kilometres and 10 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 Cemetery 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.

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.

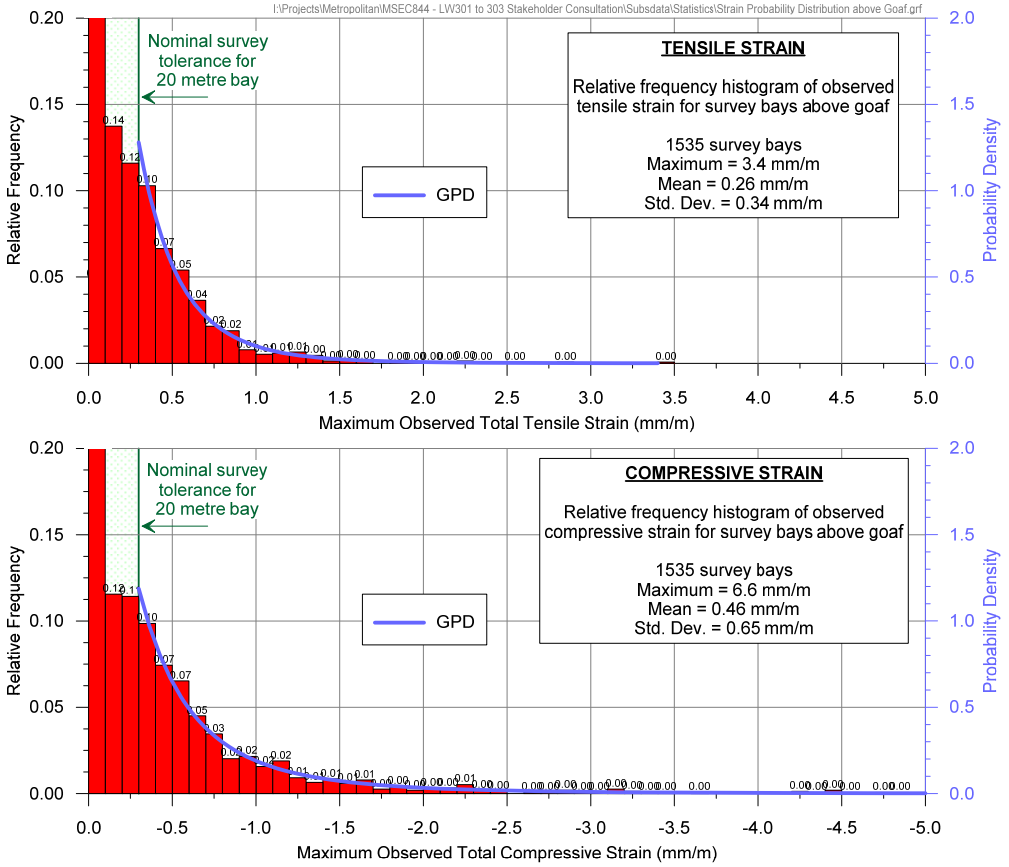


Figure 1 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Goaf

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 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. There are no identified geological structures in the vicinity of the Cemetery.

It is possible that the Cemetery 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 Cemetery is not located near any streams within the Study Area. The Cemetery, therefore, is not expected to experience any measurable valley closure effects.

Impact Assessments for the Cemetery

The maximum predicted conventional tilt for the Cemetery is 5.0 mm/m (i.e. 0.5 %, or 1 in 200). The predicted changes in grade are small, less than 1 %, and therefore are unlikely to result in adverse impacts on the Cemetery features including headstones or fencing.

The maximum predicted conventional curvatures for the Cemetery are 0.04 km^{-1} hogging and 0.1 km^{-1} sagging, which equate to minimum radii of curvature of 25 kilometres and 10 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 Cemetery are similar to those typically experienced elsewhere in the Southern Coalfield.

It is possible that some minor cracking of the surface soils or exposed bedrock in the cemetery could occur as a result of the extraction of the extraction of Longwalls 301 to 303. Identification of cracking may be difficult given the overgrown nature of the Cemetery. If these cracks eventuate and can be identified, they can be readily repaired by infilling with soil or other suitable materials.

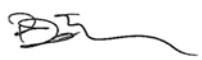
It is recommended that monitoring and management strategies are developed, in consultation with WCC, to manage the potential impacts on the Cemetery.

Summary

The Cemetery is located directly above Longwall 301. The previous experience from the Southern Coalfield has found that the potential impacts 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 Cemetery.

Yours sincerely



Peter DeBono

Attachments:

Drawing No. MSEC844-11 – Longwalls 301 to 303 – Cemetery WCC

I:\Projects\Metropolitan\MSECI:\Projects\Metropolitan\MSEC844 - LW301 to 303 Stakeholder Consultation\AcadData\MSEC844-11.dwg

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www.minesubsidence.com

METROPOLITAN COAL

METROPOLITAN COLLIERY
LONGWALLS 301 TO 303
CEMETERY WCC

DATE:	SCALE:	DRAWING No:	Rev No
30-Aug-2016	1:12500	MSEC844-11	A

313 000
314 000
6 218 000
6 217 000
6 216 000
6 215 000

Grid to MGA co-ordinates

CAWLEY ROAD OVERPASS
CAWLEYS CK
STUDY AREA
METROPOLITAN FAULT
M1 PRINCES MOTORWAY
WORONORA RESERVOIR
OLD PRINCES HWY
PREDICTED 20mm SUBSIDENCE CONTOUR
20
20
LW303
LW302
LW301
CEMETERY
WILSONS CK
PRINCES HIGHWAY UNDERPASS 2
FAULT
MAIN WEST FAULT
POWELL FAULT

GEOLOGICAL STRUCTURES
FAULTS
DYKES

APPENDIX 2

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER

Built Features Management Plan - Subsidence Impact Register

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

Notes:

1: Fill out all details in the Assessment Form and record the register number here.

2: Built feature (e.g. headstone, etc.).

3: Impacts to access roads/tracks to be included in the Land Management Plan – Subsidence Impact Register.

Built Feature Management Plan – Subsidence Impact Register
Assessment Form

Date:	
Observer (Name and position):	
Register Number (i.e. Number 1, 2, etc.):	
Longwall Number and Chainage:	

Location of Observed Impact:

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

Description of Observed Impact:

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

Person Notified:	Manager - Technical Services	☐

Description of Photographs:

Actions Required:	Contingency Plan Initiated	☐
	Incident Notification	☐
	Safety Measures/Public Safety Management Plan Requirements	☐

Management or Contingency Measures Implemented:

Effectiveness of Management or Contingency Measures: