METROPOLITAN COAL LONGWALLS 305-307

BUILT FEATURES MANAGEMENT PLAN

   

Peabody

METROPOLITAN COAL

LONGWALLS 305-307

BUILT FEATURES MANAGEMENT PLAN

SYDNEY TRAINS

ME-TSE-MNP-0089

Revision Status Register

Section/Page/ Annexure	Revision Number	Amendment/Addition	Distribution	DPIE Approval Date
All	LW305-307 BFMP_SYDTRAINS-R01-A	Original	Sydney Trains, DRG and DPIE	16 March 2020

October 2019

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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 (Longwalls 20-27 and Longwalls 301-317) and surface facilities at Metropolitan Coal. The underground mining longwall layout is shown on Figure 1. Longwalls 305-307 are situated to the west of Longwalls 301-304, and 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 – Sydney Trains (BFMP-SYDTRAINS) has been developed to manage the potential consequences of longwall extraction on the Sydney Trains assets.

The relationship of this BFMP-SYDTRAINS to Metropolitan Coal Environmental Management Structure is shown on Figure 4.

This BFMP-SYDTRAINS includes post-mining monitoring and management of Sydney Trains assets subject to the previously approved Metropolitan Coal Longwall 304 Extraction Plan.

In accordance with Condition 6, Schedule 3 of the Project Approval, the suitably qualified and experienced experts that have prepared this BFMP-SYDTRAINS, namely representatives from Mine Subsidence Engineering Consultants (MSEC) and Metropolitan Coal were endorsed by the Secretary of the Department of Planning and Environment (DP&E) (now the NSW Department of Planning Industry and Environment [DPIE]). This BFMP-SYDTRAINS has been prepared in consultation with Sydney Trains including consideration of prior consultation with RailCorp (now Sydney Trains) during the development of the previously approved Built Features Management Plans.

1.2 STRUCTURE OF THE BFMP-SYDTRAINS

The remainder of the BFMP-SYDTRAINS is structured as follows:

Section 2: Describes the review and update of the BFMP-SYDTRAINS.

Section 3: Outlines the statutory requirements applicable to the BFMP-SYDTRAINS.

Section 4: Provides a revised assessment of the potential subsidence impacts and environmental consequences for Longwalls 305-307.

Section 5: Details the performance measures and indicators that will be used to assess the Project.

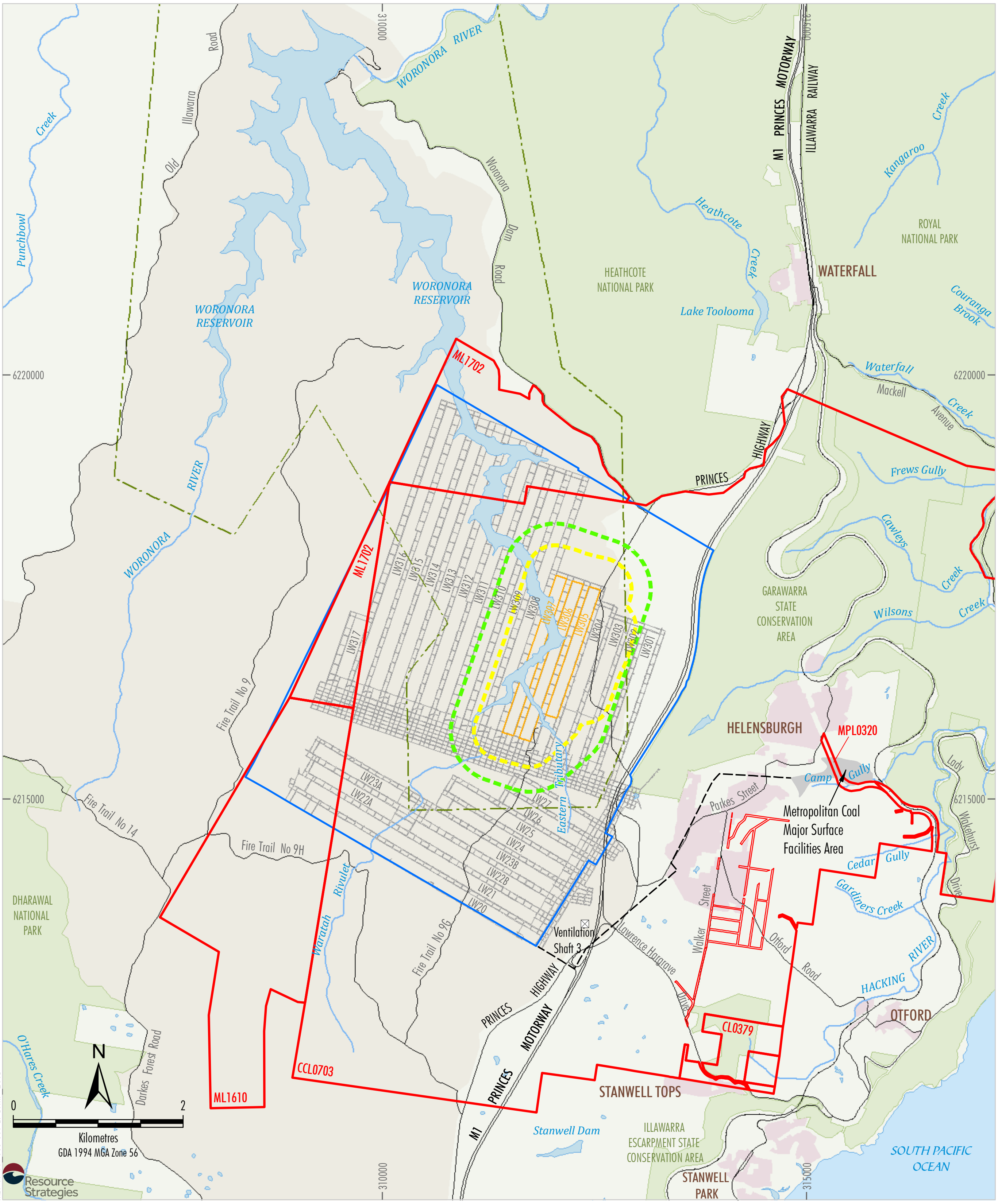
Section 6: Provides the detailed baseline data.

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.



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307 Secondary Extraction
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

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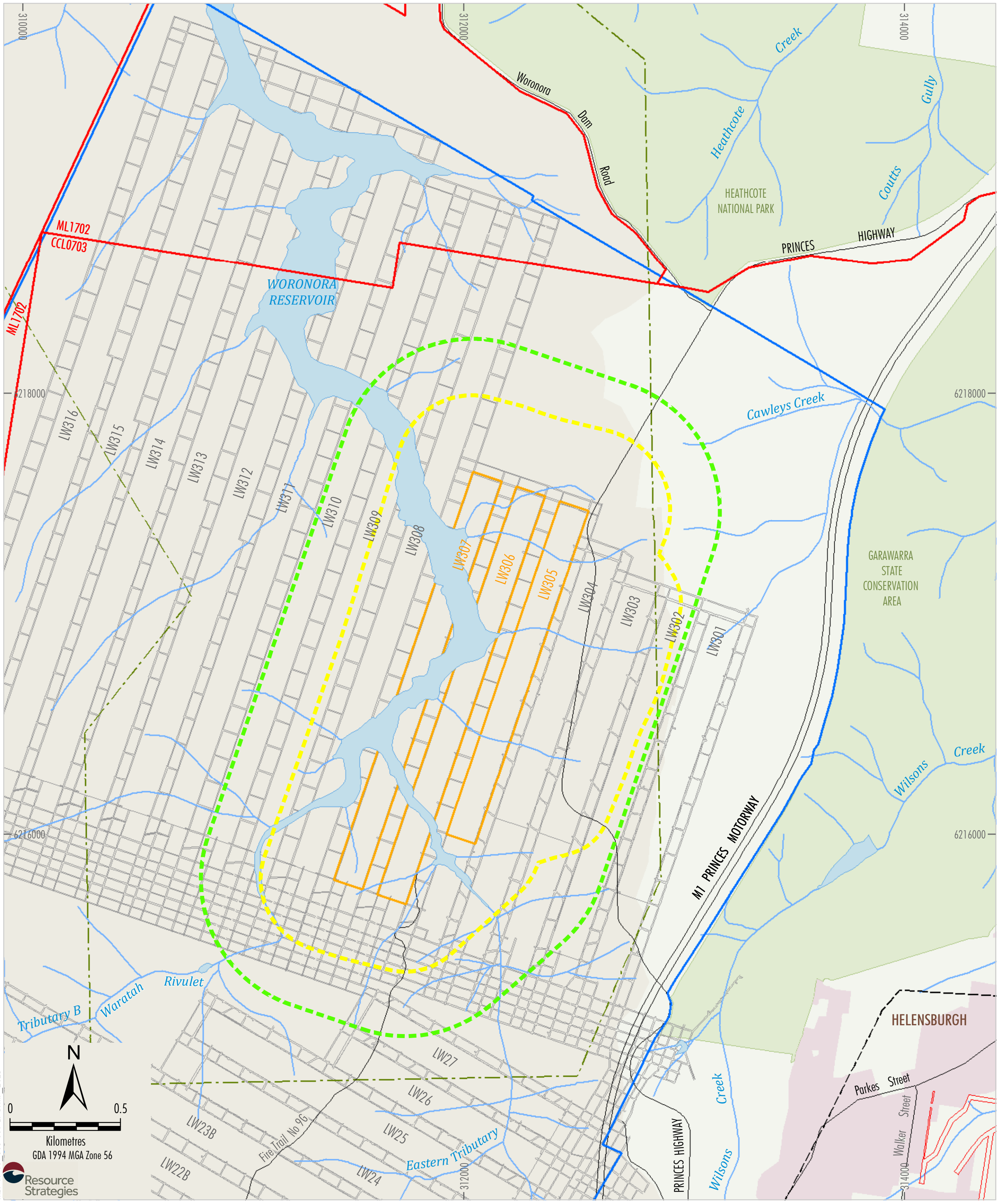
Longwalls 305-307 and Project Underground Mining Area

Figure 1



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Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

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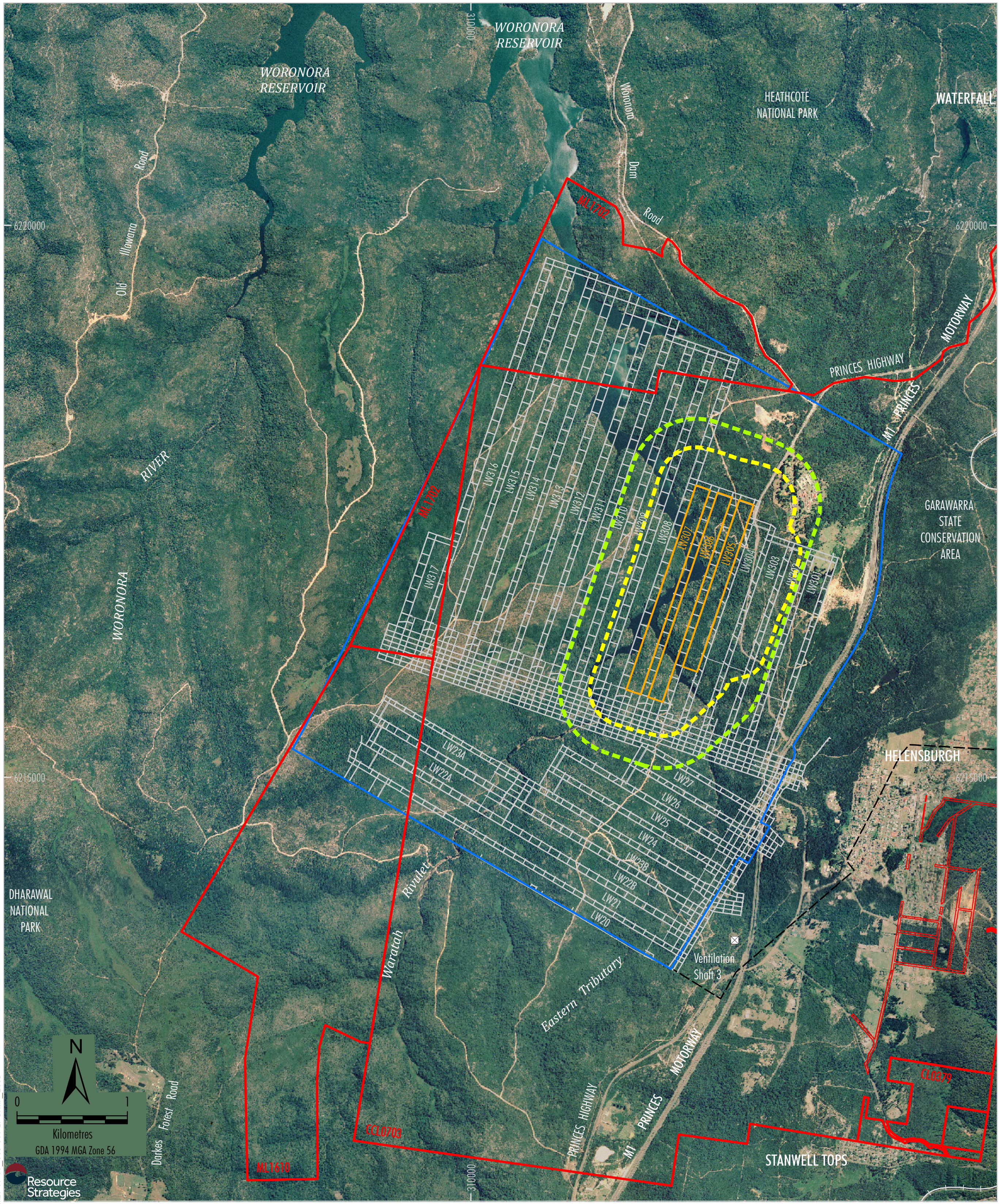
Longwalls 305-307 Layout

Figure 2



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- Longwalls 305-307 Secondary Extraction
- Longwalls 305-307 35° Angle of Draw and/or Predicted 20 mm Subsidence Contour
- 600 m from Longwalls 305-307 Secondary Extraction
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

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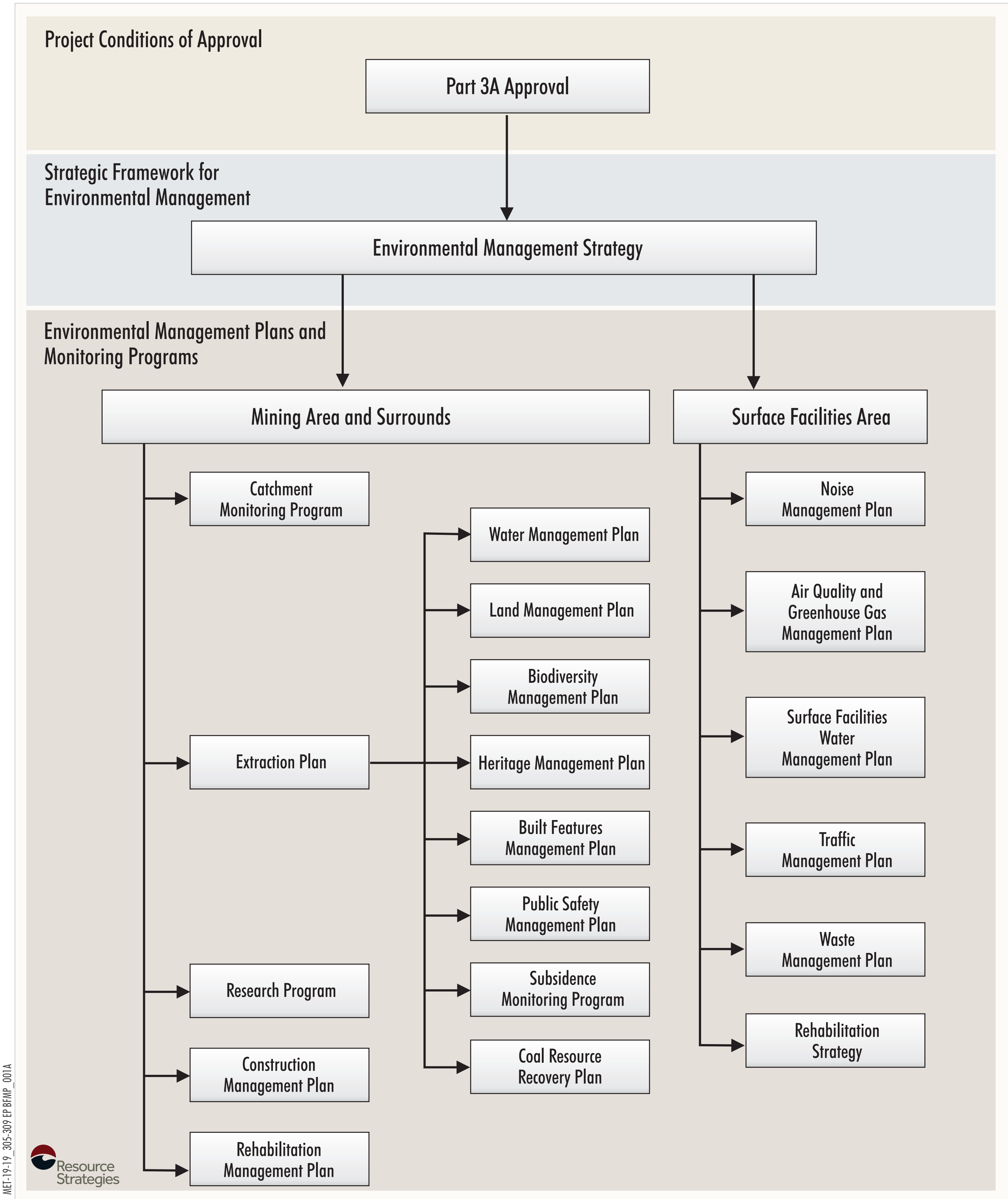
Longwalls 305-307 and Project Underground Mining Area- Aerial Photograph

Figure 3



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Environmental Management Structure

Figure 4

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 BFMP-SYDTRAINS.

2 BFMP-SYDTRAINS REVIEW AND UPDATE

In accordance with Condition 4, Schedule 7 of the Project Approval, this BFMP-SYDTRAINS will be reviewed within three months of the submission of:

- an audit under Condition 8, Schedule 7;
- an incident report under Condition 6, Schedule 7;
- an annual review under Condition 3, Schedule 7; and

if necessary, revised to the satisfaction of the Secretary of DPIE, 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 DPIE.

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

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

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

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

In addition, Metropolitan Coal employees with local computer network access will be able to view the controlled electronic version of this BFMP-SYDTRAINS 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 the Metropolitan Coal computer system and Peabody website.

3 STATUTORY REQUIREMENTS

Metropolitan Coal's statutory obligations are contained in:

(i) the conditions of the Project Approval;

(ii) relevant licences and permits, including conditions attached to mining leases; and

(iii) other relevant legislation.

These are described below.

3.1 EP&A ACT APPROVAL

Condition 6(f), Schedule 3 of the Project Approval requires the preparation of a BFMP as a component of Extraction Plan(s) for second workings. Project Approval Condition 6(f), Schedule 3, states:

> ***SECOND WORKINGS***
>
> ***Extraction Plan***
>
> *6. The Proponent shall prepare and implement an Extraction Plan for all second workings in the mining area to the satisfaction of the Director-General. This plan must:*
>
> *…*
>
> *(f) include a:*
>
> *…*
>
> - *Built Features Management Plan, which has been prepared in consultation with the owner of the relevant feature, to manage the potential environmental consequences of the Extraction Plan on any built features;*
>
> *…*

In addition, Condition 2, Schedule 7 and Condition 7, Schedule 3 of the Project Approval outline management plan requirements that are applicable to the preparation of the BFMP-SYDTRAINS. Table 1 indicates where each component of the conditions is addressed within this BFMP-SYDTRAINS.

Table 1
Management Plan Requirements

Project Approval Condition	BFMP-SYDTRAINS 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 3
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 3
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 3

3.2 LICENCES, PERMITS AND LEASES

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

- The conditions of mining leases issued by the NSW Division of Resources and Geoscience (DRG), 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 Department of Industry – Water (now the DPIE – Water) under the NSW *Water Management Act, 2000*, including WAL 36475 under the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* and WAL 25410 under the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*.
- Mining and workplace health and safety related approvals granted by the NSW Resources Regulator and WorkCover NSW.
- Supplementary approvals obtained from WaterNSW 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)[1]:

- *Biodiversity Conservation Act, 2016;*
- *Biosecurity Act, 2015;*
- *Contaminated Land Management Act, 1997;*
- *Crown Land Management Act, 2016;*
- *Dams Safety Act, 2015;*
- *Dangerous Goods (Road and Rail Transport) Act, 2008;*
- *Energy and Utilities Administration Act, 1987;*
- *Fisheries Management Act, 1994;*
- *Mining Act, 1992;*
- *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;*

[1] The list of potentially applicable Acts has been updated to reflect changes to the Acts that were in force at the time of submission of the Metropolitan Coal Project Environmental Assessment (Project EA) (HCPL, 2008).

- *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 EXTRACTION LAYOUT

Longwalls 305-307 and the area of land within 600 metres (m) of Longwalls 305-307 secondary extraction are shown on Figures 2 and 3. Longwall extraction occurs from north to south. The Longwall 305 layout includes a 138 m panel width (void), a 45 m tailgate pillar width and a 70 m maingate pillar width. The layout of Longwalls 306 and 307 includes 138 m panel widths (void) and 70 m pillar widths (solid).

The provisional extraction schedule for Longwalls 305-307 is provided in Table 2.

Table 2
Provisional Extraction Schedule

Longwall	Estimated Start Date	Estimated Duration	Estimated Completion Date
Longwall 305	March 2020	7 Months	October 2020
Longwall 306	November 2020	8 Months	July 2021
Longwall 307	August 2021	8 Months	April 2022

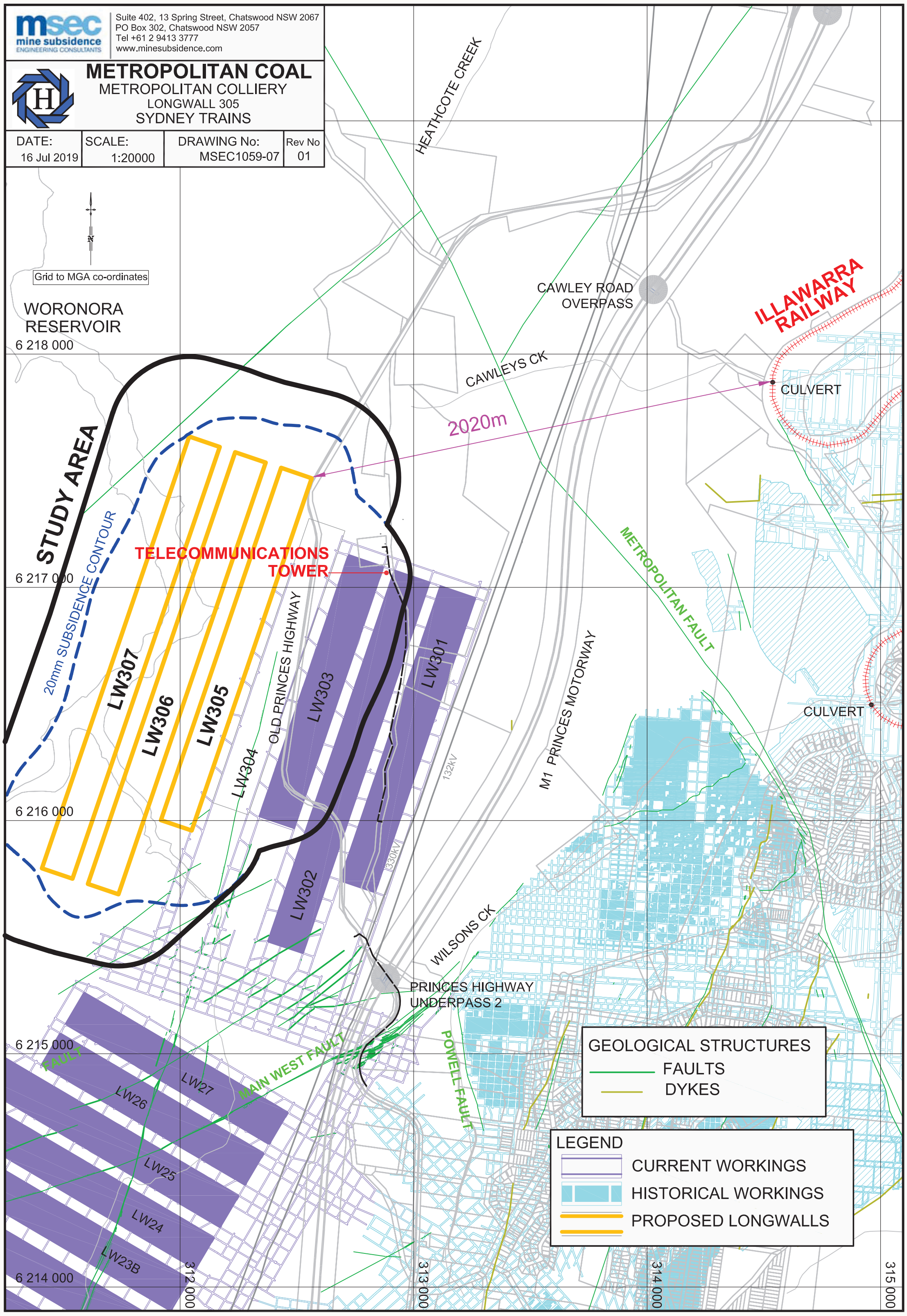
The future Extraction Plans will consider the cumulative subsidence effects, subsidence impacts and/or environmental consequences. Note that the total cumulative predicted subsidence effects, subsidence impacts and/or environmental consequences at the completion of the Project are considered in the Metropolitan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

4.1.1 Sydney Trains Assets

Figure 5 illustrates the Sydney Trains assets in relation to Longwalls 301-307 extraction. The assets include:

- Illawarra Railway Line; and
- Telecommunications Tower (and Compound).

The shortest distance from the proposed Longwalls 305-307 is greater than 2,000 m at the closest point (at Longwall 305). The telecommunications tower (and compound) is located above the chain pillar between Longwall 302 and Longwall 303, 430 m to the east of Longwall 305.



MET-19-19_305-309 EP BFMP_009A

Source: MSEC (2019)

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Sydney Trains Assets

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 Sydney Trains 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 305-307 on Sydney Trains assets were conducted by MSEC and reported in MSEC (2019) (Appendix 1). In relation to subsidence predictions and potential impacts for Longwalls 305-307, MSEC (2019) make the following conclusions:

- The Illawarra Railway is located more than 2.0 km from Longwalls 305-307. At this distance, the railway is not expected to experience measurable conventional subsidence, tilts, curvatures or strains or measurable non-conventional movements.
- It is unlikely that the Illawarra Railway and associated infrastructure would experience adverse impacts as a result of Longwalls 305-307.
- The magnitude of tilt predicted at the telecommunications tower (and compound) is very small (less than 0.35% or 0.2 degrees) and the tower is unlikely to be adversely impacted.
- Based on the predicted conventional curvatures and strains, the building enclosure is not expected to experience adverse impacts as a result of Longwalls 305-307.
- It is expected that the building enclosure would remain in a safe and serviceable conditions during and after mining.

4.2.2 Risk Assessment Meeting

In accordance with the *Guidelines for the Preparation of Extraction Plans* (DP&E and DRE, 2015) a risk assessment meeting for Longwalls 301-303 was held on 18 August 2016. Attendees at the risk assessment meeting included representatives from Sydney Trains, MSEC, Resource Strategies (on behalf of Metropolitan Coal) and Axys Consulting (risk assessment facilitator).

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

- preliminary identification of Sydney Trains assets[2];
- review of the revised subsidence predictions and potential impacts on Sydney Trains assets (including consideration of past experience in the Southern Coalfield); and
- development of a preliminary monitoring plan.

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

A number of risk control measures and procedures relevant to the Sydney Trains assets have been identified which considered the extraction of coal beneath (communications tower and compound) and at distance from (rail line) the assets.

The risk control measures and procedures were incorporated into the Longwalls 301-303 BFMP.

The risk control measures and procedures identified during the risk assessment for Longwalls 301-303 were reviewed and continued for the extraction of Longwall 304 and have been incorporated in this revised BFMP for Longwalls 305-307 where relevant.

A risk review was held 20 August 2019 for Longwalls 305-307. Attendees at the risk review meeting included representatives from Metropolitan Coal, Sydney Trains and MSEC. Given the distance of longwall extraction from the Sydney Trains assets (greater than 2 km) a number of risk control measures and monitoring procedures were reviewed, including discontinuing monitoring for certain items after confirmation that no significant subsidence movements or impacts were being observed due to the extraction of previous longwalls. The Sydney Trains communications tower monitoring program was reviewed as part of the risk review and the monitoring system will be continued for Longwalls 305-307, however, the frequency of monitoring will reduce given the increasing distance away from mining.

4.3 LONG-TERM STABILITY OF OLD MINE WORKINGS

Old (historic) underground mine workings are present beneath and in the vicinity of the Illawarra Railway as shown on Figure 5. There are no old (historic) underground mine workings directly above or below Longwalls 301-307 nor within the relevant Study Area (Figure 5).

An assessment of subsidence above old mine workings has previously been undertaken and presented at the 8th Triennial Conference on Mine Subsidence in 2011 in a paper titled "*An Analysis of Long Term Subsidence at Metropolitan Colliery*". A copy of the paper is provided in Appendix 1. Based on data covering a 14 year period of monitoring, the assessment concluded that the goaf/chain pillar system (similar to Longwalls 301-307) was in a longer term stable condition.

A typical stratigraphic section of the geology at the Metropolitan Colliery is provided in Appendix 1. The section is characteristic of the NSW Southern Coalfield with deep overburden of sedimentary rocks comprising Hawkesbury Sandstone at the surface overlying the Narrabeen Group. There is no Wianamatta Shale present at the surface at the Metropolitan Colliery.

Detailed groundwater modelling and assessment of underground mining at the Metropolitan Colliery has been undertaken including consideration of the long term recovery and flooding of old mine workings. The Groundwater Assessment (Heritage Computing, 2008) is available on the Peabody website.

At more than 1.4 km from Longwalls 301-307, it is considered unlikely that the Illawarra Railway and associated infrastructure would experience adverse impacts from subsidence of old workings as a result of extraction of Longwalls 301-307. At more than 2.0 km from Longwall 305, the Illawarra Railway is not expected to experience measurable conventional vertical subsidence, tilts or curvatures due to the extraction of Longwalls 305-307. Culverts are located at the Illawarra Railway crossing at Cawleys and Wilsons Creeks. At more than 2.0 km from Longwall 305, it is unlikely that the Illawarra Railway would experience measurable valley related movements at the creek crossings.

4.4 UNDERGROUND BLAST VIBRATION IMPACTS

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

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

5 PERFORMANCE MEASURES AND INDICATORS

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

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

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

- the structural integrity of the telecommunications tower (and compound) is maintained.

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

6 BASELINE DATA

An audit on the Sydney Trains telecommunications compound was conducted within the Study Area prior to extraction of Longwall 302 to document the asset condition. A structural review of the Sydney Trains telecommunications tower was completed prior to extraction of Longwall 302, by Cardno Engineering on behalf of Metropolitan Coal. This structural assessment was reviewed by the Sydney Trains structural engineering group who engaged an external consultant to review the assessment to determine that mining did not pose a safety concern to the tower suitability. The monitoring program for the tower was determined in consultation with Sydney Trains and took into account the relevant outcomes of the structural assessment. The monitoring program included defining Trigger Action Response Plan levels for differential leg movements.

The telecommunications tower and compound are shown on Plates 1 and 2.

Plates 1 and 2 – Telecommunications Tower and Compound (March 2018)

As described in Section 4.2.1 and Appendix 1, the magnitude of tilt predicted at the telecommunications tower (and compound) is very small (0.35% or 0.2 degrees).

6.1 KEY CONTACTS LIST

The list of key contacts for Peabody and Sydney Trains during the development and implementation of this BFMP are provided in Table 3.

Table 3
List of Key Contacts

Company / Agency	Peabody (Metropolitan Coal)	Sydney Trains
Position	Technical Services Manager	Program Manager Capital & External Party Works Engineering & Maintenance
Name	Jon Degotardi	Joe O'Brien
Contact	Control Room 24hr 02 4294 7333	131 500

7 MONITORING

A monitoring program has been implemented to monitor the impacts of the Project in consultation with Sydney Trains. Table 4 summarises the BFMP-SYDTRAINS monitoring components.

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

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

The frequency of monitoring will be reviewed either:

- in accordance with the Annual Review outlined in Section 12; or
- if triggered as a component of the Contingency Plan as outlined in Section 9 of this BFMP-SYDTRAINS.

Table 4
BFMP-SYDTRAINS Monitoring Program Overview

Program	Aspect	Method	How	Why	Timing	Frequency
Baseline	Communication Tower (and compound)	Survey	Adjacent optic / water subsidence line points at approximately 20 m spacing	Establish base conditions – to track general land movement*	Prior to Longwall 301 extraction	Complete
			Survey marks at Tower legs and footings	Establish base conditions – to track any 3D movement	Prior to Longwall 302 extraction	Complete
		Condition assessment (including infrastructure, services and cables)		Establish base condition	Prior to Longwall 302 extraction	Complete
	Access roads/tracks	Visual inspection (including notes on general condition of access roads/tracks)		Establish base condition	Prior to Longwall 301 extraction	Complete

Table 4 (Continued)
BFMP-SYDTRAINS Monitoring Program Overview

Program	Aspect	Method	How	Why	Timing	Frequency
During Mining	Communication Tower (and compound)	Survey Line	GPS survey of optic / water subsidence line points at approximately 20 m spacing	Monitor subsidence effects during mining	On commencement of LW305,	Monthly for LW305
					Within 3 months of completion of LW305, 306 and 307	Once per longwall
		Survey Tower monitoring	Relative survey 4 x ground monitoring points & 4 x tower leg mounted prisms.	Monitor any structural movements as per Tower TARP	On commencement of LW305	Weekly until effects of subsidence no longer detectable
					Within 3 months of completion of LW305, 306 and 307	Once per longwall
		Visual inspection (for evidence of subsidence effects on compound – movement of building/cables entering compounds)		Monitor structural integrity of compounds and cable entries	On commencement of LW305	Weekly until effects of subsidence no longer detectable
					Within 3 months of completion of LW305, 306 and 307	Once per longwall
	Access roads/tracks	Visual inspection (including notes on general condition of access roads/tracks)		Monitor for surface cracks, buckling and general safety	On commencement of LW305	Monthly
					Within 3 months of completion of LW305, 306 and 307	Once per longwall
					As per Longwall 304 LMP	
Post Mining	Communication Tower (and compound)	Condition assessment (including infrastructure, services and cables)		Determine level of impact of mining (if any)	Within 3 months of the completion LW307	Once
	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 LW307	Once

7.1 SUBSIDENCE PARAMETERS

Subsidence parameters (i.e. subsidence, tilt, tensile strain, compressive strain) associated with mining will be measured in accordance with the Longwalls 305-307 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 and directly at the communication tower foundations.

Subsidence parameters specific to the Sydney Trains assets include the survey line along the optical fibre and water lines (in the vicinity of the telecommunications tower and compound) and specific survey prisms mounted on the communication tower legs and footings. These surveys will monitor the general movement about the longwalls and the data will allow evaluation of the likely ground movements about the communications tower and compound (by comparison between measured and predicted movements). Monitoring of towers will also be undertaken as shown on Figure 6.

7.2 SUBSIDENCE IMPACTS

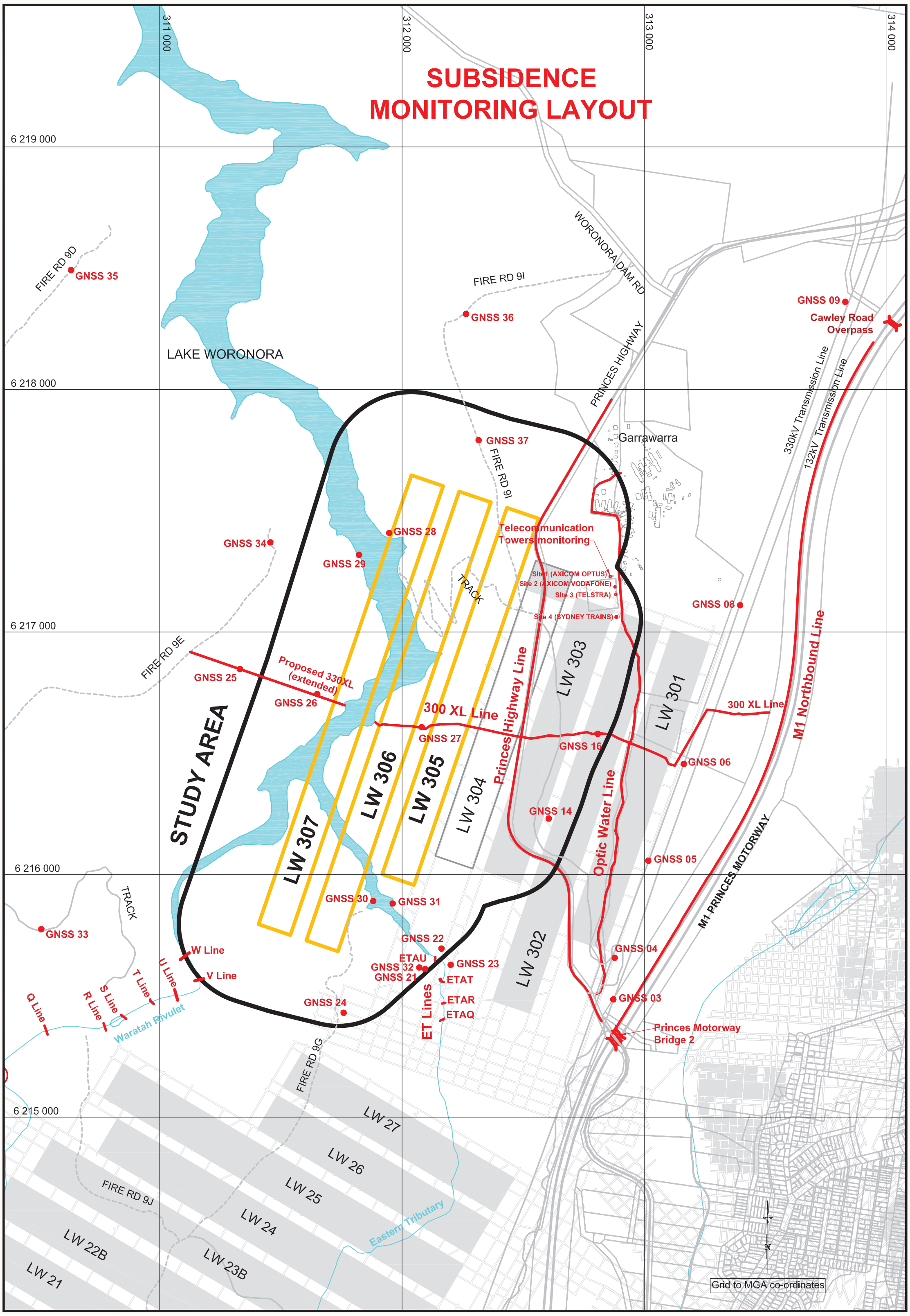
7.2.1 Rail Line

Visual inspections conducted during extraction of Longwalls 301-303 did not identify any changes to the rail line infrastructure. Sydney Trains conducts inspections on track conditions, structure conditions, drainage changes and culvert conditions.

Detailed monitoring was undertaken by Metropolitan Coal on the two railway culverts for any evidence of far field valley closure effects during the extraction of Longwalls 301-303. Cardno Engineering was unable to identify any changes to the culverts during the Longwalls 301-303 extraction period and will review again for any changes after Longwall 304 is completed. Real time valley closure monitoring was installed for the extraction of Longwalls 303 and 304. No movement was recorded above the installed instruments accuracy capability, (being ±5 mm absolute per unit and ±10 mm closure per unit pair) in either Wilsons Creek valley or Cawley's Creek valley.

There has been no evidence of any changes to the railway infrastructure and no evidence of any ground movement as a result of more proximal longwall extraction to the rail line. In addition to this, given the increasing distance of Longwalls 305-307 from the rail line (i.e. greater than 2 km), surveying and structural inspections of the culverts will be discontinued for Longwalls 305-307.

Notwithstanding the above, if any defects or deformation of the rail line (as a result of mining activities associated with Longwalls 305-307) are recorded by Sydney Trains and confirmed with Metropolitan Coal, 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.



MET-19-19_305-309 EP BFMP_017A

Source: MSEC (2019)

Peabody

METROPOLITAN COAL

Subsidence Monitoring Layout

Figure 6

7.2.2 Telecommunications Tower and Compound

Visual inspections of the telecommunications tower and compound will be conducted in consultation with the Sydney Trains. Monitoring of towers will be conducted by Metropolitan Coal as described in Table 4.

7.3 ENVIRONMENTAL CONSEQUENCES

Metropolitan Coal and Sydney Trains will compare the results of the subsidence impact monitoring against the built features performance indicators and performance measure. In the event the observed subsidence impacts exceed the performance indicators or performance measure, Metropolitan Coal and Sydney Trains will assess the consequences of the exceedance in accordance with the Contingency Plan described in Section 9.

8 MANAGEMENT MEASURES

Potential management measures for the telecommunications tower and compound include bracing and/or changing splice plates to relieve any mining induced stress and/or implementation of building maintenance techniques.

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 indicators or measure detailed in Section 5 of this BFMP, Metropolitan Coal will implement the following Contingency Plan (Appendix 3):

- The observation will be reported to the Technical Services Manager within 24 hours.
- The observation will be recorded in the Built Features Management Plan - Subsidence Impact Register (Appendix 2) consistent with the monitoring program described in Section 7 of this BFMP-SYDTRAINS.
- Metropolitan Coal will report any exceedance of the performance indicators or performance measure to the DPIE and Sydney Trains 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 305-307 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 DPIE for approval.
- Metropolitan Coal will implement the approved course of action to the satisfaction of the DPIE.

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 Secretary of the DPIE if either the contingency measures implemented by Metropolitan Coal have failed to remediate the impact or the Secretary determines that it is not reasonable or feasible to remediate the impact.

Metropolitan Coal will comply with the NSW *Coal Mine Subsidence Compensation Act, 2017* in the event that property damages occur as a result of mining Longwalls 305-307.

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 consequences).

Contingency measures that could be considered in the event the performance measure for the rail line and telecommunications tower and compound is exceeded are summarised in Table 5. The decision trees for the contingency measures are shown in Appendix 3.

Table 5
Contingency Measures –Telecommunications Tower and Compound

Environmental Consequence	Contingency Measures	
	Measure	Description
Impact on:		
Telecommunications Tower	Repair of tower	• Additional bracing and/or strengthening members to the frame. • Replace tower leg splice plates with wider aperture plates to remove and detected mining induced stress. • Replacement of tower.
Building Compound	Repair of building	• Building maintenance techniques. • Replacement of building compound.

10 TARP – MANAGEMENT TOOL

The framework for the various components of the BFMP-SYDTRAINS are summarised in the BFMP-SYDTRAINS TARP shown in Tables 6. The BFMP-SYDTRAINS TARPs 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 performance and the implementation of management and/or contingency measures.

Table 6
Trigger Action Response Plan – Telecommunications Tower and Compound

SYDNEY TRAINS – Telecommunications Tower (and Compound)			
SYDNEY TRAINS Telecommunications Tower (and Compound)	*Risk: Subsidence effect on tower or compound resulting in impact to structural integrity.*		
	TRIGGER LEVEL		**RESPONSE**
	Level 1 - Normal **Expected subsidence conditions**		
	LW 304 Subsidence • less than 400 mm Tilt • less than 3.5 mm/m Strain • 0.9 mm/m tensile • 1.6 mm/m compressive Differential vertical leg movement • less than 1.0 mm Differential horizontal leg movement • less than 5.4 mm	LW 305-307 Subsidence • less than 450 mm Tilt • less than 3.5 mm/m Strain • 0.9 mm/m tensile • 1.6 mm/m compressive Differential vertical leg movement • less than 1.0 mm Differential horizontal leg movement less than 5.4 mm	**Normal Operations** • Telecommunications tower (and building compound) is safe and serviceable. • Negligible impact to telecommunications tower (and compound). • Continue monitoring activities as planned. • Survey data within predictions.

Table 6 (Continued)
Trigger Action Response Plan – Telecommunications Tower and Compound

SYDNEY TRAINS – Telecommunications Tower (and Compound)			
SYDNEY TRAINS Telecommunications Tower (and Compound)	*Risk: Subsidence effect on tower or compound resulting in impact to structural integrity.*		
	TRIGGER LEVEL		**RESPONSE**
	Level 2 - Monitor **Subsidence elevated up to +15% of predicted but service condition normal**		
	LW 304 Subsidence • between 400 and 460 mm Differential vertical leg movement • between 1.0 and 2.0 mm Differential horizontal leg movements • between 5.4mm and 8.6 mm Strain - Tensile • between 0.9 and 1.0 mm/m Strain - Compressive between 1.6 and 1.8 mm/m	LW 305-307 Subsidence • between 450 and 517 mm Differential vertical leg movement • between 1.0 and 2.0 mm Differential horizontal leg movements • between 5.4mm and 8.6 mm Strain - Tensile • between 0.9 and 1.0 mm/m Strain - Compressive • between 1.6 and 1.8 mm/m	**Continue operations but report on subsidence anomaly** • Telecommunications tower (and building compound) is safe and serviceable. • Negligible impact to telecommunications tower (and compound). **Metropolitan Coal** • Immediately resurvey subsidence line (Optic / Water Line) in affected area 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 Sydney Trains of subsidence results. • Collaboratively share information with Sydney Trains to monitor situation. **Sydney Trains** • Assess information provided by Metropolitan Coal.

Table 6 (Continued)
Trigger Action Response Plan – Telecommunications Tower and Compound

<table>
<tr><th colspan="4">SYDNEY TRAINS – Telecommunications Tower (and Compound)</th></tr>
<tr><td rowspan="5">SYDNEY TRAINS Telecommunications Tower (and Compound)</td><td colspan="3">Risk: Subsidence effect on tower or compound resulting in impact to structural integrity.</td></tr>
<tr><td colspan="2">TRIGGER LEVEL</td><td>RESPONSE</td></tr>
<tr><td colspan="3">Level 3 - Cautionary
Anomalous service condition detected or Subsidence beyond +15% of predicted</td></tr>
<tr><td>LW 304
Subsidence
• greater than 460 mm
Differential vertical leg movement
• greater than 2.0 mm
Differential horizontal leg movements
• greater than 8.6 mm
Strain -Tensile
• greater than 1.0 mm/m
Strain - Compressive
• Greater than 1.8 mm/m</td><td>LW 305-307
Subsidence
• greater than 517 mm
Differential vertical leg movement
• greater than 2.0 mm
Differential horizontal leg movements
• greater than 8.6 mm
Strain -Tensile
• greater than 1.0 mm/m
Strain - Compressive
• Greater than 1.8 mm/m</td><td><u>Investigate & Resolve</u>
• Telecommunications tower (and building compound) is safe and serviceable.
• Indication of impact to telecommunications tower (and compound).
<u>Metropolitan Coal</u>
• Steps as per Level 2 event, plus:
  ○ Increase frequency of subsidence line (Optic / Water Line) surveys to weekly in affected area.
  ○ In conjunction with Sydney Trains identify impact location and work with Sydney Trains to resolve.
  ○ Review the subsidence monitoring program and update the program where appropriate.
  ○ Provide report on issue to both Sydney Trains and DPIE.
<u>Sydney Trains</u>
• In conjunction with Metropolitan Coal identify impact location, inspect tower, assess condition and determine appropriate response. (e.g. greater monitoring data or frequency, or schedule maintenance on the structure).
• Make determination if other measures necessary to avoid further impact.</td></tr>
</table>

Table 6 (Continued)
Trigger Action Response Plan – Telecommunications Tower and Compound

SYDNEY TRAINS – Telecommunications Tower (and Compound)		
SYDNEY TRAINS Telecommunications Tower (and Compound)	*Risk: Subsidence effect on tower or compound resulting in impact to structural integrity.*	
	TRIGGER LEVEL	**RESPONSE**
	Level 4 – Restoration **Fault detected**	
	Fault Detected	**Implement Contingency Plan** • As per BFMP Section 9 and Appendix 4. **Metropolitan Coal** • As per Level 3 event, plus: o General Manager to be involved in all decision making processes. o Assess public safety implications and where appropriate implement safety measures in accordance with Metropolitan Coal Public Safety Management Plan. o Report exceedance of the performance measure or indicators to the DPIE and Sydney Trains as soon as practicable. o Update the 'Built Features Management Plan – Subsidence Impact Register'. o Investigate circumstances of the fault and determine requirement for adaptive management of mining operations prior to future operations in vicinity of the telecommunications tower (and compound). **Sydney Trains** • As per Level 3 event, plus: o Sydney Trains to enact use of alternative communications system. o Determine appropriate course of action for restoration of service (e.g. deploy temporary tower) and rebuilding (e.g. construct new tower and foundations). o Complete restoration works. o Work in conjunction with Metropolitan Coal to investigate root cause of incident and determine appropriate future control measures.

11 FUTURE EXTRACTION PLANS

In accordance with Condition 7, Schedule 3 of the Project Approval, Metropolitan Coal will collect baseline data for the next Extraction Plan (i.e. Longwalls 308 on). The collection of baseline data will be consistent with the baseline data collected for Longwalls 301-307. However, the baseline (and any post-mining) data collected for Longwalls 301-307 will be used as baseline for Longwalls 308 onward as longwall mining progressively moves further away from the Sydney Trains assets.

In addition to the baseline data collection, consideration of the environmental performance and management measures in accordance with the review(s) conducted as part of this BFMP-SYDTRAINS will inform the appropriate type and frequency of monitoring of the assets relevant to the next Extraction Plan.

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 Secretary of the DPIE 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 Secretary of the DPIE and any relevant agencies with a detailed report on the incident.

Sydney Trains 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 Technical Services Manager 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 Secretary of the DPIE 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 Secretary of the DPIE 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 Secretary of the DPIE 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 Secretary of the DPIE.

16 REFERENCES

Cardno (2018) *Investigation of potential effects of ground movement due to mining*. Helensburgh Repeater Tower. Sydney Trains Infrastructure. 23 March 2018

Department of Planning & Environment and Division of Resources and Energy (2015) *Guidelines for the Preparation of Extraction Plans*.

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

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

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

Heritage Computing (2008) *Metropolitan Coal Project Groundwater Assessment: A Hydrogeological Assessment in Support of Metropolitan Colliery Longwalls 20 to 44.* Appendix B in the Metropolitan Coal Project Environmental Assessment.

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 (2019) *Metropolitan Colliery – Proposed Longwalls 305-307 - Subsidence Predictions and Impact Assessments for the Sydney Trains Infrastructure*.

APPENDIX 1

MSEC (2019) METROPOLITAN COLLIERY – PROPOSED LONGWALLS 305 TO 307 – SUBSIDENCE PREDICTIONS AND IMPACT ASSESSMENTS FOR THE SYDNEY TRAINS INFRASTRUCTURE

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26th July 2019

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

Ref: MSEC1059-07

Dear Jon,

RE: Metropolitan Colliery – Proposed Longwalls 305 to 307 - Subsidence Predictions and Impact Assessments for the Sydney Trains Infrastructure

This letter report summarises the predicted subsidence movements and the assessed subsidence impacts for the Sydney Trains infrastructure resulting from the extraction of the proposed Longwalls 305 to 307 at Metropolitan Colliery.

The locations of the Sydney Trains infrastructure and the proposed Longwalls 305 to 307 are shown in the attached Drawing No. MSEC1059-07. A Study Area is shown in Drawing No. MSEC1059-07 and is based on the outer limits of a 35° angle of draw line from Longwalls 305 to 307 and the predicted 20mm subsidence contour for Longwalls 305 to 307.

The Illawarra Railway is located to the east of the proposed and existing longwalls at a minimum distance of over 2 km from the northern end of Longwall 305. A telecommunications tower and compound are located 430 m to the east of Longwall 305, above the chain pillar between extracted Longwalls 302 and 303. Photographs of this installation are provided in Figure 1.

Figure 1 Telecommunications Tower and Compound

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

Conventional Subsidence Parameters for the Sydney Trains Infrastructure

The following provides summaries of the maximum predicted conventional movements for the Sydney Trains due to the extraction of Longwalls 305 to 307. It is possible that localised and elevated movements could develop above and in the vicinity of the longwalls 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 Illawarra Railway is located at a minimum distance of over 2 km from Longwall 305. At this distance, the railway is not expected to experience measurable conventional vertical subsidence, tilts or curvatures or measurable horizontal movements.

The telecommunications tower and compound are located above the chain pillar between extracted Longwalls 302 and 303. A summary of the maximum predicted values of total subsidence, tilt and curvature for this installation, following the extraction of Longwall 304 and after extraction of Longwalls 305 to 307, is provided in Table 1.

Table 1 Maximum Predicted Total Subsidence, Tilt and Curvature for the Telecommunications Tower and Compound after the Extraction of Longwalls 304 to 307

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 LW304	400	3.5	0.03	< 0.01
After LW305	425	3.5	0.03	< 0.01
After LW306	450	3.5	0.03	< 0.01
After LW307	450	3.5	0.03	< 0.01

The maximum predicted conventional tilt for the telecommunications tower and compound is 3.5 mm/m (i.e. 0.35 %, or 0.2 degrees). The maximum predicted conventional curvatures are 0.03 km^{-1} hogging and < 0.01 km^{-1} sagging, which equate to minimum radii of curvature of 33 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 Sydney Trains 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 transmission tower and compound are located above the pillar between extracted longwalls but not directly above the proposed Longwalls 305 to 307. 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 2. The probability distribution functions, based on a fitted *Generalised Pareto Distribution (GPD)*, have also been shown in this figure.

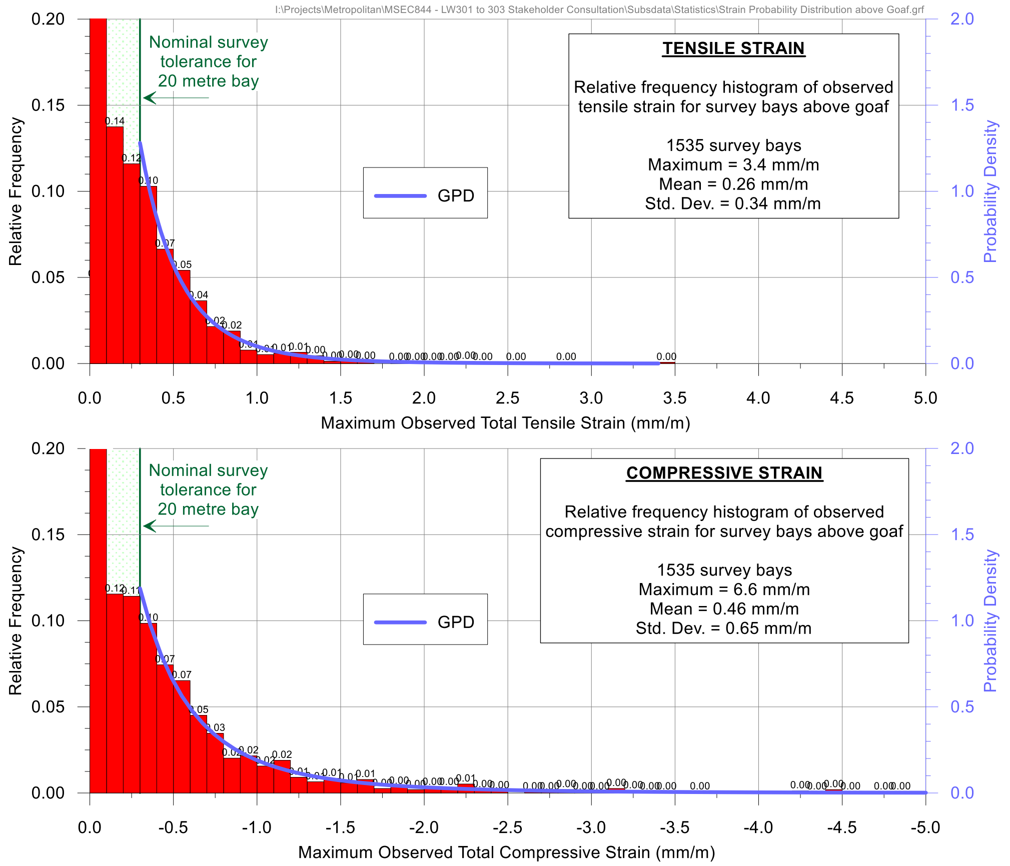

Figure 2 Distributions of the Measured Maximum Tensile and Compressive Strains during the Extraction of Previous Longwalls in the Southern Coalfield Above Goaf

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 2.

Table 2 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 Illawarra Railway is located approximately 2 km from the proposed Longwalls 305 to 307. At this distance, it is unlikely that the railway would experience measureable movements due to the presence of geological structures.

The locations of the known geological structures at seam level and the major streams are shown in Drawing No. MSEC1059-07. There are no mapped faults located within the Study Area that extend beneath the Sydney Trains infrastructure. It is possible that the infrastructure located above the longwalls could experience localised and elevated strains due to unknown geological structures (i.e. anomalies). Non-conventional or anomalous movements have not been identified during the extraction of Longwalls 301 and 303. The range of strains provided in the previous section include those resulting from irregular anomalous movements.

Two culverts are located along the Illawarra Railway at Cawleys and Wilsons Creeks as shown on MSEC1059-07. At over 2 km from Longwall 305, it is unlikely that the railway would experience measurable valley related movements at the creek crossings.

Impact Assessments and Recommendations for the Illawarra Railway

The Illawarra Railway is located over 2 km from the proposed Longwalls 305 to 307. It is considered unlikely that the railway and railway culverts would experience any measurable movements from the extraction of Longwalls 305 to 307. It is unlikely that the railway and associated infrastructure would experience adverse impacts as a result of extracting Longwalls 305 to 307.

Old workings are present beneath, and in the vicinity of, the Illawarra Railway as shown in Drawing No. MSEC1059-07. At approximately 2 km from the proposed Longwall 305, it is unlikely that the railway and associated infrastructure would experience adverse impacts from old workings as a result of the extraction of the proposed Longwalls 305 to 307. An assessment of long term subsidence above old workings was undertaken and presented at the 8th Triennial Conference on Mine Subsidence in 2011 in a paper titled "*An Analysis of Long Term Subsidence at Metropolitan Colliery*". A copy of the paper is attached. The assessment covered data over a 14 year period of monitoring and found that the goaf/chain pillar system was in a longer term stable condition and ongoing subsidence movements appeared to be reducing to zero. The old workings beneath, and in the vicinity of, the Illawarra Railway as shown in Drawing No. MSEC1059-07, are likely to be more than 50 years old.

Total station survey within the culverts has been conducted since the commencement of Longwall 301 and real time 3D monitoring of the valley sides of both culverts, including closure, has been conducted since the commencement of Longwall 303. Observed movements to date have been within the limits of accuracy of the survey methods with no indications of developing subsidence related movements. The total station survey within the culverts and real time 3D monitoring will be continued during the extraction of Longwall 304.

Given the increasing distance of the longwall extraction from the Illawarra Railway, it is considered that monitoring developed for the extraction of Longwalls 301 to 304 could be relaxed for the extraction of future longwalls from LW305 onwards. Consideration could be given to cessation of monitoring following a review of the monitoring conducted during the extraction of Longwall 304.

Impact Assessments for the Telecommunications Tower

The telecommunications tower and compound are located within the Study Area above the chain pillar between extracted Longwalls 302 and 303. The maximum predicted tilt for this installation is 3.5 mm/m (i.e. 0.35 %, or 0.2 degrees). The magnitude of tilt is very small and therefore is unlikely to adversely impact on the tower or compound. Tilt can potentially effect directional antennas and therefore it is recommended that the radio engineer reviews the predicted change in alignment.

The maximum predicted conventional curvatures are 0.03 km^{-1} hogging and < 0.01 km^{-1} sagging, which equate to minimum radii of curvature of 33 kilometres and less than 100 kilometres, respectively, though these values are not predicted to increase due to the extraction of Longwalls 305 to 307. The predicted strains are 0.9 mm/m tensile and 1.6 mm/m compressive based on the 95 % confidence level and 1.5 mm/m tensile and 3.2 mm/m compressive based on the 99 % confidence level.

The structural integrity of the tower was assessed for the extraction of Longwalls 301 to 303. It can be seen from Table 1 that there is an increase in subsidence but no change to the predicted tilt and curvatures after the extraction of Longwall 305 to 307. Comprehensive monitoring of the tower has been undertaken during the extraction of Longwalls 302 and 303 and will be continued for the extraction of Longwall 304. Observed movements to date have been within expected limits.

The building enclosure is not expected to experience adverse impacts due to the extraction of Longwalls 305 to 307. It is expected that the enclosure would remain in safe and serviceable conditions during and after mining. Adverse impacts could be remediated using normal building maintenance techniques.

It is recommended that monitoring and management strategies developed for the extraction of Longwalls 304 are revised and continued, in consultation with Sydney Trains, to manage the tower and compound for potential non-conventional ground movements. Given the increasing distance of the longwall extraction from the tower and compound, it is considered that monitoring developed for the extraction of Longwalls 301 to 304 could be relaxed for the extraction of future longwalls from LW305 onwards. Consideration could be given to reducing the frequency of ground survey monitoring to monthly during the extraction of Longwall 305 then to end of panel survey for Longwalls 306 and 307 after confirmation that no significant subsidence movements or impacts were observed during Longwall 305.

Summary

The Illawarra Railway is located approximately 2 km from the proposed Longwall 305. At this distance, it is unlikely that the railway and associated infrastructure would experience adverse impacts as a result of extracting the proposed Longwalls 305 to 307.

A telecommunications tower and compound are located above the chain pillar between extracted Longwalls 302 and 303. The predicted conventional tilt and curvature do not change due to the extraction of Longwalls 305 to 307. It is possible that the tower and compound could experience localised and elevated strains due to the presence of geological structures (known or unknown). Non-conventional subsidence movements have not been observed during the extraction of Longwalls 301 to 303 and the likelihood of non-conventional subsidence movements at the tower and compound due to Longwalls 305 to 307 is considered to be very low.

Based on monitoring data observed during Longwalls 301 to 303 and the increased distance from the tower and compound, a revision of the monitoring and management strategies is recommended in consultation with Sydney Trains with a view to reducing the frequency of monitoring. It is expected that the potential impacts on the Sydney Trains infrastructure can be managed with the implementation of the appropriate monitoring and management strategies.

Yours sincerely

Peter DeBono

Attachments:

Drawing No. MSEC1059-07 – Longwalls 305 to 307 – Sydney Trains Infrastructure

DeBono and Tarrant (2011). *An Analysis of Long Term Subsidence at Metropolitan Colliery.* Proceedings of the 8th Triennial Conference on Mine Subsidence, 2011, pp 81 to 88.

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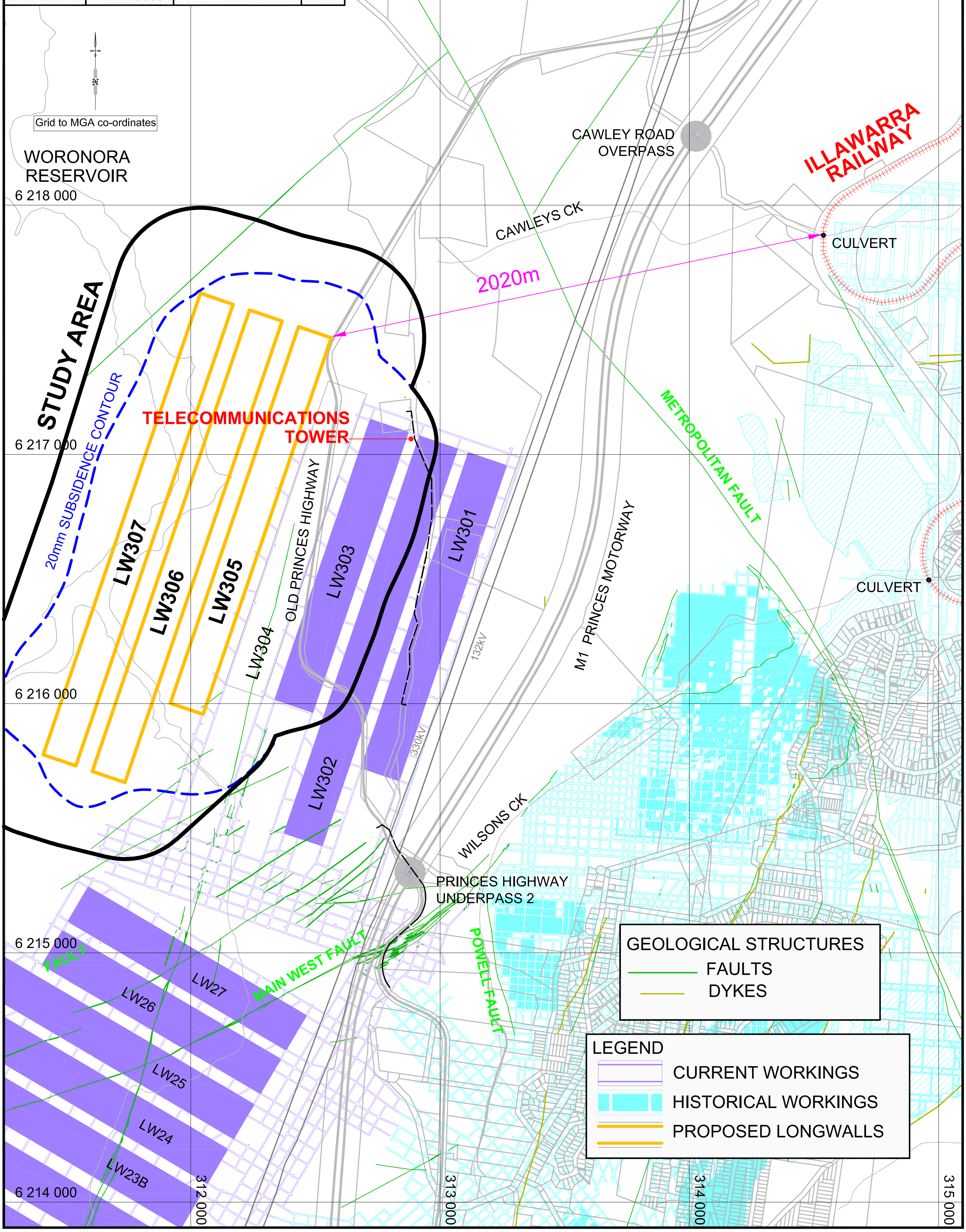
METROPOLITAN COAL

METROPOLITAN COLLIERY
LONGWALL 305
SYDNEY TRAINS

DATE:	SCALE:	DRAWING No:	Rev No
16 Jul 2019	1:20000	MSEC1059-07	01



An Analysis of Long Term Subsidence at Metropolitan Colliery

P. DeBono, Mine Subsidence Engineering Consultants
G. Tarrant, Metropolitan Coal

Summary

Metropolitan Coal commenced longwall extraction in 1995 and extracted 18 longwall panels to the end of 2009. Longwalls 1 to 7 were extracted at approximately 126 m void width, Longwalls 8 to 10 were extracted at 140 m void width, and Longwalls 11 to 18 were extracted at 163 m void width. The chain pillars were 35 m (rib to rib) for each longwall. A subsidence survey line (D-Line) was established perpendicular to the longwall panels and has been re-surveyed at the end of each extracted panel. The subsidence data has been analysed to better understand the long term behaviour of conventional subsidence movements at the survey monitoring peg locations. The detailed analysis focuses specifically on the long term subsidence that occurs after the active subsidence phase and residual subsidence phase during which it is typically considered that the maximum subsidence has been attained. The analysis is expected to better inform the longer term management of subsidence effects and consequential impacts on natural and built surface features.

1. Introduction

It is generally accepted that conventional vertical subsidence resulting from longwall coal mining occurs in two phases: an active dynamic subsidence phase as the face advances, and a residual subsidence phase after all extraction has been completed near a point. The dynamic subsidence over a series of longwall panels results from both caving of strata into the goaf, and yielding of the chain pillar and/or the strata above and below the pillars.

The dynamic subsidence profiles are influenced by many variables, including the rate of extraction, geological setting and longwall geometry. Time dependent residual subsidence over a series of longwalls generally reduces with time and increased distance of the active mining from a point. In most instances, subsidence is commonly considered to have been completed once subsidence rates reduce sufficiently below agreed limits, which are typically set based on the type of surface feature being monitored and its sensitivity to subsidence movements. Ongoing minor subsidence movements can occur, however, for several years beyond the cessation of monitoring as a result of factors that may include far field vertical subsidence, deterioration of the confined pillar, deterioration of the materials above and/or below the pillar, and goaf consolidation.

Prior to longwall extraction, management plans are developed to manage the various features on the surface that are likely to be influenced by subsidence. Some features that may be sensitive to small subsidence movements may require the introduction of detailed and accurate monitoring methods and/or mitigation measures, to manage the subsidence as the longwalls are extracted. Following extraction, and once subsidence is deemed to have been completed, which may be subject to an agreed rate of subsidence or some other indicator, monitoring and management of the feature is discontinued. Subsidence may, however, continue to develop at slow rates for many years following the completion of mining near or below a surface feature.

With this in mind, the rates of subsidence movements at each survey peg along the D-Line and over Longwalls 1 to 18 have been analysed to assess the long term subsidence behaviour.

2. Mine Layout and Extraction Geometry

The layout of the Metropolitan Colliery Longwalls 1 to 18 and the D Line are shown in Figure 1. The longwalls, which are extracted in the Bulli Seam, form a north westerly expansion of pillar extraction areas to the south east.

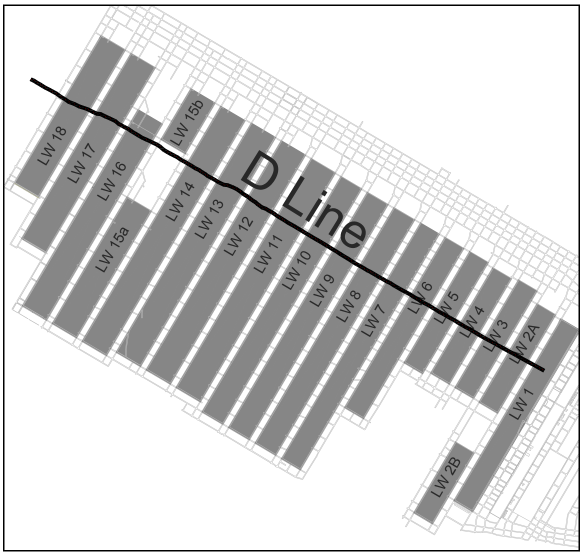


Figure 1 Metropolitan Colliery Longwalls 1 to 18 and D Line Monitoring Line

A summary of the extraction geometry of Metropolitan Colliery Longwalls 1 to 18 is provided in Table 1. The extraction direction of all of these longwalls was from the South West to the North East.

Extraction of the Longwalls 1 to 18 commenced in 1995 and was completed in 2009. The extraction dates of each of the longwalls is summarised in Table 2.

Table 1 Panel and Pillar Widths

Longwall	Panel Void Width (m)	Pillar Width (m)
LW1	123	35
LW2	126	35
LW3	126	35
LW4	125	35
LW5	127	35
LW6	127	35
LW7	140	35
LW8	140	35
LW9	140	35
LW10	163	35
LW11	163	35
LW12	163	35
LW13	163	35
LW14	163	35
LW15A	163	35
LW15B	163	35
LW16	163	35
LW17	163	35
LW18	163	35

2.1. Monitoring Data

The D-Line is located approximately perpendicular to the longwalls as shown in Figure 1. A plot of the surface levels, depth of cover, seam thickness, and observed subsidence along the D-Line is shown in Figure 2. The D-Line crosses several streams, the largest of which is the Waratah Rivulet.

Monitoring of the D-Line was carried out at the completion of each extracted longwall, which was extracted over a period ranging from 6 months to 12 months. The total monitoring period of the D-Line covers approximately 13 years.

Table 2 Extraction Dates

Longwall	Start Date	End Date
LW1	31-07-95	01-05-96
LW2	03-11-96	17-09-96
LW3	23-05-97	24-09-97
LW4	11-10-97	02-03-98
LW5	14-05-98	20-11-98
LW6	25-02-00	20-11-00
LW7	13-12-00	28-09-01
LW8	25-10-01	23-08-02
LW9	16-09-02	09-08-03
LW10	30-08-03	08-05-04
LW11	29-05-04	19-03-05
LW12	02-04-05	03-12-05
LW13	17-12-05	16-09-06
LW14	30-09-06	22-08-07
LW15A	10-09-07	08-03-08
LW15B	24-03-08	25-05-08
LW16	15-06-08	26-02-09
LW17	25-03-09	08-10-09
LW18	03-11-09	20-04-10

The layouts of Longwalls 15 and 16 were modified due to the presence of geological structures. The modified layouts can be seen in Figure 1. As a result of the modifications, Longwall 15 was not mined beneath the D-Line, which was located close to the finishing end of Longwall 16.

The subsidence profiles presented in Figure 2 show that only minor incremental subsidence profiles were observed for Longwalls 15 and 16.

The data used for the analysis of long term subsidence in this paper, are based on monitoring results for the period following active and residual subsidence.

At Metropolitan Colliery, this occurs after a 5 to 6 year period from the commencement of active subsidence at a survey peg location. As a result, many of the monitoring pegs for the later, wider, longwalls (163 metres width) do not have monitoring data within this range of long term subsidence. Similarly, the survey pegs 1 to 15 were not monitored for a sufficient period to be included in the long term subsidence data.

2.2. Geology

The Metropolitan Colliery is located in the NSW Southern Coalfield which is characterised by a deep overburden of sedimentary rocks, with depths of cover over extracted coal seams commonly exceeding 300 metres.

Longwalls 1 to 18 were extracted in the Bulli Seam with thicknesses varying from 2.9 metres to 3.4 metres. The depth of cover above the Bulli Seam along the D Line varies from approximately 400 metres to 520 metres. The Bulli Seam thickness and depth of cover along the D-Line are shown in Figure 2.

The Bulli Seam is located in the upper part of the Illawarra Coal Measures. A typical stratigraphic section of the overburden material is shown in Figure 3

The major geological structures identified within the footprint of Longwalls 1 to 18 are shown in Figure 4. Most of these structures have been identified at seam level or projected from known locations. The most significant structure is the Madden Fault/Dyke Zone, which is up to approximately 700 metres in width and is associated with at least one known diatreme in Darkes Forest Colliery.

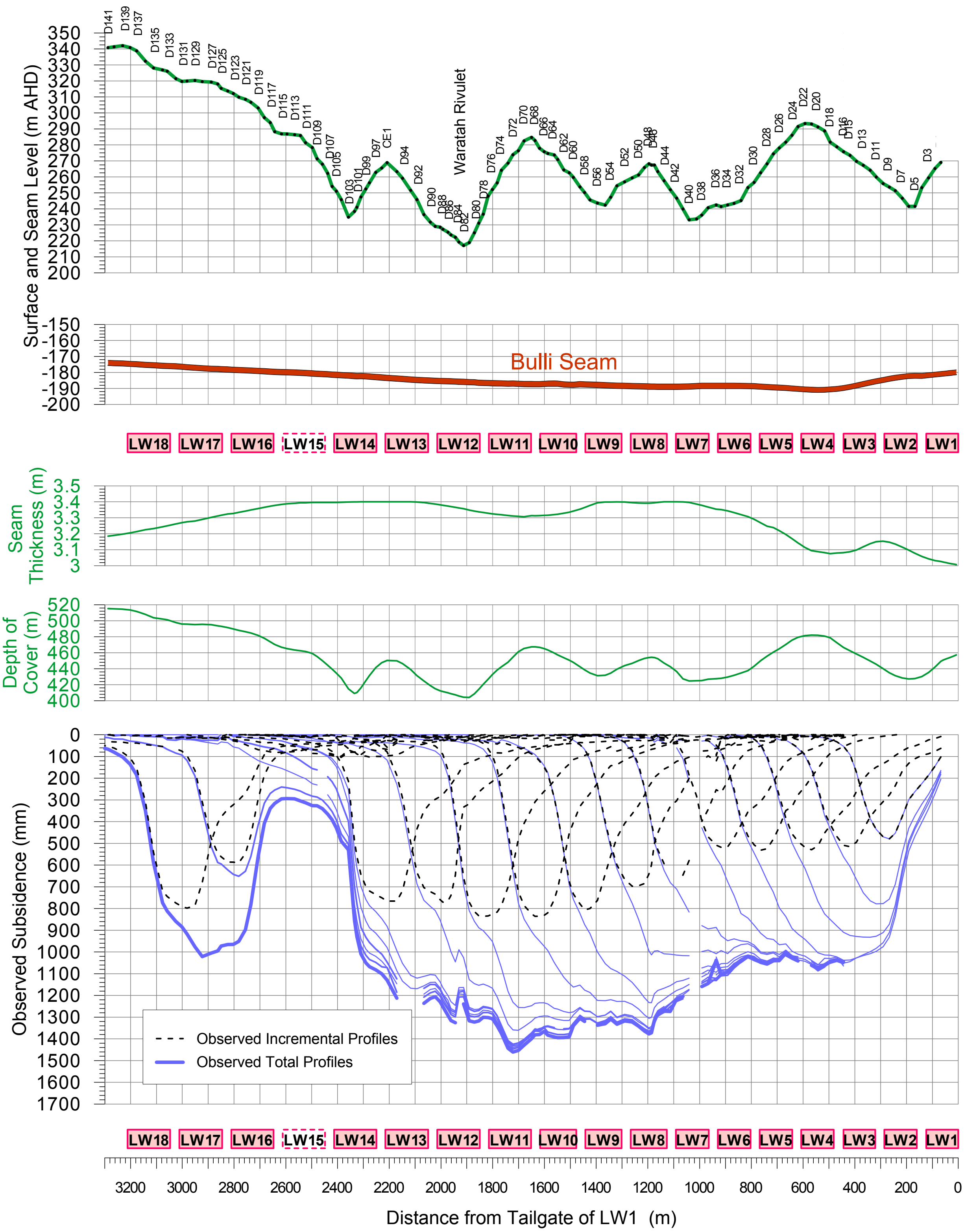


Figure 2 D-Line Monitoring Data

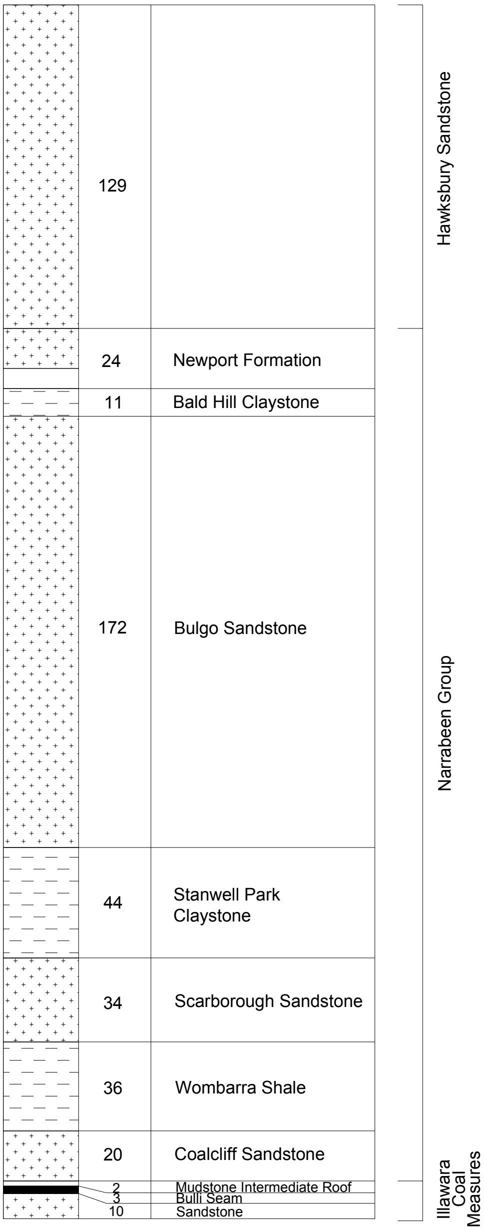


Figure 3 Typical Stratigraphic Section

The D-Line monitoring data for the longwalls in this fault/dyke zone are not however, used in the analysis, as described in Section 2.1. With the exception of the north western part of the extracted Longwalls 15 to 18, there are no significant geological structures in the vicinity of the D-Line.

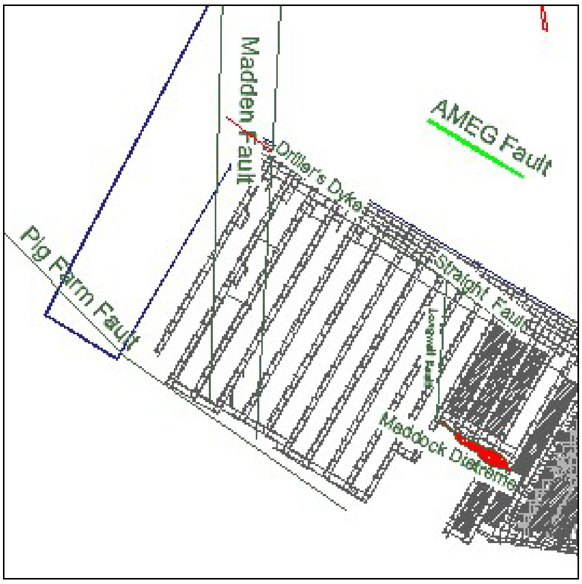


Figure 4 Geological Structures

3. Subsidence Analysis

In order to analyse the long term behaviour of subsidence it is necessary to present the temporal characteristics of subsidence to show the subsidence behaviour that occurs following the active and residual subsidence phases. The observed subsidence profiles were therefore, plotted against time. A plot of the observed total subsidence versus the date of survey for each of the D-Line monitoring pegs is shown in Figure 5

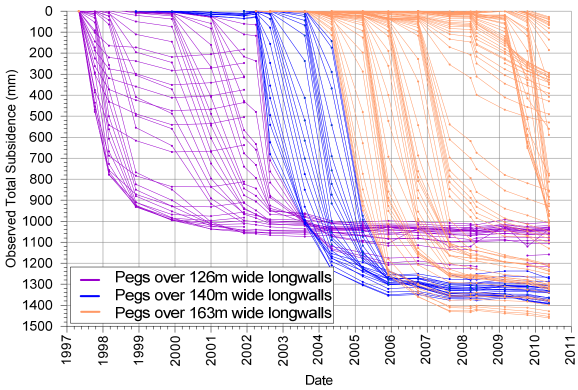


Figure 5 Observed Total Subsidence Versus Survey Date

This plot was further refined to show subsidence versus the time from the approximate commencement of active subsidence. The resulting plot is shown in Figure 6.

It is apparent from Figure 6 that following the active subsidence phase and residual subsidence phase, the subsidence reaches a relatively uniform rate after approximately 5 to 6 years from the commencement of active subsidence. The close up view of this rate from years 5 to 14 shows, however, that subsidence continues to develop at a slow, but reasonably uniform rate.

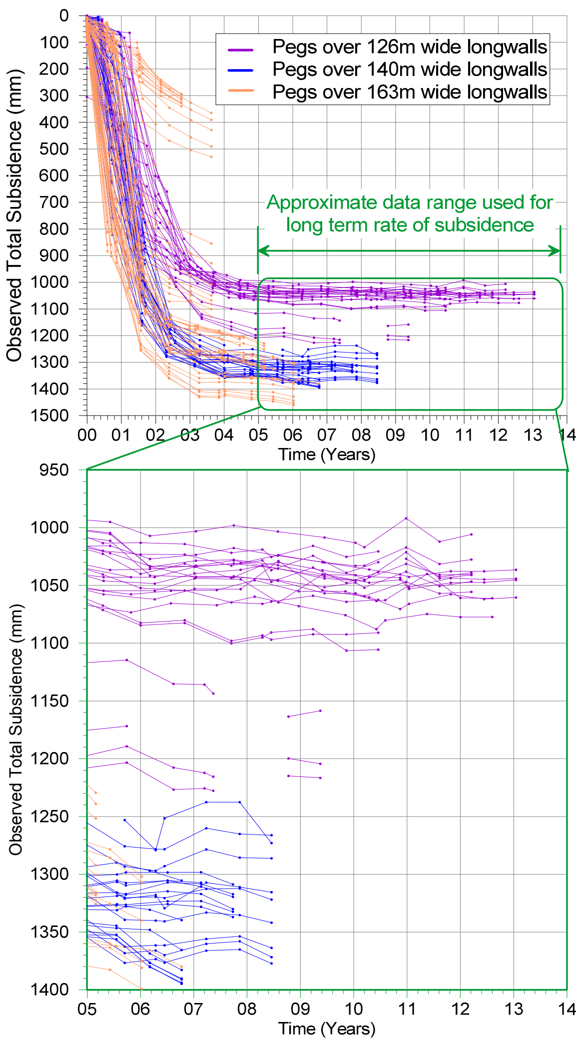


Figure 6 Observed Total Subsidence Versus Time

Most of the survey pegs located above the narrow 126 metre wide longwalls have approximately 8 years of survey data during this long term period following the active and residual subsidence phase. There is approximately 4 years of monitoring data during this period for the 140 metre wide longwalls, and only some of the data from the 163 metre wide longwalls are just entering this period.

The data in Figure 6 has been reproduced to present in Figure 7, a rate of subsidence per survey epoch for each of the monitored survey pegs, instead of observed total subsidence. The rate of subsidence was calculated as the change in subsidence over the time between survey epochs for each survey peg.

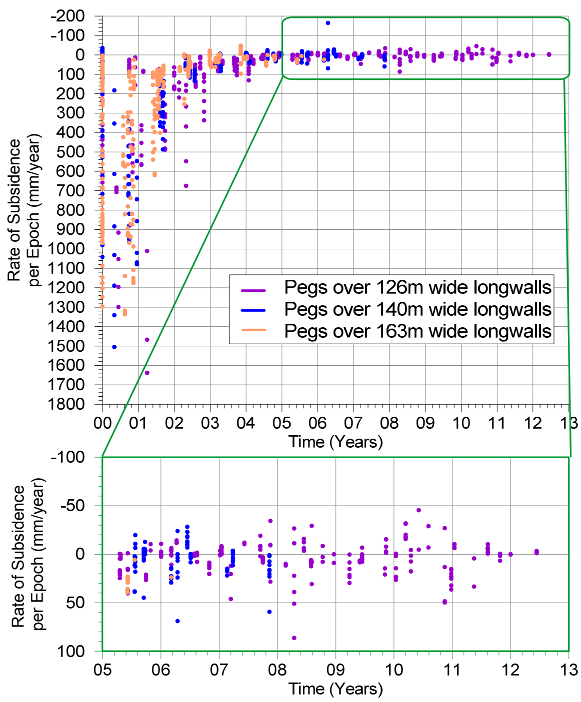


Figure 7 Observed Rate of Subsidence Versus Time

There is some scatter in the rates during this long term period in the order of ±50 mm. The distribution of data is shown in the histograms of the periods 5 to 7 years, 7 to 9 years, and 9 to 12 years presented in Figure 8.

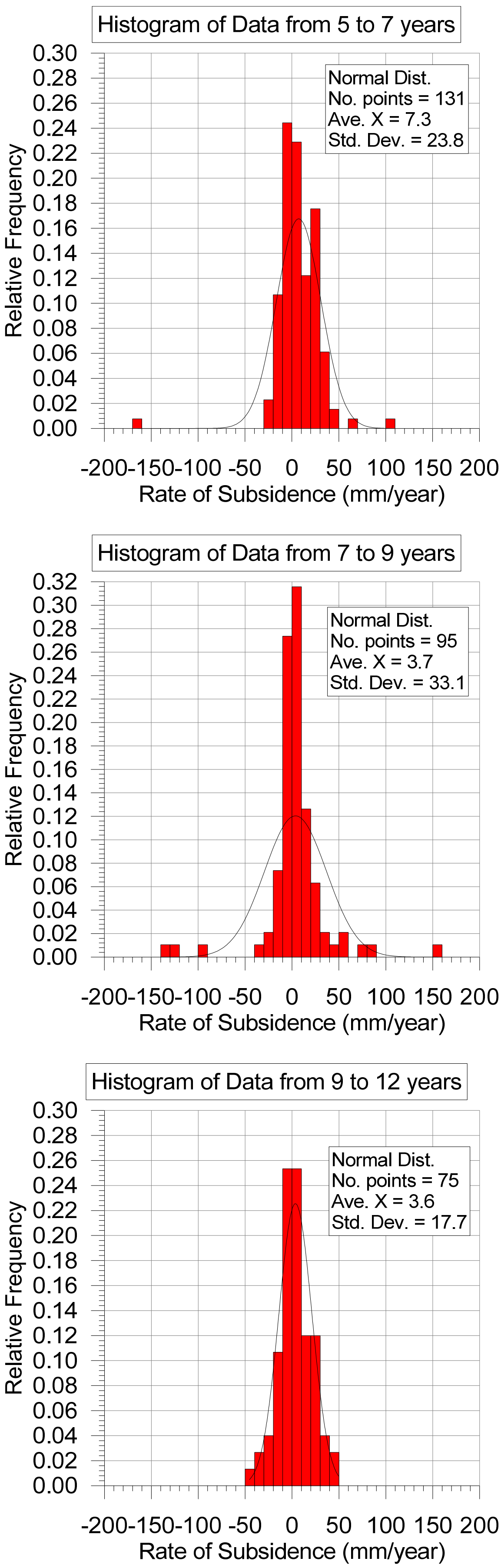


Figure 8 Rate of Subsidence Histograms

A longer period was selected for the final data subset due to the limited number of data points. The histograms show that the average rate of subsidence continues to reduce and has reduced to within 3 to 4 mm/year based on current monitoring data.

The spatial distribution of the rates of subsidence is shown in Figure 9 for the data used in the analysis. The data shows a greater scatter of the rates for the survey pegs that are located towards the base of the deep valley. It is possible that the wider scatter in these rates is the result of the influence of valley related upsidence and closure movements.

In addition to the rates of subsidence between each epoch, an average rate of subsidence was also calculated for each survey peg over the monitoring period between 5 and 14 years by taking the slope of a linear regression line through the subsidence plot for this time period. These results based on linear regression show peaks and troughs, with the peaks coinciding in most cases with the pillar locations.

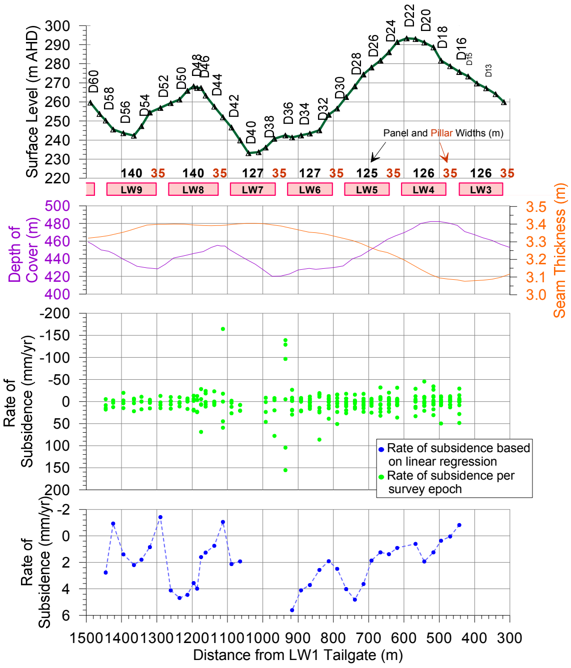


Figure 9 Rate of Subsidence at Monitoring Peg Locations

Four of the peaks have an overall negative rate of subsidence, indicating that at these locations, the ground surface may have rebounded to some degree.

4. Discussion

It is considered that there are two key points to note from this analysis of the long term subsidence monitoring data: firstly, that subsidence continues to develop for many years after mining has passed an area and the active and residual subsidence has been completed and; secondly, that the goaf/chain pillar system is indicated to be in a longer term stable condition.

It is acknowledged that the degree of ongoing subsidence is small and in many cases, these movements would have little to no effect on surface features and may be less than ground movements from other sources, such as seasonal shrink/swell behaviour. It should also be recognised, however, that while small subsidence rates were encountered at Metropolitan Colliery, much higher long term rates could be encountered at other locations depending on geological conditions and extraction geometry. Preliminary assessment of data from other collieries confirms that this is the case.

These subsidence rates may be of significance to features that are sensitive to very small ground movements. As a result, certain sensitive features may require a long term monitoring program to assess the ongoing rates of subsidence to verify that subsidence has reduced to an acceptable level and the risk of long term impact to the feature is below an acceptable level.

The indications from the analysis are that the goaf/chain pillar system is in a long term stable condition. This longer term monitoring data indicates that the continued strength and integrity of the confined pillar core is performing as it was designed to do and gives greater confidence that it will continue to do so.

It should be recognised that this assumes continuance of sufficient pillar strength and confining conditions, which potentially could change with a change to those conditions. Such changes could include future mining of other coal seams, possible seismic events, or contact with water or air.

Current methods of subsidence prediction and impact assessment do not take into account long term subsidence behaviour beyond the active and residual subsidence phase. It is considered prudent, however to recognised that these long term rates of subsidence do occur and whilst they are relatively small at Metropolitan Colliery, higher rates may encountered.

5. Conclusions

The findings of this case study indicate that the goaf/chain pillar goaf system at Metropolitan colliery is in a longer term stable condition and the ongoing subsidence movements appear to be reducing to zero. It is known that significantly higher long term rates of subsidence have occurred at other collieries.

It is hoped that further analysis of data from other collieries could be carried out to develop a more detailed database of long term subsidence movements that could be used for the management of surface features that may be sensitive to small movements, as well as to provide information on the long term behaviour of the goaf/chain pillar system.

6. References

Doyle, J., Newland, A. (2008). "*A Compilation of Surface Geological Features in the Western Portion of Metropolitan Colliery*". Geosensing Solutions.

Kratzsch, H. 1983 "*Mine Subsidence Engineering"* ISBN 3-540-11930-2, pp 320-321.

APPENDIX 2

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER

Built Features Management Plan - Subsidence Impact Register

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

Notes:

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

2: Built feature (e.g. tower, rail line, etc.).

Built Feature Management Plan – Subsidence Impact Register
Assessment Form

Date:

Observer (Name and position):

Register Number (i.e. Number 1, 2, etc.):

Longwall Number and Chainage:

Location of Observed Impact:

(<u>Examples</u>: location of viaduct, include GPS co-ordinates and a sketch)

Description of Observed Impact:

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

Person Notified:	Technical Services Manager	☐

Description of Photographs:

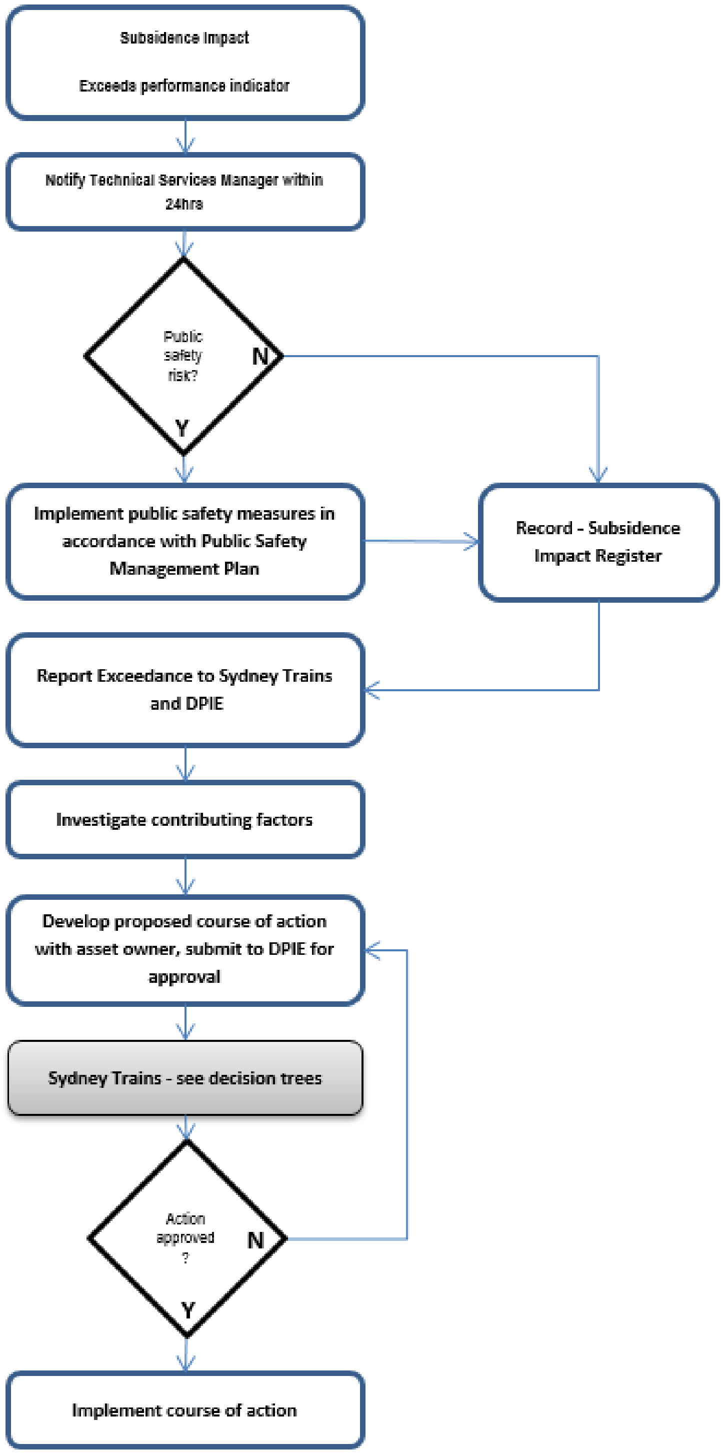
Actions Required:	Contingency Plan Initiated	☐
	Incident Notification	☐
	Safety Measures/Public Safety Management Plan Requirements	☐

Management or Contingency Measures Implemented:

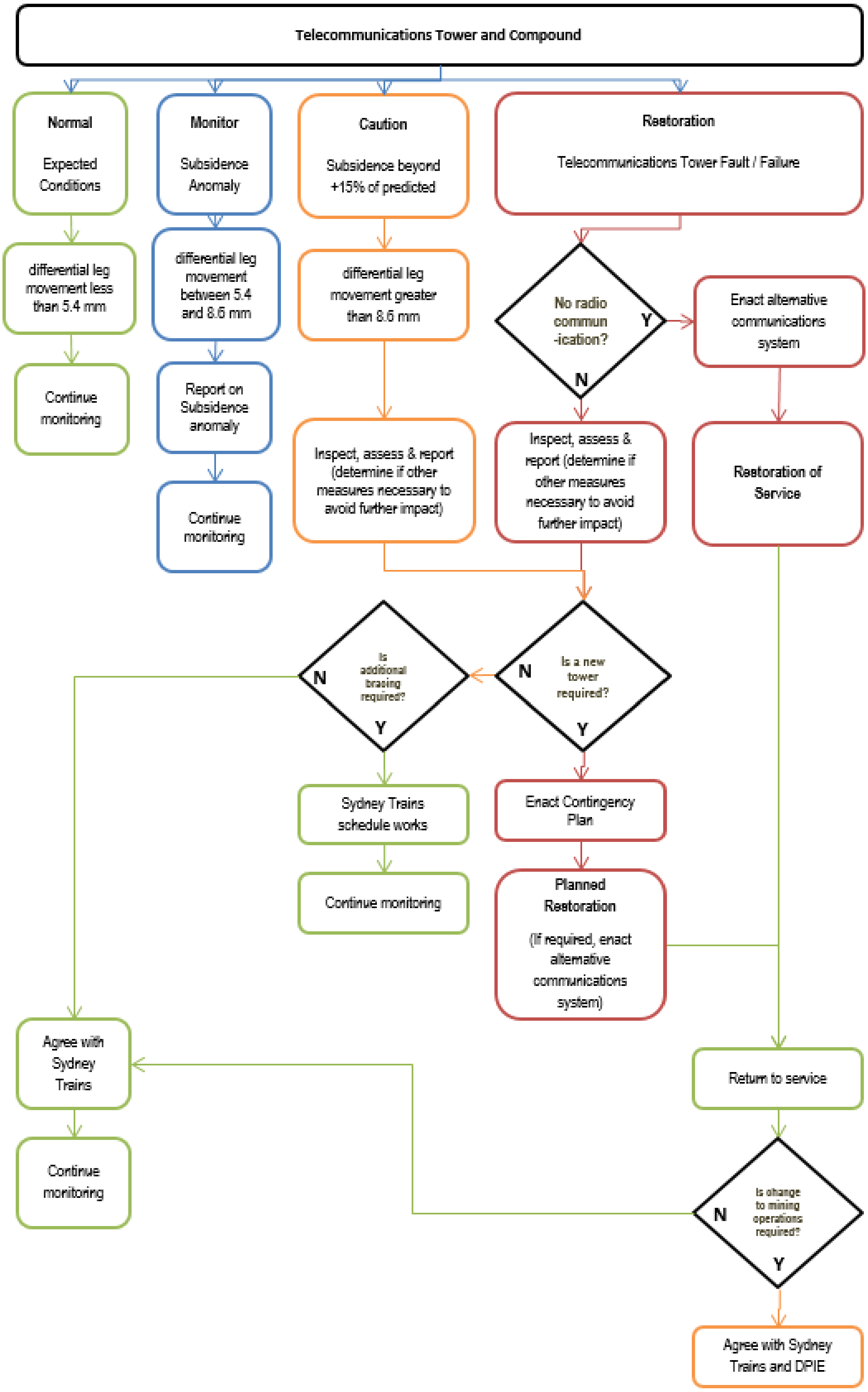
Effectiveness of Management or Contingency Measures:

APPENDIX 3

CONTINGENCY PLAN PROCEDURE AND DECISION TREES



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 Sydney Trains and DPIE
Investigate contributing factors
Develop proposed course of action with asset owner, submit to DPIE for approval
Sydney Trains - see decision trees
Action approved ?
N
Y
Implement course of action


Telecommunications Tower and Compound
Normal
Expected Conditions
Monitor
Subsidence Anomaly
Caution
Subsidence beyond +15% of predicted
Restoration
Telecommunications Tower Fault / Failure
differential leg movement less than 5.4 mm
differential leg movement between 5.4 and 8.6 mm
differential leg movement greater than 8.6 mm
No radio commun -ication?
Y
N
Enact alternative communications system
Continue monitoring
Report on Subsidence anomaly
Inspect, assess & report (determine if other measures necessary to avoid further impact)
Inspect, assess & report (determine if other measures necessary to avoid further impact)
Restoration of Service
Continue monitoring
Is additional bracing required?
N
Y
Is a new tower required?
N
Y
Sydney Trains schedule works
Enact Contingency Plan
Continue monitoring
Planned Restoration
(If required, enact alternative communications system)
Agree with Sydney Trains
Return to service
Continue monitoring
Is change to mining operations required?
N
Y
Agree with Sydney Trains and DPIE

APPENDIX 2

BUILT FEATURES MANAGEMENT PLAN – SUBSIDENCE IMPACT REGISTER

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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)

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

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Description of Photographs:

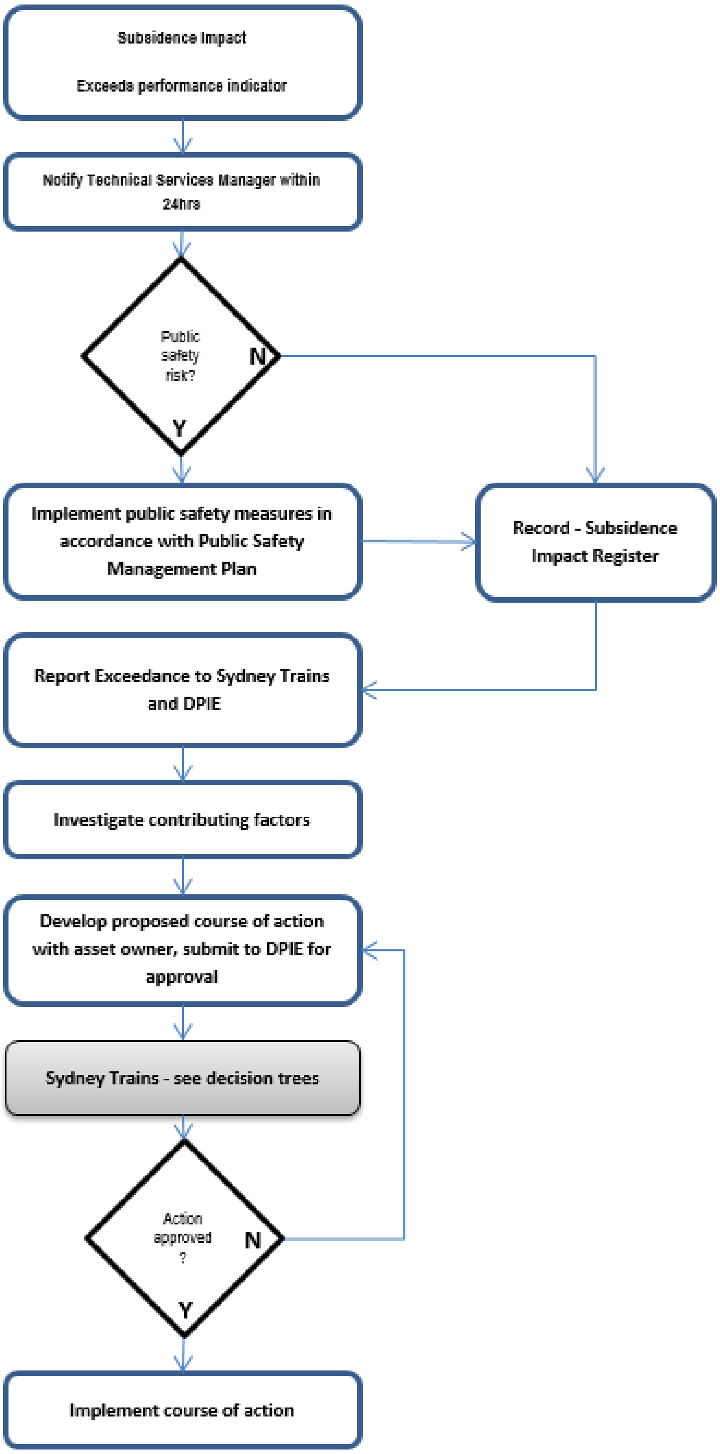
Actions Required:	Contingency Plan Initiated	☐
	Incident Notification	☐
	Safety Measures/Public Safety Management Plan Requirements	☐

Management or Contingency Measures Implemented:

Effectiveness of Management or Contingency Measures:

APPENDIX 3

CONTINGENCY PLAN PROCEDURE AND DECISION TREES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Exceeds performance indicator
Notify Technical Services Manager within 24hrs
Public safety risk?
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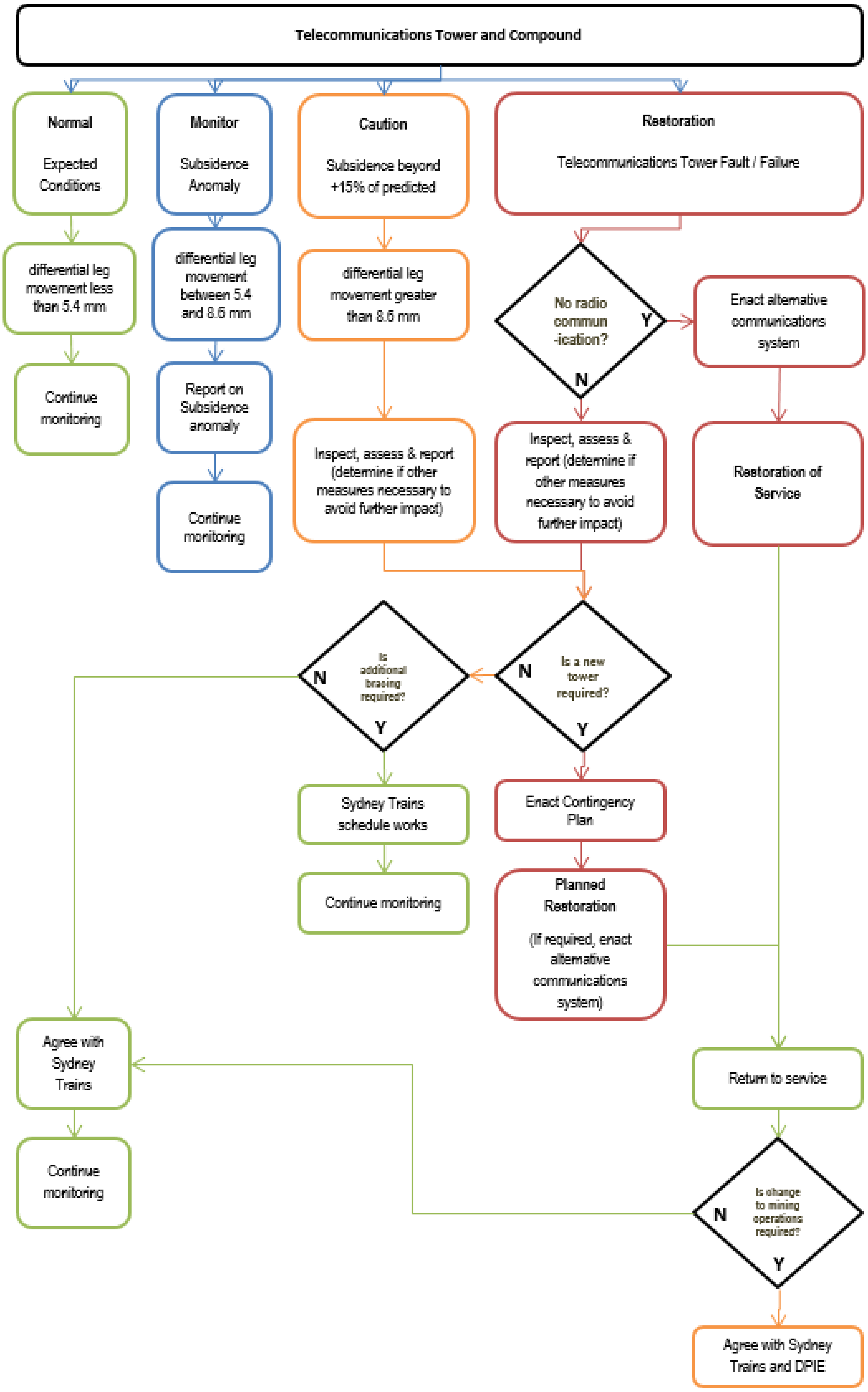
Y
Implement public safety measures in accordance with Public Safety Management Plan
Record - Subsidence Impact Register
Report Exceedance to Sydney Trains and DPIE
Investigate contributing factors
Develop proposed course of action with asset owner, submit to DPIE for approval
Sydney Trains - see decision trees
Action approved ?
N
Y
Implement course of action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Agree with Sydney Trains and DPIE