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LONGWALLS 301-303

BUILT FEATURES MANAGEMENT PLAN
Nextgen (Vocus Group)

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DP&E Approval Date
All	LW301-303 BFMP_Nextgen-R01-A	Original – Draft for Consultation	Nextgen, DRG and DP&E	-
Section 4.1.1, Tables 3, 5 & 6, Figure 4 and Appendix 1	LW301-303 BFMP_Nextgen-R01-B	Revised – Incorporating Nextgen Agreement and updates	Nextgen, DRG and DP&E	11 May 2017*
Section 7.2.2, Tables 2, 5 & 7 and Appendix 4	LW301-303 BFMP_Nextgen-R01-C	Revised – Addressing DP&E and DRG requirements	Nextgen, DRG and DP&E	-
All	LW301-303 BFMP_Nextgen-R01-D	Revised TARP. Revised for LW303.	Nextgen (Vocus) and DRG	-

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

June 2018

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

The relationship of this Longwalls 301-303 BFMP-NEXTGEN 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-NEXTGEN, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and Metropolitan Coal were endorsed by the Director-General (now Secretary) of the NSW Department of Planning and Environment (DP&E) on 6 June 2016. This Longwalls 301-303 BFMP-NEXTGEN has been prepared in consultation with Nextgen including consideration of prior consultation during the development of the previously approved Longwalls 20-22, Longwalls 23-27, and Longwalls 301-303 Built Features Management Plans.
Consistent with the previous approach Nextgen has developed a Management Plan Agreement (Nextgen, 2016) (Appendix 1) for Longwalls 301-303 that outlines procedures for the management and monitoring of Nextgen assets in areas impacted by underground mining activities. To avoid duplication, this Longwalls 301-303 BFMP-NEXTGEN references the Nextgen Management Plan Agreement (2016) wherever possible.

1.2 STRUCTURE OF THE LONGWALLS 301-303 BFMP-NEXTGEN

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

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

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

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

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.

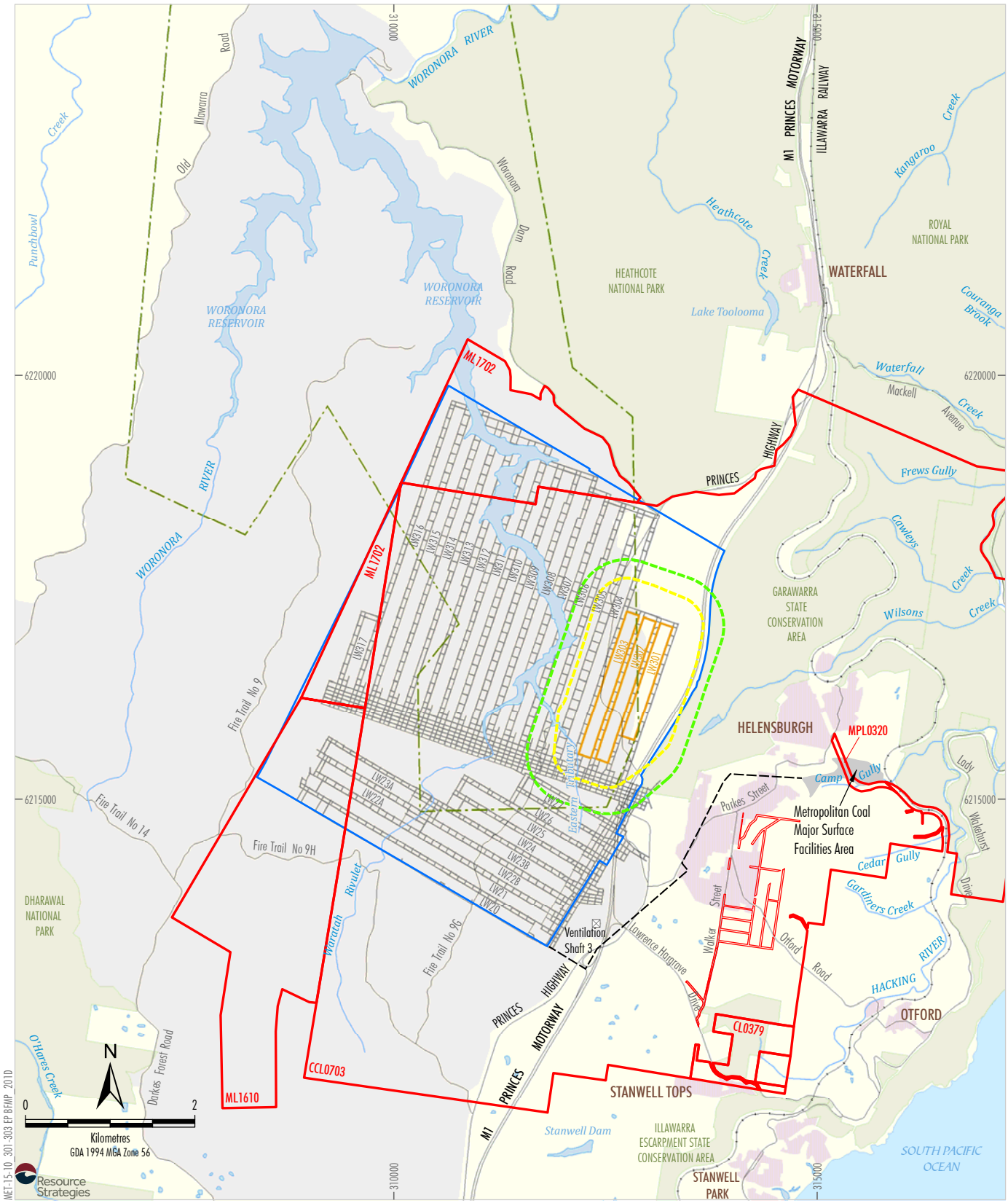
Section 12: Describes the annual review and improvement of environmental performance.

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-NEXTGEN.



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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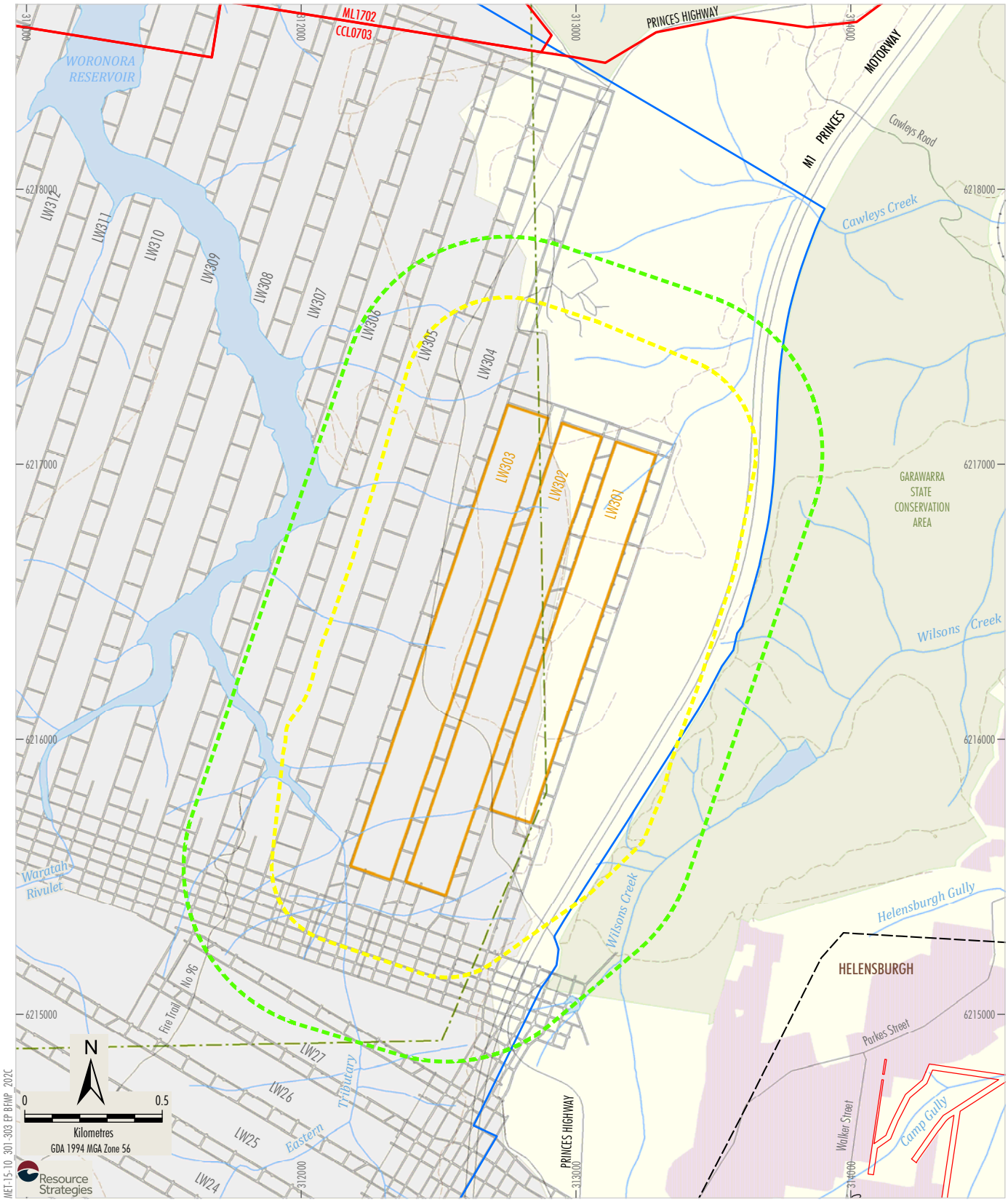
Project Longwalls 20 - 27 and Longwalls 301 - 317 Layout

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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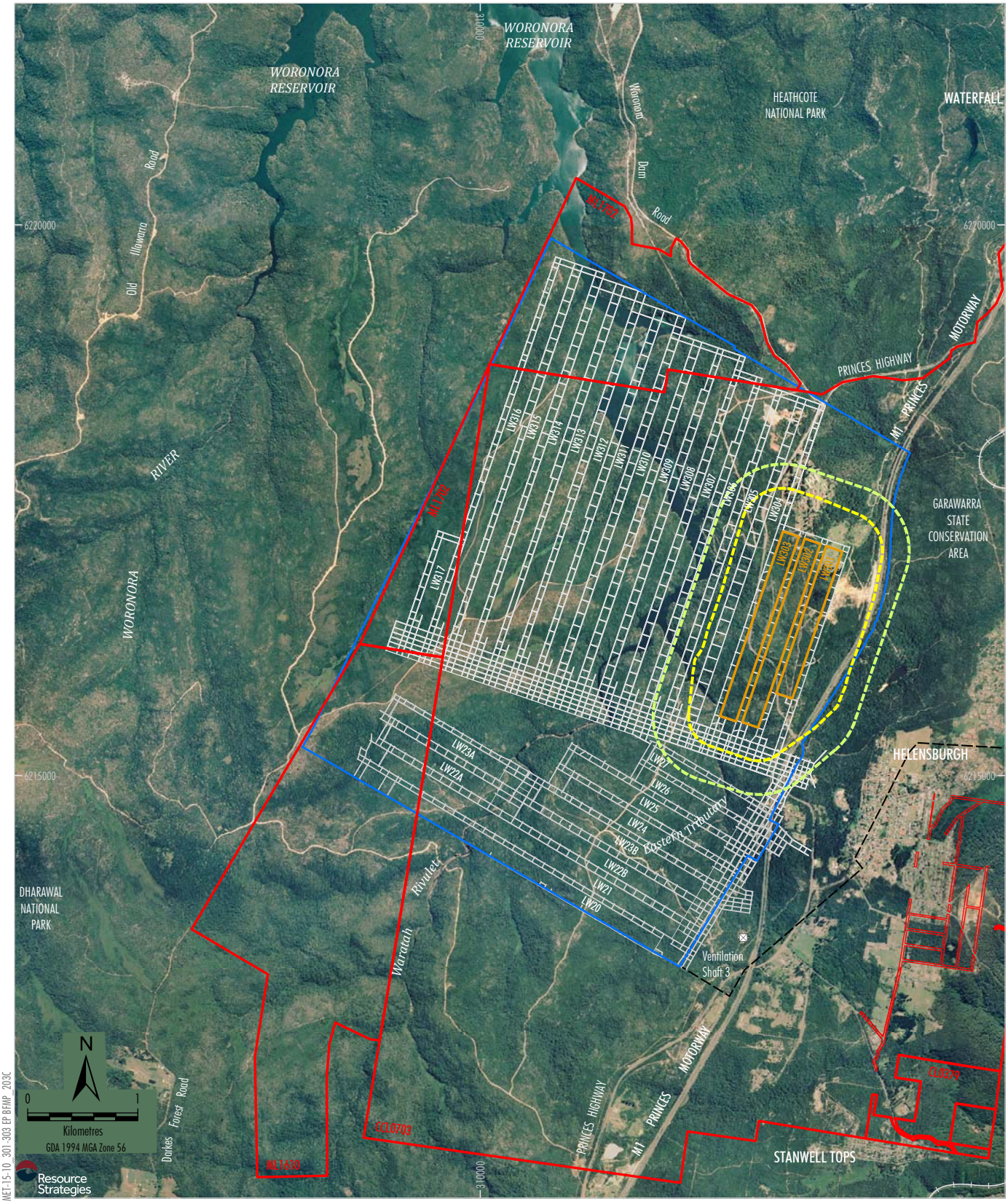
Longwalls 301 - 303 Layout

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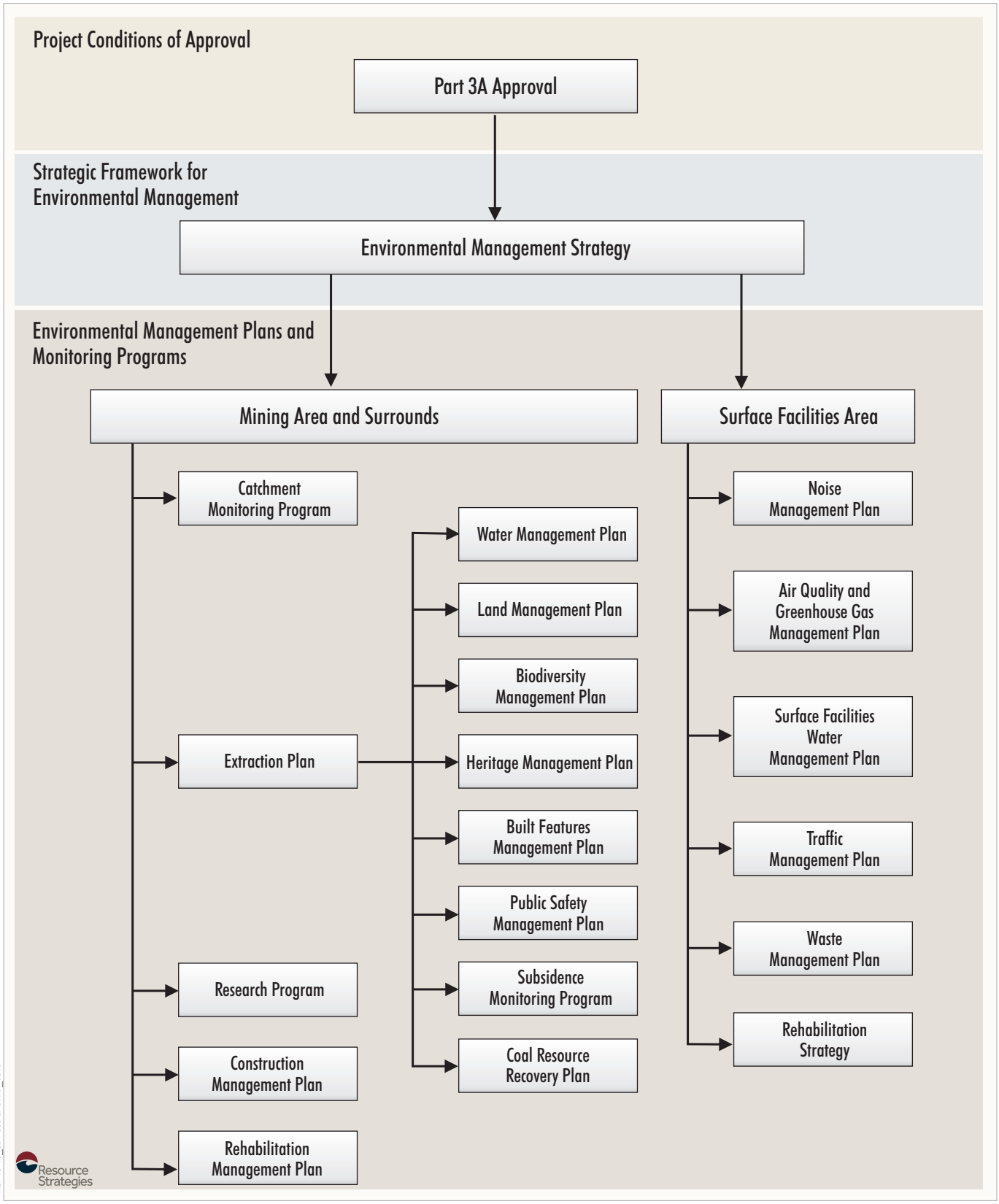
Project Longwalls 20 - 27 and Longwalls 301 - 317 Layout - Aerial Photograph

Figure 3



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Environmental Management Structure

Figure 4

2 LONGWALLS 301-303 BFMP-NEXTGEN REVIEW AND UPDATE

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

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

Metropolitan Coal has made the Distribution Register publicly available on the Peabody website.

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

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

Table 1
Management Plan Requirements

Project Approval Condition	Longwalls 301-303 BFMP-NEXTGEN 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 and Appendix 4
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 and Appendix 4
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 and Appendix 4

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 DRG (Division of Resources and Geoscience, previously Division of Resources and Energy [DRE]), under the NSW Mining Act, 1992 (e.g. Consolidated Coal Lease [CCL] 703, Mining Lease [ML] 1610, ML 1702, Coal Lease [CL] 379 and Mining Purpose Lease [MPL] 320).

- The Metropolitan Coal Mining Operations Plan 1 October 2012 to 30 September 2019 approved by the DRG.

- The conditions of Environment Protection Licence (EPL) No. 767 issued by the NSW Environment Protection Authority (EPA) under the NSW Protection of the Environment Operations Act, 1997. Revision of the EPL will be required prior to the commencement of Metropolitan Coal activities that differ from those currently licensed.

- The prescribed conditions of specific surface access leases within CCL 703 for the installation of surface facilities as required.

- Water Access Licences (WALs) issued by the NSW Department of Primary Industries – Water (DPI Water) (now the Department of Industry – Crown Lands and Water Division [CLWD]) under the NSW Water Management Act, 2000, including WAL 36475 under the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 and WAL 25410 under the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011.

- Mining and workplace health and safety related approvals granted by the NSW Resources Regulator and WorkCover NSW.

- Supplementary approvals obtained from WaterNSW (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):

- *Biodiversity Conservation Act, 2016;*
- *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;*
- *Water Act, 1912;*
- *Water Management Act, 2000;*
- *Water NSW Act, 2014;*
- *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	June 2017	6 months	February 2018
302	March 2018	7 months	October 2018
303	November 2018	7 months	May 2019

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 Nextgen Assets

The Nextgen assets of relevance for the Longwalls 301-303 extraction include (Appendix 1):

- Major Interstate Trunk Cable Sydney-Melbourne SM1 optical fibre cable (Waterfall to Corrimal Section).
- Associated Nextgen Joint Housing Pit (SM1-SN-SN J08) linked to Telstra manhole using P50 conduit and P32 sub-duct passing through concrete Joint Housing Pit.

The Nextgen optical fibre cable is located adjacent to Longwall 301 and above the southern end of Longwall 301 (Figure 5).

4.2 REVISED SUBSIDENCE AND IMPACT PREDICTIONS

4.2.1 Revised Subsidence Predictions

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

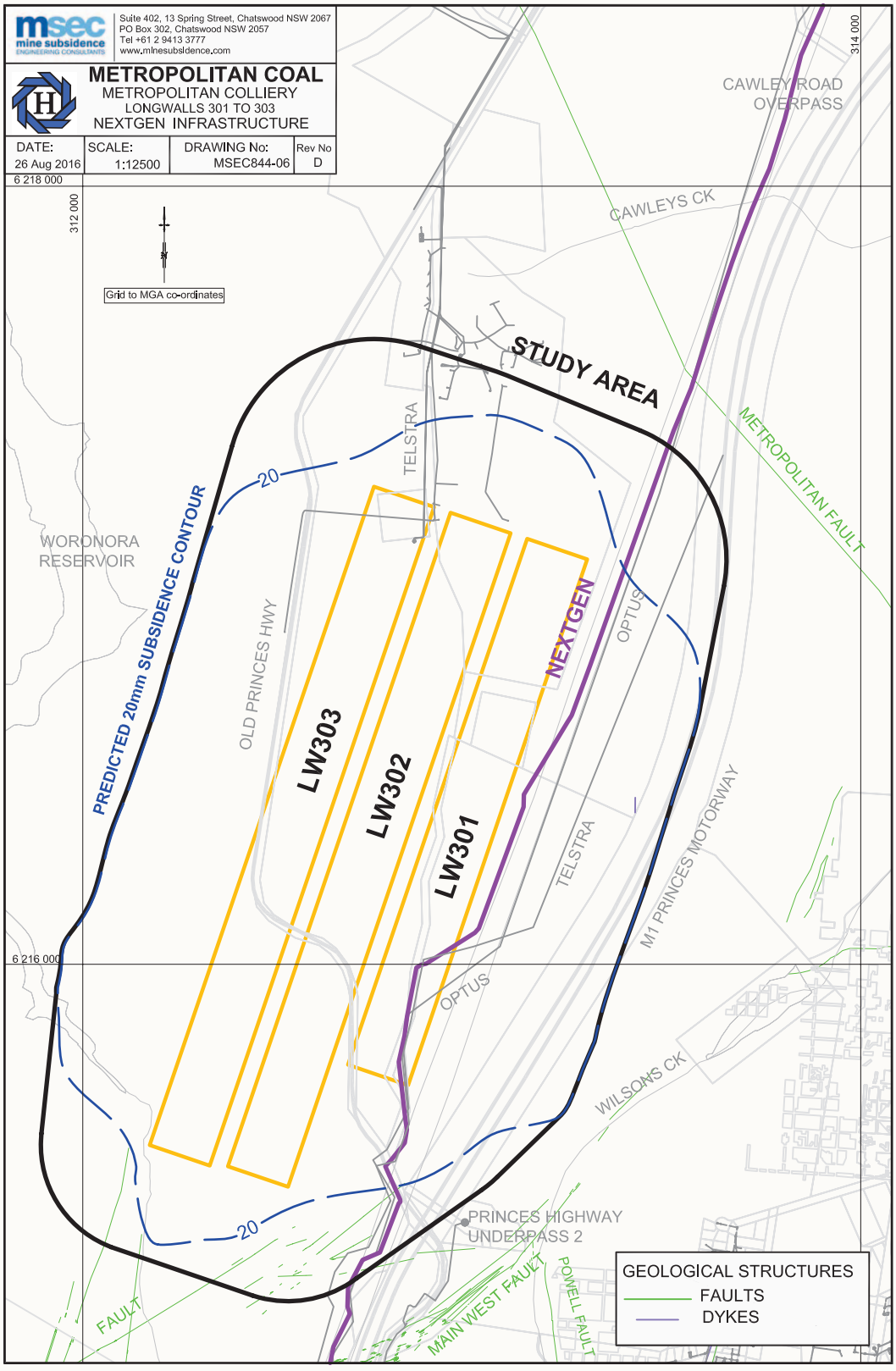
Revised subsidence and impact predictions for the extraction of Longwalls 301-303 on Nextgen assets were conducted by MSEC and reported in MSEC (2016) (Appendix 2).

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

- The optical fibre cable is direct buried and, therefore, will not be impacted by the tilts resulting from the extraction of Longwalls 301-303.
- The buried optical fibre cable is likely to experience curvatures and ground strains resulting from the extraction of Longwalls 301-303.
- The predicted curvatures and strains for the optical fibre cable are similar to those where longwalls in the Southern Coalfield have previously mined directly beneath similar cables.

4.2.2 Risk Assessment Review

In accordance with the draft *Guidelines for the Preparation of Extraction Plans* (DP&E and DRE, 2014) a risk assessment review was undertaken for the Nextgen assets. The risk assessment review built on previous risk assessments undertaken for other BFMP(s) in the Extraction Plan relating to optical fibre cables which included representatives from Metropolitan Coal, Comms Network Solutions Pty Ltd, MSEC and Resource Strategies.



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Nextgen Assets

Figure 5

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

- preliminary identification of Nextgen assets;
- review of the revised subsidence predictions and potential impacts on Nextgen 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 have been identified which considered the extraction of coal beneath the Nextgen assets, and are summarised as follows:

Baseline Data / Validation

1. Obtain from Nextgen an audit to confirm that all services (including any vulnerabilities due to age, installation process, etc.) of optical fibre cables that may be affected by mining of Longwalls 301 to 303 have been identified and document in the BFMP.
2. Carry out an audit of the physical location of the Optic Fibre Cable prior to any mining to confirm that physical access is available in the Study area.
3. Provide survey information on the Optic Fibre Cable and have Nextgen confirm that this is correct to validate the current studies.

Management / Monitoring / Response Measures

4. Develop a Trigger Action Response Plan (TARP) and include a trigger to confirm that the Optical Fibre Cables monitoring is being carried out when the mining of Longwalls 301 to 303 may impact on the Optic Fibre Cable.
5. Include in the TARP a trigger to conduct physical audits of the Optic Fibre Cable when mining is likely to affect the cable so that rectification work can commence if required based on the TARP Conditions.

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	Obtain from Nextgen an audit to confirm that all services (including any vulnerabilities due to age, installation process, etc.) of optical fibre cables have been identified and document in the BFMP	Appendix 1	Complete
2	Carry out an audit of the physical location of the Optic Fibre Cable to confirm that physical access is available in the Study area	Section 6	Complete
3	Provide survey information to Nextgen on the Optic Fibre Cable	Section 6	Complete

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

	Risk Control Measure / Procedure	BFMP Section	Proposed Timing
Management / Monitoring / Response Measures			
4	Develop a TARP and include a trigger to confirm that the Optical Fibre Cables monitoring is being carried out when mining is likely to affect the main Optic Fibre	Appendix 1 / Section 10 / Table 7	Complete
5	Include in the TARP a trigger to conduct physical audits of the Optic Fibre Cable when mining is likely to affect the cable	Appendix 1 / Section 10 / Table 7	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:

- negligible transmission loss in fibre optic cables from mine subsidence impacts;
- the structural integrity of the cable line and associated joint housing pit is maintained; and
- the serviceability of the access roads/tracks is maintained.

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

6 BASELINE DATA

An audit of the physical location of the Optic Fibre Cable to confirm that physical access is available was conducted prior to commencement of Longwall 301 extraction. Survey information was provided to Nextgen.

Baseline data (including photograph of manholes and relevant conduits, trenches, etc.) is documented in the Nextgen Management Plan Agreement (Appendix 1).

6.1 STATE OF ASSET BEFORE MINING

In consultation with Nextgen (and similar to the approach adopted for other optical fibre cables), Metropolitan Coal has assessed and determined the state of the Nextgen optical fibre cables before mining of Longwall 301.

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

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

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

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

dBm = decibel-milliwatt.

6.2 PRE-MINING INSPECTION

A pre-mining inspection was conducted prior to commencement of Longwall 301.

6.3 KEY CONTACTS

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

Table 5
List of Key Contacts

Company	Position	Contact
Peabody (Metropolitan Coal)	Manager – Technical Services Jon Degotardi	Metropolitan Coal Control Room 24hr 02 4294 7333
Nextgen	Peter Hickey	Nextgen Networks 1800 099 299

7 MONITORING

The monitoring components are described in the Nextgen Management Plan Agreement (Appendix 1) and summarised below in Table 5.

Remote fibre monitoring system (RFMS) monitoring would include obtaining feedback from the continuous monitoring system installed on the adjacent Telstra cable F HOME 2005 in the cable section Engadine-Dapto using Optical Time Domain Reflectometer (OTDR) monitoring on a spare fibre, and physical inspection of the cable line.

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

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

Survey frequency will increase to weekly if the ground strain between adjacent pegs exceeds 1 mm/m. Survey frequency will be reviewed if total subsidence exceeds 20 mm.

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-NEXTGEN.

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

Program	Aspect	Method	How	Why	Timing	Frequency
Baseline	Optical Fibre	Survey	Adjacent subsidence lines - points at approximately 20 m spacing	Establish base conditions pre-mining effects	Prior to Longwall 301 extraction	Once
		Visual Inspection	Photography of cable pits			
		Remote Fibre Monitoring System (RFMS)	Optical Time Domain Reflectometer (OTDR) monitoring data	Establish signal integrity pre-mining effects	Prior to longwall face approaching within 400 m of passing under the cables	Once
	Access roads/tracks	Visual inspection (including notes on general condition of access roads/tracks)		Establish condition pre-mining effects	Prior to Longwall 301 extraction	Once
During Mining	Optical Fibre	Survey	GPS survey of subsidence lines	Determine subsidence, tilt, tensile strain, compressive strain	Survey to commence as longwall face approaches within 400 m of passing under the cables, or If the ground strain exceeds 1 millimetre per metre (mm/m) between adjacent survey pegs on adjacent transmission survey line	Weekly, until movement stabilises
		RFMS	Automated alarm. Initial loss level set at ±1.0 dB	Monitor fibre signal integrity (loss signal)	Monitoring commencement to occur as longwall face approaches within 400 m of passing under the cables	Continuous
		Visual inspection	Open applicable cable pits and record any movement or changes evident	Direct signs of conduit movement, and degree of freedom of cable in conduit	Commence when longwall face is at 100m prior to cable and finish 400m past cable line	Weekly, when in nominated zone
	Access roads/tracks	Visual inspection (including notes on general condition of access roads/tracks)		Monitor for surface cracks, buckling and general safety	At the completion of each longwall	Once per Longwall
					As per Longwalls 301-303 LMP	
Post Mining	Optical Fibre	Visual Inspection	Surface marker locations and photography of cable pits	Determine level of impact of mining (if any)	Within 3 months of the completion of each Longwall	Once per longwall
		RFMS	Record any changes to OTDR monitoring data			

Table 5 (Continued)
Longwalls 301-303 BFMP-NEXTGEN Monitoring Program Overview

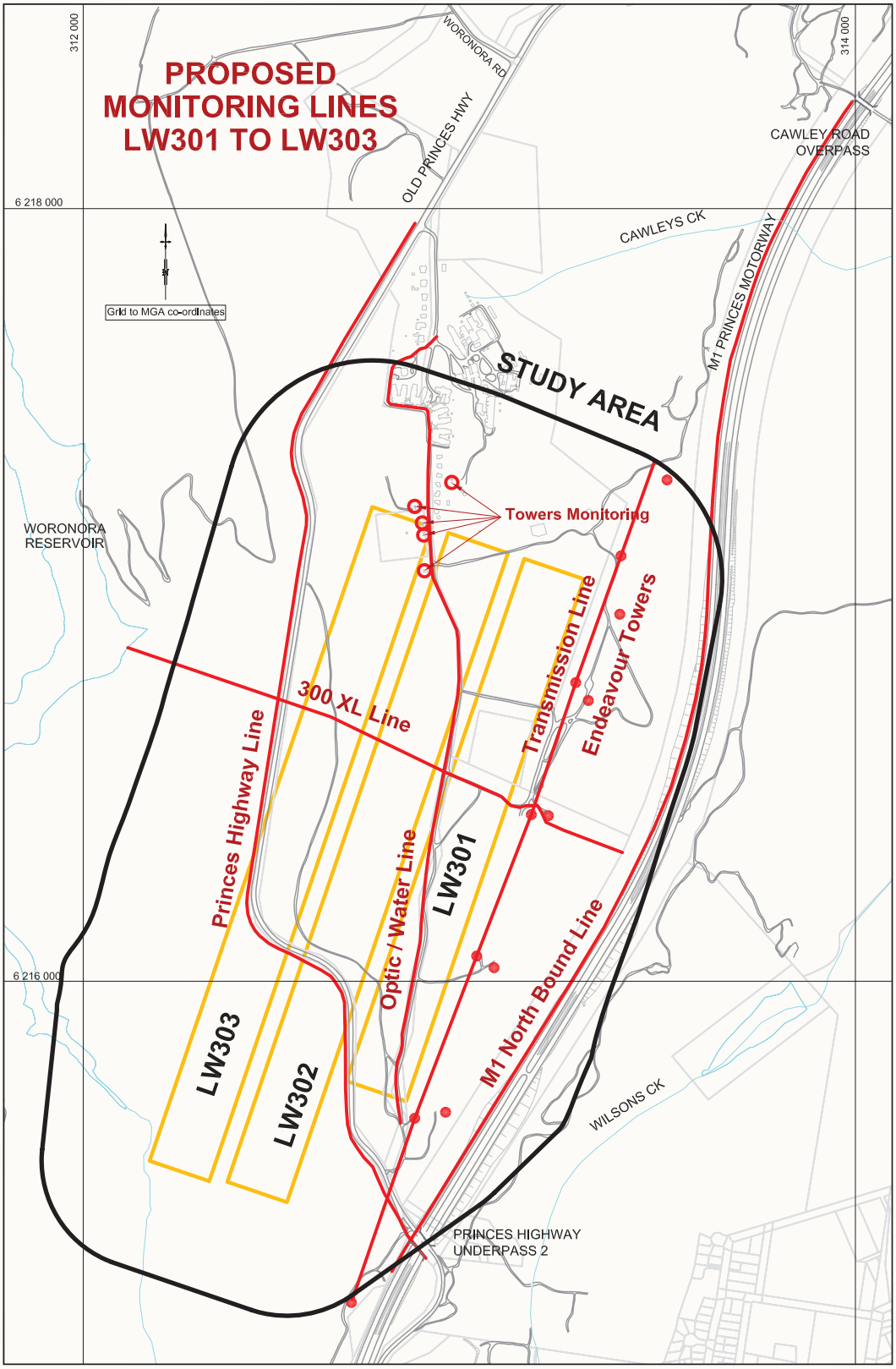
Program	Aspect	Method	How	Why	Timing	Frequency
Post Mining (Cont.)	Access roads/tracks	Visual inspection (including notes on general condition of access roads/tracks)		Determine level of impact of mining (if any)	Within 3 months of the completion of each Longwall	Once oer longwall

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



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Resource Strategies

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METROPOLITAN COAL

Longwalls 301-303 Subsidence Monitoring
Layout

Figure 6

7.2 SUBSIDENCE IMPACTS

7.2.1 Fibre Optic Cables

Visual inspections will be conducted on the cable line and joint house pit in accordance with the Nextgen inspection system or if triggered by a transmission fault detected by the Nextgen monitoring system (Appendix 1).

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.

7.2.2 Access Roads/Tracks

Visual inspection of the access roads/tracks to the Nextgen assets will occur prior to the commencement of Longwall 301, and following extraction of each longwall panel.

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

Specific details that will be noted and/or photographed that are relevant to the Nextgen access roads/tracks include:

- the location, approximate dimensions (length, width and depth), and orientation of surface tension cracks;
- the location of the surface tension crack in relation to the access road/track to the Nextgen asset;
- whether any actions are required (e.g. implementation of management measures as outlined in the Longwalls 301-303 LMP, initiation of the Contingency Plan as outlined in the Longwalls 301-303 LMP, incident notification, implementation of appropriate safety controls, review of public safety, etc.); and
- any other relevant information.

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

The information obtained will be recorded in the Longwalls 301-303 LMP - Subsidence Impact Register and reported in accordance with the Project Approval conditions.

The information obtained will be used to assess the potential environmental consequences of the subsidence impact (described in Section 7.3 of 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 Nextgen will compare the results of the subsidence impact monitoring against the built features performance measure and indicators. In the event the observed subsidence impacts exceed the performance measure or indicators, Metropolitan Coal and Nextgen 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 fibre optic cables are considered to be applicable. These are described in the Nextgen Management Plan Agreement (Appendix 1).

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

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

9 CONTINGENCY PLAN

In the event the subsidence impacts observed exceed the performance measure or indicators detailed in Section 5 of this Longwalls 301-303 BFMP-NEXTGEN, Metropolitan Coal will implement the following Contingency Plan (Appendix 4):

- The observation will be reported to the Manager - Technical Services within 24 hours.
- With the exception of access roads/tracks, the observation will be recorded in the Built Features Management Plan – Subsidence Impact Register (Appendix 3) consistent with the monitoring program described in Section 7 of this Longwalls 301-303 BFMP-NEXTGEN.
- If relating to an access road/track, the observation will be recorded in the Metropolitan Coal Longwalls 301-303 Land Management Plan – Subsidence Impact Register.
- Metropolitan Coal will report any exceedance of the performance measure or indicators to the DP&E and Nextgen 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.

  Contingency measures are provided in Section 9.1.

- Metropolitan Coal will submit the proposed course of action to the DP&E for approval.
- Metropolitan Coal will implement the approved course of action to the satisfaction of the DP&E.

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

Metropolitan Coal will comply with the NSW Coal Mine Subsidence Compensation Bill 2017 in the event that property damages occur as a result of mining Longwalls 301-303.

9.1 CONTINGENCY MEASURES

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

In the event of unforeseen impacts, contingency measures will be developed as described in the Nextgen Management Plan Agreement (Appendix 1) and may include those summarised in Table 6. The decision tree for the contingency measures is shown in Appendix 4.

Table 6
Contingency Measures

Asset	Contingency Measures / Description	
Fibre Optic Cable	Stabilisation	• Automatic monitoring detects degradation in signal. Trench fill material is removed from the identified degradation zone, allows fibre to flex, and relieve compression forces.
	Emergency	• Spare cores available in cable. Bypass affected cores to re-establish functionality.
	Rebuilding	• Fibre heat treatment to soften compression point and return affected cores to operation.
	Contingency	• Temporary alternative diverse path for Sydney-Melbourne fibre optic cable [*NB: alternative potentially undermined concurrently at Douglas Park*].

10 TARP – MANAGEMENT TOOL

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

Performance Measure	Performance Indicator	Monitoring Site(s)	Parameters	Frequency/ Sample Size	Analysis Methodology	Error Types	Baseline	Significance Levels/ Triggers		Action/Response
Safe, serviceable and repairable	Negligible transmission loss in fibre optic cables from mine subsidence impacts	.Remote fibre monitoring system (RFMS).	Signal loss.	Continuous	Monitor when longwall within 400m of passing under the optic cables.		Pre-mining audit conducted prior to commencement of LW 301.	Level 1	Signal loss < 0.3dB	Continue monitoring.
	The structural integrity of the cable line and associated joint housing pit is maintained.	Physical inspection of the cable pits.	Movement about cable pits Direct signs of conduit movement, and degree of freedom of cable in conduit	Weekly when LW is between 100m before and 400m after the cable.	Visual inspection by experienced person.				No movement about cable pits. No signs of conduit movement or reduction in freedom of movement of the cable conduit.	
	Subsidence parameters.	Survey lines along the adjacent transmission line corridor and the 300 XL subsidence monitoring line	Subsidence, Strain.	Weekly when LW is within ±400m of being directly under cable and after LW 301, 302, and 303	Evaluation of the general ground movements about the site by comparison between measured and predicted movements.	Subsidence measurement accuracy.			At end of LW 302 and at end of LW 303 Subsidence <425 mm Tensile strain < 1.5 mm/m Compressive strain < 3.2 mm/m (ie measured subsidence parameters generally in accordance with predicted). .	
								Level 2	Signal loss between 0.3 and 0.5 dB Movement about cable pits detected. Restriction in movement of cable conduits identified. Subsidence effects up to 15% greater than predicted. Subsidence between 425 mm and 490 mm Strain between 3.2 and 3.4 mm/m.	Implement actions in accordance with the Nextgen Management Plan Agreement (Appendix 1). Report subsidence anomaly. Immediately resurvey subsidence line to confirm results. Engage subsidence expert to assess results. Confirm results are consistent with other subsidence lines. Compare and critically analyse measured versus predicted subsidence. Inform and provide report to Nextgen of subsidence results. Collaboratively share information with Nextgen to monitor situation. **Nextgen** Assess information provided by Metropolitan Coal. Coordinate Comms Network Solutions Pty Ltd to complete “close-in” detailed monitoring of Telstra Cable F KNST 2005 from Engadine exchange. Increase frequency of OTDR assessments to weekly for signs of signal loss.

Table 7 (Continued)
Longwalls 301-303 BFMP-NEXTGEN Trigger Action Response Plan

Performance Measure	Performance Indicator	Monitoring Site(s)	Parameters	Frequency/ Sample Size	Analysis Methodology	Error Types	Baseline	Significance Levels/ Triggers		Action/Response
								Level 3	Signal loss > 0.5dB Strain > 3.4 mm/m	Implement actions in accordance with the Nextgen Management Plan Agreement (Appendix 1). **Nextgen** Inform Metropolitan Coal of anomalous signal degradation from continuous monitoring. Physically audit cable pits in area. In conjunction with Metropolitan Coal identify signal loss location; expose cable to investigate if tension/compression being imposed on cable. Relieve cable tension or compression by adjusting the trench geometry, the outer conduit, the fill material or by heat treatment of cable. Make determination if necessary to leave trench open for remainder of longwall extraction to avoid further stress build-up.
								Level 4	Fault detected	Implement Contingency Plan as per BFMP Section 9. General Manager to be involved in all decision making processes. Assess public safety implications and where appropriate implement safety measures in accordance with Metropolitan Coal Longwalls 301-303 Public Safety Management Plan. Report exceedance of the performance measure or indicators to the DP&E as soon as practicable. Update the 'Built Features Management Plan – Subsidence Impact Register'. **Nextgen** • As per Level 3 event, plus: o Nextgen to enact emergency transmission cutover of affected fibres at exchange and transmit on alternate fibres in bundle and/or on alternate routes. o Expose the affected section of cable and determine appropriate course of action for cable restoration being straightening/ heat treatment or full joint to joint replacement depending on severity of physical cable fault. o Complete restoration works. Work in conjunction with Metropolitan Coal to investigate root cause of incident and determine appropriate future control measures.
	The serviceability of the access roads and tracks are maintained.	Access roads and tracks in the vicinity of the Nextgen assets.	Cracking about access road/tracks.	After LW 301, 302, and 303	Visual Inspection. 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).		Pre-mining audit conducted prior to commencement of LW 301.	Level 1	Minor cracking.	**Continue monitoring.** Consider 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.).
								Level 2	Moderate cracking (ie cracking that requires implementation of management measures).	Implement management measures as outlined in the Longwalls 301-303 LMP.
								Level 3	Greater than moderate cracking.	Implement contingency measures as outlined in the Longwalls 301-303 LMP.

11 FUTURE EXTRACTION PLANS

In accordance with Condition 7 of Schedule 3, 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. Specifically, baseline data obtained will include pre-mining inspection of the telecommunications lines.

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-NEXTGEN 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 Longwalls 302 and 303, Metropolitan Coal will review the available subsidence monitoring results and assess the changes to, and impacts on, Nextgen assets.

12 ANNUAL REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE

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

The Annual Review will:

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

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

13 INCIDENTS

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

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

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

14 COMPLAINTS

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

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

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

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

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

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

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

In accordance with Condition 10, Schedule 7 of the Project Approval, the complaints register will be made publicly available on the website and updated on a monthly basis. A summary of complaints received and actions taken will be presented to the Community Consultative Committee as part of the operational performance review.

15 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS

A protocol for the managing and reporting of non-compliances with statutory requirements has been developed as a component of Metropolitan Coal's Environmental Management Strategy and is described below.

Compliance with all approvals, plans and procedures will be the responsibility of all personnel (staff and contractors) employed on or in association with Metropolitan Coal, and will be developed through promotion of Metropolitan Coal ownership under the direction of the General Manager.

The Manager - Technical Services and/or Environment & Community Superintendent will undertake regular inspections, internal audits and initiate directions identifying any remediation/rectification work required, and areas of actual or potential non-compliance.

As described in Section 13, Metropolitan Coal will notify the Director-General (now Secretary) of the DP&E and any other relevant agencies of any incident associated with Metropolitan Coal as soon as practicable after Metropolitan Coal becomes aware of the incident. Within seven days of the date of the incident, Metropolitan Coal will provide the Director-General (now Secretary) of the DP&E and any relevant agencies with a detailed report on the incident.

A review of Metropolitan Coal's compliance with all conditions of the Project Approval, mining leases and all other approvals and licenses will be undertaken prior to (and included within) each Annual Review. The Annual Review will be made publicly available on the Peabody website.

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

16 REFERENCES

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 – Proposed Longwalls 301 to 303 - Subsidence Predictions and Impact Assessments for the Nextgen Infrastructure*, 31 August 2016.

APPENDIX 1

NEXTGEN MANAGEMENT PLAN AGREEMENT (2016)

Nextgen Networks Pty Ltd
Level 1, 74 Mentmore Avenue
Roseberry, NSW, 2018.

Metropolitan Coal,
Peabody Energy Pty Ltd,
Helensburgh, N.S.W,

Management Plan

Helensburgh Coal,
Metropolitan Colliery,
Longwall Coal Extraction LW301 toLW303,
Below Nextgen Network,
@ Garrawarra, N.S.W.

Authorised on behalf of
Nextgen Networks Pty Ltd

…….

(Name:…….)
(Position:…….)
(Date: …….)

Authorised on behalf of
Metropolitan Coal,

……..

(Name:……)
(Position…….)
(Date: …….)

Issue Date: **DRAFT 26-10-16**

Revision No. & Date:

TABLE OF CONTENTS

1.0 Introduction

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

MCPL has identified surface assets which may potentially be affected by the mining operations during the longwall extraction. Some of the assets in the area are owned by Nextgen, and there is a possibility of subsidence impacts, on these assets. Refer to Mine Subsidence Engineering Consultants (MSEC) Report " Metropolitan Colliery – Proposed Longwalls 301 to 303 – Subsidence Predictions and Impact Assessments for the Nextgen Infrastructure" dated 31st August 2016, Reference No 1, for subsidence predictions affecting Telstra infrastructure within the Study Area. This assessment of predictions for the Telstra cables has been used for the Nextgen cables since both cables are co-located crossing the south eastern end of LW301. Following preliminary identification of the Nextgen network within the subsidence zone and in consultation with Peter Hickey Field Manager Nextgen Networks it was advised to MCPL that Comms Network Solutions Pty Ltd (CNS) be engaged to carry out a survey and audit of the Nextgen network and to then prepare a management plan for the Nextgen network in the proposed mining area

The audit by CNS of the Nextgen network was completed on 9th and 21st September 2016 covering the Nextgen network installed within the Study Area, defined by the 35 degree angle of draw outlined in yellow on Plate 1, following page. The area of the audit is also shown in the attached Google Earth Plan, Appendix A. "Telstra & Nextgen Cable Route -Longwalls LW301 to LW303". Following the audit of the Nextgen network, the information is presented in this management plan for MCPL and Nextgen Operations to review and if found acceptable then sign off, by both parties, as acceptance of the management plan. This management plan will only consider the potential impacts on the Nextgen network located within the SMP investigation area as shown in Appendix A and Plate 1 on the following page and within the Predicted 20mm Subsidence Contour outlined on Appendix B. The Nextgen network located in the SMP Area has been identified from the field audit as follows :-

i) Major Interstate Trunk Cable Sydney-Melbourne SM1 optical fibre cable Waterfall to Corrimal Section.
ii) Associated Nextgen Joint Housing Pit (SM1-SN-SN J08) linked to Telstra manhole using P50 conduit and P32 sub-duct passing through concrete Joint Housing Pits carrying the cable across the SMP area

Refer to Appendix B & C for location details of the Nextgen cable network installed within investigation area to the north of the Nextgen joint at SM1-SN-SN-LP2.

The two items above within 35 degree angle of draw Plate 1, the yellow outlined area, are both within LW301 and then run alongside and parallel to the eastern goaf edge of LW301 following the Telstra main optical fibre cable route through this area.

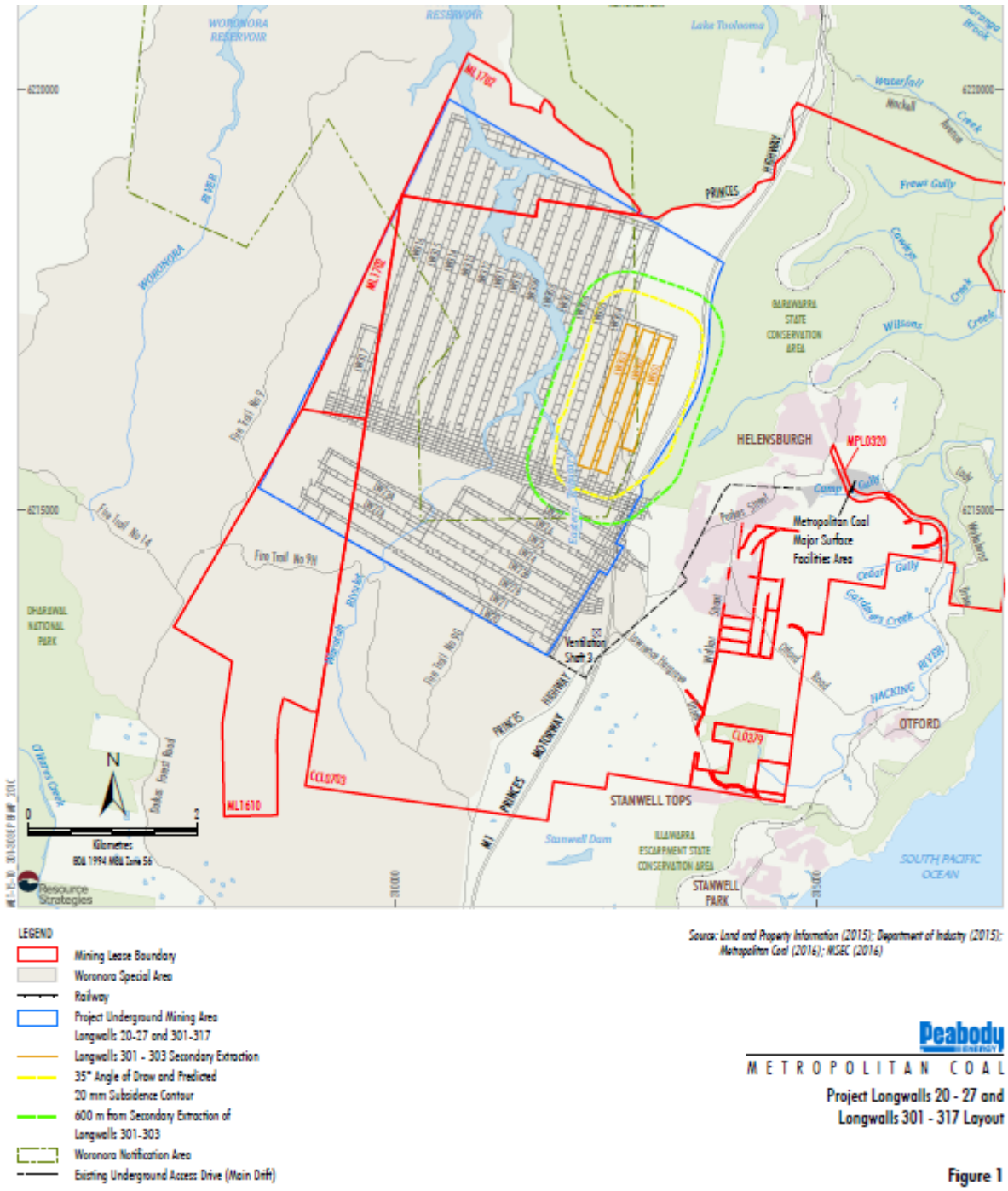

Plate 1:
Extract from Figure 1 Reference No 1:
General Arrangement of the Metropolitan Mine longwall mining area showing area under consideration for this management Plan, Longwalls LW301-303. Yellow outline around extraction area is the 20mm Subsidence Contour line and green outline is the 600m limit from Secondary Extraction.

The Nextgen Built Features Management Plan (Nextgen BFMP) August 2016 has been prepared by MCPL and references this management plan as Appendix 1. This management plan will detail predicted impacts and proposed monitoring actions on the Nextgen infrastructure.

1.1) Predicted Systematic Ground Movements:

As discussed above in Reference No 1 predictions have been made for ground movements related to the various items of the Telstra network which directly relates to the Nextgen infrastructure identified above, items i) to ii). The degree of ground subsidence and curvature generally provides an indication of the impact anticipated on the network however ground strain has the greatest impact on buried cables and on the conduit and pit network. The other relevant ground movement factor is tilt and for above ground structures however this is not relevant to the Nextgen plant in this area.

The predicted compressive and tensile strain levels from Reference 1 are as per extract below:-
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.

1.2) Anomalous Movement & Valley Closure:

There is also the potential for anomalous ground movement occurring during mine subsidence however this is minimised by the exclusion of known geological faults within the study area and also including an allowance for valley upsidence and closure within the predictions for ground strain. As indicated in the extract from Reference 1 below there are no known geological faults present in the study area as it is located just south of the east-west Metropolitan Fault line and to the north of the Main West Fault line. See Appendix A for location of known fault lines.

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. MSEC844-04.

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

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

For a continuous cable line the predictions of relative movement between observed survey marks is the critical issue for impacts on the buried cable. From previous experience it has been found that impacts occur on buried optical fibre cables when there is an area of continuous compressive strain which is able to build up over a number of bay lengths. This sustained compression or indeed tension over a continuous number of survey bays, can transfer to the cable sheath at stress concentrators along the line, to cause localised deformation of the cable, resulting in transmission loss on individual fibres. A stress concentration can occur due to a change in ground conditions soft soil / clay to rock, rock intrusion, tree root or void area around the cable.
Relative movements recorded by survey between survey pegs provide a high degree of confidence of the level of actual ground strain that develops with the longwall progress. However it must be remembered that these are average strains levels recorded over 20m survey bay lengths and it is also possible that much higher localised ground strain can occur at a specific locations within a bay along a continuous cable line. Hence instead of a 20mm movement over 20m, 0.1% strain this same movement may be confined to say 1m where it would present as a 2.0% strain. This may occur where for example, surface rock has been cut, which may allow stress relief in the rock structure at the surface, near or along the cable line.

Over LW301 at the southern end due to the presence of sandstone boulders and surface rock which have been cut with a rock saw to allow placement of the conduit and subsequently cables, it is considered that there is some added risk to the cable line, due to the possibility of anomalous movement due to the installation method providing a stress relief in the surrounding rock surface. This area over approximately 350m should be monitored carefully during subsidence as it presents a unique installation method compared to the general plough method of cable installation.

Plate 2:
View north along cable line approximately 400m north of Princes Highway over LW301. Shows cable trench cut into old sandstone road cutting where the potential is for relative movement between sandstone road area and trench line.

2.0) Scope

The predicted systematic strains at 99% confidence levels of 1.5mm/m tensile and 3.2mm/m compression are relatively high particularly for optical fibre cables however the extent of the cable projection into the south eastern area of LW301 indicates that the cable may be subject to these maximum strain levels. The cable at the south eastern finishing end of LW301 will develop tensile travelling and compressive strains and then will also develop systematic compressive and tensile strains due to the location of the cable line along and then across the longwall. Therefore it is anticipated that particularly for this cable it may sustain the high levels of compressive strain predicted.

The Nextgen cable is the major interstate Sydney-Melbourne No 1 cable carrying the majority of Nextgen's telephone, data and internet traffic between the two major capital cities in Australia. The network, identified in section 1.0), has been assessed, in relation to the predicted level of subsidence impact, based on previous experience with telecommunication cables in mine subsidence areas. Currently the adjacent cable in the conduit network with the Nextgen cable, the Telstra interstate cable

F HOME 2005 has a RFMS installed on a spare fibre in the cable and additionally it will be monitored using an OTDR at 1625nm from Engadine exchange. Through consultation with Colin Dove any loss detected on this cable will be advised to Nextgen to indicate any potential problem developing within the Telstra cable and conduit network so that Nextgen are able to evaluate the extent of any possible impact on their network.

The RFMS and OTDR feedback will be combined with feedback to Nextgen Networks from MCPL survey monitoring data along the cable line combined with a physical monitoring / inspection also along the cable line, including pit inspections, during mining at the south eastern ends of LW301 & LW302. See Appendix C for proposed cable monitoring lines

Monitoring at 1625nm of the Telstra cable, which is a similarly constructed optical fibre cable, would provide detailed surveillance to indicate any minor loss that may occur on a fibre. Cable monitoring is important in this instance since the Nextgen Sydney-Melbourne No 2 cable is potentially impacted within the same two year period by longwall mining operations at Douglas Park NSW. So with mining somewhat concurrent in two geographic areas the combined risk to the Nextgen network increases as the mining operations coincide. Hence the management plan will put in place some actions to monitor the condition of the cable and associated pit and pipe network, during the extraction of coal principally from longwalls LW301 and LW302.

2.1) Limitations.

It must be understood that the mechanism of mine subsidence and its impact on the telecommunications network has only been studied recently in some detail. Generally it has been considered that impacts were only possible on optical fibre cables in tension in that tension applied to the cable sheath would then transmit to the fibres within the sheath causing attenuation of transmission signal and interruption to services. However experience has shown that cable compression can also lead to transmission loss due to micro bending of the fibres contained within the loose tubes that supports the fibres. Since cable installation is continuous through varying ground conditions it is possible that cumulative strains or physical constraints within the trench line can cause high localised stress concentrations on the conduit and then on the cable at specific locations from unpredicted ground movement.

Once the mine subsidence is initiated there is no method of halting the subsidence event. Hence if the degree of ground movement begins to affect the Telstra conduit then there are limited options available to relieve the stresses on the cables, without exposing the cables to high risk of damage from the remedial work undertaken. The aim of the management plan is to identify any vulnerability present in the network and monitor the performance of that part of the network during and after subsidence impacts. This action will not prevent the remote possibility of damage but provides a risk assessment and a method for monitoring that risk.

2.2) Objectives & Risk

The objectives of this management plan in relation to the Nextgen Sydney-Melbourne cable are to initially audit the network and then identify risks associated with the existing cable network and to provide a strategy for monitoring this risk.

In relation to the assets identified in 1.0) and 2.3) below, the following are the assessed relative risks associated with existing plant within the proposed mine subsidence area. The two main items of plant at risk have been assessed according to the probability of damage and the consequences resulting from that damage. The Risk Factors are shown in the following table, Table 1.

Table 1
Relative Risk Factor **(RF)** for Telecommunications Plant

Risk Assessment Matrix		**Consequence**				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Almost Certain	Significant	Significant	High	High	High
	Likely	Moderate	Significant	Significant	High	High
	Moderate	Low	Moderate	Significant	High	High
	Unlikely	Low	Low	Moderate	Significant	High
	Rare	Low	Low	Moderate	Significant	Significant
	Very Rare	Low	Low	Low	Moderate	Significant

Refer to Appendix A & B for cable locations identified in the field audit.

2.3) Nextgen Network & Audit Details - Risk Assessment

2.3.1) Major Interstate Optical Fibre Cable Sydney-Melbourne No1, Waterfall –Corrimal Section SM1 –SN:SN.
(Likelihood – Moderate, Consequence- Major, Risk Assessment **- High)**

Due to potential for high compressive strains and the possibility of anomalous ground movement in the rocky terrain as mentioned in 1.1) above, the likelihood of damage is possible with major consequences. However offsetting this is the fact that the cable is installed in conduit and sub-duct similarly configured Telstra cables have sustained subsidence levels of 1000mm and strains of + and – 1.5mm/m without impact on the cable or conduit network.

This optical fibre cable is a standard haul construction optical fibre cable installed in the mid 1990's. The cable is hard jacketed with glass reinforced central strength member with Kevlar wrapping with an allowable haul tension of 2000 N and short term crush resistance of 2000 Newtons. Since the haul cable construction is suitable for cable hauling and accepting reasonable tensile loads during cable installation it is considered relatively robust.

This cable, however is installed in continuous 32mm diameter sub-duct and then installed in 50mm PVC pipe along & across the longwalls and hence it is relatively isolated from anomalous movement that may impact on the conduit installation. Therefore due to the relatively high level of predicted subsidence along with the presence of sub-duct and 4mm wall thickness uPVC conduit it is very unlikely that there will be any impact on this cable. However since the cable is installed in very rocky isolated terrain where anomalous surface movements are a remotely possibility, as a precautionary measure, it is recommended that close physical inspection, detailed survey data be provided by MCPL and feedback also to be provided to Nextgen from monitoring of the adjacent Telstra cable F HOME 2005 in the cable section Engadine-Dapto.
The physically inspected must be completed during the subsidence process by a suitably qualified expert familiar with subsidence ground movements and optical fibre cable behaviour in these conditions to ensure that there are no adverse ground impacts occurring as subsidence develops. The ground inspection regime should be combined with relevant ground survey data to indicate if any particular areas along the cable are indicating additional subsidence impacts or anomalous ground movement.

Plate 3
View of Nextgen optical fibre joint pit SM-01-13 located adjacent to the Telstra manhole at change of angle of cable route approximately 350 metres north of Princess Highway over LW301. Pit and manhole are linked with P50 conduit and north and south tails are jointed in the Nextgen pit.

2.3.2) Nextgen Joint Housing Pit (SM1-01-12) linked to Telstra manhole using P50 conduit. This also includes the Telstra P100 conduit and P32 sub-duct installed between concrete Joint Housing Pits across the SMP area
(Likelihood – Moderate, Consequence- Major, Risk Assessment - **High**)

As discussed above, the Sydney Melbourne optical fibre cable, is installed in continuous 32mm polyethylene sub-duct which has been hauled into 50mm and 100mm PVC conduit and which passes through reinforced concrete joint housing pits in the area east of LW301 and east of LW302.

Plate 4:
Typical reinforced concrete Transition Pit showing four polyethylene 32mm dia.sub-ducts entering pit from 100mm conduit. Nextgen optical fibre cable is installed within tagged sub-duct exiting manhole in P50 conduit to the joint location shown in Plate 3.

3.0) <u>Control Procedure</u>

As identified in Item 2.3.1) to 2.3.2) above it is considered there are **High** risks associated with mine subsidence impacts on the Nextgen network principally due to the importance of the Sydney-Melbourne cable and the location of the cable route over LW301. Since subsidence and developing ground strain produces risk to the interstate Sydney - Melbourne No 1 optical fibre cable it is recommended that actions be taken to ensure this critical part of the Nextgen network is secure. This is particularly the case since an alternate diverse path for the Sydney-Melbourne link may be subject to mine subsidence impacts at Douglas Park from Illawarra Coal's mining in LW707 & LW708, in a similar time period.

As mentioned above the control methods proposed, since the network is isolated from general subsidence impacts by the presence of the sub-duct and conduit, is to:-

a) i) Obtain feedback from Telstra RFMS monitoring of the adjacent Telstra cable using 1625nm OTDR monitoring to supervise the performance of the conduit network containing the Nextgen cable. The RFMS is installed on the Telstra cable monitoring the cable section between Engadine and Dapto. Should transmission loss be detected on the fibre the system will generate an alarm that will

be recorded by the Telstra Global Operations Centre and the "Hazard Advice" issued will provide contact details for Telstra maintenance operations and their consultant Colin Dove who will advise Nextgen Field Manager Peter Hickey of the location and extent of the alarm generated.

ii) CNS P/L to complete 'close-in' detailed monitoring of the Telstra cable F KNST 2005 from Engadine exchange so that any minor loss presents can be detected prior to the loss becoming a transmission issue.

In the event of loss being recorded of (+ or –) 0.3 dB then:-

- The point loss or area of loss should be recorded and an investigation carried out of the conduit network at that location to determine if any damage is evident, i.e. movement of conduit, relative movement between pit/manhole and conduit, degree of freedom of cable in conduit, degree of ground compression / tension.
- The loss event should continue to be continuously monitored and should the loss progress to (+ or -) 0.5dB then the cable and conduit should be exposed at the recorded location to attempt to relieve pressure or tension/compression on the conduit and or cable.
- In the event of the loss on the cable continuing and exceeding 1dB an interruption cable should be laid and pits installed in preparation for cable cutover of the cable if considered necessary.

b) MCPL to install subsidence monitoring survey line in the area adjacent to the Telstra conduit carrying the Nextgen optical fibre cable over LW301 and LW302 as identified in Appendix C. MCPL to report survey data obtained at regular intervals to Nextgen Networks, during mining particularly during LW301 & LW302 extraction. Survey data to be reported for both total and incremental subsidence, strain and tilt:-

Should the ground strain exceed 1.0 mm/m between adjacent survey pegs that section of the survey line should be re-surveyed at a minimum of weekly intervals until results stabilise and the results reported to Nextgen Networks. Additionally should subsidence survey results show subsidence above 225mm in the area along the cable line then Nextgen is to be advised, to complete inspections and to review current information and amend survey frequency in that area as required. Note 400mm is predicted maximum subsidence along the cable line after LW303 extraction Reference 1 Table 1.

c) As a final control to supplement the RFMS monitoring and survey data physical inspections should be maintained during the critical periods of mining LW301 to 303, where there is the possibility of mining impacting on the cable line. This would involve an inspection along the cable line checking pit entries and condition of the cable line. This physical inspection of the network should be supplemented by feedback to Nextgen from MCPL of the subsidence monitoring in b) above and any objective or anecdotal subsidence information available in the area concerning impacts on other structures such as access roads, transmission towers, R&MS Freeway and bridges and creek lines in the area of the cable installation. Hence MCPL is to advise Nextgen of mining commencement dates and progress in the longwall extraction of LW301 to LW303 so that inspections can be completed during extraction. The physical cable monitoring of the telecommunications network required by this management plan is to be carried out by a suitably qualified consultant experienced with both mine subsidence issues and the behaviour of optical fibre cables during mine subsidence impacts.

4.0) Geological fault:

Refer to the discussion in Section 1.1) above identifying the fault lines present to the north and south of the Study Area which both cross the Southern Freeway. See Appendix A. There is an area immediately south of the longwalls where fault lines are present in the vicinity of the Nextgen cable line near the Princes Highway underpass which have the potential to intersect with the cable line and may cause differential movement at the structures along the cable line. Should any detailed evidence of anomalous surface movement be detected during survey monitoring in this area, this information should be reported

to Nextgen immediately to consider the implications for the network in the area. See Appendix A for location of known fault lines

5.0) Resources

Resources required to carry out the monitoring as identified in Section 3) above are to be provided by Nextgen. The costs associated with the monitoring work required for the protection of the Nextgen network are to be accepted by MCPL. As well MCPL will provide the survey resources required for the line surveys to determine incremental subsidence, strain and tilt during the operation of the management plan, at agreed intervals, as each longwall approaches the cable line. Should survey results show any anomalous ground movement in the area of the cables then Nextgen is to be advised, to complete immediate inspections and to be able to review current survey information and amend the monitoring regime on the network as required.

In the event of unforeseen impacts on the Nextgen network, prior to commencing any proposed repair work, Nextgen Operations representatives will detail the extent of the proposed work and the associated costs to Metropolitan Colliery. A meeting should be called with representatives of Nextgen, Metropolitan Colliery, and the Mine Subsidence Board to discuss the responsibility for the costs of the proposed work. In the event of a dispute as to responsibility for the costs, involving work to secure Nextgen's network, where loss of service to customers or line system outage is involved, the work will be carried out by Nextgen immediately to protect their customer network, while the discussion and resolution of the dispute regarding costs will continue.

6.0) Functions

The monitoring of the Nextgen network described in this management plan is to be carried out by Nextgen, their consultants and MCPL as required. Regular discussions are to take place between Nextgen, their consultants and MCPL who are to provide :-

- regular updates of the mine progress and distance from cable line.
- relevant survey data showing subsidence, strain and tilt along the agreed survey lines.
- advice as to anomolous ground subsidence or other observed impacts on adjacent infrastructure such as transmission towers, freeway or freeway bridges access roads and creeks in the area.
- current understanding of the status of the subsidence relative to the predictions and any change in potential risk to the network determined as mining progresses.
- timing details of future longwallextraction to determine revision of the management plan and the frequency of contact on mining related issues.

The representatives involved in discussions involving potential impacts on the Nextgen network are:-

Jon Degotardi, Technical Services Manager, Metropolitan Colliery.
Peter Hickey, Field Manager, Nextgen.
Matthew Montgomery, District Manager, Mine Subsidence Board
Colin Dove, Consultant Telecommunications Engineer.

Meetings via teleconference should be convened where necessary to resolve any issues raised during mining. Should significant risk be identified to the Nextgen network then either party involved may call for a meeting, with one day's notice, to discuss proposed action and to keep other parties informed of developments in the monitoring and protection of the Nextgen cable.

7.0) Audit and Review

It is anticipated that this plan will be in place for approximately 2 years from the commencement of LW301 operations or for a minimum period of three months following final ground settlement after completion of mining in LW303.

Should an audit of the management plan be required during its period of operation then a representative is to be appointed by Nextgen, MCPL and the Mine Subsidence Board to review the operation of the plan and prepare a draft management plan for review by the interested parties.

Other factors which may require the management plan to be reviewed are:-

- Poor performance of the Nextgen cable in regard to mine subsidence impacts, such as cable damage.
- Favourable performance of the Nextgen cable in regard to mine subsidence, no observed or recorded impacts.
- Significant variations between actual and predicted subsidence, tilt or strain occurring.
- Significant movement identified at the geological fault lines

8.0) Associated Documents

8.1) References:

Reference No 1 - Mine Subsidence Engineering Consultants (MSEC) Report " Metropolitan Colliery – Proposed Longwalls 301 to 303 – Subsidence Predictions and Impact Assessments for the Nextgen Infrastructure" dated 31st August 2016

8.2) Appendices

Appendix A.-

Telstra & Nextgen Cable Route,
Showing Metropolitan Coal's
Longwalls LW301 to LW303
(Google Earth 2016) Sheet 1 of 1

Appendix B -

"Metropolitan Coal Pty Ltd, Metropolitan Colliery
Longwalls 301 to 303, Nextgen Infrastructure"
MSEC Dwg – MSEC844-06 Rev D Sheet 1 of 1

Appendix C -

"Metropolitan Coal Pty Ltd, Metropolitan Colliery
Proposed Monitoring Lines LW301 to LW303"
MSEC Drawing Sheet 1 of 1

9.0) Contact List.

Metropolitan Colliery
Jon Degotardi,
Technical Services Manager,
PO Box 402, Helensburgh, NSW, 2508
Telephone: 4294 7233, Mobile 0407 241 761
Email : jdegotardi@peabodyenergy.com

Nextgen Networks
Peter Hickey,
Field Manager,
PO Box 1125, Mascot, 1460, NSW,
Telephone: 1300 653 351, Mobile 0409 215 690, Fax: 8339 1134,
Email :peterhickey@nn.com.au

Mine Subsidence Board
Matthew Montgomery,
District Manager,
Southern Coalfields
Telephone: 4677 1967,
Mobile: 0425 275 564.
Email: m.montgomery@minesub.nsw.gov.au

Colin Dove,
Telecommunications Consultant, External Plant,
Mobile 0428 970 826,
Email cdove@bigpond.com.au,

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Appendices

Appendix A.-

Telstra & Nextgen Cable Route,
Showing Metropolitan Coal, Longwalls LW301 to LW303
(Google Earth 2016) Sheet 1 of 1

Appendix B -

"Metropolitan Coal Pty Ltd, Metropolitan Colliery
Longwalls 301 to 303, Telstra Infrastructure"
MSEC Dwg – MSEC844-04 rev D Sheet 1 of 1

Appendix C -

"Metropolitan Coal Pty Ltd, Metropolitan Colliery
Proposed Monitoring Lines LW301 to LW303"
MSEC Drawing Sheet 1 of 1

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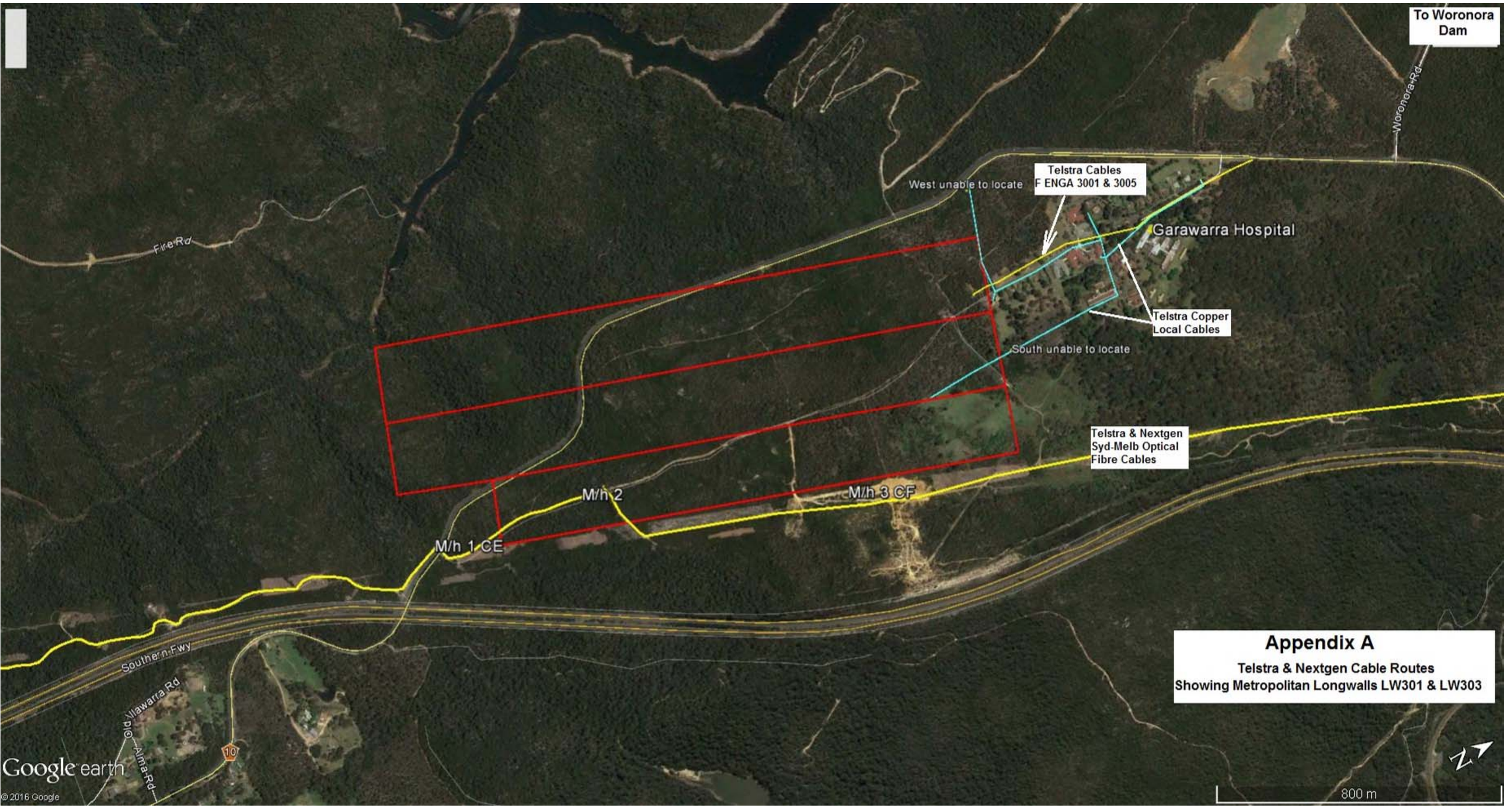
To Woronora Dam
Woronora Rd
West unable to locate
Telstra Cables
F ENGA 3001 & 3005
Garawarra Hospital
Fire Rd
Telstra Copper
Local Cables
South unable to locate
Telstra & Nextgen
Syd-Melb Optical
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Appendix A
Telstra & Nextgen Cable Routes
Showing Metropolitan Longwalls LW301 & LW303

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msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

METROPOLITAN COAL

METROPOLITAN COLLIERY
LONGWALLS 301 TO 303
NEXTGEN INFRASTRUCTURE

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Grid to MGA co-ordinates

CAWLEY ROAD OVERPASS
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STUDY AREA
TELSTRA
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WORONORA RESERVOIR
PREDICTED 20mm SUBSIDENCE CONTOUR
20
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LW301
NEXTGEN
OPTUS
TELSTRA
M1 PRINCES MOTORWAY
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PRINCES HIGHWAY UNDERPASS 2
FAULT
MAIN WEST FAULT
POWELL FAULT

GEOLOGICAL STRUCTURES
FAULTS
DYKES

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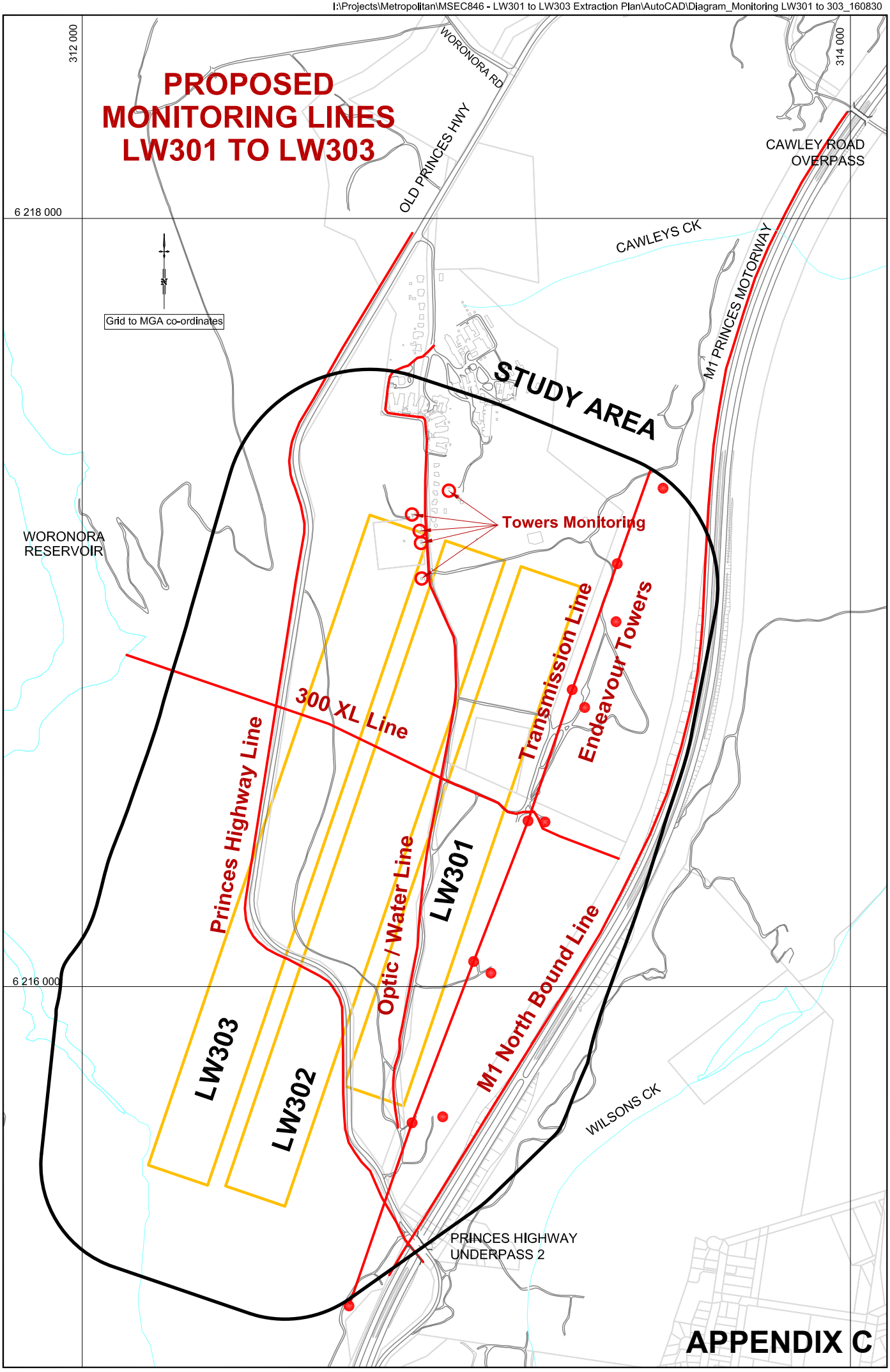

APPENDIX 2

MSEC (2016) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 301 TO 303 - SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE NEXTGEN INFRASTRUCTURE, DATED 31 AUGUST 2016

Suite 402, Level 4, 13 Spring Street
Chatswood NSW 2067
PO Box 302
Chatswood NSW 2057
Tel +61 2 9413 3777
enquiries@minesubsidence.com
www.minesubsidence.com

31st August 2016

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

Ref: MSEC844-06

Dear Jon,

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

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

The locations of the Nextgen infrastructure and the proposed longwalls are shown in the attached Drawing No. MSEC844-06. The infrastructure within the Study Area comprises one optical fibre cable that is located above the southern end of Longwall 301.

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

Conventional Subsidence Parameters for the Nextgen Infrastructure

The following provides summaries of the maximum predicted conventional movements for the Nextgen 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 Nextgen optical fibre cable, 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 optical fibre cable, due to the extraction of each of the Longwalls 301 to 303, are provided in Table 1. The values are the maxima anywhere along the cables at any time during or after the extraction of each longwall.

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

Longwall	Maximum Predicted Incremental Subsidence (mm)	Maximum Predicted Incremental Tilt (mm/m)	Maximum Predicted Incremental Hogging Curvature (km^{-1})	Maximum Predicted Incremental Sagging Curvature (km^{-1})
Due To LW301	80	< 0.5	< 0.01	< 0.01
Due To LW302	275	2.5	0.04	< 0.01
Due To LW303	80	< 0.5	< 0.01	< 0.01

The maximum predicted incremental subsidence for the optical fibre cable, due to the extraction of each of the Longwalls 301 to 303, varies from 80 mm to 275 mm. It is noted, that the maximum predicted incremental subsidence due to Longwall 302 is greater than that due to Longwall 301, as it is a second panel in the series and therefore results in higher magnitudes of subsidence above the mining area.

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

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

Longwall	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Maximum Predicted Total Hogging Curvature (km^{-1})	Maximum Predicted Total Sagging Curvature (km^{-1})
After LW301	80	< 0.5	< 0.01	< 0.01
After LW302	350	2.5	0.03	< 0.01
After LW303	425	3.0	0.04	< 0.01

The maximum predicted total subsidence for the optical fibre cable, resulting from the extraction of Longwalls 301 to 303, is 425 mm. The maximum predicted conventional tilt for this cable is 3.0 mm/m (i.e. 0.3 %, or 1 in 335). The maximum predicted conventional curvatures are 0.04 km^{-1} hogging and less than 0.01 km^{-1} sagging, which equate to minimum radii of curvature of 25 kilometres and greater than 100 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 Nextgen 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 Nextgen infrastructure 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 1. The probability distribution functions, based on a fitted *Generalised Pareto Distribution (GPD)*, have also been shown in this figure.

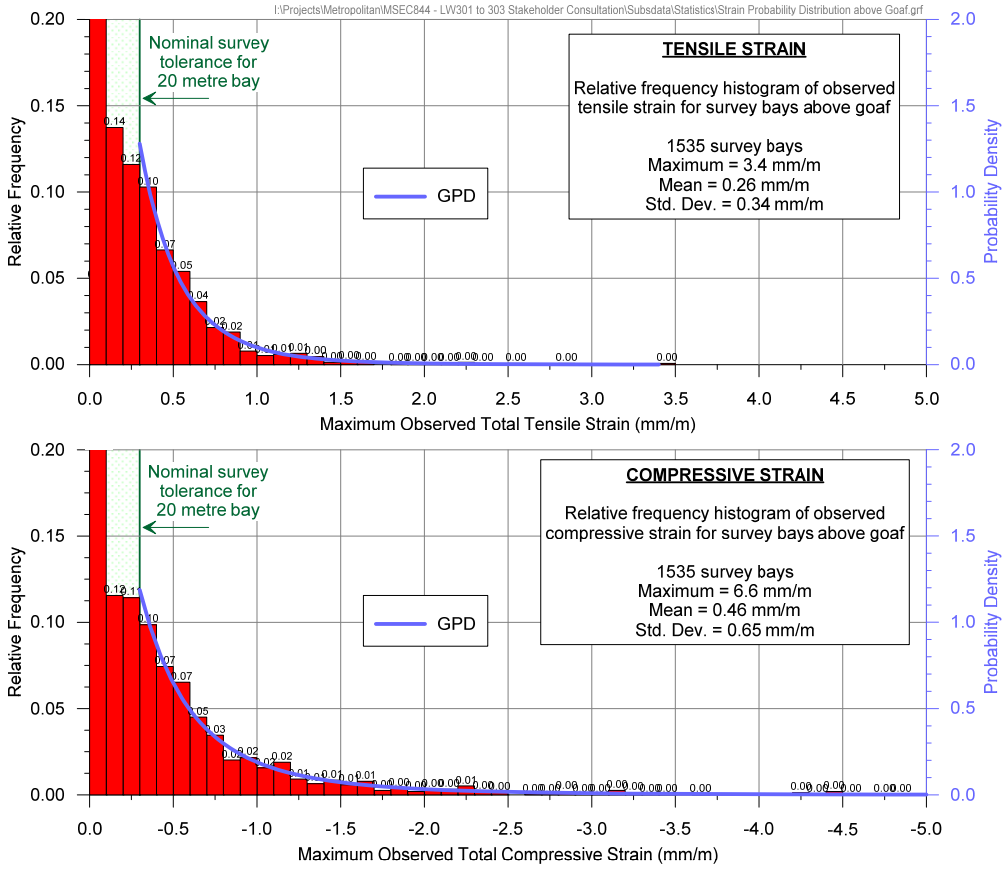

Figure 1 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Goaf

Confidence intervals have been determined from the empirical strain data using the fitted GPDs. In the cases where survey bays were measured multiple times during a longwall extraction, the maximum tensile strain and the maximum compressive strain were used in the analysis (i.e. single tensile strain and single compressive strain measurement per survey bay).

A summary of the probabilities of exceedance for tensile and compressive strains for survey bays located above goaf, based on the fitted GPDs, is provided in Table 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. MSEC844-06.

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

The optical fibre cable does not cross any major streams within the Study Area. This cable, therefore, is not expected to experience any measurable valley closure effects.

Impact Assessments for the Optical Fibre Cable

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

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

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

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

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

Some examples of mining beneath optical fibre cables in the Southern Coalfield are provided in Table 4.

Table 4 Examples of Mining Beneath Optical Fibre Cables in the Southern Coalfield

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

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

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

Summary

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

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

Yours sincerely

Peter DeBono

Attachments:

Drawing No. MSEC844-06 – Longwalls 301 to 303 – Nextgen Infrastructure

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

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msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

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LONGWALLS 301 TO 303
NEXTGEN INFRASTRUCTURE

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Grid to MGA co-ordinates

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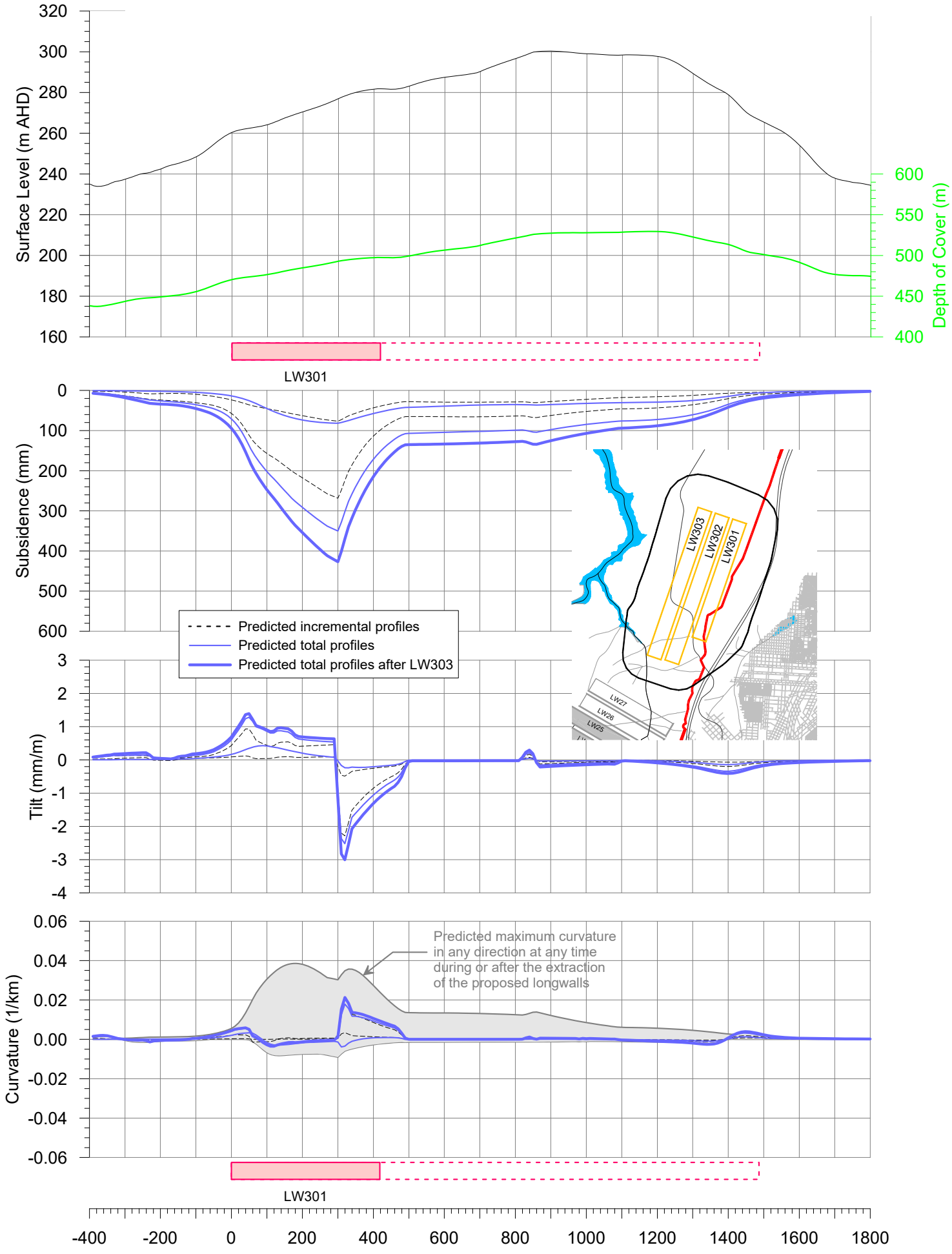
CAWLEYS CK
STUDY AREA
TELSTRA
METROPOLITAN FAULT
WORONORA RESERVOIR
PREDICTED 20mm SUBSIDENCE CONTOUR
20
OLD PRINCES HWY
LW303
LW302
LW301
NEXTGEN
OPTUS
TELSTRA
M1 PRINCES MOTORWAY
OPTUS
WILSONS CK
PRINCES HIGHWAY UNDERPASS 2
FAULT
MAIN WEST FAULT
POWELL FAULT

GEOLOGICAL STRUCTURES
FAULTS
DYKES

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



msec

Fig. A.1

APPENDIX 3

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. cable, 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 cable, include GPS co-ordinates and a sketch)

Description of Observed Impact:

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

Person Notified:	Manager - Technical Services	☐

Description of Photographs:

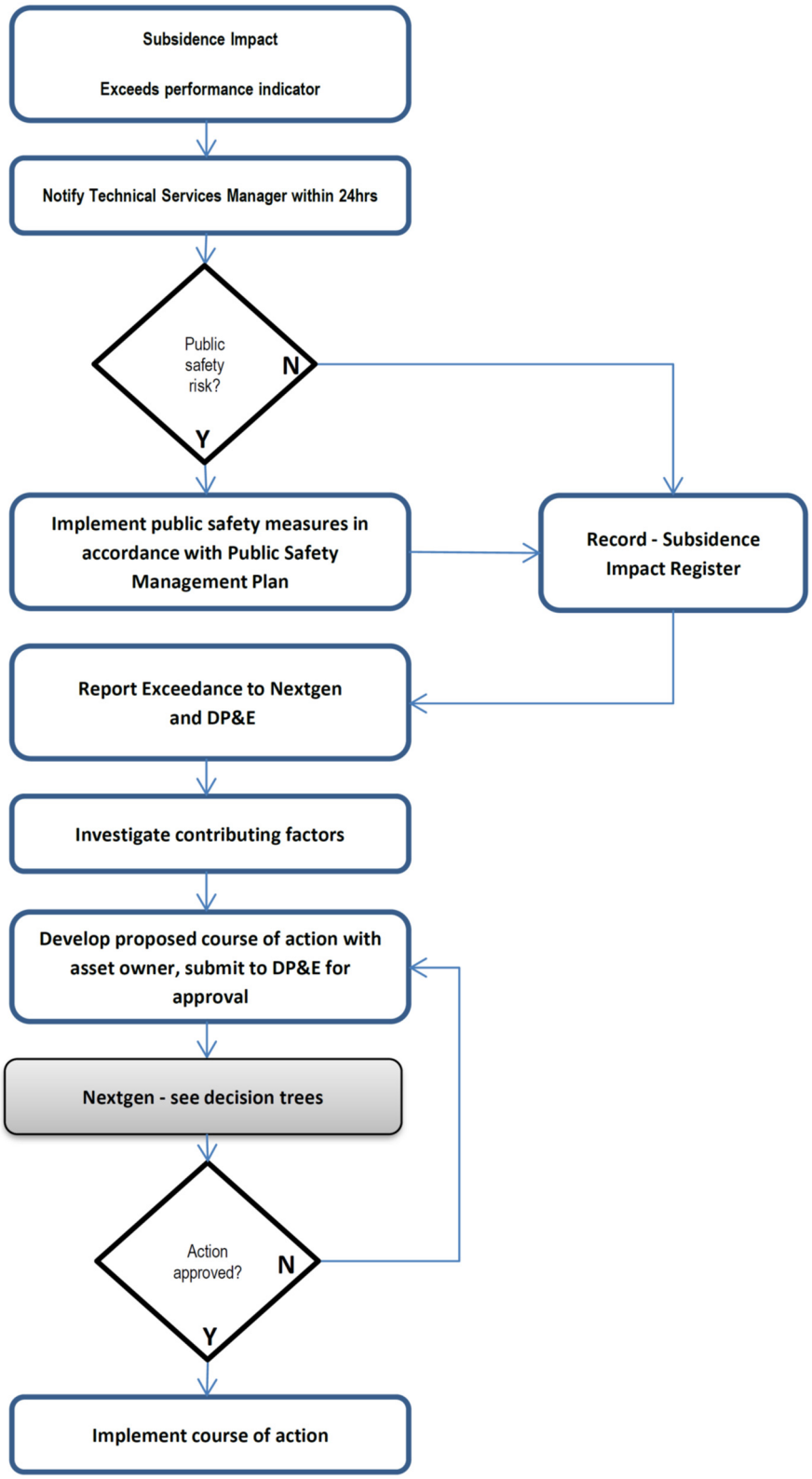
Actions Required:	Contingency Plan Initiated	☐
	Incident Notification	☐
	Safety Measures/Public Safety Management Plan Requirements	☐

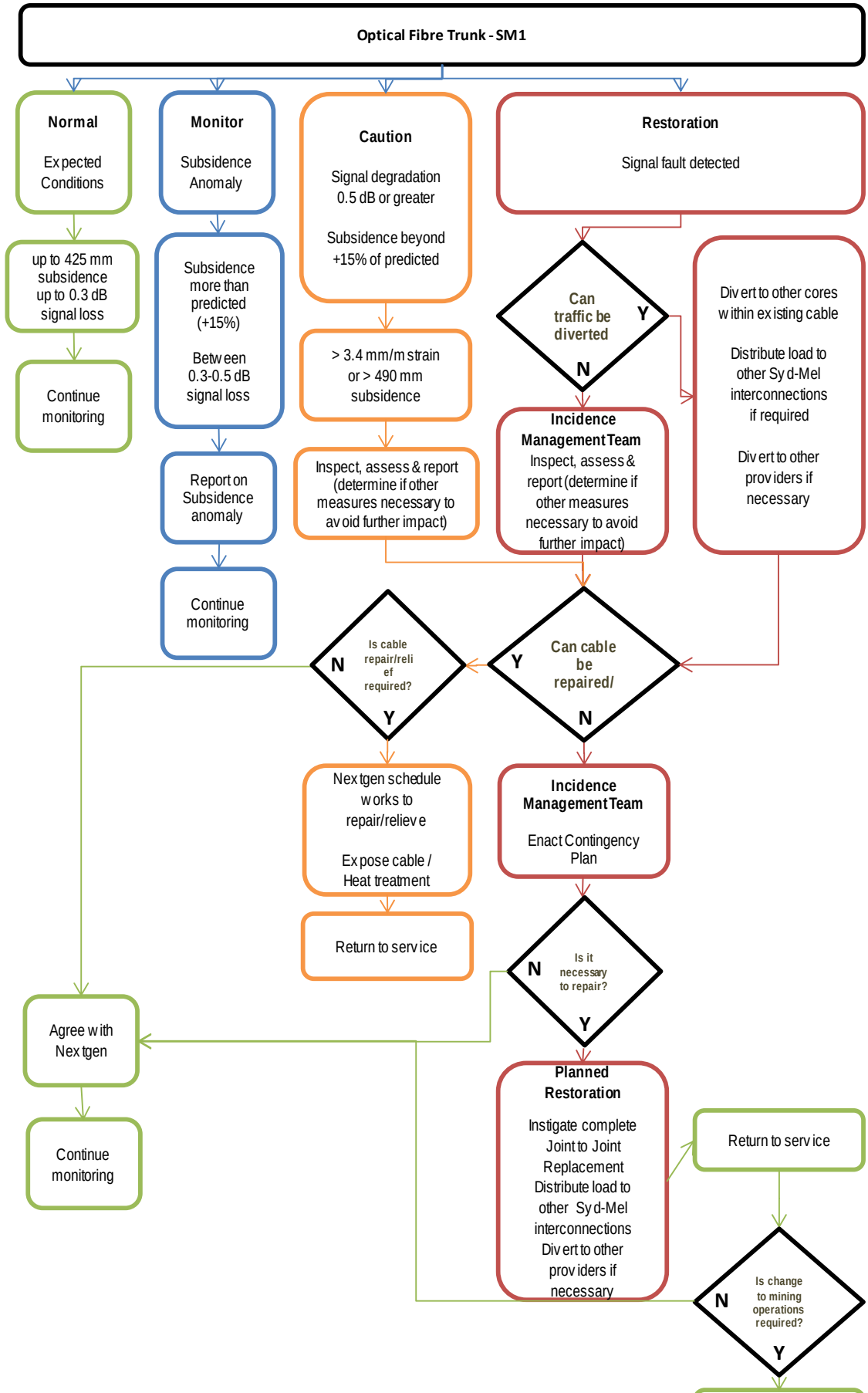
Management or Contingency Measures Implemented:

Effectiveness of Management or Contingency Measures:

APPENDIX 4

CONTINGENCY PLAN PROCEDURE AND DECISION TREE


Subsidence Impact
Exceeds performance indicator
Notify Technical Services Manager within 24hrs
Public safety risk?
N
Y
Implement public safety measures in accordance with Public Safety Management Plan
Record - Subsidence Impact Register
Report Exceedance to Nextgen and DP&E
Investigate contributing factors
Develop proposed course of action with asset owner, submit to DP&E for approval
Nextgen - see decision trees
Action approved?
N
Y
Implement course of action


Optical Fibre Trunk - SM1
Normal
Expected Conditions
up to 425 mm subsidence up to 0.3 dB signal loss
Continue monitoring
Monitor
Subsidence Anomaly
Subsidence more than predicted (+15%)
Between 0.3-0.5 dB signal loss
Report on Subsidence anomaly
Continue monitoring
Caution
Signal degradation 0.5 dB or greater
Subsidence beyond +15% of predicted
> 3.4 mm/m strain or > 490 mm subsidence
Inspect, assess & report (determine if other measures necessary to avoid further impact)
Restoration
Signal fault detected
Can traffic be diverted
Y
N
Incidence Management Team
Inspect, assess & report (determine if other measures necessary to avoid further impact)
Divert to other cores within existing cable
Distribute load to other Syd-Mel interconnections if required
Divert to other providers if necessary
Can cable be repaired/
Y
N
Is cable repair/relief required?
N
Y
Nextgen schedule works to repair/relieve
Expose cable / Heat treatment
Return to service
Incidence Management Team
Enact Contingency Plan
Is it necessary to repair?
N
Y
Agree with Nextgen
Continue monitoring
Planned Restoration
Instigate complete Joint to Joint Replacement
Distribute load to other Syd-Mel interconnections
Divert to other providers if necessary
Return to service
Is change to mining operations required?
N
Y
Agree with Nextgen and DP&E