

Metallurgical Coal



ANNEX B SUBSIDENCE MONITORING PROGRAM

WEST CLIFF AREA 5 LONGWALLS 37 AND 38 EXTRACTION PLAN

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ATTACHMENT A – MASTER TARPS

Review History

Revision	Description of Changes	Date	Approved
P1	New Document	July 2012	
P2	Document revised following comments	March/April 2013	
A	Draft for Agency comment	June 2013	
A	Final (no further comments)	August 2013	

Persons involved in the development of this document include:

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

BHP Billiton Illawarra Coal (BHPBIC) operates the Bulli Seam Operations (BSO) (Appin and West Cliff Collieries) extracting hard coking coal used for steel production.

On 22 December 2011 the Planning and Assessment Commission (PAC), under delegation of the Minister for Planning, approved the BSO Project (MP 08_0150) under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to continue these mining operations until 31 December 2041.

This Subsidence Monitoring Program (Monitoring Program) supports the Longwalls 37 and 38 Extraction Plan for the mining of coal from these longwalls in West Cliff Area 5. The relationship between this Monitoring Program and the other components of the Extraction Plan is shown in Figure 1 of the Extraction Plan.

1.2 SCOPE

This Monitoring Program has been prepared in accordance with BSO Approval *Condition 5 (m), Schedule 3* as follows:

5. *The Proponent shall prepare and implement an Extraction Plan for first and second workings within each longwall mining domain to the satisfaction of the Director-General. Each extraction plan must:*
- m. Include a subsidence monitoring program, which has been prepared in consultation with DRE, OEH and SCA to:*
- provide data to assist with the management of the risks associated with subsidence;*
 - validate the subsidence predictions;*
 - analyse the relationship between the predicted and resulting subsidence effects and the predicted and resulting impacts under the plan and any ensuing environmental consequences; and*
 - inform the contingency plan and adaptive management process.*

The Study Area for the Extraction Plan is defined in accordance with Mine Subsidence Engineering Consultants (MSEC, 2013), as the surface area predicted to be affected by the proposed mining of Longwalls 37 and 38 and encompasses the area bounded by, whichever is the greater of the following limits:

- 35° Angle of Draw for the maximum depth of cover, which equates to a horizontal distance of between 320 m and 380 m outside the limit of the proposed extraction area); and
- The 20 mm predicted limit of vertical subsidence, which is generally within the 35° Angle of Draw.

Additionally, features sensitive to far-field movements, which includes potential horizontal, valley closure and valley upsidence movements, which may be outside the 20 mm subsidence zone or 35° Angle of Draw have been assessed including:

- Watercourses (including the Georges River), within the predicted limits of 20 mm total upsidence and 20 mm total closure;
- Wedderburn Airport;

- Groundwater bores; and
- Survey control marks.

Two separate Study Areas have been defined, one for each of the longwalls. The Longwall 37 Study Area is located primarily to the west of the Georges River, with the Longwall 38 Study Area primarily to the east of the Georges River. The Study Area locations are illustrated by **Figure 1** (MSEC, 2013). It is noted that while the Study Areas do traverse the Georges River, neither of the proposed longwalls would result in mining under the River.

1.3 OBJECTIVES

The key objective of this Monitoring Program is to satisfy Condition 5 (m) of the BSO Approval in relation to the potential impacts and/or environmental consequences from the proposed mining to sensitive environmental and built features within the Longwalls 37 to 38 Study Area. In order to achieve this, a number of associated objectives are provided including:

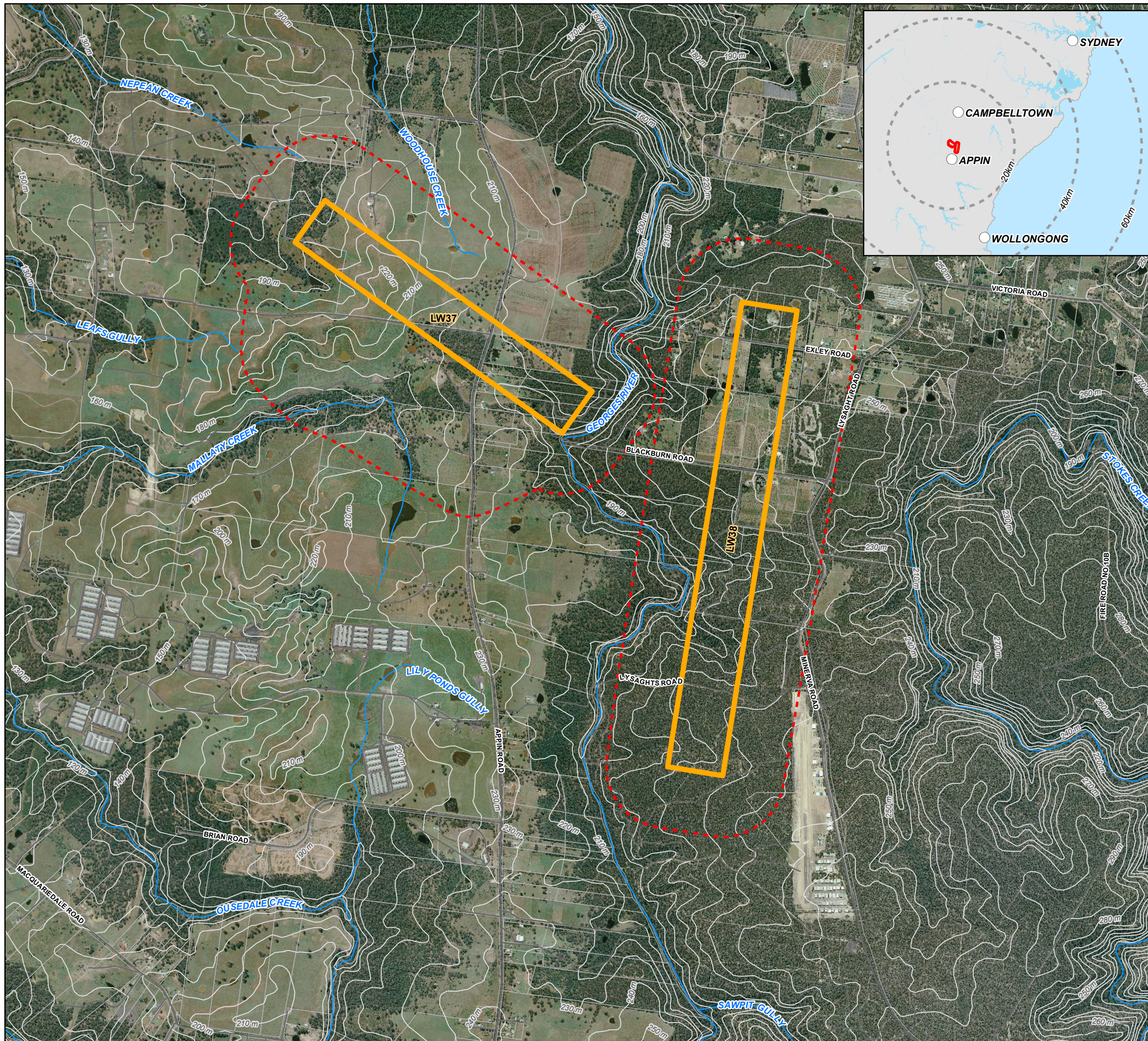
- Provide consolidated monitoring parameters based on the recommendations and commitments in the Management Plans (refer to Annexes C – H of the Extraction Plan).
- Detail the process undertaken to validate subsidence predictions.
- Review predicted subsidence impacts in the context of ongoing monitoring.
- Provide contingency and management processes responsive to monitoring results.

1.4 DISTRIBUTION

This Monitoring Program will be developed through ongoing consultation with:

- Office of Environment and Heritage (OEH)
- Sydney Catchment Authority (SCA)
- Department of Planning and Infrastructure (DP&I)
- Trade and Investment - Division of Resources and Energy (DRE)

The finalised Monitoring Program will be distributed to the above agencies. Additionally, BHPBIC will make this Monitoring Program and other relevant documentation publicly available on the BHPBIC website (*Condition 11, Schedule 6* of BSO approval).



**West Cliff Area 5
Study Areas
(LW37 and 38)**

- Legend**
- - - Study Area
 - Local Roads (LPI)
 - 10m Contours (LPI)
 - Watercourses (LPI)
 - Cadastre (LPI)
 - West Cliff LW 37 and 38 (BHPBIC 2013)



FIGURE 1

Scale 1:20,000 (at A3)

Kilometres

0 0.25 0.5 0.75 1



Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 14/03/2013
Coordinate System: GDA 1994 MGA Zone 56
Project: 112054-01
Map: G1002_WCA5_ExtractionPlan.mxd 03
Aerial imagery supplied by BHPBIC (2007 and 2009)

2 STATUTORY REQUIREMENTS

Extraction of coal from Longwalls 37 and 38 will be in accordance with the conditions set out in the BSO Approval (MP 08_150), applicable legislation as detailed in **Section 2.2** and the requirements of relevant licenses and permits (including conditions attached to mining leases).

2.1 BSO APPROVAL

Condition 5 (m), Schedule 3 of the BSO Approval requires the preparation of a subsidence monitoring program to provide data to assist with the management of the risks associated with subsidence, validate the subsidence predictions, analyse the relationship between the subsidence effects and impacts under the plan and any ensuing environmental consequences and inform the contingency plan adaptive management process.

2.2 LEGISLATION AND GUIDELINES

This Monitoring Program and the Extraction Plan has been designed to conform to the requirements of the relevant advisory documents and guidelines and any other legislation that is applicable under the EP&A Act. The following Acts may apply:

- *Contaminated Land Management Act, 1997;*
- *Dangerous Goods Act, 1975;*
- *Mining Act, 1992;*
- Noxious Weeds Act, 1993;
- Rail Safety Act, 2002;
- Road and Rail Transport (Dangerous Goods) Act, 1997
- Roads Act, 1993;
- Protection of the Environment Operations Act, 1997;
- Threatened Species Conservation Act, 1995;
- National Parks and Wildlife Act, 1974
- Environmental Protection Biodiversity and Conservation Act, 2000
- Sydney Water Catchment Management Act, 1998;
- Coal Mine Health and Safety Act, 2002;
- Crown Lands Act, 1989;
- Dams Safety Act, 1978;
- Energy and Utilities Administration Act, 1987;
- Fisheries Management Act, 1994;
- Water Act, 1912; and
- Water Management Act, 2000.
- Further details of applicable advisory documentation and guidelines can be found in the relevant management plans annexed to the Extraction Plan (Annexes C – H of the Extraction Plan).

2.3 RELEVANT LEASES AND LICENSES

The following leases and licences apply to BHPBIC's operations in West Cliff Area 5:

- Mining Leases as per **Table 2.1**.
- Environmental Protection Licence (EPL) 2504 which applies to the BSO, including both Appin and West Cliff Mines. A copy of the license can be accessed at the EPA website via the following link [/www.environment.nsw.gov.au/poee](http://www.environment.nsw.gov.au/poee)
- West Cliff Mining Operations Plan (MOP) July 2007 to June 2014.
- All relevant OH&S and HSEC approvals.
- Additional leases, licences of approvals resulting from the BSO Approval.

Table 2.1 – West Cliff Leases, Licenses & Other Reference Documents

Mining Lease - Document Number	Issue Date	Expiry Date/ Anniversary Date
CCL 724	4 July 1991	26 October 2011 (renewal pending)
Part CCL 767	29 October 1991	September 2010 (renewal pending)
CCL 381	24 October 1991	23 October 2012 (renewal pending)
ML 1678	27 September 2012	26 September 2033
MPL 200	13 January 1982	13 January 2024
MPL 201	13 January 1982	13 January 2024

3 PLAN ADMINISTRATION

3.1 REVIEW AND UPDATE

This Monitoring Program, and all of its components, will be reviewed on a regular basis to ensure that it incorporates any recommended measures to improve the environmental performance of the project.

If deficiencies in the Monitoring Program and/or Extraction Plan are identified throughout the course of extraction the plans will be modified as required. This process has been designed to ensure that all environmental documentation continues to meet current environmental requirements, including changes in technology and operational practice, and the expectations of stakeholders.

3.2 EXTRACTION SEQUENCE

Extraction of the longwalls will occur in a staged process commencing with Longwall 37 and continuing to Longwall 38. The estimated timing schedule for mining of Longwalls 37 and 38 is shown in **Table 3.1**. The geology, seam structure, and depth of cover are described in the Extraction Plan.

Table 3.1 – Expected Schedule for Longwall Extraction 37 to 38

Longwall	Start	End	Characteristics(void length and width)
37	May 2014	February 2015	1795 x 282 m
38	April 2015	March 2016	2575 x 305 m

Note: the above width measurements include first workings.

4 SURFACE FEATURES INCLUDED IN THE MONITORING PROGRAM

4.1 THE STUDY AREA

The Study Area is defined by MSEC (2013) in Section 2.1 and includes features within the 35 degree angle of draw of the proposed longwalls; and those features that lie outside the Study Area that were expected to experience, and are sensitive to either far-field movements, or valley related upsidence and closure movements. The surface features which are sensitive to such movements include:

- Watercourses (including the Georges River), within the predicted limits of 20 mm total upsidence and 20 mm total closure;
- Wedderburn Airport;
- Groundwater bores; and
- Survey control marks.

4.2 OVERVIEW OF POTENTIALLY AFFECTED FEATURES

The features identified by the Management Plans are discussed in detail in MSEC (2013) and summarised below to provide context for the development of the monitoring regime.

4.2.1 Natural Features

Watercourses within the Study Area are shown in MSEC (2013) Drawing No. MSEC533-07 and include:

- The Georges River and various tributaries;
- Mallaty Creek and its tributaries;
- Nepean Creek and its tributaries; and
- Woodhouse Creek.

A comprehensive survey of the above watercourses is provided in MSEC (2013) and Ecoengineers (2013).

Aquifers or known Groundwater Resources within the Study Area are not *Ground Water Management Areas*, as defined by the Department of Environment, Climate Change and Water (DECCW). However, there are groundwater resources, which are extracted using groundwater bores, shown on MSEC (2012) Drawing No. MSEC533-22. A comprehensive survey of these groundwater bores is provided in MSEC (2013) and GeoTerra (2013).

Cliffs within the Study Area are shown in MSEC (2013) Drawing No. MSEC533-10 and are located generally within the valley of the Georges River and associated tributaries.

Steep slopes within the Study Area are shown in MSEC (2013) Drawing No. MSEC533-10 and are predominantly located along the alignment of the Georges River and its tributaries. Isolated steep slopes have been identified over the existing Longwalls 35 and 36.

Swamps and Wetlands are not located within the Study Area, however there are water related ecosystems associated with the Georges River and the major tributaries.

Protected or Threatened Species, which have been declared as critical habitat under the *Threatened Species Conservation Act 1995*, are not located within the Study Area. There are, however, threatened and protected species within the Study Area which are described in the report by *Niche (2013a)* and *Cardno Ecology Lab (2013)*.

Natural Vegetation in the Study Area can be seen from the aerial photograph provided in Figure 1.1 of MSEC (2013). The locations of the *Endangered Ecological Communities* are indicated on MSEC (2013) Drawing No. MSEC533-07. A survey of the natural vegetation within the Study Area has been undertaken by *Niche (2013a)*.

4.2.2 Public Utilities

Railway infrastructure is not located within the Study Area.

Major Roads either located within or potentially affected by far field movements include:

- Appin Road, which is shown in MSEC (2013) Drawing No. MSEC533-11.

Local Roads within the Study Area are shown in MSEC (2013) Drawing No. MSEC533-11 and include:

- Lysaght/Minerva Road, located at the eastern edge of the of the Study Area is the primary local road;
- Two smaller roads, Exley and Blackburn Roads are located within the Study Area, which cross over the footprint of Longwall 38.

Local Road Drainage Culverts do not exist on public land within the Study Area; however there are drainage culverts on private land.

Sydney Water infrastructure within the Study Area is shown in MSEC (2013) Drawing No. MSEC533-12, and comprises a rising sewer main between Appin and Rosemeadow.

Macarthur Water Supply System as shown in MSEC (2013) Drawing No. 533-12, is located to the west of the Study Area and comprises a 1200 mm diameter treated water gravity main.

Sydney Catchment Authority (SCA) infrastructure is not located within the Study Area but may be subjected to very minor far field horizontal movements.

Electrical infrastructure within the Study Area is shown in MSEC (2013) Drawing No. MSEC533-13 and comprises 11kV powerlines, which follow local roads through the Study Area. There is a 66kV powerline and a 330kV transmission line located outside the Study Area, approximately 780 m from proposed Longwall 37 at its nearest point.

Telecommunications infrastructure within the Study Area, as shown in MSEC (2013) Drawing No. MSEC533-14, comprises of direct buried optical fibre cable and aerial and direct buried copper cables as summarised below in **Table 4.1**.

Table 4.1 – Summary of Telecommunications Infrastructure within the Study Area

Type	Location	Total length of cable within the Study Area (km)
Optical Fibre Cables	Above LW37 along the alignment of Appin Road	1.4
Copper Cables	Above LW37 and LW38	8.0

Gas Pipelines do not exist within the Study Area. There are three gas pipelines (being the Alinta EGP and AGN Natural Gas Pipelines and the Gorodok Ethan Pipeline), which are approximately 650 m west of proposed Longwall 37 at its nearest point, as shown in MSEC (2013) Drawing No. MSEC533-12.

Air Strips are not located within the Study Area. However, Wedderburn Airport, as shown in MSEC (2013) Drawing No. 533-21, is located very close to the south east of the Longwall 38 Study Area.

4.2.3 Public Amenities

There are no public amenities identified within the Study Area, including hospitals, places of worship, schools, shopping centres, community centres, office buildings, swimming pools, bowling greens, ovals or cricket grounds, race courses, golf courses or tennis courts.

4.2.4 Farmland and Facilities

Rural Building Structures within the Study Area are shown in MSEC (2013) Drawing Nos. MSEC533-15 to MSEC533-21 and comprise 207 rural building structures, which include sheds, garages, gazebos, pergolas, greenhouses, playhouses, shade structures and other non-residential building structures.

Water Tanks within the Study Area are shown in MSEC (2013) Drawing Nos. MSEC533-15 to 533-21. There are 82 water tanks that have been identified within the Study Area.

Farm Dams within the Study Area are shown in MSEC (2013) Drawings Nos. MSEC533-15 to MSEC533-21. There are 43 farm dams that have been identified in the Study Area. Dams are typically of earthen construction and have been established by localised cut and fill operations within drainage lines.

Groundwater Bores within the Study Area are shown in MSEC (2013) Drawing No. 533-22. There is one registered groundwater bore.

4.2.5 Industrial Commercial and Business Establishments

Mine Infrastructure located within the Study Area comprises a number of exploration bores, as shown in MSEC (2013) Drawing No. MSEC533-22.

There are no other Industrial, Commercial or Business establishments within the Study Area.

4.2.6 Areas of Archaeological or Heritage Significance

Archaeological Sites located within the Study Area are shown in MSEC (2013) Drawing No. 533-22. There are ten archaeological sites within the Study Area, which are described in detail in Niche (2013b).

There are no declared Aboriginal Places under the *National Parks and Wildlife Act 1974* within the Study Area.

Heritage Sites are not located within the Study Area, with the nearest sites being a house and monument to the north of the Longwall 37 Study Area and a Bridge and Road Remains to the west of the Longwall 38 Study Area.

There are no items of architectural significance within the Study Area (MSEC, 2013).

4.2.7 Permanent Survey Control Marks

There are five Survey Control marks located within the Study Area. The locations of Survey Control Marks are shown in MSEC (2013) Drawing No. MSEC533-22. The Survey Control marks are located across the Study Area and, therefore, are expected to experience the full range of predicted subsidence movements.

4.2.8 Residential Establishments

There were 33 houses and associated structures identified within the Study Area as at the date of the MSEC (2013) Report, including garages, water or gas tanks, waste water systems and swimming pools and tennis courts. The locations of these houses and associated structures within the Study Area are shown in MSEC (2013) Drawing Numbers MSEC533-15 to MSEC533-21.

There are no other residential establishments within the Study Area including flats or units, caravan parks and retirement or aged care villages.

5 REVISED SUBSIDENCE PARAMETERS AND IMPACTS DUE TO THE EXTRACTION OF LONGWALLS 37 AND 38

MSEC (2013) provides a detailed description of the mine subsidence process and methods used to predict subsidence movements resulting from the extraction of the longwalls. The report includes the maximum predicted systematic subsidence parameters for the longwalls (Section 4 of MSEC, 2013) including:

- **Incremental Subsidence Parameters**, which are the predicted subsidence parameters due to the extraction of a single longwall.
- **Cumulative Subsidence Parameters**, which are the accumulated parameters which result from the extraction of a series of longwalls.
- **Total Subsidence Parameters**, which include the predicted subsidence parameters resulting from the extraction of Longwalls 37 and 38 and also include the predicted total subsidence parameters from previously extracted longwalls.

Maximum incremental subsidence predicted for the Study Area is 775 mm for Longwall 37 and 625 mm for Longwall 38.

The maximum predicted subsidence parameters for the Extraction Plan Layout are similar to but slightly less than those predicted based on the BSO Part 3A Base Case EA Layout. It can be seen from Section 4.3 of MSEC (2013) that the maximum predicted total conventional subsidence, based on the Extraction Plan Layout, is 50 mm less than that predicted based on the Part 3A Base Case Layout. The maximum predicted tilt and curvatures, based on the Extraction Plan Layout, are similar to or slightly less than those predicted based on the Part 3A Base Case Layout.

5.1 PREDICTED SUBSIDENCE PARAMETERS AND IMPACTS FOR NATURAL FEATURES AND ITEMS OF SURFACE INFRASTRUCTURE WITHIN THE STUDY AREA

MSEC (2013) provides a comprehensive description of revised site specific predicted subsidence parameters and impact assessments for each of the natural features and items of surface infrastructure that are located within the Study Area, due to the extraction of Longwalls 37 and 38. Additionally, the natural features and items of surface infrastructure located outside the Study Area, which may be subjected to far-field movements and may be sensitive to the predicted subsidence parameters, were also included in the revised assessments undertaken by MSEC (2013). An overview of the surface features assessed is provided in **Section 4.2** of this Monitoring Program.

The monitoring described below has been developed in consideration of the predicted subsidence parameters and subsidence impacts outlined in MSEC (2013), as well as the findings, recommendations and commitments within specific management plans (refer to Extraction Plan Annexes C – H).

6 MONITORING

The objectives of the Monitoring Program are discussed in **Section 1.3**. This Monitoring Program is comprised of two components:

1. the monitoring of subsidence movements (**Section 6.1**); and
2. the monitoring of subsequent environmental and other consequences of those movements (**Section 6.2**).

6.1 SUBSIDENCE MOVEMENTS

The program of monitoring and management of subsidence movements currently established for the ongoing extraction of longwalls within the West Cliff Area 5 domain, is proposed to be extended to incorporate Longwalls 37 and 38. The main objective of the Monitoring Program is to show whether any measured subsidence movements or impacts are greater than predicted. If subsidence movements or impacts are greater than predicted, BHPBIC will initiate management and/or contingency actions, including investigating reasons for the occurrence.

All data from the Monitoring Program will be available to technical experts and government agencies. BHPBIC has provided significant quantities of data for the refinement of predictive models and research related to mining induced subsidence and will continue to measure this important and useful information.

Subsidence movement monitoring supports other components of the Monitoring Program. This is important for impact assessment, mitigation and rehabilitation. Regular reviews of subsidence data will be undertaken, and an End of Panel Report on subsidence for Longwalls 37 and 38 will be undertaken following the completion of extraction.

The Monitoring Program would include a number of components as detailed below.

6.1.1 Airborne Laser Scanning

Due to the efficiencies of remote sensing in this area, the primary method of monitoring the subsidence bowl over West Cliff Area 5 will be via Airborne Laser Scanning (ALS). This

technique generates a complete topographic model of the terrain. A Base survey for the area above Longwalls 37 and 38 will be conducted prior to extraction.

Contours of the complete subsidence bowl from each longwall will be provided. A survey is generally completed after the completion of each longwall; and subsequently, 12 months following the completion of longwall extraction in each mining domain.

6.1.2 3D Survey Points

Selected 3D survey marks will be established and monitored to augment the ALS data. The points will be established in accessible areas as control for the ALS and at selected features sensitive to subsidence movements.

6.1.3 2D Survey Lines

Monitoring of 2D subsidence will be undertaken at selected lines throughout the Study Area. Where applicable these lines will be integrated with the existing 2D Monitoring Lines in West Cliff Area 5.

6.2 ENVIRONMENTAL CONSEQUENCES OF SUBSIDENCE

Monitoring of the environmental and other consequences of subsidence includes recommended monitoring regimes detailed in the management plans and associated Trigger Action Response Plans (TARPs). **Table 6.1** provides a directory to each of the feature specific monitoring.

Table 6.1 – Monitoring Directory

Monitoring Component	Documentation	Monitoring Summary	Location
Natural Features			
Rivers or Creeks	Assessments of surface water and groundwater have been developed to manage the potential impacts on the Georges River and other watercourses as a result of the extraction of Longwalls 37 and 38.	Baseline surface flow and water quality monitoring have been undertaken in Georges River, Mallaty Creek and Nepean Creek upriver and adjacent to proposed Longwalls 37 and 38. This will continue up until the commencement of Longwall 37. The stream surface flow and quality monitoring program would continue during extraction of Longwalls 37 and 38; and 2 years post mining.	<ul style="list-style-type: none"> • Extraction Plan: Annex C - Water Management Plan, Section 6.1.1 & 6.1.2 • Assessment of Water Quality Effects and Water Quality Monitoring Plan, West Cliff Colliery Longwalls 37 and 38 (Ecoengineers, 2013) • West Cliff Longwalls 37 and 38 Groundwater Assessment (GeoTerra 2013)
Cliffs, Steep Slopes	Assessments of cliffs and steep slopes in the Study Area have been conducted to manage the potential impacts of extraction of Longwalls 37 and 38. The Land Management Plan addresses monitoring, response action, reporting and public safety.	A detailed Subsidence Movement Survey Plan will be developed in consultation with key stakeholders, including Principal Subsidence Engineer, prior to mining.	<ul style="list-style-type: none"> • Extraction Plan: Annex E - Land Management Plan Section 6.1 • West Colliery, Longwalls 37 and 38 Subsidence Predictions and Impact Assessments (MSEC 2013)
Public Utilities			
Roads	Appin Road intersects Longwall 37, due to the distance from Longwall 38, prediction results for Longwall 37 only were presented. A management plan for Longwalls 34 to 36 will be extended to include predicted movements resulting from extraction of Longwall 37.	Subsidence movement monitoring will be installed prior to mining to measure subsidence movements at sensitive features in proximity to Longwalls 37 and 38.	<ul style="list-style-type: none"> • Extraction Plan: Annex H - Built Features Management Plan Section 6.1
Local Roads – Culverts	BHPBIC has developed a Public Road Management Plan for the longwalls at West Cliff and Appin Area 7 to manage the potential impacts on road drainage culverts. The Management Plan was developed in consultation with the Wollondilly Shire Council, the Roads and Traffic Authority and the Mine Subsidence Board. It is proposed that the Management Plan be reviewed and, where required, revised to include the local roads within the potentially affected area.	The management strategies and associated monitoring will be extended to include the proposed Longwalls 37 and 38.	<ul style="list-style-type: none"> • Extraction Plan Annex H, Built Features Management Plan Section 6.1

Monitoring Component	Documentation	Monitoring Summary	Location
Sydney Water Infrastructure	Management strategies have been developed by BHPBIC, in consultation with Sydney Water, to manage the impacts on water infrastructure at West Cliff Colliery. It is proposed that these management strategies are extended to include the proposed Longwalls 37 and 38.	The management strategies and associated monitoring will be extended to include the proposed Longwalls 37 and 38.	<ul style="list-style-type: none"> Extraction Plan Annex H, Built Features Management Plan Section 6.1
Electrical Infrastructure	A management plan has been established for the electrical infrastructure for Longwalls 34 to 36. It is proposed that the existing management plan be reviewed, in consultation with the infrastructure owners, and amendments made where necessary to include electrical infrastructure within the Study Area.	The management strategies and associated monitoring will be extended to include the proposed Longwalls 37 and 38.	<ul style="list-style-type: none"> Extraction Plan Annex H, Built Features Management Plan Section 6.1
Telecommunication Lines or Associated Plant	BHPBIC has developed specific telecommunication infrastructure management plans for the longwalls within West Cliff Area 5 to manage the potential impacts on copper and optical fibre cables owned by Telstra, Optus, NextGen and PowerTel. The Management Plans were developed in consultation with telecommunications experts and the infrastructure owners. The Management Plans will be reviewed and, where required, revised to incorporate the telecommunications infrastructure within the Study Area.	The management strategies and associated monitoring will be extended to include the proposed Longwalls 37 and 38.	<ul style="list-style-type: none"> Extraction Plan Annex H, Built Features Management Plan Section 6.1
Residential Establishments			
Houses	<p>BHPBIC has developed a number of management strategies for houses which have been directly mined beneath by previously extracted longwalls at Appin, Tower and West Cliff Collieries. Similar management strategies will be developed for the houses within the potentially affected area.</p> <p>BHPBIC will prepare Property Subsidence Management Plans (PSMPs) for all landholders within the Study Area, similar to those which have been prepared for the properties at Appin</p>	<p>The PSMPs will include any recommendations from structural assessments of the houses. The PSMPs are also anticipated to include the following where access is provided to the property:</p> <ul style="list-style-type: none"> Inspection of houses considered to be at higher risk by a structural engineer or a suitably qualified building inspector prior to the longwall mining directly beneath them; Implementing any mitigation measures, where necessary to address specific 	<ul style="list-style-type: none"> Extraction Plan Annex H, Built Features Management Plan Section 6.1

Monitoring Component	Documentation	Monitoring Summary	Location
	<p>Area 7 and West Cliff Colliery. The PSMPs will address the management of all surface infrastructures including the houses and will include subsidence movement monitoring where required.</p>	<p>identified risks to public safety;</p> <ul style="list-style-type: none"> • Undertaking detailed monitoring of ground movements at or around structures, where necessary to address specific identified risks to public safety; • Periodic inspections of structures that are considered to be at risk. These may include: <ul style="list-style-type: none"> - Structures in close proximity to steep slopes where recommended by a geotechnical or subsidence engineer, - Structures identified as being potentially unstable where recommended by a structural or subsidence engineer, and - Pool fences. 	
<p>Associated Structures</p>	<p>As above</p>	<p>As above</p>	<p>As above</p>

7 MONITORING VALIDATION

The performance of the Monitoring Program is validated through ongoing reporting and review as outlined below and with contingency measures in place should environmental consequences exceed predictions.

7.1 REPORTING

The Monitoring Program survey results are typically reported within 48 hours of the completion of a survey. Results will be forwarded electronically in an “Excel” spread sheet to asset owners, technical experts and regulators as prescribed in the various management plans. Particular and specific presentable formats (i.e. coordinate listings, relative / absolute movements, and graphical representation) will be defined in consultation with key stakeholders, including asset owners. Embedded within the spread sheet is a plan showing the nominal position of the longwall currently being mined at the time of the survey.

Section 6.2 of each Management Plan contains monitoring and reporting requirements. Reporting is generally undertaken at the completion of baseline data collection, as well as annually in the Annual Environmental Management Report (AEMR), in accordance with *Condition 4, Schedule 6* of the BSO approval. The AEMR details the outcomes of monitoring undertaken, as well as providing results of visual inspections to determine whether performance indicators have been exceeded and whether mitigation/contingency measures are required.

End of Panel (EoP) reports would be prepared and submitted to the relevant government agencies on completion of extraction from each longwall. The EoP reports would detail the findings of the monitoring programs and inspections associated with the longwall extraction.

7.2 REVIEW

All survey results are checked, reviewed and assessed prior to reporting, with further review performed by BHPBIC’s Subsidence Management Committee which meets on a monthly basis. The analysis undertaken by the Subsidence Management Committee includes:

- Comparison of predicted subsidence effects and measured parameters.
- Comparison of predicted subsidence impacts and measured impacts.
- Analysis of any variations between predicted and measured subsidence effects and impacts (e.g. consideration of underlying parameters to determine the predicted subsidence profile); analysis of variations between predicted and measured non-systematic subsidence effects and impacts.
- Analysis of the 3D movement associated with longwall extraction with particular reference to the transverse and longitudinal movements versus distance in advance of the longwall panel.

The analysis will be used to assess the validity of the subsidence predictions detailed in the MSEC Report (2013) (refer to Extraction Plan, Annex A) and to provide feedback and data to MSEC to refine the predictive methods where appropriate.

Should the movements be classed as ‘*greater than predicted*’ a review of the potential causes of the exceedance would be undertaken and mitigation/contingency measures implemented (refer to **Section 7.3**). The mitigation/contingency measures would be implemented to limit potential environmental consequences, improving the environmental performance of the project.

A comprehensive review of the objectives and targets associated with the BSO is undertaken on an annual basis via the BHPBIC Balanced Planning (1 year outlook) and Balanced Strategy (5 year outlook) processes. These reviews, which include involvement from senior management and other key personnel, assess the performance of the mine over the previous year and develop goals and targets for the following period.

If deficiencies in the Monitoring Program are identified in the interim period, the plans will be modified as required. This process has been designed to ensure that all environmental documentation continues to meet current environmental requirements, including changes in technology, operational practice, and the expectations of stakeholders.

7.3 CONTINGENCY PLAN

Contingency and emergency response options are available and will be implemented if it is demonstrated that environmental consequences are greater than those predicted or authorised by the BSO Consent. This would involve:

- Capture and record the event in a timely fashion.
- Notify relevant stakeholders as soon as practicable.
- Notify relevant agencies and specialists as soon as practicable.
- Conduct site visits with stakeholders as required.
- Contract specialists to investigate and report on changes identified.
- Provide incident reports to relevant agencies within seven days.
- Establish weekly monitoring frequency until stabilised.
- Monthly updates from specialists on investigation process.
- Inform relevant agencies and stakeholders of results of investigation within 1 week of completion.
- Develop site Corrective Management Action (CMA) in consultation with key stakeholders if required within 1 month, (pending stakeholder availability) and seek approvals.
- Implement CMA as agreed with stakeholders following approvals.
- Conduct initial follow up monitoring and reporting within two months of CMA completion.
- Review Management Plan within three months.
- Report in regular reporting and AEMR.

BHPBIC will consult with appropriate specialists and relevant agencies in order to devise an appropriate response in respect to any identified exceedance.

If the contingency measures implemented by BHPBIC fail to remediate the impact or the Director-General determines that it is not reasonable or feasible to remediate the impact BHPBIC will provide a suitable offset to compensate for the impact to the satisfaction of the Director-General of DP&I in accordance with *Condition 2, Schedule 3* of the BSO Approval.

The individual management plans supporting the Extraction Plan (Annex C – H) provide further detail relating to specific features and the actions that will be undertaken.

8 REFERENCES

Ecoengineers, 2013, *Assessment of Water Quality Flow and Quality Effects West Cliff Colliery Longwalls 37 and 38*. Report prepared for BHP Billiton Illawarra Coal.

Geoterra, 2013, *West Cliff Colliery Longwalls 37 and 38 Groundwater Assessment*. Report prepared for BHP Billiton Illawarra Coal.

Mine Subsidence Engineering Consultants, 2009, *Bulli Seam Operations Subsidence Assessment*. Report for BHP Billiton Illawarra Coal.

Mine Subsidence Engineering Consultants, 2013, *Subsidence Predictions and Impact Assessments for the West Cliff Colliery Longwalls 37 and 38*: Report Number: MSEC533 Revision B. A report to BHPBIC.

Niche Environment and Heritage Consultants, 2013a, *West Cliff Area 5 Longwalls 37 and 38 Biodiversity Impact Assessment*. Report prepared for BHP Billiton Illawarra Coal.

Niche Environment and Heritage Consultants, 2013b, *West Cliff Area 5 Longwalls 37 and 38 Heritage Impact Assessment*. Report prepared for BHP Billiton Illawarra Coal.

Attachment A – MASTER TARPs

Attachment A – West Cliff Area 5 Longwall 37 and 38 Key Monitoring

Monitoring Site	Monitoring Type	Monitoring Frequency	Monitoring Parameters	
SURFACE WATER				
Longwall 37				
Georges River Upstream monitoring site: • Pool 54 Downstream monitoring site: • Pool 64	<ul style="list-style-type: none"> Field testing of water quality parameters Grab sample for testing of specific analytes at an accredited laboratory Water level measurements (using benchmarks where they can be installed and/or photos) Observational and photographic monitoring 	<ul style="list-style-type: none"> Monthly before and after mining Weekly during mining (when the longwall is within 400 m) 	<p>Field Testing:</p> <ul style="list-style-type: none"> Field pH Temp EC DO % Sat ORP <p>Laboratory Analytes:</p> <ul style="list-style-type: none"> Filt Na, K, Ca, Mg Total Alk, Cl, Br, I Filt SO4 TSS, TDS Total Fe, Mn, Al Filt As, Cu Filt Pb, Ni, Se, Zn Filt Fe, Mn, Al TKN, NH₃-N NO_x-N (TON) FRP, TP DOC <p>Observations: Visual signs of impacts in creeks and drainage lines (i.e. fracturing, cracking, diversion of flow, vegetation changes, increased erosion, water cloudiness, iron staining etc.) determined by comparing baseline photos with photos during the mining period</p>	
Mallaty Creek Downstream monitoring sites: • MC100, MC106 and MC110				
Nepean Creek Downstream monitoring site: • NC10				
Tributary of Georges River Downstream monitoring site: • GR104 and 105				
Longwall 38				
Georges River Upstream monitoring site: • Pool 34 Adjacent monitoring site: • Pool 54 Downstream monitoring site: • GR100	<ul style="list-style-type: none"> Field testing of water quality parameters Grab sample for testing of specific analytes at an accredited laboratory Water level measurements (using benchmarks where they can be installed and/or photos) Observational and photographic monitoring 	<ul style="list-style-type: none"> Monthly before and after mining Weekly during mining (when the longwall is within 400 m) 		
Tributaries of Georges River Upstream monitoring site: • GR119 Adjacent monitoring sites: • GR107, GR108, GR110 Downstream monitoring sites: • GR102, GR103, GR114 and GR117				

AREA 5

	Monitoring Site	Monitoring Type	Monitoring Frequency	Monitoring Parameters
GROUNDWATER				
AREA 5	BHPBIC piezometers: <ul style="list-style-type: none"> GR27 GR28 GR29 Three additional sites subject to land access 	<ul style="list-style-type: none"> Field testing of water quality parameters Grab sample for testing of specific analytes at an accredited laboratory Water level (measured and logged at least twice daily) 	<ul style="list-style-type: none"> At least one pre-mining sample One sample following the completion of Longwall 37 One sample following the completion of Longwall 38 	Field Testing: <ul style="list-style-type: none"> pH EC Temperature Lab analytes TDS, filterable Na, Ca, K and SO₄; Cl, F, total alk., total and filterable Fe, Mn and Al; filterable Ni, Zn, As, Ba, Cs, Cu, Pb, Li, Rb, Se, Sr and B; Total nitrogen and phosphorous
	Private bores: <ul style="list-style-type: none"> GW32310 GW72454 GW105921 GW108322 	<ul style="list-style-type: none"> Monitoring as agreed in Property Subsidence Management Plans or as requested by landholder 	<ul style="list-style-type: none"> One pre-mining level measurement and water sample One post mining level measurement and water sample 	Field Testing: <ul style="list-style-type: none"> pH EC Temperature Lab analytes TDS, filterable Na, Ca, K and SO₄; Cl, F, total alk., total and filterable Fe, Mn and Al; filterable Ni, Zn, As, Ba, Cs, Cu, Pb, Li, Rb, Se, Sr and B; Total nitrogen and phosphorous
	BHPBIC piezometer: <ul style="list-style-type: none"> S2087 	<ul style="list-style-type: none"> Vibrating wire piezometers within a cemented hole (note that some are damaged due to ground shear) 	<ul style="list-style-type: none"> Monitoring of functional piezometers 	
	Groundwater inflows to the mine	<ul style="list-style-type: none"> Mine water budget 	<ul style="list-style-type: none"> Flow meters 	<ul style="list-style-type: none"> Water flow from the goaf to the mine (20 day average)
INSPECTION OF MINING AREA - LANDSCAPE FEATURES, VEGETATION, WATERCOURSES				
	All mapped cliffs, steep slopes and watercourses within the mining areas, including: <ul style="list-style-type: none"> Cliffs GR-CL01 and GR-CL02 Georges River including pools and rockbars (GR-RB42, GR-RB43, GR-RB44, GR-RB45, GR-RB47, GR-RB48, GR-RB49, GR-RB51, GR-RB52, GR-RB53, GR-RB54, GR-RB55, GR-RB56a, GR-RB56b, GR-RB57, GR-RB59, GR-RB60, GR-RB61, GR-RB62, GR-RB63, GR-RB64, GR-RB65, GR-RB66, GR-RB67) Tributaries (GR103, GR104, GR105, GR107, GR108, GR110, GR114) 	Site inspections include: <ul style="list-style-type: none"> General inspection of active subsidence areas Re-visits to identified impact sites 	<ul style="list-style-type: none"> Monthly before and after mining Weekly during mining (when the longwall is within 400 m) 	Inspections will target observations, measurements and photos of: <ul style="list-style-type: none"> Drainage areas and inundation Disturbance at a site Erosion and aggradations Rock fracturing and soil cracking Changes in runoff Changes in vegetation Impacts to fauna/fish Rockfalls Gas releases

Monitoring Site		Monitoring Type	Monitoring Frequency	Monitoring Parameters
AQUATIC ECOLOGY				
AREA 5	Longwalls 37 and 38: <ul style="list-style-type: none"> • Site 6 • Site 7 • Site 8 • Site 9 • Site 10 • Site 118 	<ul style="list-style-type: none"> • Observations of pool water level and connectivity, changes to habitat • Quantitative sampling 	<ul style="list-style-type: none"> • Observations monthly before and after mining and weekly during mining (when the longwall is within 400 m) • Two baseline monitoring campaigns in Spring prior to mining, Spring monitoring during mining, monitoring post mining for two years or as otherwise required 	
ABORIGINAL ARCHAEOLOGY				
AREA 5	Longwalls 37 and 38: <ul style="list-style-type: none"> • 52-2-0021 • 52-2-3583 • 52-2-2062 • 52-2-2064 • 52-2-2066 • 52-2-1680 • 52-2-1682 • 52-2-2234 • 52-2-2235 • 52-2-2236 • 52-2-2237 • 52-2-2240 • 52-2-2241 • 52-2-2242 • 52-2-2243 • 52-2-2244 • 52-2-2063 • 52-2-2264 • 52-2-2265 • 52-2-2266 • 52-2-2284 • 52-2-3690 • 52-2-3691 • 52-2-2036 	<ul style="list-style-type: none"> • Observational and photographic monitoring in consultation with stakeholders 	<ul style="list-style-type: none"> • Baseline archival recording prior to longwall mining • Sandstone shelter Aboriginal sites will be monitored during mining • First impact assessment recording following initial subsidence movement of the site • Further impact assessment recording twelve months after undermining or final subsidence movement of the site 	<ul style="list-style-type: none"> • Re-recording of the principal components identified by Sefton (Sefton 2000) • Macro and micro recording using digital photography (Navin Officer 2003) • Detailed elevation plans of shelter walls recording structural and surface features including but not limited to the art, graffiti, joints, bedding planes, exfoliation, cracks, mineral and micro-organism growth, drip line and water seepage locations
EUROPEAN HERITAGE				
AREA 5	Longwall 38: <ul style="list-style-type: none"> • Site WH1 (bridge and road remains) 	<ul style="list-style-type: none"> • Observational monitoring 	<ul style="list-style-type: none"> • Impact assessment recording following identification of any impacts to site • Final assessment recording following the completion of subsidence 	<ul style="list-style-type: none"> • Pre-mining inspection and assessment • Observational monitoring to identify subsidence impacts • Assessment of heritage impacts by a suitably qualified heritage expert (if required)

Attachment A – West Cliff Area 5 Longwall 37 and 38 Master TARP, Key Monitoring, Triggers and Response

Monitoring	Trigger	Action
WATER QUALITY		
Adjacent and downstream sites for Longwalls 37 and 38. <ul style="list-style-type: none"> • Georges River: <ul style="list-style-type: none"> - Pool 54 - Pool 64 and - GR100 	Level 1 * <ul style="list-style-type: none"> • Temporary reduction in water quality (observed for 2 consecutive months) at any site when comparing the baseline period to mining period for that site i.e. : <ul style="list-style-type: none"> - pH drop between 0.5 and 1.0 units from the minimum baseline value 	<ul style="list-style-type: none"> • Continue monitoring program • Report trigger to key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR
	Level 2 * <ul style="list-style-type: none"> • Temporary reduction in water quality (observed for 2 consecutive months) at any site when comparing the baseline period to mining period for that site i.e.: <ul style="list-style-type: none"> - pH drop between 1.0 and 1.5 units from the minimum baseline value 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 1</i> • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	Level 3 * <ul style="list-style-type: none"> • Reduction in water quality (observed for more than 2 consecutive months) when comparing the baseline period to mining period for that site i.e.: <ul style="list-style-type: none"> - pH drop of 1.5 units from the minimum baseline value 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 2</i> • Notify DP&I, DPI, relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> - Emplacement of sandstone rocks in constricted stream flow areas to increase the aeration capacity where it is appropriate to do so - Grouting of fractures which result in flow diversion • Completion of works following approvals • Issue CMA report within 1 month of works completion • Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	Exceeding Performance Measures <ul style="list-style-type: none"> • Subsidence impacts or environmental consequences greater than minor 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful

Monitoring	Trigger	Action
GROUNDWATER		
<p>BHPBIC Piezometers:</p> <ul style="list-style-type: none"> • GR18 • GR21 • GR27 • GR28 • GR30 • GR55 <p>Private bores:</p> <ul style="list-style-type: none"> • GW32310 • GW72454 • GW105921 • GW108322 <p>Mine water budget</p>	<p>Level 1 *</p> <ul style="list-style-type: none"> • Increase in water flow from the goaf between 2.7-3 ML/day (20 day average) • 5.0 – 7.5 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period <p>Level 2 *</p> <ul style="list-style-type: none"> • Rise in water flow from the goaf between 3-3.4ML (20 day average) • 7.5 – 10 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period <p>Level 3 *</p> <ul style="list-style-type: none"> • Abnormal rise in water flow from the goaf >3.4ML (20 day average) • >10m reduction in the Hawkesbury Sandstone standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period • Total loss of groundwater level within the bore <p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • Subsidence impacts or environmental consequences greater than minor 	<ul style="list-style-type: none"> • Continue monitoring program • Report trigger to key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR <hr/> <ul style="list-style-type: none"> • <i>Actions as stated for Level 1</i> • Review monitoring program • Review impacts against the Performance Measures • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <hr/> <ul style="list-style-type: none"> • <i>Actions as stated for Level 2</i> • Notify DP&I, DPI, relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> - Any actions agreed to in the Property Subsidence Management Plan - Provision of alternate water supply where this has been impacted by mining • Completion of works following approvals • Issue CMA report within 1 month of works completion • Review the TARP and Management Plan in consultation with key stakeholders <hr/> <ul style="list-style-type: none"> • <i>Actions as stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
APPEARANCE AND POOL WATER LEVEL		
<p>Georges River:</p> <ul style="list-style-type: none"> • Mapped pools 	<p>Level 1 *</p> <ul style="list-style-type: none"> • Fracturing with no observable surface water diversion • Pool water level lower than baseline in any mapped pool located in the mining area (within 400m of the longwall) • Increase in turbidity, iron staining, algal growth, or other visible water quality parameters determined by comparing baseline photos with photos during the mining period 	<ul style="list-style-type: none"> • Continue monitoring program • Report trigger to key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR

Monitoring	Trigger	Action
	<p>Level 2 *</p> <ul style="list-style-type: none"> Pool water level lower than baseline in the majority of mapped pools located in the mining area (within 400m of the longwall) Fracturing with observable surface water diversion 	<ul style="list-style-type: none"> Actions as stated for Level 1 Review monitoring program Review impacts against the Performance Measures Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts. Prevailing rainfall and catchment conditions will be taken into account when assessing pool water level response and the need for CMAs</i></p>
	<p>Level 3 *</p> <ul style="list-style-type: none"> Pool water level lower than baseline in all mapped pools in the mining area (within 400m of the longwall) Fracturing with observable water diversion results in any mapped pool becoming dry 	<ul style="list-style-type: none"> Actions as stated for Level 2 Notify DP&I, DPI, relevant resource managers and technical specialists and seek advice on any CMA required Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Grouting of fractures which result in flow diversion Completion of works following approvals Issue CMA report within 1 month of works completion Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts. Prevailing rainfall and catchment conditions will be taken into account when assessing pool water level response and the need for CMAs</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> More than negligible diversion of flows or changes in the natural drainage behaviour of pools over more than 20% of the stream length subject to vertical subsidence >20mm More than negligible increase in water cloudiness over more than 20% of the stream length subject to vertical subsidence >20mm More than negligible increase in iron staining over more than 20% of the stream length subject to vertical subsidence >20mm Subsidence impacts or environmental consequences greater than minor 	<ul style="list-style-type: none"> Actions as stated for Level 3 Investigate reasons for the exceedance Update future predictions based on outcomes of the investigation Provide environmental offset if CMAs are unsuccessful

Monitoring	Trigger	Action
LANDSCAPE FEATURES		
<p>Cliffs:</p> <ul style="list-style-type: none"> GR-CL01 and GR-CL02 <p>Steep slopes</p> <p>Georges River – including pools and rockbars:</p> <ul style="list-style-type: none"> GR-RB42 GR-RB43 GR-RB44 	<p>Level 1 *</p> <ul style="list-style-type: none"> Rock fall from a cliff where the cliff is left mostly intact (<10% length of the cliff) Surface movement or rock displacement where any exposed soil surface is stable Crack at the surface which does not result in ongoing erosion or ground movement Erosion which stabilises within the period of monitoring without CMA Crack or fracture up to 100mm width Crack or fracture up to 10m length 	<ul style="list-style-type: none"> Continue monitoring program Report trigger to key stakeholders Summarise impacts and report in the End of Panel Report and AEMR
<ul style="list-style-type: none"> GR-RB45 GR-RB47 GR-RB48 GR-RB49 GR-RB51 GR-RB52 GR-RB53 GR-RB54 GR-RB55 GR-RB56a 	<p>Level 2 *</p> <ul style="list-style-type: none"> Rock fall from cliff where the characteristics of the cliff change (>10% length of the cliff) Ground disturbance that is unlikely to stabilise within the period of monitoring without CMA Mass movement of a slope causing areas of exposed soil Crack or fracture between 100 and 300mm width Crack or fracture between 10 and 50m length 	<ul style="list-style-type: none"> Actions as stated for Level 1 Review monitoring program Review impacts against the Performance Measures Notify relevant technical specialists and seek advice on any CMA required Provide safety signage and barricades as appropriate Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
<ul style="list-style-type: none"> GR-RB57 GR-RB59 GR-RB60 GR-RB61 GR-RB62 GR-RB63 GR-RB64 GR-RB65 GR-RB66 GR-RB67 	<p>Level 3 *</p> <ul style="list-style-type: none"> Cliff collapse (100% length of cliff) Ground disturbance that does not stabilise within the period of monitoring Mass movement of a slope causing areas of exposed soil that does not stabilise within the period of monitoring Crack or fracture over 300mm width Crack or fracture over 50m length 	<ul style="list-style-type: none"> Actions as stated for Level 2 Notify DP&I, DPI, relevant resource managers and technical specialists and seek advice on any CMA required Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Erosion prevention works Establishment of vegetation Completion of works following approvals Issue CMA report within 1 month of works completion Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>

Monitoring	Trigger	Action
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> For cliffs of 'special significance' - more than negligible environmental consequences (i.e. more than occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total impact more than 0.5% of the total face area of such cliffs within any longwall mining domain) Other cliffs - more than minor environmental consequences (that is occasional rockfalls, displacement or dislodgment of boulders or slabs or fracturing, that in total impact more than 3% of the total face area of such cliffs within any longwall mining domain) 	<ul style="list-style-type: none"> Actions as stated for Level 3 Investigate reasons for the exceedance Update future predictions based on the outcomes of the investigation
AQUATIC ECOLOGY		
<p>Pool water level, connectivity of pools and habitat changes</p> <p>Longwall 37:</p> <ul style="list-style-type: none"> Site 9 Site 10 and Site 11 <p>Longwall 38:</p> <ul style="list-style-type: none"> Site 3 and Site 8 <p>General observations of the mining area</p>	<p>Level 1 *</p> <ul style="list-style-type: none"> Reduction of aquatic habitat for 1 season <p>Level 2 *</p> <ul style="list-style-type: none"> Reduction of aquatic habitat for 2 seasons <p>Level 3 *</p> <ul style="list-style-type: none"> Reduction of aquatic habitat for >2 seasons or complete loss of habitat <p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Subsidence impacts or environmental consequences greater than minor More than negligible environmental consequences in respect of threatened species, threatened populations, or EEC's 	<ul style="list-style-type: none"> Continue monitoring program Report trigger to key stakeholders Summarise impacts and report in the End of Panel Report and AEMR <p>Level 1</p> <ul style="list-style-type: none"> Actions as stated for Level 1 Review monitoring program Review impacts against the Performance Measures Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p> <p>Level 2</p> <ul style="list-style-type: none"> Actions as stated for Level 2 Notify DP&I, DPI, relevant resource managers and technical specialists and seek advice on any CMA required Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Grouting of fractures which result in flow diversion Completion of works following approvals Issue CMA report within 1 month of works completion Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p> <p>Level 3</p> <ul style="list-style-type: none"> Actions as stated for Level 3 Investigate reasons for the exceedance Update future predictions based on outcomes of the investigation Provide environmental offset if CMAs are unsuccessful

Monitoring	Trigger	Action
TERRESTRIAL FLORA AND FAUNA		
<p>General observation of active mining areas including:</p> <p>Cliffs:</p> <ul style="list-style-type: none"> GR-CL01 and GR-CL02 <p>Steep slopes</p> <p>Georges River – including pools and rockbars:</p> <ul style="list-style-type: none"> GR-RB42 GR-RB43 GR-RB44 GR-RB45 GR-RB47 GR-RB48 GR-RB49 GR-RB51 GR-RB52 GR-RB53 GR-RB54 GR-RB55 GR-RB56a GR-RB56b GR-RB57 GR-RB59 GR-RB60 GR-RB61 GR-RB62 GR-RB63 GR-RB64 GR-RB65 GR-RB66 GR-RB67 	<p>Level 1 *</p> <ul style="list-style-type: none"> Vegetation impacted by mining (e.g. rockfalls, soil slippage, gas emissions) that naturally regenerates within the monitoring period 	<ul style="list-style-type: none"> Continue monitoring program Report trigger to key stakeholders Summarise impacts and report in the End of Panel Report and AEMR
	<p>Level 2 *</p> <ul style="list-style-type: none"> Vegetation impacted by mining (e.g. rockfalls, soil slippage, gas emissions) that does not regenerate within the monitoring period 	<ul style="list-style-type: none"> Actions as stated for Level 1 Review monitoring program Review impacts against the Performance Measures Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Level 3 *</p> <ul style="list-style-type: none"> Vegetation impacted by mining that is not responding to CMAs 	<ul style="list-style-type: none"> Actions as stated for Level 2 Notify DP&I, DPI, relevant resource managers and technical specialists and seek advice on any CMA required Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Erosion prevention works Establishment of vegetation Completion of works following approvals Issue CMA report within 1 month of works completion Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Subsidence impacts or environmental consequences greater than minor More than negligible environmental consequences in respect of threatened species, threatened populations, or endangered ecological communities 	<ul style="list-style-type: none"> Actions as stated for Level 3 Investigate reasons for the exceedance Update future predictions based on outcomes of the investigation Provide environmental offset if CMAs are unsuccessful

Monitoring	Trigger	Action
ABORIGINAL ARCHAEOLOGY		
Area 5: <ul style="list-style-type: none"> • 52-2-2064 • 52-2-2234 • 52-2-2236 • 52-2-2241 • 52-2-2242 • 52-2-2243 • 52-2-2062 • 52-2-2063 • 52-2-2264 • 52-2-3691 	Level 1 * <ul style="list-style-type: none"> • Change in shelter conditions not attributable to natural weathering or preservation – mineral growth or micro-organism growth (as observed by comparing pre-mining photographs with post-subsidence/mining photographs) • Changes external to the shelter that affect the site context (e.g. ground cracking, boulder slumping, rock and/or tree falls) 	<ul style="list-style-type: none"> • Continue monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders (e.g. Registered Aboriginal Parties) • Summarise impacts and report in the End of Panel Report and AEMR
	Level 2 * <ul style="list-style-type: none"> • Change in shelter conditions not attributable to natural weathering or preservation – change in drip line or seepage, cracking or exfoliation of overhang or shelter, movement or opening of existing planes and joints at panel, block fall within shelter or overhang, shelter or overhang collapse 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 1</i> • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with Registered Aboriginal Parties and the landowner
	Level 3 * <ul style="list-style-type: none"> • Level 2 impacts at greater frequency than predicted • Level 2 impacts attributable to mining remote from the mining area 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 2</i> • Investigate reasons for the impacts • Update future predictions based on outcomes of the investigation
	Exceeding Performance Measures <ul style="list-style-type: none"> • More than negligible environmental consequences for sites determined to hold “special significance” as a result of the studies required for Extraction Plans • More than 10% of sites determined to hold high or moderate significance as a result of studies for Extraction Plans (or 1 such site, whichever is the greater) within any longwall mining domain are/is affected by subsidence impacts (other than minor impacts or environmental consequences) • More than 10% of other Aboriginal heritage sites (or 1 such site, whichever is the greater) within any longwall mining domain are/is affected by subsidence impacts (other than minor impacts or environmental consequences) 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on outcomes of the investigation
EUROPEAN HERITAGE		
Longwall 38: <ul style="list-style-type: none"> • Site WH1 (bridge and road remains) 	Level 1 * <ul style="list-style-type: none"> • Changes external to the site that affect the site context (e.g. ground cracking) 	<ul style="list-style-type: none"> • Continue monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR

Monitoring	Trigger	Action
	Level 2 * <ul style="list-style-type: none"> Change in site conditions not attributable to natural weathering or preservation – movement or opening of existing fractures, bedding planes and joints 	<ul style="list-style-type: none"> Actions as stated for Level 1 Review monitoring program Review impacts against the Performance Measures Develop site management plan to mitigate effects in consultation with stakeholders, where appropriate
	Level 3 * <ul style="list-style-type: none"> Fracturing of the bridge footings 	<ul style="list-style-type: none"> Actions Stated for Level 2 Investigate reasons for the impacts Update future predictions based on outcomes of the investigation
	Exceeding Performance Measures <ul style="list-style-type: none"> Loss of heritage value greater than predicted under the HMP 	<ul style="list-style-type: none"> Actions as stated for Level 3 Investigate reasons for the exceedance Update future predictions based on outcomes of the investigation

* These may be revised in consultation with DP&I and DPI and other key stakeholders following analysis of natural variability within the pre-mining baseline data. These TARP's relate to West Cliff Area 5 Longwalls 37 and 38.

Office of Environment and Heritage (OEH)

Department of Planning and Infrastructure (DP&I)

Department of Primary Industries: including Division of Resources and Energy, Office of Water, Fisheries (DPI)