

ASSESSMENT REPORT

RUSSELL VALE COLLIERY – PRELIMINARY WORKS PROJECT

Commencement of Longwall 6 (Mod 2)

1. BACKGROUND

1.1 Project Location

Wollongong Coal Pty Ltd (formerly Gujarat NRE Coking Coal Ltd) owns and operates the Russell Vale Colliery (Russell Vale); located in the Illawarra region, approximately eight kilometres (km) north of Wollongong and 70 km south of Sydney (see **Figure 1**). Jindal Steel and Power Limited acquired a majority stake in Gujarat NRE Coking Coal Ltd (NRE) in October 2013. The mine was known as the NRE No. 1 Colliery prior to February 2014.

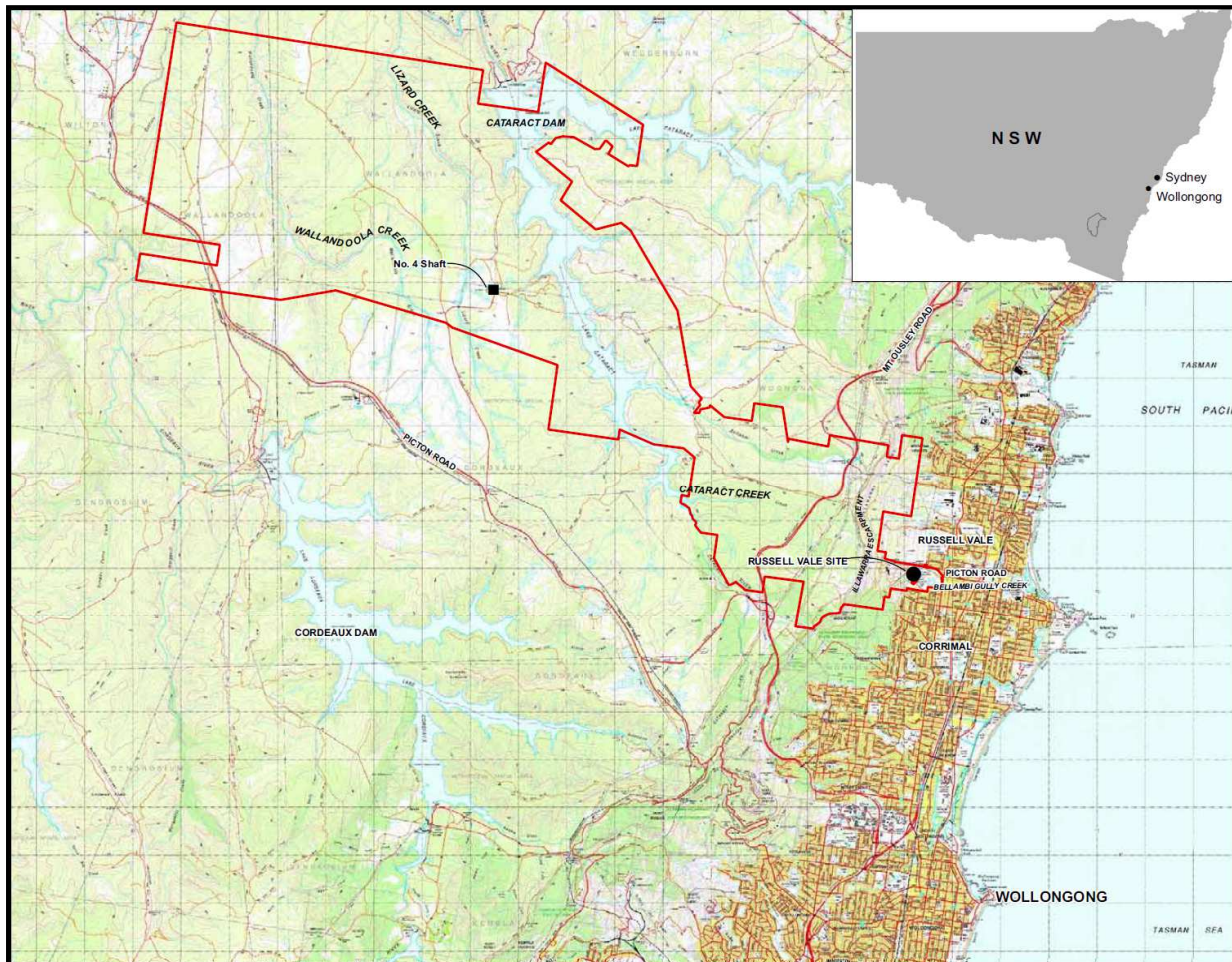


Figure 1: Regional Location and Existing Project Area (marked in red edge)

1.2 History of Mining

Mining at Russell Vale has been undertaken since 1887 using a range of mining techniques including bord and pillar mining, pillar extraction and longwall mining. The Bulli Seam was previously mined using pillar extraction techniques (early to mid 1900s) and the Balgownie Seam was extracted using longwall mining techniques (between 1970 - 1982 and 2001 - 2003). More recently, longwall mining commenced in the underlying Wongawilli Seam (2012 – early 2014).

1.3 Existing Project Approval and Operations

On 13 October 2011, the Planning Assessment Commission (PAC) approved the Preliminary Works Project (PWP) at Russell Vale under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In summary, this project approval (MP 10_0046) allows:

- extraction of up to 1 million tonnes per annum (Mtpa) of run-of-mine (ROM) coking coal through first workings and pillar extraction from the Bulli and Wongawilli Seams for a period of three years;
- upgrade of existing mining infrastructure at the mine's surface facilities site; and
- trucking of ROM coal from Russell Vale to Port Kembla Coal Terminal.

On 4 May 2012, NRE lodged an application (MOD 1) to modify the PWP approval, for approval to:

- extract coal using longwall mining techniques in the Wongawilli Seam from two panels (Longwalls 4 and 5); and
- develop the maingates for Longwalls 6, 7 and 8.

NRE extracted coal using longwall mining techniques from one panel (Longwall 4) prior to determination of this modification. This occurred under a Subsidence Management Plan (SMP) approved by NSW Trade and Investment's Division of Resources and Energy (DRE), pursuant to an existing transitional provision in the *Environmental Planning & Assessment Regulation 2000* (clause 8K). This provision allowed mining within existing mining leases up until the end of September 2012, providing that Director-General's requirements had been issued for a project application prior to the end of December 2010.

During the course of assessing MOD 1, the length of the second panel (Longwall 5) was shortened (from 1,145 to 845 metres (m)), primarily to reduce the potential impact on upland swamps. On 24 December 2012, the PAC approved the amended MOD 1 application, but excluded approval for development of the maingates for Longwalls 7 and 8 on the basis that the application lacked an assessment of the subsidence impacts that would be caused by extraction of the longwall blocks.

Extraction of Longwall 5 was completed on 12 January 2014. The development of the maingate for Longwall 6 is currently nearing completion.

1.4 Other Related Approvals

On 12 August 2009, NRE submitted a Part 3A project application for its proposed Underground Expansion Project (UEP). This project (MP 09_0013) involved a significant expansion of longwall mining across the Wonga East and Wonga West areas, to extract 31 million tonnes (Mt) of ROM coal over a project life of 18 years. The Environmental Assessment (EA) supporting this application was exhibited in early 2013.

In response to issues raised in agency and public submissions and in independent expert reviews of the EA undertaken for the Department, NRE made significant changes to the original project. These changes are outlined in a Preferred Project Report (PPR), which was submitted in September 2013. Under the PPR, the UEP application has been amended by:

- reducing the proposed project life from 18 years to 5 years;
- reducing the total ROM coal production from 31 Mt to 4.7 Mt;
- removing all proposed longwall mining (7 panels) from the Wonga West area and removing one panel from the Wonga East area; and
- reorienting the remaining 8 longwall panels in the Wonga East area to minimise impacts to identified significant natural features.

In October 2013, NRE's PPR was placed on the Department's website and distributed to all key government agencies for comment. **Figure 2** provides a figure showing the location of the amended UEP in relation to the two extracted longwalls within the Wongawilli Seam (ie Longwalls 4 and 5) and the proposed Longwall 6 modification (MOD 2).

Wollongong Coal has recently completed a formal response to the issues raised in agency and public submissions on the PPR (a 'residual matters report').

The Department is now completing its assessment of the merits of the UEP. The application to the UEP is likely to be sent to the PAC for review or determination in September/October 2014.

2. PROPOSED MODIFICATION

On 11 April 2014, Wollongong Coal lodged an application and supporting EA (see **Appendix A**) to further modify the PWP approval under section 75W of the EP&A Act. The proposed modification (MOD 2) involves:

- extracting coal using longwall mining techniques for the first 400 m of Longwall 6 in the Wongawilli Seam (see **Figures 2 and 3**); and
- extending the existing project approval until 31 December 2015.

The modification is considered to be very minor. The extraction area of the first 400 m of Longwall 6 is wholly within the existing approved project area and the panel layout has been designed to minimise the surface and other environmental impacts from subsidence, primarily by providing a significant buffer from the Cataract Reservoir.

In addition, when compared to other mining operations in the Southern Coalfields, the longwall has a narrow panel width (150 m), large chain pillars (45 m wide) and significant depth of cover (between 320 and 345 m). The longwall has a seam thickness of between 2.6 and 2.8 m and a maximum cutting height of 2.8 m.

The total coal resource within the first 400 m of Longwall 6 is 260,000 tonnes, which Wollongong Coal has estimated would take only around 1-2 months to mine. The extraction rate would therefore remain well within the current limit of 1 Mtpa. The proposed modification would also make use of existing facilities and would not involve any vegetation clearing or increased trucking.

Wollongong Coal has informed the Department that it is nearing completion of development of the maingates for Longwall 6. These works are therefore likely to be finished well ahead of the expiration of the current approval (13 October 2014) and the expected determination of the UEP (early 2015). Wollongong Coal has indicated that mining the first 400 m of Longwall 6 would provide sufficient coal capacity and cash flow to allow the mine to remain open and maintain employment for the existing 300 staff until such time as the assessment of the UEP is complete and the PAC determines that project application.

If the modification application is approved, Wollongong Coal has indicated that it would immediately submit a draft Extraction Plan to the Department and a revised SMP application to DRE. Both the Extraction Plan and SMP would need to be approved prior to any extraction of Longwall 6.

The Department is aware that if the determination of the UEP extends beyond early 2015, then it is unlikely that Wollongong Coal would be in the financial position to continue operating the mine.

3. STRATEGIC CONTEXT

3.1 Economic Importance of Mining in the Illawarra

The Southern Coalfield is a major source of high quality hard coking coal used for production of steel, both in Australia and internationally. The unique nature of this hard coking coal resource within NSW makes it a very important contributor to the local, regional and State economy. The proximity of the Southern Coalfield to the coast and the Port Kembla Coal Terminal is a major factor supporting export of coal from the region. It also supports the BlueScope Steelworks at Port Kembla.

Wollongong Coal owns and operates both the Russell Vale Colliery and the Wongawilli Colliery in the Southern Coalfield. Together they have approval to produce up to 3 Mtpa of ROM coal and directly employ about 600 people.

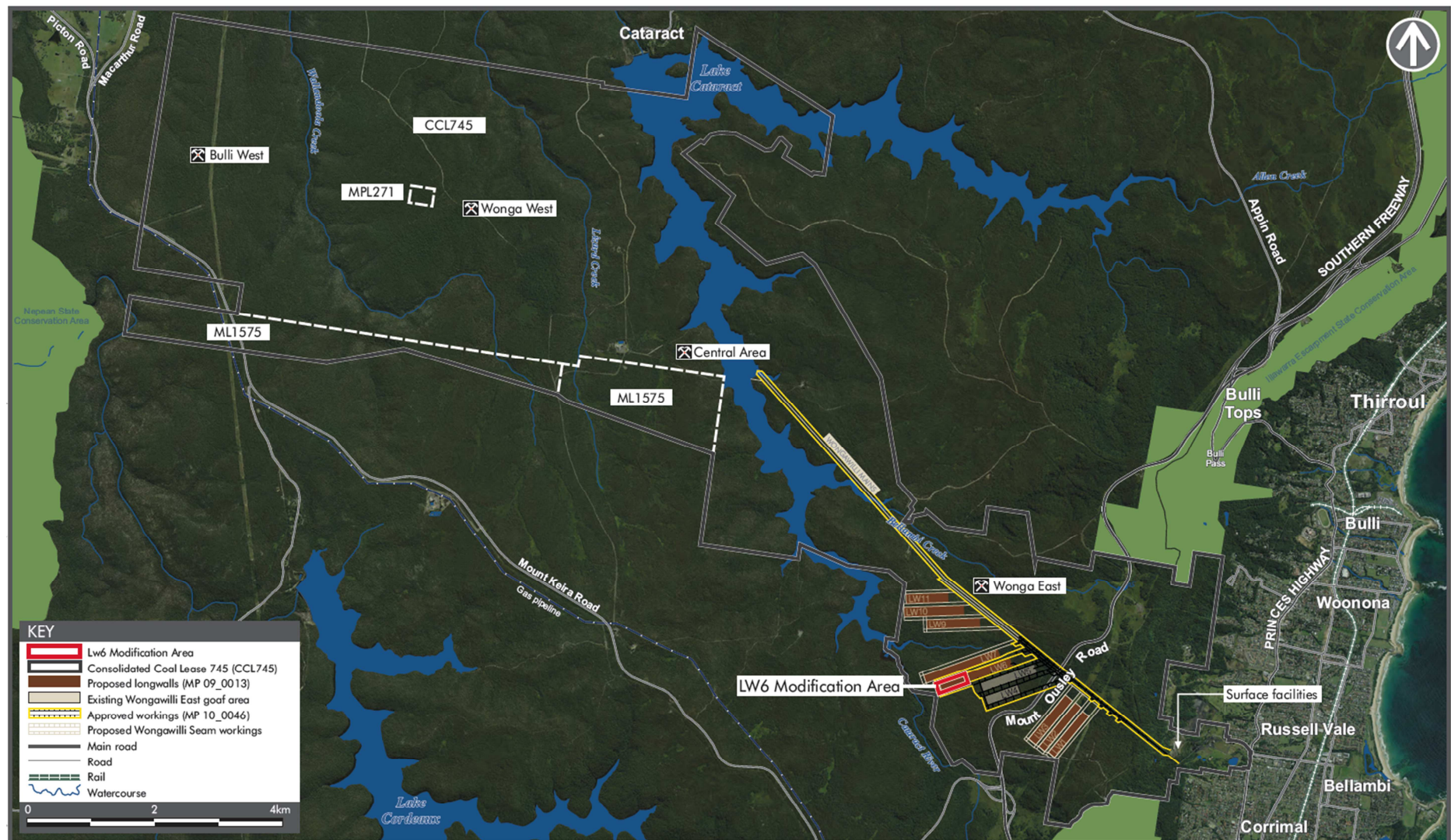


Figure 2: Russell Vale Longwall 6 Modification (marked in red edge) and Underground Expansion Project (marked in brown)

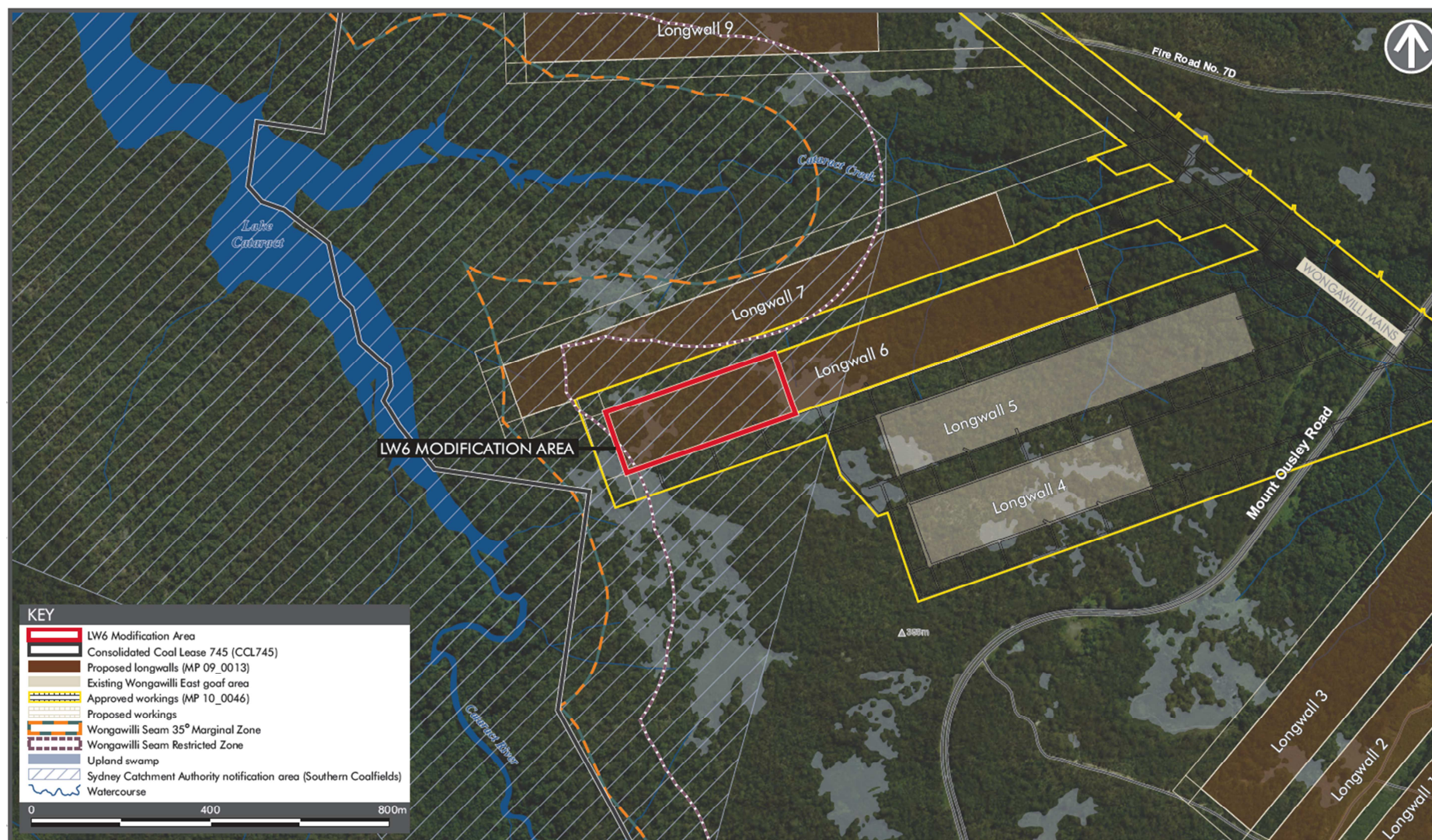


Figure 3: Russell Vale Longwall 6 Modification (marked in red)

The proposed modification would ensure continued employment of approximately 300 persons at Russell Vale Colliery. Wollongong Coal has informed the Department that it wants to mine the first 400 m of Longwall 6 to provide coal production and cash flow and thereby continue to employ existing staff until such time as the assessment of the UEP is complete and the PAC determines the UEP project.

The great majority of Wollongong Coal's employees reside within the Illawarra Region, and the majority of payments to employees, suppliers and contractors are paid into the regional economy. The Department understands that, if the modification application is not approved, the colliery would be placed into care and maintenance, which would lead to significantly reduced staffing and the risk that the site would not be able to recommence mining operations. This may in turn threaten the viability of the Wongawilli Colliery.

3.2 Mining in the Drinking Water Catchment

The current application to mine the first 400 m of Longwall 6 at the Russell Vale Colliery lies within the Dam Safety Committee's (DSC's) Notification Area for Cataract Dam and its stored waters.

In 2013, the then Board of the Sydney Catchment Authority (SCA) adopted a policy position that the SCA would oppose any longwall mining within the DSC Notification Areas. These are areas where the DSC considers and controls the potential impacts of coal and other mining on dam infrastructure and stored waters. As such, they are 'investigation areas' for technical review and regulation of mining and related impacts, rather than areas where mining has been prohibited. For the past 35 years, the DSC has played a significant role in determining the type and extent of coal mining allowed in the vicinity of dams. Any mining that is proposed within a Notification Area is currently required to obtain approval from DSC under provisions of the *Mining Act 1992*.

To date, SCA has provided no research or technical argument to support its position to oppose mining within the Notification Areas. The SCA is also not a determining authority for mining proposals and its policy position is not NSW Government policy. Current Government policy is that mining is permissible in the DSC Notification Areas, subject to consent and DSC approval. In considering whether to grant consent, the consent authority must consider the risk of impacts (eg damage to water-related infrastructure such as dams and storages or water take from the catchment), weigh this up against the potential benefits and decide what is in the public interest.

To examine the matters which led the SCA Board to adopt its position, the Government asked the NSW Chief Scientist and Engineer to consider the impacts of underground mining in the water supply catchments as part of her existing Independent Review of Coal Seam Gas activities in NSW. This report was published in May 2014 and found that:

- water quality issues can largely be managed through treatment works and the current multi-barrier process operated by the SCA and Sydney Water for protecting water quality for Sydney's consumers is sufficient, by and large, to protect water quality no matter the type of adverse impact;
- the current cautious approach by the DSC and other Government agencies appears to be preventing development that could cause obvious disastrous cumulative impact and therefore there is no reason to stop longwall mining immediately;
- however, there is insufficient data available to provide a deep and reliable understanding of the cumulative impacts of mining in the Catchment; and
- more data is required to adequately assess and model potential water quantity losses and their causes, however current activities should proceed while this data is gathered as current impacts are not seeming to affect water quantity in a major way.

The report also recognised the importance of mining in the Southern Coalfield.

3.3 Upland Swamps

In December 2006, the NSW Government established an independent inquiry into underground coal mining in the Southern Coalfield. The Inquiry was established because of concerns held within both Government and the community over existing and potential impacts of underground mining operations on natural features, including upland swamps. In July 2008, the Southern Coalfield Inquiry released a report titled the *Independent Strategic Review of Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield*.

The Southern Coalfield Inquiry examined the impacts and consequences of longwall mining on upland swamps. It noted the lack of robust scientific information that would support a conclusion about the relationship between longwall mining, risk or impact and possible consequences. The Inquiry recommended the additional identification and assessment of the significance of swamps, as well as the establishment of risk management zones to minimise impacts on swamps considered to have special significance.

These recommendations were considered and refined during the PAC's later merit reviews of the Metropolitan Coal Project in 2009 and the Bulli Seam Operations Project in 2011. These reviews used a risk assessment approach for swamps, which involved:

- defining the subsidence impact parameters relevant to individual swamps;
- identifying all swamps in the project areas and characterising them in terms of their biodiversity, topographic and hydrologic features;
- identifying any swamps of special significance based on their conservation value and supported by evidence of substantial size, unusual complexity, contiguous habitat, presence of threatened species, etc;
- assessing the risk of negative environmental consequences for individual swamps; and
- determining the acceptability of negative environmental consequences.

When determining the acceptability of negative environmental consequences, the PAC adopted the standard that swamps of special significance were to be protected from negative environmental consequences. All other swamps should be protected unless the costs of avoidance would be prohibitive and mitigation or remediation options were not reasonable or feasible. In this case, an offset strategy would be developed. However, the PAC reports made it clear that, for mining to proceed in the catchment, some swamps not classified as being of special significance would be impacted.

Since publication of these PAC reports, all upland swamps in the Southern Coalfield have been listed as endangered Ecological Communities (EECs) under both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Department considers that upland swamps should be treated like any other EEC in NSW. There is little (if any) additional utility in the concept of special significance. Therefore, the appropriate approach is that outlined in the Office of Environment & Heritage's (OEHS) recently released *Draft NSW Biodiversity Offset Policy for Major Projects*, which requires avoidance where possible, then minimising, mitigating and remediating (in that order). However, beyond this framework of impact minimisation, it is recognised that trade-offs may be necessary. Where trade-offs are considered necessary, then developers should be required to provide suitable compensatory offsets to compensate for negative environmental consequences.

Within the draft Offset Policy, there is a clear preference for like-for-like offsets. However, the capacity for like-for-like offsets for upland swamps in the Southern Coalfields is very limited, given that the vast majority of swamps are located within conservation reserves or other publicly-owned land. Therefore, the draft Offset Policy makes provision for funding of important supplementary measures such as:

- actions outlined in threatened species recovery programs;
- actions that contribute to threat abatement programs;
- biodiversity research and survey programs; and/or
- rehabilitating degraded habitats.

Under the policy, offsets should be proportional to the level of impact or damage to the swamp that has occurred.

4. STATUTORY CONTEXT

4.1 Section 75W Modification

Following the repeal of Part 3A of the EP&A Act, the approved project is classified as a 'transitional Part 3A project', under Schedule 6A of the Act. The proposed modification must therefore be considered under section 75W of the EP&A Act, despite its repeal in 2011.

The proposed modification would not change the nature of the development subject to the existing project approval (ie an underground coal mine). MOD 2 proposes continued longwall mining along a short length (400 m) of one longwall in the Wonga East area. The Department considers that this is a minor extension of the existing project.

The proposed modification would not increase the currently approved extraction rate. It would use existing surface facilities and lead to no change or increase to the approved trucking of coal. The additional mining would require a relatively short extension of time (ie eight months) beyond the term approved for the existing PWP.

The Department is satisfied that the proposed modification is a minor change to the approved project, and can be readily characterised as a modification to the current approval rather than a new development proposal in its own right. Consequently, the Department is satisfied that the proposed modification may be determined under section 75W of the EP&A Act.

By comparison, the UEP proposes a substantial increase in mining in the Wonga East area, a substantial increase in extraction rate (up to a total of 3 Mtpa), extensive upgrading of surface facilities and increased levels of product coal trucking.

4.2 Approval Authority

The Minister for Planning is the approval authority for the modification application. However, the PAC must determine the application under the Minister's delegation of 14 September 2011, because 25 public submissions in the nature of objections were received.

4.3 Permissibility

The land subject to the modification application is zoned as E2 Environmental Conservation under the *Wollongong Local Environmental Plan 2009* (Wollongong LEP). Under this plan, mining is prohibited within this zone. However, clause 7(1)(a) of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* makes underground mining permissible with consent on any land. Consequently, all aspects of the modification proposal are permissible with development consent. It should be noted that the Wollongong LEP was approved in the knowledge that the Mining SEPP would override its provisions in respect of the E2 zone.

4.4 Environment Protection and Biodiversity Conservation Act 1999

Wollongong Coal has confirmed that it has lodged a referral with the Commonwealth Department of Environment (DOE) under the EPBC Act regarding the modification. Due to the recent listing of Coastal Upland Swamps as 'endangered ecological communities' under the EPBC Act, DOE has requested that Wollongong Coal provide additional information in relation to the potential impacts of the modification on upland swamps prior to DOE making a decision on whether or not the modification is a 'controlled action'. This additional information was provided to the DOE in early August 2014.

If the modification is determined to be a 'controlled action', then Wollongong Coal will need to obtain a separate approval for the modification under the EPBC Act from the Commonwealth DOE.

5. CONSULTATION

In accordance with Section 75H(3) of the EP&A Act, the Department:

- made the EA publicly available from 22 April 2014 until 13 May 2014:
 - on the Department's website,
 - at the Department's Information Centre;
 - at the offices of Wollongong City Council; and
 - at the offices of the Nature Conservation Council;

- notified relevant State government agencies and Wollongong City Council by letter; and
- advertised the exhibition of the EA in the Illawarra Mercury.

The Department received 39 submissions on the proposal; comprising 9 from public authorities, 5 from special interest groups and 23 from the general public.

Of the 28 submissions from special interest groups and the general public, 25 objected to the modification, two made comments on the modification and one supported the modification. A full copy of these submissions is attached in **Appendix B**.

5.1 Key Issues Raised

The key environmental issues raised in submissions from objectors were potential subsidence impacts on natural features (including surface water, groundwater, upland swamps and biodiversity) and built features (including Cataract Reservoir). These concerns are addressed in detail in **Section 6** of this report, with a particular focus on Cataract Creek, two upland swamps and the Cataract Reservoir. Other environmental concerns raised in submissions include potential impacts on air quality and greenhouse gases, noise and traffic. These latter issues are discussed in **Table 3**.

Other regulatory and technical issues relating to Russell Vale (including a perceived piecemeal approach to project development and non-compliances at the mine) were also raised. These matters are not directly related to subsidence and the other environmental impacts of the proposed modification, but have been addressed in **Section 6.7** of this report.

The public submission in support of the modification cited employment and socio-economic benefits in the Wollongong region as key reasons why the modification should be approved.

The number of times that each issue was raised in public objections is shown in **Figure 4**, below.

5.2 Response to Submissions

Wollongong Coal provided a formal Response Submissions (RTS) to the Department for MOD 2 on 4 July 2014 (see **Appendix C**). The RTS addresses the issues raised in submissions, and includes a significant amount of additional information and updated assessment beyond that provided in the EA. In particular, the RTS for MOD 2 includes:

- an updated subsidence assessment, including revised subsidence contours specific to the extraction of the first 400 m of Longwall 6, undertaken by SCT Operations Pty Ltd and dated 18 June 2014;
- revised groundwater modelling and assessments for the UEP and specifically for the Longwall 6 400 m extraction area undertaken by GeoTerra Pty Ltd and Groundwater Exploration Services and dated 19 June 2014;
- geological reports on the Wonga East area and on the Corrimal Fault undertaken by Wollongong Coal and dated May 2014 and June 2014, respectively;
- an updated surface water assessment undertaken by WRM Water & Environment Pty Ltd and dated May 2014; and
- an updated ecological assessment undertaken by Biosis Pty Ltd and dated 20 June 2014.

The Department is aware that the majority of these updated assessments have been prepared as part of the 'residual matters report' for the UEP. They have been relied on by Wollongong Coal to respond to the submissions received on this modification application to the extent that they are relevant to the initial extraction of Longwall 6. Appropriately, the assessments incorporate monitoring information gathered following extraction of Longwalls 4 and 5 and address issues raised by Government agencies and the Department's independent expert reviewers following exhibition of the RTS and PPR for the UEP.

The Department forwarded the RTS to all affected Government agencies. The **Office of Environment and Heritage** (OEH), the **Department of Primary Industries** (DPI) and its component **NSW Office of Water** (NOW), the **Sydney Catchment Authority** (SCA) and **Wollongong City Council** (Council) the provided further comments which outlined their residual concerns. The **Dams Safety Committee** (DSC), the **Environmental Protection Authority** (EPA) and **Roads and Maritime Services** (RMS) did not provide further comments to the Department. A full copy of agency comments on the RTS is included in **Appendix B**.

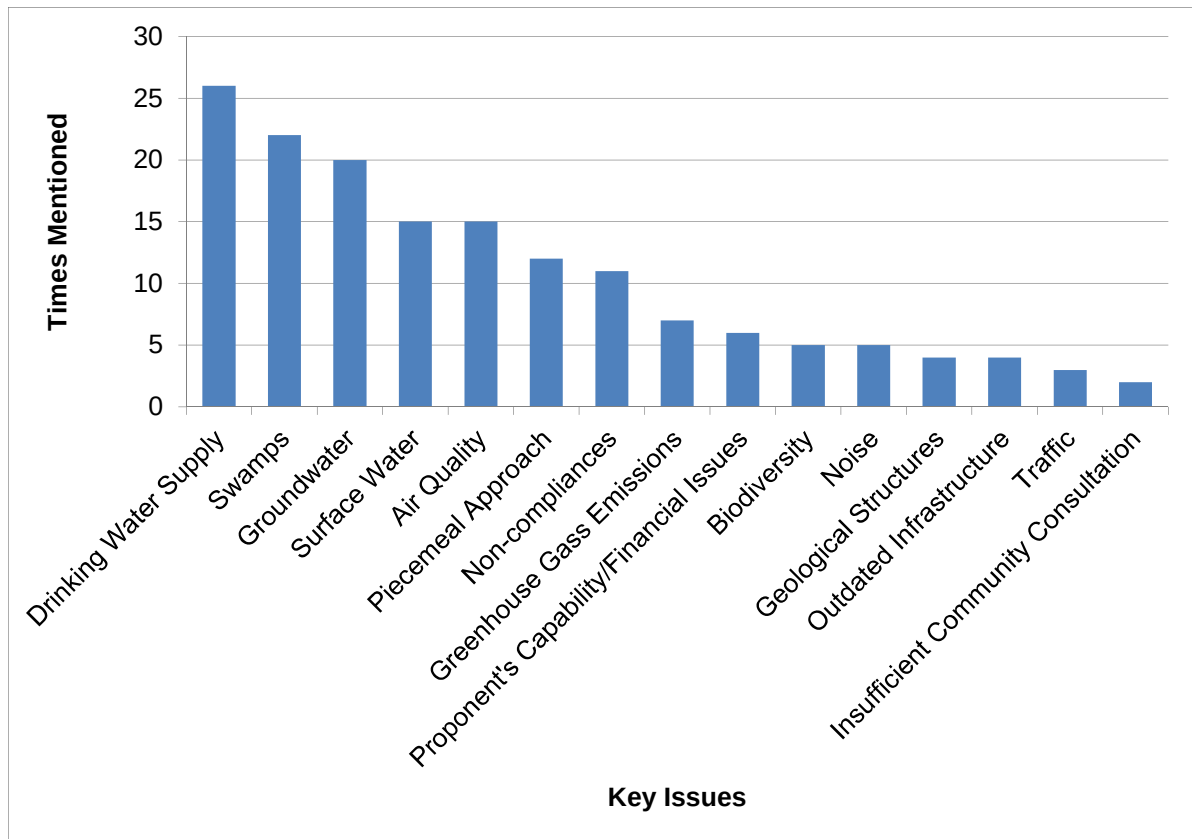


Figure 4: Key Issues Raised in Public Submissions by way of Objection

5.3 Residual Concerns in Agency Submissions

OEH remains concerned about the potential impacts of Longwall 6 on the two overlying upland swamps and believes the mining layout should be amended to avoid impacts to these natural features and associated threatened species habitat. If amendments to the mining layout are not considered feasible, then OEH believes a biodiversity offset strategy, addressing both swamps and threatened species, should be prepared.

SCA objected to the proposal, particularly because it is located in the DSC's Lake Cataract Notification Area (see **Figure 3**). SCA was also concerned over a lack of specificity in the subsidence predictions, incomplete knowledge of geological structures, potential loss of water from Cataract Reservoir and the potential impacts on upland swamps.

NOW has not identified any specific concerns about the potential impacts of the proposed Longwall 6. NOW indicates that the groundwater modelling now satisfies the requirements of the *NSW Aquifer Interference Policy*, but requests that a discrepancy between the groundwater and surface water models over the predicted loss of surface water is clarified. Clarification in relation to this issue is provided in **Section 5.2** of this report.

DSC raised concern about the impact of Longwall 6 on the water security of Cataract Reservoir (ie the potential for leakages) and requested additional information on geological structures and a groundwater model that addresses the possibility of losses from the reservoir. This information was provided in the RTS. Wollongong Coal is separately required to lodge an application with the DSC to mine within the Lake Cataract Notification Area. In line with a request from DSC, the Department has recommended a condition requiring Wollongong Coal to install a borehole between Longwall 6 and the reservoir to investigate and monitor groundwater depressurisation during mining.

DRE raised no concerns but requested that Wollongong Coal is required to continue to implement the subsidence risk management strategies used during the extraction of Longwalls 4 and 5.

RMS raised no concerns, but requested that any technical implications regarding subsidence impacts on roads are referred to the Wollongong Coal - RMS Technical Committee.

EPA indicated that if the modification is approved, it must comply with the *Protection of the Environment Operations Act 1997* and associated regulations and the mine's Environment Protection Licence. The EPA has endorsed the Department's proposed conditions for this modification.

OEH's **Heritage Branch** raised no concerns.

Council remains concerned about the impact of the proposal on upland swamps and holds the view that Longwall 6 should be reoriented to avoid impacts. Council also raised concerns regarding Wollongong Coal's recent non-compliances, which have been addressed in Section 6.7 of this report.

6. ASSESSMENT

The Department notes that this modification relies on a significant amount of assessment information that was undertaken for the UEP (refer to **Section 5.2**). The Department has commissioned independent expert advice to assist with its assessment of the UEP, specifically in relation to:

- subsidence impacts (Dr Bruce Hebblewhite);
- groundwater impacts (Mr Paul Tammetta); and
- surface water impacts (Evans & Peck).

Copies of the expert review reports and responses from Wollongong Coal's specialists are attached at **Appendix D**. The outcome of these reviews has informed the Department's confidence in the predictions for this modification.

6.1 Subsidence

Underground Mining Environment

The proposed modification is considered to be minor. It involves extraction of coal from a 400 m long section of one longwall, known as Longwall 6, in the Wongawilli Seam. Longwall 6 has been designed to minimise the surface and other environmental impacts from subsidence with a narrow panel width (150 m) and large chain pillars (45 m wide). The depth of cover is between 320 and 345 m and the recoverable seam thickness is between 2.6 and 2.8 m with a maximum cutting height of 2.8 m.

Longwall extraction has previously taken place in the overlying Balgownie Seam, and bord and pillar extraction has previously taken place in the uppermost Bulli Seam. Thus the proposed modification involves 'multi-seam' mining, where subsidence impacts from the lowermost mining would add to (and possibly intensify) the subsidence impacts that previously took place as a result of mining in the two higher seams.

Surface Features

As shown in **Figure 5**, Longwall 6 is situated in a highly constrained environment. The Illawarra Escarpment is located not far to the east, an impounded section of the Cataract River is located to the west and Cataract Creek is situated to the north. Longwall 6 is located immediately to the west of one minor tributary to Cataract Creek. The tributary is ephemeral but Cataract Creek has permanent flows to the west, draining directly into Cataract Reservoir. Wollongong Coal has designed the Longwall 6 layout to ensure that none of these watercourses would be directly undermined.

Wollongong Coal has also positioned the longwall to avoid the majority of the large, contiguous swamp systems in the area (see **Figure 5**). The land above the 400 m section of Longwall 6 proposed to be extracted only includes the northern periphery of one large upland swamp (CRUS1) and the western edge of a smaller swamp (CCUS4).

As shown in **Figure 3**, Longwall 6 falls within the DSC's Lake Cataract Notification Area for the Cataract Reservoir. To protect the stored waters of the reservoir, Wollongong Coal has designed the Longwall 6 panel layout to provide a sufficient buffer (ie 375m from the full supply level of the reservoir) between the panel and the reservoir.

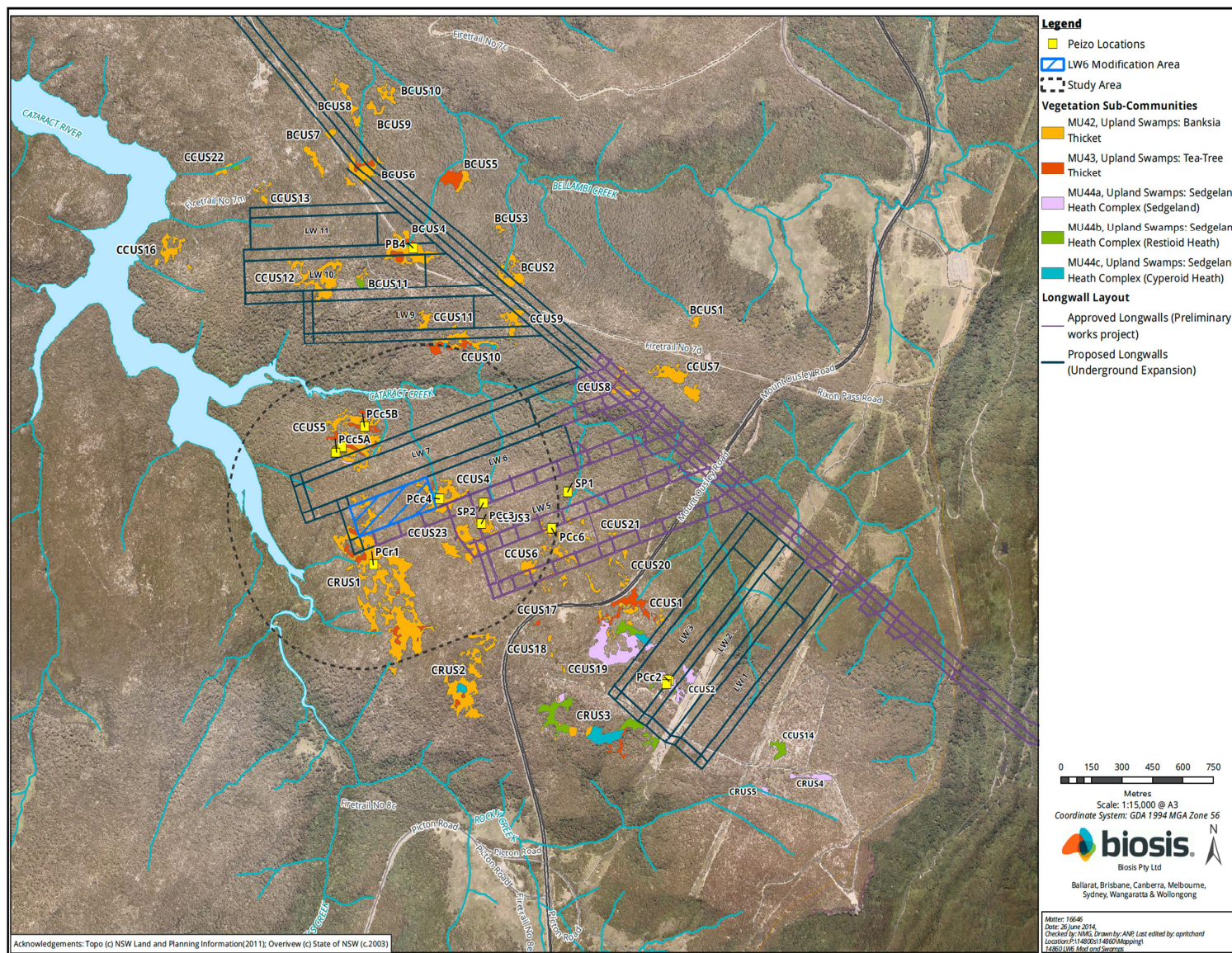


Figure 5: Upland Swamps and Watercourses near Longwall 6 and Wonga East

Longwall 6 is located in an area dominated by native bushland with few other built features. Built features, including Mount Ousley Road and numerous transmission lines, are located at far enough distances from the Longwall 6 to be protected from subsidence related impacts.

The topography over Longwall 6 gently slopes towards the northeast, with altitude varying from a high point of 340 m AHD at the southwestern end of Longwall 6, to a low point of 310 m AHD at the northeastern end.

Subsidence Assessment

SCT Operations Pty Ltd (SCT) prepared a detailed Subsidence Assessment (September 2013) to predict subsidence levels and to assess potential subsidence impacts associated with the preferred UEP. This assessment was updated after the exhibition of the EA for MOD 2 to include subsidence monitoring results to the end of Longwall 5, revision of the valley closure estimates, and identification of a small sandstone cliff formation downstream of swamp CCUS4. The updated Subsidence Assessment (June 2014) was also included in Appendix A of the MOD 2 RTS and summarised in the main body of the RTS to provide predictions relevant to the Longwall 6 modification area.

The updated assessment also addresses recommendations made in Dr Hebblewhite's review of the original UEP Subsidence Assessment. Dr Hebblewhite's review is attached in **Appendix D**. The Department has relied on SCT's updated Subsidence Assessment for its assessment of the modification's potential subsidence impacts.

The Subsidence Assessment's predictions were primarily based on existing monitoring data for the Bulli, Balgownie and Wongawilli Seams, including:

- subsidence profile measures during the 1990s for extraction in the Bulli Seam, with adjustments made based on surface observations for the Balgownie Seam;
- measured subsidence data sourced from the mine archives for the Balgownie Seam; and
- subsidence predictions and measured subsidence profiles for the Wongawilli Seam based on mining in Longwalls 4 and 5.

The Department is satisfied that the approach used by SCT to predict subsidence movements is appropriate and provides a strong basis for predictions in the complex multi-seam environment, particularly considering that actual subsidence data from mining in Longwalls 4 and 5 in the Wongawilli Seam has been used to provide confirmation of behaviours when a third seam is mined. Dr Hebblewhite agrees that the approaches used to predict subsidence are valid and appropriate.

Review of Mining in Longwalls 4 and 5

SCT notes that the monitoring results available for Longwalls 4 and 5 indicate that the subsidence behaviour is predictable, albeit with somewhat different characteristics to subsidence over single seam mining operations. The effect of the overlying goaf areas is to reduce the stiffness and rigidity of the overburden strata, which leads to reduced bridging capacity in these strata and significantly increased maximum subsidence for the same overburden depth and longwall panel geometry.

SCT states that, in previously undisturbed overburden strata, the maximum subsidence above a 150 m wide longwall panel at 300 - 360 m depth would be of the order of 0.1 - 0.3 m, leading to barely perceptible impacts. However, the measured maximum 'sag' subsidence in both Longwall 4 and Longwall 5 has been 1.8 m, due to the 'softening' of the overburden strata by previous mining and consequent reduced bridging capacity (see **Figure 6**).

Although the amount of vertical subsidence associated with multi-seam mining is significantly greater than for single-seam mining, the lateral extent of vertical subsidence is similar (see **Figure 7**). SCT reports that the measured subsidence in Longwalls 4 and 5 did not extend greatly over the adjoining pillars. This is the key outcome of the monitoring data – subsidence is predominantly constrained to within the limits of the surface expression of the longwall panel itself, and is expressed as narrow subsidence troughs which are relatively deep and steep sided.

The Department is satisfied that the subsidence effects associated with extraction of Longwalls 4 and 5 were limited in scale and extent and generally limited to within the footprint of the panels. They are not, in themselves, of concern.

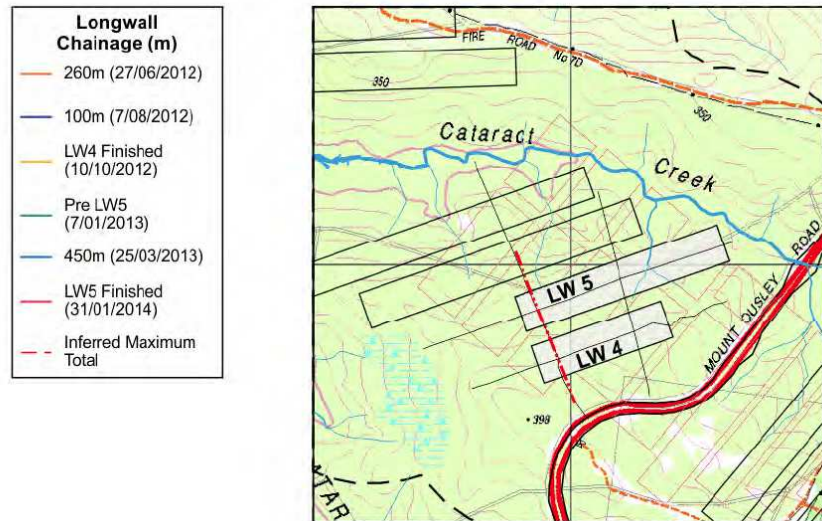
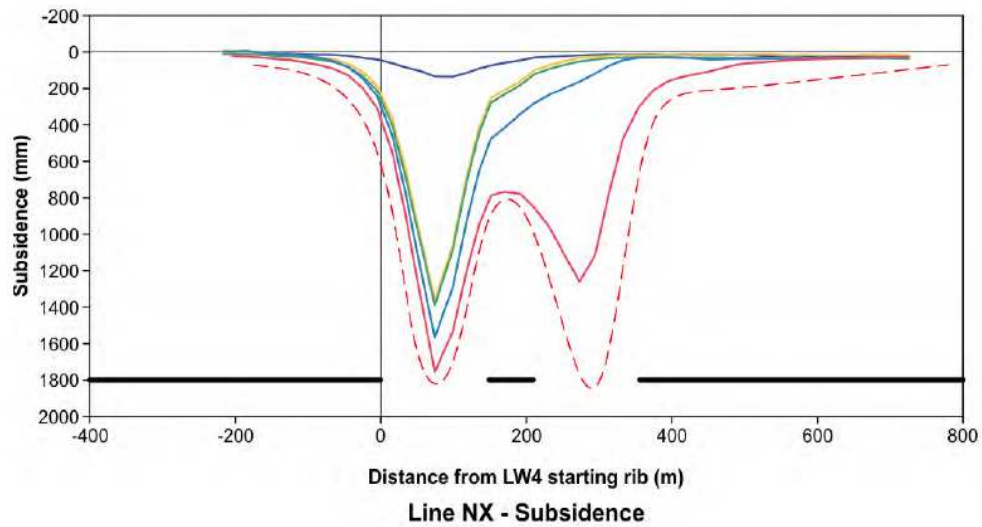


Figure 6: Typical Subsidence Monitoring Results for Longwalls 4 and 5 (Wongawilli Seam)

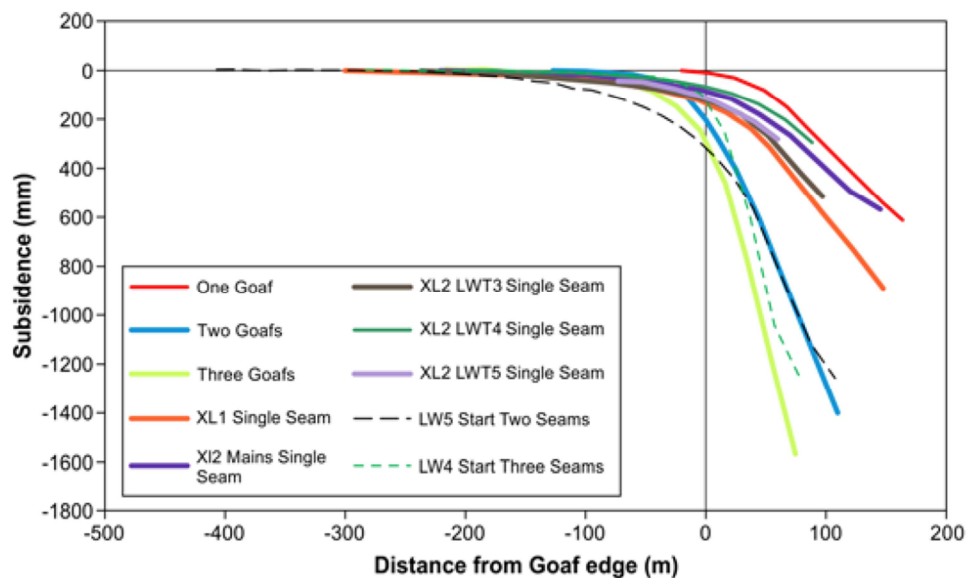


Figure 7: Summary of Goaf Edge Profiles for Multi-Seam Mining

Predicted Subsidence Effects

Table 1 provides a summary of the predicted subsidence effects modelled to occur over Longwalls 4, 5 and 6 and compares these to the actual subsidence measurements taken for Longwall 4 and 5 (included in parentheses). It should be noted that the subsidence predictions for Longwall 6 assume full extraction of Longwall 6 and the adjacent Longwall 7, and therefore overestimate the subsidence impacts of extracting only the first 400 m of Longwall 6.

Table 1: Actual and Predicted Subsidence Measurements

Subsidence Parameter	Longwall Panel		
	Longwall 4	Longwall 5	Longwall 6 (1 st 400m)
Overburden Depth to Wongawilli Seam (m)	300 (min)	265 (min)	320-345
Previous Bulli and Balgownie Seam subsidence (m)	1.9	0.9	1.5
Predicted subsidence for Wongawilli Seam (<i>measured data</i>) (m)	2.1 (1.8)	1.9 (1.8)	2.1
Predicted tilt for Wongawilli Seam (<i>measured data</i>) (mm/m)	35 (30)	36 (16)	38
Predicted tensile strain for Wongawilli Seam (<i>measured data</i>) (mm/m)	10.5 (7.5)	10.8 (6)	11
Predicted compressive strain for Wongawilli Seam (<i>measured data</i>) (mm/m)	21 (14)	22 (12)	23
Predicted maximum valley closure on Cataract Creek (Southern Tributary) (<i>measured data</i>) (mm)	N/A	300 (49)	290

Figure 8 presents the contours for predicted vertical subsidence over the first 400 m of Longwall 6 and the actual subsidence recorded for Longwalls 4 and 5. Maximum subsidence over Longwall 6 within the Wongawilli Seam is predicted to be up to 2.1 m, maximum tilt is predicted to peak at 38 mm/m and maximum strains are predicted to peak at 23 mm/m. These high levels of predicted tilt and strain reflect the relatively deep but narrow and steep-sided subsidence troughs that are expected to develop above the relatively narrow longwalls proposed beneath existing extracted areas (see **Figure 5**). SCT states that, across the majority of the longwall panel, tilts and strains would be significantly less than these maxima, with most tilts anticipated to be in the range of 50-90% of the peak value and most strains anticipated to be in the range of 20-30% of the peak value.

SCT reports that the valley closure estimates presented in **Table 1** were predicted using the ACARP Method, which is based on experience of closure in deep gorges at high stress levels. Monitoring undertaken for Longwall 5 indicates that actual measurements of valley closure are significantly less (see level in parenthesis). Given the undulating topography in the vicinity Longwall 6, SCT advised that significant valley closure along Cataract Creek is unlikely to occur.

Subsidence beyond the goaf edge is predicted to be similar to the subsidence observed during mining of Longwalls 4 and 5. SCT states that vertical movements of >20 mm are expected to be limited to within a distance of 0.7 times the overburden depth from the nearest goaf edge, which is equivalent to an AOD of 35°. This results in a subsidence profile that falls predominantly within the footprint of the panel being mined.

The Subsidence Assessment's conclusions are accepted as reasonable. However, the Department notes that the predictions are made from a relatively small database of observed data and that there is still scope for localised anomalies due to the multi-seam environment, geological structures and other effects in natural systems which are not fully predictable. Consequently, the Extraction Plan for Longwall 6 would need to include detailed monitoring and validation of SCT's predictions.

Subsidence Impacts on Built Features

SCT assessed the potential subsidence impacts on surface features as a result of mining the first 400 m of Longwall 6. In terms of built features located in the general vicinity of Longwall 6 (see **Figure 8**), the Department is satisfied that:

- impacts on Mount Ousley Road are unlikely, given the distance between the road and Longwall 6 (625 m). Minor surface cracking was evident on Mount Ousley Road following extraction of Longwall 4, which is considerably closer to the road than Longwall 6. However, this cracking did not affect the safety or serviceability of the road, and was appropriately managed by NRE in accordance with the conditions of its existing approval; and

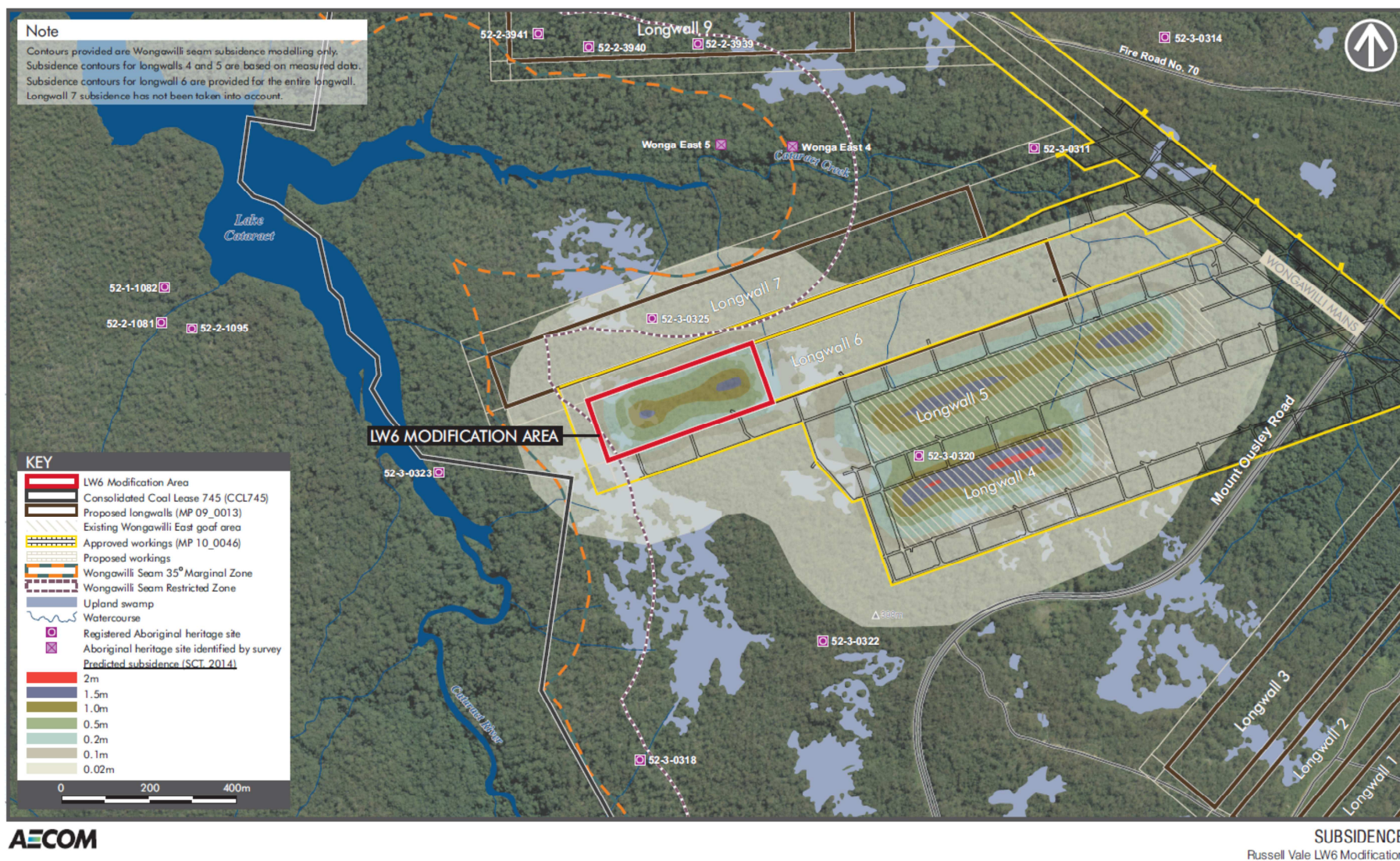


Figure 8: Subsidence Contours from Previous and Proposed Extraction in the Wongawilli Seam

- impacts on the four transmission lines are very unlikely, given the distances between the towers and Longwall 6, with the nearest tower located 1.5 km away.

Dr Hebblewhite supports the conclusion that impacts to these built features are likely to be minimal to negligible. The Department is satisfied that the subsidence impacts of the modification on these built features can be suitably managed to ensure acceptable outcomes via the existing performance measures and an updated Extraction Plan.

Subsidence Impacts on Cataract Reservoir, which is technically a built feature, are discussed in **Section 6.2** below. Subsidence impacts on natural features are discussed in detail in the subsequent sections of this report. This includes impacts on upland swamps (see **Section 6.3**), impacts on Cataract Creek and its associated tributary (see **Section 6.4**) and groundwater (see **Section 6.5**).

6.2 Cataract Reservoir

Numerous submissions, including those from DSC and SCA, raised concerns about whether the setback distance from Longwall 6 to the Cataract Reservoir is sufficient to protect the stored waters of the reservoir. Concerns were also raised about the presence of geological structures, particularly the Corrimall Fault, causing potential hydraulic connectivity between the mine and the reservoir.

Setback Distance

The extreme southwestern corner of the proposed longwall extraction area falls within the 26.5° AOD from the full storage level (FSL) of the reservoir, but is well outside of the 35° AOD (see **Figure 8**). The 35° AOD is the area within which the DSC is unlikely to grant approval for any mining causing subsidence. The 26.5° AOD is the area within which DSC closely examines mining proposals causing subsidence before considering approval. The DSC's purpose is to protect the reliability of water supply and the structural integrity of the reservoir from the potential impacts of mining.

The horizontal distance in the seam from the extracted seam to the point immediately below FSL that is equivalent to a 35° AOD varies according to the overburden depth. For the southwestern extremity of Longwall 6, which has an overburden depth of about 330 m, a 233 m setback from FSL to the surface footprint of Longwall 6 is equivalent to a 35° AOD (or 0.7 times the overburden depth to the coal seam from FSL).

Wollongong Coal has designed the layout of the longwall panel to substantially exceed this setback distance and has confirmed that the closest Longwall 6 goaf is approximately 375 m from the FSL. This is 1.25 times the 300 m overburden depth at the FSL. The Department is satisfied that this provides an AOD well above what is typically required and in itself provides a high level of protection for the stored waters of the reservoir.

However, the DSC and NOW raised concerns about the presence of a Bulli Seam goaf in the barrier between Longwall 6 and the reservoir, which has the potential to reduce the effectiveness of the barrier. A detailed discussion on this topic (with particular reference to proposed Longwall 7) is provided by SCT in the updated SA (see Appendix B of the RTS). This discussion was provided in response to deficiencies identified by Dr Hebblewhite in the original SA.

SCT notes that there are a number of areas where the Bulli Seam has been extracted that are located within the 0.7 times depth protection zone around the FSL allowed for Longwall 7. However, there does not appear to be any direct connection between the reservoir and the mining horizon through these mining areas. SCT notes that, although the presence of Bulli Seam goaf areas may reduce the effectiveness of this 0.7 times depth barrier for mining of Longwall 7, the pathway for seepage from the reservoir to the mine is likely to be predominantly along horizontal shear planes at or just below the level of the valley. As discussed in more detail in the **Section 6.5**, the calculated height of depressurization for Bulli Seam pillar extraction panel is well below the level of any horizontal shear planes capable of interaction with the reservoir.

On this basis, SCT concludes that there is no potential for these existing Bulli Seam goaf areas to significantly reduce the effectiveness of the 0.7 times depth barrier for Longwall 7. The Department considers that the same conclusion must be drawn for Longwall 6, which has a proposed barrier of 1.25 times depth of cover.

Geological Structures

In response to issues raised in submissions, and at the request of the Department, Wollongong Coal undertook additional field inspections and prepared additional reports to investigate the significance of geological structures near the Longwall 6 modification area, as follows:

- *Geological Report on the Wonga East Area* (May 2014); and
- *Geological Report on the Corrimal Fault* (June 2014).

These reports are included in Appendix C of the RTS.

Wollongong Coal states that a significant benefit of previous mining within the Bulli and Balgownie Seams, and the mining of Longwalls 4 and 5 in the Wongawilli Seam, is that the geological structures in the area are now well understood and defined. SCT believes that the level of information available on geological structures in the vicinity of the modification area is far in excess of the detail that is usually available and more than adequate to confirm potential impacts.

The Corrimal Fault is the only known significant geological structure located in the vicinity of Longwall 6 that could influence potential hydraulic connectivity between the mine workings and the reservoir.

The geological reports include results from reviews of historic mine geological surveys, detailed Lidar topographic data at 1 m contour intervals and aerial photography. The reports also provide results of recent ground-truthing traverses, which were undertaken at the request of the Department to provide additional information on the likelihood of the fault extending further to the northwest of Longwalls 6 and 7. The surveys were undertaken along the known and predicted alignment of the fault, extending in a north-westerly direction to both the eastern and western banks of the Cataract Reservoir.

As shown in **Figure 9a**, the Corrimal Fault extends some 3000 m in a northwest-southeast orientation in the southern part of the Wonga East area. The fault was first intersected in the Wongawilli Seam during the development of Maingate 5 and again during the development of Maingate 6. Wollongong Coal reports that, in the vicinity of Maingate 5 the fault was a single, tight structure with a displacement of 1.8 m to 0.35 m decreasing to the northwest. Near Maingate 6 the fault fragments into several small-scale faults of an erratic character, which are considered to be characteristics typical of a terminating fault structure. Wollongong Coal anticipates that the fault would continue to decrease and terminate within about 500 m from Maingate 6, as shown in **Figure 9b**.

More information about the northwestern extent of the fault would be available when (or if) the maingates for Longwall 7 are driven. However, Wollongong Coal and SCT consider that hydraulic conductivity between the mine workings and the reservoir via the Corrimal Fault is unlikely given that:

- the fault is fragmented in the vicinity of Longwall 6 and likely to terminate part way through Longwall 7;
- ground movements associated with previous mining in the Bulli and Wongawilli Seams do not appear to have resulted in any hydraulic connectivity with the reservoir;
- no surface expression of the Corrimal Fault was found during the ground-truthing traverses to the northwest of the existing fault alignment (including on the banks of the reservoir); and
- no water make was observed from the fault plane in the overlying Bulli and Balgownie Seam workings, and no water make has been observed in the Wongawilli Seam workings to date.

Wollongong Coal and SCT also believe that reactivation along the fault plane as a result of subsidence and goaf formation is unlikely, given that the recent extraction of Longwalls 4 and 5, which was 140 m away from the fault plane, has not resulted in evidence of reactivation of the fault. The Department accepts that the existing information provides a high level of confidence that the Corrimal Fault peters out in the vicinity of the proposed Longwall 7, and that a hydraulic connection between the fault and Cataract Reservoir is unlikely.

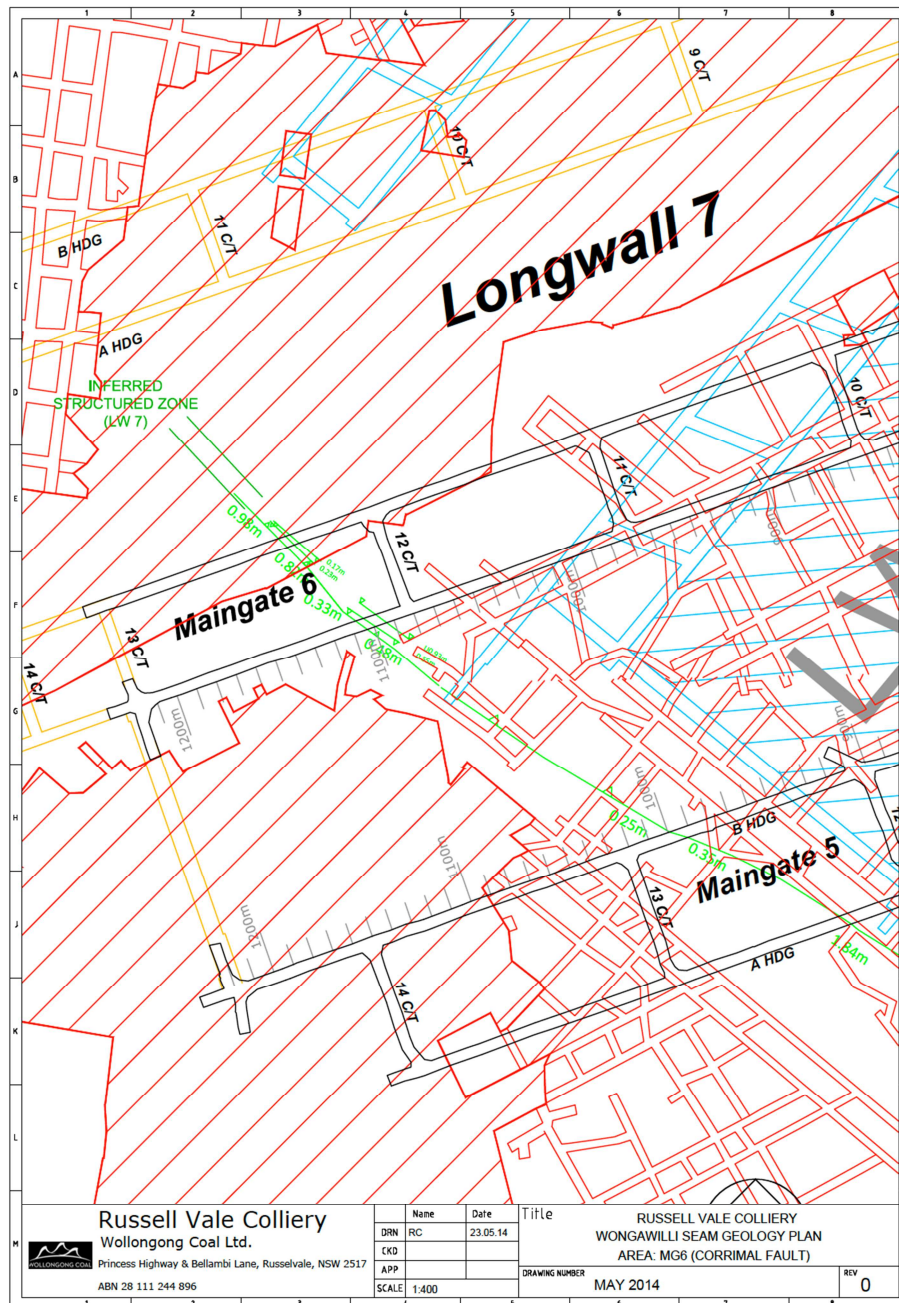


Figure 9b: Corrimal Fault in the vicinity of the modification area

6.3 Upland Swamps

Biosis Pty Ltd (Biosis) prepared a comprehensive swamp impact assessment (Biosis, 2012b) for all upland swamps within Wollongong Coal's UEP area, including upland swamps located in the vicinity of Longwall 6 (see Appendix G of the UEP EA). This report involved the use of LiDAR (Light Detection and Ranging) data to identify upland swamps and detailed ground-truthing and mapping of all vegetation sub-communities within the upland swamps. The Biosis report also draws on baseline monitoring of several upland swamps, which has been undertaken since Autumn 2011. OEH and SCA have commented on the good quality of the Biosis report, and the Department considers it to be the most comprehensive swamp impact assessment yet undertaken in the Southern Coalfield.

Additional field inspections, which have been conducted since the original Biosis assessment, have identified the presence of small waterfalls at two of the swamps that were not apparent in the original LiDAR surveys. In light of this, Biosis updated the original swamp impact assessment contained in the EA. The revised assessment is included at Appendix F of the RTS.

Avoidance

It is important to recognise that Wollongong Coal has committed to avoid and significantly minimise impacts to upland swamps as a result of major changes to the broader UEP project. These changes have included removing all of Wonga West from the current project application and re-orientating some previously proposed longwalls in the Wonga East area to avoid and minimise impacts. The revised mine plan would result in reducing the number of swamps potentially impacted from 39 to 13. Of the 13 swamps within the Wonga East area, Biosis indicated that there is a low risk of potential subsidence impacts to 11 swamps.

This conclusion was supported by Evans & Peck (January, 2014 – see **Appendix D**), who were engaged by the Department to undertake an independent expert review of the surface water issues associated with the UEP, including a detailed review of Biosis's original swamp impact assessment (2012b). Both specialists agreed that only two swamps had a greater than low risk of potential subsidence impacts.

One of these swamps, known as CCUS4, is located on the western edge of the initial section of Longwall 6. As discussed in detail in the following sections, this swamp is predicted to have a high risk of impact from subsidence related effects. Extraction of Longwall 6 is predicted to lead to a low risk of impact of the only other swamp (CRUS1) in the vicinity of the modification area.

The Department is satisfied that Wollongong Coal has made major changes to its original UEP to avoid a significant number of upland swamps, and accepts that it is not possible to economically lay out the remaining longwall panels out to avoid all swamps.

Historic Mining Impacts to Swamps

It is also important to note that the majority of swamps in the Wonga East area have been subject to previous subsidence impacts associated with mining of the Bulli and Balgownie Seams. Previous mining has resulted in compressive strains ranging from 0.9 to 21.4 mm/m and tensile strains ranging from 0.4 to 10.7 mm/m. SCT indicates that, when strains are greater than about 1 - 2 mm/m in tension and 2 - 3 mm/m in compression, perceptible fracturing of the sandstone strata below swamps is expected, which would result in short term loss of piezometric pressure resulting from rainfall within some swamps. The magnitude of tilts and strains from previous mining are therefore likely to have already resulted in some fracturing of the bedrock beneath the upland swamps.

Despite this likelihood, Biosis states that the majority of upland swamps in the Wonga East area are thriving, both in terms of the health of their vegetation communities and baseflows. SCT and Biosis therefore suggest that the drop in near-surface piezometric pressure recently observed following undermining of other swamps in the Southern Coalfield may not have a significant impact on their long-term health. The Department notes this position. It also notes the position is based on a very limited database, and can at best be characterised as a preliminary conjecture. Significant research would be required to substantiate this position.

The Biosis assessment also provides a summary of additional data available following recent mining at Wongawilli Colliery, as well as data from the extraction of Longwalls 4 and 5. Monitoring results from extraction of Longwalls 11, 12, 19 and 20 at Wongawilli Colliery indicate that, despite measured tilts of up to 6.8 mm/m, no observable adverse impacts to groundwater level variability or vegetation within the four overlying swamps have been observed. Similarly, the recent extraction of Longwalls 4 and 5, which undermined swamps CCUS3 and CCUS6 (see **Figure 5**), has not resulted in any observable adverse impacts, despite the high levels of tilt and strain.

The Department accepts that predicting impacts on swamps is complex, particularly in relation to changes brought about by multi-seam mining, and that it is still unclear how sensitive swamps are to mining subsidence. There is currently an incomplete data set regarding short-term, medium-term, long-term and catastrophic impacts on swamps by longwall mining in the Southern Coalfield. There is also a lack of data on which to draw quantitative conclusions regarding the nature and degree of impact of the two previous episodes of undermining beneath CRUS1 and CCUS4.

However, there appears to be no evidence of large-scale loss of or impacts on upland swamps undermined by the relatively narrow longwalls which have been employed at either Russell Vale or Wongawilli Colliery. Further, the current condition of CRUS1 and CCUS4, following two previous subsidence episodes (one of which involved longwall panels of 185 m width at a depth of cover of 260 m), appears to be much better and more resilient than some observers might have predicted.

A visit by Departmental and other agency officers in May 2014 showed reasonable outflow from the downstream neck of CCUS4 over a rock shelf and small waterfall (see **Photo 1**) and general good health in the swamp vegetation (see **Photo 2**). A very substantial but aged tensional crack (20 - 30 cm in width and several metres in depth) in a rock shelf at the edge of the valley to the northwest of this swamp was also seen. This crack probably resulted from longwall mining in the Balgownie Seam in 1980-82. Thus, the significant scale of previous impacts (see also **Table 1**) and the current resilience of the swamp, including its surface water discharge, were both observed.

Potential Mining Impacts to Swamps

The first 400 m of Longwall 6 underlies the northern limits of one large upland swamp (CRUS1, total area of 9.84 ha) and the northwestern arm of a smaller swamp (CCUS4, total area of 1.8 ha) (see **Figure 5**). The area of each swamp to be directly undermined is about 0.57 ha (5.8%) in the case of CRUS1 and 0.38 ha (21%) in the case of CCUS4. Based on the subsidence assessment above, it is reasonable to conclude that the likelihood of direct impacts to these swamps would be limited to the area directly undermined.

Biosis states that potential impacts to these swamps would primarily result from:

- fracturing of bedrock beneath the swamps, resulting in increased porosity and permeability, with potential for surface waters to drain into deeper sandstone strata;
- tilting in upland swamps resulting in the redistribution of perched water levels and surface runoff, and potential scouring and erosion; and
- changes in baseflow discharges.



Photo 1: Sandstone cliff downstream of Swamp CCUS4, showing surface drainage from the downstream neck of the swamp



Photo 2: Swamp CCUS4, showing Tea-Tree Thicket and a small Sedgeland Community

Biosis provided an overall assessment of the potential for impact to occur to the affected areas of swamp, based on the updated subsidence predictions and groundwater modelling results, as well as revised flow accumulation modelling. The risk assessment identified CCUS4 as having a high risk of negative environmental impacts and CRUS1 as having a low risk of negative environmental impacts. A summary of this assessment is provided in **Table 2**.

Biosis notes that the risk ranking for swamp CCUS4 was increased from a 'moderate' ranking in the original assessment to a 'high' ranking in the updated assessment based on the identification of a sandstone small cliff formation with overhang, which forms a small waterfall at the downstream limit of this arm of the swamp (see **Photo 1**). The small cliff is approximately 110 m in length, and tapers in height from rocky outcrops at either end to a maximum height at the watercourse of about 7.1 m. The waterfall drains into the 1st order tributary of Cataract Creek. There is evidence of impacts from previous undermining, including the partial collapse of a nearby 20 m section of the overhang and the tensional crack noted above.

Table 2: Risk Assessment for Upland Swamps Potentially Impacted by Longwall 6

Swamp (direct undermining)	Groundwater	Flow Accumulation	Compressive Tilts and Strains	Final (Highest) Risk Ranking
CCUS4 (0.38 ha)	Moderate	Low	High	High
CRUS1 (0.57 ha)	Low	Low	Low	Low

SCT states that subsidence is expected to cause further impacts to the area of CCUS4 underlying Longwall 6, including possible rock falls, cracking of the sandstone bedrock base of the swamp and surface water diversions. Biosis considers that, as this sandstone formation forms a rockbar at the downstream extent of CCUS4, any further fracturing is likely to result in changes in swamp hydrology, including water holding capacity. The Department agrees, while noting that the swamp currently discharges surface water at the rockshelf and waterfall, notwithstanding undermining by the Balgownie Seam longwalls in 1980-82.

Biosis assessed swamp CRUS1 as having a 'low' risk of negative environmental consequences, primarily because the risk of subsidence impacts would be confined to a very small portion of the swamp (ie a maximum of 5.8%). The Department accepts this assessment, given that the great majority of the swamp is unlikely to be subject to any subsidence impacts, and the swamp has been previously undermined in any case.

Performance Measures

OEH considers that the proposed extraction of Longwall 6 may not meet the existing performance measure included in the project approval of 'negligible environmental consequences' for swamps CRUS1 and CCUS4. Consequently, OEH proposed that Wollongong Coal should prepare a biodiversity offset strategy for the modification in the expectation that this performance measure would not be met.

The Department accepts Biosis's conclusion that there is a low risk of potential impacts on swamp CRUS1 from extraction of Longwall 6, particularly considering that only a very small area (ie 5.8%) of the swamp would be undermined, and believes that the existing performance measure of 'negligible' remains appropriate for swamp CRUS1. However, the Department accepts that Wollongong Coal may not achieve the existing performance measure of 'negligible' in relation to swamp CCUS4.

The key questions are whether swamp CCUS4 should be subject to a performance measure, at what level it should be set, and for what level of impact Wollongong Coal should be required to provide an offset. Performance measures should be set at a level which is likely to be achievable by the project as approved. It is inappropriate that performance measures are set which are not able to be achieved, or that are unlikely to be achieved. Given the existing multi-seam mining, and the uncertainty associated with impacts on the CCUS4 rockbar, the precise level of impact to swamp CCUS4 from the extraction of Longwall 6 cannot be predicted. Thus a performance measure may not be the best way to manage impacts which may be construed as 'likely to occur but uncertain in expected extent and significance'.

The Department also has concerns about requiring an offset for impacts greater than 'nil', or even 'negligible'. OEH's draft Biodiversity Offset Policy only deals directly with offsetting impacts which are total (ie complete clearing), rather than partial. The Department firmly considers that offsets should be directly proportional to the level or degree of impact or damage that has occurred, and that a total offset (ie hectare for hectare) is not appropriate in the case of partial impacts. Offsetting a 'negligible' impact also seems inconsistent with the spirit or intent of the draft Offset Policy.

In considering the appropriate management regime for swamp CCUS4, the Department has taken a number of factors into account, including:

- the substantial avoidance measures previously adopted by Wollongong Coal;
- the swamp has been undermined and subsided on two occasions previously, and so cannot be considered as 'pristine';
- notwithstanding these previous impacts, the swamp is presently in good condition;
- the great majority of the swamp would not be undermined;
- subsidence impacts are likely to be confined to the direct footprint of Longwall 6, and total not more than 0.38 ha.

On this basis, the Department considers that the approval should contain a trigger (rather than a performance measure) which requires a proportional offset for impacts on CCUS4, where those impacts are greater than 'minor' environmental consequences.

The Department's February 2013 approval of the Area 3B SMP for Dendrobium Coal Mine includes two different performance measures controlling impacts on various upland swamps. Seven swamps were subject to a standard of 'minor environmental consequences' expressed in the following terms:

- *negligible* erosion of the surface of the swamps;
- *minor* changes in the size of the swamps;
- *minor* changes in the ecosystem functionality of the swamp;
- *no significant* change to the composition or distribution of species within the swamp; and
- *maintenance or restoration* of the structural integrity of controlling rockbars.

The Department considers that this is an appropriate level beyond which an offset, which is directly proportional to the impact, should be required to be provided by Wollongong Coal. Wollongong Coal should also be required to comprehensively monitor the swamp to determine any impacts from mining. The Department considers this management regime is consistent with the much larger Dendrobium Area 3B SMP approval and reflects OEH's draft Offset Policy. It also deals appropriately with the uncertainty associated with the level of impact which may occur within CCUS4.

Monitoring and Management

The Department believes that a rigorous monitoring regime and associated Trigger, Action, Response Plan (TARP) is necessary to provide a clear basis to decide whether or not the performance measures and conditions are being met and certainty in determining the appropriate management response to any exceedance.

In this regard, the Department is aware that Wollongong Coal is already monitoring the terrestrial and aquatic ecology of the swamps and has installed 8 piezometers in and near both swamps to measure perched water table levels (see **Figure 10**). The Department and Evans & Peck agree that this monitoring program provides an excellent basis for achieving a better understanding of the hydrology of headwater swamps in the area. However, Evans & Peck also recommended that additional monitoring and analysis activities should include:

- establishing piezometers at the upslope end and downslope end of some swamps in order to understand the down-slope movement of shallow groundwater;
- adding two flow monitoring points to swamps in which pairs of piezometers (upslope and downslope) are to be installed;
- monthly review of the water balance of each monitored swamp based on recorded rainfall, estimated evapotranspiration and recorded water levels and outflow measurements; and
- characterisation of soils within the swamps to determine:
 - porosity;
 - a basis for relating piezometer water levels to rainfall and evapotranspiration; and
 - the presence, or absence, of clay materials at the interface with the underlying sandstone which could mitigate water loss from the swamp to the underlying sandstone in the event that subsidence-induced cracking of the sandstone occurred.

The Department agrees that this monitoring would be sufficient to determine if performance measures are being met and would provide valuable information on the magnitude of any medium to long-term impact to swamps from mining. The monitoring would also significantly enhance the body of knowledge relating to the hydrology of headwater swamps, their role in sustaining different vegetation communities and providing baseflow to creek systems.

Consequently, the Department has recommended that this monitoring regime apply to swamp CCUS4 and be included in the updated Extraction Plan required prior to commencement of mining in Longwall 6. Wollongong Coal has already moved to install this additional monitoring. A further 7 piezometers are currently being installed in this area (see **Figure 10**).

The Department is satisfied that the TARP for upland swamps included in the existing Biodiversity Management Plan component of the Extraction Plan for Longwall 5 is comprehensive and can be readily extended for Longwall 6.

Offsets

The Department notes that the existing conditions of approval require Wollongong Coal to provide a suitable offset if the subsidence impact performance measures for swamps are exceeded and remediation is not possible or is not effective. As discussed above, the Department has also recommended a condition requiring Wollongong Coal to offset any impacts to swamp CCUS4 which are greater than 'minor environmental consequences'.

The Department agrees with Evans & Peck that there is little evidence to date of successful remediation of significant impacts to upland swamps and that impacts from extensive remediation works may be worse than the environmental benefits that result. As mentioned previously, the Department is also aware that like-for-like offsets for upland swamps in the Southern Coalfields are very limited given that the great majority of swamps are located on publicly-owned land.

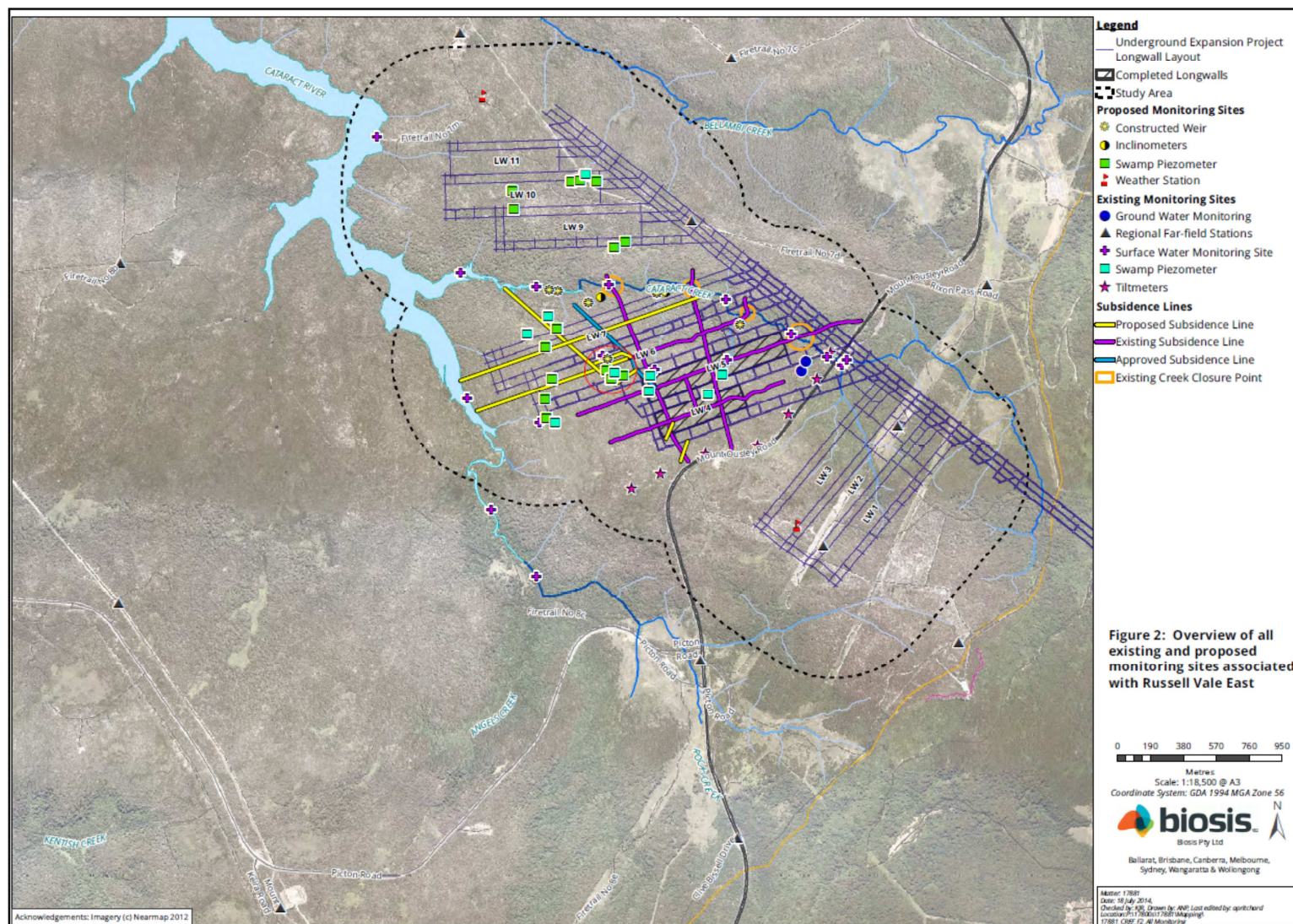


Figure 10: Existing and Proposed Monitoring Sites (Swamp CCUS4 sites shown in red circle)

As discussed above, the Department considers that offsets should be directly proportional to the level of impact, and while giving preference to like-for-like physical offsets, conditions of approval should also (in line with the draft Offset Policy) allow for offsets to include funding of supplementary measures such as:

- actions outlined in threatened species recovery programs;
- actions that contribute to threat abatement programs;
- biodiversity research and survey programs; and/or
- rehabilitating degraded habitat.

The Department has recommended that the existing conditions of approval are updated to reflect these options.

Conclusion

Extraction of the first 400 m of Longwall 6 has the potential to impact on two upland swamps. There is general agreement that there are low risks of potential impacts on swamp CRUS1 considering that only a very small area (ie <6%) of the swamp would be undermined. However, there is considered to be a higher risk of impact to swamp CCUS4 due to potential fracturing of a small sandstone cliff at the downstream neck of the swamp that may result in changes in hydrology and the water-holding capacity of a limited area of the swamp (probably not exceeding 0.4 ha).

It is generally accepted that predicting subsidence impacts on swamps is complex, particularly in relation to changes brought about by multi-seam mining, and that it is still unclear how sensitive swamps are to mining subsidence. Both swamps located above and adjacent to Longwall 6 have been previously subject to significant tilts and strains from mining of the Bulli and Balgownie Seams, and yet both swamps appear to contain healthy vegetation communities and baseflows.

The Department accepts that the potential for impacts to swamp CRUS1 is low and recommends that the existing performance measure of 'negligible' remains. However, given that swamp CCUS4 has already been impacted by mining and that only a small percentage (or area) of the swamp is likely to be impacted, and the extensive avoidance and minimisation measures already undertaken by Wollongong Coal, the Department recommends that it is subject to a condition triggering offsets where impacts cause greater than 'minor environmental consequences', which are defined as:

- *negligible* erosion of the surface of the swamps;
- *minor* changes in the size of the swamps;
- *minor* changes in the ecosystem functionality of the swamp;
- *no significant* change to the composition or distribution of species within the swamp; and
- *maintenance or restoration* of the structural integrity of controlling rockbars.

While Wollongong Coal has already installed a substantial monitoring regime in and around the two swamps, the Department has recommended additional monitoring to provide a more comprehensive information base and to determine with certainty whether the performance measures and/or offset conditions are being met. If performance measures and/or offset conditions are exceeded, Wollongong Coal would be required to provide an offset. Given that like-for-like offsets are generally not available, the Department has recommended alternative offsetting options which are consistent with those for other recently-approved mining projects.

6.4 Surface Water

Surface Water Environment

The Longwall 6 modification area is located in the Lake Cataract catchment. The catchment in the study area is predominantly drained by Cataract Creek, and to a much lesser degree, by the Cataract River. Cataract Creek has permanent flows to the west, draining directly into Cataract Reservoir. As shown in **Figure 8**, the proposed Longwall 6 panel does not underlie either the Cataract River or Cataract Creek. However, a small 1st order tributary to Cataract Creek, which drains swamp CCUS4, is located immediately to the east and north of the modification area.

The modification area is part of Metropolitan Sydney's potable water supply catchment and is managed by the SCA with the aim of protecting water quantity and quality. Longwall 6 also falls within the DSC's Lake Cataract Notification Area for the Cataract Reservoir. As such, Wollongong Coal is required to lodge a separate application with the DSC to mine within the Notification Area.

Surface Water Assessments

The EA includes a Surface Water Modelling Assessment prepared by WRM Water & Environment Pty Ltd (WRM) (November 2012) to describe the catchment and streams potentially impacted by mining associated with the preferred UEP, and to model the relative contributions of potentially affected and unaffected parts of the catchment to the reservoir. The EA also includes a Stream Assessment undertaken by GeoTerra (November 2012) and a Water Management Report undertaken by Beca Pty Ltd. These surface water specialist reports are included in Appendix E of the EA.

An updated Surface Water Modelling Assessment (WRM, May 2014) is included as Appendix E of the RTS. The updated assessment includes additional modelling undertaken to assess the potential of subsidence cracking in tributaries on the streamflow in Cataract Creek in the context of the full period of available climate data. The surface water impacts relevant to the Longwall 6 modification area are summarised in the main body of the RTS.

The Department is satisfied that there is a significant quantity of available surface water information, which is more than sufficient to assess the impacts of the proposed modification.

Potential Impacts

Potential impacts to surface waters in the vicinity of the Longwall 6 modification area would primarily result from:

- valley closure and stream bed cracking altering stream hydrology in Cataract Creek and the 1st order tributary near the mining area; and
- increased connectivity between the surface and groundwater systems resulting in loss of baseflow to creeks and tributaries.

Valley Closure and Stream Bed Cracking

Cataract Creek is a relatively steep watercourse, particularly in its headwaters, and flows to the reservoir through a series of short pools, rock bars and boulder fields. While the creek lies within a plateau of Hawkesbury Sandstone, the stream itself does not have a bed of Hawkesbury Sandstone. GeoTerra reports that the section of the creek closest to Longwall 6 has eroded through the Hawkesbury Sandstone and sequentially through a number of underlying geological strata (the Newport and Garie Formations and the Bald Hill Claystone) and into the uppermost layers of the Bulgo Sandstone. This downstream section of the creek has a much lower gradient and comprises interspersed incised channels in sandy clay colluvium and cobble/boulder constrained pools and rock bars in the exposed Bulgo Sandstone. Thus the bed and substrate of Cataract Creek is fundamentally different to many streams in the Southern Coalfield which have shown significant subsidence impacts from mining (eg Waratah Rivulet).

Longwall mining beneath or close to streams in the Southern Coalfield where the streambed is composed of Hawkesbury Sandstone commonly causes streambed cracking and potential environmental consequences such as the draining of pools, loss of surface flows through the bed of the stream, iron staining, opacity and water quality deterioration.

While Cataract Creek has also previously been partially undermined by longwall mining in the Balgownie Seam and bord and pillar and pillar extraction workings in the Bulli Seam, very little evidence has been found of existing stream bed cracking, and there is no apparent evidence of flow loss or adverse effects on pool levels. Similarly, detailed observations by Wollongong Coal and its consultants have revealed no evidence that the extraction of the Wongawilli Seam associated with Longwalls 4 and 5 has caused any subsidence impacts on the creek.

Cataract Creek does not appear therefore to have been impacted by previous mining in the same way as rock strata in streambeds located on Hawkesbury Sandstone. SCT believes that the Bulgo Sandstone in the bed of Cataract Creek does not react to compressive strains in the same way as the Hawkesbury Sandstone. The Southern Coalfield Inquiry reported that there are substantial directional horizontal stresses present in the Southern Coalfield. Highly competent (ie massive and strong) geological strata (such as the Hawkesbury Sandstone) carry the load of these stresses and resist stress relief. Strata that are less strong (such as claystones and the relatively soft Bulgo Sandstone) deform more easily to release these horizontal stresses. Thus, valleys which cut through the Hawkesbury Sandstone into the softer underlying rocks represent a natural opportunity for gradual stress relief over geologic time. Subsidence of the valley therefore does not act as a trigger to relieve

regional horizontal stresses. On this basis, SCT states that valley closure (or horizontal movement in a downslope direction) appears to be concentrated on a horizon at the bottom of the overlying Hawkesbury Sandstone, which in this case, is above the level of the creek channel. The Department accepts that this is the most likely explanation of the limited subsidence impacts on Cataract Creek.

SCT states that the valley closure estimates presented in **Table 1** are predicted using the ACARP Method, which bases predictions on experience of closure in deep gorges at high stress levels. Monitoring undertaken for Longwall 5 indicates that actual measurements of valley closure are 40% less than predicted using this method (see **Table 1**). Given the undulating topography in the vicinity of Longwall 6 and the relatively large distance between the extraction area and the creek (>300 m), SCT states that the modification is unlikely to cause significant valley closure along Cataract Creek.

However, given the relative proximity of the 1st order tributary east and north of Longwall 6, there is a risk of subsidence impacts such as minor stream bed cracking, diversion of stream flow and minor reduction in pool holding capacity. The magnitude of these baseflow losses is discussed below.

SCT reports that only the southern end of Longwall 6 is located below the slopes that lead down to Cataract River and that as a result only very low levels of valley closure are expected across Cataract River from mining in Longwall 6. The maximum valley closure indicated by the ACARP method is approximately 30 mm, which SCT states would have no perceptible impact on Cataract River.

Baseflow losses

In response to issues raised by OEH, the RTS includes estimates of baseflow losses from surface water systems, including potential loss of flow via cracking in the 1st order tributary and possible (but unlikely) losses from valley closure in Cataract Creek. These estimates were undertaken by both GeoTerra (June 2014) and WRM (May 2014) and are included in Appendices D and E of the RTS, respectively.

The WRM estimates used a model of Lake Cataract to investigate the impact that various loss rates from the upstream catchment would have on reservoir yield. This included baseflow losses from Cataract Creek as well as all other individual tributaries within the Wonga East area that drain to the creek. For the 1st order tributary most affected by the Longwall 6 modification area, the WRM model estimated median streamflow losses of 0.03 ML/day and median baseflow losses of 0.09 ML/day. These are very low figures compared with an estimated median flow in Cataract Creek close to the reservoir of 2.54 ML/day and median baseflow of 1.71 ML/day. However, it must be noted that even these figures are very likely to be a substantial over-estimate, since they are based on total loss of both streamflow and baseflow within the entire catchment of this 1st order tributary. On this basis, the model shows that even total loss of streamflow and baseflow contributions throughout this tributary's catchment would have negligible impacts on the water level of Cataract Reservoir.

Geoterra predicts that depressurisation associated with extraction of 400 m of Longwall 6 would reduce baseflows to the connected surface water system by a maximum of 0.0071 ML/day or 2.57 ML/year. Geoterra also predicts minor leakage from the Cataract Reservoir of 0.0009 ML/day or 0.33 ML/year to the underlying groundwater system due to depressurisation of the regional groundwater system (see **Section 5.4** below). GeoTerra states that these modelled losses represent less than 0.01% of the low level, or 0.003% of the full storage capacity of Cataract Reservoir.

DPI raised concerns about the differences between WRM's and Geoterra's estimates of baseflow losses. The Department first notes the two reports have been prepared with different purposes and from a different frame of reference. Whereas the Geoterra report is essentially a predictive report, the WRM model does not seek to make any firm or reliable predictions or estimates. Instead, it uses a pure modelling approach, assessing (for example) how various levels of streamflow loss would impact on reservoir storage volumes. However, it does this in a reasonably blunt fashion, by removing entire catchments from total flow calculations, while nonetheless recognising that 'the likelihood of losing all tributary streamflow to the underground workings via subsidence cracking is very improbable.' It also undertakes this calculation regardless of rainfall intensity and periodicity. The 'additional effect of catchment losses was assumed to be proportionally the same for all flows', ie even storm events and flood flows were assumed to report to the mine workings, rather than to primarily travel overland and down the streambed. Although it presents some useful comparative data, it also presents a number of results that are highly unlikely to eventuate in reality.

Therefore, the Department considers that the GeoTerra assessment presents more realistic predictions and is the more useful report for assessing the actual impacts of the proposed modification.

On this basis, the Department is satisfied that baseflow losses associated with the modification are likely to be very small (ie <3 ML/year) and in line with the minor scale of the mining operations proposed. Even if these losses were to increase by several orders of magnitude, they would still be considered acceptable. Any baseflow losses are expected to report to the surface either further downstream in Cataract Creek, or else directly to the reservoir. Baseflow losses are therefore highly unlikely to result in adverse impacts to Cataract Creek or Cataract Reservoir yields.

Surface Water Licensing

Under the *Water Management Act 2000*, Wollongong Coal is required to hold a surface water access licence for predicted baseflow reductions within the Upper Nepean and Upstream Warragamba Water Source. According to the *Water Sharing Plan for the Greater Metropolitan Region Unregulated Rivers Water Source 2011*, there are 15,540 one-megalitre (ML) unit shares in this water source, which provides sufficient market depth for Wollongong Coal to secure the required 2.9 ML/year water licence. Wollongong Coal currently does not hold any licences for surface water use for the region, but has confirmed that it has commenced negotiations to source this licence.

Monitoring and Management

The Department is satisfied that Wollongong Coal is implementing a comprehensive surface water monitoring regime along both Cataract Creek and Cataract River which includes:

- 2 stream flow monitoring stations along Cataract Creek, which would be designed to monitor changes in stream flow; and
- 10 stream monitoring sites along Cataract Creek, 3 along Cataract Creek tributaries and 4 along Cataract River, which are regularly monitored for stream and pool water levels, flow depths and rates, water quality, channel stability and erosion.

The Department believes an additional monitoring site along the tributary of Cataract Creek located immediately to the east of the proposed extraction area should be established, and has recommended a condition to ensure this occurs.

Wollongong Coal would be required to update its existing Water Management Plan (including its component Surface and Ground Water Impact Response Plan). The Department is satisfied that an updated Water Management Plan, approved prior to the commencement of mining in Longwall 6, would be able to provide an appropriate adaptive management approach to prevent any adverse impacts on Cataract Creek and inform decisions about future mining.

Conclusion

The Department is satisfied that the potential for loss of surface water baseflows as a result of mining the first 400 m of Longwall 6 is very minor and would not result in any significant environmental consequences on Cataract Creek or the stored waters within the Cataract Reservoir. Potential losses of <3 ML/year are considered very small in a water source with a total of 15,540 shares.

The existing conditions of approval include performance measures requiring negligible reduction in the volume of water in Cataract Creek reporting to the Cataract Reservoir. The Department considers the existing condition is sufficient to manage the potential impacts on Cataract Creek and the reservoir from the proposed partial extraction of Longwall 6.

6.5 Groundwater

Groundwater Systems

Groundwater systems within the vicinity of Longwall 6 can be broadly defined as either shallow or deep aquifers. Shallow systems include soils and the underlying weathered bedrock on hill slopes, plateaus and swamps and minor alluvial deposits (primarily associated with Cataract Creek). Deep systems exist within unweathered bedrock and comprise rock strata with a porous matrix (commonly sandstones) sometimes enhanced by fracturing. These two types of groundwater systems are recharged by rainfall and runoff over geologic time.

As discussed in **Sections 6.3** and **6.4** above, the shallow alluvial groundwater systems may be impacted by surface cracking which can cause subsurface creek flow diversions and swamp drying and (if it is associated with connective cracking) can allow surface waters to leak into the mine goaf. Deep systems may be impacted by aquifer depressurisation, groundwater connectivity to mined goaves and to springs on the Illawarra Escarpment to the east.

Deep groundwater aquifers in the Southern Coalfield generally have high levels of salinity and are not very productive or useful for beneficial purposes, indicating low rates of recharge from overlying surface waters. There are very minor productive supplies of groundwater within the Narrabeen Group lithologies, including the Bulgo Sandstone, but these have significantly lower yielding aquifers than the overlying Hawkesbury Sandstone. The Bulgo Sandstone aquifers can contain salinities of up to 1500 mg/L. There are no registered bores within Wollongong Coal's mining lease and no groundwater extraction is conducted in the vicinity of Longwall 6.

Groundwater Assessments

The EA includes a groundwater assessment, which was undertaken by GeoTerra and GES (2012) and a supplementary groundwater assessment, which was undertaken by SCT (2014). Both these reports were prepared as part of the UEP and the EA extrapolated certain predictions and parameters that were considered particularly relevant to the Longwall 6 modification area. These groundwater assessments are included in Appendix D of the MOD 2 EA.

In response to criticisms from several key Government agencies regarding a lack of groundwater information specific to the modification, Wollongong Coal engaged GeoTerra to update the original groundwater assessment and prepare a groundwater assessment addendum to assess potential changes to the groundwater system specific to extraction of the first 400 m of Longwall 6. The updated assessment and addendum are included in Appendix C of the RTS.

Dr Noel Merrick of Hydro Simulations has provided a modelling review report (see **Appendix D**). NOW has confirmed that the modelling study and review report satisfy the requirements of the *NSW Aquifer Interference Policy* (AIP).

Groundwater Predictions

Shallow groundwater aquifers

GeoTerra reports that, where mining of all three seams has occurred, there is a potential for interaction between surface water features and the top of the depressurised groundwater zone that is recharged from rainfall and adjacent creeks. The potential may be enhanced if there is interaction between the hill-slope basal shear plane that may have been reactivated by subsidence and the top of the zone of depressurisation above each longwall panel.

OEH and DSC raised concerns that the height of groundwater depressurisation above mining in the first 400 m of Longwall 6, where previous mining has taken place, may extend into the basal shear planes and shallow aquifers of the Bulgo Sandstone. GeoTerra accepts that this is possible for mining in shallower areas such as the northern end of the UEP's proposed Longwall 7. However, given the depth of cover associated with the first 400 m of Longwall 6 (320 – 345 m), interaction between the surface water features and the top of the depressurised groundwater zone is considered unlikely. The maximum depressurisation contour for the upper strata (Hawkesbury Sandstone as well as the underlying Newport/Garie Formation, the Bald Hill Claystone and the Upper Bulgo Sandstone) as a result of mining in the first 400 m of Longwall 6 is shown in **Figure 11**.

GeoTerra has also modelled that there may be transfer of a small volume of water from the Cataract Reservoir to the underlying groundwater system due to depressurisation of the regional groundwater system. This sub-surface transfer due to extraction of Longwall 6 (400 m) is predicted to be 0.0009 ML/day (0.33 ML/year). This represents less than 0.001% of the low level, or 0.0003% of the FSL of the reservoir, and can be considered negligible.

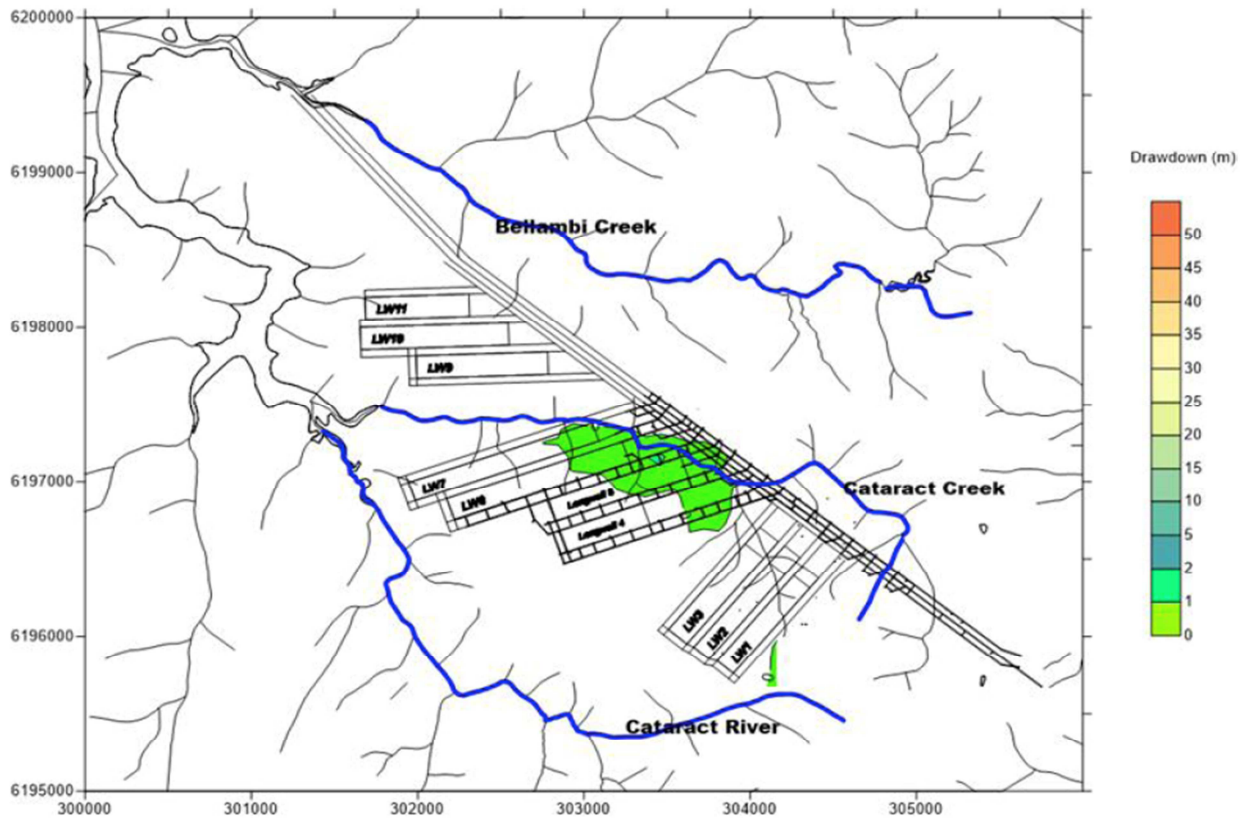


Figure 2 Layer 1 Depressurisation Associated with the Proposed Mining of LW6 (400m)

Figure 11: Depressurisation of Upper Strata Associated with Mining the First 400 m of Longwall 6

Deep groundwater aquifers

Current measured groundwater inflow from deep aquifers to the Wonga East workings, after extraction of Longwall 5, is 1.05 ML/day (383 ML/year). The GeoTerra model predicts that this rate of inflow would reduce after the extraction of the first 400 m of Longwall 6, to 0.8 ML/day (292 ML/year). This is largely due to the existing gateroads for Longwall 6 providing an avenue for pre-drainage of the panel. GeoTerra notes that 72 ML/year of this continuing groundwater inflow would be sourced from up-gradient seepage out of adjoining decommissioned workings within the Bulli and Balgownie Seams. These modelled seepage rates into the Wongawilli Seam workings may be enhanced if unidentified fracture-related storages are intercepted, which GeoTerra reports may lead to short term increases of potentially up to 0.1 – 0.5 ML/day. These additional inflows would be expected to dissipate over a period of weeks or months.

Groundwater Quality

In terms of groundwater quality, GeoTerra states that the modification may result in some localised iron hydroxide precipitation and limited lowering of pH if the groundwater is exposed to freshly-fractured rock surfaces through dissolution of unweathered iron sulphide or carbonate minerals. It is important to note however that groundwater quality within the region has not been adversely affected by previous mining and that many aquifers in the Southern Coalfield already have significant iron hydroxide levels.

NSW Aquifer Interference Policy

In accordance with the AIP, GeoTerra completed an assessment of the minimal impact considerations for 'less productive porous rock water sources' and 'perched ephemeral aquifer water sources'. The assessment concluded that the criteria for minimal impact would not be exceeded. NOW has confirmed that the project would meet the Level 1 impact thresholds of the AIP, which it considers to be acceptable.

Groundwater Licensing

Under the *Water Management Act 2000*, Wollongong Coal is required to hold a water access licence (WAL) for groundwater take within the Sydney Basin Nepean Groundwater Source in accordance with the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* (Groundwater WSP). Under the Groundwater WSP, the proposed mining is located within Management Zone 2 of the *Sydney Basin Nepean Groundwater Source*. The Groundwater WSP controls all aquifers below the surface of the ground, including alluvium, weathered and basement rocks.

Wollongong Coal has confirmed that it currently holds a groundwater licence under Part 5 of the *Water Act 1912* for 365 ML/year, and that this would need to be converted to a WAL. Since the Groundwater WSP applies to all aquifers, Wollongong Coal would require WALs for all groundwater taken in the course of mining, including inflows (principally from saline groundwater in the coal seam) into the mine (292 ML/year) and leakage from shallow, good quality aquifers (0.33 ML/year).

There are 16,283 ML of unit shares in this water source, which is considered sufficient to allow the conversion of the existing and modelled groundwater take. It should be noted that seepage from the Bulli and Balgownie Seams workings does not require to be licensed.

Groundwater Monitoring

The DSC proposed that a borehole between Longwall 6 and the reservoir should be installed prior to extraction of Longwall 6 to investigate and monitor the height of groundwater depressurisation. The Department is aware that monitoring of the multi-seam estimated height of depressurisation is currently limited to one location (GW-01) in the Wonga East area (east of Longwall 4), and that this is not located over the centre of the Wongawilli Seam longwall.

The Department therefore agrees with DSC that a bore between the Longwall 6 and the reservoir would provide valuable information on groundwater depressurisation in multi-seam environments. Wollongong Coal has confirmed that it has approval from SCA to establish additional bores in the UEP area, including a bore located between Longwall 6 and the reservoir, and that the bore locations were negotiated and agreed with SCA and the DSC. The Department has recommended a condition requiring the bore between Longwall 6 and the reservoir to be installed prior to commencement of mining in Longwall 6.

Groundwater Management

The Department is satisfied that the proposed mining of Longwall 6 can be managed such that it would not result in any significant impacts on groundwater resources, and that existing conditions of approval are generally adequate to manage the risk of groundwater impacts.

Under the existing conditions of approval, Wollongong Coal is required to:

- obtain appropriate water licences from NOW for groundwater inflows to the mine; and
- develop a comprehensive Water Management Plan (WMP) for the project in consultation with relevant authorities, that includes an agreed:
 - groundwater monitoring program;
 - impact assessment criteria or trigger values; and
 - Surface and Ground Water Impact Response Plan.

Wollongong Coal would be required to update its WMP to address the potential groundwater impacts of Longwall 6, prior to mining.

6.6 Other Issues

Other environmental issues associated with the proposed modification are considered in **Table 3**.

Table 3: Other Issues

Issue	Potential impact and consideration	Conclusion and recommendation
Biodiversity	• The EA includes a series of ecological impact assessments which were prepared in support of the UEP (see Appendix G of the EA). An updated ecological assessment undertaken by Biosis was included in the RTS (see Appendix F). As indicated in Section 5.2, this assessment took into	• The Department is satisfied that it is unlikely that there would be any significant impacts to biodiversity as a result of the proposed modification.

	account the revised subsidence predictions and groundwater model results, as well as additional surveys undertaken for the threatened Giant Dragonfly. The potential biodiversity impacts relevant to the Longwall 6 modification are summarised in the main body of the RTS. • Biosis identifies that 2 flora species and 7 fauna species listed under the EPBC Act and/or TSC Act have the potential to occur in and be dependent on habitat in the Wonga East area. • The proposed modification does not require the direct removal of native vegetation or fauna habitat. The key concern relating to biodiversity impacts is the potential for habitat alteration due to subsidence, which is listed as a Key Threatening Process under the TSC Act. • The EA and RTS both concluded that there would be no significant subsidence-related impacts to threatened flora or fauna species. • At OEH's request, Wollongong Coal engaged Biosis to undertake additional surveys for the Giant Dragonfly in late 2013 and early 2014. These additional surveys found exuviae (ie shed exoskeletons) for this species in upland swamps CCUS4 and CRUS1. Biosis considers that the risk of changes in water availability impacting on habitat for the Giant Dragonfly in CCUS4 is high. However, Biosis concludes that impacts are unlikely to result in significant impact to the local population of this species, as the Giant Dragonfly has been recorded elsewhere in the immediate area, and the species has regularly been observed in previously undermined upland swamps.	• As discussed in Section 6.3, the Department has recommended a performance measures which requires not more than minor environmental consequences to swamp CCUS4, including not more than minor change to the composition or distribution of species within swamps. • Existing performance measures also require not more than negligible environmental consequences on threatened species.
<i>Aboriginal and non-Aboriginal Heritage</i>	• The EA includes an Aboriginal and Historic Heritage Assessment undertaken by ERM for the UEP in 2012. Biosis undertook a supplementary assessment in 2013. Both assessments are included in Appendix F of the EA. • The assessment indicated that there are 3 Aboriginal heritage sites located reasonably close to the proposed Longwall 6. The EA predicts that impacts on all three sites are likely to be negligible, as follows: - o site 52-3-0320 (an axe grinding groove site located between Longwalls 4 and 5 and assessed as being of low significance). Impacts likely to be negligible given that the site was not impacted during previous extraction and subsidence associated with Longwall 6 is predicted to be considerably less (<20 mm); - o site 52-3-0323 (a small rock shelter with limited artefact deposit located close to the shores of Lake Cataract and assessed as being of moderate significance). Impacts likely to be negligible given the distance from Longwall 6 and that it is predicted to experience subsidence <20 mm; and - o site 52-3-0325 (a rock shelter site with limited artefact deposits and degraded art located directly above proposed Longwall 7 and assessed as being of moderate significance). Impacts likely to be negligible given the site is associated with detached boulders and the area is predicted to experience subsidence <20 mm. • Wollongong Coal has committed to monitoring the sites during extraction of Longwall 6.	• The Department and OEH are satisfied with the level of assessment undertaken in relation to cultural heritage. • The Department notes that the existing project approval requires negligible impact or environmental consequences to Aboriginal heritage site 52-3-0320. • Wollongong Coal would be required to update the existing Heritage Management Plan to include mitigation and management of the sites in the vicinity of Longwall 6.
<i>Air Quality & Greenhouse Gas Emissions</i>	• Coal production volumes and associated numbers of laden trucks would not be increased under the proposed modification.	• Wollongong Coal has committed to continued implementation of its Air Quality and Greenhouse Gas Management Plan.
<i>Waste</i>	• The annual rate of waste production is as per the approved project. No coal reject is produced on site.	• Waste mitigation would continue in accordance with existing conditions of the project approval.
<i>Noise</i>	• Production volumes, coal processing, surface activities and associated coal transport are as per the approved project.	• Noise mitigation measures would continue in accordance with existing conditions of the project approval.
<i>Term of approval</i>	• The existing approval contains a 3-year limit on the term during which mining operations may be carried out, which expires on 13 October 2014. Wollongong Coal's application for MOD 2 requested that this date be extended until 30 June 2015, to enable it to carry out the proposed longwall extraction. On 6 August 2014, Wollongong Coal sought to amend its application to further extend this date, until 31 December 2015. • Wollongong Coal indicated that the further extension was	• The Department does not oppose the extension of the term during which mining operations may be carried out until 31 December 2015, and has recommended conditions to this effect.

	required to ensure that it had sufficient time to complete the proposed extraction, should determination of UEP be further delayed. It would also permit the continuation of other mining-related activities.	
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6.7 Other Regulatory and Non-compliance Issues

Piecemeal Approach

Many submissions raised concerns about the perceived 'piecemeal' approach being adopted by Wollongong Coal (or more particularly, its predecessor NRE) to re-establish mining at Russell Vale. The PAC also made comments to the same effect in both its PWP determination report and its MOD 1 determination report. The Department endorses this position and accepts that NRE's previous approach has not been best practice.

Nonetheless, the Department is aware that the modification is required due to delays in completing the assessment of the UEP. As noted above, the Department has required substantial changes to the UEP to minimise its potential impacts, particularly on creeks and upland swamps. It is important to Government and the community that the amended UEP is thoroughly assessed. Wollongong Coal is still completing some documents supporting assessment of the revised project. At this stage, it is estimated that the assessment and determination of the revised project could take between 4-8 months.

Although the Department would prefer to assess broader, long-term proposals (such as the UEP), it accepts that the current modification application is essential for mine continuity, and ultimately the economic future of the mine and Wollongong Coal itself. The Department also recognises that this application would provide an ideal opportunity for gathering additional information to assist in assessing the larger UEP application. Finally, the Department notes that it is bound to consider all applications on their merits, which is what it has done in the present case.

Non-Compliances

A number of submissions raised concerns about the recent history of non-compliances at Russell Vale, specifically in relation to the assessment of noise mitigation options in the vicinity of the pit top area and the realignment of Bellambi Gully Creek.

The Department takes all non-compliances seriously. The Department's Compliance Branch has thoroughly investigated both these issues.

Noise Mitigation

On 13 July 2013, the Department's Compliance Branch issued a penalty infringement notice (PIN) to NRE for failure to assess and submit noise mitigation options (such as acoustic screens) to protect surrounding residential areas from noise generated from the mine's pit top operations, in accordance with condition 14A of Schedule 3 of the PWP approval. The Department is aware that NRE and Wollongong Coal have subsequently been working with acoustic consultants to determine the most appropriate noise mitigation options for the pit top, and that NRE and Wollongong Coal has since implemented a wide range of noise mitigation and management measures, including:

- installation of a real time air and noise monitoring system and a meteorological station capable of detecting temperature inversions;
- enclosure of the WM1-RV1 conveyor transfer point (continuing);
- completing modifications to mitigate noise and dampen vibration from the tripper on the RV1 conveyor over the stockpile;
- constructing a 4-5 m high soil bund around the northern side of the stockpile area and around the eastern machinery parking area, including vegetation planting;
- constructing 2-3 m high soil bund on sections of the eastern edge of the Pit Top equipment laydown area;
- replacing or readjusting the reverse alarms of underground vehicles to significantly reduce noise when they are reversing on the surface; and
- assessing and scheduling repairs to the workshop building.

Wollongong Coal has indicated that these works have cost the company around \$790,000. Wollongong Coal has also confirmed that it has engaged an acoustic consultant to reassess the noise

modelling for the UEP. The revised noise modelling and assessment will be submitted to the Department during the assessment of the UEP.

Bellambi Gully Creek Flood Mitigation

On 6 May 2014, the Department's Compliance Branch issued Wollongong Coal with a draft Order in response to its failure to complete its proposed Bellambi Gully Creek realignment works, as proposed in NRE's Statement of Commitments included in the PWP approval. NRE had committed to undertake these works in response to a major pollution incident during the 1998 floods, which involved the Bellambi Gully Creek overtopping the constructed underground culvert beneath the Russell Vale pit top site, and consequently scouring a significant quantity of coal from the mine's ROM stockpile, which in turn was transported off the site, affecting a number of residences and the creekline. Under the Statement of Commitments, the works were required to be completed by 31 December 2013.

In response to the draft Order, Wollongong Coal indicated that the original undertaking as presented in the EA for the PWP was made on the basis of incomplete and incorrect information regarding the cause of the overtopping incident. Wollongong Coal subsequently committed to preparing a detailed flood mitigation study to assess the flood risks and determine the most appropriate flood mitigation option for the surface infrastructure and stockpile areas at the pit top site.

The Department has since received the resultant Bellambi Gully Flood Study, which was undertaken by Cardno Pty Ltd and is included as Appendix G of the RTS for MOD 2. The Bellambi Gully Flood Study includes a review of all past flood studies, a topographic survey and a digital terrain model, identification of peak flows (5, 10 and 100 year ARI), a flood model based on three scenarios and recommended flood mitigation measures.

The study indicates that runoff originating from the Illawarra Escarpment flows down the escarpment's heavily vegetated, steep slopes to the Russell Vale site in the foothills, where it enters the Bellambi Gully Creek. Some reaches of the watercourse are conveyed by pipes and constructed channels within the site. The total catchment area is 427 ha and the total creek length is 4.3 km.

Cardno modelled three scenarios to assess flooding throughout the site. The models represented 100 year ARI events where the current stormwater pipes are completely blocked, 20% blocked and fully operational. Results indicate that flooding within the site is significant under all these scenarios. In all scenarios, while overland flows are mainly contained within the stockpile area, they also overtop the access road and continue as sheet flow towards and onto Bellambi Lane.

The study recommends a range of mitigation measures to reduce clean runoff entering the stockpile area, while conveying all site runoff in a controlled way to Bellambi Gully Creek (ie preventing flooding of Bellambi Lane). In summary, these measures include:

- raising the stockpile area access road, installing a new culvert and formalising the open channel via a swale with a 5 m base close to the southern margin of Bellambi Lane;
- implementing a debris control structure at the 1800 mm diameter pipe entrance;
- formalising the swale in the vicinity of the 600 mm clean water inlet;
- upgrading the existing 600 mm diameter clean water pipe to an 825 mm diameter pipe;
- installing culverts across the access road along the northern boundary of the site; and
- ongoing maintenance of the system.

Cardno states that the proposed culvert and swale structure would be adequate to convey the 100 year ARI flows and eliminate the flooding on Bellambi Lane, even if the existing pipes are 20% blocked.

The Department considers that the Cardno report, as presented, does not contain sufficient information for it to support the proposed option. For example, there is no information as to whether there is any residual risk of the coal stockpile being eroded or scoured. It also doesn't address what size of flood is likely to lead to overland flows (ie the point at which the capacity of the pipe network is exceeded). Most importantly, there is no comparative analysis between its recommended approach and the re-establishment of the original creek alignment previously proposed (and still required under existing conditions of approval).

Council has also completed a review of the flood study and requested that it be revised to use a standard modelling approach which assesses the 100 year ARI, adopts appropriate tailwater levels and applies a 100% blockage criteria for all stormwater pipes less than 6 mm in diameter.

The Department has recently asked Wollongong Coal to revise the flood model to address both Council and the Department's concerns. Until this information is provided, the Department considers that no change should be proposed to existing conditions of approval. The Department expects that it will be in a position to recommend one option or the other as part of the proposed determination of the UEP project. Wollongong Coal has agreed to the Flood Study and the finalisation of the best option for flood mitigation at the site being dealt with as part of the UEP project.

7 RECOMMENDED CONDITIONS

The Department has prepared recommended conditions of approval for the project (see **Appendix E**). These conditions are required to:

- prevent, minimise, and/or offset adverse impacts of the project;
- set standards and performance measures for acceptable environmental performance;
- ensure regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.

A consolidated version of the conditions of approval is also attached in **Appendix F**.

Wollongong Coal has reviewed and accepted the recommended conditions. Key agencies, including OEH and SCA, have also provided comments on the conditions which primarily reiterate concerns in relation to the performance measure proposed for swamp CRUS4.

The Department believes the conditions reflect current best practice for the regulation of underground coal mines in the Southern Coalfield of NSW.

8 CONCLUSION

In assessing this modification application, the Department recognises that there are inherent uncertainties in the multi-seam mining environment proposed at Russell Vale. Consequently, the Department has given additional weight to the precautionary principle, risk minimisation and the potential for adaptive management. Notwithstanding, it is important to note that the application would lead only to subsidence from a single, very short longwall panel, which was specifically designed with a narrow panel width and large chain pillars, and has also been designed to minimise potential impacts on key surface features. In that respect, Wollongong Coal has adopted a very conservative mine design in order to substantially limit the potential for unpredicted environmental impacts on key surface features.

The Department considers that it is unlikely that there would be any significant subsidence-related impacts on most nearby key surface features, including Cataract Reservoir, Cataract Creek, Cataract River and three Aboriginal heritage sites. The Department is satisfied that the existing project approval includes appropriate performance measures to manage potential subsidence impacts and environmental consequences on these features.

Extraction of the first 400 m of Longwall 6 has the potential to impact on two upland swamps. There is general agreement that there are low risks of potential impacts on swamp CRUS1 considering that only a very small area (<6%) of the swamp would be undermined. However, there is considered to be a higher risk of impact to swamp CCUS4 due to potential fracturing of a sandstone small cliff formation at the downstream neck of the swamp that may result in changes in hydrology and the water holding capacity of a limited area of the swamp (probably not exceeding 0.4 ha).

Given that swamp CCUS4 has already been impacted by mining and that only a small percentage (or area) of the swamp is likely to be impacted, and the extensive avoidance and minimisation measures already undertaken by Wollongong Coal, the Department recommends that it is subject to conditions requiring a proportional offset if impacts exceed 'minor environmental consequences', defined as:

- *negligible* erosion of the surface of the swamps;

- *minor* changes in the size of the swamps;
- *minor* changes in the ecosystem functionality of the swamp;
- *no significant* change to the composition or distribution of species within the swamp; and
- *maintenance or restoration* of the structural integrity of controlling rockbars.

If greater than 'minor' impacts are identified to swamp CCUS4 as a result of mining in Longwall 6, then Wollongong Coal would be required to provide an offset.

The existing approval contains conditions which require the development of an Extraction Plan to manage extraction in Longwall 6 and review and update of the project's Water, Biodiversity and Heritage Management Plans, to ensure that they are fully integrated with the Extraction Plan and reflect the current performance measures. Each of these plans must be approved prior to commencing mining in Longwall 6.

The Department is also aware that Wollongong Coal considers the current modification application to be essential for mine continuity, and ultimately the economic future of the mine and the company.

The Department has assessed the proposed modification in accordance with the relevant requirements of the EP&A Act, including the objects of the Act and the principles of ecologically sustainable development, and is satisfied that it is in the public interest and should be approved.

9 RECOMMENDATION

It is RECOMMENDED that the Planning Assessment Commission exercise the powers and functions delegated to it in the Minister for Planning and Infrastructure's Instrument of Delegation, dated 14 September 2011, and:

- **considers** the findings and recommendations of this report;
- **determines** that the proposed modification is within the scope of section 75W of the EP&A Act;
- **approves** the modification application, subject to conditions, under section 75W of the EP&A Act; and
- **signs** the attached notice of modification (Tagged A).

Howard Reed

Howard Reed
Manager Mining Projects

5.9.14

10.9.14

Chris Wilson
Executive Director
Development Assessment and Systems Performance

APPENDIX A – Environmental Assessment
APPENDIX B – Full Copy of Submissions
APPENDIX C – Response to Submissions
APPENDIX D – Peer Review Comments

See the Department's website link at:

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6487

APPENDIX E – Notice of Modification

APPENDIX F – Consolidated Conditions of Approval