



**APPIN AREA 9
LONGWALL 901 END OF PANEL
LANDSCAPE REPORT
November 2017**



Executive Summary

This report has been prepared by the South32 Illawarra Coal Environmental Field Team (ICEFT) to summarise the observed and measured subsidence effects on watercourse and landscape features resulting from the extraction of Longwall 901.

Extraction of Appin Longwall 901 commenced on the 19th of January 2016 and was completed on the 8th of September 2017.

The ICEFT conducts detailed monitoring and inspections of landscape features including the Nepean River and associated tributaries, groundwater, cliffs and steep slopes; and private properties. This monitoring was conducted in accordance with the Appin Area 9 (AA9) Extraction Plan (EP), dated 2 September 2014.

ICEFT identified 27 impacts associated with the extraction of Longwall 901. Twenty-five of these impacts are gas releases on the Nepean River. Two impacts to private boreholes were observed.

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Abbreviations

AA9 - Appin Area 9

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 (now part of DPE)

EoP – End of Panel

EP – Extraction Plan

ICCT - Illawarra Coal Community Team

ICEFT – Illawarra Coal Environmental Field Team

OEH - Office of Environment and Heritage

SMP – Subsidence Monitoring Program

TARP – Trigger Action Response Plan

WaterNSW – previously Sydney Catchment Authority

1. Introduction

This report outlines monitoring of landscape features relevant to Longwall 901 and forms part of the AA9 Longwall 901 End of Panel Report (EoP Report). Monitored features include the Nepean River and its tributaries, cliffs and steep slopes, terrestrial flora, groundwater as well as private properties (farm dams, private boreholes and surface area). Monitoring of landscape features relevant to Longwall 901 has been carried out in accordance with the AA9 EP, dated 2 September 2014. The Trigger, Action, Response Plan (TARP) in the Subsidence Monitoring Program (SMP), details the actions required for any subsidence impacts (**Attachment A**).

Extraction of Longwall 901 commenced on the 19th of January 2016 and was completed on the 8th of September 2017.

Monitoring was conducted for landscape features in the SMP Area for Longwall 901 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 Coal and private boreholes) and observations of the landscape features within the mining area. The results of the monitoring are outlined in the relevant sections below.

2. Summary of Monitoring Program

The AA9 monitoring sites, which have been installed to identify the impacts and consequences of mining are provided in

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters	
SURFACE WATER				
AREA 9	<p>Nepean River and tributaries</p> <ul style="list-style-type: none"> NR110 (Lab, Field, Level, Obs) NR0 (Lab, Field, Level, Obs) SW2 (Lab, Field, Obs) SW3 (NR1) (Field, Obs – LW901 only) SW4 (Field, Obs – LW901 only) NR2 (Lab, Field, Level, 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) 	<ul style="list-style-type: none"> Lab sample Field parameters Water levels Observations 	<ul style="list-style-type: none"> 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 	<p>Field Parameters:</p> <ul style="list-style-type: none"> Temperature Dissolved Oxygen (DO) Specific Conductivity pH ORP <p>Standard Lab Sample:</p> <ul style="list-style-type: none"> pH and EC Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ Total Fe, Mn, Al Total Alkalinity TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, DOC <p>Lab Sample for Gas Releases:</p> <ul style="list-style-type: none"> CH₄ C₂H₆ Trace Phenols Sulphide <p>Observations:</p> <ul style="list-style-type: none"> Iron or salinity staining (e.g. orange or white staining in water or on banks/seeps)

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters
			<ul style="list-style-type: none"> • 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

and displayed on Figure 1. The TARPs containing key monitoring sites, trigger thresholds and response measures are summarised in Attachment B (Table 4) of this report.

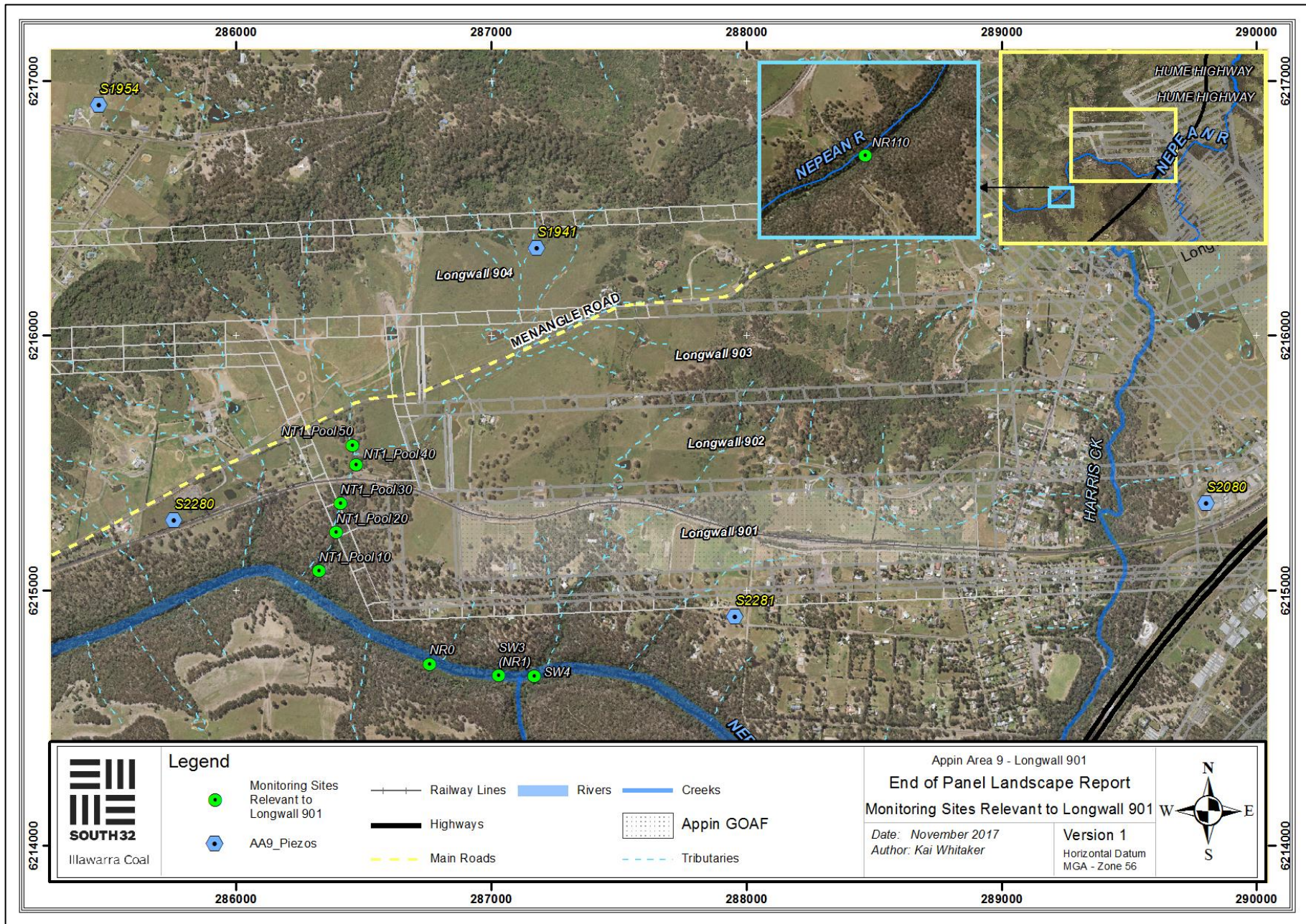


Figure 1: Map showing IC monitoring sites relevant to Longwall 901.

3. Summary of Impacts

Monitoring and inspections of the Nepean River and its associated tributaries is undertaken in accordance with the approved AA9 EP. Monitoring is conducted by the ICEFT monthly, prior to mining, and weekly during mining (i.e. longwall is within 400m). Water quality and water levels are recorded along with photographic records and observations.

During the extraction of Longwall 901, 27 new impacts were observed. Twenty-five of these impacts are surface water quality impacts; specifically, gas releases on the Nepean River. These impacts are labelled "AA9_LW901_001 to AA9_LW901_025". Two private boreholes were also impacted.

3.1. Water Quality

In-situ water quality parameters were measured at the relevant monitoring sites on the Nepean River and its tributaries. In-situ water quality parameters include: temperature, specific conductivity (SpC), oxidation-reduction potential (ORP), pH and dissolved oxygen (DO). Detailed analysis of water quality is included in the Surface and Groundwater Assessment of the Longwall 901 EoP Report.

3.2. Gas Releases

Twenty-five gas release zones were reported as Level 1 Triggers in accordance with the TARP in the Appin Area 9 EP: Annex B- SMP (Appendix A, Table 1.1); 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 AEMR

AA9_LW901_001 (286880, 6214670)

Impact AA9_LW901_001 was identified on the 2nd of March 2016 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of one constant release and three other intermittent releases, of light to moderate intensity, over an area of approximately 5 m by 5 m. This site was passed by Longwall 901 at an approximate distance of 370 m. During the latest inspection on the 7th of November 2017, this gas release zone was observed as inactive.

AA9_LW901_002 (286712 6214745)

Impact AA9_LW901_002 was identified on the 7th of March 2016 and consisted of a gas release zone on the Nepean River, located approximately 60 m upstream of monitoring point 'NR0' (Figure 1 and Figure 2). The zone was comprised of five constant release points and approximately seven intermittent release points, of light to moderate intensity, over an area of approximately 12 m by 5 m (Photo 2). This site was passed by Longwall 901 at an approximate distance of 340 m. During the latest inspection on the 7th of November 2017, this gas release zone was inactive.



Photo 1: Impact AA9_LW901_001 looking across stream. Taken on 2/03/2016.



Photo 2: Impact AA9_LW901_002 looking downstream. Taken on 08/03/2016.

AA9_LW901_003 (286766, 6214713)

Impact AA9_LW901_003 was identified on the 7th of March 2016 and consisted of a gas release zone on the Nepean River, extending from approximately 18 m upstream and 27 m downstream of monitoring site 'NR0' (Figure 1 and Figure 2). The zone consisted of multiple gas release points, of light to moderate intensity, over an area of approximately 45 m by 6 m (Photo 3). The gas release zone was comprised of both intermittent and constant gas release points. This site was passed by Longwall 901 at an approximate distance of 350 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_004 (286820, 6214695)

Impact AA9_LW901_004 was identified on the 7th of March 2016 and consisted of a gas release zone on the Nepean River, approximately 63 m downstream of monitoring point 'NR0' (Figure 1 and Figure 2). The zone was comprised of approximately twenty gas release points, of light to moderate intensity, over an area approximately 20 m by 8 m, most of which, had a constant release (Photo 4). This site was passed by Longwall 901 at an approximate distance of 357 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.



Photo 3: Impact AA9_LW901_003, looking downstream. Taken on 08/03/2016.



Photo 4: Impact AA9_LW901_004, looking downstream. Taken on 08/03/2016.

AA9_LW901_005 (286962, 6214666)

Impact AA9_LW901_005 was identified on the 7th of March 2016 and consisted of a gas release zone on the Nepean River, approximately 67 m upstream of monitoring point 'SW3' (Figure 1 and Figure 2). The zone was comprised of approximately ten gas release points, of light to moderate intensity, with constant releases over an area of approximately 7 m by 2 m (Photo 5). This site was passed by Longwall 901 at an approximate distance of 380m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_006 (286997, 6214667)

Impact AA9_LW901_006 was identified on the 7th of March 2016, which consisted of a gas release zone located on the Nepean River, approximately 32 m upstream of monitoring point 'SW3' (Figure 1 and Figure 2). The zone was comprised of approximately six gas release points, of light intensity, with constant releases, over an area of approximately 3 m by 4 m (Photo 6). This site was passed by Longwall 901 at an approximate distance of 380 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_007 (287506, 6214668)

Impact AA9_LW901_007 was identified on the 15th of March 2017 and consisted of a gas release zone on the Nepean River, approximately 320 m downstream of monitoring point 'SW4' (Figure 1 and Figure 2). The zone was comprised of approximately 30 individual gas release points, of light intensity, over an area approximately 24 m by 15 m (Photo 7). This site was passed by Longwall 901 at an approximate distance of 517 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_008 (287065, 6214662)

Impact AA9_LW901_008 was identified on the 18th of March 2016 and consisted of a gas release zone on the Nepean River, approximately 35 m downstream of monitoring point 'SW3'; and 40 m upstream from the Allens Creek and Nepean River confluence (Figure 1 and Figure 2). The zone was comprised of approximately eight gas release points, of light intensity, with release rates ranging from constant to intermittent, over an area of approximately 7 m by 4 m (Photo 8). This site was passed by Longwall 901 at an approximate distance of 400 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.



Photo 5: Impact AA9_LW901_005, close-up. Taken on 08/03/2016.



Photo 6: Impact AA9_LW901_006, looking downstream. Taken on 08/03/2016.



Photo 7: Impact AA9_LW901_007, looking upstream. Taken on 15/03/2016.

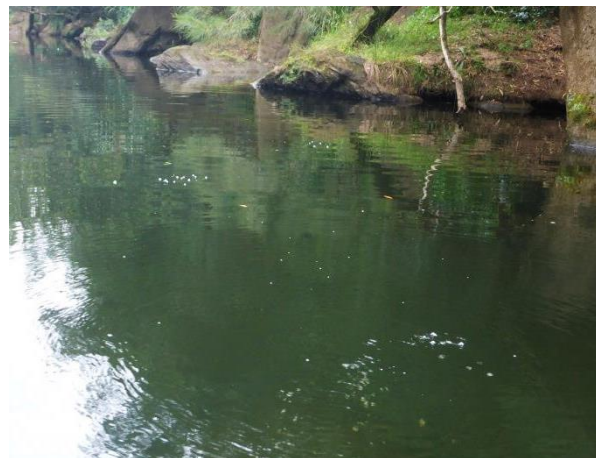


Photo 8: Impact AA9_LW901_008, looking downstream. Taken on 18/03/2016.

AA9_LW901_009 (287249, 6214679)

Impact AA9_LW901_009 was identified on the 18th of March 2016 and consisted of gas release on the northern bank of the Nepean River, approximately 80 m downstream of monitoring point 'SW4' (Figure 1 and Figure 2). The zone was comprised of approximately 35 individual gas releases, of light intensity, over an area of approximately 6 m by 8 m (Photos 3 to 5). The gas release rates range from intermittent to constant. This site was passed by Longwall 901 at an approximate distance of 390 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of multiple light intensity gas releases at a constant rate, in an area approximately 6 m by 3 m.

AA9_LW901_010 (287317, 6214697)

Impact AA9_LW901_010 was identified on the 18th of March 2016 and consisted of a gas release zone on the Nepean River, approximately 150 m downstream of monitoring point 'SW4' (Figure 1 and Figure 2). The zone was comprised of approximately 80 individual releases, of light to moderate intensity, over an area of approximately 50 m by 20 m (Photo 9). The gas release rates range from intermittent to constant. This site was passed by Longwall 901 at an approximate distance of 390 m. During the

latest inspection on the 7th of November 2017, this gas zone was active, comprised of multiple light intensity gas releases at a constant rate, in an area approximately 2 m by 3 m.

AA9_LW901_011 (287036, 6214664)

Impact *AA9_LW901_011* was identified on the 21st of March 2016 and consisted of a gas release zone on the Nepean River, approximately 5 m downstream of monitoring point 'SW3' (Figure 1 and Figure 2). The zone was comprised of approximately 22 constant gas releases, of light intensity, over an area of approximately 7 m by 8 m (Photos 10 and 11). This site was passed by Longwall 901 at an approximate distance of 400 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_012 (287191, 6214670)

Gas release zone *AA9_LW901_012* was identified on the 21st of March 2016 and consisted of a gas release zone on the Nepean River, adjacent to monitoring site 'SW4' (Figure 1 and Figure 2). The zone was comprised of two areas of constant release, separated by approximately 8 m (Photo 12). The upstream area consists of 12 individual releases, of light intensity, over a 6 m by 5 m area; and the downstream area consists of 10 releases, of light intensity, in a 5 m by 5 m area. This site was passed by Longwall 901 at an approximate distance of 385 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of multiple light intensity gas releases at an intermittent rate, in two areas approximately 5 m by 5 m and 0.3 m by 0.3 m.



Photo 9: Impact AA9_LW901_009, looking across stream. Taken on 21/03/2016.



Photo 10: Impact AA9_LW901_010, looking across stream at upstream end. Taken on 18/03/2016.



Photo 11: Impact AA9_LW901_011, looking across stream. Taken on 21/03/2016.



Photo 12: Impact AA9_LW901_012, looking across stream. Taken on 21/03/2016.

AA9_LW901_013 (287377, 6214698)

Gas release zone AA9_LW901_013 was identified on the 21st of March 2016 and consisted of a gas release zone on the Nepean River, approximately 210 m downstream of monitoring point 'SW4' (Figure 1 and Figure 2). The zone was comprised of approximately 15 constant releases, of light to moderate intensity, over an area of approximately 8 m by 8 m (Photo 13). This site was passed by Longwall 901 at an approximate distance of 420 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of two light intensity releases at an intermittent rate, in an area approximately 0.1 m by 0.1 m.

AA9_LW901_014 (287575, 6214652)

Gas release zone AA9_LW901_014 was identified on the 21st of March 2016. It is located approximately 400 m downstream of monitoring point 'SW4' (Figure 1 and Figure 2). The zone consists of approximately 30 constant gas releases, of light to moderate intensity, over an area of approximately 30 m by 10 m (Photo 14). This site was passed by Longwall 901 at an approximate distance of 580 m from Longwall 901 (Figure 1). During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of one light intensity release at a constant rate, in an area approximately 0.1 m by 0.1 m.

AA9_LW901_015 (287102, 6214639)

Impact AA9_LW901_015 was identified on the 29th of March 2016 and consisted of a gas release zone on Allens Creek, approximately 20 m upstream of the Allens Creek – Nepean River confluence, adjacent to monitoring site 'SW2' (Figure 1 and Figure 2). The zone was comprised of three intermittent gas release points, of light intensity, over an area of approximately 1 m² (Photo 15). This site was passed by Longwall 901 at an approximate distance of 410 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_016 (287651, 6214611)

Impact AA9_LW901_016 was identified on the 4th of April 2016 and consists of a gas release zone on the Nepean River (Figure 1 and Figure 2). The zone was comprised of five gas release points, of light intensity, ranging from intermittent to constant, over an area of approximately 1 m by 2 m (Photo 16). This site was passed by Longwall 901 at an approximate distance of 580 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.



Photo 13: Impact AA9_LW901_013, close-up of largest releases. Taken on 21/03/2016.



Photo 14: Impact AA9_LW901_014, looking downstream. Taken on 21/03/2016.



Photo 15: Impact AA9_LW901_015, looking downstream. Taken on 29/03/2016.



Photo 16: Impact AA9_LW901_016, close up of one of the constant release points. Taken on 04/04/2016.

AA9_LW901_017 (287156, 6214658)

Impact AA9_LW901_017 was identified on the 8th of April 2016 and consisted of a gas release zone on the Nepean River, approximately 50 m downstream of the Nepean River and Allens Creek confluence (Figure 2). The zone was comprised of 14 intermittent gas release points, of light intensity, over an area of approximately 5 m by 6 m (Photo 17). This site was passed by Longwall 901 at an approximate distance of 430 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_018 (E287429, N6214691)

Impact AA9_LW901_018 was identified on the 21st of April 2016 and consisted of a gas release zone on the Nepean River between previously reported impacts AA9_LW901_013 and AA9_LW901_007 (Figure 2). The zone was comprised of approximately 20 constant gas release points, of light intensity, over an area of approximately 25 m by 2 m (Photo 18). This site was passed by Longwall 901 at an approximate distance of 375 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of multiple light intensity gas releases at an intermittent rate, in an area of approximately 0.1 m by 0.1 m

AA9_LW901_019 (E288075, N6214239)

Impact AA9_LW901_019 was identified on the 4th of April 2017 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of approximately 16 release points, of moderate intensity, ranging from constant to intermittent, over an area of approximately 20 m by 4 m (Photo 19). This site was passed by Longwall 901 at an approximate distance of 850 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of two light intensity gas releases at a constant rate, in an area of approximately 2 m by 2 m.

AA9_LW901_020 (E288157, N6214154)

Impact AA9_LW901_020 was identified on the 4th of April 2017 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of approximately 15 release points, of light to moderate intensity, ranging from constant to intermittent, over an area of approximately 12 m by 6 m (Photo 20). This site was passed by Longwall 901 at an approximate distance of 940 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.



Photo 17: Impact AA9_LW901_017, looking across stream. Taken on 08/04/2016.



Photo 18: Impact AA9_LW901_018, looking upstream. Taken on 21/04/2016.



Photo 19: Release at Gas Zone AA9_LW901_019, Nepean River. Taken on 4/04/2017.



Photo 20: Release at Gas Zone AA9_LW901_020, Nepean River. Taken on 4/04/2017.

AA9_LW901_021 (E288455, N6214091)

Impact AA9_LW901_021 was identified on the 26th of April 2017 and consisted of a gas release zone on the Nepean River (Figure 2). The zone consists of approximately 45 intermittent releases, of light intensity, over an area approximately 30 m by 10 m (Photo 21). This site was passed by Longwall 901 at an approximate distance of 1000 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of multiple light intensity gas releases at constant rate, in an area of approximately 0.1 m by 0.1 m.

AA9_LW901_022 (E288620, N6214128)

Impact AA9_LW901_022 was identified on the 26th of April 2017 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of approximately 20 intermittent releases, of moderate intensity, over an area of approximately 8 m by 5 m (Photo 22). This site was passed by Longwall 901 at an approximate distance of 1000 m. During the latest inspection on the 7th of November 2017, this gas zone was active, comprised of two light intensity gas releases at an intermittent rate, in an area of approximately 0.1 m by 0.1 m.

AA9_LW901_023 (E288292, N6214083)

Impact AA9_LW901_023 was identified on the 17th of July 2017 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of one intermittent release, of light intensity, over an area of 1 m² (Photo 23). This site was passed by Longwall 901 at an approximate distance of 1000 m. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_024 (E288253, N6214102)

Impact AA9_LW901_024 was identified on the 24th of May 2017 and consisted of a gas release zone on the Nepean River (Figure 2). This site was passed by Longwall 901 at an approximate distance of 1000 m. The zone consisted of one intermittent release of light intensity. During the latest inspection on the 7th of November 2017, this gas zone was inactive.

AA9_LW901_025 (E288218, N6214128)

Impact AA9_LW901_025 was identified on the 24th of May 2017 and consisted of a gas release zone on the Nepean River (Figure 2). This site was passed by Longwall 901 at an approximate distance of 1000 m. The zone consisted of one intermittent release of light intensity. During the latest inspection on the 7th of November 2017, this gas zone was inactive.



Photo 21: Release at Gas Zone AA9_LW901_021, Nepean River. Taken on 26/04/2017.



Photo 22: Release at Gas Zone AA9_LW901_022, Nepean River. Taken on 26/04/2017.



Photo 23: Photo 1: AA9_LW901_023, looking downstream taken 17/07/2017.



Photo 24: AA9_LW901_024, close-up. Taken on 24/5/2017.

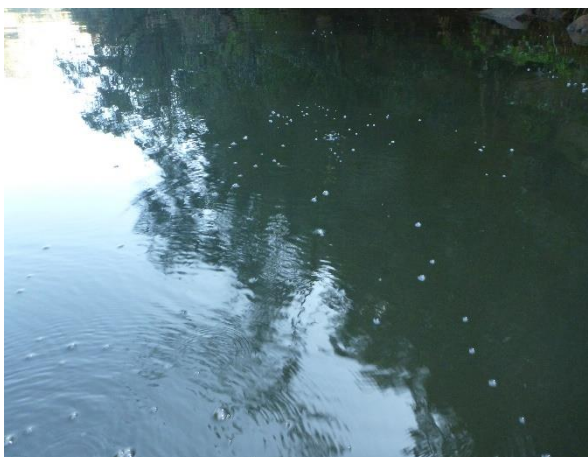


Photo 25: AA9_LW901_025, close-up. Taken on 24/5/2017.

3.3. Water Level and Flow

Water levels in the Nepean River and its tributaries were monitored by the ICEFT using photo observations and benchmark measurements monthly, and weekly when the longwall was within 400m of the River (where access was safe and granted). No subsidence induced flooding of river banks was observed. Additionally, no areas of dry river bed were observed. For assessment of water level and flow refer to the Surface and Groundwater Assessment of the Longwall 901 EoP Report.

3.4. Appearance

The appearance of the Nepean River and its tributaries was monitored by the ICEFT monthly, and weekly when the longwall was within 400m of the River. Photographs are taken of monitoring sites, gas zones and any other known or potential impact site. Apart from the gas release zones, no impacts to the appearance of the Nepean River or tributaries were observed during the extraction of Longwall 901.

3.5. Groundwater

For analysis of groundwater data refer to the Surface and Groundwater Assessment of the Longwall 901 EoP Report

3.6. Landscape Features

Observations of clifflines and steep slopes along the Nepean Gorge and associated tributaries were conducted by the ICEFT monthly, and weekly during mining. Observational and photographic monitoring; piezometers and slope inclinometers were used to monitor cliffs and steep slopes. No impacts to cliffs were identified during the extraction of Longwall 901. Observations above the active longwall were conducted where access was available. Some minor impacts were identified on private properties as discussed below.

3.7. Terrestrial Ecology

Terrestrial ecology in Appin Area 9 is monitored by the ICEFT in conjunction with 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 901.

3.8. Private Property Inspections

Built Feature Management Plans (BFMPs) have been prepared by South32 Illawarra Coal for landholders above AA9. Post-mining inspection of dams, boreholes and natural features set out in the BFMPs are conducted by the ICEFT with the consent of the relevant property/infrastructure owner and tenant, if applicable (Table 2).

Impacts to two private properties were reported during the extraction of Longwall 901. These impacts are described below; more detailed information can be found in the relevant property report.

Lots 59 – 69, DP1321

Longwall 901 passed Lots 59 – 69, DP1321 from the 16th of April 2016 to the 6th of August 2016 (Figure 3). The landowner requested an inspection of a borehole on the 13th of February 2017; and an inspection of the same borehole and two dams on the 29th of September 2017. The landowner noted that the water level of the borehole had decreased and the turbidity of one of the dams had increased. Groundwater level data from a nearby IC monitoring borehole (S2281) was used to determine that mining had likely reduced the amount of water accessible from the private borehole. A Water Management Plan (WMP) has been implemented in response to the impacted borehole. Due to the nature of any likely impact, mining was not attributed to the high turbidity in the property dams.

However, quarterly water quality monitoring will be carried out on the dams to inform the likelihood of a mining-related impact.

Lot 22, DP203255

Longwall 901 passed Lot 22, DP203255 on the 27th of September 2016, at an approximate distance of 150 m (Figure 3). On the 2nd of November 2017, a post-mining inspection of the property Lot 22 DP803255 was undertaken, including borehole GW072249. Observations showed that the borehole pressure had reduced relative to pre-mining observations. A WMP has been implemented in response to the impacted borehole.

3.9. Aboriginal Archaeology

Archaeological Sites are not located within the Study Area. There is one Shelter with Art which has been identified outside the Study Area, as shown in MSEC (2012) Drawing No. MSEC448-33. No permission from the landholder was granted for access to this site. There are no declared Aboriginal Places under the National Parks and Wildlife Act 1974 or identified Aboriginal Sites within the Study Area.

3.10. European Heritage

Heritage Sites listed within the Study Area comprise the Railway Cottage at Douglas Park Railway Station, which is listed in the Wollondilly Local Environmental Plan 1999. The Illawarra Coal Community Team (ICCT) attempted to contact the resident (by site visit and letter box drop) to conduct a baseline inspection. However, no contact was made, thus, no baseline property inspection was conducted. No impacts have been reported by the resident.

Table 1: Summary table of Longwall 901 impacts.

Site ID	Easting	Northing	Impact Type	Identification Date	Status	Description	Impact Level	Report Date
AA9_LW901_001	286880	6214670	Gas Release	2/03/2016	Inactive	Four individual releases in a 5 m ² 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	Approximately 12 releases, low to moderate intensity within 12 x 4 m area; releases range from constant to intermittent.	1	8/03/2016
AA9_LW901_003	286766	6214713	Gas Release	7/03/2016	Inactive	Multiple releases (too many to count). Low to moderate intensity, releases are both intermittent and constant within a 45 x 6 m area.	1	8/03/2016
AA9_LW901_004	286820	6214695	Gas Release	7/03/2016	Inactive	Approximately 20 releases; most releases are constant with a low to moderate intensity. Covers approximately 20 x 8 m area.	1	8/03/2016
AA9_LW901_005	286962	6214666	Gas Release	7/03/2016	Inactive	Approximately 10 releases, releases are constant with a low to moderate intensity across approximately 7 x 2 m area.	1	8/03/2016
AA9_LW901_006	286997	6214667	Gas Release	7/03/2016	Inactive	Approximately 6 releases, releases are constant with low intensity. 3 x 4 m area.	1	8/03/2016
AA9_LW901_007	287506	6214668	Gas Release	15/03/2016	Active	Approximately 30 light gas releases across the width of the river in a 15 x 24 m area. Releases are both constant and intermittent.	1	16/03/2016
AA9_LW901_008	287065	6214662	Gas Release	18/03/2016	Inactive	Approximately 8 light releases, 4 constant and 4 intermittent in a 7 x 4 m area.	1	22/03/2016
AA9_LW901_009	287249	6214679	Gas Release	18/03/2016	Active	> 35 light releases, 4 intermittent, 4 constant; 7 x 4 m area.	1	22/03/2016
AA9_LW901_010	287317	6214697	Gas Release	18/03/2016	Active	Multiple (> 80), constant and intermittent, 15 x 30 m area.	1	22/03/2016
AA9_LW901_011	287036	6214664	Gas Release	21/03/2016	Inactive	Approximately 22 light releases, constant, 7 x 8 m area. Approximately 10 m DS of SW3.	1	22/03/2016
AA9_LW901_012	287191	6214670	Gas Release	21/03/2016	Active	2 areas of release separated by approximately 8 m. US area has 12 light constant releases in a 6 x 5 m area. DS area has 10 similar releases in a 5 x 5 m area.	1	22/03/2016

Site ID	Easting	Northing	Impact Type	Identification Date	Status	Description	Impact Level	Report Date
AA9_LW901_013	287377	6214698	Gas Release	21/03/2016	Inactive	Approximately 20 constant releases, light to moderate intensity, extending across the river, approximately 8 m long.	1	22/03/2016
AA9_LW901_014	287575	6214652	Gas Release	21/03/2016	Active	> 25 releases, all light and constant, predominately on southern bank, approximately 30 x 10 m in area.	1	22/03/2016
AA9_LW901_015	287103	6214639	Gas Release	29/03/2016	Inactive	Allens Ck Gas zone. 3/4 releases light and intermittent.	1	29/03/2016
AA9_LW901_016	287651	6214611	Gas Release	4/04/2016	Inactive	5 releases, 2 constant, 3 intermittent, southern bank. 1 x 2 m 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 approximately 50m from Allens Ck confluence.	1	8/04/2016
AA9_LW901_018	287429	6194691	Gas Release	21/04/2016	Active	Approximately 20 releases on the northern bank of the Nepean River. All releases are light and constant. Area is 2 x 25 m.	1	22/04/2016
AA9_LW901_019	288075	6214239	Gas Release	4/04/2017	Active	Approximately 15 light releases, intermittent to constant, stretching along approximately 20 m 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 12 m.	1	5/04/2017
AA9_LW901_021	288455	6214091	Gas Release	26/04/2017	Active	45 intermittent releases mostly low intensity with a few medium. Area of approximately 30 x 10 m ² .	1	9/05/2017
AA9_LW901_022	288620	6214128	Gas Release	26/04/2017	Active	Approximately 20 light intermittent releases with an area of 5 x 8m ² .	1	9/05/2017
AA9_LW901_023	288292	6214083	Gas Release	17/07/2017	Inactive	Approximately 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	30/05/2017
AA9_LW901_025	288218	6214128	Gas Release	24/05/2017	Inactive	One intermittent release of light intensity.	1	30/05/2017

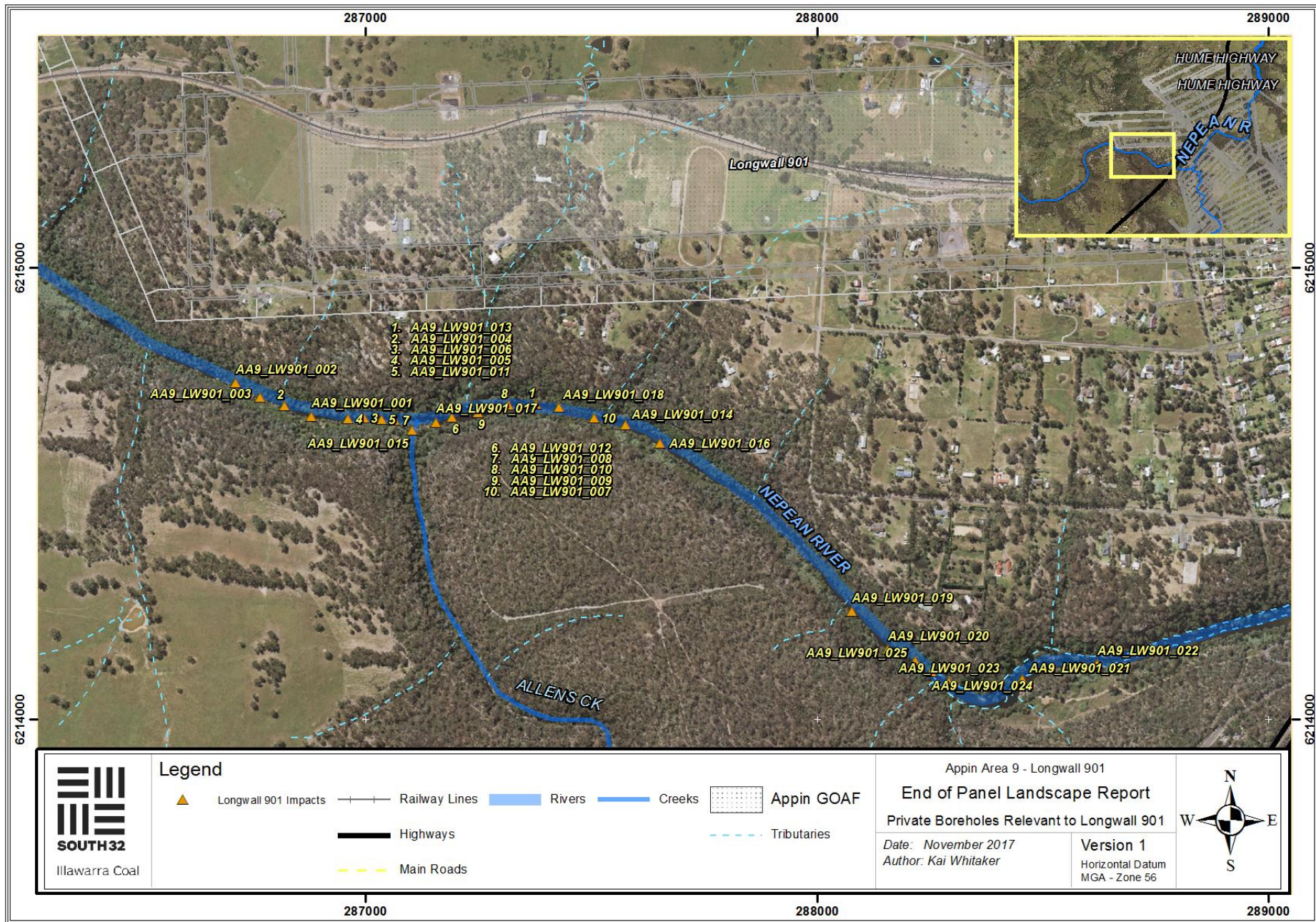


Figure 2: Map showing landscape impacts relevant to LW901.

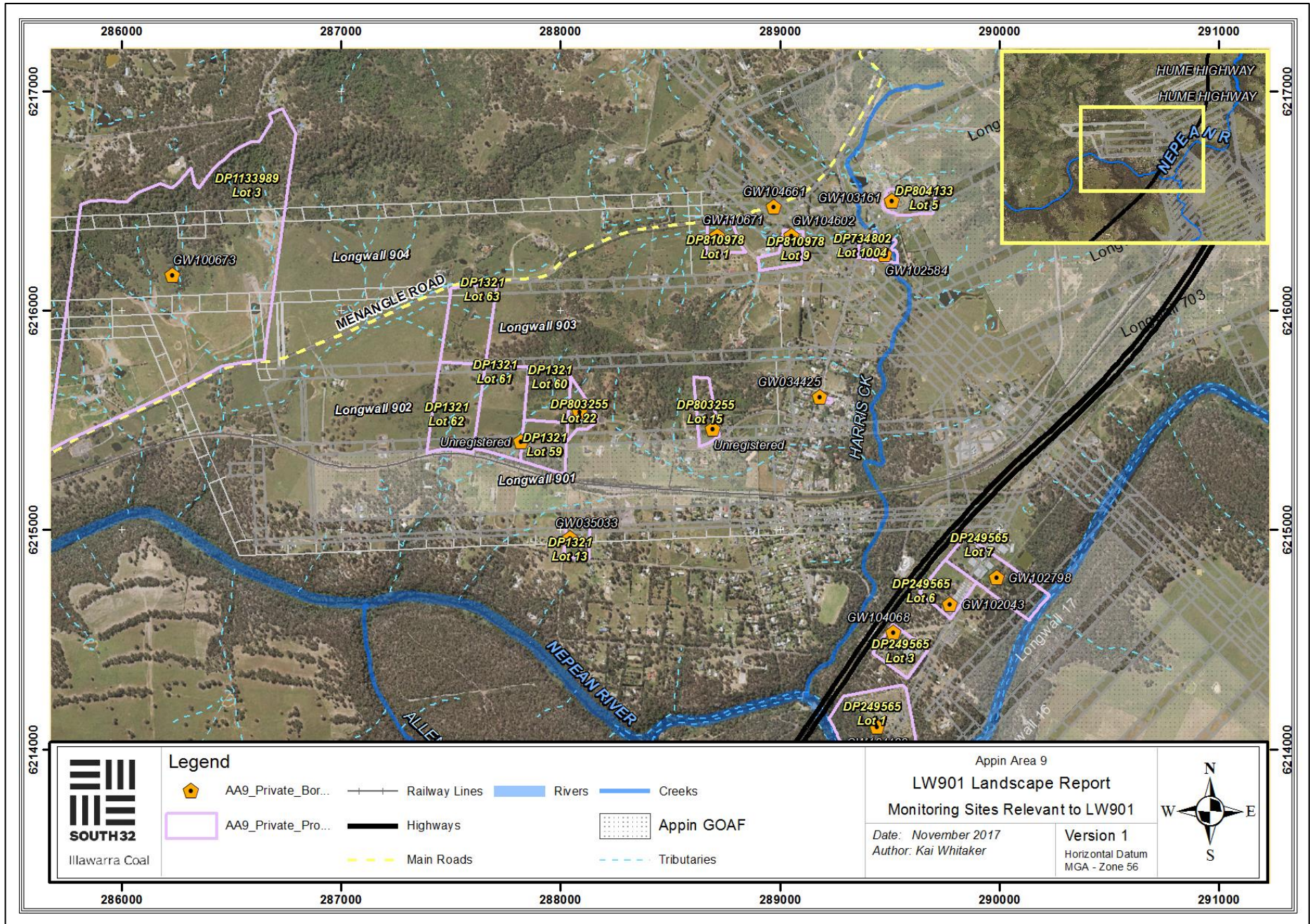


Figure 3: Map showing private properties with boreholes relevant to Longwall 901. (remove the unregistered labels)

Table 2: Summary table of private boreholes relevant to Appin Area 9. Highlighted rows refer to impacted boreholes.

Borehole	DP Number	Lot Number	Eastings	Northings	Drilled Depth	Baseline Inspection Date	Post Longwall 901 Inspection Date	Lateral Distance to Longwall 901 (m)	Comment
	DP1321	59	287824	6215400	-	NA	29/09/2017	24	Baseline inspection was not carried out pre-Longwall 901.
	DP803255	15	288697	6215458	-	NA	2/11/2017	48	Baseline inspection was not carried out pre- Longwall 901. Post-mining inspection carried out. Report of decreased water level in bore, likely due to mining.
GW035033	DP1321	13	288045	6214961	131	NA	NA	128	Landholder has stated that the borehole is not in use.
GW072249	DP803255	22	288091	6215538	97.5	29/06/2015	2/11/2017	152	Above Longwall 902. Baseline and post-mining borehole inspection captured. Decrease in water pressure, likely due to mining.
GW034425	DP8999	2	289184	6215603	70.1	NA	NA	342	Contact attempted on 1/4/2016; no response from landholder.
GW104068	DP249565	3	289519	6214530	180	NA	No	854	Contact attempted on 15/11/2017; no response. Letter requesting contact left at property.
GW110671	DP810978	1	288717	6216340	240	15/11/2017	15/11/2017	930	Above Longwall 904 Landholder is currently using.
GW104602	DP810978	9	289054	6216338	231	NA	NA	931	Landholder not responded to contact.
GW102043	DP249565	6	289777	6214659	192	NA	No	987	Contact attempted on 15/11/2017; no response. Letter requesting contact left at property.
GW102584	DP734802	1004	289480	6216255	186	11/10/2013	No	1019	Baseline borehole inspection captured for Longwall 706. Post Longwall 706 conducted on 27/05/2014.
GW104661	DP780739	1	288973	6216470	219	NA	NA	1052	Landholder advised the borehole was inactive.
GW100673	DP1133989	3	286235	6216160	104	12/04/2012	No	1053	Above Longwall 904. Borehole is used for farm.
GW102798	DP249565	7	289990	6214783	148	NA	No	1136	Contact attempted on 15/11/2017; no response. Letter requesting contact left at property.
GW101133	DP249565	1	289443	6214100	96	NA	15/11/2017	1157	Contacted landholder on 15/11/2017. The landholder advised that the borehole was in use but working normally.
GW103161	DP804133	5	289511	6216499	120	11/11/2015	No	1242	Previously impacted from Longwall 706.

4. Future Monitoring

No changes to the monitoring plan are proposed.

Appendix A

Table 3: Appin Area 9 Key Monitoring

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters	Observations from Longwall 901	Future Monitoring (LW 902)	
SURFACE WATER						
AREA 9	<p>Nepean River and tributaries</p> <ul style="list-style-type: none"> NR110 (Lab, Field, Level, Obs) NR0 (Lab, Field, Level, Obs) SW2 (Lab, Field, Obs) SW3 (NR1) (Field, Obs – LW901 only) SW4 (Field, Obs – LW901 only) NR2 (Lab, Field, Level, 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) 	<ul style="list-style-type: none"> Lab sample Field parameters Water levels Observations 	<ul style="list-style-type: none"> 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 	<p>Field Parameters:</p> <ul style="list-style-type: none"> Temperature Dissolved Oxygen (DO) Specific Conductivity pH ORP <p>Standard Lab Sample:</p> <ul style="list-style-type: none"> pH and EC Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ Total Fe, Mn, Al Total Alkalinity TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, DOC <p>Lab Sample for Gas Releases:</p> <ul style="list-style-type: none"> CH₄ C₂H₆ Trace Phenols Sulphide <p>Observations:</p> <ul style="list-style-type: none"> 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, 	<p>25 recorded gas release zones</p> <p>Water quality addressed in the Surface and Groundwater Assessment</p>	<p>No changes proposed</p>

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters	Observations from Longwall 901	Future Monitoring (LW 902)
			changes in water colour etc) <ul style="list-style-type: none"> • Stream flow and pool water level • Impacts determined from comparing photo points taken prior to, during and post mining 		

Monitoring Site		Monitoring Type	Monitoring Frequency	Parameters	Observations from Longwall 901	Future Monitoring (LW 902)
AREA 9	Flow monitoring <ul style="list-style-type: none"> • Maldon Weir • Broughtons Pass Weir • Menangle Weir 	<ul style="list-style-type: none"> • Gauged flow station 	<ul style="list-style-type: none"> • Daily flow 	Analysis: <ul style="list-style-type: none"> • 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 	Addressed in Surface and Groundwater Assessment	No changes proposed
GROUNDWATER						
AREA 9	Private Bores <ul style="list-style-type: none"> • GW 34425 • GW 35033 • GW 72249 • GW 100673 • GW 101133 • GW 102043 • GW 102584 • GW 102798 • GW 103161 • GW 104068 • GW 104602 • GW 104661 • GW 110671 <i>(in consultation with bore owner)</i>	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP Standard Lab Sample: <ul style="list-style-type: none"> • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, TDS, DOC 	Impact to two private boreholes	No changes proposed

	BHPBIC Piezometers: <ul style="list-style-type: none"> • Potentiometric head; <ul style="list-style-type: none"> – EAW9 – EAW18 – EAW58 • Piezometers and water samples between Longwall 901 and the Nepean River <ul style="list-style-type: none"> – S2280 (POSP A) – S2281 (POSP B) 	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • Water levels to be logged at least twice daily in the pre-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 	Lab Sample for Gas Releases: <ul style="list-style-type: none"> • CH4 • C2H6 • Trace Phenols • Sulphide Observations: <ul style="list-style-type: none"> • Iron or salinity staining (e.g. orange or white staining in water or in the bores) • Evidence of inflows to the bores e.g. sound of falling water • Visual signs of impacts (i.e. cracking, fracturing near the bore or changes in water colour etc.) 	Addressed in Surface and Groundwater Assessment	No changes proposed
	Groundwater inflows to the mine	<ul style="list-style-type: none"> • Mine water budget • Observations 	<ul style="list-style-type: none"> • Flow meters 	Water flow from the goaf to the mine (analysed as a moving average i.e. 20-day average)	Addressed in Surface and Groundwater Assessment	No changes proposed
AQUATIC ECOLOGY						
AREA 9	Nepean River <ul style="list-style-type: none"> • Sites 1 and 2 (downstream) • Sites X3 and X4 (adjacent to Longwalls 901 and 902) • Sites X5 and X6 (upstream) • Sites X7 and X8 to be identified (upstream) 	<ul style="list-style-type: none"> • Water quality - field parameters • Survey and sampling • Observations 	<ul style="list-style-type: none"> • Twice in spring for two years prior to the commencement of mining • Once every two years during mining • Once every two years after mining 	<ul style="list-style-type: none"> • Habitat surveys • Aquatic macrophyte observations • Macroinvertebrate monitoring • AUSRIVAS sampling • Fish sampling • Observations of threatened species • Assessments of: <ul style="list-style-type: none"> ○ Water quality ○ Flow ○ River morphology 	Addressed in Surface and Groundwater Assessment	No changes proposed

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters	Observations from Longwall 901	Future Monitoring (LW 902)	
TERRESTRIAL ECOLOGY						
AREA 9	<ul style="list-style-type: none"> Inspection of the area will be conducted as outlined in the Landscape TARP 	<ul style="list-style-type: none"> As indicated in the Landscape TARP 	<ul style="list-style-type: none"> 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 In response to any identified impacts on flora/fauna or threatened species, communities or populations 	<ul style="list-style-type: none"> 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 impacts or changes observed	No changes proposed
ABORIGINAL ARCHAEOLOGY						
AREA 9	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Observational and photographic monitoring 	<ul style="list-style-type: none"> In accordance with Landscape TARP 	<ul style="list-style-type: none"> Subsidence Impacts to cliff lines on the southern side of the Nepean River (e.g. directly north of Bradcorp 1) 	No impacts or changes observed	No changes proposed
	<ul style="list-style-type: none"> Bradcorp 1 (if required) 	<ul style="list-style-type: none"> Observational and photographic monitoring 	<ul style="list-style-type: none"> Baseline archival recording (when triggered by above) During the extraction of Longwalls 901, 902 and 903 Final impact assessment recording twelve months after final subsidence movement at the site 	<ul style="list-style-type: none"> Macro and micro recording using digital photography Detailed elevation plans of shelter walls recording structural and surface features including but not limited to the art, graffiti, joints, bedding planes, exfoliation scars, cracks, mineral and micro-organism growth, drip line and water seepage locations 	Not required	No changes proposed
EUROPEAN HERITAGE						
AREA 9	<ul style="list-style-type: none"> Douglas Park Railway Cottage – Item 30 	<ul style="list-style-type: none"> Observational monitoring 	<ul style="list-style-type: none"> Baseline archival recording prior to commencement of mining 	<ul style="list-style-type: none"> With the consent of the owner, the subsidence monitoring program will include: 	No impacts or changes observed	No changes proposed

			<ul style="list-style-type: none">• Impact assessment recording following the identification of impacts or when a MSB claim is lodged• Final assessment recording following the completion of mining of Longwalls 901 and 902 and/or after any repairs	<ul style="list-style-type: none">• 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• Assessment of heritage impacts by a suitably qualified heritage expert (if required)• This assessment would be made available to the MSB and include recommendations for management of heritage value during any repairs		
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LANDSCAPE FEATURES

<p>AREA 9</p>	<ul style="list-style-type: none"> • Nepean River cliff lines • Harris Creek cliff lines • Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) <p>Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner/s</p>	<ul style="list-style-type: none"> • Observational and photographic monitoring • Piezometers • Slope inclinometers 	<ul style="list-style-type: none"> • Harris Creek and Nepean River cliff lines <ul style="list-style-type: none"> - Baseline recording once prior to mining. - Monthly routine inspections with weekly inspections during critical periods • Low Terrain Sensitivity (visual inspection) <ul style="list-style-type: none"> - 6 months prior to mining - 6 months after active subsidence • Medium Terrain Sensitivity <ul style="list-style-type: none"> - 6 to 12 months prior to mining - 3 monthly during active subsidence - 6 months after active subsidence • High Terrain Sensitivity <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Visual inspections • Photographic records • Ground survey (mid to high terrain sensitivity) • Piezometers (high terrain sensitivity) • Slope inclinometers (high terrain sensitivity) 	<p>No changes proposed</p>
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Appendix B

Table 4: AA9 TARPS, Key Monitoring, Triggers and Response

Monitoring	Trigger	Action
WATER QUALITY		
Adjacent and downstream sites: <ul style="list-style-type: none"> • Nepean River: <ul style="list-style-type: none"> – 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: <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Continue monitoring program • Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	Level 2* Impact monitoring sites when comparing the baseline period to the mining period for that site: <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p> <p><i>Strata Gas Emission Plume:</i></p> <ul style="list-style-type: none"> • Estimate gas emission flow rates. Re-estimate should significant change be observed • Take sample of plume (if possible) for: <ul style="list-style-type: none"> – 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: <ul style="list-style-type: none"> • Level 2-type reduction in water quality resulting from the mining observed for more than 6 consecutive months 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Notify OEH, DP&I, NoW, DPI, DRE, 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 <p><i>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</i></p>

Monitoring	Trigger	Action
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Mining results in more than negligible gas releases, iron staining or water cloudiness 	<ul style="list-style-type: none"> 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		
<p>Groundwater flow into the mine</p> <p>Registered Bores:</p> <p>GW 34425 GW 35033 GW 72249 GW 100673 GW 101133 GW 102043 GW 102584 GW 102798 GW 103161 GW 104068 GW 104602 GW 104661 GW 110671</p> <p>BHPBIC Piezometers:</p> <p>EAW9 EAW18 EAW58 PROSP A PROSP B</p>	<p>Level 1*</p> <ul style="list-style-type: none"> 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 <p>Level 2*</p> <ul style="list-style-type: none"> 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 <p>Level 3*</p> <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR <p><i>Actions stated for Level 1</i></p> <ul style="list-style-type: none"> Review monitoring program Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p> <ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> 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 MSB 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 <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
LANDSCAPE FEATURES		
<p>Cliffs and Steep Slopes</p> <ul style="list-style-type: none"> Nepean River cliff lines Harris Creek cliff lines 	<p>Level 1</p> <ul style="list-style-type: none"> Rock fall from a cliff where the cliff is left mostly intact (<10% length of any single cliff) 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report

Monitoring	Trigger	Action
<ul style="list-style-type: none"> Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) <p>Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner</p>	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Summarise actions and monitoring in AEMR
	<p>Level 2</p> <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Actions stated for Level 1 Report trigger to key stakeholders 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 <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Level 3 *</p> <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Erosion prevention works Establishment of vegetation Completion of works following approvals, including monitoring and reporting on success Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> 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 more than 3% of the total face area of such cliffs within any longwall mining domain 	<ul style="list-style-type: none"> 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

AQUATIC ECOLOGY		
Nepean River <ul style="list-style-type: none"> Sites 1 and 2 (downstream) Sites X3 and X4 (adjacent to Longwalls 901 and 902) 	Level 1* <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining over 1 season 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR
	Level 2* <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining over 2 seasons 	<ul style="list-style-type: none"> 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 <p><i>Note: 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</i></p>
	Level 3* <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. Invite stakeholders for site visit Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> Grouting of fractures which result in flow diversion Completion of works following approvals Completion of works following approvals, including monitoring and reporting on success Review the TARP and Management Plan in consultation with key stakeholders <i>Note: 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</i>
	Exceeding Performance Measures <ul style="list-style-type: none"> Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities 	<ul style="list-style-type: none"> 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* <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR

	<p>Level 2*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Report trigger to key stakeholders • Review monitoring program • Notify relevant specialists and develop and implement any CMA required. • Implement agreed CMA's as approved <p><i>Note: 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</i></p>
	<p>Level 3*</p> <ul style="list-style-type: none"> • 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 • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Notify OEH, DP&I, DPI, NoW, DRE, relevant resource managers and technical specialists and seek advice on any CMA required. • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> – Erosion prevention works – Establishment of vegetation • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • Mining results in more than negligible environmental consequences on threatened species, threatened populations, or endangered ecological communities 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
ABORIGINAL ARCHAEOLOGY		
<ul style="list-style-type: none"> • 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 	<p>Level 1*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with Registered Aboriginal Parties and the landowner
	<p>Level 3*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Investigate reasons for impacts • Update future predictions based on outcomes of the investigation

	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • More than 10% of sites across the mining area are affected by subsidence impacts (other than negligible impacts or environmental consequence) 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation
EUROPEAN HERITAGE		
<ul style="list-style-type: none"> • Douglas Park Railway Cottage – Item 30 from the BSOP EA 	<p>Level 1*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Continue monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with stakeholders, where appropriate
	<p>Level 3*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Investigate reason for impacts • Notify DP&I and MSB 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
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • Loss of heritage value greater than predicted under the Heritage Management Plan 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation

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

Office of Environment and Heritage (OEH)

Department of Planning and Environment (DoPE)

NSW Trade and Investment: including Division of Resources and Energy (DRE), and Fisheries (DPI)

NSW Office of Water (NoW)

Mine Subsidence Board (MSB)