ENVSTD4.3.03.01.02.007
LONGWALLS BSLW1 - BSLW6 TELECOMMUNICATIONS SUBSIDENCE MANAGEMENT PLAN

1 INTRODUCTION

This Telecommunications Subsidence Management Plan was prepared in accordance with the NSW Department of Mineral Resources (now known as Industry and Investment NSW) *Guideline for Subsidence Management Approvals (2003)* to seek approval for the extraction of Longwalls BSLW1 – BSLW6 in the Blakefield seam. The guideline requires specific management plans to be developed to manage subsidence impacts which may have a high level of risk or consequence. Approval of the SMP (submitted in July 2008), including the Telecommunications Subsidence Management Plan) was issued by I&I NSW in April 2009.

Following minor modifications to the mine plan, as outlined in Section 4 below, this plan has been reviewed accordingly.

2 PURPOSE

The purpose of this plan is to outline the management measures to be implemented to minimise the risk to public safety and telecommunications infrastructure during mining of Longwalls BSLW1 to BSLW6 in the Blakefield seam. Required actions and responsibilities are also defined to ensure detection of any potential damage from mining induced subsidence.

3 SCOPE

This plan applies to telecommunications infrastructure within Longwalls BSLW1 - BSLW6 of the Blakefield seam at the Beltana Underground Mine (SMP area), as shown in **Figure 1**.

4 MINE PLAN

The majority of the SMP area (refer to **Figure 1**) is located within land owned by BJV, which is currently utilised for mining and agricultural purposes. The remainder of the SMP area is located under privately owned land currently predominantly utilised for grazing and rural activities. The surface of the land within the application area is generally flat to undulating with vegetation dominated by pasture and woodland species.

Due to the limitations of geological faults identified in the vicinity of Longwalls 1 and 2, the mine plan extents have changed from those originally approved in the SMP application submitted in July 2008. The BSLW1 void width has been narrowed by 80m and slightly shortened by 30m. Also the commencing end (south-western) of BSLW2 has been shortened by 155m. The revised current mine plan is shown in **Figure 1**. Accordingly, updated subsidence reports for longwalls BSLW1 and BSLW2 have been provided by MSEC (MSEC393 March 2010 & MSEC452 March 2010, respectively) for the revision of this plan.

The depth of cover to the seam varies between approximately 130 metres at the eastern end of Longwall BSLW1 to approximately 335 metres at the maingate of Longwall BSLW6. The seam floor within the SMP area generally dips from the north to the south.

The seam thickness varies between a minimum of 2.2 metres near the western end of BSLW1 to a maximum of 3.65 metres at the maingate of BSLW6.

The longwalls will be extracted below the previously extracted Whybrow seam. The interburden thickness between the Whybrow and Blakefield seams varies between 70 metres and 100 metres.

First workings for the Blakefield seam commenced in mid 2008, with Longwall BSLW1 extraction to commence in June 2010 and Longwall BSLW6 scheduled to be completed during mid 2014. The mining sequence will progress from north (BSLW1) to south (BSLW6), with the longwall face expected to advance at a rate of approximately 100 metres per week.

5 TELECOMMUNICATIONS INFRASTRUCTURE WITHIN BLAKEFIELD SOUTH MINING AREA

The telecommunications infrastructure within the Blakefield South mining area is shown on **Figure 1**. The infrastructure includes underground optical fibre cables, underground copper cables and aerial consumer copper cables, all of which are owned by Telstra (MSEC 2008). The two underground optical fibre cables generally follow the alignments of Broke and Charlton Roads (refer to **Figure 1**). The main underground copper cables generally follow the alignment of Charlton and Fordwich Roads and the local consumer copper cable are mostly laid underground, with some aerial cables (refer to **Figure 1**) (MSEC 2008).

6 PREVIOUS UNDERMINING OF TELECOMMUNICATIONS INFRASTRUCTURE

At the end of 2009, the Underground Operations in the Central Mining Area had completed the extraction of Longwalls 1 to 11 in the Whybrow seam and had extracted the majority of Longwall 12 in the Whybrow seam. Depths of cover above the longwalls ranged from 50 to over 200 metres and the extracted thickness of coal ranged from 2.5 to 3.0 metres.

Subsidence monitoring during 2007 to 2009 was undertaken in accordance with the Beltana 'Longwall 4-14 Subsidence Monitoring Program' and Longwalls 7 to 12 Survey Subsidence Monitoring Strategies which are developed as part of the SMP process. The purpose of the monitoring is to provide a comparison between actual observed subsidence and the predictions made in the BCCUO EIS and SMP Applications. These comparisons can be used to assess whether the predictions and management strategies in place are adequate.

Table 6.1 provides details of the subsidence monitoring lines established during 2007. The monitoring lines cover the start and end of the Longwalls, Charlton Road and the Whybrow highwall.

Table 6. 1 - Details on Available Subsidence Monitoring Lines during 2007

Monitoring Line	Longwall	Average depth of Cover (m)	Average Seam Thickness Extracted (m)
East Cross Line near Charlton Road	7	95	3.15
	8	90	3.2
Line 7C	8	220	3.15
Line 7D	7 & 8	215	3.1
Line 8A	8	215	3.15
Line 8B	8	65	3.3
Line 8C	8	55	3.4
Line 9	9	220	3.1
Line 9A	9 & 10	195	3.2

Table 6.2 shows the results of the subsidence monitoring against the levels predicted. This survey data was provided to Mine Subsidence Engineering Consultants to evaluate the observed subsidence and revise the accuracy of the predictions and adequacy of the management strategies in place. Mine Subsidence Engineering Consultants completed a report titled 'MSEC354 - Subsidence Monitoring Report 2007'. A summary of the findings of this report are contained below.

Table 6.2 - Comparison between the Maximum Predicted Subsidence, Tilt, Compressive and Tensile Strain Values versus the Observed Values

Monitoring Line	Longwall		Maximum incremental subsidence (mm)	Maximum incremental tilt (mm/m)	Maximum incremental tensile strain (mm/m)	Maximum incremental compressive strain (mm/m)
East Cross Line near Charlton Road	7	**Observed**	**1420**	**40**	**11**	**7.9**
		Predicted	2015	60	35	30
East Cross Line near Charlton Road	8	**Observed**	**1240**	**30**	**17.5**	**8.5**
		Predicted	2100	45	13.0	11.9
Line 7C	7	**Observed**	**17**	**<1**	**0.6**	**0.3**
		Predicted	<20	<1	<1	<1
Line 7D	7	**Observed**	**1685**	**25**	**6.4**	**12**
		Predicted	1875	20	3.3	5.0

Table 6.2 - Comparison between the Maximum Predicted Subsidence, Tilt, Compressive and Tensile Strain Values versus the Observed Values (cont)

Monitoring Line	Longwall		Maximum incremental subsidence (mm)	Maximum incremental tilt (mm/m)	Maximum incremental tensile strain (mm/m)	Maximum incremental compressive strain (mm/m)
Line 8A	8	**Observed**	**1700**	**25**	**10**	**25**
		Predicted	1950	30	7.9	7.6
Line 8B	8	**Observed**	**1240**	**>100**	**45**	**30**
		Predicted	2155	100	>50	>50
Line 8C	8	**Observed**	**15**	**<1**	**1**	**1.1**
		Predicted	<20	<1	<1	<1
Line 9	9	**Observed**	**1050**	**25**	**6.0**	**1.9**
		Predicted	590	25	7.6	<1
Line 9A	9	**Observed**	**255**	**8**	**1.8**	**1.3**
		Predicted	275	7	1.4	<1

Table 6.3 provides details of the subsidence monitoring lines established during 2008. The monitoring lines cover the start of Longwall 10 and Charlton Road.

Table 6. 3 - Details on Available Subsidence Monitoring Lines during 2008

Monitoring Line	Longwall	Average depth of Cover (m)	Average Seam Thickness Extracted (m)
Line 10	10	210	3.2
Line 10A	10	190	3.2
Line 10-XLCR	10	90 ~ 100	3.2

Table 6.4 shows the results of the subsidence monitoring against the levels predicted. This survey data was provided to Mine Subsidence Engineering Consultants to evaluate the observed subsidence and revise the accuracy of the predictions and adequacy of the management strategies in place. Mine Subsidence Engineering Consultants completed a report titled 'MSEC392 - Subsidence Monitoring Report 2008'. A summary of the findings of this report are contained below.

Table 6.4 - Comparison between the Maximum Predicted Subsidence, Tilt, Compressive and Tensile Strain Values versus the Observed Values

Monitoring Line	Longwall		Maximum incremental subsidence (mm)	Maximum incremental tilt (mm/m)	Maximum incremental tensile strain (mm/m)	Maximum incremental compressive strain (mm/m)
Line 10	10	**Observed**	**1852**	**26**	**9**	**9**
		Predicted	2010	32	8	9
Line 10A	10	**Observed**	**1924**	**24**	**8**	**12**
		Predicted	2040	21	3	4
Line 10-XLCR	10	**Observed**	**1508**	**51**	**26**	**24**
		Predicted	2175	63	40	30

Table 6.5 provides details of the subsidence monitoring lines established during 2009. The monitoring lines cover the start and end of Longwall 11 and Charlton Road.

Table 6. 5 - Details on Available Subsidence Monitoring Lines during 2009

Monitoring Line	Longwall	Average depth of Cover (m)	Average Seam Thickness Extracted (m)
Line 11A	11	175	2.7
Line 11B	11	60 ~ 90	3.2
Line 11-XLCR	11	90	3.0

Table 6.6 shows the results of the subsidence monitoring against the levels predicted. This survey data was provided to Mine Subsidence Engineering Consultants to evaluate the observed subsidence and revise the accuracy of the predictions and adequacy of the management strategies in place. Mine Subsidence Engineering Consultants completed a report titled 'MSEC435 - Subsidence Monitoring Report 2009'. A summary of the findings of this report are contained below.

Table 6.6 - Comparison between the Maximum Predicted Subsidence, Tilt, Compressive and Tensile Strain Values versus the Observed Values

Monitoring Line	Longwall		Maximum incremental subsidence (mm)	Maximum incremental tilt (mm/m)	Maximum incremental tensile strain (mm/m)	Maximum incremental compressive strain (mm/m)
Line 11A	11	**Observed**	**1894**	**26**	**6**	**10**
		Predicted	2100	22	4	4
Line 11B	11	**Observed**	**1908**	**76**	**15**	**40**
		Predicted	1950	110	> 50	> 50
Line 11-XLCR	11	**Observed**	**1820**	**58**	**16**	**12**
		Predicted	1950	65	50	35

Subsidence Profiles

The observed subsidence profiles for Longwalls 7 to 11 showed good correlation with the predictions made in the BCCUO EIS and SMP Applications as shown in **Tables 6.2 to 6.6**. The observed subsidence was generally less than predicted with only occasional exceedances.

The development of subsidence has in general been consistent with that predicted in the SMP Application. Predicted and observed profiles compare more favourably in areas of a greater depth of cover. This observation is consistent with the comments provided in both the BCCUO EIS and SMP Application. At shallow depths of cover, such as those near the finishing end of Longwall 7 to 11, the overlying strata is expected to crack and dilate, causing the surface to subside in a 'blocky' manner, which produces more irregular subsidence, tilt and strain profiles, as shown by the results along Monitoring Line 8B.

Tilt

The maximum observed tilts have been shown to be reasonably similar to or less than those predicted (see **Tables 6.2 to 6.6**).

Strain

The maximum observed strains compare reasonably well with predicted levels. However, the discrepancies between predicted and observed profiles at a specific point are much greater than those observed for subsidence and tilt. This result was expected due to the difficulty in predicting ground strains at a point, particularly in shallow mining conditions. This was acknowledged in reports for the BCCUO EIS and SMP Applications.

Summary

As the predicted and observed subsidence parameters were generally similar, the Subsidence Monitoring Reports (MSEC354, MSEC392 and MSEC435) concluded that no adjustments need to be made to the subsidence predictions or the Underground Operations management strategies in place.

Telecommunications Infrastructure

Copper cables and a major Inter Exchange Network (IEN) optical fibre cable are located within the Central Mining Area. All telecommunications cables are subject to pre-, during and post-subsidence monitoring by an experienced consultant in consultation with Telstra.

As part of the management measures for the fibre optic cable, the entire length of the cable along Charlton Road was replaced and placed in conduit.

Longwalls 7 to 13 passed under the fibre optic and copper cable during the reporting period with no significant impacts or interruptions to service.

7 SUBSIDENCE DEFINITIONS AND PREDICTION

The fibre optic cables within the Blakefield South mining area are all underground and owned by Telstra. Fibre optic cable will be undermined by the Blakefield seam along Charlton Road and Broke Roads.

Subsidence, tilt and strain are the subsidence parameters normally used to define the extent of the surface movements that will occur as mining proceeds.

Subsidence is the vertical distance (usually measured in millimetres) that the ground surface lowers as a result of mining, and depends on the depth of the coal seam, the thickness of the seam, the width of the extraction area and the characteristics of the overburden.

Tilt is calculated as the change in subsidence between two points divided by the distance between those points (i.e. change in slope of the surface landform as a result of mining). Tilt is usually expressed in millimetres per metre.

Strain results from horizontal movements in the strata. Strain is determined from monitoring survey data by calculating the change in the horizontal length of a section of a subsidence profile and dividing this by the initial horizontal length of that section. If the section has been extended, the ground is in tension and the change in length and resulting strain are both positive. If the section has been shortened, the ground is in compression and the change in length and strain are both negative. Strain is usually expressed in millimetres per metre.

The predicted systematic subsidence parameters for the proposed longwalls were determined using the Incremental Profile Method, which was developed by Mine Subsidence Engineering Consultants (MSEC). The subsidence model was calibrated for multi-seam conditions using the available multi-seam empirical data and the results of a numerical model (SCT, 2008).

The predicted mine subsidence movements were determined for two cases, referred to as the Stacked Case and the Staggered Case. The predicted systematic subsidence parameters for the Stacked Case adopt conservative subsidence profiles based on the worst condition where the chain pillars in the Blakefield seam are located directly beneath the chain pillars in the Whybrow seam. A maximum predicted subsidence of 100% of extracted seam thickness has been adopted for this case. The predicted systematic subsidence parameters for the Staggered Case adopt less conservative subsidence profiles based on the condition where the longwalls in the Blakefield seam are staggered with respect to the longwalls in the Whybrow seam. A maximum predicted subsidence of 75% of extracted seam thickness has been adopted for this case.

The proposed longwalls in the Blakefield seam are oblique to the existing longwalls in the overlying Whybrow seam and, therefore, the multi-seam interaction will vary between the Stacked Case and the Staggered Case across the mining area. The transitions between these two cases are extremely complex due to the complexity of multi-seam interactions and due to the complexities of the longwall geometries, which includes the oblique angle between the longwall layouts and the varying widths of the longwalls in the overlying Whybrow seam.

Due to the complexity of multi-seam subsidence predictions, the predicted systematic subsidence parameters have been determined based on the two cases such that a range of predicted movements is provided. In this way, the Stacked Case provides a more conservative or upperbound condition and the Staggered Case provides a less conservative or lowerbound condition.

A summary of the predicted impacts from the MSEC (2008, 2010a and 2010b) reports is provided in **Sections 7** and **8** below. **Attachment 1** provides the detailed sections of the MSEC reports for further information of subsidence impacts and management strategies.

8 POTENTIAL FOR DAMAGE TO OPTIC FIBRE CABLES AS A CONSEQUENCE OF SUBSIDENCE

The maximum predicted tensile ground strain for the fibre optic cables are 25mm/m for the cable along Broke Road and greater than 50mm/m for the cable along Charlton Road.

Tensile strains of these magnitudes are likely to cause damage. Compressive strains can also cause losses in transmission or reductions in the capacity of the fibre optic cables.

To address these impacts management strategies are further outlined in **Table 10.1** below.

9 POTENTIAL FOR DAMAGE TO COPPER CABLES AS A CONSEQUENCE OF SUBSIDENCE

The copper cables are owned by Telstra and most are located underground with the exception of some of the consumer copper lines which are aerial.

The maximum predicted tensile strain in the copper cables is greater than 50mm/m.Tensile strains of these magnitudes are likely to cause damage.

Management strategies to mitigate these impacts are further outlined in **Table 10.1** below.

10 ACCOUNTABILITIES TABLE

Table 10.1 assigns timeframes and responsibilities of personnel to implement required actions for Telecommunications management. Due to the time period involved in mining the six longwalls, the actions outlined are to be considered longwall by longwall.

Table 10.1 - Action Plan – Telecommunications Management Plan

TIMING	ACTION	PERSON RESPONSIBLE
Prior to Longwall Mining	Establish fibre optic and copper cable network baseline conditions. Develop a report on baseline conditions, including the provision of recommendations for undermining.	Beltana Environment and Community Co-ordinator Telecommunications Consultant Telstra
Prior to Longwall Mining	If the buried fibre optic is not installed in suitable conduit replace existing direct buried fibre optic with a new fibre installed inside of conduit, and install extra loops of cable in pits (as required by Telstra) (refer to **Attachment 2**). Provide extra loops of copper cable in pits (as required by Telstra). Beltana have engaged a Telecommunications Consultant (Colin Dove) to assist with the development of management strategies for the telecommunications infrastructure and undertake monitoring and reporting during undermining. Once completed, hold a meeting with Telstra to discuss the outcomes.	Beltana Environment and Community Co-ordinator Telstra Telecommunications Consultant MSB
During Longwall Mining	Notifying Telstra of the advance mining schedule for each longwall.	Beltana Environment and Community Co-ordinator Telecommunications Consultant
During Longwall Mining	Providing Telstra with revised subsidence predictions, based on a comparison of actual versus predicted subsidence levels.	Beltana Environment and Community Co-ordinator Telecommunications Consultant
During Longwall Mining	Have spare cables available, in case actual strain conditions are exceeded during undermining.	Beltana Environment and Community Co-ordinator Telecommunications Consultant
During Longwall Mining	Undertake physical inspections of cable and conduit network during the critical subsidence events.	Telecommunications Consultant

TIMING	ACTION	PERSON RESPONSIBLE
During Longwall Mining	For the subsidence event along Charlton Road from BSLW1, regularly monitor the Bulga cable from Broke exchange using an OTDR @ 1625nm to record any changes in the transmission characteristics of the fibre. Monitoring to be completed at cost to BJV	Telstra NIS
During Longwall Mining	For the subsidence event along Charlton & Broke Roads from BSLW1 to BSLW4, regularly monitor the old optical fibre cable line from the Fordwich Road Joint and Broke Road Joint using an OTDR @ 1625nm to record any changes in the transmission characteristics of the fibre. This will provide indication of possible locations which may impact on the new cable network during subsidence impacts. Monitoring to be completed at cost to BJV	Telstra NIS Telecommunications Consultant Beltana Environment & Community Co-ordinator
During Longwall Mining	For continuing subsidence events along Broke Road from BSLW1 to BSLW4 & Charlton Roads from BSLW2 to BSLW3, Telstra will install a Remote Fibre Monitoring System (RFMS) to continually monitor both cables @ 1625nm along Charlton and Broke Roads during these subsidence events over the next 2 to 3 years. This system will be installed by Telstra at a cost to BJV and will provide early indication of any potential impacts occurring along the cables.	Telstra NIS Beltana Environment & Community Co-ordinator.
During Longwall Mining	Monitor cable ground movements to ensure that any unpredicted movement can be accommodated within the conduit and pit network.	Telecommunications Consultant
During Longwall Mining	Obtain error reports (from central testing office in Brisbane) and determine if there is any significant change in copper cable transmission characteristics.	Beltana Environment and Community Co-ordinator Telecommunications Consultant
During Longwall Mining	Report details of physical movement of cable during critical periods for each longwall to Bulga Coal and Telstra.	Telecommunications Consultant
During Longwall Mining	Negotiate agreements on remuneration for repair works.	Beltana Environment and Community Co-ordinator MSB

TIMING	ACTION	PERSON RESPONSIBLE
During Longwall Mining	Scheduling for cable repair works. Negotiate agreement for Repair Work & Scheduling for Cable Repairs	Beltana Environment and Community Co-ordinator Telecommunications Consultant MSB Telstra
After Longwall Mining	Following each subsidence event along Charlton & Broke Roads carry out OTDR testing @ 1625nm on both cables to verify that there are no transmission impacts on the fibres. Monitoring to be completed at cost to BJV	Beltana Environment and Community Co-ordinator Telecommunications Consultant Telstra

11 REPORTING

The results of inspections will be recorded and filed. The effectiveness of the Telecommunications Management Plan in managing risks will be reported in the AEMR.

12 REVIEW

As an active/live management plan, the document will continue to be revised and updated when and where required in consultation with key stakeholders as part of continuous improvement processes.

This plan is to be reviewed after the completion of each longwall or as a result of an incident.

13 REFERENCES

- Bulga Coal Continued Underground Operations EIS July 2003
- SEE for the Bulga Underground - Southern Mining Area Modification - Section 96(2) Application to Modify Consent DA 376-8-2003.
- Mine Subsidence Engineering Consultants Report Number MSEC334, Revision C.
- MSEC 2010a – Mine Subsidence Engineering Consultants Report Number MSEC393, Revision B.
- MSEC 2010b – Mine Subsidence Engineering Consultants Report Number MSEC452, Revision A.
- SCT 2008 – Strata Control Technology Report Number BEL3288, April 2008.
- Galvin 2008 – Galvin and Associates Report Number 0908/6-1b, November 2008.
- Subsidence Risk Assessment Associated with Mining Longwalls SB1- SB6 of the Blakefield Seam November 2007

Attachment 1 – Relevant MSEC (2008, 2010a and 2010b) Sections

OPTICAL FIBRE CABLES

The locations of the optical fibre cables within the SMP Area are shown in Figure 1. The predictions and impact assessments for the optical fibre cables are provided in the following sections.

PREDICTIONS FOR THE OPTICAL FIBRE CABLES

The optical fibre cables within the SMP Area generally follow the alignments of Broke and Charlton Roads. The predicted profiles of systematic subsidence and strain along the alignments of the optical fibre cables are, therefore, similar to those along Broke and Charlton Roads, which are shown in the attached Figs. MSEC334-D.06 and MSEC393-A.06,(which details assessment for the relocated optic fibre cable and the modified LWBS1/BS2 mine layout) respectively. A summary of the maximum predicted cumulative systematic subsidence parameters along the optical fibre cables, after the extraction of each proposed longwall, is provided in Table 5.11.

Table 5.11 - Maximum Predicted Systematic Subsidence Parameters along the Alignments of the Optical Fibre Cables Resulting from the Extraction of the Proposed Longwalls

Location	Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tensile Strain (mm/m)	Maximum Predicted Cumulative Compressive Strain (mm/m)
Optical Fibre Cable along Broke Road	After LW1	2350	25	40
	After LW2	3050	25	40
	After LW3	3050	25	40
	After LW4	3100	25	40
	After LW5	3100	25	40
Optical Fibre Cable along Charlton Road	After LW1	2800	> 50	> 50
	After LW2	2975	> 50	> 50
	After LW3	3025	> 50	> 50
	After LW4	3025	> 50	> 50

The values provided in the above table are the maximum predicted systematic subsidence parameters determined using either the *Stacked Case* or the *Staggered Case*, whichever is the greater.

The optical fibre cables will also be subjected to travelling strains where the extraction faces of the proposed longwalls pass beneath them. It is expected that the optical fibre cables could be subjected to travelling strains up to 25 mm/m.

The optical fibre cables cross a number of drainage lines and, therefore, could also be subjected to some valley related movements resulting from the extraction of the proposed longwalls. The equivalent valley heights of the drainage lines are small, typically in the order of 5 metres and, therefore, the upsidence and closure movements at the cables are expected to be an order of magnitude smaller than the predicted systematic movements and not significant.

IMPACT ASSESSMENTS FOR THE OPTICAL FIBRE CABLES

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

The maximum predicted systematic tensile and compressive strains at the optical fibre cable along Broke Road, at any time during or after the extraction of the proposed longwalls, are 25 mm/m and 40 mm/m, respectively, and the associated minimum radii of curvature are 0.4 kilometres and 0.3 kilometres, respectively. The maximum predicted systematic tensile and compressive strains at the optical fibre cable along Charlton Road, at any time during or after the extraction of the proposed longwalls, are both greater than 50 mm/m and the associated minimum radii of curvature are both less than 0.2 kilometres.

Based on previous experience of mining beneath optical fibre cables, it is likely that the predicted systematic tensile strains are of sufficient magnitudes to result in impacts on the optical fibre cables along Broke and Charlton Roads. The tensile strains in the optical fibre cables could also be higher than predicted where the cables connect to the support structures, which may act as anchor points, preventing any differential movements that may have been allowed to occur between the cables and the ground.

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

The costs of consequential losses resulting from impacts on optical fibre cables can be very high. It is recommended, therefore, that the optical fibre cables along Broke and Charlton Roads are duplicated with new cables within flexible ducts, leaving sufficient slack in draw pits to accommodate the predicted ground movements. This approach has been successfully used to protect the optical fibre cable which crosses Longwalls 1 to 14 in the Whybrow Seam within the Central Mining Area, which is described in the report by Dove (2004).

IMPACT ASSESSMENTS FOR THE OPTICAL FIBRE CABLES BASED ON INCREASED PREDICTIONS

If the predicted systematic strains at the optical fibre cables were increased by a factor of 1.25 times, the likelihood of impact would increased accordingly. It would still be expected, however, that the impacts on the optical fibre cables could be managed by duplicating them in flexible ducts, similar to that adopted in the Central Mining Area.

It is not expected that the observed systematic movements would exceed those predicted by any more than a factor of 1.25, as the predictions based on the *Stacked Case* adopts a maximum subsidence of 100 % of the extracted seam thickness.

RECOMMENDATIONS FOR THE OPTICAL FIBRE CABLES

It is recommended that the optical fibre cables along Broke and Charlton Roads are duplicated with new cables within flexible ducts, leaving sufficient slack in draw pits to accommodate the predicted ground movements.

It is also recommended that the optical fibre cables are monitored during the extraction of the proposed longwalls using optical fibre sensing techniques, such as Optical Time Domain Reflectometer (OTDR) monitoring. Mitigation measures can be undertaken, such as excavating and exposing the cables, if strain concentrations are detected during mining.

It is recommended that management strategies are developed, in consultation with Telstra, such that the optical fibre cables can accommodate the predicted movements resulting from the extraction of the proposed longwalls. With the implementation of these management strategies, it is expected that the optical fibre cables can be maintained in a serviceable condition throughout the mining period.

COPPER TELECOMMUNICATIONS CABLES

The main copper telecommunications cables within the SMP Area generally follow the alignments of Charlton and Fordwich Roads, with branches above the commencing (western) ends of proposed BSLW1 and BSLW4. The locations of the copper telecommunications cables are shown in Figure 1. The predictions and impact assessments for the copper telecommunications cables are provided in the following sections.

PREDICTIONS FOR THE COPPER TELECOMMUNICATIONS CABLES

The predicted profiles of systematic subsidence and strain along the alignments of the copper telecommunications cables along Charlton and Fordwich Roads are similar to those along these roads, which are shown in the attached Figs. MSEC393-A06 and MSEC452-A.02, respectively. A summary of the maximum predicted cumulative systematic subsidence and strain along the copper telecommunications cables, after the extraction of each proposed longwall, is provided in Table 5.12.

Table 5.12 - Maximum Predicted Systematic Subsidence Parameters along the Main Copper Telecommunications Cables Resulting from the Extraction of the Proposed Longwalls

Location	Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tensile Strain (mm/m)	Maximum Predicted Cumulative Compressive Strain (mm/m)
Copper Telecom. Cables along Charlton Road	After LW1	2800	> 50	> 50
	After LW2	2975	> 50	> 50
	After LW3	3025	> 50	> 50
	After LW4	3025	> 50	> 50
Copper	After LW1	< 20	< 0.5	< 0.5

Telecom. Cables along Fordwich Road	After LW2	1075	0.5	< 0.5

The values provided in the above table are the maximum predicted systematic subsidence parameters determined using either the *Stacked Case* or the *Staggered Case*, whichever is the greater.

The copper telecommunications cable along Charlton Road will also be subjected to travelling strains where the extraction faces of the proposed longwalls pass beneath it. It is expected that this cable could be subjected to travelling strains up to 25 mm/m. It is expected that the travelling strains at the copper telecommunications cable along Fordwich Road would be less than the cumulative strains provided in the above table.

The copper telecommunications cables cross a number of drainage lines and, therefore, could also be subjected to some valley related movements resulting from the extraction of the proposed longwalls. The equivalent valley heights of the drainage lines are small, typically in the order of 5 metres and, therefore, the upsidence and closure movements at the cables are expected to be an order of magnitude smaller than the predicted systematic movements and not significant.

IMPACT ASSESSMENTS FOR THE COPPER TELECOMMUNICATIONS CABLES

The copper telecommunications cables within the SMP Area are direct buried and, therefore, will not be impacted by the tilts resulting from the extraction of the proposed longwalls. The cables, however, are likely to experience the ground strains resulting from the extraction of the proposed longwalls.

The maximum predicted systematic tensile and compressive strains at the copper telecommunication cable along Charlton Road, at any time during or after the extraction of the proposed longwalls, are both greater than 50 mm/m and the associated minimum radii of curvature are both less than 0.2 kilometres. The maximum predicted systematic tensile and compressive strains along the copper telecommunication cable along Fordwich Road, at any time during or after the extraction of the proposed longwalls, are 0.5 mm/m and less than 0.5 mm/m, respectively, and the associated minimum radii of curvature are 20 kilometres and greater than 20 kilometres, respectively.

Based on previous experience of mining beneath copper telecommunications cables, it is possiblethat the predicted systematic strains at the copper telecommunications cable along Charlton Road are of sufficient magnitudes to result in impact. The tensile strains along this cable could also be higher than predicted where the cable connects to the support structures, which may act as anchor points, preventing any differential movements that may have been allowed to occur between the cable and the ground.

The copper telecommunications cables within the SMP Area were previously mined beneath by the longwalls in the overlying Whybrow Seam and there were no reported impacts. The maximum predicted systematic strains at the cables along Charlton and Fordwich Roads, resulting from the extraction of the longwalls in the overlying Whybrow Seam, were 20 mm/m and 15 mm/m, respectively.

Whybrow Longwalls 1 to 12 within the Central Mining Area previously mined beneath the copper telecommunications cables along Charlton and Cobcroft Roads and there were no reported impacts. The maximum predicted systematic tensile and compressive strains along these cables were both 22 mm/m.

The copper telecommunications cables within the SMP Area are local cables and if any impacts occur, as a result of the extraction of the proposed longwalls, the cables can be easily repaired. With the implementation of suitable management strategies, it is expected that the cables can be maintained in a serviceable condition throughout the mining period.

IMPACT ASSESSMENTS FOR THE COPPER TELECOMMUNICATIONS CABLES BASED ON INCREASED PREDICTIONS

If the predicted systematic strains at the copper telecommunications cables were increased by a factor of 1.25 times, the likelihood of impact on the cable along Charlton Road would increase accordingly. It would be expected, however, that the likelihood of impact on the cable along Fordwich Road would not significantly increase, as the maximum predicted systematic tensile strain would still be less than 1 mm/m.

It is not expected that the observed systematic movements would exceed those predicted by any more than a factor of 1.25, as the predictions based on *the Stacked Case* adopts a maximum subsidence of 100 % of the extracted seam thickness.

RECOMMENDATIONS FOR THE COPPER TELECOMMUNICATIONS CABLES

It is recommended that management strategies are developed, in consultation with Telstra, for the implementation of suitable remediation measures should any impacts on the copper telecommunications cables occur as a result of the extraction of the proposed longwalls. With the implementation of these management strategies, it is expected that the copper telecommunications cables can be maintained in a serviceable condition throughout the mining period.

Predicted Profiles of Systematic Subsidence, Tilt and Strain along Broke Road Resulting from the Extraction of Longwalls 1 to 6

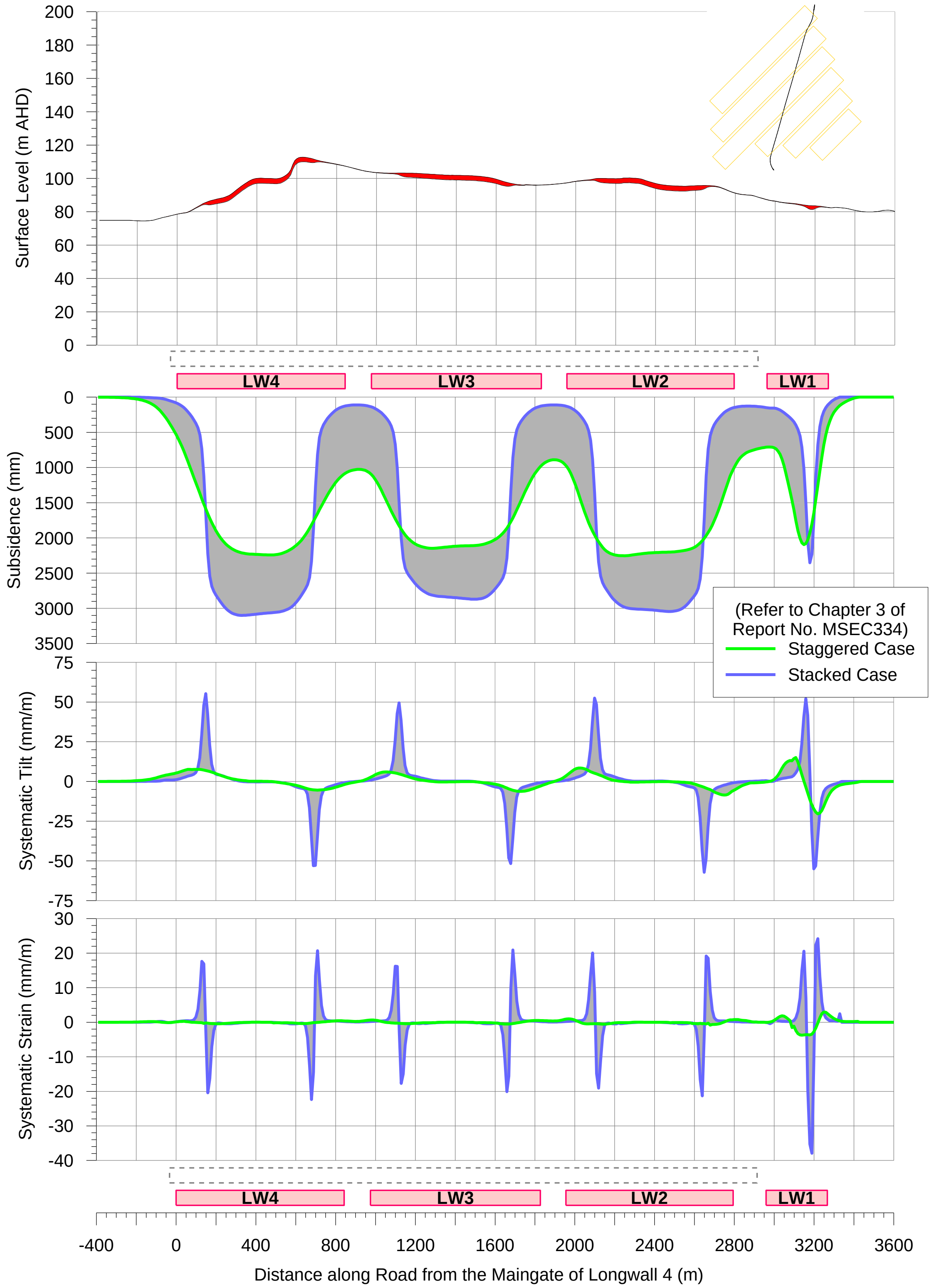

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Fig. MSEC334-D.06

Predicted Profiles of Systematic Subsidence, Tilt and Strain along Charlton Road Resulting from the Extraction of Longwalls 1 to 6

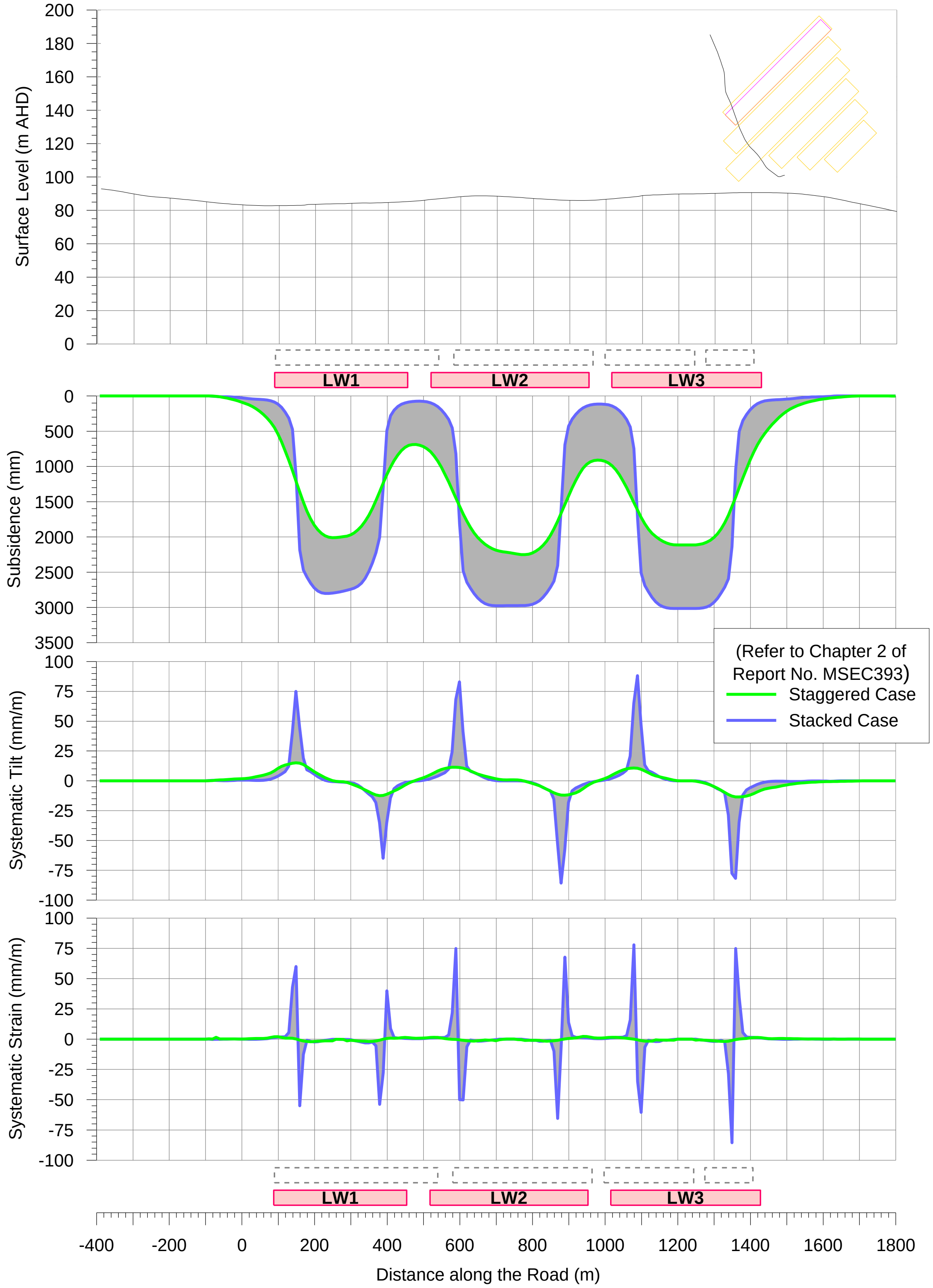

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Fig. MSEC393-A.06

Predicted Profiles of Systematic Subsidence, Tilt and Strain along Fordwich Road Resulting from the Extraction of Longwalls 1 to 6

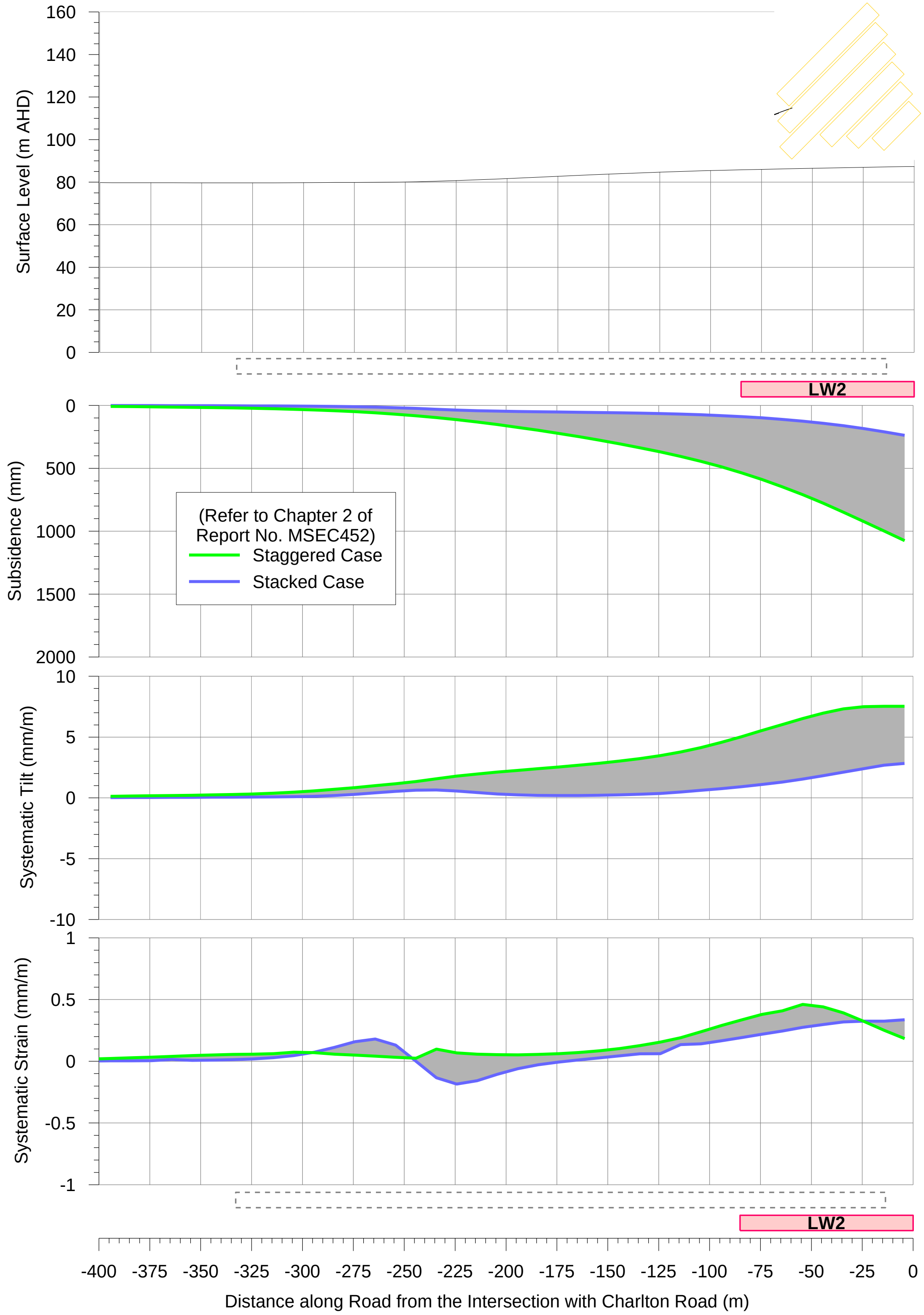

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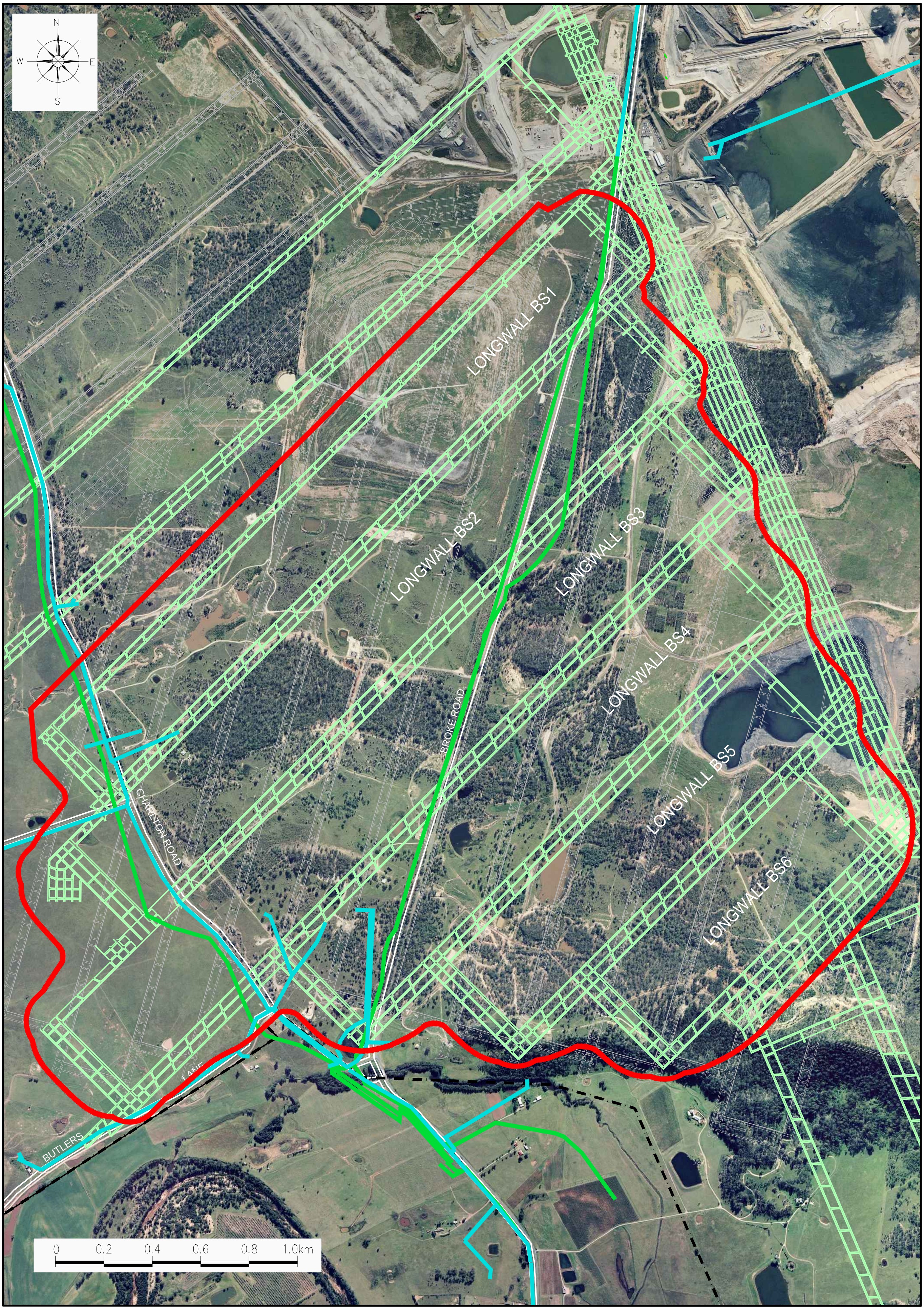
Fig. MSEC452-A.02

Attachment 2 – Photo of Extra Loops of Cable in Optic Fibre Cable Pit



Legend

- Development Consent Boundary
- Blakefield South Seam Workings
- Whybrow Seam Workings
- SMP Boundary (as approved 2009)
- Telstra Local Copper Cable (Existing)
- Telstra Optic Fibre Cable (Existing)

Telecommunications
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Figure 1