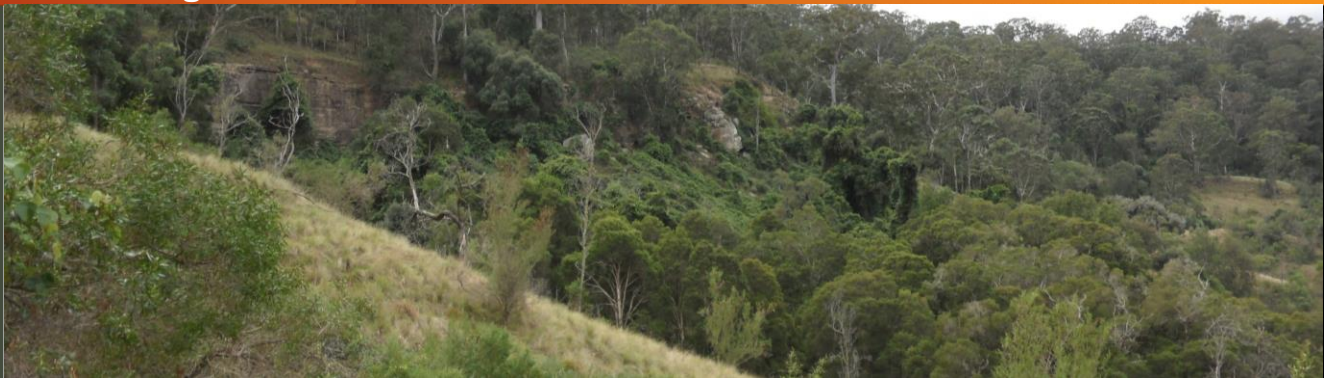


Metallurgical Coal



ANNEX E LAND MANAGEMENT PLAN

WEST CLIFF AREA 5 LONGWALLS 37 AND 38 EXTRACTION PLAN

Document No: <ADD No. HERE>

Rev: A

<ADD No. HERE> Rev A



Table of Contents

1	INTRODUCTION	1
1.1	PROJECT BACKGROUND	1
1.2	SCOPE.....	1
1.3	OBJECTIVES	2
2	STATUTORY REQUIREMENTS	4
2.1	BSO APPROVAL.....	4
2.2	LEGISLATION AND GUIDELINES	5
2.3	RELEVANT LEASES AND LICENCES.....	5
3	BASELINE ASSESSMENT	6
3.1	CLIFFS, STEEP SLOPES AND ROCK OUTCROPS.....	6
3.1.1	Existing Environment	6
3.2	BASELINE RECORDING	7
3.2.1	Slope Stability Assessment.....	7
3.2.2	Cliff Stability Assessment.....	9
3.2.3	Rock Outcrops	9
4	PREDICTED IMPACTS	9
4.1	STEEP SLOPES	9
4.1.1	Subsidence Effects	9
4.1.2	Subsidence Impacts.....	10
4.1.3	Environmental Consequences	11
4.2	CLIFFS AND OVERHANGS	12
4.2.1	Subsidence Effects	12
4.2.1	Subsidence Impacts.....	12
4.2.2	Environmental Consequences	13
5	PERFORMANCE MEASURES AND INDICATORS	14
6	MONITORING AND REPORTING.....	14
6.1	MONITORING PROGRAM.....	14
6.2	REPORTING	15
7	MANAGEMENT AND MITIGATION STRATEGIES	15

7.1	PROPERTY IN AREAS OF SENSITIVE TERRAIN	15
7.2	GEORGES RIVER CLIFF LINES	16
7.3	TARPS	16
8	CONTINGENCY AND RESPONSE PLANS	18
8.1	CONTINGENCY PLAN	18
9	INCIDENTS, COMPLAINTS, EXCEEDANCES AND NON-CONFORMANCES	19
9.1	INCIDENTS	19
9.2	COMPLAINTS HANDLING	19
9.3	NON-CONFORMANCE PROTOCOL	20
10	PLAN ADMINISTRATION	20
10.1	ROLES AND RESPONSIBILITIES	20
10.2	RESOURCES REQUIRED	22
10.3	TRAINING	22
10.4	RECORD KEEPING AND CONTROL	23
10.5	DOCUMENT CONTROL	23
10.6	MANAGEMENT PLAN REVIEW	23
11	REFERENCES	24

Tables

Table 2.1 – Management Plan Requirements	4
Table 2.2 – West Cliff Leases, Licences and other Reference Documents	6
Table 3.1 – Details of Cliffs within the vicinity of the Study Area (MSEC, 2013)	7
Table 4.1 – Maximum Predicted Total Conventional Subsidence, Tilt and Curvature after the Extraction of the Proposed Longwalls along the Georges River and tributaries (MSEC, 2013)	10
Table 4.2 – Maximum Predicted Total Conventional Subsidence Parameters Cliffs resulting from the Extraction of Proposed Longwalls (MSEC, 2013).....	12
Table 5.1 – Subsidence Impact Performance Measures	14
Table 7.1 – West Cliff Area 5 Trigger Action Response Plan (TARP)	17

Figures

Figure 1 – West Cliff Longwalls 37 to 38 Study Area.....	3
Figure 2 – Cliff, Steep Slopes and Rock outcrop locations	8

Review History

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

Persons involved in the development of this document include:

Name	Title	Company
Daniel Thompson	Environmental Planner	Cardno
Danyil Skora	Senior Environmental Planner	Cardno
Gary Brassington	Manager Approvals (Mining)	BHP Billiton Illawarra Coal

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 BSO (MP 08_0150) under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to continue these mining operations until 2041.

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

1.2 SCOPE

This LMP has been prepared by Cardno on behalf of BHPBIC in accordance with the BSO Approval (MP 08_150) *Condition 5 (j), 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:*
- j. include a **Land Management Plan**, which has been prepared in consultation with any affected public authorities, to manage the potential impacts and/or environmental consequences of the proposed second workings on land in general, with a specific focus on cliffs and steep slopes;*

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:

- 35⁰ 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 35⁰ 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 35⁰ 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.

Figure 2 illustrates the Study Area and the steep slopes, cliffs and rock outcrops for Longwalls 37 and 38, to which the Extraction Plan applies.

1.3 OBJECTIVES

The objectives of this LMP are to identify at risk land geomorphology and manage the potential environmental and safety consequences of the proposed workings on land in general.

Specific focus will be on cliffs and steep slopes including cliffs of 'special significance' (i.e. longer than 200 m and/or higher than 40 m and cliff like rock faces higher than 5 m that constitute waterfalls, as defined by BSO approval *Condition 1, Schedule 3*), and other cliffs flanking the Georges River and associated tributaries, as shown in **Figure 2** and the drawing in MSEC (2013), Drawing No. MSEC533-10.

Distribution

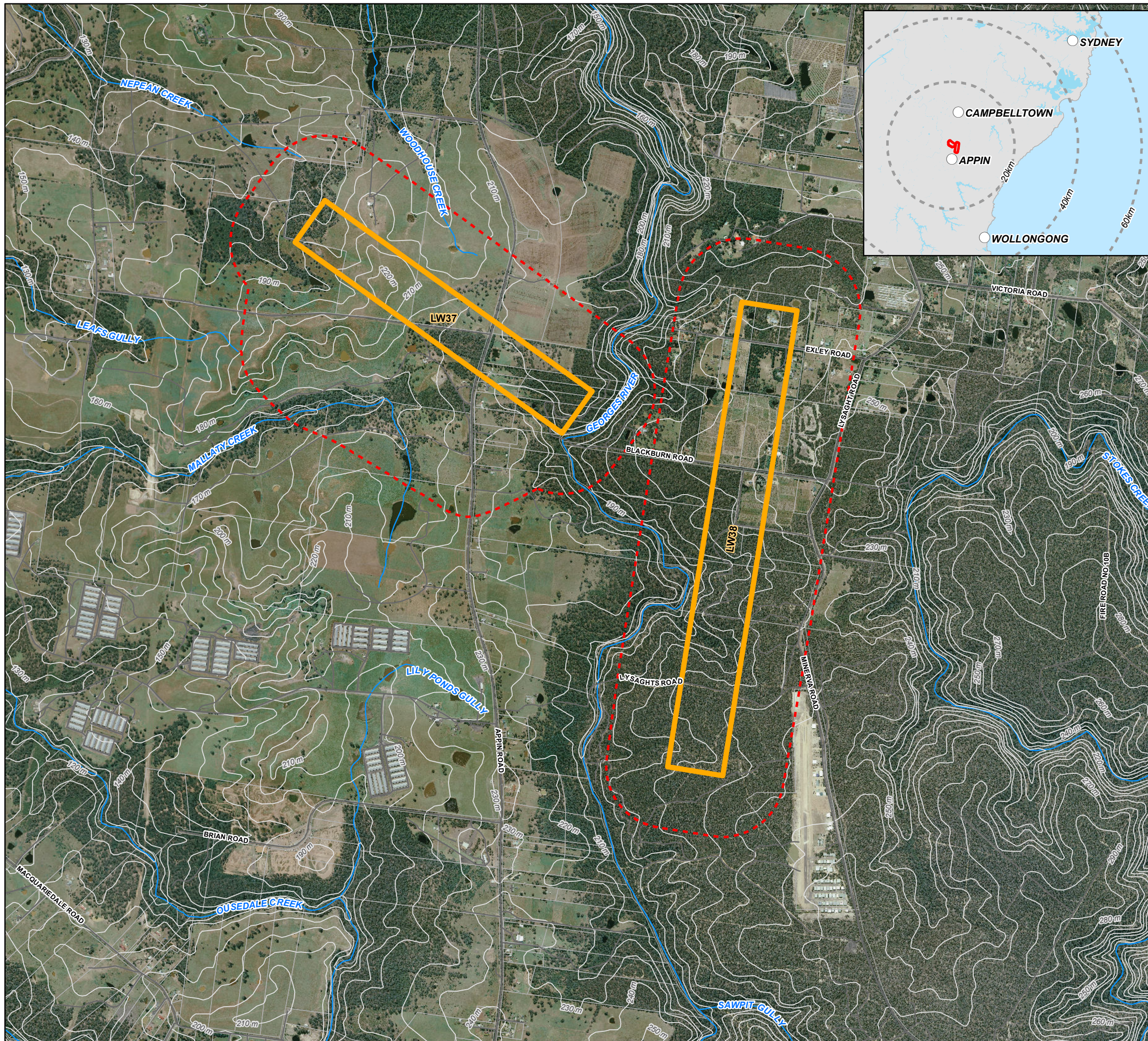
The finalised LMP will be distributed to:

- Department of Planning and Infrastructure (DP&I)
- Campbelltown City Council (CCC)
- Wollondilly Shire Council (WSC).

The Project Approval requires that this LMP be developed in consultation with any potentially affected public authorities.

Arrangements for individual private properties and assets will be made in the relevant Property Subsidence Management Plans (PSMPs) and or asset agreements to be negotiated with the property owners.

BHPBIC will make the LMP and other relevant environmental documentation publicly available on the BHPBIC website (*Condition 11, Schedule 6*).



West Cliff Area 5 Study Areas (LW37 and 38)

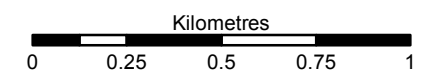
Legend

- - - 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)



2 STATUTORY REQUIREMENTS

Extraction of coal from Longwalls 37 and 38 will be in accordance with the conditions set out in the BSO Approval, and the requirements of relevant licences and permits (including conditions attached to mining leases).

2.1 BSO APPROVAL

Condition 5 (j), Schedule 3 of the BSO Approval requires the preparation of an LMP to manage the potential environmental consequences of the proposed workings on land in general in the Study Area, including a specific focus on cliffs and steep slopes (refer **Section 1.2**).

This LMP also addresses the requirements detailed in *Condition 6, Schedule 3* and *Condition 2, Schedule 6* of the BSO Approval as shown in **Table 2.1**.

Table 2.1 – Management Plan Requirements

Project Approval Condition	Relevant LMP Section
<p>Condition 6 – Schedule 3</p> <p>The Proponent shall ensure that the management plans required under <i>Condition 6(g)-(l)</i> above include:</p> <ul style="list-style-type: none"> (a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval; (b) a detailed description of the measures that would be implemented to remediate predicted impacts. 	<p style="text-align: center;">Section 4</p> <p style="text-align: center;">Section 7</p>
<p>Condition 2 – Schedule 6</p> <p>The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</p> <ul style="list-style-type: none"> (a) detailed baseline data; (b) a description of: <ul style="list-style-type: none"> – the relevant statutory requirements (including any relevant approval, licence or lease conditions); – any relevant limits or performance measures/criteria; – the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures; (c) a description of the measures that would be implemented to comply with the relevant statutory, limits, requirements or performance measures/criteria; 	<p style="text-align: center;">Section 3</p> <p style="text-align: center;">Section 2</p> <p style="text-align: center;">Section 5</p> <p style="text-align: center;">Sections 5 to 8</p> <p style="text-align: center;">Sections 5 to 8</p>

<i>Project Approval Condition</i>	<i>Relevant LMP Section</i>
(d) a program to monitor and report on the: <ul style="list-style-type: none"> - impacts and environmental performance of the project; - effectiveness of any management measures (see c above); 	Section 6
(e) a contingency plan to manage any predicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Section 8
(f) a program to investigate and implement ways to improve the environmental performance of the project over time;	Section 10
(g) a protocol for managing and reporting any: <ul style="list-style-type: none"> - incidents; - complaints; - non-compliances with statutory requirements; and - exceedances of the impact assessment criteria and/or performance criteria; and 	Section 9
(h) a protocol for periodic review of the plan.	Section 10

Due consideration has been given to all the BSO Approval Conditions in the preparation of this LMP, including those relating to auditing, rehabilitation and environmental management.

2.2 LEGISLATION AND GUIDELINES

This LMP conforms to the requirements of the relevant legislation and advisory documents and guidelines including:

- Australian Geo-mechanics Society Landslide Risk Management Guidelines, 2007.
- Australian Soil and Land Survey Field Handbook, 2009.

2.3 RELEVANT LEASES AND LICENCES

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

- Mining Leases as per **Table 2.2**.
- Environmental Protection Licence (EPL) 2504 which applies to BSO, including Appin and West Cliff Mines. A copy of the licence can be accessed at the EPA website via the following link <http://www.environment.nsw.gov.au/poeo>.
- West Cliff Mining Operations Plan (MOP) July 2007 to June 2014.
- All relevant OH&S and HSEC approvals.
- Any additional leases, licences or approvals resulting from the BSO Approval.

Table 2.2 – West Cliff Leases, Licences and 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 BASELINE ASSESSMENT

A Major Cliff Line Risk Assessment was conducted by BHPBIC (2009) to address the requirements of the PAC for inclusion in the BSO EA based on information provided by MSEC, Gilbert & Associates, Flora Search and Biosis Research.

The Cliff Line Risk Assessment included a description of the BSO mine parameters and likely types of subsidence impacts that might occur, the identification of significant natural features including major cliff lines, cliff lines of special significance, and an assessment of the risk of impacts and consequences to each cliff line. There were no Major Cliff Lines identified within the Longwall 37 and 38 Study Area.

A revised Baseline Assessment of the cliffs, rock outcrops and steep slopes within the Longwall 37 and 38 Study Area was conducted by MSEC (2013).

MSEC (2013) defines a *cliff* as a continuous rock face having a minimum height of 10 m and a minimum slope of 2 to 1 (i.e. having a minimum angle to the horizontal of 63 degrees). A *rock outcrop* is defined as an isolated rock-face having a height of less than 10 m. A *steep slope* is defined as an area of land having a natural gradient greater than 1 in 3 (i.e. grade of 33%, or an angle to the horizontal of 18°).

The locations of cliffs and steep slopes within the Study Area (**Figure 2**) were determined by MSEC (2013) from:

- Site investigations
- The ortho-photograph
- The 1 m surface level contours which were generated from an aerial laser scan of the area.

3.1 CLIFFS, STEEP SLOPES AND ROCK OUTCROPS

3.1.1 Existing Environment

Cliffs, steep slopes and rock outcrops have been identified within the Longwalls 37 and 38 Study Area and surrounds at locations described in **Table 3.1**.

Table 3.1 – Details of Cliffs within the vicinity of the Study Area (MSEC, 2013)

Cliff Ref.	Overall Length (m)	Maximum Height (m)	Description
GR-CL01	65	15	Along Georges river approximately 250 m west of Longwall 38 and 180 m south east of Longwall 35
GR-CL02	80	10	Along Georges River approximately 14 m south east of Longwall 37

The characteristics of cliffs, steep slopes and rock outcrops within the Study Area include:

- The cliffs are generally located within the valley of the Georges River and associated tributaries. There are no cliffs identified directly above the proposed longwalls.
- Rock outcrops are primarily located within stream valleys, particularly the Georges River.
- Rock faces with heights between 5 m and 10 m have been identified along the Georges River.
- Steep slopes are predominantly located along the alignment of the Georges River and its tributaries.
- Cliffs within the Study Area have formed from Hawkesbury Sandstone.

3.2 BASELINE RECORDING

3.2.1 Slope Stability Assessment

No large-scale slope failures have been observed along steep slopes in the Southern Coalfield, even where longwalls have been mined directly beneath them. Although no large scale slope failures have been observed in the Southern Coalfield, tension cracking has been observed at the tops of steep slopes as the result of downslope movements.

Cracks resulting from downslope movements at depths of cover greater than 400 m, as would be the case during the extraction of Longwalls 37 and 38, are generally isolated and narrow, typically having maximum widths in the order of 50 mm. Larger cracks have been observed at the tops of very steep slopes and adjacent to large rock formations, where maximum crack widths in the order of 100 mm to 150 mm have been observed at depths of cover greater than 400 m (MSEC, 2013).

**Locations of Cliffs,
 Steep Slopes and
 Rock Outcrops**

WESTCLIFF AREA 5
 LW 37 and 38

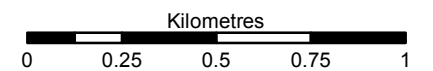
Legend

- - - Study Area
- █ Cliffs
- █ Rock Outcrops along Georges River 5-10m high
- Major Roads (LPI)
- Watercourses (LPI)
- █ Steep Slopes
- █ West Cliff LW 37 and 38 (BHPBIC 2013)

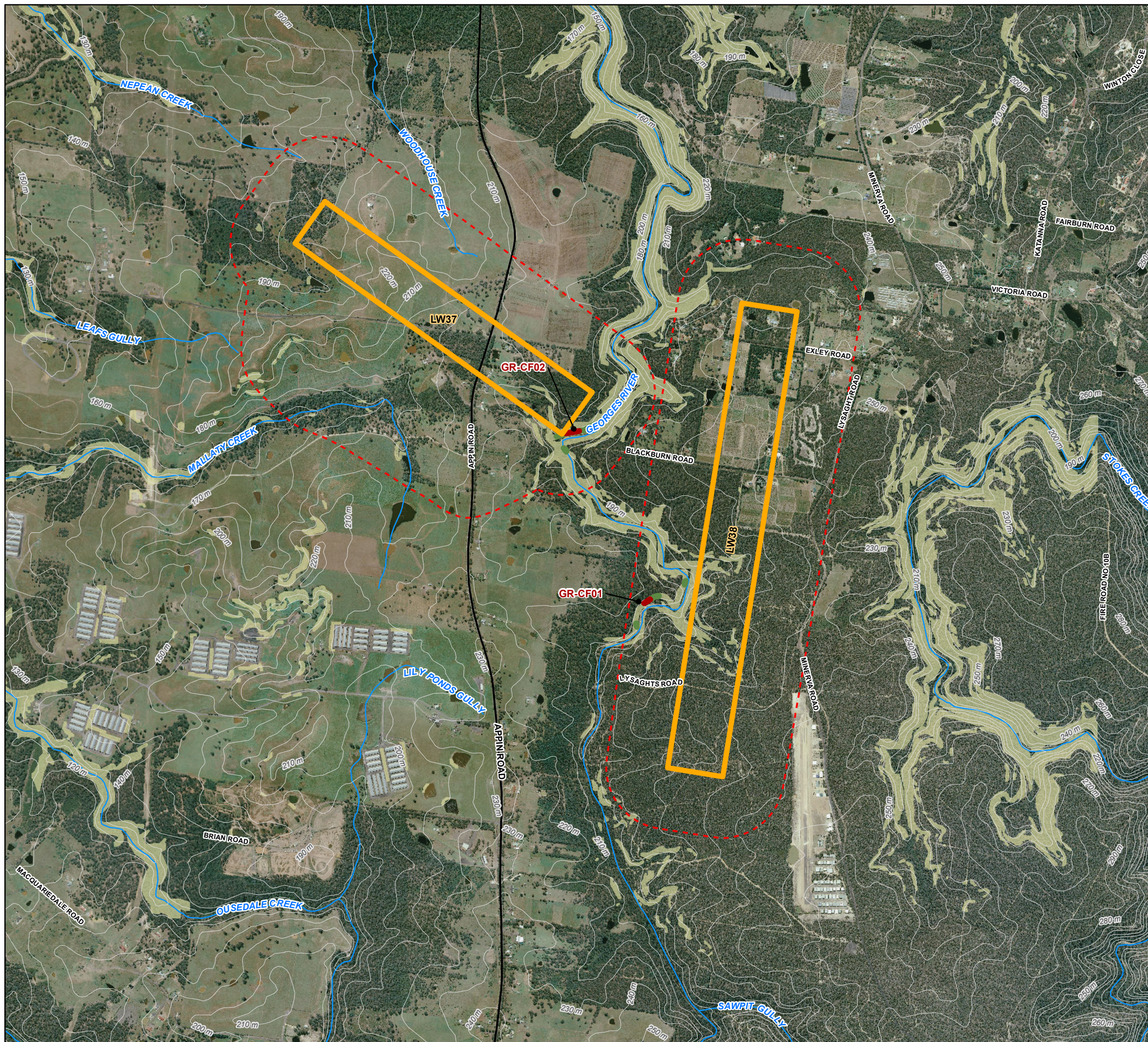


FIGURE 2

Scale 1:20,000 (at A3)



Map Produced by Cardno NSWACT Pty Ltd (WOL)
 Date: 14/03/2013
 Coordinate System: GDA 1994 MGA Zone 56
 Project: 112054-01
 Map: G1006_CliffsSteepSlopes.mxd 01
 Aerial imagery supplied by BHPBIC (2007 and 2009)



3.2.2 Cliff Stability Assessment

It is extremely difficult to assess the likelihood of cliff instabilities based upon predicted ground movements. The likelihood of a cliff becoming unstable is dependent on a number of factors which are difficult to fully quantify. These factors include jointing, inclusions, weaknesses within the rock mass, groundwater pressure and seepage flow behind the rock face. Even if these factors could be determined, it would still be difficult to quantify the extent to which these factors may influence the stability of a cliff naturally or when it is exposed to mine subsidence movements. It is therefore possible that cliff instabilities may occur during mining that may be attributable to either natural causes, mine subsidence or both.

MSEC (2013) researched case studies to assess the likelihood of cliff instabilities within the Study Area, where previous longwall mining has occurred close to, but not directly beneath cliffs. Minor rock falls have been observed over solid coal outside the extracted goaf areas of longwall mining in the Southern Coalfield. However, there have been no recorded cliff instabilities outside the extracted goaf areas of longwall mining in the Southern Coalfield. This is based on observations made at Appin Longwalls 301 and 302 near the Cataract River and Tower Longwalls 18 to 20 and Appin Longwalls 701 and 705 near the Nepean River.

3.2.3 Rock Outcrops

Longwall extraction is likely to result in some fracturing of the rock outcrops predominantly where outcrops are located above the existing and proposed longwalls and, where the rock is marginally stable, (MSEC, 2013). However, previous experience in the Southern Coalfield indicates that the percentage of rock outcrops that are likely to be impacted by mining is very small.

4 PREDICTED IMPACTS

In accordance with the findings of the Southern Coalfield Inquiry (SCI):

- **Subsidence effects** are defined as the deformation of ground mass such as horizontal and vertical movement, curvature and strains.
- **Subsidence impacts** are the physical changes to the ground that are caused by subsidence effects, such as tensile and shear cracking and buckling of strata.
- **Environmental consequences** are the flow on effects to the environment, for example, a loss of surface water flows and standing pools.

4.1 STEEP SLOPES

4.1.1 Subsidence Effects

The maximum predicted total conventional subsidence after the extraction of Longwalls 37 and 38, as determined by MSEC (2013) is provided in **Table 4.1**.

Table 4.1 – Maximum Predicted Total Conventional Subsidence, Tilt and Curvature after the Extraction of the Proposed Longwalls along the Georges River and tributaries (MSEC, 2013)

Longwalls	Maximum predicted Total Conventional Subsidence	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Curvature Hogging Curvature (km ⁻¹)	Maximum Predicted Total Conventional Sagging Curvature (km ⁻¹)
LW37	780	5.4	0.05	0.11
LW38	820	5.6	0.05	0.12

Slope instability is governed by slope angle, soil strength, and water pressures within the potentially unstable soil or rock mass (MSEC, 2013)

There is the potential for minor tilts associated with mine subsidence to alter the angle of potential slide planes. Where sliding occurs on low angle slide planes sliding can be triggered where tilts increase the angle of the slide planes in the down-slope direction.

The maximum predicted tilt at the steep slopes, resulting from the extraction of the proposed longwalls, is 5.9 mm/m, which represents a change in grade of 1 in 165. The predicted changes in grade are small comparative to the natural grades of the steep slopes therefore; the tilts are unlikely to result in any significant impact on stability (MSEC, 2013).

The steep slopes are more likely to be impacted by ground curvatures and strains. The potential impacts would generally result from the down slope movement of the soil, causing tension cracks to appear at the tops and on the sides of the slopes and compression ridges to form at the bottoms of the slopes (MSEC, 2013).

The maximum predicted ground curvatures for the steep slopes in the Study Area are similar to those typically experienced in the Southern Coalfield. The potential impacts on steep slopes are predicted to be similar to those previously observed in the Southern Coalfield, with no large-scale slope failures even where extraction has occurred directly beneath steep slopes (MSEC, 2013).

Other forms of ground movements besides systematic subsidence movements may occur within the Study Area as a result of the extraction of Longwalls 37 and 38. These are referred to as irregular subsidence movements, non-conventional movements and far-field effects.

A number of geological conditions may influence these non-conventional subsidence movements. These may include the blocky nature of near surface sedimentary strata layers and the possible presence of unknown dykes, faults, or other anomalous geological structures, cross-bedded strata, thin and brittle near surface strata layers and pre-existing natural joints.

The presence of these natural features could result in changes to an otherwise smooth subsidence profile. They are also usually accompanied by locally increased tilts and strains (MSEC, 2013).

4.1.2 Subsidence Impacts

Potential impacts on steep slopes from the extraction of Longwalls 37 and 38 are predicted to be similar to those previously observed in the Southern Coalfield (MSEC, 2013). To date

no large-scale mining induced slope failures have been identified, even in cases where longwalls have mined directly beneath existing areas of instability.

Tilting Impacts

Tilts within the Longwalls 37 and 38 Study Area are predicted to be less than 10 mm/m, which is considered unlikely to cause greater than negligible impacts. Low shear strength on some bedding planes could make these areas sensitive to some movement in combination with other contributing factors such as undercutting, or prolonged rainfall events.

Strength Reduction

Subsidence movements can reduce the strength of a slope profile by introducing cracking that reduces the tensile resistance of a slope to failure. Also, in sedimentary sequences bedded at low angles, differential movement along low angle bedding planes can introduce shearing along the plane. These shear movements reduce the available shear strength of the plane and can contribute to slope failure.

The expected subsidence effects identified within the Study Area are minor, and are not expected to produce significant cracking or differential lateral movements.

Water Concentration

Cracking associated with mine subsidence can allow ingress of water to a slope. This could potentially introduce water to slide planes within the soil or weathered rock horizons that may assist in triggering instability. The addition of water to a slope can impact the shear resistance and pressure of the sediments in the slope.

The predicted effects from systematic subsidence movements on the surface within the Study Area are unlikely to produce cracking that would significantly promote ingress of water to the slope or to failure planes. However, where non-systematic (down-slope) movements occur there is potential for increased tension and cracking at the tops of slopes which, if not mitigated, could increase water infiltration and associated pore pressures.

Strain

Tensile and compressive strains typically occur due to down-slope movement. MSEC (2013) predicts the maximum tensile strain and maximum compressive strain after extraction of Longwalls 37 and 38 to be 1.2 mm/m and 1.8 mm/m respectively. Impacts are not anticipated as a result of these strains.

4.1.3 Environmental Consequences

No large-scale slope failures have been observed along steep slopes in the Southern Coalfield, even where longwalls have been mined directly beneath them. However, tension cracking has been observed in the Southern Coalfield at the tops of and on steep slopes as the result of downslope movements.

The majority of the steep slopes along the Georges River valley and associated tributaries are not directly mined beneath by the proposed longwalls. It is likely therefore that only minor cracking would occur near the tops of and on these steep slopes.

If tension cracks were to develop, as the result of the extraction of the proposed longwalls, it is possible that soil erosion could occur if these cracks were left untreated. Required remediation, including infilling of surface cracks with soil or other suitable materials, or by locally re-grading and re-compacting the surface will be undertaken. Where required, erosion protection measures, such as planting of additional vegetation in order to stabilize the slopes in the longer term will be implemented.

While in most cases, impacts on steep slopes are likely to consist of surface cracks, there remains a low probability of large-scale downslope movements. Experience indicates that the probability of mining induced large-scale slippages is extremely low due to the significant depth of cover within the Study Area.

While the risk is extremely low, some risk remains and any features or items of infrastructure that are located in the vicinity of steep slopes directly above the proposed longwalls will be monitored. Furthermore, slope instabilities, as well as surface cracking, have potential to impact public safety. Features to be monitored include houses, local roads, low voltage powerlines, as well as optical fibre and copper cables.

Public safety is addressed in the Public Safety Management Plan (PSMP). Other potential environmental consequences of slope instabilities may include impacts on stream water quality, flora and fauna or their habitats, and Aboriginal heritage sites. These potential environmental consequences are addressed in the Water Management Plan (WMP), Biodiversity Management Plan (BMP) and Heritage Management Plan (HMP).

4.2 CLIFFS AND OVERHANGS

4.2.1 Subsidence Effects

A summary of maximum predicted total conventional subsidence of cliffs within the Longwalls 37 and 38 Study Area is provided in **Table 4.2**. The cliffs are located outside the extents of mining, at a minimum distance of approximately 25 m to the south-east of the finishing end of Longwall 37.

Table 4.2 – Maximum Predicted Total Conventional Subsidence Parameters Cliffs resulting from the Extraction of Proposed Longwalls (MSEC, 2013)

Cliff Reference	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Conventional Hogging Curvature (km ⁻¹)	Maximum Predicted Total Conventional Sagging Curvature (km ⁻¹)
GR-CL01	25	<0.5	<0.01	<0.01
GR-CL02	125	1.3	0.02	<0.01

4.2.1 Subsidence Impacts

Tilting Impacts

The maximum predicted conventional tilt at the cliffs, resulting from the extraction of the proposed longwalls, is 1.3 mm/m or 0.1 %, which equates to a change in grade of 1 in 770,

occurring at Cliff Ref. GR-CF02 (MSEC, 2013). Tilt can result in toppling type failures. However, the predicted maximum tilts at the cliffs within the Study Area are very small comparative to the existing slopes of the cliff faces and are therefore unlikely to result in toppling type failures.

Some sections of rock may fracture along existing bedding planes or joints due to conventional subsidence effects. This may result in toppling type failures along the cliffs, especially during or after heavy rainfall events.

Other Impacts

It is extremely difficult to assess the likelihood of cliff instabilities based upon predicted ground movements, with the likelihood of a cliff becoming unstable being dependent on a number of factors difficult to quantify. These factors include jointing, inclusions, weaknesses within the rock mass, groundwater pressure and seepage flow behind the rockface. It is therefore possible that cliff instabilities may occur during mining that may be attributable to either natural causes, mine subsidence or both.

According to MSEC (2013), based on the history of mining at Appin and Tower Collieries, it is possible that isolated rock falls could occur as a result of the extraction of the proposed longwalls. It is not expected, however, that any large cliff instabilities would occur as a result of the extraction of the longwalls, as the longwalls are not proposed to be extracted directly beneath the cliffs.

4.2.2 Environmental Consequences

Environmental consequences of a rock fall could potentially change the aesthetics of the Study Area temporarily. A rock fall or landslide may result in the exposure of a fresh face of rock and debris scattered around the base of the cliff. As with naturally occurring instabilities, the exposed fresh rock-face weathers and erodes over time to a point where it blends in with the remainder of the cliff face and in time the vegetation below the cliff regenerates.

Whilst the risk of cliff instability is extremely low, there is some risk to any structures or roads that may be in the vicinity of the cliffs. There is an access track located in the vicinity of cliff GR-CF02 along the Georges River. MSEC (2013) recommends that BHPBIC in consultation with landowners, develop management measures to ensure that properties remain safe and serviceable throughout the mining period.

Cliff and overhang instabilities as well as surface cracking have potential to impact public safety. Public safety is addressed in the PSMPs. Other potential environmental consequences of cliff/overhang instabilities may include impacts on stream water quality, flora and fauna or their habitats, and Aboriginal heritage sites. These potential environmental consequences are addressed in the WMP, BMP and HMP respectively.

5 PERFORMANCE MEASURES AND INDICATORS

The BSO Approval provides Subsidence Impact Performance Measures (*Condition 1, Schedule 3*). **Table 5.1** below details the conditions relevant to the general land, cliffs and steep slopes.

The term negligible is defined within the Project Approval as “*small and unimportant, such as not to be worth considering*” or as otherwise defined in **Table 5.1** for cliffs of ‘special significance’ and those flanking the Nepean River.

Table 5.1 – Subsidence Impact Performance Measures

Land (Condition 1, Schedule 3)	
Cliffs of ‘Special Significance’ (i.e. cliffs no longer than 200 m and/or higher than 40 m; and cliff-like rock faces higher than 5 m that constitute waterfalls).	Negligible environmental consequences (that is occasional rock falls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within any longwall mining domain).
Other cliffs.	Minor environmental consequences (that is occasional rock falls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 3% of the total face area of such cliffs within any longwall mining domain).

As noted in **Section 4.1.3** and **4.2.2** the environmental consequences of rock falls, fracturing and other impacts may include consequences to other environmental components or systems such as groundwater, biodiversity or heritage. As such a range of other Impact Performance Measures related to those environmental factors are applicable to this LMP, and are discussed in the relevant Management Plans.

In order to mitigate the potential subsidence impacts and environmental consequences from the mining of Longwalls 37 and 38 monitoring and recording will be undertaken prior to mining, throughout the extraction and at the completion of subsidence (refer **Section 6**).

In the event that any subsidence impact is recorded, consideration would be given to implementing appropriate management, remediation and/or mitigation measures in consultation with relevant stakeholders (refer **Section 7**).

If the subsidence impact performance measures are exceeded, BHPBIC will notify the appropriate stakeholders and implement the Contingency Plan (**Section 8**).

6 MONITORING AND REPORTING

6.1 MONITORING PROGRAM

General landscape monitoring will be undertaken by BHPBIC as part of routine subsidence monitoring included in the Subsidence Monitoring Program attached to the Extraction Plan as Annex B. This will generally include visual inspections of the land and monitoring actual subsidence against the predictions along selected survey lines in accordance with the TARPs included as an attachment to Annex B - Subsidence Monitoring Program. Specific monitoring for slope instability will be conducted as required.

6.2 REPORTING

Monitoring results will be presented and reviewed at the monthly BHPBIC Subsidence Management Meeting. However, if the findings of monitoring are deemed to warrant an immediate response the Manager Approvals will initiate the requirements of the TARP.

Monitoring results will be made publically available in accordance with BSO Approval *Condition 8 & 11, Schedule 6* and will also be included in the Annual Reporting *Condition 4, Schedule 6*.

7 MANAGEMENT AND MITIGATION STRATEGIES

7.1 PROPERTY IN AREAS OF SENSITIVE TERRAIN

A review of slope stability conditions around structures in areas of sensitivity on private property will be undertaken in consultation with the landowner prior to mining, during and on completion of longwall mining activities. Monitoring, management and mitigation measures for properties that are located in areas of sensitive terrain will be undertaken where appropriate and in consultation with the landowner where required. These measures will be provided as part of the BFMP and PSMP processes.

Mitigation of any subsidence cracks by infilling and re-profiling will be conducted with the approval of the landholder in any areas of high susceptibility (e.g. steep slopes) to minimise the ingress of water into the soil profile.

Where slope instability in areas of sensitive terrain is ongoing or increasing, or where a property exists on a hillside or close to a steep hillside, measures that may be implemented with the approval of the landholder to reduce the risk to property resulting from slope instability include:

- The installation of subsoil drains.
- Regrading of slopes and sealing of tension cracks in active landslides.
- Provision of surface water cut-off drains above potential landslides.
- Provision of shear piles through the slide zone.
- Improvements to vegetation including slashing of thick matted grass and planting of suitable trees.
- Removal or re-shaping of the soil slope to reduce loads within the sliding mass.
- Provision of toe support and associated drainage to support the soil mass depending on the scale of the landslide.
- Diverting overland flows around the slide area and providing localised drainage improvements e.g. repair leaking drains or re-direct drains that may discharge into landslide areas, or improvements to septic seep-away systems.

- Redirect stock where tracks are disturbing slopes or creating flow paths in landslide areas.
- Restrict grazing in areas where slope instability is indicated by monitoring.

The implementation of management measures will be related to the scale of impacts and the ability for and value in undertaking migratory measures on a case by case basis as negotiated with the landowner and described in the relevant PSMP. This means that management measures will be considered and implemented prior to the land performance measure being exceeded.

Management measures will be implemented, as appropriate, to comply with the relevant statutory requirements and the subsidence performance measures.

7.2 Georges River Cliff Lines

Risk of cliff instability is extremely low, although there is an access track located in the vicinity of cliff GR-CF02 along the Georges River. BHPBIC in consultation with landowners will develop management measures to ensure that properties remain safe and serviceable throughout the mining period. Management measures would be detailed in the PSMPs and may include:

- Shot-crete to support surface materials.
- Buttress support.
- Rock bolt and/or scale.
- Removal of boulders and debris infill.
- Installation of a rockfall fence.
- Retaining wall repair/or demolish.
- Scale and groom.
- Rock armour.
- Rock fall protection.

7.3 TARPS

Table 7.1 shows the West Cliff Area 5 Land Management Trigger Action Response Plan (TARP).

More detailed TARPs for individual properties will be developed (if required) during the PSMP process. Monitoring will be undertaken in consultation and with the agreement of the landowner where necessary.

Table 7.1 – West Cliff Area 5 Trigger Action Response Plan (TARP)

Monitoring	Trigger	Action
Slope Stability		
Cliffs	Level 1 *	<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-CL01 and GR-CL02 	<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 	
Steep slopes	<ul style="list-style-type: none"> • Crack at the surface which does not result in ongoing erosion or ground movement 	
Georges River – including pools and rockbars	<ul style="list-style-type: none"> • Erosion which stabilises within the period of monitoring without CMA • Crack or fracture up to 100 mm width • Crack or fracture up to 10 m length 	
<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 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 300 mm width • Crack or fracture between 10 and 50 m length 	<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 • 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>
	Level 3 *	<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"> - 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>
	Exceeding Performance Measures	<ul style="list-style-type: none"> • <i>Actions as stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation
	<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 	

Monitoring	Trigger	Action
	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)	

** These may be revised in consultation with DP&I, DRE and other key stakeholders following analysis of natural variability within the pre-mining baseline data.*

8 CONTINGENCY AND RESPONSE PLANS

8.1 CONTINGENCY PLAN

In the event the Subsidence Performance Measures detailed in **Section 5** of this LMP are considered to have been exceeded, or are likely to be exceeded, BHPBIC will implement a Contingency Plan to manage any unpredicted impacts and their consequences.

This would involve:

- Capture photographic record immediately.
- Notify relevant stakeholders soon as practicable.
- Notify relevant agencies and specialists soon as practicable.
- Conduct site visits with stakeholders as required.
- Contract specialists to investigate and report on changes identified.
- Provide incident report to relevant agencies within seven days.
- Undertake a condition assessment to record impacts completed within 14 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 the identified exceedance.

The development and implementation of contingency measures will be specifically designed to address the specific circumstances of the exceedance and assessment of environmental consequences.

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 the BSO Approval *Condition 2, Schedule 3*.

All incidents will be reported internally through BHPBIC's Incident Procedure and related records will be maintained in accordance with the Records Management Procedure (refer **Section 10.4**).

9 INCIDENTS, COMPLAINTS, EXCEEDANCES AND NON-CONFORMANCES

9.1 INCIDENTS

BHPBIC will notify the DP&I and any other relevant agencies of any incident associated with the West Cliff Mine as soon as practicable after BHPBIC becomes aware of the incident. BHPBIC will provide the DP&I and any relevant agencies with a detailed report on the incident within seven days of the date of the occurrence.

9.2 COMPLAINTS HANDLING

BHPBIC will:

- Provide a readily accessible contact point through a 24 hour toll-free Community Call Line (1800 102 210). The number will be displayed prominently on BHPBIC sites in a position visible by the public as well as on publications sent to the local community.
- Respond to complaints in accordance with the BHPBIC Community Complaints and Enquiry Procedure.
- Maintain good relations and communication lines between the community and BHPBIC staff.
- Keep a register of any complaints, including the details of the complaint with information such as:
 - Time and date.
 - Person receiving the complaint.
 - Complainant's contact name and phone number.
 - Description of the complaint.
 - Work area where complaint relates to.
 - Details of any verbal response.

- Details of any written response where appropriate.

9.3 NON-CONFORMANCE PROTOCOL

The requirement to comply with all approvals, plans and procedures is the responsibility of all personnel (staff and contractors) employed on or in association with the West Cliff Mine. Regular inspections, internal audits and initiation of any remediation/rectification work will be undertaken by the Manager Approvals.

Non-conformities, corrective actions and preventative actions are managed in accordance with the BHPBIC *Non-Conformance, Preventative and Corrective Action Procedure (IHP0107)*. This procedure details the processes to be utilised with respect to the identification of non-conformances, the application of appropriate corrective actions(s) to address non-conformances and the establishment of preventative actions to avoid non-conformances. The key elements of the process include:

- Identification of non-conformance and/or non-compliances.
- Recording of non-conformance and/or non-compliance.
- Evaluation of the non-conformance and/or non-compliance to determine specific corrective and preventative actions.
- Corrective and preventative actions to be assigned to a responsible person.
- Management review of corrective actions to ensure the status and effectiveness of the actions.

An Annual Review will be undertaken to assess BHPBIC's compliance with all conditions of the BSO Approval, mining leases and all other approvals and licences.

An independent environmental audit will also be undertaken (*Condition 9, Schedule 6*) to review the adequacy of strategies, plans or programs under these approvals and if appropriate, recommend actions to improve the environmental performance of the BSO. The independent environmental audit will be undertaken by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General of DP&I.

10 PLAN ADMINISTRATION

This LMP will be administered in accordance with the requirements of the West Cliff Area 5 EMS and the BSO Approval Conditions. A summary of the administrative requirements is provided below.

10.1 ROLES AND RESPONSIBILITIES

All statutory obligations applicable to the West Cliff Area 5 operations are identified and managed via an online compliance management system (TICKIT). The online system can be accessed from the following link <https://illawarracoal.tod.net.au/login>.

The overall responsibility for the implementation of this LMP resides with the Manager Approvals who shall be the LMP's authorising officer.

Parties responsible for environmental management in West Cliff Area 5 and the implementation of the LMP include:

Head of External Affairs

- Ensure that the requisite personnel and equipment are provided to enable this LMP to be implemented effectively.

Manager Approvals

- Authorise the LMP and any amendments thereto.
- Delegate to an appropriately qualified person the responsibility to document any changes to the LMP, recognising the potential for those changes to affect other aspects of the LMP.
- Provide regular updates to BHPBIC on the results of the LMP.
- Arrange information forums for key stakeholders as required.
- Prepare any report in accordance with the LMP. Maintain records required by the LMP.
- Organise and participate in assessment meetings called to review mining impacts.
- Within 24 hours, respond to any queries or complaints made by members of the public in relation to mining effects on heritage features.
- Organise audits and reviews of the LMP.
- Address any identified non-conformances, assess improvement ideas submitted and implement if considered appropriate.
- Arrange for the implementation of any agreed actions, responses or remedial measures.
- Ensure surveys required by this LMP are conducted and record details of instances where circumstances prevent these from taking place.

Environmental Field Team Coordinator

- Instruct suitable person(s) in the required standards for inspections, recording and reporting and be satisfied that these standards are maintained.
- Investigate significant subsidence impacts.
- Identify and report any non-conformances with LMP provisions.
- Participate in any other assessment meetings called to review subsidence impacts in the area affected by mining.

Survey Coordinator

- Collate survey data and present in an acceptable form for review at assessment meetings.
- Bring to the attention of the Manager Approvals any findings indicating an immediate response may be warranted.
- Bring to the attention of the Manager Approvals any non-conformances identified with the Plan provisions or ideas aimed at improving the LMP.

Technical Experts

- Conduct the roles assigned to them in a competent and timely manner to the satisfaction of the Manager Approvals and formally provide expert opinion as requested.

Person(s) Performing Inspections

- Formally bring to the attention of the Environment Field Team Coordinator any non-conformances identified with the Plan, or ideas aimed at improving the Plan.
- Conduct inspections in a safe manner.

10.2 RESOURCES REQUIRED

The Head of External Affairs provides resources sufficient to support this LMP.

Equipment will be needed for the TARPs provisions of this LMP. Where this equipment is of a specialised nature, it will be provided by the supplier of the relevant service. All equipment is to be appropriately maintained, calibrated and serviced as required in operation manuals.

It shall be the responsibility of the Manager Approvals to ensure that personnel and equipment are provided as required to allow the provisions of this Plan to be implemented.

10.3 TRAINING

All staff and contractors working on BHPBIC sites are required to complete the BHPBIC training program which includes:

- An initial site induction (incl. all relevant aspects of environment, safety and community).
- Safe Work Methods Statements and Job Safety Analyses, Toolbox Talks and Pre-shift communications.
- On-going job specific training and re-training (where required).

All training records are maintained by the BHPBIC Safety and Training Department (STAX database system), which can be accessed via the iPick system.

It shall be the responsibility of the Manager Approvals to ensure that all persons and organisations having responsibilities under this Plan are trained and understand their responsibilities.

The person(s) performing regular inspections shall be under the supervision of the Environment Field Team Coordinator and be trained in observation and reporting. The Environment Field Team Coordinator shall be satisfied that the person(s) performing the inspections are capable of meeting and maintaining this standard.

10.4 RECORD KEEPING AND CONTROL

Environmental Records are maintained in accordance with the BHPBIC procedure *Records Management (ICHP0108)*.

10.5 DOCUMENT CONTROL

The BHPBIC *Document Control Procedure (ICHP0103)* outlines the method for control of defined 'business critical' documentation for all Illawarra Coal operations. The system has been designed in such a manner to ensure that:

- Documents are approved for adequacy by authorised personnel prior to use.
- Obsolete documents are promptly removed from circulation.
- Documents are reissued, or made available, to relevant persons in a timely fashion after changes have been made and the authorisation process is complete.

The LMP and other relevant documentation will be made available on the BHPBIC website (*Condition 11, Schedule 6*).

10.6 MANAGEMENT PLAN REVIEW

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 the senior site management and other key site personnel, assess the performance of the mine over the previous year and develop goals and targets for the following period.

An annual review of the environmental performance of the BSO will also be undertaken in accordance with *Condition 4, Schedule 6*.

More specifically this LMP will be subject to review (and revision if necessary, to the satisfaction of the Director-General) within three months of:

- The submission of an annual review under *Condition 4 of Schedule 6*.
- The submission of an incident report under *Condition 7 of Schedule 6*.
- The submission of an audit report under *Condition 9 of Schedule 6*.
- Any modification to the conditions of this approval.

If deficiencies in the EMS and/or LMP are identified in the interim period, the plans will be modified and approvals for these modifications sought 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.

11 REFERENCES

Australian Geomechanics Society, 2007. *Landslide Risk Management Guidelines*, Vol 42 No. 1, March 2007

BHPBIC, 2009. *Major Cliffline Assessment*, Bulli Seam Operation Environmental Assessment. Appendix R.

Cruden D.M., Varnes D. J, 1996. *Landslide types and processes*. In: Turner A.K.; Shuster R.L. (eds) *Landslides: Investigation and Mitigation*. Trans. Res Board, Spec Rep 247, pp 36–75

Mine Subsidence Engineering Consultants, 2009. *The Prediction of Subsidence parameters and the Assessment of Mine Subsidence Impacts on Natural Features and Surface Infrastructure Resulting from the Bulli Seam Operations in Support of the Part 3A Application*. Report prepared for BHP Billiton Illawarra Coal. Revision D, August 2009.

Mine Subsidence Engineering Consultants, 2013. *West Cliff Colliery – Longwalls 37 and 38. Subsidence Predictions and Impact Assessments for the Natural Features and Surface Infrastructure in support of the Extraction Plan*, Report Number: MSEC553 Revision B. A report to BHPBIC

The National Committee on Soil and Terrain, 2009. *Australian Soil and Land Survey handbook*. CSIRO March 2009