

Illawarra Coal



# Appin Area 7 Longwall 705 Landscape End of Panel Report

May 2014

## **Executive Summary**

This report has been prepared by the BHP Billiton Illawarra Coal Environmental Field Team (ICEFT) to summarise the observed and measured subsidence effects on landscape features resulting from the extraction of Longwall 705.

Extraction of Longwall 705 began on the 7<sup>th</sup> of September 2012 and was completed on 27<sup>th</sup> March 2014.

The ICEFT conducted detailed monitoring of landscape features including the Nepean River, watercourses, groundwater, cliffs and steep slopes as well as private properties. This monitoring was conducted in accordance with the Appin Longwall 705 to 706 Subsidence Management Plan (SMP).

During the monitoring three impacts to natural features were observed by the ICEFT. These three impacts, Gas Zones 16, 17 and 18 are Level 1 Impacts according to TARPs for Appin Area 7, Longwalls 705 and 706. Gas zones 16 and 17 have been inactive for some time with Gas Zone 18 remaining as the only impact for Longwall 705.

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## Abbreviations

**CMA** – Corrective Management Action

**DP&I** - Department of Planning and Infrastructure

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

**EoP** – End of Panel

**Illawarra Coal** – BHP Billiton Illawarra Coal

**ICEFT** – Illawarra Coal Environmental Field Team

**OEH** - Office of Environment and Heritage

**SMP** – Subsidence Management Plan

**TARP** – Trigger Action Response Plan

## 1. Introduction

This report has been prepared by the BHP Billiton Illawarra Coal Environmental Field Team (ICEFT) as part of the Appin Area 7 Longwall 705 End of Panel Report (EoP Report). Monitoring programs and impacts associated with subsidence from Longwall 705 are outlined in this report. Extraction of Longwall 705 began on the 7<sup>th</sup> of September 2012 and was completed on the 27<sup>th</sup> March 2014.

Monitoring of environmental features was carried out in accordance with the Appin Longwall 705 to 706 Subsidence Management Plan (SMP). This report outlines monitoring of the Nepean River, other watercourses, groundwater, cliffs and steep slopes as well as private properties. The Trigger, Action, Response Plans (TARPs) set out in the SMP provide the actions required to be undertaken for subsidence impacts (Appendix A).

For all observed impacts associated with Longwall 705, the appropriate TARP was applied and actions implemented. This report provides a summary of impacts and triggers observed during the extraction of Longwall 705.

Monitoring was conducted for landscapes in the zone of influence of Longwall 705 during baseline, active mining and post-mining periods. Baseline inspections were conducted until the longwall was within 400m of each feature. Weekly inspections of each feature were conducted during active mining until the longwall was 400m past the feature. Post-mining inspections started after this and will continue as required.

An overview of the monitoring conducted is provided as Table 1 and in Figure 1. Observations and measurements of surface water parameters, groundwater parameters and key landscape features were conducted by the ICEFT. Natural features monitored in association with Longwall 705 include the Nepean River and its surrounding gorge, watercourses in the area and groundwater through instrumented boreholes.

Inspections of dams, boreholes and natural features on properties within the influence of Longwall 705 were conducted by the ICEFT before and after mining. Property inspection reports have been prepared and made available to relevant landholders. All inspections are conducted with the consent of the relevant property/infrastructure owner and/or tenant. Information on private properties can be found within the main EoP Report.

## 2. Summary of Monitoring Results

**Table 1: Summary of Monitoring**

MONITORING SITE	SITE TYPE	MONITORING FREQUENCY	MONITORED SITES ASSOCIATED WITH LONGWALL 705
<b>WATER QUALITY</b>			
<p><b>Nepean River</b> Baseline upriver sites for cross- checking for upriver perturbations:</p> <ul style="list-style-type: none"> <li>• NR0</li> <li>• NR2 (pre Area 9 mining)</li> <li>• NR110 (New site - post Area 9 mining)</li> <li>• NR4</li> <li>• NR5</li> <li>• NR6</li> </ul> <p>Impact monitoring sites adjacent to each longwall:</p> <ul style="list-style-type: none"> <li>• NR11</li> <li>• NR12</li> <li>• NR13</li> <li>• NR20</li> <li>• NR30</li> </ul> <p>Other sites</p> <ul style="list-style-type: none"> <li>• NR7</li> <li>• NR9</li> <li>• NR50</li> </ul>	<p>Grab Sample and field measurements</p>	<ul style="list-style-type: none"> <li>• Monthly baseline prior to mining (data has been recorded for most sites since 2003).</li> <li>• Weekly observations and field analysis during mining.</li> <li>• Monthly detailed laboratory analysis during mining.</li> <li>• Monthly monitoring for 2 years post mining (or as otherwise required/approved).</li> <li>• If required as a result of assessment of mining impacts.</li> </ul>	<p><b>Nepean River</b> Baseline upriver sites for cross- checking for upriver perturbations:</p> <ul style="list-style-type: none"> <li>• NR0</li> <li>• NR2 (pre Area 9 mining)</li> <li>• NR110 (New site - post Area 9 mining)</li> <li>• NR4</li> <li>• NR5</li> <li>• NR6</li> </ul> <p>Impact monitoring sites adjacent to each longwall:</p> <ul style="list-style-type: none"> <li>• NR11</li> <li>• NR12</li> <li>• NR13</li> <li>• NR20</li> <li>• NR30</li> </ul> <p>Other sites</p> <ul style="list-style-type: none"> <li>• NR7</li> <li>• NR9</li> <li>• NR50</li> </ul>
<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek (HC10)</li> <li>• Foot Onslow Creek (FO1)</li> <li>• Navigation Creek (NAV1)</li> </ul>	<p>Grab sample and field measurements</p>	<ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying watercourse or mining of any immediately adjacent longwall.</li> <li>• Monthly detailed laboratory analysis during mining.</li> <li>• Following the development of incremental subsidence for each longwall that will impact on the feature.</li> </ul>	<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek (HC10)</li> </ul>
<b>LEVEL AND FLOW</b>			
<p><b>Nepean River</b> At benchmark sites and water pump sites:</p> <ul style="list-style-type: none"> <li>• NRL05</li> <li>• NRL10</li> <li>• NRL12</li> <li>• NRL13</li> <li>• NRL15</li> </ul>	<p>Water Level</p> <p>Water flow (measured at SCA weirs)</p>	<ul style="list-style-type: none"> <li>• Monthly baseline prior to mining (data has been recorded for most sites since 2007).</li> <li>• Weekly manual monitoring at nails during mining.</li> <li>• Flow monitoring at weirs (data supplied by SCA).</li> <li>• Ongoing monthly monitoring for 2 years post</li> </ul>	<p><b>Nepean River</b> At benchmark sites and water pump sites:</p> <ul style="list-style-type: none"> <li>• NRL05</li> <li>• NRL10</li> <li>• NRL12</li> <li>• NRL13</li> <li>• NRL15</li> </ul>

<ul style="list-style-type: none"> <li>• NRL20</li> <li>• Pump 1 NRL</li> <li>• Pump 2 NRL</li> <li>• NRL25</li> <li>• NRL30</li> <li>• NRL33</li> <li>• NRL35</li> <li>• NRL40</li> <li>• NRL45</li> <li>• NRL48</li> <li>• NRL50</li> <li>• Pump 5 NRL</li> <li>• Pump 6 NRL</li> </ul>		<p>mining (or as otherwise required/approved).</p>	<ul style="list-style-type: none"> <li>• NRL20</li> <li>• Pump 1 NRL</li> <li>• Pump 2 NRL</li> <li>• NRL25</li> <li>• NRL30</li> <li>• NRL33</li> <li>• NRL35</li> <li>• NRL40</li> <li>• NRL45</li> <li>• NRL48</li> <li>• NRL50</li> <li>• Pump 5 NRL</li> <li>• Pump 6 NRL</li> </ul>
<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek (HC10)</li> <li>• Foot Onslow Creek (F01)</li> <li>• Navigation Creek (NAV1)</li> </ul>	<p>Water Level</p>	<ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying watercourse or mining of any immediately adjacent longwall.</li> <li>• Following the development of incremental subsidence for each longwall that will impact on the feature.</li> </ul>	<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek (HC10)</li> </ul>
<b>APPEARANCE</b>			
<p><b>Nepean River</b></p> <ul style="list-style-type: none"> <li>• Visual observations along the length of the Nepean River within the active mining area.</li> </ul>	<p>Observational and photographic monitoring</p>	<ul style="list-style-type: none"> <li>• Monthly baseline prior to mining (data has been recorded for most sites since 2003).</li> <li>• Weekly observations and field analysis during mining.</li> <li>• Monthly monitoring for 2 years post mining (or as otherwise required/approved).</li> <li>• If required as a result of assessment of mining impacts.</li> </ul>	<p><b>Nepean River</b></p> <ul style="list-style-type: none"> <li>• Visual observations along the length of the Nepean River within the active mining area</li> </ul>
<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek</li> <li>• Foot Onslow Creek</li> <li>• Navigation Creek</li> </ul>	<p>Observational and photographic monitoring</p>	<ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying watercourse or mining of any immediately adjacent longwall.</li> <li>• Following the development of incremental subsidence for each longwall that will impact on the feature.</li> </ul>	<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek</li> </ul>
<p><b>Water Pumps</b></p> <ul style="list-style-type: none"> <li>• Pump 1 NRL</li> <li>• Pump 2 NRL</li> <li>• Pump 3</li> </ul>	<p>Observational and photographic monitoring</p>	<ul style="list-style-type: none"> <li>• Pre mining photographs</li> <li>• Weekly visual inspection during mining</li> <li>• If required as a result of assessment of mining impacts.</li> </ul>	<p><b>Water Pumps</b></p> <ul style="list-style-type: none"> <li>• Pump 1 NRL</li> <li>• Pump 2 NRL</li> <li>• Pump 3</li> </ul>

<ul style="list-style-type: none"> <li>• Pump 4</li> <li>• Pump 5 NRL</li> <li>• Pump 6 NRL</li> </ul>			<ul style="list-style-type: none"> <li>• Pump 4</li> <li>• Pump 5 NRL</li> <li>• Pump 6 NRL</li> </ul>
<b>GROUNDWATER</b>			
<p><b>Water Level</b></p> <p>IC monitoring bores</p> <ul style="list-style-type: none"> <li>• NGW3</li> <li>• NGW4</li> <li>• NGW6</li> <li>• NGW5</li> <li>• NGW7</li> <li>• NGW9</li> <li>• NGW10</li> <li>• NGW11</li> <li>• EAW5</li> <li>• EAW7 (S1936)</li> <li>• S1584</li> <li>• S1809</li> <li>• S1853</li> <li>• S1854</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• 10 registered bores within the SMP area (refer to Built Feature Management Plans for monitoring/management)</li> </ul>	<p>Groundwater level</p>	<p>IC Bores</p> <ul style="list-style-type: none"> <li>• Pre-mining (data has been recorded since September 2004 for some sites)</li> <li>• Water level logged hourly</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will potentially impact on the borehole.</li> <li>• Monitoring to continue for at least 12 months post mining.</li> </ul> <p>Private Bores</p> <ul style="list-style-type: none"> <li>- Prior to mining of longwall underlying bore or mining of any immediately adjacent longwall (if in agreement with landholder).</li> <li>- Post-mining – following the development of incremental subsidence for each longwall that will impact on the borehole (if in agreement with landholder).</li> <li>- As requested by landholder or if physical impacts to bore identified (landholder to observe during use of bore).</li> </ul>	<p><b>Water Level</b></p> <p>IC monitoring bores</p> <ul style="list-style-type: none"> <li>• No IC monitoring bores associated with Longwall 705</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• 1 registered bore monitored for Longwall 705 (see main report “Property Inspections” section for details on Private bore impacts).</li> </ul>
<p><b>Water Quality</b></p> <p>IC monitoring bores</p> <ul style="list-style-type: none"> <li>• NGW6</li> <li>• NGW5</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• 10 registered bores within the SMP area (refer to Built Feature Management Plans for monitoring/management)</li> </ul>	<p>Grab Sample</p>	<p>IC Bores</p> <ul style="list-style-type: none"> <li>• Pre-mining – prior to mining of longwall underlying bore or mining of any immediately adjacent longwall.</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will impact on the feature (i.e. each longwall).</li> <li>• As required to provide additional data for any bore impact investigation or if physical impacts to bore identified.</li> </ul> <p>Private Bores</p> <ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying bore or mining of any immediately adjacent longwall (if in agreement with landholder).</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will impact on the borehole (if in agreement with landholder).</li> <li>• As requested by landholder or if physical</li> </ul>	<p><b>Water Quality</b></p> <p>IC monitoring bores</p> <ul style="list-style-type: none"> <li>• No IC monitoring bores associated with Longwall 705</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• 1 registered bore monitored for Longwall 705 (see main report “Property Inspections” section for details on Private bore impacts).</li> </ul>



LANDSCAPE FEATURES		impacts to bore identified (landholder to observe during use of bore).	
<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>Along Nepean Gorge</li> </ul> <p><b>Steep Slopes</b></p> <ul style="list-style-type: none"> <li>Along Nepean Gorge, associated tributaries and above western end of the proposed longwalls.</li> </ul>	<p>Observational and photographic monitoring</p>	<ul style="list-style-type: none"> <li>Once prior to mining. Photographic records taken.</li> <li>During mining, monthly visual inspections, increased to weekly inspections during critical periods (for cliffs and steep slopes along the Nepean Gorge and associated tributaries).</li> <li>Monitoring to continue 6 monthly for 2 years following the completion of mining (or as otherwise required/approved).</li> <li>As required when specific impacts are identified or when concern is raised by a landowner.</li> <li>As required, in accordance with Built Feature Management Plans and landholder agreement.</li> </ul>	<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>Along Nepean Gorge</li> </ul> <p><b>Steep Slopes</b></p> <ul style="list-style-type: none"> <li>Along Nepean Gorge, associated tributaries and above western end of the proposed longwalls.</li> </ul>

*\* Analytes tested for only when gas release observed*

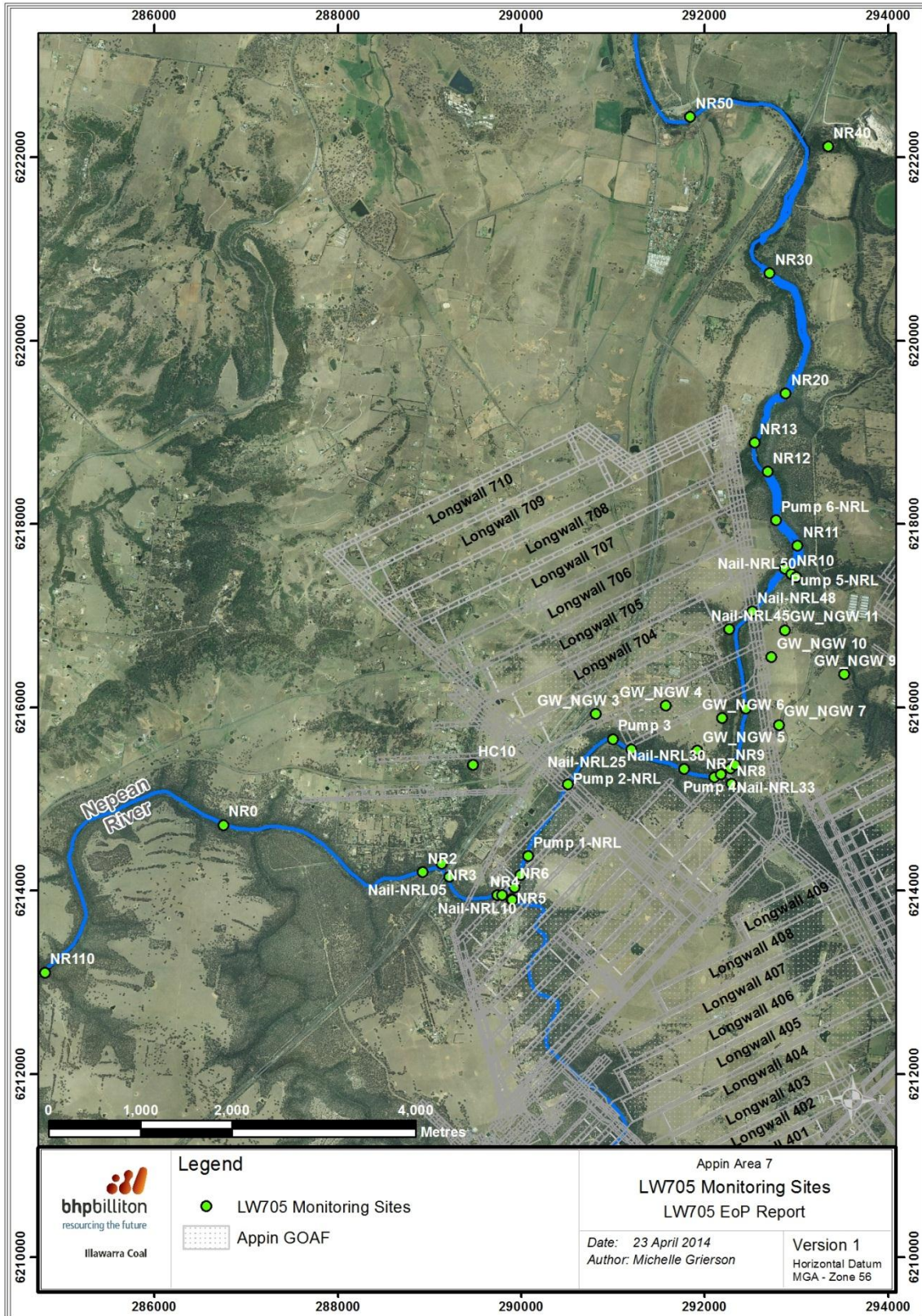


Figure 1: Location of Monitoring Sites



## 2.1. Water Quality

In-situ water quality parameters for the Nepean River and its tributaries are collected by the ICEFT on a weekly basis (when access is available). Parameters measured include temperature, specific conductivity (SpC), Oxidation-Reduction Potential (ORP), pH and dissolved oxygen (DO). Water samples are collected on a monthly basis to test for a range of laboratory parameters. In-situ and sampled water quality results are assessed by EcoEngineers and is included in the relevant water quality section of the EoP Report.

## 2.2. Gas Releases

Three gas zones (Gas Zones 16, 17 and 18) have been observed on the Nepean River. Gas Zone 16 was first observed on the 4<sup>th</sup> October 2012 and consisted of multiple releases in an approximate 60m x 5m area. This release has not been active since the 17<sup>th</sup> January 2014 (**Photos 1 - 3**). Gas Zone 17 was first observed on the 12<sup>th</sup> February 2013 and has not been active since the 19<sup>th</sup> February 2014. It consisted of up to seven releases (**Photos 4 & 5**). Gas Zone 18 was first observed on the 18<sup>th</sup> March 2013 and consisted of up to 20 releases; it remains active at the time of this report (**Photos 6 & 7**).

The flow rate from Gas Zone 16 was estimated to be approximately 200L/min. Gas Zones 17 and 18 were too small and diffused to estimate flow rates. The releases are Level 1 Impacts according to the TARPs, specifically: Identification of strata gas plume of flow rate <3000L/min.



**Photo 1:** AA7LW705 Gas Zone 16 looking downstream. Taken on 04/10/2012.



**Photo 2:** AA7LW705 Gas Zone 16 looking downstream. Taken on 23/10/2012.



**Photo 3:** AA7LW705 Gas Zone 16 looking down stream. Gas zone not active. Taken on 17/01/2014.



**Photo 4:** AA7LW705 Gas Zone 17 looking across stream. Taken on 18/03/2013.



**Photo 5:** AA7LW705 Gas Zone 17 looking across stream. Gas zone not active. Taken on 19/02/2014.



**Photo 6:** AA7LW705 Gas Zone 18 looking downstream. Taken on 18/03/13.

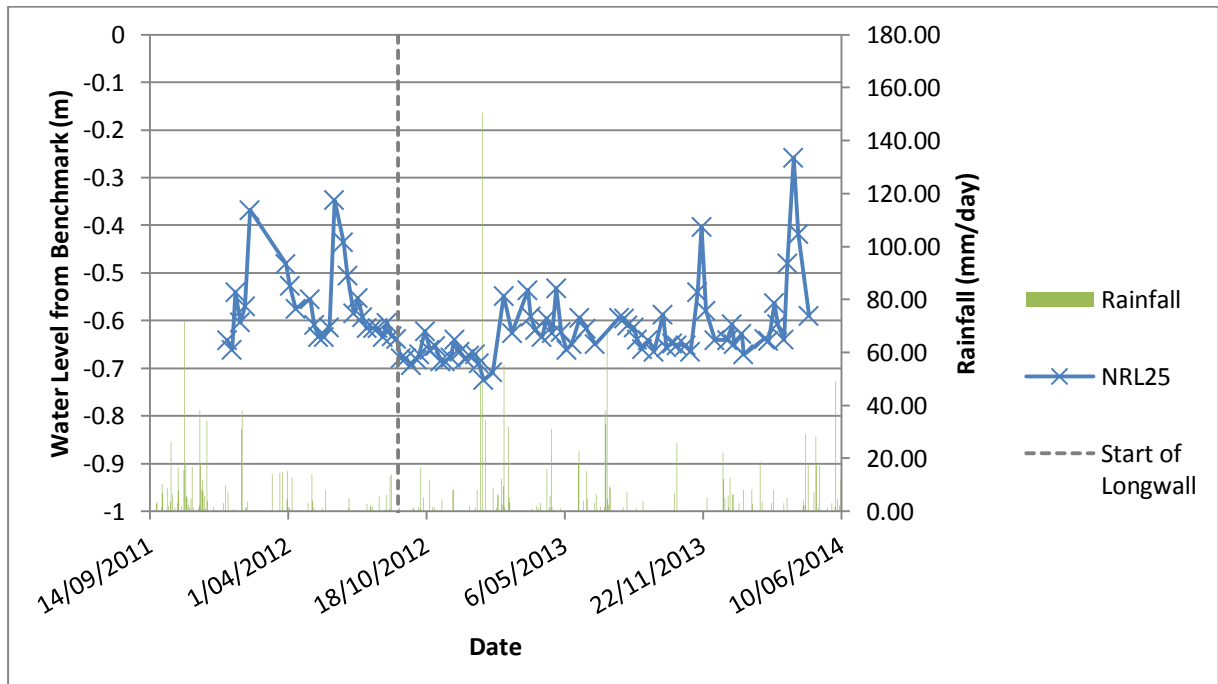


**Photo 7:** AA7LW705 Gas Zone 18 looking downstream across stream. Taken on 18/03/13.

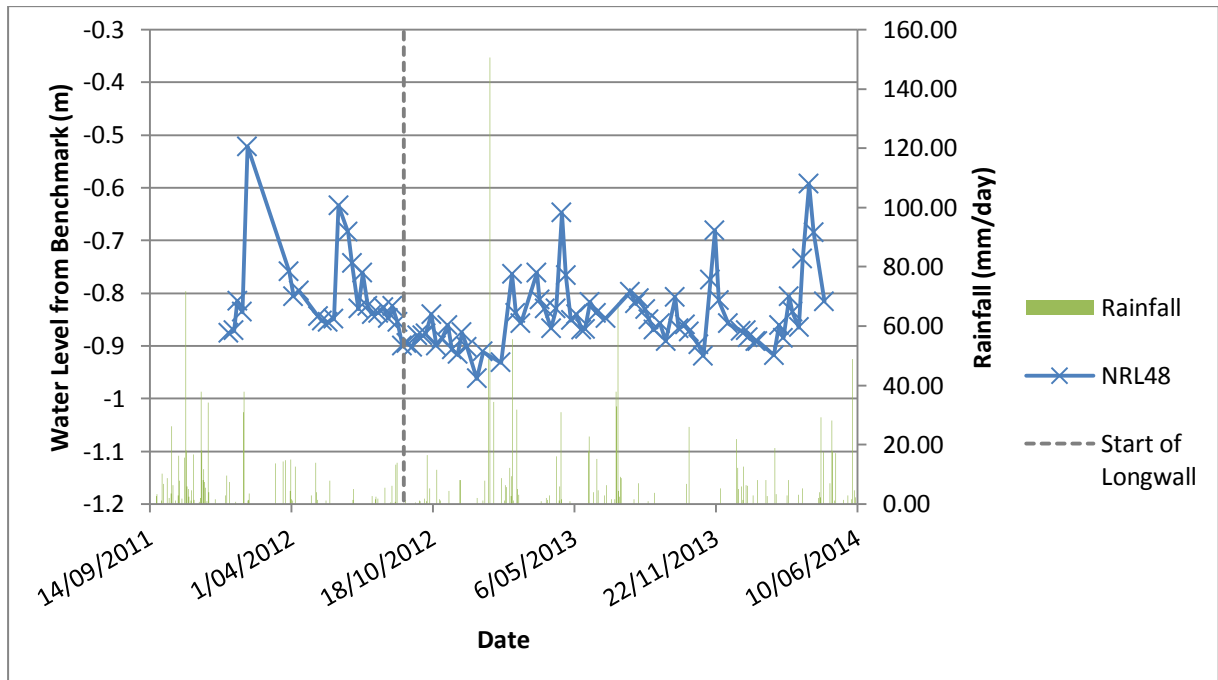
### **2.3. Water Level and Flow**

Water levels in the Nepean River and its tributaries are monitored by the ICEFT using observations and measured benchmarks on a weekly basis (when access is available). No

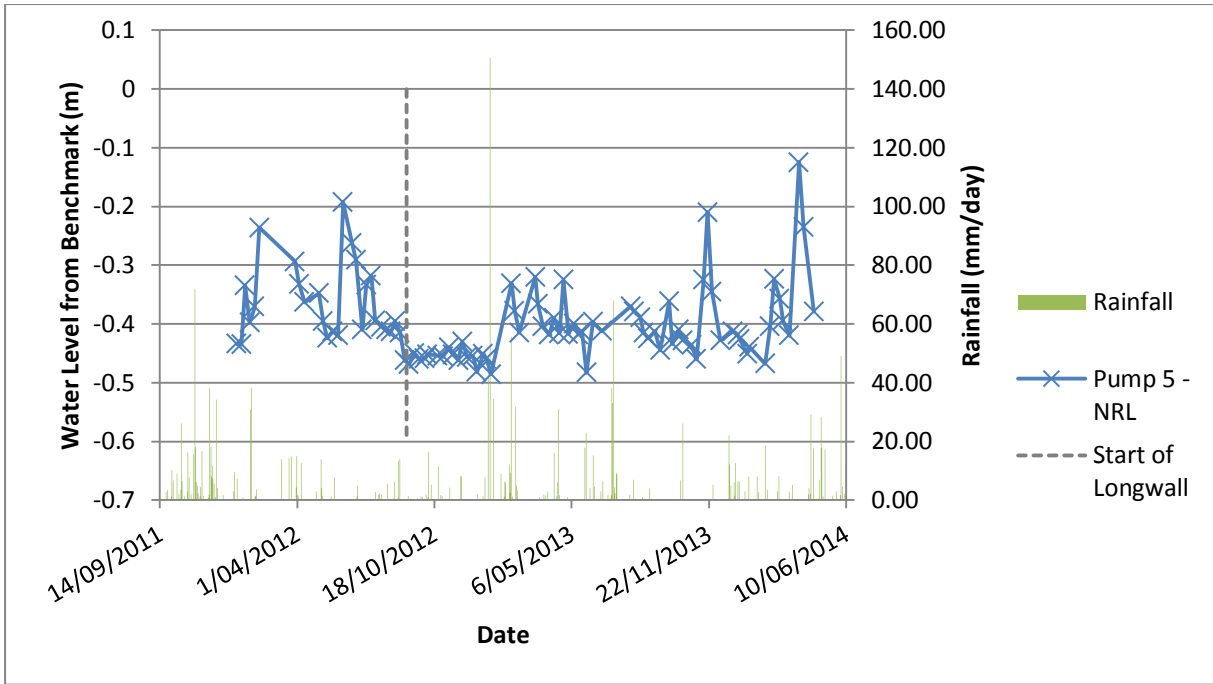
impacts to the water levels of the Nepean River or its tributaries were observed during the extraction of Longwall 705 (**Figures 2 – 5**).



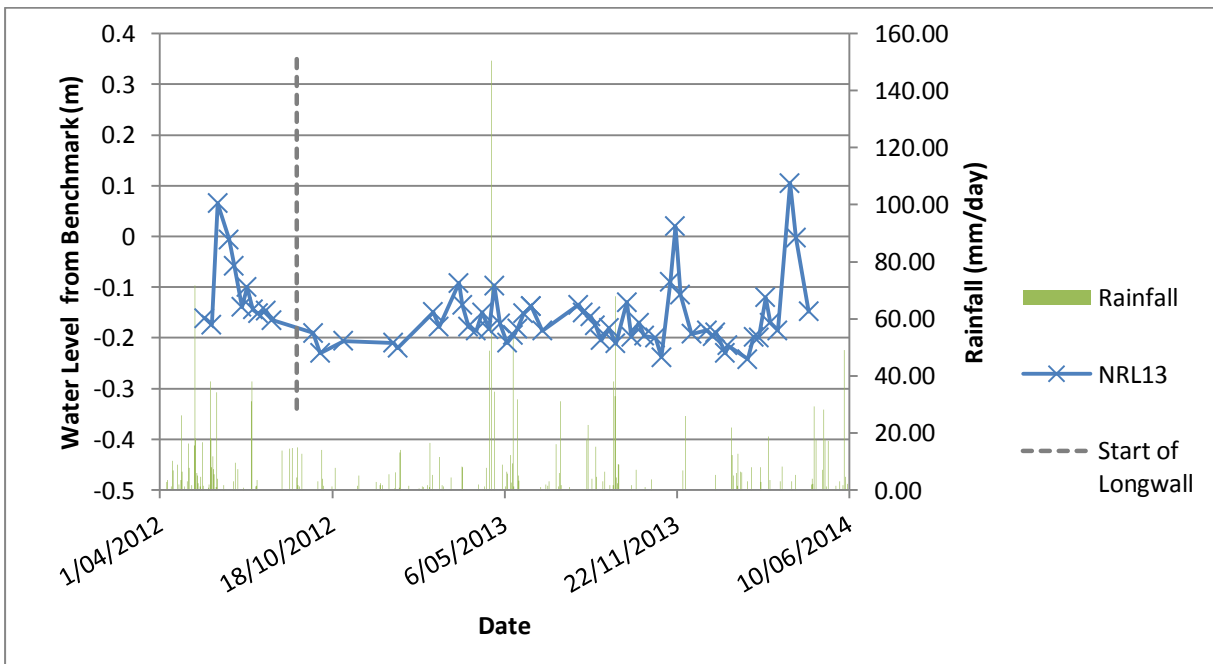
**Figure 2:** Comparison of Water Level at Nepean River site NRL25 with Daily Rainfall before and after the beginning of Longwall 705. Rainfall data collected from *Bureau of Meteorology (BoM) Douglas Park (St Marys Towers) NSW*.



**Figure 3:** Comparison of Water Level at Nepean River site NRL48 with Daily Rainfall before and after the beginning of Longwall 705. Rainfall data collected from *Bureau of Meteorology (BoM) Douglas Park (St Marys Towers) NSW*.



**Figure 4:** Comparison of Water Level at Nepean River site Pump 5 – NRL with Daily Rainfall before and after the beginning of Longwall 705. Rainfall data collected from *Bureau of Meteorology (BoM) Douglas Park (St Marys Towers) NSW*.



**Figure 5:** Comparison of Water Level at Nepean River site NRL13 with Daily Rainfall before and after the beginning of Longwall 705. Rainfall data collected from *Bureau of Meteorology (BoM) Douglas Park (St Marys Towers) NSW*.



## 2.4. Appearance

The appearance of the Nepean River and its tributaries is monitored by the ICEFT on a weekly basis (when access is available). Photographs are taken of monitoring sites, gas zones and any other potential impact site. No impacts to the appearance of the Nepean River or its tributaries were observed during the extraction of Longwall 705 (**Photos 8 – 13**).



**Photo 8:** NRL25, located downstream of Longwall 705, looking downstream. Taken on 05/09/12 (prior to start of Longwall 705).



**Photo 9:** NRL25, located downstream of Longwall 705, looking downstream. Taken on 16/04/14 (Following extraction of Longwall 705).



**Photo 10:** NRL48, located upstream of Longwall 705, looking upstream. Taken on 05/09/12 (prior to start of Longwall 705).



**Photo 11:** NRL48, located upstream of Longwall 705, looking upstream. Taken on 16/04/14 (Following extraction of Longwall 705).



**Photo 12:** NR13, located downstream of Longwall 705, looking downstream. Taken on 05/09/12 (prior to start of Longwall 705).



**Photo 13:** NR13, located downstream of Longwall 705, looking downstream. Taken on 16/04/14 (Following extraction of Longwall 705).

## 2.5. Groundwater

Groundwater levels were collected for Nepean Groundwater (NGW) piezometers.

Groundwater will be assessed by GeoTerra and the relevant sections of the EoP Report.

## 2.6. Landscape Features

Observations and photographs of landscape features such as cliffs and steep slopes along the Nepean Gorge and associated tributaries were conducted by the ICEFT. No impacts to landscape features were found during the extraction of Longwall 705 (**Photos 14 - 17**).



**Photo 14:** Cliffline downstream of site Pump 2 – NRL before mining. Taken on 05/09/12 (before start of Longwall 705).



**Photo 15:** Cliffline downstream of site Pump 2 – NRL before mining. Taken on 30/04/14 (after start of Longwall 705).





**Photo 16:** Cliffline near NR11, no impact. Taken on 30/04/14.



**Photo 17:** Cliffline and steep slope area near NR11, no impact. Taken on 30/04/14.

## 2.7. Summary of Impacts

Three impacts to water quality were identified by ICEFT during the monitoring of Longwall 705. All three impacts are Gas Zones occurring on the Nepean River and are summarised in **Table 2**. A detailed description of these impacts can be found in the relevant impact reports provided as an attachment to the Longwall 705 EoP Report.

**Table 2: Summary of Impacts to Water Quality**

Site ID	Easting	Northing	Impact	First Obs	Last Obs	Description	Feature Affected	TARP Level Triggered	Impact Report/s Dated
AA7LW 705 Gas Zone 16	290956	6215645	Gas Zone	4/10/12	17/01/14	Multiple releases on western side of river with one main constant release. This gas zone is spread variably over approximately 280m <sup>2</sup>	Nepean River	Level 1	5 <sup>th</sup> October 2012
AA7LW 705 Gas Zone 17	290815	6215562	Gas Zone	12/02/13	19/02/14	Up to 7 intermittent releases	Nepean River	Level 1	14 <sup>th</sup> February 2013
AA7LW 705 Gas Zone 18	290623	6215275	Gas Zone	18/03/13	16/04/14	Up to 20 intermittent releases	Nepean River	Level 1	18 <sup>th</sup> March 2013 & 6 <sup>th</sup> May 2013

### 3. Recommendations for Future Monitoring

Recommendations for future monitoring in Appin Area 7, particularly concerning monitoring of Nepean River are outlined in **Table 3**. These recommendations are based on monitoring commitments in the SMP, data gathered during mining Longwall 705 and the proximity of sites to Longwall 706.

**Table 3: Summary of Recommended Future Monitoring**

MONITORED SITES ASSOCIATED WITH LONGWALL 705	MONITORING FREQUENCY	RECOMMENDED FUTURE MONITORING
<b>WATER QUALITY</b>		
<p><b>Nepean River</b> Baseline upriver sites for cross- checking for upriver perturbations:</p> <ul style="list-style-type: none"> <li>• NR0</li> <li>• NR2 (pre Area 9 mining)</li> <li>• NR110 (New site - post Area 9 mining)</li> <li>• NR4</li> <li>• NR5</li> <li>• NR6</li> </ul> <p>Impact monitoring sites adjacent to each longwall:</p> <ul style="list-style-type: none"> <li>• NR11</li> <li>• NR12</li> <li>• NR13</li> <li>• NR20</li> <li>• NR30</li> </ul> <p>Other sites</p> <ul style="list-style-type: none"> <li>• NR7</li> <li>• NR9</li> <li>• NR50</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly baseline prior to mining (data has been recorded for most sites since 2003).</li> <li>• Weekly observations and field analysis during mining.</li> <li>• Monthly detailed laboratory analysis during mining.</li> <li>• Monthly monitoring for 2 years post mining (or as otherwise required/approved).</li> <li>• If required as a result of assessment of mining impacts.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly observations and field analysis due to distance from mining.</li> <li>• Removal of NR20 and NR30 due to distance from mining and adequate location of NR12, NR13 and NR50.</li> </ul>
<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek (HC10)</li> </ul>	<ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying watercourse or mining of any immediately adjacent longwall.</li> <li>• Monthly detailed laboratory analysis during mining.</li> <li>• Following the development of incremental subsidence for each longwall that will impact on the feature.</li> </ul>	<ul style="list-style-type: none"> <li>• As per the monitoring program</li> </ul>
<b>LEVEL AND FLOW</b>		
<p><b>Nepean River</b> At benchmark sites and water pump sites:</p> <ul style="list-style-type: none"> <li>• NRL05</li> <li>• NRL10</li> <li>• NRL12</li> <li>• NRL13</li> <li>• NRL15</li> <li>• NRL20</li> <li>• Pump 1 NRL</li> <li>• Pump 2 NRL</li> <li>• NRL25</li> <li>• NRL30</li> <li>• NRL33</li> <li>• NRL35</li> <li>• NRL40</li> <li>• NRL45</li> <li>• NRL48</li> <li>• NRL50</li> <li>• Pump 5 NRL</li> <li>• Pump 6 NRL</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly baseline prior to mining (data has been recorded for most sites since 2007).</li> <li>• Weekly manual monitoring at nails during mining.</li> <li>• Flow monitoring at weirs (data supplied by SCA).</li> <li>• Ongoing monthly monitoring for 2 years post mining (or as otherwise required/approved).</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly measurement of benchmark sites due to distance from mining</li> </ul>

<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek (HC10)</li> </ul>	<ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying watercourse or mining of any immediately adjacent longwall.</li> <li>• Following the development of incremental subsidence for each longwall that will impact on the feature.</li> </ul>	<ul style="list-style-type: none"> <li>• As per the monitoring program</li> </ul>
<b>APPEARANCE</b>		
<p><b>Nepean River</b></p> <ul style="list-style-type: none"> <li>• Visual observations along the length of the Nepean River within the active mining area</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly baseline prior to mining (data has been recorded for most sites since 2003).</li> <li>• Weekly observations and field analysis during mining.</li> <li>• Monthly monitoring for 2 years post mining (or as otherwise required/approved).</li> <li>• If required as a result of assessment of mining impacts.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly observations and field analysis due to distance from mining</li> </ul>
<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>• Lower Harris Creek (NR3)</li> <li>• Elladale Creek (NR8)</li> <li>• Ousedale Creek (NR10)</li> <li>• Menangle Creek (NR40)</li> <li>• Upper Harris Creek</li> </ul>	<ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying watercourse or mining of any immediately adjacent longwall.</li> <li>• Following the development of incremental subsidence for each longwall that will impact on the feature.</li> </ul>	<ul style="list-style-type: none"> <li>• As per the monitoring program</li> </ul>
<p><b>Water Pumps</b></p> <ul style="list-style-type: none"> <li>• Pump 1 NRL</li> <li>• Pump 2 NRL</li> <li>• Pump 3</li> <li>• Pump 4</li> <li>• Pump 5 NRL</li> <li>• Pump 6 NRL</li> </ul>	<ul style="list-style-type: none"> <li>• Pre mining photographs</li> <li>• Weekly visual inspection during mining</li> <li>• If required as a result of assessment of mining impacts.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly inspection due to distance from mining.</li> </ul>
<b>GROUNDWATER</b>		
<p><b>Water Level</b></p> <p>IC monitoring bores</p> <ul style="list-style-type: none"> <li>• No IC monitoring bores associated with Longwall 705</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• 1 registered bore monitored for Longwall 705</li> </ul>	<p>IC Bores</p> <ul style="list-style-type: none"> <li>• Pre-mining (data has been recorded since September 2004 for some sites)</li> <li>• Water level logged hourly</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will potentially impact on the borehole.</li> <li>• Monitoring to continue for at least 12 months post mining.</li> </ul> <p>Private Bores</p> <ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying bore or mining of any immediately adjacent longwall (if in agreement with landholder).</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will impact on the borehole (if in agreement with landholder).</li> <li>• As requested by landholder or if physical impacts to bore identified (landholder to observe during use of bore).</li> </ul>	<p>IC monitored bores</p> <ul style="list-style-type: none"> <li>• S1936</li> <li>• Cease regular monitoring of IC boreholes as mining has been outside the area of influence for at least 12 months</li> <li>- NGW3</li> <li>- NGW4</li> <li>- NGW5</li> <li>- NGW6</li> <li>- NGW7</li> <li>- NGW9</li> <li>- NGW10</li> <li>- NGW11</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• Monitoring of private boreholes prior-to and post-mining of Longwall 705</li> <li>- GW104661</li> <li>- GW104602</li> <li>- GW102584</li> <li>- GW108312</li> </ul>
<p><b>Water Quality</b></p> <p>IC monitoring bores</p> <ul style="list-style-type: none"> <li>• NGW5</li> <li>• NGW6</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• 1 registered bore monitored for Longwall 705</li> </ul>	<p>IC Bores</p> <ul style="list-style-type: none"> <li>• Pre-mining – prior to mining of longwall underlying bore or mining of any immediately adjacent longwall.</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will impact on the feature (i.e. each longwall).</li> <li>• As required to provide additional data for any bore impact investigation or if physical impacts to bore identified.</li> </ul>	<p>IC monitored bores</p> <ul style="list-style-type: none"> <li>• Cease regular monitoring of following IC boreholes as mining has been outside the area of influence for at least 12 months:</li> <li>- NGW3</li> <li>- NGW4</li> <li>- NGW5</li> <li>- NGW6</li> <li>- NGW7</li> <li>- NGW9</li> </ul>

	<p>Private Bores</p> <ul style="list-style-type: none"> <li>• Prior to mining of longwall underlying bore or mining of any immediately adjacent longwall (if in agreement with landholder).</li> <li>• Post-mining – following the development of incremental subsidence for each longwall that will impact on the borehole (if in agreement with landholder).</li> <li>• As requested by landholder or if physical impacts to bore identified (landholder to observe during use of bore).</li> </ul>	<ul style="list-style-type: none"> <li>- NGW10</li> <li>- NGW11</li> </ul> <p>Private bores</p> <ul style="list-style-type: none"> <li>• Monitoring of private boreholes prior-to and post-mining of Longwall 706:             <ul style="list-style-type: none"> <li>- GW104661</li> <li>- GW102584</li> <li>- GW108312</li> </ul> </li> </ul>
<b>LANDSCAPE FEATURES</b>		
<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>• Along Nepean Gorge</li> </ul> <p><b>Steep Slopes</b></p> <ul style="list-style-type: none"> <li>• Along Nepean Gorge, associated tributaries and above western end of the proposed longwalls.</li> </ul>	<ul style="list-style-type: none"> <li>• Once prior to mining. Photographic records taken.</li> <li>• During mining, monthly visual inspections, increased to weekly inspections during critical periods (for cliffs and steep slopes along the Nepean Gorge and associated tributaries).</li> <li>• Monitoring to continue 6 monthly for 2 years following the completion of mining (or as otherwise required/approved).</li> <li>• As required when specific impacts are identified or when concern is raised by a landowner.</li> <li>• As required, in accordance with Built Feature Management Plans and landholder agreement.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly inspections due to distance from mining</li> </ul>



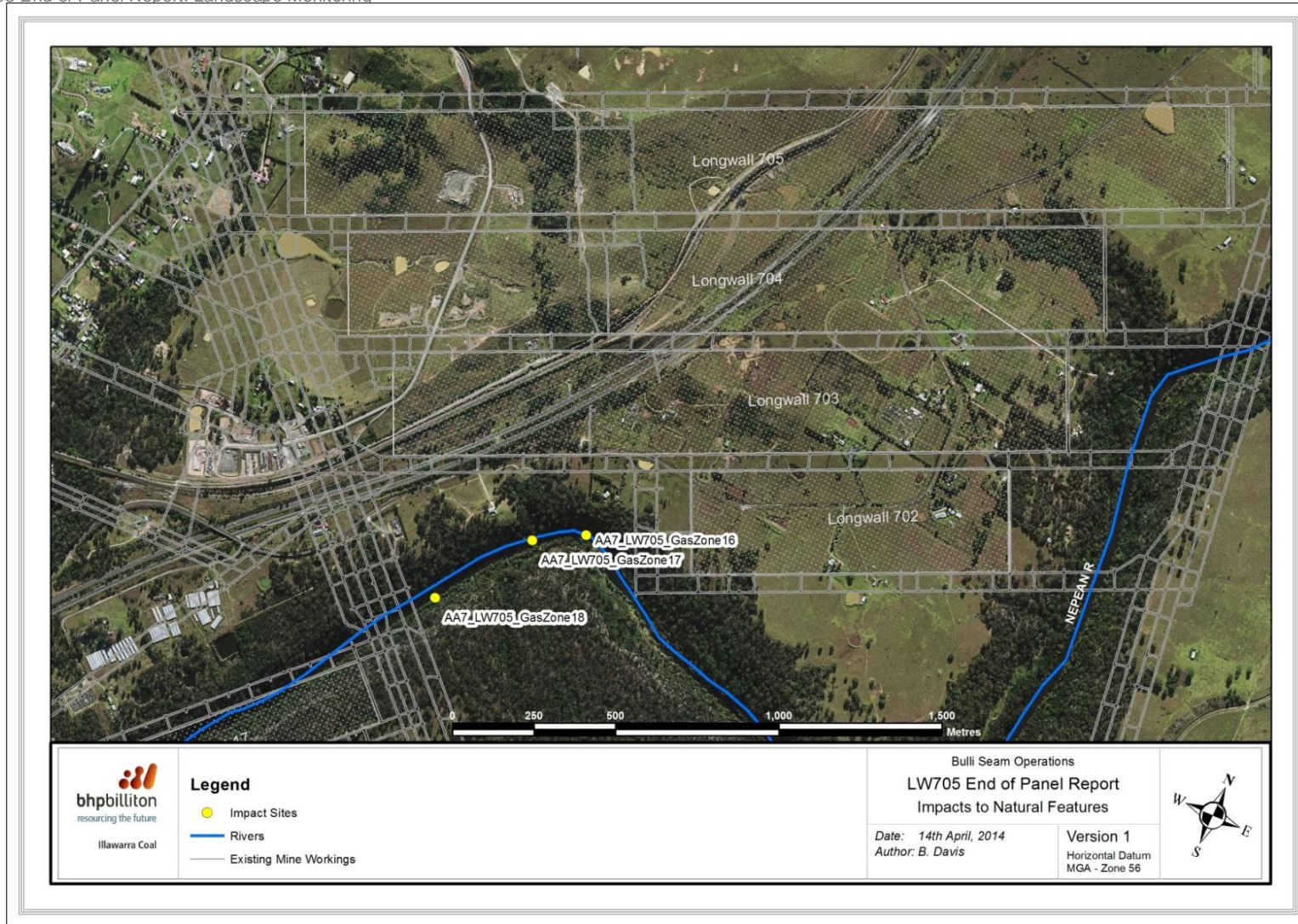


Figure 6: Location of impacted sites

## Appendix A – Subsidence Predictions, TARP Trigger Observations and Impacts Associated with Longwall 705

Monitoring	Trigger	Actions Undertaken if Impact was Observed	Impacts Observed	Impacts within prediction?	Further Actions or Recommendations
<b>WATER QUALITY</b>					
<p><b>Nepean River</b> Impact monitoring sites adjacent to each Longwall:</p> <ul style="list-style-type: none"> <li>▪ NR11</li> <li>▪ NR12</li> <li>▪ NR13</li> <li>▪ NR20</li> <li>▪ NR30</li> </ul> <p>Refer Figure 1a</p> <p><b>Notes:</b> <i>Baseline upriver sites will be used for cross-checking for upriver perturbations<sup>(3)</sup></i> <i>Baseline Upriver site NR2 data to be updated at end of panel following completion of each longwall, subject to checks-for, and discard-of upriver perturbed data</i></p>	<p><b>Level 1 (Within Prediction)<sup>(1)</sup></b> Impact monitoring sites:</p> <ul style="list-style-type: none"> <li>▪ 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</li> <li>▪ 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</li> <li>▪ Identification of strata gas plume of flow rate &lt; 3000 L/min <sup>(2)</sup></li> </ul>	<ul style="list-style-type: none"> <li>▪ Continue monitoring program</li> <li>▪ Report impacts to key stakeholders</li> <li>▪ Summarise impacts and record</li> </ul>	<p>Three Gas Zones in the Nepean River with flow rate &lt;3000L/min</p> <ul style="list-style-type: none"> <li>▪ AA7LW705 Gas Zone 15</li> <li>▪ AA7LW705 Gas Zone 16</li> <li>▪ AA7LW705 Gas Zone 17</li> </ul>	<p>Yes</p>	<p>Continue Monitoring Program</p>
	<p><b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b> Impact monitoring sites:</p> <ul style="list-style-type: none"> <li>▪ pH reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months</li> <li>▪ DO reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>▪ Actions as stated for Level 1 plus:</li> <li>▪ Review monitoring program</li> <li>▪ Notify relevant specialists (BHPBIC) and develop and implement remedial action if necessary</li> </ul> <p><i>Strata Gas Emission Plume:</i></p> <ul style="list-style-type: none"> <li>▪ Estimate gas emission flow rates. Re-estimate should significant change be observed</li> <li>▪ Take sample of plume (if possible)</li> </ul>	<p><i>No such impacts observed</i></p>	<p>N/A</p>	<p>N/A</p>

	<ul style="list-style-type: none"> <li>EC, total Fe and total Mn increases greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months</li> <li>Identification of strata gas plume of flow rate &gt; 3000 L/min<sup>(2)</sup></li> </ul>	<p>for:</p> <ul style="list-style-type: none"> <li>chemical composition</li> <li>dissolved methane from exactly above gas plume and at established downriver monitoring sites</li> <li>dissolved sulfide and total phenols from exactly above gas plume and at nearest downriver monitoring site(s)</li> </ul>			
	<p><b>Level 3 (CMAs likely to be required)</b><sup>(1)</sup> Impact monitoring sites:</p> <ul style="list-style-type: none"> <li>Level 2-type reduction in water quality resulting from the mining observed for more than 6 consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2 plus:</li> <li>Immediately notify OEH, D&amp;PI, NoW &amp; DRE and any other relevant specialist.</li> <li>Consultation with stakeholders.</li> <li>Collect laboratory samples and analyse for:                             <ul style="list-style-type: none"> <li>pH, EC, Total Fe and Mn</li> <li>Suite of Filterable metals.</li> <li>Dissolved methane, sulfide and total phenols (if relevant).</li> </ul> </li> <li>Develop site management measures as soon as practically possible (pending stakeholder availability) and seek any approvals required to implement</li> </ul>	<i>No such impacts observed</i>	NA	N/A
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>More than negligible gas releases</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 3</li> <li>Investigate reasons for the exceedance</li> <li>Update future predictions based on the outcomes of the investigation</li> </ul>	<i>No such impacts observed</i>	N/A	N/A
<b>WATER LEVEL AND FLOW</b>					
<p><b>Nepean River</b></p> <ul style="list-style-type: none"> <li>Visual observations along the length of the Nepean River within the active mining area</li> </ul>	<p><b>Level 1 (Within Prediction)</b><sup>(1)</sup></p> <ul style="list-style-type: none"> <li>Observation of areas of dry and/or flooded riverbed in comparison to pre-mining baseline observations and flows, for less than 2 consecutive months.</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Report impacts to key stakeholders</li> <li>Summarise impacts and record</li> </ul>	<i>No such impacts observed</i>	N/A	N/A

	<p><b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>Observation of areas of dry and/or flooded riverbed in comparison to pre-mining baseline observations and flows, for more than 2 consecutive months.</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring program</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved</li> </ul>	No such impacts observed	N/A	N/A
	<p><b>Level 3 (CMAs likely to be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>Observation of areas of dry and/or flooded riverbed in comparison to pre-mining baseline observations and flows, for more than 6 consecutive months.</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> <li>Immediately notify relevant government agencies, other resource managers and relevant technical specialists and seek advice on any CMA required.</li> <li>Site visits with stakeholders if required</li> <li>Develop site CMA in consultation with key stakeholders within 1 month.</li> <li>Completion of works following approvals</li> <li>Issue CMA report within 1 month of works completion</li> <li>Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion if required</li> <li>Review the relevant TARP and Management Plan in consultation with key stakeholders</li> </ul>	No such impacts observed	N/A	N/A
<b>APPEARANCE</b>					
<p><b>Nepean River</b></p> <ul style="list-style-type: none"> <li>Visual observations along the length of the Nepean River within the active mining area</li> </ul>	<p><b>Level 1 (Within Prediction)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>Identified iron staining resulting from the mining for two consecutive months</li> <li>Identified water cloudiness resulting from the mining for two consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Report impacts to key stakeholders</li> <li>Summarise impacts and record</li> </ul>	No such impacts observed	N/A	N/A
	<p><b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b></p>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring program</li> </ul>	No such impacts observed	N/A	N/A



	<p><b>be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Iron staining greater than baseline monitoring resulting from the mining for two consecutive months</li> <li>▪ Water cloudiness greater than baseline monitoring resulting from the mining for two consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>▪ Notify relevant technical specialists and seek advice on any CMA required</li> <li>▪ Implement agreed CMAs as approved</li> </ul>			
	<p><b>Level 3 (CMAs likely to be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Iron staining greater than baseline monitoring resulting from the mining for six consecutive months</li> <li>▪ Water cloudiness greater than baseline monitoring resulting from the mining for six consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 2</i></li> <li>▪ Immediately notify relevant government agencies, other resource managers and relevant technical specialists and seek advice on any CMA required.</li> <li>▪ Site visits with stakeholders if required</li> <li>▪ Develop site CMA in consultation with key stakeholders within 1 month.</li> <li>▪ Completion of works following approvals</li> <li>▪ Issue CMA report within 1 month of works completion</li> <li>▪ Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion if required</li> <li>▪ Review the relevant TARP and Management Plan in consultation with key stakeholders</li> </ul>	<p><i>No such impacts observed</i></p>	<p>N/A</p>	<p>N/A</p>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>▪ More than negligible iron staining resulting from the mining</li> <li>▪ More than negligible increase in water cloudiness resulting from the mining</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 3</i></li> <li>▪ Investigate reasons for the exceedance</li> <li>▪ Update future predictions based on the outcomes of the investigation</li> </ul>	<p><i>No such impacts observed</i></p>	<p>N/A</p>	<p>N/A</p>
<p><b>Ephemeral Watercourses</b></p> <ul style="list-style-type: none"> <li>▪ Upper Harris Creek (HC10)</li> <li>▪ Foot Onslow Creek (FO1)</li> </ul>	<p><b>Level 1 (Within Prediction)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Fracturing with no observable loss of surface water flow</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continue monitoring program</li> <li>▪ Report impacts to key stakeholders</li> <li>▪ Summarise impacts and record</li> </ul>	<p><i>No such impacts observed</i></p>	<p>N/A</p>	<p>N/A</p>

<ul style="list-style-type: none"> <li>▪ Navigation Creek (NAV1)</li> </ul> <p>Visual observations at water quality monitoring sites and along the length of the stream within the active mining area where landholder access is granted</p>	<ul style="list-style-type: none"> <li>▪ Fracturing with no reduction in pool water level when compared to similar environmental conditions in baseline period</li> <li>▪ Increase in turbidity, iron staining, algal growth, or other visible water quality parameters resulting from the mining for two consecutive months determined by comparing baseline photos with photos during the mining period</li> </ul>				
	<p><b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Fracturing resulting in loss of surface flow in some creeks or tributary</li> <li>▪ Fracturing resulting in water loss from some permanent pools</li> <li>▪ Reduced water retention time in pools</li> <li>▪ Increase in turbidity, iron staining, algal growth, or other visible water quality parameters resulting from the mining for two consecutive months determined by comparing baseline photos with photos during the mining period</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 1</i></li> <li>▪ Review monitoring program</li> <li>▪ Notify relevant technical specialists and seek advice on any CMA required</li> <li>▪ Implement agreed CMAs as approved</li> </ul>	No such impacts observed	N/A	N/A
	<p><b>Level 3 (CMAs likely to be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Fracturing resulting in total loss of surface flow in all sections of a creek or tributary</li> <li>▪ Fracturing resulting in total water loss from all permanent pools in the mining area</li> <li>▪ Reduced water retention time in all pools in the mining area</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 2</i></li> <li>▪ Immediately notify relevant government agencies, other resource managers and relevant technical specialists and seek advice on any CMA required.</li> <li>▪ Site visits with stakeholders if required</li> <li>▪ Develop site CMA in consultation with key stakeholders within 1 month.</li> <li>▪ Completion of works following approvals</li> <li>▪ Issue CMA report within 1 month of works completion</li> </ul>	No such impacts observed	N/A	N/A

		<ul style="list-style-type: none"> <li>Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion if required</li> <li>Review the relevant TARP and Management Plan in consultation with key stakeholders</li> </ul>			
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>Fracturing of controlling rockbars and/or stream bed, resulting in the diversion of all stream flow in the mining area</li> <li>Increased leakage from all pools in the mining area</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 3</li> <li>Investigate reasons for the exceedance</li> <li>Update future predictions based on the outcomes of the investigation</li> </ul>	<i>No such impacts observed</i>	N/A	N/A
<p><b>Water Pumps</b></p> <ul style="list-style-type: none"> <li>There are six pumps in the Nepean River which will be monitored for the effects from subsidence:                             <ul style="list-style-type: none"> <li>Pump 1</li> <li>Pump 2</li> <li>Pump 3</li> <li>Pump 4</li> <li>Pump 5</li> <li>Pump 6</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Pump not functioning due to physical disturbance from subsidence</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Report impacts to key stakeholders</li> <li>Summarise impacts and record</li> <li>Develop and implement CMA (if required) in consultation with key stakeholders</li> </ul>	<i>No such impacts observed</i>	N/A	N/A
<b>GROUNDWATER</b>					
<p><b>Water Level</b></p> <p>IC monitoring bores:</p> <ul style="list-style-type: none"> <li>NGW3</li> <li>NGW4</li> <li>NGW6</li> <li>NGW5</li> <li>EAW5</li> <li>EAW7 (S1936)</li> <li>Private Bores</li> <li>Registered bores and any</li> </ul>	<p><b>Level 1 (Within Prediction)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>Up to an additional 2.5m reduction from the predicted standing water level or pressure (outside of pumping influences) over 2 consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Report impacts to key stakeholders</li> <li>Summarise impacts and record</li> </ul>	<i>Refer to Longwall 705 End of Panel specialist report on Groundwater for more information</i>		
	<p><b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>Between 2.5m and 5m additional reduction from the predicted standing</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring program</li> <li>Notify relevant technical specialists and seek advice on any</li> </ul>			

<p>new bores within the SMP area</p> <p><b>Notes:</b>  <i>Impact monitoring data during longwall mining is compared to predicted groundwater levels from the BSOP (or later updates) groundwater model, during preparation of the End of Panel Report</i></p> <p><i>Privately owned water supplies are monitored as agreed with landowners in the Built Feature Management Plans</i></p> <p>Refer Figure 1a</p>	<p>water level or pressure (outside of pumping influences) over 2 consecutive months</p> <p><b>Level 3 (CMAs likely to be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Greater than 5m of additional reduction from the predicted standing water level or pressure (outside of pumping influences) over 2 consecutive months</li> <li>▪ Privately owned water supply adversely impacted from the mining (other than impact that is negligible)</li> </ul>	<p>CMA required</p> <ul style="list-style-type: none"> <li>▪ Implement agreed CMAs as approved</li> </ul> <p><b>Actions as stated for Level 2</b></p> <ul style="list-style-type: none"> <li>▪ Immediately notify relevant government agencies, other resource managers and relevant technical specialists and seek advice on any CMA required.</li> <li>▪ Site visits with stakeholders if required</li> <li>▪ Develop site CMA in consultation with key stakeholders within 1 month.</li> <li>▪ Completion of works following approvals</li> <li>▪ Issue CMA report within 1 month of works completion</li> <li>▪ Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion if required</li> <li>▪ Review the relevant TARP and Management Plan in consultation with key stakeholders</li> <li>▪ Compensatory water supply measures must be provided as an alternative long-term supply that is equivalent to the loss attributed to the mining impact, and be provided (at least on an interim basis) within 24 hours of the loss being identified.</li> </ul>			
<p><b>Water Quality</b>                  IC monitoring bores</p> <ul style="list-style-type: none"> <li>▪ NGW6</li> <li>▪ NGW5</li> </ul> <p>Private Bores</p>	<p><b>Level 1 (Within Prediction)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Groundwater quality reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continue monitoring program</li> <li>▪ Report impacts to key stakeholders</li> <li>▪ Summarise impacts and record</li> </ul>	<p><i>Refer to Longwall 705 End of Panel specialist report on Surface Water and Shallow Groundwater</i></p>		

<ul style="list-style-type: none"> <li>▪ Registered bores and any new bores within the SMP area (where water quality samples can be taken)</li> </ul>	consecutive months		<i>for more information</i>		
	<b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b> <ul style="list-style-type: none"> <li>▪ Groundwater quality reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 1</i></li> <li>▪ Review monitoring program</li> <li>▪ Notify relevant technical specialists and seek advice on any CMA required</li> <li>▪ Implement agreed CMAs as approved</li> </ul>			
	<b>Level 3 (CMAs likely to be required)<sup>(1)</sup></b> <ul style="list-style-type: none"> <li>▪ Level 2-type reduction in water quality resulting from the mining observed for more than 6 consecutive months</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 2</i></li> <li>▪ Immediately notify relevant government agencies, other resource managers and relevant technical specialists and seek advice on any CMA required.</li> <li>▪ Site visits with stakeholders if required</li> <li>▪ Develop site CMA in consultation with key stakeholders within 1 month.</li> <li>▪ Completion of works following approvals</li> <li>▪ Issue CMA report within 1 month of works completion</li> <li>▪ Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion if required</li> <li>▪ Review the relevant TARP and Management Plan in consultation with key stakeholders</li> <li>▪ Compensatory water supply measures must be provided as an alternative long-term supply that is equivalent to the loss attributed to the mining impact, and be provided (at least on an interim basis) within 24 hours of the loss being</li> </ul>			

		identified			
<b>LANDSCAPE FEATURES</b>					
<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>▪ Along Nepean Gorge</li> </ul> <p><b>Steep Slopes</b></p> <ul style="list-style-type: none"> <li>▪ Along Nepean Gorge, associated tributaries and above western end of the proposed Longwalls</li> </ul> <p>Refer Figure 19.1 in LW705-710 SMP</p>	<p><b>Level 1 (Within Prediction)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Any rock fall, displacement, dislodgement of boulders or slabs or fracturing of a cliff line flanking the Nepean River resulting from mining</li> <li>▪ Erosion resulting from mining localised to a small area that should naturally stabilise within the monitoring period</li> <li>▪ Surface movement resulting from mining with no more than negligible soil surface exposed</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continue monitoring program</li> <li>▪ Report impacts to key stakeholders</li> <li>▪ Summarise impacts and record</li> </ul>	<i>No such impacts observed</i>	N/A	N/A
	<p><b>Level 2 (Within Prediction – CMAs may be required)<sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Any rock falls, displacements,</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 1</i></li> <li>▪ Review monitoring program</li> <li>▪ Notify relevant technical specialists</li> </ul>	<i>No such impacts observed</i>	N/A	N/A

<ul style="list-style-type: none"> <li>▪ Cliffs flanking the Nepean River</li> </ul>	<p>dislodgements of boulders or slabs or fracturing of a cliff line(s) flanking the Nepean River resulting from mining that in total impacts 0.3% of the total cliff line face area of the mining domain.</p> <ul style="list-style-type: none"> <li>▪ Erosion resulting from mining likely to naturally stabilise within the monitoring period.</li> <li>▪ Surface movement or rock displacement resulting from mining with no more than minor soil surface exposed</li> </ul>	<p>and seek advice on any CMA required</p> <ul style="list-style-type: none"> <li>▪ Implement agreed CMAs as approved</li> </ul>			
	<p><b>Level 3 (CMAs likely to be required) <sup>(1)</sup></b></p> <ul style="list-style-type: none"> <li>▪ Any rock falls, displacements, dislodgements of boulders or slabs or fracturing of a cliff line(s) flanking the Nepean River resulting from mining that in total impacts up to 0.5% of the total cliffline face area of the mining domain.</li> <li>▪ Any rock falls, displacements, dislodgements of boulders or slabs or fracturing of a cliffline(s) flanking the Nepean River resulting from mining that in total impacts 0.4% of the total cliffline face area of the mining domain after 1 longwall.</li> <li>▪ Mass movement of a slope causing large areas of exposed soil</li> <li>▪ Any form of rockfall or erosion that poses a threat to public safety</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 2</i></li> <li>▪ Immediately notify relevant government agencies, other resource managers and relevant technical specialists and seek advice on any CMA required.</li> <li>▪ Site visits with stakeholders if required</li> <li>▪ Develop site CMA in consultation with key stakeholders within 1 month.</li> <li>▪ Completion of works following approvals</li> <li>▪ Issue CMA report within 1 month of works completion</li> <li>▪ Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion if required</li> <li>▪ Review the relevant TARP and Management Plan in consultation with key stakeholders</li> </ul>	<p><i>No such impacts observed</i></p>	<p>N/A</p>	<p>N/A</p>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>▪ More than negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that</li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Actions as stated for Level 3</i></li> <li>▪ Investigate reasons for the exceedance</li> <li>▪ Update future predictions based on the outcomes of the investigation</li> </ul>	<p><i>No such impacts observed</i></p>	<p>N/A</p>	<p>N/A</p>

	<p>in total impacts more than 0.5% of the total face area of such cliffs within the Longwall mining domain)</p> <ul style="list-style-type: none"> <li>▪ Rockfall or erosion that poses more than a negligible increased risk to public safety</li> </ul>				
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- (1) These may be revised in consultation with DoPI and DPI and other key stakeholders
- (2) If strata gas emission plumes are detected – particularly coinciding with low river flow and significant gas evolution
- (3) Baseline upriver sites for cross-checking for upriver perturbations impacting Area 7 monitoring sites:
  - NR0 - possible perturbations from Allens Creek (>2 standard deviation)
  - NR2 - upstream perturbations (>2 standard deviations) pre-Area 9 mining
  - New site NR110 - possible perturbations from Area 9 (>2 standard deviations) post-Area 9 mining commencement
  - Checks at Upriver sites NR4, NR5 and NR6 for possible Cataract River-based perturbations (>2 standard deviation)

Current values:

**Level 1**

**NR11**

- pH>6.93;<7.33
- DO>47.8%;<66.0%
- EC>561 uS/cm;<758 uS/cm
- Total Fe>0.589;<0.866mg/L
- Total Mn>0.044;<0.074 mg/L

**NR2 upstream normality checks**

- pH>7.01
- DO>55.3%
- EC<890 uS/cm
- Total Fe<1.220 mg/L
- Total Mn<0.090 mg/L

**Level 2 and 3**

**NR11**

- pH<6.93
- DO<47.8%
- EC>758 uS/cm
- Total Fe>0.866
- Total Mn>0.074

**NR2 upstream normality checks**

- pH>7.01
- DO>55.3%
- EC<890 uS/cm
- Total Fe<1.220 mg/L
- Total Mn<0.090 mg/L

The above data values are updated during the preparation of each End of Panel Report