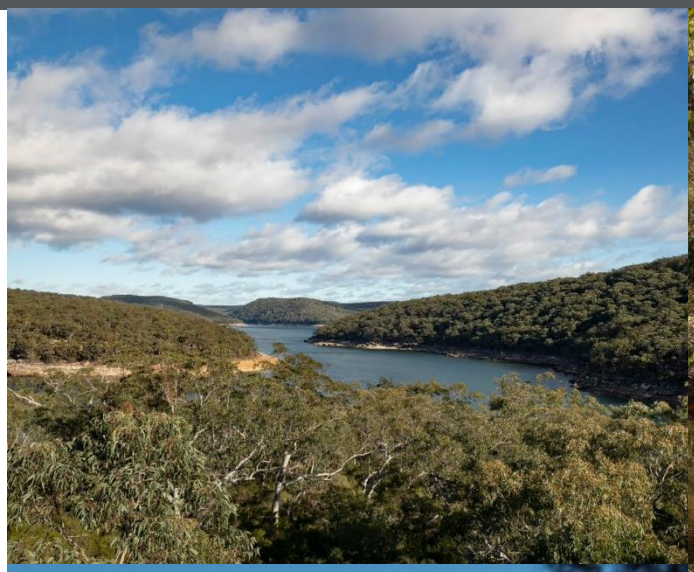
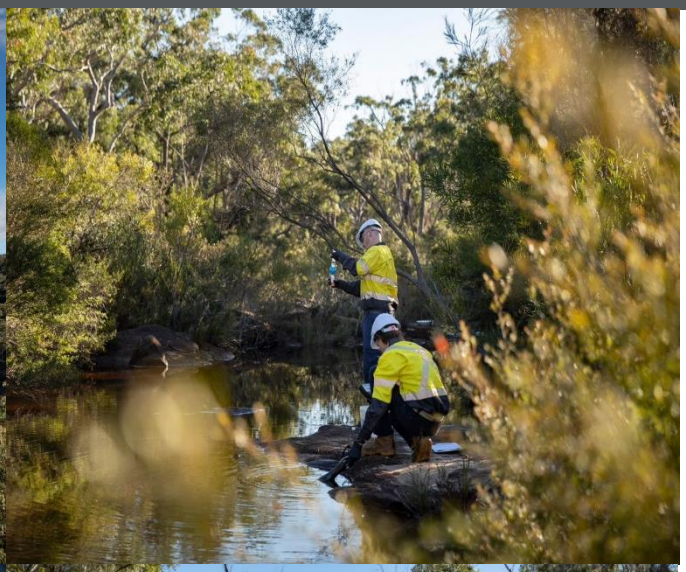
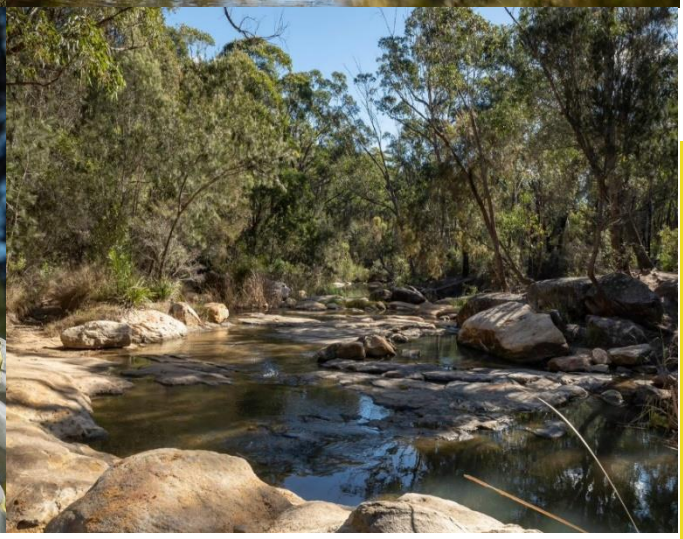
Illawarra Metallurgical Coal

Landscape Report







Appin Mine Longwall 904 Landscape Report

2022

EXECUTIVE SUMMARY

This report has been prepared by the South32 Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) to summarise the observed and measured subsidence effects on water, landscape features and terrestrial ecology, resulting from the extraction of Longwall 904.

Extraction of Longwall 904 commenced on 20 May 2021 and was completed on 9 August 2022.

The IMCEFT conducts detailed monitoring and inspections of landscape features including the Nepean River, tributaries, cliffs and steep slopes, and private properties. This monitoring was conducted in accordance with the Appin Area 9 Extraction Plan (EP), dated 2 September 2014.

IMCEFT identified one new impact associated with the extraction of Longwall 904. The impact comprised of a gas release on the Nepean River.

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ABBREVIATIONS

CMA – Corrective Management Action

DPE - Department of Planning and Environment

DPI – Department of Primary Industries

DRE - Department of Trade and Investment, Division of Resources and Energy

EoP – End of Panel

EP – Extraction Plan

IMCEFT – Illawarra Metallurgical Coal Environmental Field Team

OEH - Office of Environment and Heritage (now BCD)

BCD- Biodiversity and Conservation Division (formerly OEH)

SCA – Sydney Catchment Authority (now WaterNSW)

SA NSW – Subsidence Advisory NSW

TARP – Trigger Action Response Plan

1 INTRODUCTION

This report outlines monitoring of landscape features relevant to Longwall 904 and forms part of the Appin Area 9 Longwall 904 End of Panel Report (EoP Report). Monitored features include the Nepean River and its tributaries, cliffs and steep slopes, terrestrial flora, as well as private properties (farm dams and private boreholes). Monitoring of landscape features relevant to Longwall 904 has been carried out in accordance with the Appin Area 9 Extraction Plan, dated 2 September 2014. The Trigger Action Response Plan (TARP) details the actions required for any subsidence impacts (Appendix B).

Extraction of Longwall 904 commenced on 20 May 2021 and was completed 9 August 2022. Monitoring was conducted for landscape features for Longwall 904 during baseline, active mining (i.e. longwall within 400m of a feature) and post-mining periods. This monitoring involved measurement of surface water quality and levels, groundwater quality and levels, from Illawarra Metallurgical Coal (IMC) and private boreholes, and general observation of landscape features within the mining area. The results of the monitoring are outlined in the relevant sections below.

2 SUMMARY OF MONITORING PROGRAM

The Appin Area 9 monitoring program has been designed to identify impacts and consequences of mining and is presented in Figure 1 and Appendix A. Monitoring is conducted during baseline, active-mining and post-mining periods. Baseline inspections are undertaken up until the longwall is within 400m of a feature. During active mining, inspections typically increase to weekly until the longwall is 400m past the feature. Monthly post-mining inspections continue as outlined in the Extraction Plan.

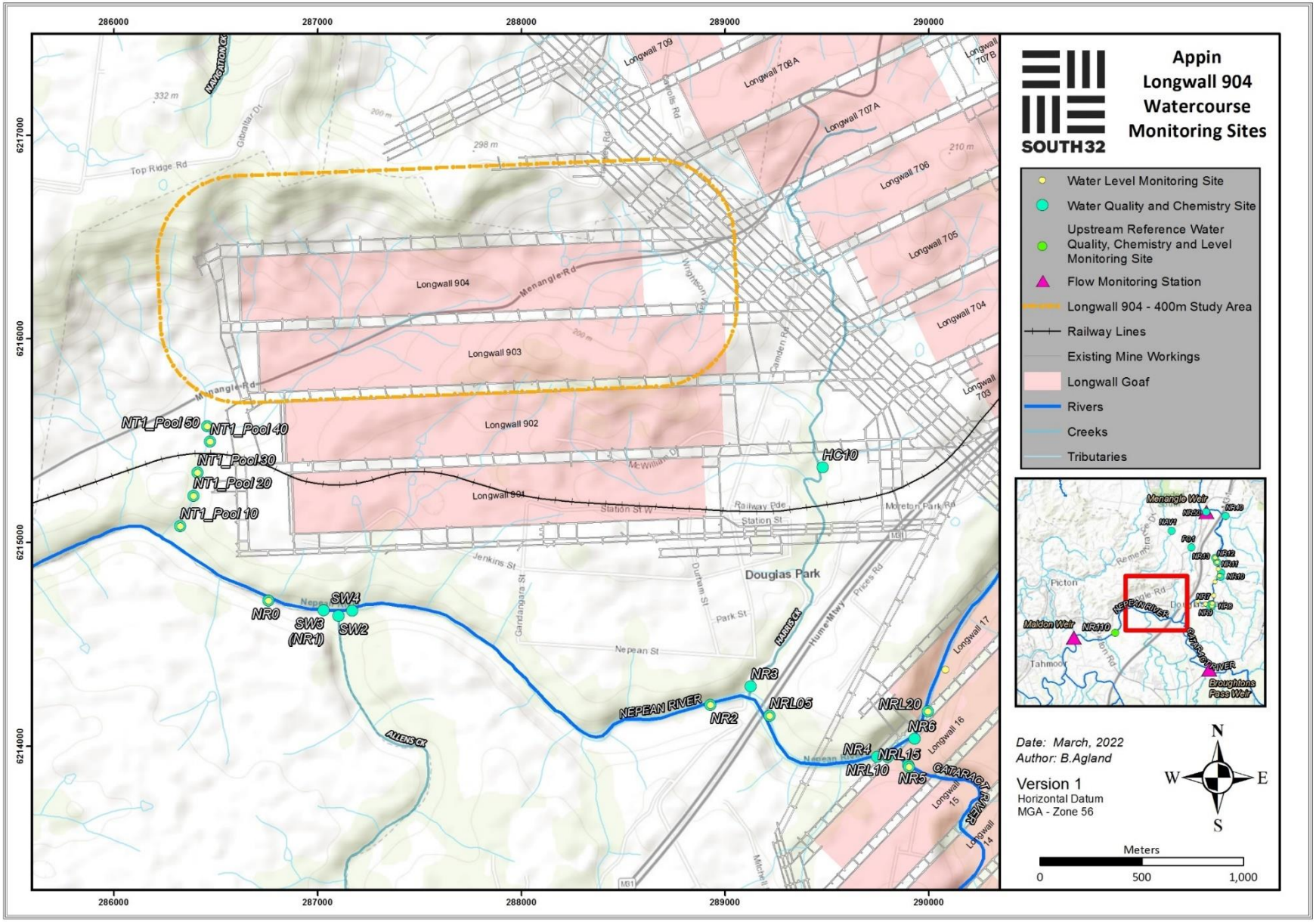

Figure 1: Map showing IMC surface water monitoring sites relevant to Longwall 904.

3 SUMMARY OF IMPACTS

Monitoring and inspections of the Nepean River and its associated tributaries is undertaken in accordance with the approved Appin Area 9 Extraction Plan (EP). Monitoring is conducted by the Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) monthly prior to mining, and weekly during active subsidence. Water quality and water levels are recorded along with photographic records and observational notes.

During the extraction of Longwall 904, one new impact, labelled "*AA9_LW904_001",* was observed (Table 1).

3.1 Water Quality

In-situ water quality parameters are measured at relevant monitoring sites on the Nepean River and its tributaries. In-situ water quality parameters include temperature, electrical conductivity (EC), oxidation-reduction potential (ORP), pH, dissolved oxygen (DO) as well as visual observations. Water samples are also taken for laboratory analysis. Specialist assessment of water quality results will be included in the Surface Water and Groundwater Assessment of the Longwall 904 EoP Report.

3.1.1 Gas Releases

One gas release zone was reported as a Level 1 Trigger in accordance with the Trigger Action Response Plan (TARP) in the *Appin Area 9 EP: Annex B- Subsidence Monitoring Program* (Appendix B); specifically:

- Identification of strata gas plume of flow rate <3000 L/min

The following actions were initiated in response to these impacts:

- Continue monitoring program
- Submit an Impact Report to relevant stakeholders
- Report in the End of Panel Report
- Summarise actions and monitoring in the Annual Review (AR)

AA9_LW904_001 (289901, 6213903)

AA9_LW904_001 was identified on 10 August 2021 and consisted of a gas release zone on the Cataract River, approximately 100m upstream of the Nepean River and Cataract River confluence. The site is approximately 2600m from the closest point of Longwall 904 (Figure 2). The zone originally comprised of approximately 4 light/intermittent gas releases within an area of approximately 15m^2 (Photo 1). During inspection on 5 September 2022, this gas zone was not active.

Photo 1: Gas release zone AA9_LW904_001. Taken on 9/9/2021.

Continued monitoring of gas release zones previously reported during the extraction of Longwall 901, Longwall 902 and Longwall 903 also occurred. The status of these releases during the latest inspection are summarised in Table 2.

3.1.2 Water Level and Flow

Water levels in the Nepean River and its tributaries were monitored by the IMCEFT using photo observations and installed benchmark measurements where available. Inspections are undertaken where access was safe and granted. No subsidence induced flooding of riverbanks was observed. Additionally, no areas of dry riverbed were observed. For assessment of water level and flow refer to Surface Water and Groundwater Assessment of the Longwall 904 EoP Report.

3.1.3 Appearance

The appearance of the Nepean River and its tributaries was monitored by the IMCEFT where access was safe and granted. Photographs are taken of monitoring sites, gas zones and any other potential impact site. Apart from the previously mentioned gas release zones, no impacts to the appearance of the Nepean River or tributaries were observed during the extraction of Longwall 904. No subsidence induced flooding of riverbanks was observed during the extraction of Longwall 904. However, high rainfall events during 2022 lead to IMCEFT observing erosion to riverbanks, loss of vegetation cover and sediment movement along the Nepean River.

3.1.4 Groundwater

Boreholes relevant to Longwall 904 are: S1941, S1954, S2080, S2280 and S2281. Specialist assessment of groundwater data (level and quality) will be included in the Surface Water and Groundwater Assessment of the Longwall 904 EoP Report. No visible impacts to groundwater boreholes were identified by IMCEFT during the extraction of Longwall 904.

3.1.5 Landscape Features

Observations of cliff lines and steep slopes along the Nepean Gorge and associated tributaries were conducted by the IMCEFT on a monthly basis. Monitoring included observational and photographic records, and monitoring of piezometers and slope inclinometers. No impacts to cliffs were identified during the extraction of Longwall 904. Observations above the active longwall were conducted where access was available.

3.1.6 Terrestrial Ecology

Terrestrial ecology in Appin Area 9 is monitored by the IMCEFT in conjunction with general observational monitoring. Aspects that are considered whilst monitoring include changes in vegetation condition and vegetation that may have been impacted by rockfalls, soil slippage or gas emissions. No impacts or changes to terrestrial ecology were observed during monitoring for Longwall 904.

3.1.7 Private Property Inspections

Built Feature Management Plans (BFMPs) have been prepared by IMC for landholders above Appin Area 9. Post-mining inspection of dams, boreholes and natural features set out in the BFMPs are conducted by the IMCEFT with the consent of the relevant property/infrastructure owner and tenant (if applicable). Post-mining inspections were undertaken at properties Lot 1 DP810978, Lot 9 DP810978, Lot 3 DP1133989, Lot 22 DP803255 (Figure 3). Lot 15 DP803255 was also reinspected following a recommendation in the Longwall 903 EoP Report. Monitoring included collection of in-situ water quality parameters and water samples for laboratory analysis. Results of water quality will be assessed in the Surface Water and Groundwater Assessment of the Longwall 904 EoP Report.

3.1.8 Aboriginal Archaeology

No Registered Aboriginal Archaeological Sites are located within the Study Area. There is one Shelter with Art which has been identified just outside the Study Area, as shown in MSEC (2012) Drawing No. MSEC448-33. There are no declared Aboriginal Places under the National Parks and Wildlife Act 1974 or identified Aboriginal Sites within the Study Area.

3.1.9 European Heritage

Heritage Sites listed in the Study Area comprise the Railway Cottage at Douglas Park Station, which is listed in the Wollondilly Local Environmental Plan 1999. No impacts have been reported.

Table 1: Summary of Longwall 904 impacts.

Site ID	Easting	Northing	Impact/Trigger Type	Identification Date	Status	Description	Impact Level	Report Date
AA9_LW904_001	289901	6213903	Gas Release	10/08/2021	Inactive	Four light/intermittent releases within an area of approximately 15m^2.	1	15/09/2021

Table 2: Summary of Nepean River gas zones relevant to Appin Area 9, as of 5 September 2022.

Site ID	Easting	Northing	Impact Type	Identification Date	Status	Reported Description	Impact Level	Report Date
AA9_LW901_001	286880	6214670	Gas Release	2/03/2016	Inactive	Four individual releases in a 5m² area. One is moderate and constant; the others are light and intermittent.	1	3/03/2016
AA9_LW901_002	286712	6214745	Gas Release	7/03/2016	Inactive	Approx. 12 releases, low to moderate intensity within 12m by 4m area; releases are both constant and intermittent.	1	8/03/2016
AA9_LW901_003	286766	6214713	Gas Release	7/03/2016	Inactive	Multiple releases. Low to moderate intensity, releases are both intermittent and constant within a 45m by 6m area.	1	8/03/2016
AA9_LW901_004	286820	6214695	Gas Release	7/03/2016	Inactive	Approx. 20 releases, most releases are constant with a low to moderate intensity. Covers approx. 20m by 8m area.	1	8/03/2016
AA9_LW901_005	286962	6214666	Gas Release	7/03/2016	Active	Approx. 10 releases, releases are constant with a low to moderate intensity across approx. 7m by 2m area.	1	8/03/2016
AA9_LW901_006	286997	6214667	Gas Release	7/03/2016	Inactive	Approx. 6 releases, releases are constant with low intensity. 3m by 4m area.	1	8/03/2016
AA9_LW901_007	287506	6214668	Gas Release	15/03/2016	Inactive	Approx. 30 light gas releases across the width of the river in a 15m by 24m area. Releases are both constant and intermittent.	1	16/03/2016
AA9_LW901_008	287065	6214662	Gas Release	18/03/2016	Inactive	Approx. 8 releases, light. 4 constant and 4 intermittent in a 7m by 4m area.	1	22/03/2016
AA9_LW901_009	287249	6214679	Gas Release	18/03/2016	Inactive	>35 releases, light, 4 intermittent, 4 constant; 7m by 4m area.	1	22/03/2016
AA9_LW901_010	287317	6214697	Gas Release	18/03/2016	Active	Multiple (>80), constant and intermittent, 15m by 30m area.	1	22/03/2016
AA9_LW901_011	287036	6214664	Gas Release	21/03/2016	Inactive	Approx. 22 releases, light, constant, 7m by 8m area. Approx. 10m DS of SW3.	1	22/03/2016

AA9_LW901_012	287191	6214670	Gas Release	21/03/2016	Active	Two areas of release separated by approx. 8m. Upstream area has 12 light constant releases in a 6m by 5m area. Downstream area has 10 similar releases in a 5m by 5m area.	1	22/03/2016
AA9_LW901_013	287377	6214698	Gas Release	21/03/2016	Inactive	Approx. 20 constant releases, light to moderate in intensity, extending across the river, approx. 8m long.	1	22/03/2016
AA9_LW901_014	287575	6214652	Gas Release	21/03/2016	Inactive	>25 releases, all light and constant, predominately on southern bank, approx. 30m by 10m in area.	1	22/03/2016
AA9_LW901_015	287103	6214639	Gas Release	29/03/2016	Inactive	Allens Ck Gas zone. 3 to 4 releases. Light. Intermittent	1	29/03/2016
AA9_LW901_016	287651	6214611	Gas Release	4/04/2016	Active	5 releases, 2 constant, 3 intermittent (5secs), southern bank. 1m by 2m area.	1	4/04/2016
AA9_LW901_017	287156	6214658	Gas Release	8/04/2016	Inactive	14 light constant releases on southern bank (RHS) between LW901_008 and 012. Area is approx. 50m from Allens Ck confluence.	1	8/04/2016
AA9_LW901_018	287429	6194691	Gas Release	21/04/2016	Inactive	~20 releases on the northern bank of the Nepean River. All releases are light and constant. Area is 2m by 25m.	1	22/04/2016
AA9_LW901_019	288075	6214239	Gas Release	4/04/2017	Inactive	Approximately 15 light releases, intermittent to constant, stretching along approximately 20m section.	1	5/04/2017
AA9_LW901_020	288157	6214154	Gas Release	4/04/2017	Inactive	Approximately 15 light constant releases along a stretch of approximately 12m.	1	5/04/2017
AA9_LW901_021	288455	6214091	Gas Release	26/04/2017	Inactive	45 intermittent releases mostly low strength with a few medium. Area of approximately 30 by 10m. On the 23/4/2020, the gas zone was extended 25m downstream with 25 light, intermittent releases.	1	9/05/2017 & 24/04/2020
AA9_LW901_022	288620	6214128	Gas Release	26/04/2017	Inactive	Approximately 20 light intermittent releases with an area of 5m by 8m.	1	9/05/2017
AA9_LW901_023	288292	6214083	Gas Release	17/07/2017	Inactive	Approx. 10 Light constant releases within 1 m^2.	1	19/07/2017

AA9_LW901_024	288253	6214102	Gas Release	24/05/2017	Inactive	One intermittent release of light intensity.	1	30/05/2019
AA9_LW901_025	288218	6214128	Gas Release	24/05/2017	Inactive	One intermittent release of light intensity.	1	30/05/2019
AA9_LW901_026	288016	6214314	Gas Release	31/01/2018	Inactive	One constant, light intensity release in the center of the river.	1	01/02/2018
AA9_LW902_001	287733	6214551	Gas Release	16/07/2018	Inactive	Three light intermittent releases within an area of approximately 1m by 5m.	1	18/07/2018
AA9_LW902_002	287704	6214562	Gas Release	4/09/2018	Inactive	Five small, constant releases within an area of approximately 1m by 10m.	1	4/09/2018
AA9_LW902_003	288805	6214172	Gas Release	29/01/2019	Inactive	Four small intermittent releases within an area of approximately 1m.	1	30/01/2019
AA9_LW902_004	289876	6214000	Gas Release	26/04/2019	Inactive	Five light, intermittent releases within an area of approximately $5m^2$.	1	1/05/2019
AA9_LW902_005	288692	6214136	Gas Release	26/04/2019	Inactive	Five light releases approximately 70m downstream of gas release zone AA9_LW901_022.	1	1/05/2019
AA9_LW902_006	288955	6214209	Gas Release	24/05/2019	Inactive	Three light, intermittent releases within an area of approximately 1.5m by 0.5m.	1	31/05/2019
AA9_LW902_007	287982	6214357	Gas Release	15/08/2019	Inactive	Five moderate, constant releases within an area of approximately 5m by 5m.	1	19/08/2019
AA9_LW902_008	288500	6214109	Gas Release	11/09/2019	Inactive	15 constant and intermittent releases within an area of approximately 15m by 5m.	1	12/09/2019
AA9_LW903_001	287602	6214639	Gas Release	23/04/2020	Active	Three light intermittent releases within an area of approximately 2m by 2m.	1	24/04/2020

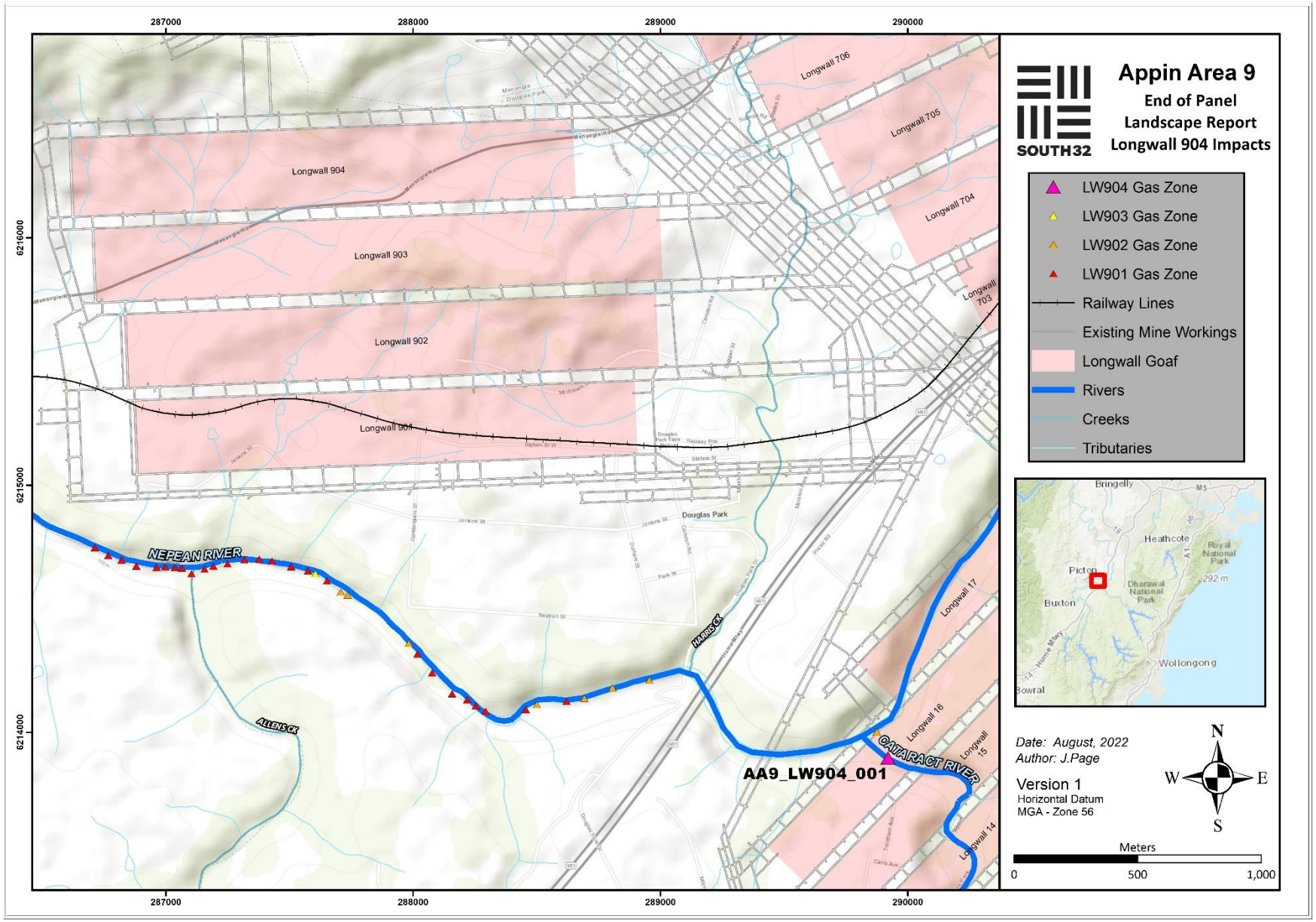

Figure 2: Map showing subsidence impacts relevant to Longwall 904.

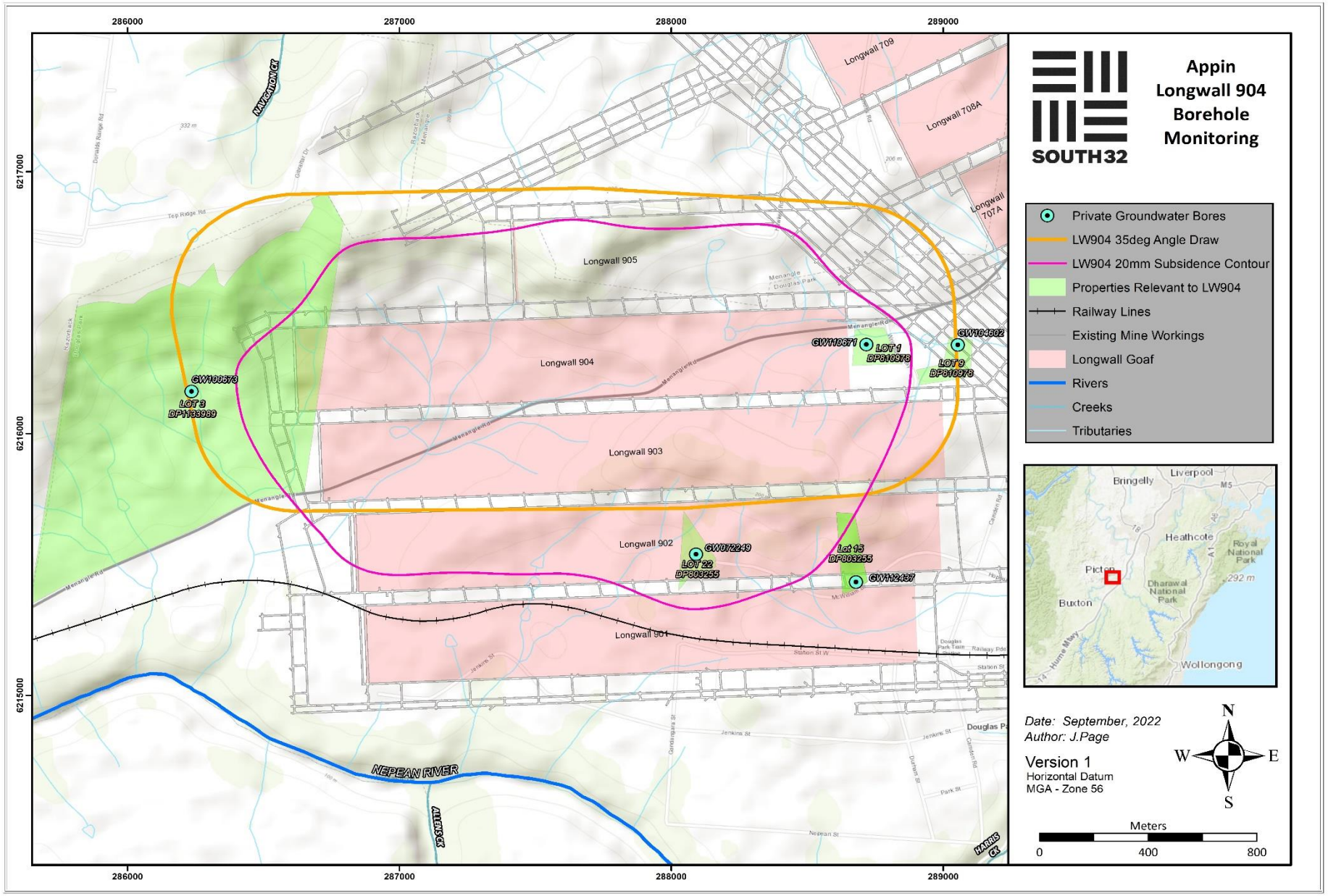

Figure 3: Map showing private properties with boreholes relevant to Longwall 904.

4 FUTURE MONITORING

Future monitoring of Appin longwalls will comprise of combining both areas Appin Area 7 and 9 as seen in Figure 4. Recommendations for future monitoring in Appin Area 7 and 9 are outlined in Appendix A. These recommendations are based on monitoring commitments in the Appin Mine Areas 7 and 9 Longwalls 709 to 711 and 905 Extraction Plan, and longwall proximity monitoring sites.

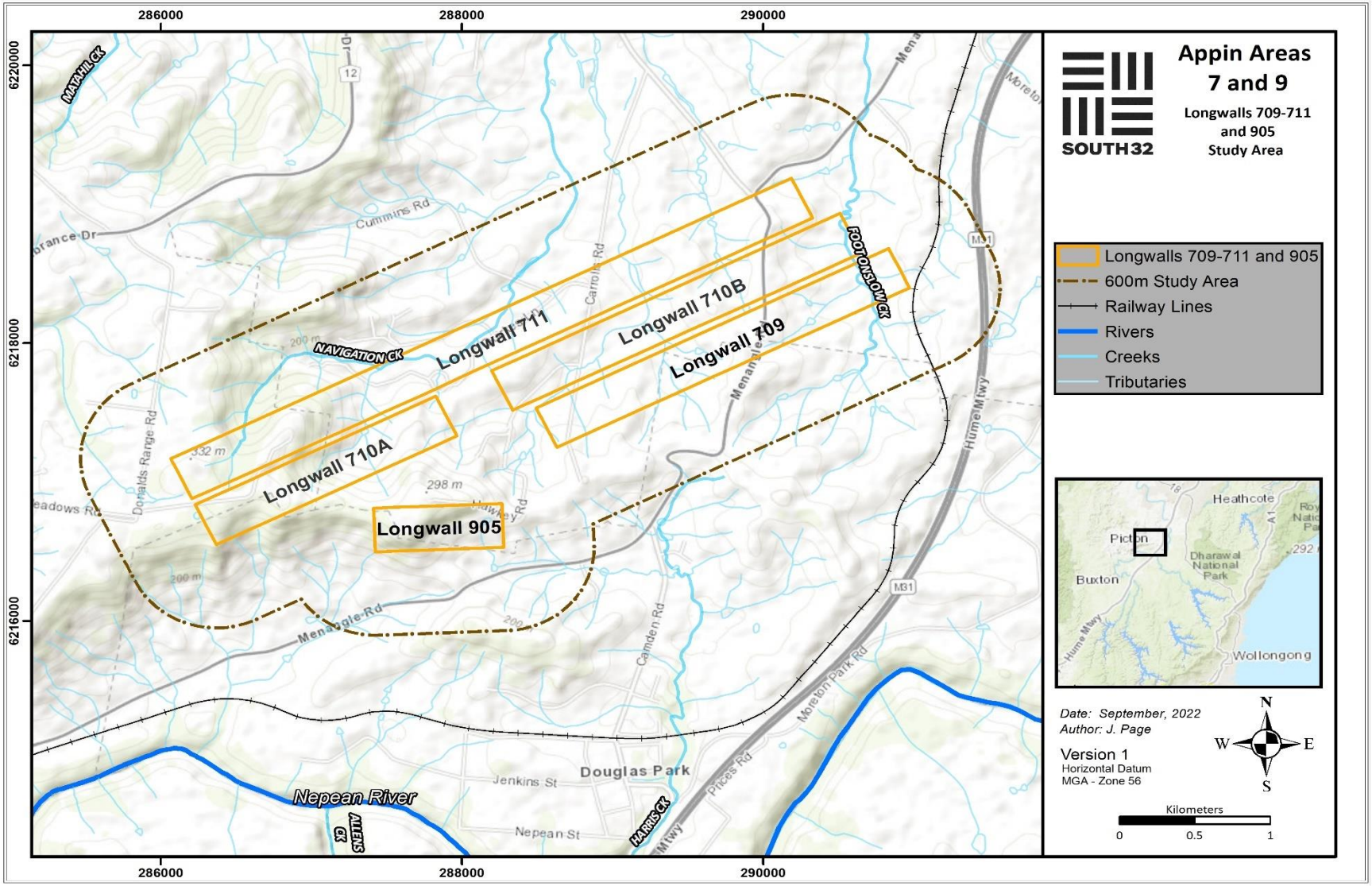

Figure 4: Future monitoring Appin longwalls 709 to 711 and 905 study area.

5 APPENDIX A

Appendix A 1: Appin Area 9 Key Monitoring

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709 TO 711 AND 905)
SURFACE WATER				
Nepean River and tributaries • NR110 (Lab, Field, Level, Obs) • NR0 (Lab, Field, Level, Obs) • SW2 (Lab, Field, Obs) • SW3 (NR1) (Field, Obs) • SW4 (Field, Obs) • NR2 (Lab, Field, Obs) • NR3 (Lab, Field, Obs) • NT1_Pool 10 (Lab, Field, Level, Obs) • NT1_Pool 20 (Field, Level, Obs) • NT1_Pool 30 (Field, Level, Obs) • NT1_Pool 40 (Field, Level, Obs) • NT1_Pool 50 (Field, Level, Obs) If and where strata gas emission plumes above 3000 L/min are detected (Lab, Field, Obs)	• Laboratory analysis (Lab) • Field parameters (Field) • Water levels (Level) (where a suitable stricture exists) • Observations (Obs)	• Monthly baseline monitoring prior to mining • Weekly observations and field analysis during active subsidence • Monthly laboratory analysis during active subsidence • Monthly monitoring for two years post mining	**Field Parameters:** • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP **Standard Lab Sample:** • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO_4 • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH_3-N, NO_x-N (TON), FRP, TSS, DOC **Lab Sample for Gas Releases:** • CH_4 • C_2H_6 • Trace Phenols • Sulphide **Observations:** • Iron or salinity staining (e.g. orange or white staining in water or on banks/seeps) • Evidence of springs in the Nepean River • Visual signs of impacts (i.e. cracking, fracturing, vegetation changes, increased erosion, changes in water colour etc) • Stream flow and pool water level • Impacts determined from comparing photo points taken prior to, during and post mining	**Foot Onslow Creek** • FO1 (Lab, Field, Level, Obs) • FO2 (Obs) **Harris Creek** • HC10 (Lab, Field, Obs) • HC20 (Level, Obs) • HC30 (Obs) **Navigation Creek** • NAV1 (Lab, Field, Level, Obs) • NAV2 (Obs) **Nepean River** • NR110 (Lab, Field, Level, Obs) • NR0 (Lab, Field, Level, Obs) • SW2 (Lab, Field, Obs) • SW3 (Lab, Field, Obs) • SW4 (Field, Obs) • NR2 (Lab, Field, Level, Obs) • NR3 (Lab, Field, Obs) • NR4 (Field, Level, Obs) • NR5 (Lab, Field, Obs) • NR6 (Lab, Field, Obs) • NR7 (Lab, Field, Obs) • NR8 (Lab, Field, Obs) • NR9 (Lab, Field, Level, Obs) • NR10 (Lab, Field, Obs) • NR11 (Lab, Field, Obs) • NR12 (Lab, Field, Obs) • NR13 (Lab, Field, Obs)

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709 TO 711 AND 905)
				• NR40 (Lab, Field, Obs) • NR50 (Lab, Field, Obs) **Remembrance Drive** • RC1 (Lab, Field, Level, Obs) – Reference Site

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709 TO 711 AND 905)
Flow monitoring • Maldon Weir • Broughtons Pass Weir • Menangle Weir	• Gauged flow station	• Daily flow	**Analysis:** • 51 baseline dry weather recession periods for Menangle minus Maldon minus Broughtons Pass Weirs with recession curve slope ranging from 0.76 to 0.99 • Recession curves calculated during and post mining • These recessions will be compared from the period of mining to the pre-mining period • Monitoring undertaken by WaterNSW. Observational data to be compared with flow records at weir sites.	• Maldon Weir • Broughtons Pass Weir • Menangle Weir • Foot Onslow Creek (to be established) • Navigation Creek (to be established)
GROUNDWATER				
Private Bores • GW34425 • GW35033 • GW72249 • GW100673 • GW101133 • GW102043 • GW102584 • GW102798 • GW103161 • GW104068 • GW104602 • GW104661 • GW110671 • GW12437 *(in consultation with bore owner and if accessible and access is granted)*	• Lab sample • Field parameters • Water levels Observations	• Where access is available and granted, water level and water quality monitoring at least once before and once after the bore is mined under	**Field Parameters:** • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP **Standard Lab Sample:** • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO_4 • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH3-N, NOx-N (TON), FRP, TSS, TDS, DOC **Lab Sample for Gas Releases:** • CH4 • C2H6 • Trace Phenols • Sulphide	**Private Bores** • GW108990 • GW100289 • GW072874 • GW100673 • GW101986 • GW105531 • GW105534 • GW106675 • GW111781 • GW112381 • GW105376 • GW105574 • GW106574 • GW107791 • GW108907 • GW108990 • GW072196 • GW110671 *(in consultation with bore owner; if accessible and access is granted)*
IMC Piezometers: • Potentiometric head;	• Lab sample • Field parameters	• Water levels to be logged at least twice daily in the pre-	**Observations:**	**IMC Piezometers** • S1913

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709 TO 711 AND 905)
– EAW9 (S1941) – EAW18 (S1954) – EAW5 (S1913) – EAW7 (S1936) – EAW58 (S2080 • Piezometers and water samples between Longwall 901 and the Nepean River – S2280 (Harris Ck 7) – S2281 (Harris Ck 6)	• Water levels Observations	mining baseline, impact and post-mining period • At least one appropriately purged sample pre-mining and post mining, where access permits, tested for the analytes in the previous column	• Iron or salinity staining (e.g. orange or white staining in water or in the bores	• S1936 • S1941 • S1954 • S2157 • S2315 • S2536 • S2536A • S2537 • S2538 • S2632
Groundwater inflows to the mine	• Mine water budget Observations	• Flow meters	Water flow from the goaf to the mine (analyzed as a moving average i.e. 20 day average)	No Changes
AQUATIC ECOLOGY				
Nepean River • Sites 1 and 2 (downstream) • Sites X3 and X4 (adjacent to Longwalls 901 and 902) • Sites X5 and X6 (upstream) • Sites X7 and X8 (upstream)	• Water quality - field parameters • Survey and sampling • Observations	• Twice in spring for two years prior to the commencement of mining • Once every two years during mining • Once every two years after mining	• Habitat surveys • Aquatic macrophyte observations • Macroinvertebrate monitoring • AUSRIVAS sampling • Fish sampling • Observations of threatened species • Assessments of: – Water quality – Flow – River morphology	**Impact Sites** • Sites 5, 6, X3 and X4 **Control Sites** • Sites 1, 2, 7, 8, X5, X6, X7 and X8
TERRESTRIAL ECOLOGY				
• Inspection of the area will be conducted as outlined in the Landscape TARP	• As indicated in the Landscape TARP	• Prior to mining provide pre-mining baseline survey of vegetation communities and threatened flora populations for comparison with post-mining • Monthly prior to mining • Weekly during active subsidence	• Observations of threatened species and endangered ecological communities • Changes in vegetation condition • Stressed or dead vegetation not readily explained by natural processes (causes may include rock / cliff falls or mass movement, gas emissions, changes in flooding/ ponding)	No Changes

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709 TO 711 AND 905)
		• In response to any identified impacts on flora/fauna or threatened species, communities or populations		
ABORIGINAL ARCHAEOLOGY				
• Impacts to the cliff lines on the southern side of the Nepean River will trigger an inspection of Bradcorp 1 and any adjacent sections of the river and creek valleys that have not been inspected	• Observational and photographic monitoring	• In accordance with Landscape TARP	• Subsidence Impacts to cliff lines on the southern side of the Nepean River (e.g. directly north of Bradcorp 1)	• No sites requiring monitoring
EUROPEAN HERITAGE				
• Douglas Park Railway Cottage Item 30	• Observational monitoring	• Baseline archival recording prior to commencement of mining • Impact assessment recording following the identification of impacts or when a SA NSW claim is lodged • Final assessment recording following the completion of mining of Longwalls 901 and 902 and/or after any repairs	• With the consent of the owner, the subsidence monitoring program will include: • Pre-mining inspection and assessment (as part of PSMP) • Observational monitoring to identify potential subsidence impacts to the fabric of the building and/or its interior (if required) • Assessment of heritage impacts by a suitably qualified heritage expert (if required) • This assessment would be made available to the SA NSW and include recommendations for management of heritage value during any repairs	• No non-Aboriginal heritage sites were identified in the Longwalls 709 to 711 and 905 Study Area during the assessments undertaken for the BSO EA
LANDSCAPE FEATURES				

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709 TO 711 AND 905)
• Nepean River cliff lines • Harris Creek cliff lines • Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner/s	• Observational and photographic monitoring • Piezometers • Slope inclinometers	• ***Harris Creek and Nepean River cliff lines*** - Baseline recording once prior to mining. - Monthly routine inspections with weekly inspections during critical periods • ***Low Terrain Sensitivity*** (visual inspection) - 6 months prior to mining - 6 months after active subsidence • ***Medium Terrain Sensitivity*** - 6 to 12 months prior to mining - 3 monthly during active subsidence - 6 months after active subsidence • ***High Terrain Sensitivity*** • 12 months before commencement of subsidence for visual and on ground survey • Monthly for visual during active subsidence • 3 monthly for ground survey during active subsidence • Installation of piezometers and inclinometers as required and in consultation with landowners as part of PSMP process	• Visual inspections • Photographic records • Ground survey (mid to high terrain sensitivity) • Piezometers (high terrain sensitivity) • Slope inclinometers (high terrain sensitivity)	No Changes

6 APPENDIX B

Appendix B 1: AA9 TARPS, Key Monitoring, Triggers and Response

Monitoring	Trigger	Action
WATER QUALITY		
Adjacent and downstream sites: • Nepean River: – NR0 – SW3 (NR1) – NR2 – If and where strata gas emission plumes above 3000 L/min are detected	***Level 1**** Impact monitoring sites when comparing the baseline period to the mining period for that site: • pH reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • DO reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate < 3000 L/min	• Continue monitoring program • Submit an Impact Report to BCS, DPE, DPI Fisheries, RR and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* Impact monitoring sites when comparing the baseline period to the mining period for that site: • pH reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • DO reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • EC, total Fe and total Mn increases greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate >3000 L/min	• *Actions stated for Level 1* • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts* *Strata Gas Emission Plume:* • Estimate gas emission flow rates. Re-estimate should significant change be observed • Take sample of plume (if possible) for: – chemical composition – dissolved methane from exactly above gas plume and at established downriver monitoring site – dissolved sulfide and total phenols from exactly above gas plume and at nearest downriver monitoring site
	Level 3* Impact monitoring sites when comparing the baseline period to the mining period for that site:	• *Actions stated for Level 2*

Monitoring	Trigger	Action
	• Level 2-type reduction in water quality resulting from the mining observed for more than 6 consecutive months	• Notify BCS, DPE, DPI Fisheries, RR, 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) • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Exceeding Performance Measures • Mining results in more than negligible gas releases, iron staining or water cloudiness	• *Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
GROUNDWATER		
Groundwater flow into the mine **Registered Bores:** GW 34425 GW 35033 GW 72249 GW 100673 GW 101133 GW 102043 GW 102584 GW 102798 GW 103161	***Level 1**** • Increase in water flow from the goaf between 2.7 to 3 ML/day (over 20 day average) • 5.0 – 7.5 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period	• Continue monitoring program • Submit an Impact Report to BCS, DPE, DPI Fisheries, RR and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* • Increase in water flow from the goaf between 3 to 3.4ML (over 20 day average) • 7.5 – 10 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period	• *Actions stated for Level 1* • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved *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*

Monitoring	Trigger	Action
GW 104068 GW 104602 GW 104661 GW 110671 **BHPBIC Piezometers:** EAW9 EAW18 EAW58 S2280 S2281	***Level 3**** • Abnormal increase in water flow from the goaf >3.4ML (20 day average) • >10m reduction in the Hawkesbury Sandstone standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period • Mining results in groundwater bores unsafe, unserviceable or damaged	• *Actions stated for Level 2* • Notify BCS, DPE, DPI Fisheries, RR, 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: – Make area safe – Any actions agreed to in the Property Subsidence Management Plan – Provisions of alternate water supply where this has been impacted by mining – SA NSW to repair any infrastructure damaged by mining • Completion of works following approvals, including monitoring and reporting on success • Review the Groundwater Model, TARP and Management Plan in consultation with key stakeholders *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*
LANDSCAPE FEATURES		
Cliffs and Steep Slopes • Nepean River cliff lines • Harris Creek cliff lines • Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner	***Level 1*** • Rock fall from a cliff where the cliff is left mostly intact (<10% length of any single cliff) • Surface movement or rock displacement where any exposed soil surface is stable • Crack at the surface which does not result in ongoing erosion or ground movement • Erosion which stabilises within the period of monitoring without CMA • Crack or fracture up to 100 mm width • Crack or fracture up to 10 m length	• Continue monitoring program • Submit an Impact Report to BCS, DPE, DPI Fisheries, RR and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2	• *Actions stated for Level 1* • Report trigger to key stakeholders

Monitoring	Trigger	Action
	• Rock fall from cliff where the characteristics of the cliff change (>10% length of any single 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 – 300 mm width • Crack or fracture between 10 – 50 m length	• Review monitoring program • Notify relevant specialists and develop and implement any CMA required. • Provide safety signage and barricades where appropriate in areas as required for public safety (refer PSMP) • Implement agreed CMA's as approved *<u>Note:</u> 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*
	Level 3 * • Cliff collapse (100% length of any single cliff) • Ground disturbance that does not stabilise within the period of monitoring • Mass movement of a slope causing areas of exposed soil that does not stabilise within the period of monitoring • Crack or fracture over 300 mm width • Crack or fracture over 50 m length	• *Actions stated for Level 2* • Notify BCS, DPE, DPI Fisheries, RR, 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: – Erosion prevention works – Establishment of vegetation • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders *<u>Note:</u> 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*
	Exceeding Performance Measures • For cliffs of 'special significance' and other cliffs flanking the Nepean River - mining results in more than negligible environmental consequences (i.e. more than occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total impact more than 0.5% of the total face area of such cliffs within any longwall mining domain • Other cliffs – mining results in more than minor environmental consequences (that is occasional rockfalls, displacement or dislodgment of boulders or slabs or fracturing, that in total impact	• *Actions stated for Level 3* • Make area safe • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful

Monitoring	Trigger	Action
	more than 3% of the total face area of such cliffs within any longwall mining domain	

AQUATIC ECOLOGY		
Nepean River • Sites 1 and 2 (downstream) • Sites X3 and X4 (adjacent to Longwalls 901 and 902)	***Level 1**** • Reduction in aquatic habitat resulting from the mining over 1 season	• Continue monitoring program • Submit an Impact Report to BCS, DPE, DPI Fisheries, RR and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* • Reduction in aquatic habitat resulting from the mining over 2 seasons	• *Actions stated for Level 1* • Report trigger to key stakeholders • Review monitoring program • Notify relevant specialists and develop and implement any CMA required. • Implement agreed CMA's as approved *<u>Note:</u> CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3* • Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat	• *Actions stated for Level 2* • Notify BCS, DPE, DPI Fisheries, RR, 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: – Grouting of fractures which result in flow diversion – Completion of works following approvals • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders • *<u>Note:</u> CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to*

		aquatic ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts
	Exceeding Performance Measures • Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities	• *Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
TERRESTRIAL ECOLOGY		
Visual inspections as part of landscape and water monitoring programs in active mining areas	***Level 1**** • Impacts detectable via observational monitoring (e.g. canopy thinning, thinning of shrub layer, minor loss of ground cover) to a single vegetation strata • Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will mitigate without CMA	• Continue monitoring program • Submit an Impact Report to BCS, DPE, DPI Fisheries, RR and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* • Impacts detectable via observational monitoring (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata • Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will not mitigate without CMA	• *Actions stated for Level 1* • Report trigger to key stakeholders • Review monitoring program • Notify relevant specialists and develop and implement any CMA required. • Implement agreed CMA's as approved *<u>Note:</u> CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3* • Impacts (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata caused by subsidence effects	• *Actions stated for Level 2* • Notify BCS, DPE, DPI Fisheries, RR, relevant resource managers and technical specialists and seek advice on any CMA required. • Invite stakeholders for site visit

	• Subsidence impacts (such as surface cracking, rock falls) resulting in large areas of disturbance that will not mitigate without CMA • Negligible environmental consequences to threatened species, populations or EEC	• Develop site CMA (subject to stakeholder feedback). This may include: – Erosion prevention works – Establishment of vegetation • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders <u>Note:</u> *CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Exceeding Performance Measures • Mining results in more than negligible environmental consequences on threatened species, threatened populations, or endangered ecological communities	• *Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
ABORIGINAL ARCHAEOLOGY		
• Impacts to the cliff lines on the southern side of the Nepean River will trigger an inspection of Bradcorp 1 and any sections of the river and creek valleys that have not been surveyed for Aboriginal heritage	***Level 1**** • Change in shelter conditions not attributable to natural weathering or preservation that do not alter the heritage values of the place e.g. mineral growth or micro-organism growth • Changes external to shelter conditions that effect the sites context e.g. ground cracking, boulder slumping, rock and/or tree falls	• Continue with monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders (e.g. Registered Aboriginal Parties) • Summarise impacts and report in the End of Panel Report and Annual Review
	Level 2* • Change in shelter conditions not attributable to natural weathering or preservation e.g. change in drip line or seepage, cracking or exfoliation of overhang or shelter, movement or opening of existing planes and joints	• *Actions stated for Level 1* • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with Registered Aboriginal Parties and the landowner

	Level 3* • Change in shelter conditions not attributable to natural weathering or preservation e.g. cracking or exfoliation of art panel, movement of existing planes and joints at panel, block fall within shelter or overhang, shelter or overhang collapse	• *Actions stated for Level 2* • Investigate reasons for impacts • Update future predictions based on outcomes of the investigation

	Exceeding Performance Measures • More than 10% of sites across the mining area are affected by subsidence impacts (other than negligible impacts or environmental consequence)	• *Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation
EUROPEAN HERITAGE		
• Douglas Park Railway Cottage – Item 30 from the BSOP EA	***Level 1**** • Cracks or warping of external weatherboards, • Cracks or movement < 5 mm in width in any external or internal wall claddings, linings, or finish • Isolated cracked, loose, or drummy floor or wall tiles • No impact to heritage values of the site	• Continue monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders • Summarise impacts and report in the End of Panel Report and AR
	Level 2* • Continuous cracking or warping of weatherboards, • Slippage along the damp proof course of 5 to 15 mm • Loss of bearing to isolated walls, piers, columns, or other load-bearing elements • Loss of stability of isolated structural elements • Loss of heritage value no greater than predicted in HMP	• *Actions stated for Level 1* • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with stakeholders, where appropriate
	Level 3* • Continuous cracking or warping of weatherboards • Slippage along the damp proof course of 15 mm or greater anywhere in the total external façade • Re-levelling of building • Loss of stability of several structural elements • Loss of heritage value greater than predicted in HMP	• *Actions stated for Level 2* • Investigate reason for impacts • Notify DP&I and SA NSW as soon as practicable • Seek advice on any CMA required. • Consultation with stakeholders (undertake site inspection if required). • Review the relevant TARP and Management Plan in consultation with key stakeholders

	Exceeding Performance Measures • Loss of heritage value greater than predicted under the Heritage Management Plan	• *Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation

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

Department of Planning and Environment (DPE)

Department of Primary Industries – Fisheries (DPI Fisheries)

Biodiversity Conservation and Science Division (BCS)

Resources Regulator (RR)