



Illawarra Coal



SUBSIDENCE

PRINCIPAL HAZARD MANAGEMENT PLAN

Appin Colliery

APNMP0099

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1 INTRODUCTION

This principal hazard management plan addresses the requirements for PHMPs as set out in **Section 24** of the **WHS (MPS) Regulation** by:

- a) Providing for the management of all aspects of risk control in relation to the principal hazard of Subsidence, including by reference to risk assessment(s), procedures, management plans and other relevant documents used to identify hazards and control the risk of the principal hazard;
- b) Having been prepared with consideration to the matters set out in Schedule 1 of the WHS (MPS) Regulation and any other matter relevant to managing risks associated with the principal hazard of Subsidence at the Appin mine.

This PHMP for Subsidence forms part of the **Appin Safety Management System (SMS) (APNMP0062)**.

This PHMP is reviewed and revised in accordance with the requirements of Section 25 of the **WHS (MPS) Regulation**.

2 DEFINITIONS

Term	Definition
Control Measure	A measure to eliminate or minimise risks
Guideline	The NSW Department of Industry, Resources Regulator, Mine Safety, <i>Managing Risks of Subsidence Guide</i> , dated February 2017
Horizontal displacement	Mining-induced change in the horizontal position of any part of the ground surface or subsurface strata.
Pillar	An area of coal left to support the overlying rock
Stakeholders	Relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence.
TARP	Trigger Action Response Plan – a plan designed to prevent a risk from escalating by identifying potential indicators to the hazard, assigning a hierarchy of alarms, or trigger levels, to each potential indicator, and specifying responses for each trigger level
WHS (MPS) Regulation	Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (NSW).

3 HAZARD IDENTIFICATION AND ASSESSMENT

3.1 Nature of The Principal Hazard

Deformation or displacement caused by subsidence has potential to cause hazardous conditions to the health and safety of workers and other persons. The following subsidence risks have been identified for Appin Mine in **Subsidence Qualitative Risk Assessment 2017 (APNRA1391)**:

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- Water inflow underground (e.g. old workings, strata bound or surface water bodies);
- Strata instability underground (e.g. Pillar failure, roof fall);
- Surface rockfall (e.g. escarpments);
- Surface gas release;
- Damage to transport infrastructure (e.g. rail, roads and bridges);
- Damage to public utilities (e.g. power lines);
- Damage to residential or business establishments (e.g. houses); and
- Damage to public space.

3.2 How the Principal Hazard Relates To Other Hazards Associated With Mining Operations At Appin Mine

Other hazards to which this PHMP may be relevant include:

- Inundation and inrush; and
- Strata failure.

Inundation and Inrush and Strata Failure are addressed in:

- ***Inundation and inrush PHMP (APNMP0027);***
- ***Strata Failure PHMP (APNMP0003);*** and
- The Authority to Mine (ATM) process evaluates hazards for Longwalls prior to extraction which includes an assessment of geology, groundwater, boreholes and adjacent works. Refer to ***Outburst Management Plan Check Sheet - Longwall (APNF0208).***

3.3 Analysis Methods Used in Identifying The Principal Hazard

The ***South32 Risk Management Framework Policy*** and ***South32 Material Risk Management Standard*** set out the overall approach to risk management of South32 Limited (the Company) and its subsidiaries (the Group).

Subsidence Qualitative Risk Assessment 2017 (APNRA1391) identifies risks, causes, events, impacts and maximum foreseeable loss. The hierarchy of controls are applied and the residual risk ranking confirmed.

The risk assessment identified the following principal risk events that are not already addressed within another PHMP:

- Train derailment along Main Southern Railway;
- Car accidents along M31 Hume Motorway;
- Car accidents along Douglas Park Twin Bridges; and
- Surface instability, including rock falls along the Nepean River and Harris Creek Cliff Line

Appin Risk Management Procedure (APNP0627) addresses the requirements for the management of risk at Appin and ***Appin Event Reporting and Investigation***

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(**APNP0137**) outlines the process for managing information that can be used to review the effectiveness of current control measures.

3.4 Most Recent Risk Assessment Conducted in Relation To The Principal Hazard

The most recent risk assessments conducted in relation this PHMP are:

- ***Subsidence Qualitative Risk Assessment 2017 (APNRA1391)***.

3.5 Investigation and Analysis Methods Used in Determining the Control Measures to Be Implemented

Each of the identified principal risk events within ***Subsidence Qualitative Risk Assessment 2017 (APNRA1391)*** have individual risk assessments and management plans developed for Control Measures in accordance with ***AS/NZ ISO 3100:2009 Risk Management – Principals and Guidelines***.

These management plans have been developed considering take into account historical data from mining in the area and in consultation with the relevant infrastructure owners; relevant technical assessments (geotechnical, bridge, structural), and appropriate infrastructure standards and have been developed in consultation with the relevant infrastructure owners.

3.5.1 Limitations & Assumptions

The following assumptions and limitations have been applied to this risk assessment:

- Subsidence will be generally in accordance with predictions as identified in the technical assessments & approvals e.g. SMPs, etc.
- Impacts will be similar to those previously observed in comparable areas
- Monitoring can identify subsidence including anomalous subsidence which can be used to manage impacts through plans and strategies
- Risk evaluation is for the highest most likely impact of the risk being assessed.

3.6 Reasons for Adopting or Rejecting Each Control Measure Considered

Subsidence Qualitative Risk Assessment 2017 (APNRA1391) identified controls for risks associated with surface and underground hazards that may present a risk to health and safety to either;

- Appin workforce (employee and contractors);
- Community members; and
- Infrastructure asset owners within the active mining area.

Other risks associated with subsidence (e.g. environmental) are addressed in the technical assessments and associated management plans in accordance with Bulli Seam Operations Development Consent and Mining Lease conditions.

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Any incident concerning subsidence shall be investigated in accordance with **Appin Event Reporting and Investigation Procedure (APNP0137)**.

4 CONTROL MEASURES TO BE IMPLEMENTED TO MANAGE RISKS TO HEALTH AND SAFETY ASSOCIATED WITH THE PRINCIPAL HAZARD

Control Measures to address subsidence principal risk events are detailed within approved Subsidence Management Plans as follows:

Train derailment along Main Southern Railway:

- **MSEC642 - Longwalls 706 to 710 Management Plan for Longwall Mining beneath the Main Southern Railway, Revision B, January 2014; and**
- **MSEC706 - Longwalls 901 to 904 Management Plan for Longwall Mining beneath the Main Southern Railway, Rev B, July 2015.**

Car accidents along M31 Hume Motorway:

- **MSEC641 - Longwall 706 to 710 Management Plan for Longwall Mining beneath the M31 Hume Motorway Revision C, November 2013.**

Car accidents along Douglas Park Twin Bridges:

- **MSEC641 - Longwall 706 to 710 Management Plan for Longwall Mining beneath the M31 Hume Motorway Revision C, November 2013; and**
- **MSEC771 - Longwalls 901 to 904 Management Plan for Longwall Mining adjacent to the M31 Hume Motorway, Revision C, October 2015.**

Rock falls along Nepean River and Harris Creek Cliff Line:

- **Illawarra Coal Appin Mine, Harris Creek Cliff Line Management Plan, Revision 2, 12 April 2017; and**
- **Appin Area 9 Longwalls 901 to 904 Extraction Plan, October 2013.**

Control and monitoring requirements specified within these management plans include:

- Main Southern Railway; expansion switch system with Zero Toe Load fastenings, alarmed monitoring (track stress sensors, displacement sensors, inclinometers, extensometers, piezometers), regular survey, visual and geotechnical inspections;
- M31 Hume Motorway and Douglas Park Twin Bridges; pavement slotted section and slot displacement sensors (pavement and bridge expansion joints), alarmed monitoring (Fibre Bragg Grating System, slot displacement sensors), regular survey and visual inspections, regular reviews with technical experts and asset owner;
- Nepean River and Harris Creek Cliff Line; regular inspections, alarmed continuity loop for pavement failure, borehole inclinometer analysis (piezometer, Shape Accel Array (SAA), manual readings (RST), Piezometers, Time Delay reflectometry (TDR), Visual geotechnical inspections and regular ground survey; and

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- Monitoring; 2D/3D ground survey monitoring, alarmed monitoring systems that refer to specific TARPs which outline corrective actions required, scheduled reviews of relevant data by technical experts and stakeholders, automatic subsidence monitoring of the M31 Hume Motorway and Main Southern Railway alarm to Appin Mine Control and triggers specified within ***Appin Control Room and Alarm Procedure (APNP0404)***.

4.1 Design Principles, Engineering Standards and Technical Standards Relied on For Control Measures For The Principal Hazard

The approved Subsidence Management Plans and Extraction Plans have considered each of the matters listed within Schedule 1 ***WHS (MPS) Regulation*** as follows:

4.1.1 *The characteristics of all relevant surface and subsurface features*

The characteristics of all relevant surface and subsurface features of relevant areas have been explored by the Illawarra Coal Exploration Team from the surface (using boreholes, seismic, magnetic, surface mapping, airborne laser survey) and through in-seam drilling from underground.

This information has been taken into consideration by relevant technical experts in the development of subsidence Control Measures and incorporated into the Subsidence Management Plans or Extraction Plans.

4.1.2 *The characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including any conditions that may cause elevated or abnormal subsidence or the formation of sinkholes, where relevant*

These matters are addressed as follows:

- Relevant Illawarra Coal and third party technical committees and management teams have reviewed geology as part of each Subsidence Management Plan created (including subject matter experts from GHD, PSM, DC Engineering etc.);
- Relevant Illawarra Coal and third party technical committees and management teams have reviewed hydrogeology with potential influence on road and rail (e.g. Hydraulic capacity of culverts was investigated prior to concrete sleeving) as part of each Subsidence Management Plan created;
- Climatic conditions are addressed by the inclusion of extreme weather events within appropriate TARPs; In relation to abnormal subsidence, non-systematic subsidence is considered and addressed within the approved Subsidence Management Plans. Subsidence engineers have also assessed the mining parameters at Appin Mine and concluded that due to the depth of mining there is no plausible circumstance where sinkhole subsidence could develop at the surface.

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4.1.3 The characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings

There is no pre-existing mining in the relevant mining areas known as Appin Area 7 and Appin Area 9.

The nearest abandoned / old workings are from Tower Colliery and the data from that subsidence has been used to generate and refine the current prediction model.

4.1.4 The existence, distribution, geometry and stability of significant voids, standing Pillars or remnants within any old Pillar workings that may interact with any proposed or existing mine workings

Not applicable. Area 7 and Area 9 is a virgin mining area.

4.1.5 The predicted and actual nature, magnitude, distribution, timing and duration of subsidence

Subsidence predictions are based on empirical data and are reviewed internally and externally at the completion of each longwall panel. The actual nature, distribution, and timings are well understood as a result of the historical data set and previous monitoring. This data is taken into account in developing Subsidence Management Plans and Extraction Plans.

4.1.6 The rate, method, layout, schedule and sequence of mining operations.

Control Measures involving the rate, method, layout, schedule and sequence of mining operations have been developed at Appin, and include:

- The mine layout was varied to largely avoid mining beneath the township of Douglas Park and as a result of this, an increased standoff from Harris Creek Cliff Line and the Douglas Park Twin Bridges is in place.
- No longwall extraction was undertaken beneath the Main Southern Rail or Hume Highway until risk management plans were developed and endorsed by RTA (RMS) and ARTC as the infrastructure owners and the respective regulators.

The following Annexures provide further detail on controls, principals and standards above:

- **MSEC448 - Subsidence Predictions and Impact Assessments for Natural Features and surface infrastructure in support of Extraction Plan, Revision B, June 2012;**
- **Appin Area 9 Longwalls 901 to 904 Extraction Plan, Annex H – Built Features Management Plan, Revision D, dated 31 October 2013; and**
- **MSEC342 - The predication of subsidence parameters and the assessment of mine subsidence impacts on natural features and surface infrastructure 705 to 710 in support of the SMP Application, Revision C, dated June 2008.**

Other reference material includes:

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- *Environmental Planning & Assessment Act 1979 (NSW);*
- *Mining Act 1992 (NSW);*
- *Managing risks of subsidence Guide 1 (V16/6659#2) February 2017;*
- *Longwall 705 to 710 Public Safety Management Plan;*
- *Longwall 901 to 904 Public Safety Management Plan;*
- *Guideline for Applications for Subsidence Management Approvals, dated December 2003;*
- *Appin Area 9 - Subsidence Monitoring Program, dated October 2013.*
- *Appin Area 7 Longwall 707 Survey Monitoring Program Revision 1, August 2015.*

5 ARRANGEMENTS IN PLACE FOR PROVIDING INFORMATION, TRAINING AND INSTRUCTION IN RELATION TO THE PRINCIPAL HAZARD

Information, instruction and training will be provided through *Training and Competence Management Scheme (ICHP0109)*.

6 ROLES AND RESPONSIBILITIES

6.1 Planning Manager

This role must:

- Compile required information for any planned high-risk activities relating to subsidence in accordance with the *WHS (MPS) Regulation*.

6.2 Mining Engineering Manager

This role must:

- Confirm all underground mining operations have approved development consents, Subsidence Management or Extraction Plans.
- Review Subsidence PHMP in accordance with *WHS (MPS) Regulation* and confirm that subsidence impacts that occur outside of predictions trigger a review of the appropriate management plan and where necessary, findings will be included in the Plan.
- Review and provide information to the regulator in accordance with the *WHS (MPS) Regulation*
- Bring to the attention of the General Manager any non-conformance of this PHMP.

6.3 General Manager

This role must:

- Appoint personnel with responsibility under this PHMP

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- Provide resources to comply with this PHMP.

7 REFERENCES

Legislation and Guidance Notes

Mining Act 1992 (NSW)

WHS (MPS) Regulation 2014

Environmental Planning & Assessment Act 1979 (NSW)

Guideline for Applications for Subsidence Management Approvals, December 2003

South32 References

South32 Material Risk Management Standard

South32 Risk Management Framework Policy

ICHP0109 Training and Competence Management Scheme

APN References

APNMP0003 - Strata Failure PHMP

APNMP0027 - Inundation or Inrush PHMP

APNP0137 - Event Reporting and Investigation Procedure

APNP0404 - Control Room and Alarm Procedure

APNP0627 - Risk Management Procedure

APNRA1391 - Subsidence Qualitative Risk Assessment 2017

APNF0208 - Outburst Management Plan Checklist - Gas Drainage and Geotechnical Conditions (Longwall)

Appin Area 7 Longwall 707 Survey Monitoring Program Revision 1, August 2015

Appin Area 9 Longwalls 901 to 904 Extraction Plan, October 2013

Appin Area 9 Subsidence Monitoring Program, October 2013.

Harris Creek Cliff Line Management Plan, Revision 2, 12 April 2017

Longwall 705 to 710 Public Safety Management Plan

Longwall 901 to 904 Public Safety Management Plan

Management Plan, Revision D, 31 October 2013

Managing risks of subsidence Guide 1 (V16/6659#2) February 2017

Surface infrastructure in support of Extraction Plan, Revision B, June 2012

MSEC342 - The predication of subsidence parameters and the assessment of mine subsidence impacts on natural features and surface infrastructure 705 to 710 in support of the SMP Application, Revision C, June 2008

MSEC448 - Subsidence Predictions and Impact Assessments for Natural Features

MSEC641 - Longwall 706 to 710 Management Plan for Longwall Mining beneath the M31 Hume Motorway Revision C, November 2013

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MSEC642 - Longwalls 706 to 710 Management Plan for Longwall Mining beneath the Main Southern Railway, Revision B, January 2014

MSEC706 - Longwalls 901 to 904 Management Plan for Longwall Mining beneath the Main Southern Railway, Rev B, July 2015


MSEC771 - Longwalls 901 to 904 Management Plan for Longwall Mining adjacent to the M31 Hume Motorway, Revision C, October 2015

External References and Standards

AS/NZ ISO 3100:2009 Risk Management

8 REVISION LOG

8.1 Persons Authorising this Plan

Name	Title	Signature	Date
Scott Dennis	Appin Mining Engineering Manager		27/05/2019

8.2 Revision Log

Revision	Date	Change Description	Document Reviewers	Document Owner
1.0	05/10/2017	Full review and update following RA & PHMP gap analysis against Part 2 Div 2 and Schedule 1 of the WHS (MPS) Regulation – referencing ICHMP0261.		
1.1	28/11/2017	Update to Competency and Training section		
2.0	08/06/2018	Legal review / SMS Improvement Team review	N Mottee	M Lerch
2.1	27/5/2019	Update to Training & Competency Management Scheme reference from APNMP0050 to ICHP0109		S Dennis

8.3 Persons involved in the review of this Plan;

Name	Title	Company	Exp (yrs)	Date



9 APPENDIX

Appendix 1 – Legislation Compliance Map - WHS (MPS) Regulation 2014

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Appendix 1 – Legislation Compliance Map - WHS (MPS) Regulation 2014

Section No.	Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 Requirements	MP Ref
23 (3) (b)	Consider the principal hazard individually and also cumulatively with other principal hazards	Section 3.2.
24 (1)	Schedule 1	Section 1.
24 (2)	Aspects of risk control for subsidence	Section 4.
24 (2)	Readily understandable to user	See – Table format for hazards
24 (3) a)	Nature of Principal Hazard	Section 3.1.
24 (3) b)	Relationship with other hazards	Section 3.2.
24 (3) c)	Analysis methods used in identifying the principal hazard	Section 3.3.
24 (3) d)	Risk assessment	Section 3.4. APNRA1391
24 (3) e)	Investigation and analysis methods in determining controls	Section 3.5.
24 (3) f)	Description of control measures	Sections 4
24 (3) g)	Provision of information, training and instruction – aligned with WHS Regulation Cl. 39	Section 5.
24 (3) h)	Relevant design principles, engineering standards and technical standards	Section 4.1.
24 (3) i)	Reasoning included for each control measure	Section 3.6.
25 (2)	Revisions to PHMP including revision of a risk assessment recorded in writing in the plan	Section 8.
67 (1)	In complying with clause 9, the mine operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine.	APNRA1391, Development consent (EPA Act 1979) and Approved SMP or Extraction Plan
67 (2) a)	so far as is reasonably practicable, the rate, method, layout, schedule and sequence of mining operations do not put the health and safety of any person at risk from subsidence	Section 4.1 Development consent (EPA Act 1979) and Approved SMP or Extraction Plan
67 (2) b)	monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features,	Section 4. Development consent (EPA Act 1979) and Approved SMP or Extraction Plan
67 (2) c)	any investigation of subsidence and any interpretation of subsidence (a) information is carried out only by a competent person	Section 4. Development consent (EPA Act 1979) and Approved SMP or Extraction Plan

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Section No.	Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 Requirements	MP Ref		
67 (2) d)	all subsidence monitoring data is provided to the regulator in the manner and form and at the times required by the regulator	Sections 4 & 4.1 Development consent (EPA Act 1979) and Approved SMP or Extraction Plan		
67 (2) e)	so far as is reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action with respect to (a) subsidence between the mine operator and relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence.	Sections 4 & 4.1 Development consent (EPA Act 1979) and Approved SMP or Extraction Plan		
179	For the purposes of section 14 (c) of the WHS (Mines and Petroleum Sites) Act, each of the following is prescribed as a dangerous incident: a) an incident in relation to a workplace that exposes a worker or any other person to a serious risk to a person's health or safety emanating from an immediate or imminent exposure to: xvii) rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence	PHMP - Roles and Responsibilities		
Schedule 1 Matters				
3C a)	a) the characteristics of all relevant surface and subsurface features	Section 4.1.1		
3C b)	the characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including any conditions that may cause elevated or abnormal subsidence or the formation of sinkholes	Section 4.1.2		
3C c)	the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings	Section 4.1.3		
3C d)	the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings	Section 4.1.4		
3C e)	the predicted and actual nature, magnitude, distribution, timing and duration of subsidence	Section 4,1,5		
3C f)	i) the rate, method, layout, schedule and sequence of mining operations	Section 4.1.6		
Schedule 3 High Risk Activities				
(16)	(1) The following are identified as high risk activities:	PHMP - Roles and Responsibilities		
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Section No.	Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 Requirements	MP Ref
	<p>a) secondary extraction by longwall mining, shortwall mining or miniwall mining b) pillar extraction, c) pillar splitting, d) pillar reduction. (2) The waiting period for any such activity is 3 months. (3) The information and documents that must be provided in relation to any such activity are as follows: (a) details of the authoritative sources used in determining that the proposed method of work can be done safely, (b) engineering plans showing the manner and sequence of extraction, endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine, (c) information about the land above or in the vicinity of the proposed activity including land use and details of who owns or occupies any land that may be affected by subsidence, (d) in the case of a pillar extraction, details of the procedures for the recovery of buried and immobile mining plant in or around a goaf, (e) details of how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed</p>	
(17)	<p>(1) Mining operations in locations where the depth of cover is less than 50 metres is identified as a high risk activity. (2) The waiting period for the activity is 3 months. (3) The information and documents that must be provided in relation to the activity are as follows: (a) an engineering drawing of the activity, endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine (b) survey plans certified by an individual nominated to exercise the statutory function of mining surveyor at the mine, (c) a geotechnical report on the activity, (d) information on how the risks to the health and safety of workers and other persons from the potential formation of sinkholes will be managed.</p>	PHMP - Roles and Responsibilities
(28)	<p>(1) Highwall mining is identified as a high risk activity. (2) The waiting period for the activity is 1 month. (3) The information and documents that must be provided in relation to the activity are as follows: (a) an engineering drawing detailing the activity and endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine, (b) a plan of the activity certified by an individual nominated to exercise the statutory function of mining surveyor at the mine, (c) information on how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed.</p>	PHMP - Roles and Responsibilities