Subsidence Monitoring Program LW107 to LW110

Edition	Rev.	Comments	Author	Authorised By	Date
A	03 March 2017	Submitted for approval	Narrabri Coal Operations		
B	04 August 2021	Removal of Subsidence Line 107, Variation of transverse Line H and addition of Line I	[redacted] Environmental Superintendent	BB	04/08/2021

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1 INTRODUCTION

This Subsidence Monitoring Program has been prepared to document the monitoring of subsidence and associated environmental consequences as a result of longwall mining at the Narrabri Mine. This program applies to extraction of Longwalls LW107 to LW110 within the Hoskissons Seam.

A general description of the site locality and longwall extraction area is provided in Section 1.5 of the Extraction Plan. The Extraction Plan also describes the operation of the underground mine to date, and the proposed extraction of LW107 – LW110.

An updated assessment of potential subsidence movements related to Hoskissons Seam LW107 – LW110 has been prepared by Ditton Geotechnical Services (DGS, 2017). These subsidence predictions have been used as a basis for the updated assessment of impacts contained within the Extraction Plan. DGS's analysis and results are contained, in full, as an appendix to the Extraction Plan.

1.1 Scope

This Subsidence Monitoring Program is a sub-set to the Extraction Plan and has been prepared in accordance with Schedule 3, Condition 4(g) of Project Approval (PA) 08_0144. This program applies only to monitoring activities related to subsidence associated with the secondary extraction of LW107 – LW110 in the Hoskissons Seam (HS). In order to comply with the statutory requirements outlined in Section 1.2, this report provides a description of the:

- Features potentially affected by underground mining in the Extraction Plan area and summary of revised subsidence predictions, categorised into: natural features, public utilities, farm land and facilities, industrial commercial and business establishments and items of archaeological significance;
- Survey monitoring standards, method, and program;
- Summary of monitoring of subsidence consequences to built features (full details are provided in the Built Features Management Plan);
- Summary of monitoring measures provided for environmental features within Narrabri Mine Environmental Management System (full details are provided in each of the relevant environmental management plans);
- Review and reporting mechanisms; and
- Responsibilities of relevant Narrabri Mine personnel under this plan.

1.1.1 Risk Assessment

A subsidence risk assessment has been undertaken to identify the risks associated with subsidence at the Narrabri Mine. The initial risk assessment was undertaken during February 2012 for LW101 to LW105, was revised for LW106 and has subsequently been updated for to LW107 to LW110, refer to Appendix K of the Extraction Plan.

The updated risk assessment for LW107 to LW110 extraction has not identified any high risk items. As a result, risks associated with subsidence above LW107 to LW110 for the Narrabri Mine have been assessed as low to moderate.

1.2 Statutory Requirements

This document has been prepared in accordance with PA 08_0144, relevant legislation and guidelines, including the Department of Planning and Environment (DP&E) '*Guidelines for the Preparation of Extraction Plans*' and in consultation with relevant government agencies.

1.2.1 Project Approval

PA 08_0144 requires that NCOPL prepare a Subsidence Monitoring Program to the satisfaction of the Division of Resources and Energy (DRE). Specifically, Schedule 3, Condition 4(g), states inter alia:

4 The Proponent shall prepare and implement Extraction Plans for the second workings to be mined to the satisfaction of the Secretary. Each Extraction Plan must:

(g) Include the following to the satisfaction of DRE:

- *A Subsidence Monitoring Program to:*
  - *Provide data to assist with the management of the risks associated with subsidence;*
  - *Validate the subsidence predictions; and*
  - *Analyse the relationship between the subsidence effects and impacts under the plan and any ensuing consequences.*

Monitoring of environmental impacts not associated with subsidence is addressed elsewhere under the suite of management plans that forms the Narrabri Mine Environmental Management System.

1.2.2 Mining Lease

This report has also been prepared to also address statutory requirements of the Mining Lease (ML) 1609 with regard to the preparation of an Extraction Plan.

1.2.3 Work Health and Safety Legislation

This Extraction Plan – Subsidence Monitoring Program has been developed to comply with the Work Health and Safety legislation including but not limited to:

- *Work Health and Safety Act 2011*;
- *Work Health and Safety Regulation 2011*;
- *Work Health and Safety (Mines and Petroleum Sites) Act 2013*; and
- *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*.

Components of the Extraction Plan will be submitted to DRE as part of the High Risk Notification, required by the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*, for LW107 to LW110.

2 SURFACE FEATURES

The surface area impacted by mining of LW107 – LW110 is most recently described in detail in the Environmental Assessment (EA) for the longwall panel width and production limit increases (Resource Strategies, 2015) and in the EA for the Narrabri Coal Mine, Stage 2 Longwall Project (RW Corkery & Co. Pty Ltd, 2009). It is noted that there are no public amenities, or items of architectural significance that will be impacted by LW107 – LW110.

2.1 Natural Features

Natural features potentially impacted by mining activities and monitored under the scope of this document (i.e. LW107 – LW110) include:

- *Rivers and creeks:*
  - *Tributaries and contributing catchment area of Pine Creek, which is an ephemeral creek that drains to the Namoi River;*
  - *Aquifers, known groundwater resources;*
  - *Alluvial aquifers associated with creeks; and*
  - *Saline groundwater associated with the coal measures.*
- *Land prone to flooding or inundation:*
  - *Floodplain associated with Pine Creek and tributaries.*
- *Threatened and protected species:*
  - *Three threatened flora species have been recorded over LW107 – LW110, i.e. Coolabah Bertya, Lepidium aschersonii* (Spiny Peppercress) *and Tylophora linearis, while other species Cadeallia pentastylis (Ooline) and Pomaderris queenslandica may occur – all 'Vulnerable or Endangered' under state and/or Commonwealth legislation;*
  - *Inland Grey Box Woodland – Endangered Ecological Community (EEC); and*
  - *Fourteen threatened fauna species recorded, nine of which were observed over LW107 - LW110: Calyptorhynchus lathami* (Glossy Black-cockatoo); *Pomatostomus temporalis* (Grey-crowned Babbler); *Pyrrholaemus sagittata* (Speckled Warbler); *Pseudomys delicatulus* (Delicate Mouse); *Nyctophilus corbeni* (Greater Long-eared Bat); *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat); *Chalinolobus picatus* (Little Pied Bat); *Hoplocephalus bitorquatus* (Pale-headed snake); and *Macropus dorsalis* (Black-striped Wallaby).
- *Natural vegetation:*
  - *Riparian Forest along Pine Creek;*
  - *Brown Bloodwood-Pilliga Box Woodland;*
  - *Inland Greybox Woodland (EEC – as noted above); and*
  - *Cleared open grassland.*

2.2 Public Utilities

Land overlying LW107 – LW110 and associated first workings is owned by the Narrabri Mine. A detailed list of all affected built features is provided in the Built Features

Management Plan (BFMP). There are no known public utilities that exist above the LW107 – LW110 Extraction Plan area.

2.3 Farm Land and Facilities

The land associated with the Narrabri Mine has been historically used for agriculture (grazing, some cropping) and consists of:

- Agricultural utilisation or agricultural suitability:
  - Pasture (majority of land above LW107 – LW110 is Land Capability Class Vll with some small areas of III and lV).
  - Soil conservation banks (contour banks).
- Farm buildings / sheds:
  - Residential dwellings and associated infrastructure.
- Fences:
  - Fences delineating property boundaries and internal paddocks for stock/pasture management; and
  - Gates and cattle grids.
- Water storages:
  - Earth dams.

2.4 Industrial, Commercial and Business Establishments

No industrial, commercial or business establishments are located within the mining area, with the exception of infrastructure associated with the Narrabri Mine.

Affected mine infrastructure is limited to the surface facilities associated with surface to in-seam gas drainage bores and unsealed access tracks. A buried PED cable is also located within LW107 and LW108.

2.5 Areas of Archaeological and/or Heritage Significance

The surface area overlying LW107 – LW110 includes known Aboriginal heritage sites. These are predominantly found along riparian zones associated with Pine Creek and its tributaries.

The Aboriginal heritage sites potentially affected by mining of LW107 – LW110 were identified as part of the environmental assessment and approval process for the project. Potential impacts to these sites will be monitored and managed in accordance with the Heritage Management Plan (HMP) prepared as part of the Extraction Plan for subsidence related impacts. A site-wide Aboriginal Cultural Heritage Management Plan (ACHMP) addresses the management of potential impacts to heritage sites for other mining-related activities.

2.6 Residential Establishments

Two residences and associated infrastructure located within LW107 will be impacted by subsidence. Both dwellings are owned by NCOPL and will be vacated prior to undermining.

The vacation of this dwelling is a management action described in the Built Features Management Plan.

3 SUBSIDENCE MONITORING

3.1 Overview

The subsidence monitoring program consists of survey monitoring to quantify subsidence parameters, i.e. vertical movements, ground tilts and strains (refer to Section 3.2) and a consolidated summary of environmental consequence monitoring (refer to Section 3.3) to identify subsidence-related impacts to environmental and built features. Additional monitoring to identify height of fracturing will be conducted using a network of surface extensometers. The analysis of piezometric data to determine impacts on groundwater is dealt with separately in the Water Management Plan.

The objectives of this monitoring program are to:

- Measure baseline information – establish background data for the surface and environment above the mining area;
- Monitor the effects of mining – monitor identified subsidence parameters and environmental aspects at key positions relative to the longwall position;
- Regularly assess and interpret monitoring – analyse monitoring data to identify any variations to the predictions or unexpected anomalies;
- Report subsidence results (as described in Section 4.3);
- Re-assess subsidence impacts – where variations are greater than predictions, review of impacts will be undertaken; and
- Identify and implement remedial actions / contingency plans – review of impacts may indicate that remedial action is required. Implementation of remedial work and contingency plans will be undertaken in consultation with relevant stakeholders where appropriate.

The monitoring program will also enable NCOPL to obtain data on subsidence parameters and subsidence impacts relating to the extraction of LW107 – LW110. This data will be used to confirm that actual subsidence and environmental consequences are within predicted limits, as well as to:

- Validate the subsidence modelling methodology and predictions; and
- Establish and develop a subsidence database at Narrabri Mine for the purpose of future mine planning, subsidence prediction and assessment of environmental consequences for subsequent longwall extraction.

3.2 Subsidence Survey Monitoring

A subsidence survey monitoring program has been developed which includes the following elements:

- A transverse subsidence line across the longwall panels installed on an existing access track. The line will be installed into the next adjacent longwall before undermining occurs and will be discontinued in areas where movement has ceased;
- Install a longitudinal line extending in-bye and out-bye from the panel starting points where it is feasible (i.e. does not require excessive clearing) for a minimum distance

equal to the cover depth, nominally LW107 start point and LW108 starting and finishing points; and

- Complete Aerial Laser Scanning (ALS) annually.

The installed/proposed subsidence monitoring lines are shown in Plan 7 of the Extraction Plan.

ALS surveys will be conducted, which will allow comprehensive ground movement monitoring over the entire panel. The ALS may be linked into the already established survey markers and provide subsidence data to within +/-0.1m, and will be calibrated using the subsidence line monitoring over LW107 to LW110. It is anticipated that ALS scanning will provide a more thorough picture of the subsidence development along creeks and surface terrain generally. Provided the ALS proves adequate as a monitoring technique, the longitudinal monitoring lines will be progressively phased out. The subsidence line monitoring standards, schedule and methodology is detailed in Appendix A.

All survey monitoring will be undertaken in accordance with the requirements of the Narrabri Mine Health and Safety Management System, including the survey instrumentation and procedural requirements outlined in the Survey and Plan Arrangements Management Plan.

3.3 Monitoring of Environmental Consequences

The monitoring proposed under the Extraction Plan and all relevant sub-plans to identify and assist in the management of environmental consequences is summarised in Table 2. All subsidence impacts monitoring is detailed in the relevant environmental management plan or sub-plan to the Extraction Plan for LW107 – LW110.

These plans include:

- Built Features Management Plan (BFMP);
- Public Safety Management Plan (PSMP);
- Water Management Plan (WMP);
- Biodiversity Management Plan (BMP);
- Land Management Plan (LMP) ; and
- Heritage Management Plan (HMP).

Various monitoring programs are also proposed as part of the Landscape Management Plan, which includes the Rehabilitation Management Plan and Mine Closure Plan. These monitoring programs are generally an extension of the monitoring contained in the above plans, as suitable for monitoring post-mining remediation and rehabilitation. As such, monitoring under the Landscape Management Plan and sub-plans is not summarised here.

3.4 Monitoring for Extent of Fracturing

A monitoring program to determine the height of fracturing and extent of subsidence over the longwall panels has been developed in conjunction with SCT Operations Pty Ltd using

surface extensometers. This data has been used to update the height of fracturing information in the revised subsidence predictions (DGS, 2017).

Table 1: Environmental Consequences – Monitoring Summary

Aspect / Feature	Frequency	Monitoring Measures (full details provided in relevant management plan)	EP Management Plan Reference
Built Features Management Plan			
Roads and Access Tracks	Pre-subsidence	Survey (ALS or similar) to locate drainage structures; confirm road location/widths; and direction and capacity of table drains.	BFMP, Appendix A
	Pre-subsidence	Erect temporary signage advising of the potential for subsidence risks	
	During active subsidence	Visual monitoring of access tracks and roads affected internal access to note any subsidence impacts that require remediation or implementation of additional traffic controls. Grade roads as required.	
	Post-subsidence	Remediate affected areas as required within 1 month of undermining	
Water Storage Dams and Soil Conservation Banks	Pre-subsidence	Obtain xyz coordinates along contour banks and water storage dams, using either LiDAR or field survey methods.	BFMP, Appendix A
	Pre-subsidence	Photographic records of all dams and contour banks	
	During undermining of structure.	Visual inspections of dams noting their condition and any indications of the following: - Cracking or failure of earth embankment requiring immediate attention; - Erosion of bank or spillway requiring repair.	
	Post-subsidence	Inspection survey on completion of active subsidence to identify impacts for remediation. Implement any required remediation works within 12 months of undermining.	
Property and Livestock Fences	Pre subsidence	Baseline aerial survey of fence lines and in-field visual assessment.	BFMP, Appendix A
	During active subsidence.	Visual monitoring during active subsidence. Exclude stock.	
	Post subsidence	Visual inspection survey on completion of active subsidence to identify impacts for remediation. Remediation to occur prior to re-stocking.	
Dwellings and Machinery Sheds	Pre subsidence	Undertake inspection to identify the presence of harmful materials/substances unable to remain in situ. Vacate buildings and services disconnected.	BFMP, Appendix A
	Post subsidence	Buildings affected by subsidence will remain secured to prevent unauthorised access until such time as they are structurally assessed, demolished or repaired. They will remain secured until prior to the intended re-use or if being demolished this will occur within 2 years of undermining.	

Aspect / Feature	Frequency	Monitoring Measures (full details provided in relevant management plan)	EP Management Plan Reference
Mine Infrastructure	Pre and post subsidence	Inspect decommissioned SIS gas drainage sites to confirm all structures have been safely decommissioned and site is stable and safe. Design/install PED cable with enough 'slack' for subsidence related impacts.	BFMP, Appendix A
	Pre and post-subsidence	Survey collars of affected piezometers and groundwater monitoring bores to confirm accurate levels for measuring of groundwater levels.	
Survey Mark	Pre and Post Subsidence	Apply to damage SSM 14 days prior to undermining. Once undermined, restore the mark and update details following subsidence.	BFMP, Appendix A
Water Management Plan			
Surface Water Quality Monitoring			
Pine Creek	Prior to active subsidence (baseline) and during runoff events (as practical)	Obtain baseline data on surface water quality in Pine Creek prior to mining and during runoff events for electrical conductivity (EC), oil and grease, pH, total suspended solids (TSS), total organic carbon (TOC).	WMP
Surface ponding	Monthly	Sampling for EC.	
Changes in water course morphology	Monthly visual inspection during subsidence	Identification of changes in planform, creek grade, bank erosion and sedimentation. Consult with geomorphologist/DPI-Water if changes significant.	
Ground Water Level Monitoring			
Namoi River Alluviuals	Baseline and throughout duration of mining	Monitoring of groundwater levels: monthly monitoring – manual sampling locations, and recording at automatic groundwater level sampling at vibrating wire piezometers (VWPs) daily (data downloaded monthly).	WMP
Permian to Jurassic hard rock aquifers	Baseline and throughout duration of mining	Monitoring of groundwater levels: monthly monitoring – manual sampling locations, and recording at automatic groundwater level sampling at vibrating wire piezometers (VWPs) daily (data downloaded monthly).	
Hydraulic conductivity	Pre-mining and post-subsidence	Monitoring of groundwater levels: monthly monitoring – manual sampling locations, and recording at automatic groundwater level sampling at vibrating wire piezometers (VWPs) daily (data downloaded monthly).	

Aspect / Feature	Frequency	Monitoring Measures (full details provided in relevant management plan)	EP Management Plan Reference
Mine water inflows	Daily (data logger)	Measurement of groundwater volumetric flow rates at extraction bores, sumps/pumps, box cut sump and water entry to mine.	
Springs	Monthly	Spring discharge rate including the Mayfield spring.	
Ground Water Quality Monitoring			
Monitoring bores	Monthly	Sampling of monitoring bores for EC and pH.	WMP
Bore water quality	Annually	Sampling of full suite of parameters (Refer WMP for list of parameters to be tested).	
Mine water inflows	Monthly	Measurement of mine water pumped into and out of the mine (EC pH,).	
Mine water inflows	Quarterly	Sampling of full suite of parameters (Refer WMP for list of parameters to be tested).	
Biodiversity Management Plan			
Woodland and Riparian Vegetation Monitoring			
General	Baseline, Annually (Spring)	LiDAR (3-yearly) and multi-spectral imaging to measure changes in topographic form, woodland parameters (i.e. extent, cover, biomass) extent of erosion.	BMP
Canopy health, vegetation structure, habitat features, weed presence and clearing areas	Baseline, Annually (Spring)	Longwall transects, floristic-based subsidence monitoring and pre-clearing/clearing surveys.	
Terrestrial Fauna and Habitat Monitoring			
Delicate mouse and Pale-headed snake	Baseline, Annual (Spring)	Elliot traps, pit falls, funnel traps, remote sampling techniques and active searches.	BMP
Land Management Plan			

Aspect / Feature	Frequency	Monitoring Measures (full details provided in relevant management plan)	EP Management Plan Reference
Surface Cracking			
Surface Cracking behind longwall face.	Weekly and following a significant rainfall event	Visual inspections for surface impacts (including surface cracking, ponding, landslips and erosion) of areas immediately behind the longwall face.	LMP
Surface Cracking in drainage lines	Following a significant rainfall event (defined as a rainfall event > 38.4 mm over 5 consecutive days)	Monitor drainage lines to identify erosion and potential erosion following rain events.	
Remote Sensing			
Topography and landscape morphology	Baseline, Every 3 years	LiDAR survey to identify changes in topographic form over time, including creek slope, width and depth.	LMP
Vegetative cover characteristics and erosion monitoring	Baseline, Annually (early spring)	Multi-spectral imaging, processed into a normalised difference vegetation index (NVDI) to measure variability in vegetative biomass and cover (pasture) over time and compared to control sites, followed by targeted field survey where analysis (ANOVA) indicates potential impacts have/are occurring – for example weed infestation or erosion impacts to vegetation.	
Creek line Surveys			
Geomorphic survey	Baseline, Annually (in late winter/spring).	Geomorphic survey to define geomorphic zones – mapping and description, survey (100m reaches).	LMP
Channel survey	Baseline, Annually (in late winter/spring).	Cross-sectional survey to monitor change in channel parameters (width, depth, cross-sectional area).	

Aspect / Feature	Frequency	Monitoring Measures (full details provided in relevant management plan)	EP Management Plan Reference
Heritage Management Plan			
Known archaeological sites	Prior to and following each longwall	Visual inspection (including photographic record) by qualified archaeologist to record pre and post subsidence condition of each archaeological site to assess whether any intervention and remediation works are required.	HMP
Known archaeological sites	Monthly during undermining	Monthly inspection to observe relation of surface cracking or erosion (if any) in relation to archaeological sites.	
Artefact find	As required	If artefacts or potential artefacts are identified during subsidence rectification works.	
Artefact disturbance	As required	If artefacts or potential artefacts are disturbed during subsidence or subsidence rectification works.	

4 PLAN IMPLEMENTATION

4.1 Responsibilities

To ensure adequate implementation of this monitoring program, the following NCOPL responsibilities have been assigned to relevant NCOPL personnel (see Table 2). It is also noted that additional responsibilities are referred to within the relevant management plans.

Table 2: Roles and Responsibilities

Roles	Responsibilities
General Manager	- Ensure that adequate resources are available to NCOPL personnel to facilitate the completion of their responsibilities under this program.
Mine Manager	- Ensure this Subsidence Monitoring Program is implemented and adhered to.
Technical Services Superintendent	- Ensure that all monitoring and reporting under the BFMPs and Subsidence Monitoring Program is carried out within the timeframes specified, and is checked, processed and filed appropriately.
	- Liaise with stakeholders regarding subsidence impact management.
	- Authorise changes to this Subsidence Monitoring Program.
Environmental Superintendent	- Ensure that all environmental monitoring and reporting is undertaken in accordance with the relevant environmental management plans and various approval requirements, and is checked, processed and filed appropriately.
Mine Surveyor	- Ensure that all subsidence monitoring is carried out to the accuracy required, within specified timeframes and are checked, processed and filed appropriately.

4.2 Reporting

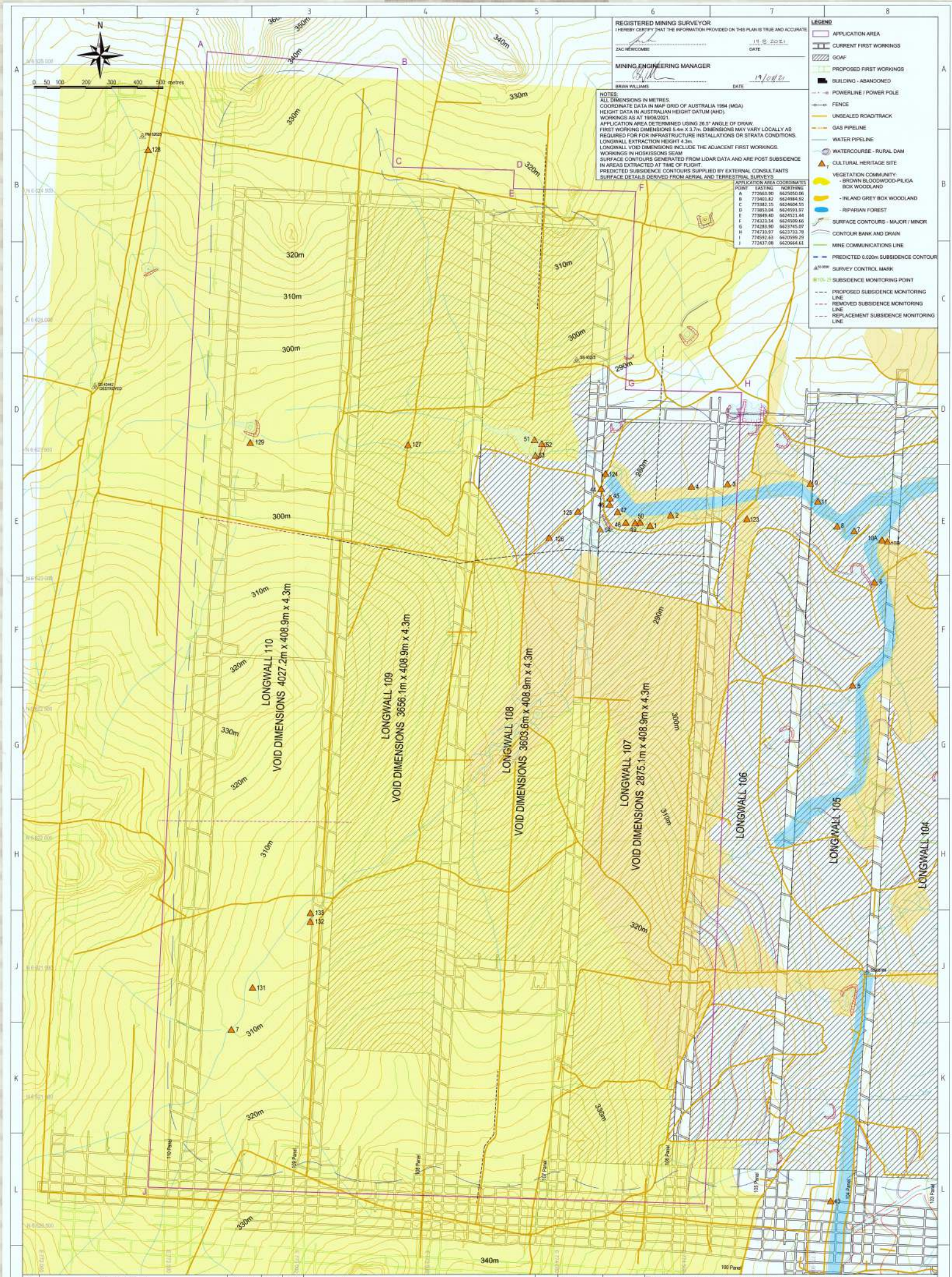
Subsidence reporting will be undertaken as described in Section 5.2 of the Extraction Plan. Information generated as a result of monitoring surveys carried out on subsidence lines will be uploaded to the subsidence data portal. Results after each survey will be forwarded promptly after they have been received at Narrabri Mine. Results will be in the format of an excel file with subsidence, tensile/compressive strains and tilts computed and also displayed graphically.

4.3 Review

The review requirements for the Extraction Plan, including this SMP, are outlined in Section 5.3 of the Extraction Plan.

Appendix A

Subsidence Monitoring Plan



REV	DESCRIPTION	DATE	DRN	CKD
1	REMOVED SUBSIDENCE LINE AND ADDITION OF SUBSIDENCE LINE	19/08/21	ZN	BB

WHITEHAVEN COAL

NARRABRI MINE

Narrabri Coal Operations Pty Ltd
Locked Bag 1002, Narrabri, NSW 2390 Australia

	Name	Date
DRN	ZN	19/08/2021
CKD	BB	19/08/2021
APP	BW	19/08/2021
SCALE	1 : 4500 @ A0	

Title: EXTRACTION PLAN - PLAN 7
SUBSIDENCE MONITORING NETWORK
LONGWALLS 107 - 110

DRAWING NUMBER: APN_15_07

REV: 1

Appendix B
Survey Monitoring Method and Schedule

STANDARDS

All monitoring will be planned and surveyed to ensure these surveys satisfy the conditions to achieve a standard of accuracy of "Class D" as prescribed in ICSM SP1 (The Inter-Governmental Committee on Surveying and Mapping Special Publication 1 "Standards and Practices for Control Surveys"). Target accuracy for survey of all points in the following tables will have a relative accuracy of +/- 3mm between co-ordinated monitoring points. Each survey will be conducted in 3D. The monitoring schedule is explained in greater detail in the following sections.

Subsidence Line Monitoring

Subsidence Line H

Subsidence Line H to be extended to monitor subsidence, tilt, strain and angle of draw across Longwalls Panels (LW) 107 to LW109. The design and monitoring schedule is shown on Plan 7 of the Extraction Plan, attached as Appendix A to this plan. The installation and monitoring details for Line H are shown in Table 3. Before mining commences in a given longwall block, Line H will be installed into the adjacent longwall panel.

Table 3: Subsidence Line H Details

Mark Type	Star Pickets driven to refusal at 10m intervals
Depth of Cover (Extension)	240m-300m
Survey Monitoring Method	Total station traverse from terrestrial baseline
Monitoring Frequency	Prior & Post Mining LW107-LW109
	LW107-109 CH 2,360, CH 2,300, & CH 2,300
	6 monthly

Subsidence Line I

Subsidence Line I to be extended to monitor subsidence, tilt, strain and angle of draw across Longwalls Panels (LW) 110. The design and monitoring schedule is shown on Plan 7 of the Extraction Plan, attached as Appendix A to this plan. The installation and monitoring details for Line I are shown in Table 4. Before mining commences in LW110, Line I will be installed.

Table 4: Subsidence Line I Details

Mark Type	Star Pickets driven to refusal at 10m intervals
Depth of Cover (Extension)	300m-350m
Survey Monitoring Method	Total station traverse from terrestrial baseline
Monitoring Frequency	Prior & Post Mining LW110
	LW110 CH 1,250
	6 monthly

Subsidence Line 107

Removed as movement has ceased.

Subsidence Line 108

Subsidence Line 108 to be installed to monitor subsidence, tilt, strain and angle of draw along the start and finish chainages of LW108. The design and monitoring schedule is shown on Plan 7 of the Extraction Plan. The installation and monitoring details for Line 108 are shown in Table 5. This monitoring line is to be installed and base survey complete prior to commencement of mining. The start-up zone will be defined as 320m north of the installation roadway through to 320m out-bye the LW108 installation roadway. The takeoff zone will be defined as the last 350m of longwall retreat and 180m south of the LW108 takeoff line.

Table 5: Subsidence Line 108 Details

Mark Type	Star Pickets driven to refusal at 10m intervals
Depth of Cover (Extension)	Start 280m – Finish 310m
Survey Monitoring Method	Total station traverse from terrestrial baseline
Monitoring Frequency	Prior & Post Mining LW108
	At 50m retreat intervals through to 320m outbye the installation roadway
	At 50m retreat from CH100 to the takeoff line
	6 monthly until movement ceases

LW109 and LW110

No start and finish subsidence lines are planned over the install and take off roads above LW109 and LW110 as extensive clearing would be required. Subsidence monitoring for these panels will be through a combination of Line A and ALS.

Appendix C
Visual Monitoring Method

Visual Inspection of Roads and Access Tracks

Visual monitoring of affected sections of unsealed access road will be conducted on as needs basis whilst affected by active subsidence. Monitoring to note and document where appropriate:

1. Location of longwall relative to the affected section of road;
2. Confirmation that any required signage under the BFMP and PSMP is located in an appropriate location and is visible / legible to road users;
3. Presence and width of any subsidence cracking within the road pavement;
4. Any subsidence effects that on inspection may affect the road formation and safe use of the road (i.e. compression humps or ground tilts);
5. Affected cattle grids (i.e. sharp edges protruding or gaps) or gates not able to be easily opened /closed;
6. Any damage/alteration to table drains or culverts that may result in water ponding or inadequate drainage during rainfall; and
7. Any other road obstructions.

Any observations of subsidence impacts requiring remediation or repair are to be recorded in the checklist provided in the BFMP and reported to the Technical Services Manager.

Visual Inspection of Water Storages

Visual inspection of water storages/dams (if storing water) during active subsidence to note and document where appropriate:

1) Any sudden changes (drops) in stored water level compared to previous day's inspection (use painted wooden survey stake or similar);
2) Condition of the dam wall and spillway, in particular noting any:
   a) Cracking within embankment;
   b) Signs of possible embankment failure (i.e. slumping or collapse of partial section);
   c) Formation of erosion (particularly formation of tunnel erosion or holes);
   d) Water seepage through wall; and
   e) Spillway damage (should be level, lower than embankment height and non-eroding).

If any of the above signs are noted, they should be reported to the Technical Services Manager. Assessment of the dam undertaken and works implemented in accordance with the Built Features Management Plan.

Visual Inspection of Property and Livestock Fences

Visual monitoring of affected sections of fence lines will be conducted whilst affected by active subsidence. Monitoring to note and document where appropriate:

1) Any breakage of permanent or temporary fencing; and
2) Location of grazing stock in relation to damaged fencing and confirmation that they are safely contained (or otherwise).

Where damage to fence lines may result in unplanned movement of livestock (i.e. Kamilaroi Highway), this is to be reported to the Environmental Superintendent.