Wambo Coal Mine
Southern Longwalls Modification
(DA 305-7-2003 MOD 12)

Environmental Assessment Report

Section 75W of the *Environmental Planning and Assessment Act 1979*

1. BACKGROUND

The Wambo Coal Mine is located in the Hunter Valley about 15 kilometres (km) west of Singleton, near the village of Warkworth. The mine is bounded by several coal mining operations to the north and east, agricultural activities associated with Wambo Creek and Wollombi Brook to the south and Wollemi National Park to the southwest (see **Figure 1**).

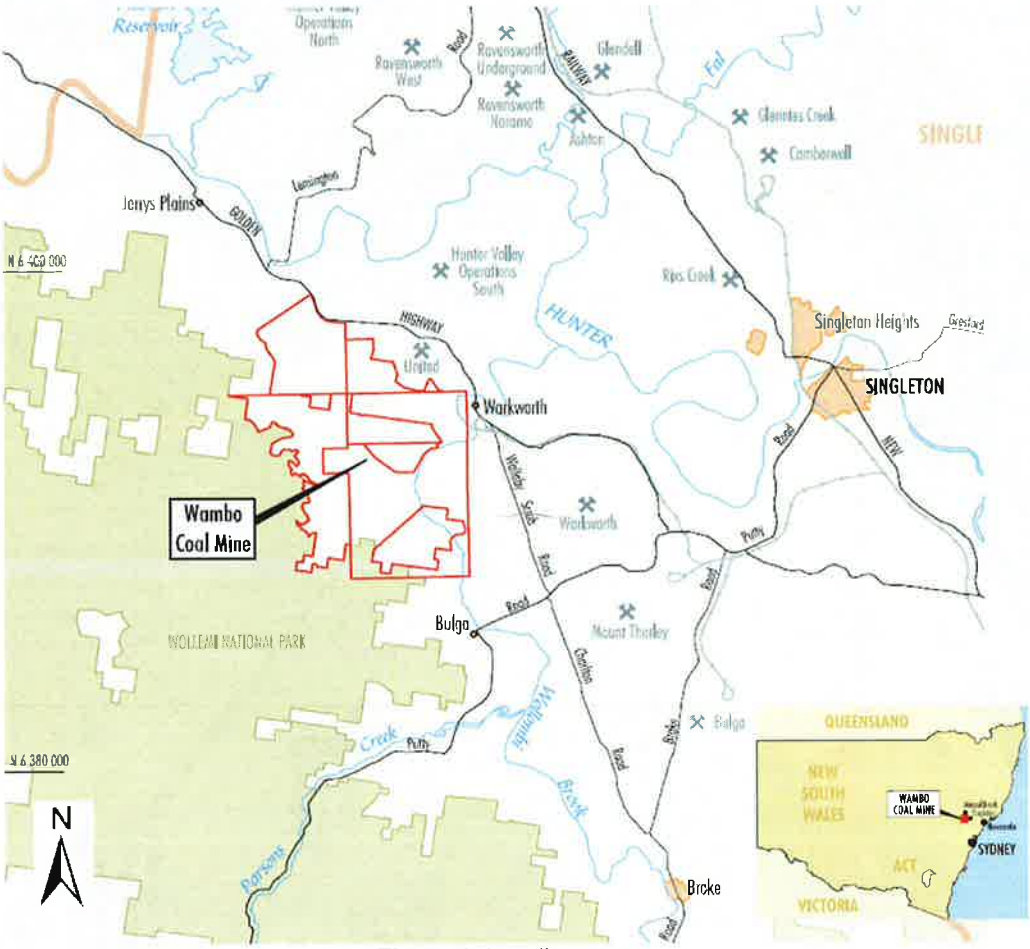

Figure 1: *Locality map*

The mine originally commenced operations in 1969 and is currently operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy. The operations currently involve longwall mining in the South Bates Underground Mine (Whybrow Seam) (Longwalls 11 to 13), and will subsequently progress to the South Bates (Wambo Seam) and South Wambo Underground Mines (see **Figure 2**).

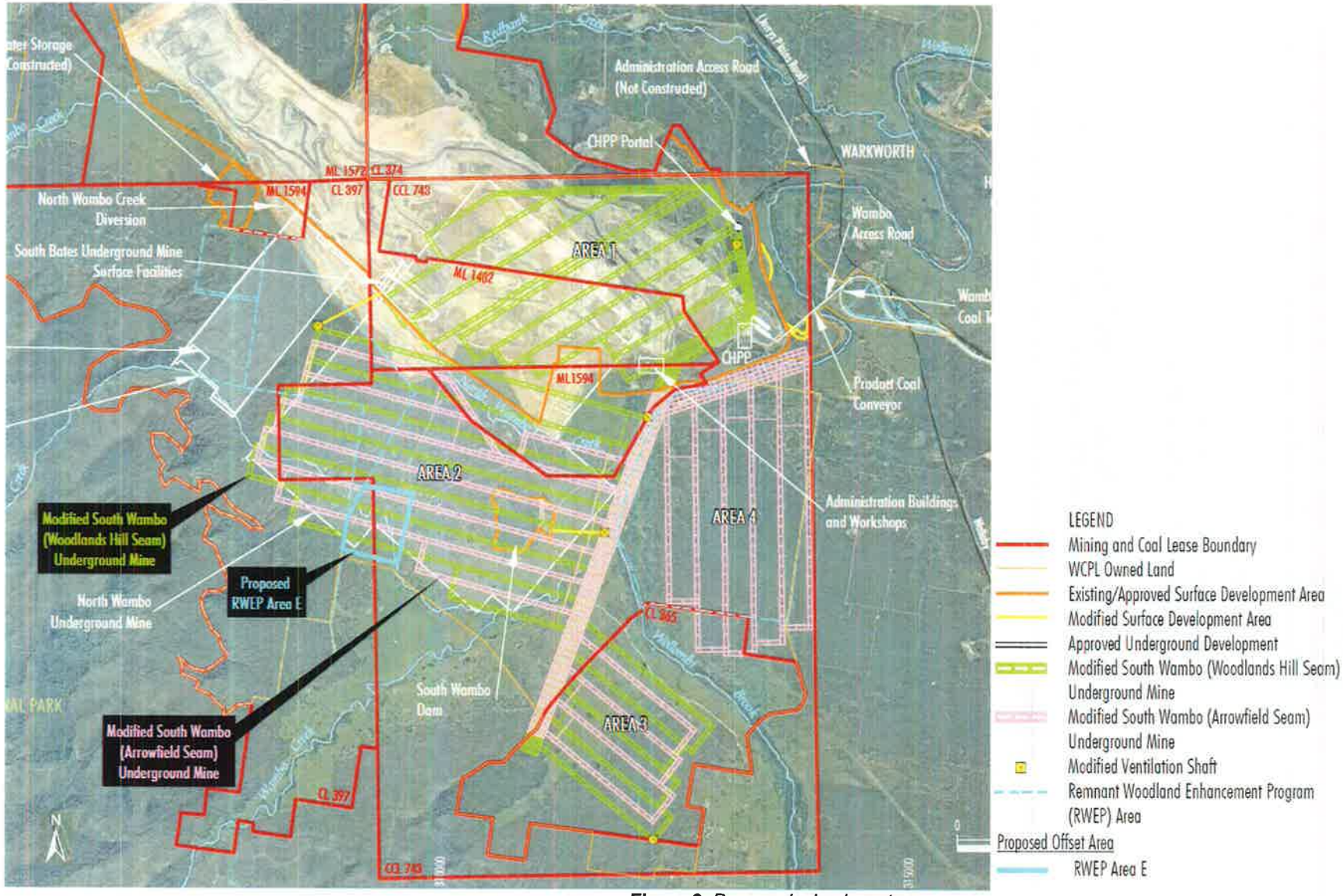

Figure 2: *Proposed mine layout*

Current operations at the mine are controlled by two Ministerial development consents: one for the open cut and underground mining operations (DA 305-7-2003, granted on 4 February 2004), and one for the associated rail operations (DA 177-8-2004, granted on 16 December 2004). Under these consents, WCPL is authorised to:

- extract up to 14.7 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal, comprising:
  - up to 8 Mtpa of ROM coal from its open cut mining operations; and
  - up to 7.5 Mtpa of ROM coal from its underground mining operations;
- process this ROM coal at its onsite coal handling and processing plant (CHPP); and
- transport up to 15 Mtpa of product coal from the mine via rail.

United Collieries Pty Ltd has separately lodged a development application (DA) for the United and Wambo Open Cut Coal Mine Project which was on public exhibition until 22 September 2016. The proposal involves a joint venture between United Collieries and WCPL to integrate the existing open cut operations at Wambo Mine with a proposed new open cut mine at the United Mine site under a modified mine plan. The project would involve extraction of an additional 150 million tonnes (Mt) of ROM coal over approximately 23 years and proposes a number of changes to the layout of existing mining and public infrastructure including relocation of both a 2 km section of the Golden Highway and a section of 330kV powerlines. Modification applications have also been lodged in conjunction with the DA to extend the life of both the Wambo train loading facility under DA 177-8-2004 and the open cut operations under DA 305-7-2003. The joint venture project is not seeking to modify underground mining operations authorised under DA 305-7-2003.

2. PROPOSED MODIFICATION

Mining of the South Wambo Underground Mine (Arrowfield and Bowfield Seams) was assessed as part of the *Wambo Development Project Environmental Impact Statement* (WCPL, 2003) and approved under Development Consent DA 305-7-2003. Since this approval, WCPL has undertaken further exploration and identified a more economical and efficient mine layout than that which is currently approved.

WCPL proposes to modify the existing development consent to:

- realign and extend the approved South Wambo Underground Mine longwall panels;
- mine the Woodlands Hill Seam rather than the Bowfield Seam;
- extend the approved surface development area;
- extend the approved mine life by 7 years;
- increase the underground mine ROM coal production rate from 7.5 to 9.75 Mtpa; and
- extend the approved life of open cut mining operations by 3 years.

Despite the proposed increased production rate for underground mining operations, no change is proposed to the approved total (open cut and underground) ROM production rate of 14.7 Mtpa. The modification's four separate longwall mining (Areas 1 to 4) are shown in **Figure 2**. The coal seams to be mined in each of the four Areas and proposed mining to be undertaken is outlined in **Table 1**.

Table 1: *Longwall mining areas and seams associated with the proposed modification*

Area	Coal Seam/s	Description
1	Woodlands Hill Seam	Includes additional longwall panels in the Woodlands Hill Seam beneath existing/approved surface development area and above historical United Mine longwalls in the Arrowfield Seam.
2	Arrowfield Seam and Woodlands Hill Seam	Includes a reorientation and minor extension westward of the approved Arrowfield Seam layout. The Woodlands Hill Seam is proposed to replace the Bowfield Seam in this location, with proposed longwalls reorientated and extended slightly westward when compared to the approved layout.
3	Arrowfield Seam and Woodlands Hill Seam	An extension of mining in the Arrowfield Seam and Woodlands Hill Seam into Area 3, comprising three longwall panels in the Arrowfield Seam and four longwall panels in the Woodlands Hill Seam.
4	Arrowfield Seam	No changes to the approved Arrowfield Seam mine layout to the east of Wollombi Brook. The modification merely proposes that previously approved mining in the underlying Bowfield Seam would no longer take place.

The modified longwall panels have lengths ranging between 0.7 and 3.7 km and widths between approximately 200 and 300 metres (m). On 13 July 2016, WCPL wrote to the Department proposing to revise the first workings layout submitted as part of the proposed modification. A portion of privately-owned land lies above the proposed main headings in Area 3. Following consultation with the landowner and a review of the mine layout, it was determined that the first workings layout could

be amended to avoid any extraction beneath privately-owned land. The Department considers this to be a beneficial outcome for the landowner and was satisfied that the request could be considered as part of the proposed modification.

An extension to the approved surface infrastructure area is also proposed, including a laydown area for underground equipment, water management infrastructure, an office and bathhouse complex, extended ROM coal facilities, electrical infrastructure, workshop, fuel bay and car park facilities. The modification proposes an additional access road to facilitate access to this infrastructure area.

The modification would also require construction and operation of five ventilation shafts to support underground mining. This would involve relocation of the one approved shaft and approval of an additional four shafts. Two centralised gas plants are also proposed to flare methane gas collected through pre-drainage and goaf drainage activities.

The proposed modification also includes a number of proposals to amend and/or delete current conditions of consent in order to remove redundant conditions and bring the consent up to date. The Department has further considered these suggestions in **Section 5.5** below.

A comparison of the approved and proposed operations is set out in **Table 2**. A detailed description of the modification is provided in WCPL's Environmental Assessment (EA, see **Appendix A**).

Table 2: *Comparison of approved and proposed operations*

Component	Approved	Modified
Life of Mine	• 21 years (until 1 March 2025)	• An additional 7 years (until 1 March 2032)
Open Cut Mining	• Open cut mining operations to March 2017 at a rate of up to 8 Mtpa	• An additional 3 years (2020). No other changes proposed
Underground Mining	• Underground mining of up to 7.5 Mtpa of ROM coal from the Whybrow, Wambo, Arrowfield and Bowfield Seams	• Changes to the alignment and extent of the South Wambo Arrowfield Seam longwall panels • Mining of the South Wambo Woodlands Hill Seam rather than the approved Bowfield Seam • Increase in the underground mining rate up to 9.75 Mtpa of ROM coal • Approximately 28.4 Mtpa of additional ROM coal from the South Wambo Underground Mine
Total ROM Coal Production Rate	• Up to 14.7 Mtpa of ROM coal	• No change
Total ROM Coal Mined	• 212.9 Mt	• 241.3 Mt
Coal Washing	• CHPP capable of processing approximately 1,800 tonnes per hour	• No change
Product Coal	• Up to 11.3 Mtpa of thermal coal, predominantly for export	• No change
CHPP Coal Reject Management	• Course rejects and tailings would be incorporated, encapsulated and/or capped within open cut voids in accordance with existing management practices	• No change
Total CHPP Coal Rejects	• Approximately 29.3 Mt of coarse rejects and approximately 19.4 Mt of tailings	• An additional 7.3 Mt of coarse rejects and 3 Mt of tailings
Surface Facilities	• Construction of surface facilities within the approved surface development area	• Extension to the surface development area to allow for South Wambo Underground Mine surface infrastructure
Total Waste Rock	• 640 million bank cubic metres	• No change
Waste Rock Management	• Waste rock deposited in open cut voids and in waste rock emplacements adjacent to open cut operations	• No change
Water supply	• Make-up water demand to be met from runoff recovered from tailings storage areas, operational areas, dewatering and licensed extraction from Wollombi Brook and Hunter River	• No change

3. STATUTORY CONTEXT

3.1 Section 75W

DA 305-7-2003 was granted in 2004, under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). In accordance with clause 8J(8) of the *Environmental Planning and Assessment Regulation 2000* and the transitional arrangements under Schedule 6A of the EP&A Act, the modification is to be determined under the former section 75W of the EP&A Act.

The Department is satisfied that the proposal can be characterised as a modification to the existing development consent. The additional coal to be recovered is a small fraction of the mine's annual and overall production, the disturbance footprint mostly occurs within an area of approved underground mining, and the proposal could be achieved with minimal environmental impact (see **Section 5**). Given these considerations, the Department is satisfied that the proposed modification is within the scope of section 75W, and may be determined accordingly.

3.2 Approval Authority

The Minister for Planning is the approval authority for the application. However, the Planning Assessment Commission must determine the application under the Minister's delegations of 14 September 2011 and 16 February 2015, as more than 25 public submissions objected to the proposal.

3.3 Environmental Planning Instruments

A number of environmental planning instruments apply to the modification, including:

- SEPP *(Mining, Petroleum and Extractive Industries) 2007* (the Mining SEPP);
- SEPP *(Infrastructure) 2007* (the Infrastructure SEPP);
- SEPP *(State and Regional Development) 2011;*
- SEPP No. 33 – *Hazardous and Offensive Development*;
- SEPP No. 44 – *Koala Habitat Protection*;
- SEPP No. 55 – *Remediation of Land*; and
- *Singleton Local Environmental Plan 2013.*

The Department has assessed the modification against the relevant provisions of these instruments and reviewed WCPL's consideration of these matters in its EA. Based on this assessment, the Department is satisfied that the proposed modification can be carried out in a manner that is consistent with the aims, objectives and provisions of these planning instruments.

3.4 Commonwealth Approval

The Wambo Coal Project was determined to be a 'controlled action' in 2003 and subsequently approved in November 2004 (EPBC 2003/1138). On 29 February 2016, a delegate of the Commonwealth Minister for the Environment determined that parts of the proposed modification (EPBC 2015/7636) are a 'controlled action' under section 75 of the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Importantly, WCPL's referral under the EPBC Act and the Commonwealth Department of the Environment's (now the Department of the Environment and Energy or DoEE) subsequent determination applies to Areas 1 and 3 only. This is because Areas 2 and 4 were covered by the Commonwealth's 2004 approval and were therefore excluded from both WCPL's 2015 referral and the Commonwealth's 2016 determination.

The action proposed by WCPL in Areas 1 and 3 was determined as likely to have a significant impact on matters protected under the EPBC Act, being:

- listed threatened species and communities (under sections 18 & 18A of the Act), including the Regent Honeyeater and *Central Hunter Valley Eucalypt Forest and Woodland Ecological Community*; and
- a water resource, in relation to coal seam gas development and large coal mining development (under sections 24D & 24E of the Act).

Subsequently, environmental assessment requirements were issued by DOEE and on 3 March 2016 the Department provided these to WCPL as supplementary Secretary's environmental assessment requirements.

As the State's environmental assessment process under the EP&A Act is an accredited process under the bilateral agreement, the Department has assessed the likely impacts to Matters of National Environmental Significance (MNES) as a result of the modification on behalf of the Commonwealth. The Department's assessment of the potential impacts of the project on water resources and

biodiversity is provided in **Sections 5.2 and 5.3**, and in **Appendix F**. Following the NSW determination of the project by the Commission, the Department will make a recommendation to the Commonwealth Minister for the Environment in relation to the acceptability of the impacts to MNES for separate determination under the EPBC Act.

As required under the Commonwealth's bilateral agreement with NSW, the project was referred jointly by the Department and DoEE to the Commonwealth's *Independent Expert Scientific Committee on Coal Seam Gas and Large Mining Development* (IESC) for advice on surface and groundwater impacts, as well as potential impacts on downstream watercourses and receiving environments. The advice provided by the IESC has been summarised in **Section 4.2** and considered in **Section 5.2**. It has also informed the conclusions presented in **Section 7** and the recommended conditions of consent in **Appendix G.**

4. CONSULTATION

The Department exhibited the modification application from 22 April until 13 May 2016 and made the accompanying EA publicly available on its website and at the Department's Information Centre, Singleton Shire Council's administrative centre and the office of the Nature Conservation Council.

In response to this exhibition, the Department received 42 submissions, comprising:

- 5 from public authorities, including NSW Government agencies;
- 36 public and special interest group submissions objecting to the project; and
- 1 public submission in support of the project.

Copies of these submissions and a copy of WCPL's Response to Submissions (RTS) are included at **Appendix B** and **Appendix C**, respectively. Three of the public submissions were received following the exhibition period and as such have been considered by the Department but are not addressed in WCPL's RTS. A summary of the residual issues raised in these submissions is provided below (see **Appendix D** for agency comments on the RTS).

4.1 Agency Submissions

The **Department of Primary Industries – Water (DPI Water)** raised a number of concerns regarding risks of increased post-mining groundwater salinity associated with the potential impacts of subsidence-induced fracturing and increased hydrological connectivity. The majority of these concerns were addressed in WCPL's RTS.

DPI Water's residual concerns related to data provision, reporting formats, groundwater model calibration and potential compliance investigations. The Department sought an additional response from WCPL to these residual comments, which was provided on 2 August 2016 (see **Appendix D**). The response provided the requested bore monitoring data and committed to consultation with DPI Water regarding data presentation formats during any revisions to Wambo's required Water Management Plan. The Department notes that the Water Management Plan must be reviewed following any approval of the proposed modification.

DPI Water recommended further investigation by an appropriate regulatory authority regarding the increased salinity of the alluvial aquifer being potentially attributable to leakage from South Wambo Dam. The Department considers this issue to be somewhat separated from assessment of the merits of the proposed modification. Wambo's 2015 Annual Review included an investigation into increased salinity at some bores and concluded that the increase was not attributable to leakage from the South Wambo Dam. The Department and the EPA will continue to monitor this situation and take action as appropriate.

DPI Water's residual concerns are discussed in further detail in **Section 5.2** below.

The **Office of Environment and Heritage (OEH)** indicated its satisfaction with the proposed offset of 41.6 hectares (ha). Although an exact like-for-like match would not be provided for all affected threatened entities, OEH was satisfied that the proposed offset meets the 'like-for-like or better' requirement of Offset Principle 6. This is because the proposed offset provides for larger areas of other affected vegetation communities, contains habitat for a range of threatened species to be affected, and is contiguous with a larger area of vegetated land also being managed for conservation.

OEH emphasised its support for the recommendation by the Registered Aboriginal Parties (RAPs) that Wambo not relocate any artefact scatters and isolated finds unless required, but that sites that

may be impacted are salvaged under an appropriate permit. OEH advised that a new Aboriginal Heritage Impact Permit (AHIP) would be required for impacts to any Aboriginal sites outside of the existing AHIPs.

The **Heritage Council of NSW (Heritage Council)** did not support the EA's consideration of the Abandoned Stoney Creek Cottage Site and requested that a statement of heritage impact be provided for the site, including advice on its existing structural condition and measures to minimise subsidence impacts. The Department is satisfied that no further detailed information is required for the Abandoned Stoney Creek Cottage Site as the proposed modification would not significantly change subsidence effects from those of the approved layout (see **Section 5.1**). Nevertheless, WCPL has committed to compiling a photographic record of the Abandoned Stoney Creek Cottage Site from 2003 and recent photos from 2015 and submitting these to the Heritage Council and a local historic society for their records.

The Heritage Council also requested inclusion of advice from a suitably qualified heritage architect and structural engineer considering the existing state of the Wambo Homestead and for the engineer to provide written advice on how additional subsidence may impact this site. The Heritage Council also noted that it not endorsed the existing Conservation Management Plan for this site due to inconsistencies with the *Heritage Act 1977*.

The Heritage Council was generally satisfied with the response in WCPL's RTS. The Department notes that WCPL is required to lodge an application under section 60 of the Heritage Act for the proposed longwalls within the curtilage of the Wambo Homestead Complex. This is a statutory requirement, as well as a requirement under condition 57 of Schedule 4 of the existing consent. This application would require approval from the Heritage Council prior to any further longwall extraction occurring within the curtilage of the Wambo Homestead Complex.

The **Division of Resources and Energy (DRE)** within the NSW Department of Industry raised concern that the EA did not provide enough detail on rehabilitation commitments. DRE asked that further information was provided on vegetation communities, final landform design and justification, and proposed mine layout and scheduling. This information was largely provided in WCPL's RTS. DRE's remaining rehabilitation recommendations related to progressive rehabilitation, tailings management, grazing carrying capacity and final landform. The Department is satisfied that, for the most part, existing conditions of consent already address these recommendations. The Department has recommended additional conditions in regards to tailings management and rehabilitation, and grazing carrying capacity in the final landform (see **Section 5.4**).

DRE advised that whilst there would be an increase in the extent of subsidence due to the proposed modification, the overall risk profile of the site would remain largely the same as for the approved mine. DRE and the Department agree that risks associated with mine subsidence would be manageable during the Extraction Plan process (see **Section 5.1**). DRE also noted that the modification would provide economic benefits to the local region and state.

The **Environment Protection Authority (EPA)** was satisfied that the modified development could operate under WCPL's existing Environmental Protection Licence (EPL). The EPA initially raised concerns that residence 19 A&B was not included in the ventilation system intrusive and amenity noise level assessment, as well as within the EPL. The EPA proposed that a noise limit of 35 dB(A) be applied at this receiver. However on later review of the relevant conditions in the existing development consent and EPL, and WCPL's RTS, EPA advised that this position was incorrect, in that the receiver already has acquisition rights and is therefore excluded from locations listed in the EPL (see **Section 5.4**).

The Department did not receive a submission from **Singleton Shire Council**.

4.2 Independent Expert Scientific Committee

The Commonwealth **Independent Expert Scientific Committee on Coal Seam Gas and Large Mining Development (IESC)** provided scientific advice on the modification to both the Department and DoEE. The IESC noted that the information provided in the EA and RTS is limited to the difference between the impacts of the proposed modification compared with the currently approved mining layout. However, the IESC adopted the approach of considering *all* potential impacts, rather than the difference from what is currently approved.

The IESC also did not limit its advice to Areas 1 and 3, as covered by the Commonwealth 'controlled action'. The Department accepts this as generally appropriate as the four areas of the proposed

modification must also be examined to meet the State's requirements. Nevertheless, the IESC's advice presents difficulties in assessing the proposed modification's water resources impacts under the Bilateral Agreement as it is difficult to 'pull apart' the separate areas.

The approach taken by the IESC also differs from the requirements of the EP&A Act under which the Department must assess the merits of the project. For areas where underground mining is not currently approved under the development consent (ie Areas 1 and 3), the Department must assess all potential impacts. For areas where only an alteration to an existing approval is proposed, (ie Areas 2 and 4) the Department must assess potential impacts against those already approved.

As an example, the IESC noted that subsidence impacts in Area 4 (where the approved Bowfield Seam mine layout is no longer proposed to be mined) were reduced and that WCPL did not undertake any further assessment. Nonetheless, the IESC considered that further assessment of potential subsidence should be considered as part of the full impact assessment for the project in order to determine the extent and magnitude of potential impacts now avoided. The Department does not consider this necessary as the overall impacts are reduced compared to those already approved under the EP&A Act. The EP&A Act permits modification of development consents in such circumstances (see **Section 3.1**). It is beyond power (*ultra vires*) for the Department to re-assess the impacts of this previously approved mining in the Arrowfield Seam in Area 4.

However, there is no scope within the EPBC Act to vary approved actions, or to 'net off' the impacts of actions previously approved under State or Territory law. All actions referred to the Commonwealth are assessed as new actions.

The IESC also raised general concerns with what it considered to be insufficient information on which to base advice on the full impacts of the project. The IESC also considered that existing monitoring and management plans should be updated to take account of any changes. The Department is satisfied that the existing consent conditions and WCPL's current management practices would ensure this would occur. Despite its overall concerns, the IESC noted that the nature and scale of the groundwater and surface water impacts of the proposed modification are largely similar to those of the approved mine layout.

The Department requested that WCPL provide a response to the IESC's concerns, which was submitted on 24 August 2016. This response largely addressed the IESC's concerns. Residual matters are discussed further in **Section 5.2**.

4.3 Public Submissions

4.3.1 Objections

The Department received 36 objections from members of the public and special interest groups. Of these objections, 6 were from the nearby towns of Bulga or Singleton, 23 were from across the broader Hunter region (mainly from Newcastle and its suburbs) and 7 were from outside the Hunter region, including Sydney and Canberra (see **Figure 3**).

Key issues raised by objectors were primarily concerned with greenhouse gases and climate change, Peabody Energy Australia's financial state and the cumulative impacts, existing surface water impacts and perceived poor mine management at Wambo (see **Figure 4**).

Greenhouse gases and climate change

The majority of submitters were opposed to approving further production of thermal coal in NSW in light of global warming and man-made climate change. Many drew upon Australia's recent signing of the *Paris Agreement*, which set out a global action plan between 195 countries to limit global warming and avoid climate change. The Department notes that the proposed modification would not significantly change the already approved air quality impacts (see **Section 5.4**).

Cumulative impacts

Twenty-five submitters raised concern with cumulative impacts associated with the proposed modification, with many noting a lack of assessment of the overall impacts within the EA. Cumulative noise and air quality were identified as specific concerns; however there was general dissatisfaction with the assessment of cumulative impacts. Given that the proposed modification largely relates to the underground mining layout, with very few surface impacts, the Department is satisfied that the noise and air quality assessments within the EA were appropriate. Nevertheless, these matters have been further discussed in **Section 5.4**.

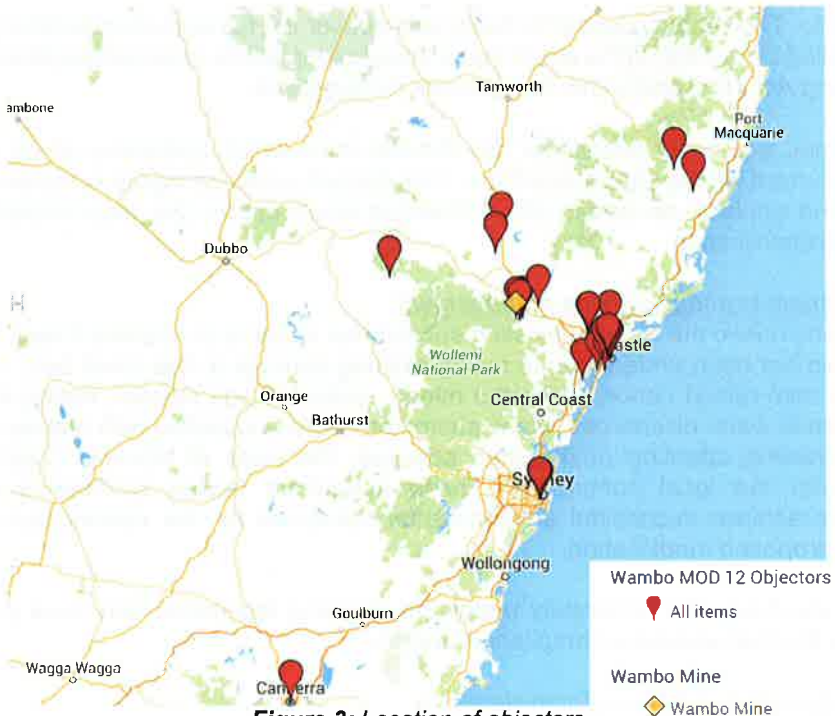

Figure 3: *Location of objectors*

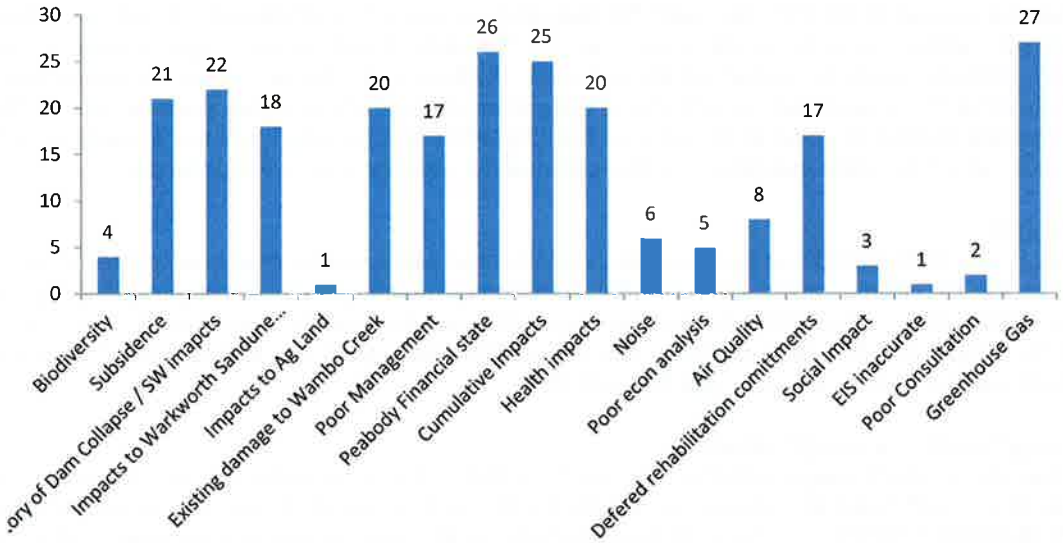

Figure 4: *Number of times issue was raised in submissions*

Peabody Energy Australia's financial state

Over 70% of submitters noted that WCPL's American parent company Peabody Energy recently filed for bankruptcy protection in the USA and raised concerns with the company's financial ability to meet its obligations under the development consent, particularly in relation to rehabilitation. The Department notes that Peabody Energy filed petitions for bankruptcy protection for the majority of its United States entities on 13 April 2016. Peabody Energy has advised that none of its Australian entities were included in this application and that its Australian operations have access to separate funding arrangements which enables it to continue operations at Wambo. Further detailed information on the filings has been provided in WCPL's RTS.

Further, strictly speaking, the Department (or a local Council) is not required by the EP&A Act to consider the financial viability of any applicant in determining a development application. This is because, the development consent relates to 'land', rather than a 'person'. The current application must be assessed in this manner.

However, the *Mining Act 1992* requires that applicants for mining leases must satisfy a 'fit and proper person' test. Further, there are mechanisms in place to ensure that the site is effectively rehabilitated. DRE holds substantial security deposits for the rehabilitation of every operating mine in NSW,

including Wambo. The security deposit is designed to cover the full cost of undertaking rehabilitation, and may be 'called in' by DRE in the event that a leaseholder fails to meet rehabilitation requirements set by the *Mining Act 1992* and within the relevant mining lease.

WCPL has lodged a security deposit for the Wambo mine which addresses all mining operations covered by its current Mining Operations Plan. This deposit would be regularly reviewed over the life of the project and would be revised to reflect changes resulting from the project/modification as well as progressive rehabilitation.

Surface water impacts and poor mine management
Most submissions raised the issue of existing subsidence impacts on Wambo Creek, and noted that repair works had not been undertaken to rectify existing damage to the creek bed. A large number of submissions also raised concern with the mine's water storage system, noting a previous dam collapse and waste water discharges. Many submitters were unsatisfied with previous management of the mine, drawing attention to the dam collapse, the state of Wambo Creek and WCPL's engagement with the local community. These submitters lacked confidence in the mine's management to achieve successful environmental outcomes for the existing operation and (by extension) the proposed modification.

Such matters are dealt with separately under the planning legislation and have previously been investigated by the Department's Compliance Branch.

Impacts to Warkworth Sand Dune Ecosystem
Eighteen submissions raised concerns over potential impacts on perched aquifers supporting the endangered *Warkworth Sands Woodlands*, with many of these submissions noting that this issue had not been assessed in the EA. However, the Department notes that *Warkworth Sands Woodland* is only present above Area 4, where mining of the Bowfield Seam is no longer proposed and subsidence impacts would be substantially reduced. Furthermore, the groundwater assessment demonstrates that there would be no cumulative drawdown in the shallow groundwater system in the areas of mapped *Warkworth Sands Woodland*. The Department is satisfied that the proposal would result in better environmental outcomes for this community than are currently approved.

Health impacts
Over 50% of submitters noted that health impacts associated with noise and air quality had not been assessed in the EA. Many raised concern that community health would be compromised by the proposed modification when considering the existing poor air quality surrounding the Hunter Coalfield. The Department notes that the proposed modification would not significantly change the already approved air quality impacts (see **Section 5.4**).

Deferred rehabilitation commencement
Concern was also raised in regards to the proposed extension of time for open cut mining operations, insofar as this could lead to deferral of rehabilitation commitments. However, under existing conditions of consent, WCPL is required to progressively rehabilitate the site, including areas of open cut mining. This has been further addressed in **Section 5.4**.

4.3.2 Support
One submission in support was received from a regional resident who emphasised the mine's role in providing local employment and indirect benefits to local service providers. This submission noted that approval of the proposal would provide job certainty and ongoing contributions to the local economy.

5. ASSESSMENT

In assessing the merits of the proposal, the Department has considered the EA, submissions on the proposal (including those from agencies and the IESC) and WCPL's RTS. The Department considers the key assessment issue to be the proposal's subsidence impacts and related potential impacts to surface water, groundwater and biodiversity values. Consideration of these key impacts is provided in **Sections 5.1 – 5.3**, with other impacts considered in **Section 5.4**.

5.1 Subsidence
5.1.1 Introduction
Underground mining commenced at Wambo in 1969 as part of the former Homestead and Wollemi Mines, both of which used bord and pillar and longwall mining methods to extract coal from the

Whybrow Seam. Under DA 305-7-2003, granted in 2004, WCPL is permitted to develop multi-seam mining operations in the Whybrow, Wambo, Arrowfield and Bowfield coal seams.

The proposed modification would involve a realignment and extension/relocation of the approved South Wambo Underground Mine longwall panels and mining of the Woodlands Hill Seam rather than the Bowfield Seam (see **Section 2**). The modification would cause surface and sub-surface subsidence impacts, including cumulative subsidence impacts, which could affect a range of built and natural features. The EA includes a detailed subsidence assessment undertaken by Mine Subsidence Engineering Consultants (MSEC). The subsidence impact zone associated with the modification was determined as being the greater of the 20 millimetre (mm) predicted subsidence contour and a 26.5 degree angle of draw from the proposed longwalls.

In accordance with the Department's standard practice for managing mine subsidence, WCPL is subject to existing consent conditions which stipulate key subsidence performance measures and require the development of a detailed Extraction Plan to govern the extraction of approved longwall panels. The Extraction Plan is required to be approved by the Secretary before carrying out any second workings (such as longwall panel extraction).

5.1.2 Existing Environment

The surface in the proposed mining Area 1 (ie above longwalls WHLW1 to WHLW5 and WHLW20 to WHLW22) has already been affected by the overlying Wambo Open Cut Mine (see **Figure 2** and **Figure 5**). These longwalls would be extracted above the existing United Collieries longwalls in the Arrowfield Seam and beneath the Wambo Open Cut pits.

The natural surface elsewhere above the proposed mining area generally falls from the west towards the east. The high point above the proposed longwalls is approximately 210 m AHD on steep slopes beneath the Wollemi Escarpment. The low point above the proposed longwalls is approximately 60 m AHD, along the lower reaches of North Wambo and Wambo Creeks. The proposed longwalls would extract beneath the existing Homestead/Wollemi workings in the Whybrow Seam and the previously extracted North Wambo Underground Mine longwalls in the Wambo Seam.

Table 3 shows the stratigraphic sequence (ie descending order) and the range of cover depths and interburden thickness for the key coal seams and mining Areas at Wambo. **Figure 5** shows the existing workings in the Arrowfield Seam (United Mine), Wambo Seam (North Wambo Underground Mine) and Whybrow Seam (Homestead and Wollemi mines), with an overlay of proposed longwalls in the Woodlands Hill Seam and Arrowfield Seam.

Table 3: *Coal seams (in descending stratigraphic sequence), depth of cover and interburden thickness for the Homestead/Wollemi, North Wambo Underground and South Wambo Underground mines (as modified)*

Seam	Mine Areas	Existing workings & status	Depth of cover (m)	Interburden thickness
Whybrow	1, 2 and 3	Homestead & Wollemi Mines – bord and pillar and longwall mining completed in 2002	50 - 250	-
Wambo	1 and 2	North Wambo Underground Mine – longwall mining completed in 2016	50 – 350	55 – 95 metres below the Whybrow Seam
Woodlands Hill	1, 2 and 3	Proposed longwall mining under this modification	80 – 490	110 – 150 metres below the Wambo Seam
Arrowfield	1, 2, 3 and 4	Approved and proposed longwall mining under this modification. Also United Colliery – longwall mining completed in 2010	175 – 560	40 – 60 metres below the Woodlands Hill Seam

Depths of cover above the Woodlands Hill Seam are shallowest in the north-eastern part of the proposed mining area, varying from 80 m to 255 m beneath the Wambo Open Cut Mine. The depths of cover are greatest in the south-western corner of the proposed mining area, varying up to 490 m beneath the steep slopes at the base of the Wollemi Escarpment.

The depths of cover above the Arrowfield Seam vary from 270 m in the north-eastern corner, to a maximum of 560 m in the western part of the proposed mining area. The depth of cover directly above the existing Homestead/Wollemi workings in the Whybrow Seam varies from 50 to 250 m. The depths of cover above existing workings in the Wambo Seam varies from 50 m to 350 m. The Bowfield Seam (no longer proposed to be mined) is stratigraphically lower than the Arrowfield Seam.

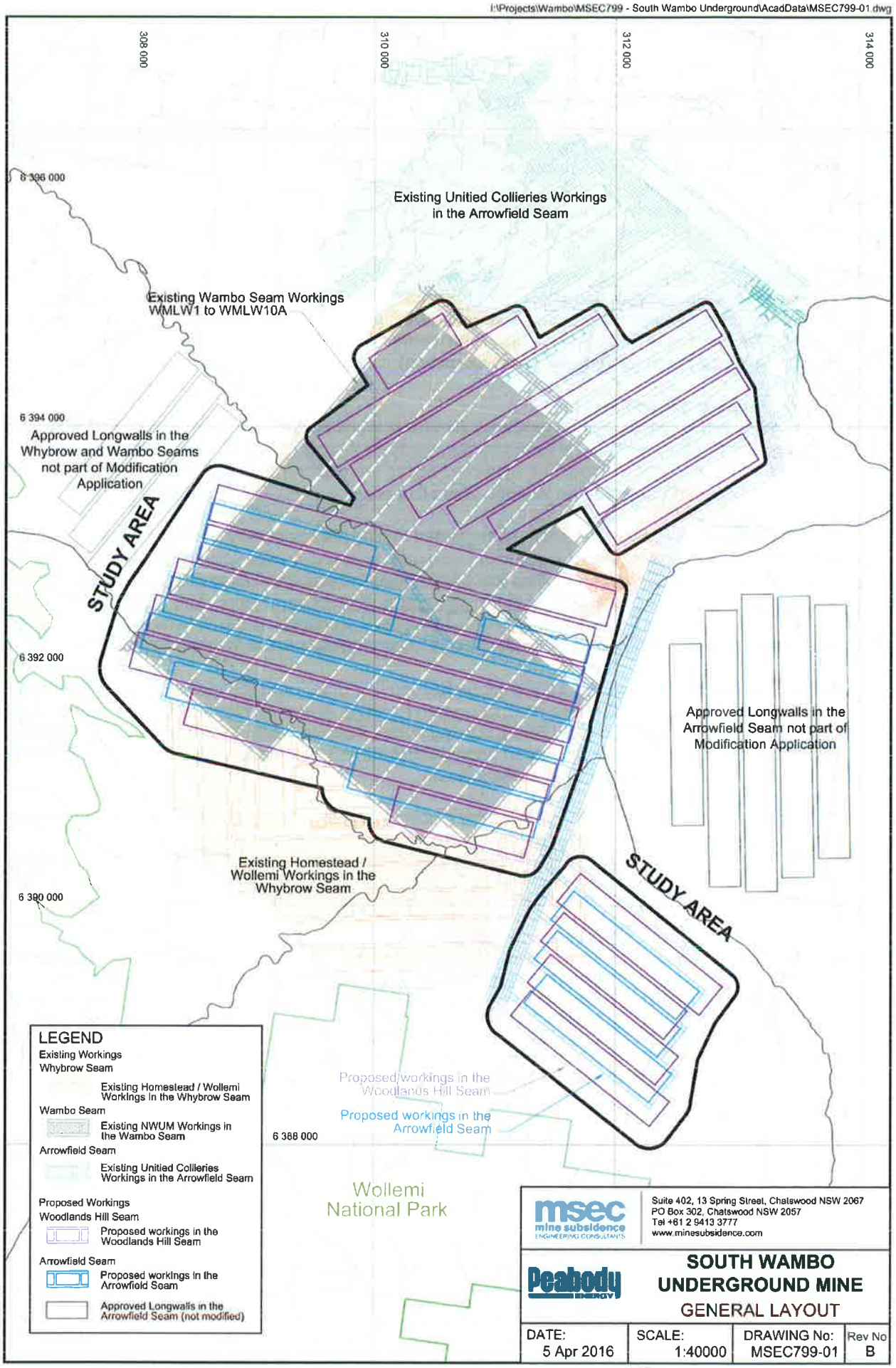

Figure 5: *Existing and proposed workings at the South Wambo Underground Mine, Areas 1, 2 and 3 (NB remaining approved longwalls in Area 4 are shown to the right)*

The interburden thickness between the Woodlands Hill and Arrowfield Seams varies between 40 m and 80 m. The interburden thickness between the Woodlands Hill and Wambo Seams varies between 110 m and 150 m above the proposed longwalls. The interburden thickness between the Wambo and Whybrow Seams varies between 55 m and 95 m. **Figure 6** shows the proposed layout of the longwalls in the Woodlands Hill and Arrowfield Seams respectively.

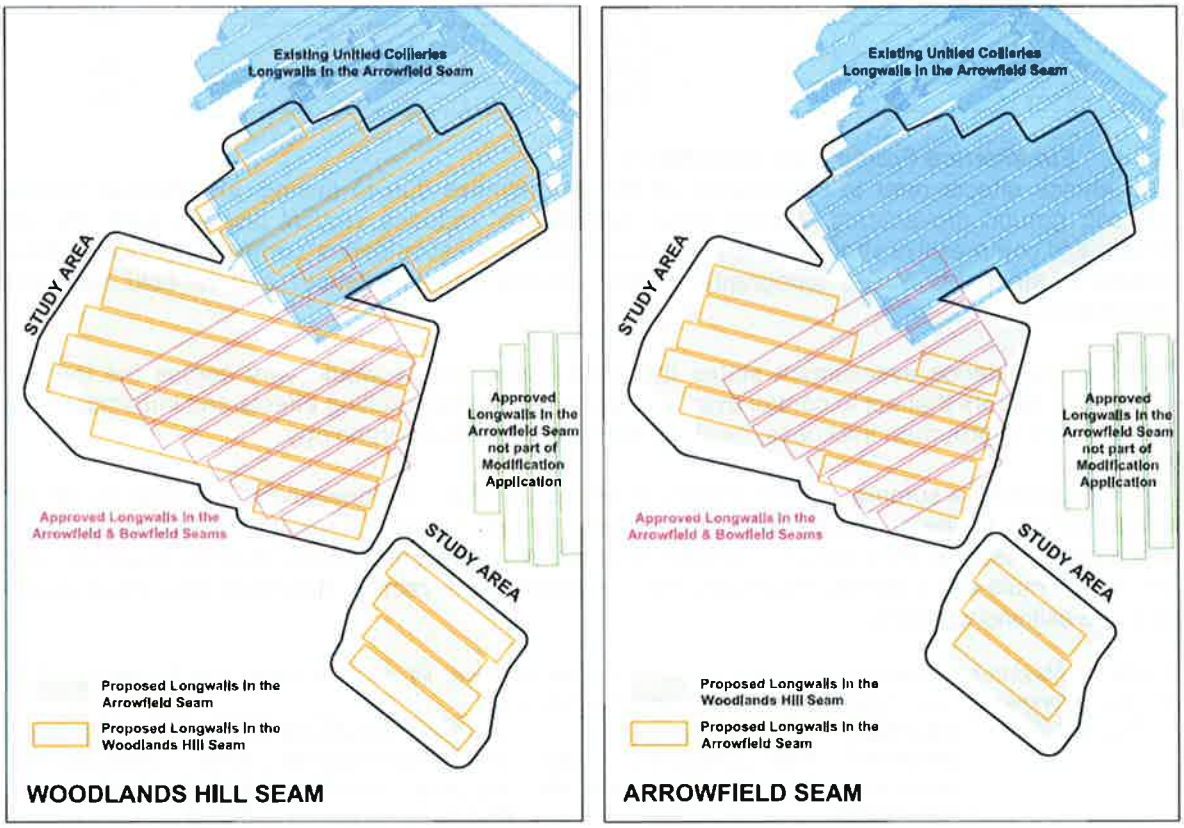

Figure 6: *Proposed longwall layouts in the Woodlands Hill and Arrowfield Seams, Areas 1, 2 and 3*

5.1.3 Mining Geometry

The key elements of the geometry of the proposed longwalls are shown in **Table 4**. The approved longwalls in the Arrowfield Seam on the eastern side of Wollombi Brook are not proposed to be modified other than by no longer proposing to mine the underlying Bowfield Seam.

Table 4: *Geometry of proposed longwalls in the Woodlands Hill and Arrowfield Seams, Areas 1, 2 and 3 only*

Longwall	*Mining Area*	*Overall void length including installation heading (m)*	*Overall void width including first workings (m)*	*Overall tailgate chain pillar width (m)*
Woodlands Hill Seam				
WHLW1	1	2,925	255	-
WHLW2	1	2,645	215	35
WHLW3	1	2,405	215	35
WHLW4	1	1,465	215	35
WHLW5	1	1,365	255	35
WHLW6	2	3,405	305	-
WHLW7	2	3,325	305	35
WHLW8	2	3,485	305	35
WHLW9	2	3,625	305	35
WHLW10	2	3,645	305	35
WHLW11	2	3,055	305	35
WHLW12	2	1,155	305	35
WHLW16	3	1,470	305	-
WHLW17	3	1,355	305	35
WHLW18	3	1,305	305	35
WHLW19	3	1,505	305	35
WHLW20	1	715	305	-
WHLW21	1	1,935	305	35
WHLW22	1	2,415	305	35

Arrowfield Seam				
AFLW1	1	1,405	305	-
AFLW2	1	1,705	305	35
AFLW2a	1	885	265	35
AFLW3	1	3,485	305	35
AFLW4	1	3,625	305	35
AFLW5	1	3,275	305	35
AFLW6	1	1,595	305	35
AFLW15	3	1,325	305	-
AFLW16	3	1,305	305	35
AFLW17	3	1,330	305	35

5.1.4 Subsidence Predictions and Effects

Subsidence effects refer to deformation of the groundmass due to mining, including all mining-induced ground movements. 'Conventional subsidence' includes vertical displacement, tilt, and tensile and compressive strains. Additional 'non-conventional subsidence' components include those arising in steep or incised topography (valley closure and upsidence) and far-field horizontal movements.

MSEC's subsidence assessment states that subsidence effects would vary across the longwall areas. The factors that act to control overall subsidence and its resulting effects and impacts include cover depth, interburden thickness, local geology and local geomorphology.

Table 5 provides a summary of the maximum predicted values of conventional subsidence, tilt and curvature due to the proposed extraction of each seam. These values do not include previous movements resulting from previous extraction in the Whybrow and Wambo Seams. However, they do include multi-seam effects associated with the proposed extraction that result from the presence of these existing workings.

Table 5: *Maximum predicted additional conventional subsidence, tilt and curvature due to mining of the proposed longwalls in the Woodlands Hill and Arrowfield Seams*

Seams	***Maximum predicted total conventional subsidence (mm)***	***Maximum predicted total conventional tilt (mm/m)***	***Maximum predicted total conventional hogging curvature (km^{-1})***	***Maximum predicted total conventional sagging curvature (km^{-1})***
Woodlands Hill Seam only	3,200	50	1.5	1.5
Woodlands Hill and Arrowfield Seams	4,050	50	1.5	1.5

The maximum predicted additional subsidence resulting from mining of the Woodlands Hill and Arrowfield Seams is 4.05 m, which represents 68% of the total proposed extraction height of 6 m. This value is less than 100% of the total extraction height due to the stagger between the longwalls in each of the seams and the relatively high depths of cover.

Table 6 summarises the predicted total conventional subsidence effects over the proposed modification area and compares these with corresponding figures for the approved project. These values are the maxima due to existing and proposed mining in the Wambo, Woodlands Hill and Arrowfield/Bowfield Seams. The maximum predicted total subsidence due to mining in the Wambo, Woodlands Hill and Arrowfield Seams based on the proposed modification layout is 6.25 m, which represents around 78% of the total extraction height of 8 m. The maximum predicted total subsidence occurs above WMLW5, WHLW8 and the chain pillar between AFLW2 and AFLW3.

Table 6: *Comparison of maximum predicted total subsidence parameters based on the approved and proposed layouts due to mining in the Wambo, Woodlands Hill and Arrowfield/Bowfield Seams*

Layout	***Maximum predicted total conventional subsidence (mm)***	***Maximum predicted total conventional tilt (mm/m)***	***Maximum predicted total conventional hogging curvature (km^{-1})***	***Maximum predicted total conventional sagging curvature (km^{-1})***
Approved Layout	9,000	90	>3.0	>3.0
Modified Layout	6,250	75	>3.0	>3.0
Longwalls located east of Wollombi Brook				
Approved Layout	6,950	90	>3.0	>3.0

Modified Layout	2,750	50	1.5	1.5

Note: These values do not include subsidence due to the previously extracted Homestead/Wollemi workings in the overlying Whybrow Seam and the existing United Collieries longwalls in the Arrowfield Seam.

MSEC's assessment notes that when the Whybrow Seam is also taken into consideration, the maximum predicted total subsidence is 8.2 m, which represents approximately 75% of the total extraction height of 11 m. This maximum predicted total subsidence would occur above longwalls AFLW4 and AFLW5. Under both scenarios, the maximum total predicted subsidence occurs above the north-eastern parts of the longwalls, where depth of cover is the shallowest and the surface is already predominately altered and disturbed due to open cut mining operations.

The maximum predicted total subsidence parameters for the longwalls located east of Wollombi Brook (ie Area 4) reduce as a result of the proposed modification. The maximum predicted total vertical subsidence based on the proposed layout is approximately 40% of the maxima previously predicted for the approved layout.

As can be seen from **Table 6**, the maximum predicted total subsidence and tilt are both less than predicted for the approved layout. The predicted subsidence decreases under the proposed modification layout for the following reasons:

- the proposed longwalls in the Woodlands Hill and Arrowfield Seams are staggered (ie offset) rather than stacked (ie directly above and below), as previously approved. This means that the subsidence maxima for each seam are offset rather than coincident;
- the interburden thickness between the proposed Woodlands Hill and Arrowfield Seams is greater than that based on the approved Arrowfield and Bowfield Seams; and
- decreased mining heights: the proposed mining heights for the modified layout would be between 2.1 m and 3 m in the Woodlands Hill Seam and 2.9 m and 4.1 m in the Arrowfield Seam, whereas under the approved layout, mining heights were proposed to be between 3.2 m and 4.2 m for the Arrowfield Seam and 3 m and 4.5 m for the Bowfield Seam.

While maximum predicted total subsidence would decrease, the surface area potentially affected would increase from 860 ha (as approved) to 1,700 ha. However, the majority of this additional surface area is above the existing Homestead/Wollemi workings in the Whybrow Seam, above the existing United Collieries longwalls in the Arrowfield Seam, or affected by the Wambo Open Cut. The total area that has not been previously affected by mining operations and not previously approved for mining impacts is 185 ha.

The maximum predicted total hogging and sagging curvature are similar to those previously predicted, since these parameters are largely governed by previous extraction of longwalls in the shallower Wambo Seam.

The Department accepts that it is not simple to predict relationships between curvature and strain for multi-seam mining conditions, since there is very limited empirical data in Australian coal mines to establish such relationships. Relationships between curvature and strain for multi-seam mining conditions are not linear, as localised strains develop as a result of remobilising the existing goaf and chain pillars in the overlying seam, which is not directly related to curvature. The most extensive nearby multi-seam strain data comes from the North Wambo Underground Mine and the Blakefield South Mine. The magnitudes of strains for the proposed longwalls are expected to be similar to those observed for multi-seam longwall extraction at North Wambo Underground Mine.

Predicted far-field movements are very small and could only be detected by precise surveys. The Department is satisfied that far-field horizontal movements and their effects on natural and built features near the proposed longwalls are unlikely to be significant or to cause any adverse impacts.

The Department notes that it is also likely that some non-conventional ground movements would occur in the vicinity of the proposed longwalls due to the multi-seam mining conditions and near-surface geological features. Whilst noting that such subsidence movements may occur, MSEC predicts they are unlikely to cause any adverse impacts, and that any impacts which do occur would not be beyond the scope of those already approved under the current mining layout and would be able to be effectively managed. For Area 3, where additional longwalls are proposed, it is considered that impacts would be of the order and magnitude experienced at North Wambo Underground Mine, which have been effectively managed to date.

The Department is satisfied that an appropriate subsidence prediction model has been used and notes that the model is already calibrated to measured heights of fracturing for a given mining

geometry and geology and therefore has allowances for natural variations built into it. The Department considers that MSEC's subsidence predictions are conservative.

5.1.5 Surface Features and Potential Impacts

The land in the eastern part of the proposed modification area has been partially cleared and is used for light grazing. Consequently, there are a number of farm-related facilities that could be affected by subsidence, including fences, dams and groundwater bores. WCPL has existing management and mitigation measures in place for these features. These would be reviewed and revised (if necessary) as part of the Extraction Plan process for the proposed longwalls.

Other built features in the vicinity of the proposed longwalls are few, and include unsealed roads, drainage culverts, water pipelines, powerlines and telecommunications cables that are all owned and maintained by WCPL. There are no other public utilities within the proposed modification area. There are no industrial, commercial or business establishments identified within the proposed modification area, other than the mine-related infrastructure associated with WCPL's open cut and underground mining operations.

There are a number of significant natural and heritage features located above and in the vicinity of the proposed longwalls. Impacts on natural features are discussed below and in **Sections 5.2 – 5.3**. Impacts on Aboriginal and historic heritage features are discussed in **Table 14** in **Section 5.4**.

Cliffs

MSEC's subsidence assessment categorised cliffs as either 'cliffs' or 'minor cliffs' according the definitions provided in the Department's *Standard and Model Conditions for Underground Mining* (DPE 2012).

The cliffs associated with the Wollemi Escarpment are located a minimum distance of 325 m from WHLW10 and 310 m from AFLW5 southwest of the proposed longwalls (see **Figure 7**). This section of cliff line is also located at a minimum distance of 210 m from the previously extracted Longwall 13 of the Homestead/Wollemi workings in the stratigraphically-higher Whybrow Seam.

The section of the Wollemi Escarpment located closest to the proposed longwalls comprises a series of disjointed cliffs and minor cliffs having an overall length of approximately 1 km. The cliffs are all located outside the 26.5 degree angle of draw and are predicted to experience less than 20 mm vertical subsidence and no significant conventional tilts, curvatures or strains.

The cliffs could experience low level far-field movements of up to around 60 mm. MSEC reports that these movements are expected to be bodily movements towards the extracted longwalls and are not expected to be associated with any significant strains. Therefore it is unlikely that the cliffs associated with the Wollemi Escarpment would be adversely impacted by far-field horizontal movements. The Department accepts that it is unlikely that these cliffs would experience any adverse impacts as a result of mining. Under existing conditions of consent, WCPL must prepare a Land Management Plan for the Secretary's approval as part of the Extraction Plan required for approval of second workings (ie longwall extraction). The potential for impact on these cliffs would be considered in more detail in relevant Extraction Plans.

Steep Slopes

Steep slopes beneath the Wollemi Escarpment are located above the western ends of proposed longwalls WHLW8 to WHLW11 in the Woodlands Hill Seam and proposed longwalls AFLW2 to AFLW5 in the Arrowfield Seam. The previously extracted Longwalls 11 to 13 of the Homestead/Wollemi workings in the stratigraphically-higher Whybrow Seam were also extracted directly beneath these steep slopes.

Table 7 provides a comparison of the maximum predicted subsidence parameters for the steep slopes due to mining under the currently approved mining layout (ie Wambo, Arrowfield and Bowfield Seams) and the proposed modified mining layout (ie Wambo, Woodlands Hill and Arrowfield Seams).

Table 7: *Comparison of maximum predicted total subsidence parameters for the steep slopes based on the approved and proposed layouts due to mining in the Wambo, Woodlands Hill and Arrowfield/Bowfield Seams*

Layout	***Maximum predicted total conventional subsidence (mm)***	***Maximum predicted total conventional tilt (mm/m)***	***Maximum predicted total conventional hogging curvature (km^{-1})***	***Maximum predicted total conventional sagging curvature (km^{-1})***

Approved Layout	4,050	35	0.50	0.70
Modified Layout	5,700	40	0.60	0.75

Maximum predicted total subsidence beneath steep slopes would increase as a result of the proposed modification. However, potential impacts on surface features are much more dependent on differential movements (ie tilt, curvature and strain) rather than on absolute movements (ie vertical subsidence). These parameters remain similar to, albeit slightly higher than, those previously approved. Given the predicted scale of the differential movements, some surface cracking and compression heaving could occur along the steep slopes located directly above longwall panels. MSEC recommended monitoring of steep slopes, with remediation methods of infilling, regrading and recompacting to be applied if necessary. Additional erosion protection measures may also be required in order to stabilise some slopes in the longer term. The Department is satisfied that WCPL has appropriate management and remediation methods in place which it would be required to implement as part of the Extraction Plan process.

Wollemi National Park

The Wollemi National Park is located a minimum distance of 340 m from the Woodlands Hill longwalls and 310 m from the Arrowfield longwalls (see **Figure 7**). The national park is predicted to experience less than 20 mm vertical subsidence and is not predicted to experience any significant conventional tilts, curvatures or strains and, therefore no significant impacts. Far-field horizontal movements of around 60 mm could occur at the boundary of the national park.

The consent already contains specific performance measures for Wollemi National Park ('negligible subsidence impacts' and 'negligible environmental consequences'). Under existing conditions of consent, WCPL is required to define more detailed performance indicators for all performance measures as part of each relevant Extraction Plan. Consent conditions also require WCPL to provide a suitable offset to compensate for the impact or environmental consequence in the event that any performance measure is exceeded, and it is not reasonable or feasible to remediate the impact or environmental consequence or remediation measures have failed.

The Department considers that the existing conditions of consent are adequate to avoid and to manage impacts (in the unlikely event that they occur) on the Wollemi National Park.

5.1.6 Conclusion

The Department is satisfied that MSEC's subsidence assessment has used conservative assumptions, and that the resulting subsidence predictions provide a sound basis to assess the proposals' potential subsidence impacts and associated environmental consequences. The subsidence assessment used empirical data from the current mining operations.

Existing conditions of consent include strict subsidence performance measures which act to protect all natural and built features in the underground mining area and require offsets if unforeseen impacts occur which cannot be successfully remediated. A comprehensive Extraction Plan must also be prepared following consultation with relevant agencies and be approved prior to extraction of any longwall. The Extraction Plan must contain a detailed subsidence impact assessment and a detailed subsidence monitoring program covering all significant built and natural features. The existing framework of conditions to manage subsidence and its potential impacts have so far proven successful in managing and mitigating subsidence risks.

The Department has carefully considered potential impacts of subsidence on natural and built features and is satisfied that these impacts are not significantly greater than, and in many cases are significantly less than, those already approved. The Department also considers that the current performance measures remain appropriate, and that these measures would provide adequate protection to all significant surface features in the modification area.

5.2 Water Resources

The modification would cause surface and sub-surface subsidence impacts, including cumulative subsidence impacts, which could affect a range of surface water and groundwater features. The EA includes a detailed Groundwater Assessment undertaken by HydroSimulations and a detailed Surface Water Assessment undertaken by Advisian.

5.2.1 Groundwater Resources

Local groundwater resources are characterised by two main aquifers, namely a highly productive alluvial aquifer system which interacts with the surrounding surface creeks, and a less productive,

deeper and more saline Permian porous rock aquifer system.

Groundwater Modelling and Monitoring

The Department and DPI Water (refer to DPI Water submission in **Appendix B**) are generally satisfied that the groundwater model is appropriate and fit for purpose. However, as noted in **Section 4.1**, DPI Water recommended that the groundwater model should be calibrated to reflect the impacts of increased vertical hydraulic conductivity across the broader model domain and the observed decline in the water table at bore P114 as reported in WCPL's 2015 Annual Review.

DPI Water has inferred that the fall in water table at this bore relates to a decline in the alluvial water table. However, WCPL and HydroSimulations report that P114 is actually located in weathered regolith. A transient electromagnetic (TEM) survey conducted in 2012 in the vicinity of Wollombi Brook, Wambo Creek and North Wambo Creek showed that P114 is located outside of the alluvial boundary. On this basis it is considered that P114 (a bore constructed in 1999 and believed to be about 11 m in depth) is located in weathered rocks (ie regolith) of Permian age. The observed drawdown of about 3 m exceeded predictions by about 1 m. The recent nature of the impact has meant that the reason for the difference between modelled and observed drawdown has not yet been conclusively determined. However, it could be attributable to the depth of the bore assumed in the model (construction details are not available) or the presence of local discontinuities generated by land subsidence.

On this basis, HydroSimulations stated that there has been no decline in alluvial water tables along North Wambo Creek and Wambo Creek that is inconsistent with the groundwater model's predictions. HydroSimulations further contended that the P114 monitoring results cannot be inferred to reflect increased vertical hydraulic conductivity across the broader model domain. Consequently, it did not consider it necessary to remodel potential groundwater impacts associated with the proposed modification.

HydroSimulations provided a detailed response to DPI Water's concerns regarding the groundwater model as an attachment to WCPL's RTS (see **Appendix C**). The Department notes that calibration of a groundwater model is a lengthy process that can take many months. Having noted DPI Water's concerns and taken HydroSimulations response into account, the Department does not see the merit in requesting recalibration of the model to take into account the latest readings at P114 prior to determining the modification. In particular, the Department does not consider an additional 1 m of drawdown at a single bore to be regionally significant, especially given that available evidence suggests that this bore is located in Permian material and not alluvium. Furthermore, should the groundwater model be recalibrated to reflect all recent monitoring, it is likely that the latest readings at P114 would cause only a very minor change in the model's calibration performance statistics (currently well within the targets suggested by relevant modelling guidelines). It is also noted that the groundwater model has been previously peer reviewed by Dr Frans Kalf and found to be adequate. Nevertheless, the Department supports the model being recalibrated following the 2016 Annual Review, if the results show a similar trend, or elsewise as part of the regular groundwater model update schedule. Hydraulic conductivity and connectivity is further discussed in **Section 5.2.3**.

The IESC raised concern that the numerical groundwater model combines the alluvium and regolith and recommended that these should be separated. WCPL and its consultants confirmed that 'layer 1' of the model is used for both the alluvium and regolith. However, the two geologies are assigned separate (ie different) recharge parameters, storage parameters and hydraulic conductivities. Furthermore, the regolith is dry both before and after mining. The Department accepts this as an appropriate approach and notes that neither DPI Water nor the peer reviewer raised similar concerns and all parties are satisfied that the groundwater model is fit for purpose.

DPI Water recommended that WCPL make a commitment to construct additional paired monitoring bores within the interburden aquifer at sites P114 and P116. This has been an ongoing request from DPI Water since the assessment of Longwall 10A (MOD 14 in 2015). DPI Water notes the potential risk of increasing the fracture interconnection between several mined coal seams up to the alluvial aquifer and surface water systems (see **Section 5.2.3** for further discussion).

The Department and DPI Water agree that DPI Water's recommendation for additional paired monitoring bores relates to the development consent and is independent of MOD 12. However, the EA and existing conditions of consent require WCPL to review and revise the mine's Groundwater Monitoring Program to address the proposed modification. The Groundwater Monitoring Program is

rquired to be prepared in consultation with the DPI Water. The Department would look to revisit the question of additional monitoring bores, in consultation with DPI Water, as part of this process.

Assessment of Impacts

- *Alluvial Aquifers*

Groundwater flow patterns within the shallow alluvial aquifers reflect topographic levels and the containment of alluvium within the principal drainage pathways. **Figure 7** shows mapped alluvium in the vicinity of the proposed modification area, together with the four proposed mining areas. HydroSimulations reports that the alluvial aquifer is responsive to rainfall recharge and it is likely that the alluvium plays an important role in supplying recharge to the underlying Permian strata as well as contributing baseflow to surface water features (ie watercourses).

The EA contains an assessment against the minimal impact considerations of the *NSW Aquifer Interference Policy* (AIP) for both highly productive and less productive groundwater systems. Only the Wollombi Brook alluvium and a small portion of Wambo Creek alluvium falls within the boundary of DPI Water's *'Highly Productive' Hunter Alluvial Water Source*, with all remaining alluvial and porous rock systems aquifers being 'less productive'.

In regard to potential impacts on alluvial aquifers, HydroSimulations concluded that:

- there are no alluvial aquifers above Areas 1 and 4 (Area 4 avoids the Wollombi Brook's alluvium);
- fracturing to the surface is not expected above Area 3; and
- extraction of the shallower seams has already occurred in Area 2.

For the 'highly productive' alluvium, the EA concludes that there would be limited Level 2 impacts to water table and water pressure (ie >2 m water table decline cumulatively at any water supply work) but Level 1 impacts for water quality. One private bore screened in the Wambo Creek alluvium (GW078577) has a predicted drawdown of 2.1 m for the approved project and 2.2 m under the proposed modification. The Department is satisfied that this difference is not significant in itself. The proposal is not expected to affect any other private user of alluvial groundwater. Notably, there would be no additional drawdown in the Wollombi Brook alluvium.

The alluvium associated with Wollombi Brook is located immediately adjacent to the proposed WHLW6 to WHLW12 and AFLW1 to AWLW6. This alluvium is predicted to experience up to 100 mm of vertical subsidence. However, it is not predicted to experience any measurable tilts, curvatures or strains. The alluvium is also partially located above the proposed WHLW19 and AFLW17 and is predicted to experience vertical subsidence up to 2.2 m.

There is a potential risk that the proposed shift from mining the deeper (approved) Bowfield Seam to the shallower Woodlands Hill Seam in Area 2 would exacerbate fracturing up to the Wambo Seam, in which mining has caused fracturing up to the Whybrow Seam, in which mining has caused fracturing up to the Wambo Creek alluvial and surface water systems. While this area is already fractured to surface, DPI Water has advised that, as a fracture doubles in width, the potential flow volume is cubed. Consequently, the ability to transmit saline water upwards to the alluvium could increase exponentially over the long term in areas where fracturing is increased. Goafing and fracturing and the resultant increase in surface contact area between Permian rock and percolating groundwater could potentially expedite the release of additional soluble salts previously held tightly within low-permeability interburden.

It is generally accepted that discharge of saline hard rock groundwater to the alluvium in the Hunter Valley would have been historically limited, due to the low vertical conductivity of the Permian strata. Nonetheless, over long periods of time (ie millennia) salinity can build up at the base of and around the edges of alluvial sediments. During and immediately after mining, this salinity build up is arrested as a result of mine-related groundwater drawdown. However, over the long term, ingress of water from the surface and from up-gradient Permain strata eventually fills the groundwater 'void' caused by mining. Increased fracturing may then allow larger quantities of this saline groundwater to eventually rise into the alluvium, displacing the better quality alluvial groundwater.

To evaluate such a complex issue (ie the likelihood of and time over which such changes might occur), the Department and DPI Water predominantly rely on available groundwater modelling. The proposal's groundwater model indicates that only minor long-term incremental increase in salinity is likely to result, beyond that already approved under the existing consent. The groundwater model did not indicate that the proposal would lead to any risk of reduced beneficial use for the highly productive alluvium. The modelling demonstrates no potential for increased flux of more saline water from the Permian strata to the alluvium for a period of at least 100 years, and only minor zones of

enhanced upflow to the alluvium after 200 years along the central part of North Wambo Creek and along Stony Creek near its confluence with Wambo Creek.

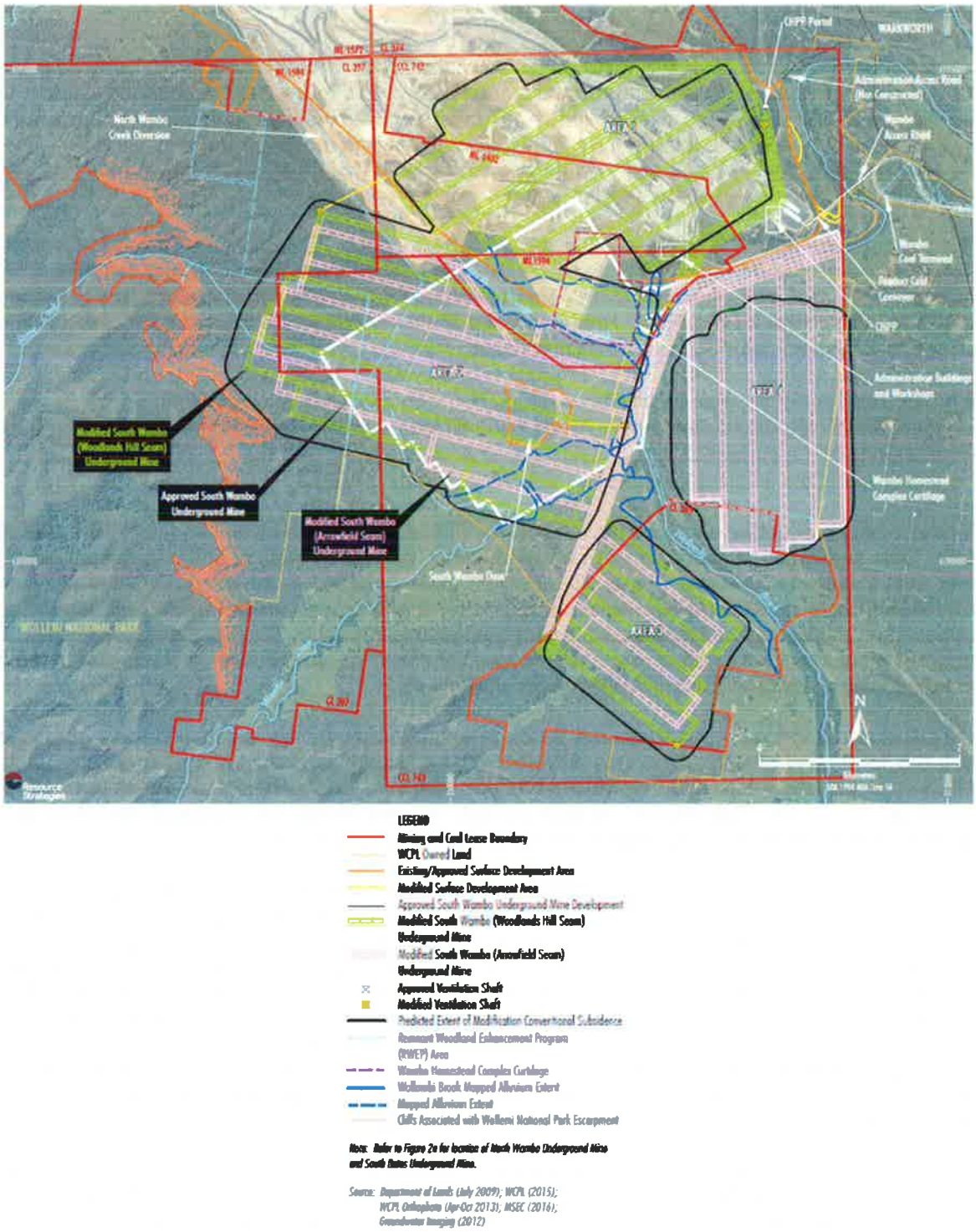

Figure 7: *Mapped alluvium in the vicinity of the proposed modification are*

Groundwater levels across the footprint of the South Wambo Underground Mine are expected to reach equilibrium at about 15 m below initial conditions (ie below the alluvium) due to permanent changes in hydraulic conductivity and storage where subsidence would occur. The proposed modification would also have no discernible effect on stream baseflow or natural river leakage for Wollombi Brook beyond already approved impacts (see **Section 5.2.2**).

As noted above, the Department and DPI Water have been (and remain) generally satisfied that the groundwater model is appropriate and fit for purpose. The Department is satisfied that there would be no change in the integrity of the hydrogeological connections between Wollombi Brook and the Permian aquifers (see also below and **Section 5.2.3**). The Department is therefore satified that there would be a negligible effect on the long-term salinity of the 'reliable water source' of Wollombi Brook (ie within Level 1 minimal impact considerations).

In regards to the less productive alluvial aquifers, the Department is satisfied that the proposed modification would not increase previously approved impacts and that these impacts fall within the AIP's Level 1 minimal impact considerations. The proposal would cause negligible additional drawdown in the small portion of alluvium adjacent to North Wambo and Wambo Creeks, when compared with the approved mine layout (in the order of 0.2 m, ie significantly less that < 2 m).

DPI Water also noted that the Longwall 10A modification (MOD 14) resulted in further modelling of increases in vertical hydraulic conductivity. This additional modelling indicated only minor changes in predicted impacts. Nevertheless, since potential risks increase further under the proposed modifcation, the Groundwater Monitoring Program also needs to be supplemented to remain commensurate with the risk. This is discussed above and will be pursued as part of the Extraction Plan process.

- *Fractured Hard Rock Aquifers*

In regards to the less productive porous rock or fractured rock aquifer, the EA concludes that there would be Level 2 impacts to the water table (ie >2 m water table decline cumulatively at any water supply work) and water pressure, but that impacts to water quality would be Level 1.

As there is currently no Water Sharing Plan relevant to the porous rock aquifer and limited information available on the three privately-owned bores in this aquifer, it is difficult to determine the significance of these impacts. However, depending on the depth from which these bores pump, it is possible they may experience >2 m cumulative drawdown. However, the Department notes that this drawdown results from existing approvals rather than the proposed modification in itself. The proposed modification (in itself) is not expected to affect any private groundwater users.

Both the approved project and the proposed modification would cause depressurisation of the Permian strata. The Upper Permian coal measures (which are generally saline aquifers) within and around the mine footprint are already largely desaturated due to intensive mining at North Wambo Underground, United Underground and South Bates Underground. Additional depressurisation would occur from mining at the approved South Wambo Underground (ie the area subject to the modification application). Overall, historical and ongoing open cut and underground mining within the Wambo area and adjoining mining operations has created a regional zone of depressurisation within the coal measures.

Due to the proposed change from the Bowfield Seam to the Woodlands Hill Seam, it follows that there would be more drawdown in the Woodlands Hill Seam due to the proposed modification and less than previously predicted in the Bowfield Seam. The main effect from the approved project on hydraulic pressures within the Permian strata will occur to the immediate south and west (ie away from Areas 1 and 3 which are covered by the Commonwealth controlled action). The proposed modification would see the area of drawdown in the Permian strata extend slightly northwest towards Area 1 and southwards due to the extension of the mine plan. The Department does not consider this to be significant at the regional scale.

Other potential impacts of the proposed modification on groundwater resources include sub-surface fracturing and shearing of strata above the proposed longwalls resulting in changes in rock mass permeability and storage capacity. This has the subsequent effect of drawing groundwater that then enters the underground mining area. It also requires dewatering of the overlying workings to mitigate inflow risk to the active underground mining area.

The IESC raised some concern over the nearby location of the Redmanvale Fault and the Hunter Valley Cross Fault. The Hunter Valley Cross Fault is present within the northern boundary of the

mining lease and appears to underlie the alluvium in this region. WCPL has advised that this fault does intersect Area 1 of the mine layout for a distance of 1.6 km. The Department notes that the United Collieries workings have previously successfully mined through about 4 km of coal at the projected location of the fault, further to the north, with no adverse groundwater inflows reported.

Furthermore, history at the site indicates that faults are likely to act as barriers to local groundwater flow rather than conduits. This is supported by the current monitoring system whereby the fault is straddled by two piezometers (P16 and P20) which consistently differ in groundwater levels by 0.3 m. The Department is satisfied that, to date, there has been no evidence for the fault causing any significant disturbance to the groundwater flow pattern. In future, the monitoring system should allow early detection of any changes to this trend.

The combined peak predicted inflow rate to the Woodlands Hill and Arrowfield Seam workings for the proposed modified layout is approximately 3.5 megalitres per day (ML/day). This is approximately 0.3 ML/day higher than that for the approved layout; however the peak would occur around four to five years later under the modified layout. DPI-Water has advised that additional take of water from both alluvial and hard rock aquifers as a result of the proposed modification is covered by existing entitlements. These predicted inflows are generally similar to the modelled inflows to the North Wambo Underground Mine, which have been successfully managed to date.

5.2.2 Surface Water Resources

Wollombi Brook

Wambo Mine is situated adjacent to Wollombi Brook, southwest of its confluence with the Hunter River. Wollombi Brook drains an area of approximately 1,950 km² and joins the Hunter River about 5 km northeast of Wambo Mine.

As discussed in **Section 5.2.1**, Wollombi Brook is the most significant water resource in the vicinity of Wambo Mine. At its closest point, Wollombi Brook is located at a distance of 180 m to the proposed longwalls (WHLW9). At this distance Wollombi Brook would experience less than 20 mm of vertical subsidence and is outside the extent of measurable tilts, curvatures or strains associated with the proposed modification (see **Table 8**).

The proposed modification would have no discernible or negligible effect on stream baseflow or natural river leakage for Wollombi Brook, beyond the effects of approved mining. The Surface Water Assessment considered the cumulative nature (ie existing and approved impacts) of increased leakage from Wollombi Brook and concluded that the cumulative increase in leakage from the Brook is less than 0.1% of the mean annual flow in Wollombi Brook.

The IESC noted that impacts to Wollombi Brook were only discussed in the context of mean annual flow and considered that any impacts would be greater during periods of low flow. The contributing catchments above the Commonwealth controlled action area (see **Section 5.2.4**) are ephemeral streams, and therefore surface water flows in these creeks do not materially contribute to baseflows in Wollombi Brook. By way of example, Advisian's assessment indicates flows in excess of 1 ML/day in North Wambo Creek can be expected on approximately 34 days per year (9% of days), whereas Wollombi Brook is generally considered a semi-perennial stream with flow on over 80% of days.

The existing consent conditions contain performance measures for Wollombi Brook of 'negligible impact'. To date, the Department is satisfied that WCPL has met this performance measure. Given that the proposed modification would not significantly affect the frequency of flow in the contributing creeks, the Department is satisfied that the proposal would have a negligible impact on the low flow in Wollombi Brook.

Other Natural Streams

The majority of the land within WCPL's mining tenements drains via Wambo, Stony, North Wambo and Redbank Creeks to Wollombi Brook (see **Figures 2** and **7**). These creeks as less significant and productive than Wollombi Brook and have all been affected to some degree by previous mining in the area.

Table 8 provides a comparison of the maximum predicted subsidence parameters for Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek due to mining under the currently approved mining layout (ie Wambo, Arrowfield and Bowfield Seams) and the proposed modified mining layout (ie Wambo, Woodlands Hill and Arrowfield Seams).

Table 8: *Comparison of maximum predicted subsidence parameters for Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek due to approved and proposed mining*

Watercourse	Layout	Maximum predicted total subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvatures(km^{-1})	Maximum predicted total sagging curvature (km^{-1})
Wollombi Brook	Approved	<20	<0.5	<0.01	<0.01
	Modified	<20	<0.5	<0.01	<0.01
North Wambo Creek	Approved	8,150	100	>3.0	>3.0
	Modified	4,050	65	>3.0	2.4
Wambo Creek	Approved	1,650	16	0.20	0.15
	Modified	3,100	20	0.50	0.40
Stony Creek	Approved	4,900	30	0.55	0.75
	Modified	5,600	30	0.65	0.70

- *North Wambo Creek*

North Wambo Creek is a 4th order stream that is ephemeral with some standing pools along the lower reaches. The natural section of this creek (ie downstream of the creek diversion) commences above the tailgate of the proposed WHLW6 in the Woodlands Hill Seam. Proposed longwalls WHLW6, WHLW7 and some of AFLW2A would undermine 1.8 km of this natural section of North Wambo Creek. The natural section of this creek has been previously directly undermined by WMLW1 to WMLW8A in the Wambo Seam, with a total length of 3.3 km located above these longwalls.

Overall, the maximum predicted vertical subsidence and tilt for North Wambo Creek are less than the maxima predicted for the approved layout. The greatest cause of this improved outcome is that the two sets of longwalls would now be overlain in a staggered arrangement, resulting in less subsidence compared with the previously-approved stacked arrangement.

- *Wambo and Stony Creeks*

Wambo Creek is a 5th order stream that is ephemeral with some standing pools in the flatter sections. The proposal would see Wambo Creek directly undermined by WHLW11, WHLW12 and AFLW6 at a total length of 0.9 km. Wambo Creek has also been previously undermined by the Homestead/Wollemi workings in the Whybrow Seam, with a total length of 3.4 km located directly above these workings.

Stony Creek is a 4th order stream and contains sections with exposed bedrock which in some locations have formed into small cascades with isolated pools along the upper reaches. The proposed modification would directly undermine Stony Creek (longwalls WHLW10, WHLW11, AFLW4 and AFLW5) for a total length of 2.6 km. Stony Creek has been previously undermined by both the Homestead/Wollemi workings in the Whybrow Seam and by WMLW1 to WMLW6 in the Wambo Seam.

The Department notes that the maximum predicted subsidence parameters for Wambo and Stony Creeks are greater than the maxima predicted under the approved layout, largely due to more of the longwall panels being located directly under the creeks. These creeks may be potentially impacted by:

- ponding, flooding, erosion and scouring; and
- cracking in the creek beds and fracturing of bedrock.

- *Ponding Impacts*

MSEC's subsidence assessment predicts that there would be reversals of grade and ponding along North Wambo, Wambo and Stony Creeks potentially causing erosion and sedimentation issues. Due to the proposed longwalls being staggered, ponding impacts along North Wambo Creek are less than predicted under the approved layout. Six ponding areas are predicted to occur along the natural section of North Wambo Creek after the completion of the proposed longwalls, having maximum depths between 0.6 m and 2.2 m and overall lengths between 100 m and 450 m.

The predicted ponding along Wambo Creek is greater than that predicted based on the approved layout. Two ponding areas are predicted to develop after completion of the proposed longwalls, having maximum depths up to 1.7 m and overall lengths up to 400 m.

Five ponding areas are predicted to develop along Stony Creek after the completion of the proposed longwalls, having maximum depths between 0.4 m and 1.4 m and overall lengths between 100 m and 300 m. This predicted ponding is similar to that already approved.

The Department notes that the predicted areas of topographic depressions (ie ponding areas – see Figure 3.8 of Appendix C of the EA) generally do not coincide with areas of listed threatened ecological communities (both TSC and EPBC listed – see Figure 5 of Appendix D of the EA).

If adverse impacts were to develop as a result of localised ponding, it could be remediated by locally re-grading the streambeds, so as to re-establish natural gradients. The Department accepts this approach as reasonable and feasible and notes that such remediation works would be covered under the relevant management plans under existing consent conditions. Furthermore, the Department notes that the potential impacts are unlikely to increase the risk of flooding, or materially affect flood hazard or flood behaviour.

- *Surface Cracking Impacts*

Based on the subsidence predictions in **Table 8**, fracturing of the topmost bedrock in North Wambo, Wambo and Stony Creeks is likely to occur. The existing fractures along the section of North Wambo Creek located above the previously extracted longwalls within the Wambo Seam would also be reactivated. Cracking would be visible at the surface where surface soils are shallow or where the bedrock is exposed.

The creeks are ephemeral with surface water flows only occurring during short periods after rainfall events. MSEC predicted that in times of heavy rainfall, the majority of runoff would flow over the natural surface soil and stream beds and would not be diverted into the dilated strata below. In times of low flow and prior to remediation, surface water flows could be diverted into the dilated strata. The potential for complete hydraulic connectivity is discussed in **Section 5.2.3**.

- *Conclusions for Impacts to 'Other Natural Streams'*

Overall, the proposed modification would result in less impacts to North Wambo Creek, more impacts to Wambo Creek and similar impacts to Stony Creek when compared to currently approved impacts. Management strategies have previously been developed and applied for sections of creeks and drainage lines previously undermined. Remediation efforts for Wambo Creek may be more extensive than predicted for the approved layout. Remediation efforts for North Wambo Creek are likely to be less than previously predicted for the approved layout.

The Department notes that the nature of the potential impacts and the methods for remediation are not expected to change significantly as a result of the proposed modification. As at present, it may be necessary, at the completion of mining, to remediate some sections of the ephemeral drainage lines, particularly where depths of cover are shallowest.

Impact assessment, monitoring, mitigation and remediation of affected watercourses must all be addressed in detail in any Extraction Plan. To strengthen the existing conditions in regards to rehabilitation of watercourses, as part of its assessment of MOD 15 (approved in October 2015), the Department included an additional rehabilitation objective in the mine's consent requiring WCPL to ensure that all watercourses subject to subsidence impacts are hydraulically and geomorphologically stable, with riparian vegetation that is the same or better than prior to mining. This rehabilitation objective would apply to the proposed modification area.

Consequently, the Department is satisfied that potential impacts to surface water bodies above the proposed modification area would not be significantly different to those already approved. Further, that any adverse impacts that may occur would be appropriately detected, managed and remediated under the existing, contemporary conditions of consent.

<u>*North Wambo Creek Diversion*</u>

North Wambo Creek has been diverted around the active Bates South Open Cut Pit. The majority of the creek diversion is located upstream of the proposed longwalls. The downstream section of the creek diversion crosses proposed WHLW6 in the Woodlands Hill Seam, with a total length of 0.6 km (out of a total length of approximately 9.2 km) located above this longwall.

The primary purpose of the creek diversion is to operate as a water control system including a water control structure across North Wambo Creek at the north-western limit of the open-cut operations and a channel to allow passage of flows to the lower reaches of North Wambo Creek around the open cut pit. The diversion is a long-term water management structure that would be retained following the completion of mining. Both the practical and restorative aims and purposes of the creek diversion make it an important consideration for the Department when considering overall impacts to water resources.

Table 9 provides a comparison of the maximum predicted subsidence parameters for the North Wambo Creek Diversion due to mining under the currently approved mining layout (ie Arrowfield and Bowfield Seams) and the proposed modified mining layout (ie Woodlands Hill and Arrowfield Seams). Because Stage 3 of the creek diversion was constructed after extraction of the Whybrow and Wambo Seams in that location, the subsidence assessment only includes additional movements from the proposed longwalls.

Table 9: *Comparison of the maximum predicted subsidence parameters for the North Wambo Creek Diversion due to mining in the Woodlands Hill and Arrowfield/Bowfield Seams*

Watercourse	Layout	Maximum predicted total subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvatures(km^{-1})	Maximum predicted total sagging curvature (km^{-1})
North Wambo Creek Diversion	Approved	20	<0.5	<0.01	<0.01
	Modified	2,400	25	0.35	0.30

Under the approved layout, the creek diversion was predicted to experience low levels of vertical subsidence, as the approved longwalls were located at a minimum distance of 200 m. The creek diversion is now located directly above proposed longwall WHLW6 in the Woodlands Hill Seam. The other subsidence parameters also increase as a result of the proposed modification.

Ponding is predicted to develop in one location along the creek diversion as a result of the proposal, with a depth of 1.3 m and a length of 200 m. The Department notes that pools were a natural feature of North Wambo Creek prior to construction of the diversion. Fracturing and dilation of the topmost bedrock is also expected to develop along the section of the creek diversion located directly above proposed longwall WHLW6.

MSEC recommended that remediation strategies are developed so that any larger surface cracking within the alignment of the creek diversion can be remediated during active subsidence. The Department accepts this approach as reasonable and feasible and notes that such remediation works are already covered under management plans required under existing consent conditions.

Furthermore, the creek diversion is already subject to ongoing monitoring and maintenance, including additional tree and shrub planting, and weed management, in order to meet the long-term objectives for the diversion.

Aquatic Biota

The IESC noted that the potential impacts of subsidence on surface water resources could potentially cause ecological implications for aquatic biota within the proposed modification area. As discussed above, the Department is satisfied that the modification would not significantly change the surface and groundwater impacts of the approved development. Furthermore, subsidence-related impacts are unlikely to directly impact biodiversity values (see **Section 5.3**). Any incremental impacts can be managed through the existing management and response plans, as may be revised following the modification (see condition 6 of Schedule 6 of the consent). This includes the existing requirement for a Flora and Fauna Monitoring Program (see condition 44 of Schedule 4 of the consent) which outlines specific monitoring requirements for aquatic fauna, including freshwater macro-invertebrate monitoring incorporating an assessment of SIGNAL A values and water quality (eg temperature, pH and salinity).

Flooding

The IESC noted that information regarding flood volume, depth, duration, extent and velocity was not provided and that potential impacts to flood behaviour in the area of the proposed modification were only considered in the context of a levee to be constructed near the surface infrastructure area. In its response to the IESC, WCPL stated that the potential impacts and risks associated with changes in flood behaviour are considered to be low, and that the level of assessment in the EA is fit for purpose.

The Department notes that the design peak discharge in Wollombi Brook for a 10% and 1% Annual Exceedance Probability (AEP) was estimated at 1,000 m^3/second (s) and 2,891 m^3/s respectively, based on 53 years of data.

A TUFLOW hydrodynamic model was used to estimate design flood levels along Wollombi Brook and validated against recorded peak water levels in the Brook for five flood events between 2007 and 2015. The predicted peak flood levels in Wollombi Brook adjacent to the proposed infrastructure area is approximately 61.5 m AHD for the 1% AEP event. The impact of constructing the proposed

flood mitigation infrastructure would result in an increase in flood level of less than 0.05 m adjacent to the Wambo Mine access road and no change on non-mine owned land.

Overall, the Department is satisfied that the proposed modification would not increase the risk of flooding or materially affect either flood hazard or flood behaviour in the vicinity of the proposed modification. Predicted subsidence and ponding impacts are further discussed in **Section 5.1** and above, respectively.

5.2.3 Hydraulic Connectivity

The EA considers the potential for hydrological connectivity between the surface and the extracted longwall panels. For the purpose of subsidence assessment, the following four zones were adopted by MSEC:

- *caved or collapsed zone*: comprises loose blocks of rock detached from the roof and occupying the cavity formed by mining (ie the goaf);
- *disturbed or fractured zone*: comprises in-situ material that has undergone significant deformation and is supported by the material in the caved zone. This zone has sagged downwards and consequently suffered significant bending, fracturing, joint opening and bed separation;
- *constrained zone*: comprises confined rock strata above the disturbed zone which have sagged slightly but, because they are constrained by the disturbed zone, have absorbed most of the strain energy without suffering significant fracturing or alteration to the original physical properties. Some bed separation or slippage can be present as well as some discontinuous vertical cracks, but not to a degree or nature which would result in connective cracking or significant increases in vertical permeability. Some increases in horizontal permeability can be found; and
- *surface zone*: comprises unconfined strata at the ground surface in which mining-induced strains may result in the formation of surface cracking or ground heaving.

It is generally accepted that the height of discontinuous fracturing can extend 1 to 1.5 times the longwall width above an extracted seam. The overall void widths for the proposed longwalls are typically 305 m in the Woodlands Hill and Arrowfield Seams. However, the void widths of longwalls WHLW1 to WHLW5, WHLW16 and AFLW2A would vary between 215 m and 265 m. Given the proposed overall maximum void widths of 305 m, discontinuous fracturing could therefore extend 300 m to 450 m above the proposed longwalls in the Woodlands Hill and Arrowfield Seams.

This height would reach to the surface in large areas of the proposal, particularly to the northeast (see **Table 3**). However, fracturing to the surface does not always imply hydraulic connectivity between the surface and the mine, as the vertical fractures may be discontinuous due to the presence of strata layers with low permeability. Nonetheless, the Department considers that this potential for hydraulic connectivity requires further consideration of its potential environmental consequences (also discussed in **Sections 5.2.1** and **5.2.2**).

The interburden thicknesses between the Woodlands Hill and Wambo Seam varies between 110 m and 150 m. The interburden thickness between the Arrowfield and Woodlands Hill Seam varies between 40 m and 80 m. Based on MSEC's subsidence assessment, discontinuous fracturing would extend from the proposed longwalls up to the existing workings in the Wambo and Whybrow Seams and re-activate the existing goaf within those workings. Fracturing would extend to the surface where depths of cover are shallowest (ie the north-eastern parts of the longwalls). It is expected that there would be no hydraulic connection between the surface and seams in Area 3 where no fracturing to the surface is expected.

MSEC also does not expect that there would be a hydraulic connection between the surface and the proposed seams. No connection was previously observed after extraction of the longwalls at the North Wambo Underground Mine (which were extracted directly beneath North Wambo Creek at a depth of cover of approximately 100 m), after extraction of the Homestead/Wollemi workings in the Whybrow Seam directly beneath Stony Creek or after extraction of longwalls WMLW1 to WMLW8A in the Wambo Seam directly beneath both North Wambo and Stony Creeks.

More recent evidence from P114 (see **Section 5.1.1**) also supports the conclusion that highly connective fracturing between the surface and underground workings does not occur at Wambo Mine, namely:

- although groundwater levels at P114 have decreased, the shallow groundwater system at this location is not fully drained; and

- there was no observation of increased water make in the North Wambo Underground Mine workings, or the overlying Whybrow Seam workings during the extraction of Longwall 10A.

WCPL has previously committed (under MOD 15) to operate a remediation works program to reduce the hydraulic conductivity of any cracks that may open at the surface. This is based on the assumption that all significant cracks are expected to be visible at the surface. The Department accepts that this assumption is reasonable, since the bed of the creek diversion is mostly exposed rock, or else rock covered by soil typically less than 1 m in depth.

Cracks would be sealed using the following actions, to be commenced as soon as cracks appear:
- washing a slurry containing well-graded sandy silt into the cracks, using water from the mine workings; and
- infilling larger surface cracks with typical alluvial material with added bentonite or other clays as necessary.

In the event that inflow to the workings indicates that sealing is inadequate, the relevant surface pool would be drained by pumping to allow access for visual inspection and any required further remedial action, including the option of cement-based grouting. The Department is satisfied with this approach and notes that it would be further considered in detail as part of the Extraction Plan process for the proposed longwalls.

The other consideration for the Department is the probability of a high rainfall event occurring in the two to three week period between the longwall face first passing under the creek diversion and WCPL being able to undertake remediation works to reduce the inflow rate to acceptable levels. In the end, this is an unlikely possibility. It is also very unlikely that such a rainfall event would lead to substantial inflows to the mine workings, such as to pose concerns for mine safety.

Based on the Department's assessment of the subsidence impacts of the proposed modification on groundwater and surface water features, it is satisfied that these impacts are either less than or else not significantly greater than those already approved and that approval of the reorientation and extension in the area would not adversely affect these features. The Department is satisfied that the modification is unlikely to significantly increase the risk of long-term impacts of the project on nearby alluvial and surface water sources (including Wollombi Brook), beyond those permitted under the existing consent.

Existing conditions include strict subsidence performance measures which act to protect all natural features in the underground mining area and require offsets if unforeseen impacts occur which cannot be successfully remediated. The Department considers that the current performance measures remain appropriate, and that these measures would provide adequate impact protection to all significant groundwater and surface water features in the modification area.

A comprehensive Extraction Plan must also be prepared following consultation with relevant agencies and be approved prior to commencing the proposed longwalls. The Extraction Plan would detail the proposed subsidence impact assessment, monitoring and reporting frameworks for all natural features. It must also include detailed consideration of the potential for hydraulic connectivity and the proposed monitoring, management and remediation measures.

The Department notes that to further mitigate the risk of any unforeseen impacts on water sources, the Department has recently required WCPL to improve its existing water monitoring and contingency response plans. The Department is satisfied that the specific effects of the modification can be adequately managed through the consent's existing requirement to review the Surface Water and Groundwater Management Plans following approval of any modification.

5.2.4 Matters of National Environmental Significance

Following its review of WCPL's referral documentation, DoEE determined that there would likely be significant impacts on a water resource in relation to coal seam gas development and large coal mining development. Specifically, DoEE determined that the proposed action would be likely to have significant impacts on ground and surface water in the vicinity of the proposed mine.

As noted in **Section 3.4**, WCPL's referral to the Commonwealth contained only components (referred to as 'the action' in this section) of the proposed modification. The action is the proposed extension to underground coal mining operations in Areas 1 and 3, together with related additional surface infrastructure and activities necessary to support the extension of underground mining.

In considering whether to approve the action, the Commonwealth Minister must consider the advice received from the IESC. As discussed in **Section 4.2**, the IESC adopted the approach of considering *all* potential impacts, rather than the increased impacts over those currently approved, and also did not limit its advice to Areas 1 and 3, as covered by the action. As noted in **Section 4.2**, it is difficult to separate impacts specifically attributable to underground mining activities in Areas 1 and 3 from the overall modification. Nonetheless, the Department considers that impacts arising in these areas are adequately captured by WCPL's 'cumulative' approach to impact assessment. Even so, the Department has separated the Areas where possible, and where not possible, has assessed the four Areas together as a worse-case scenario for the action.

Groundwater Resources

The IESC advised that, for groundwater related matters:

- the groundwater modelling required further clarification and consideration. These issues have been addressed under *Groundwater Modelling and Monitoring* in **Section 5.2.1**;
- fracturing is predicted to reach the surface in some areas (see **Section 5.2.3**);
- the action would result in reductions of water pressure in the coal seams and in the overlying Triassic sandstones and potentially affect private water supply bores via drawdown;
- potential subsidence impacts to South Wambo Dam require further consideration regarding leakages and potential impacts to surface and groundwater; and
- further consideration should be given to groundwater dependent ecosystems (GDEs) and potential impacts of soil cracking and ponding on flora and fauna habitat (see Section **5.3.3**).

The Department first notes that, prior to the commencement of any coal mining in the regional vicinity of Wambo Coal Mine, the potentiometric surface within the Permian aquifers most probably reflected the topography, with elevated water levels/pressures in areas distant from the major drainages and relatively lower levels in areas adjacent to the alluvial lands. However, past and current open cut and underground mining in and around the action area has created a regional zone of depressurisation within the Permian coal measures.

Monitoring indicates that mining to date at Wambo Coal Mine has resulted in negligible drawdown in the overlying Triassic age sandstone and other strata. The action would likely result in additional depressurisation; however this is not expected to have any significant regional impact.

The value of a water resource is determined by its utility for third party uses, including environmental and other public benefit outcomes (as detailed in Section 5.2.1 of DoEE's *Significant Impact Guidelines – Water Resources* (2013)). There are 74 groundwater bores within a 5 km radius of the Wambo Coal Mine, of which 16 are registered for irrigation, domestic and/or stock use and three are of unknown use.

The Department is satisfied that the impacts on these bores would be no greater than those previously approved by both NSW and the Commonwealth. The Permian groundwater sources are generally low yielding and brackish to saline, and therefore generally have low resource potential (see **Section 5.2.1**). Potential drawdown impacts (including in relation to the more valuable alluvial water resources) have been discussed in under *Alluvial Aquifers*, in **Section 5.2.1** above.

Furthermore, in accordance with both the *NSW Aquifer Interference Policy* (2012) and existing consent conditions, WCPL is required to 'make good' impacts on privately-owned water bores where there is > 2 m cumulative drawdown, or cumulative pressure head decline of > 40% where the 'post Water Sharing Plan' pressure head above the base of the water source is less than 5 m.

The Department is satisfied that impacts to groundwater resources in the action areas (ie Areas 1 and 3) would be minimal and generally less than impacts already approved by NSW. In summary:

- Area 1 has already been subject to impacts from open cut mining operations and underground workings at United Mine. There are no alluvial aquifers above this area and therefore nil to negligible impacts are predicted for these more-valuable water resources; and
- subsidence in Area 3 is not expected to cause fracturing to the overlying surface due to high depth of cover (see **Section 5.1.2**), therefore no discernible loss of alluvial water resources is predicted within this area.

In regards to the IESC advice concerning South Wambo Dam, the Department notes that this dam falls outside of the action area and is covered by an existing condition of consent requiring that the dam be constructed to the satisfaction of DRE and the NSW Dams Safety Committee (DSC), with the design of the dam accompanied by a detailed assessment of the potential operational and environmental risks, particularly in relation to potential subsidence-related impacts. The existing and

recommended conditions also require the South Wambo Dam to be drained prior to the commencement of mining in the underlying longwalls to minimise the risk of operational or environmental impacts from subsidence, to the satisfaction of DSC.

Surface Water Resources
The IESC advised that, for surface water related matters:

- the surface water modelling and assessment required further clarification and consideration regarding flow regimes;
- further consideration regarding aquatic biota is required (see *Aquatic Biota* under **Section 5.2.2**);
- limited information on potential flooding impacts was provided (see *Flooding* under **Section 5.2.2**);
- potential subsidence impacts such as soil cracking, ponding and loss of surface water flows were not adequately assessed for listed flora (see **Sections 5.2.2** and **5.3**); and
- there may be impacts to Wollombi Brook during low flow events as a result of the action (see below and *Wollombi Brook* under **Section 5.2.2**).

- *Surface Water Assessment and Modelling*

The IESC asked for further consideration of surface water assessment and modelling. It specifically noted that the stream flow modelling is based on stream data in a separate catchment, that the assessment does not estimate the combined impacts to hydrology and water quality, that existing and planned water extraction and/or discharge was not decribed and details of surface water monitoring were not provided.

Given the ephemeral nature of flow in the creeks above the proposed modification area (ie not just the action area), the relatively short duration of available records and missing records due to equipment failure, available monitoring records at Wambo do not provide an adequate basis for characterising long-term average flow regimes. Consequently, two analogous catchments with comparable geology, landuse and climate were used in the model. For the purposes of the proposed modification (and consequently the action), the modelling is considered to be adequate to characterise the flow regime in North Wambo, Wambo and Stony Creeks.

The Department notes that combined impacts to hydrology and water quality were assessed in the EA's Surface Water Assessment and is satisfied that the impacts to surface water have been appropriately considered (see **Section 5.2.3**). Furthermore, surface water monitoring at Wambo is comprehensively detailed in the management and monitoring programs required under existing conditions of consent and are available on WCPL's website. These would be reviewed and, if necessary, revised following any approval of the proposed modification.

The IESC also noted some limitations with the use of the Australian Water Balance Model (AWBM) for the analysis of flow regimes. The Department is satisfied with AWBM as it is a well-recognised, standard model developed specifically for assessment of runoff in Australian catchments.

In regards to water extraction and/or discharge, it is noted that the proposed action does not include any material changes to the water management system, water supply or water demand approved for the mine. In addition, the mine's water balance has recently been reviewed as part of the EIS process for the United Wambo Open Cut project, including consideration of the proposed modification. The mine's water management strategy is based on containment of mine water within water storage dams and re-use at the mine. This limits the potential for off-site release of salt and heavy metals. Furthermore, any releases to Wollombi Brook are carried out in accordance with WCPL's EPL, within the limits imposed by the Hunter River Salinty Trading Scheme.

- *Wollombi Brook and Other Streams*

The IESC noted that one strategy to avoid, mitigate or reduce impacts of longwall mining is to alter the mine layout, including narrower longwalls and wider inter-panel pillars. The IESC noted that consideration should be given to reducing longwall extents and altering configurations in the vicinity Wollombi Brook and Stony Creek to reduce subsidence impacts. It is important to note that the proposed longwalls in Area 3 (ie those closest to Wollombi Brook) are already offset from the stream's highbank by an angle of 26.5 degrees from the vertical plus a 40 m buffer. The Department notes that this would limit vertical subsidence from the additional underground mining areas to less than 20 mm (ie negligible subsidence impacts are expected). The main headings proposed to be located beneath Wollombi Brook (see **Figure 7**) would be designed to be permanently stable.

The Department notes that neither Wambo nor Stony Creeks are located above Areas 1 and 3. Both creeks would be undermined by Area 2, which does not form part of the action. Further, the modified

layout in Area 2 is largely a reorientation of approved panels, with only a minor extension of the approved mine layout. The approved mine layout already involves extraction beneath Stony Creek. The potential impacts of the modified layout are further discussed in **Section 5.2.2**. Potential surface water impacts on these creeks, such as ponding, are discussed in **Section 5.2.2**.

The Department accepts that groundwater flow paths in the vicinity of the watercourses referred to in **Section 5.2.2** are likely to be complex. HydroSimulations infers that Wambo Creek and Wollombi Brook would have been 'gaining' streams (ie groundwater would on average have discharged as baseflow to the streams) in the pre-mining hydrogeological environment. Due to the complex history of mining in the area, Wollombi Brook is now a losing stream whereas Wambo Creek remains a gaining stream. It is likely that these watercourses may continue to lose or gain groundwater from alluvium in some areas depending on the relative level of groundwater in the alluvium compared within the creeks.

The Department is satisfied that Wollombi Brook is located outside the extent of measurable tilts, curvatures or strains associated with the proposed action. Furthermore, when cumulative effects are taken into account for potential increased leakage from Wollombi Brook, it is concluded that the cumulative increase in leakage is < 0.1% of the mean annual flow.

As noted above, the value of a water resource is determined by its utility for third party uses, including environmental and other public benefit outcomes. Wollombi Brook is a valuable water resource which flows on over 80% of days per annum. There are approximately 110 surface water licences within the Lower Wollombi Brook water source with a total surface water entitlement of 6,683 ML/year of which 88% is used for irrigation purposes and 10% for industrial purposes.

There are also some emphemeral drainage lines above Area 3 that could potentially be affected by subsidence impacts including:

- increased erosion as a result of increased bed gradients;
- possible increased ponding as a result of differential subsidence; and
- possible cracking of the channel bed as a result of tensile strains.

Advisian concludes that two of the drainage lines above Area 3 would experience minimal subsidence impacts. Subsidence predictions indicate that there would be no significant change in ponding behaviour at these two drainage lines, nor would there be any significant changes in gradient. The third drainage line is located outside of the subsidence study area and is not expected to experience any subsidence impacts. WCPL has committed to consider surface water quality monitoring in the unnamed tributaries above Area 3 prior to commencing mining.

The Department is satisfied that the EA's assessment of potential impacts to surface water resources are conservative estimates, since they are based on all proposed mining areas (ie Areas 1 to 4), not just the action areas (Areas 1 and 3). The existing conditions of the development consent include subsidence performance measures (see conditions 22 and 22A of Schedule 4) which are required to be met (and historically have been), including a performance measure of negligible subsidence impacts on Wollombi Brook. These performance measures would continue to apply to the proposed action.

- *Monitoring and Management Strategies*

The IESC recommended a number of monitoring and management strategies which have been addressed by the Department in **Table 10** below.

Table 10: *IESC recommendations on monitoring and management strategies and Departmental consideration*

IESC recommendation	***Department's consideration***
Existing strategies within monitoring and management plans should take into consideration:	
• changes to drawdown within the alluvium and regolith	The proposed action would cause no discernible or negligible additional drawdown in alluvium or regolith (see **Sections 5.2.1** and **5.2.3**)
• altered flood hydrology and hydraulic characteristics, given the change in subsidence-related impacts	Potential ponding impacts would be monitored and managed through the Extraction Plan process under existing conditions of consent, including the requirement for a Water Management Plan (see condition 22C of Schedule 4)
• updates to the mine water balance with particular regard to increased groundwater inflows, storage and the requirement for discharge of surface water	The proposed action does not include any material changes to the approved water management system, water supply or water demand. In addition, the mine water balance has recently been reviewed in

	conjunction with the United Wambo Open Cut project and includes cumulative consideration of the proposed modification
• groundwater drawdown and subsidence impacts to GDEs and terrestrial vegetation overlying mine workings and in areas of predicted drawdown	Potential impacts on vegetation would be monitored and managed through the Extraction Plan process under existing conditions of consent, including the requirement for a Biodiversity Management Plan (see condition 22C of Schedule 4)
• surface water flow and quality monitoring requirements for all creeks including the unnamed tributaries of Wollombi Brook. This baseline information can be used to set trigger levels and to assess the success of mitigation strategies	Monitoring of surface water flow and quality for North Wambo, Wambo and Stony Creeks is incorporated in the existing Surface Water Monitoring Program, which would be reviewed following any approval of the action (condition 33 of Schedule 4 and condition 6 of Schedule 6) WCPL has committed to consider surface water quality monitoring in the unnamed tributaries above Area 3 prior to commencing mining The Department does not consider installation of gauging stations along the unnamed tributaries above Area 3 is warranted, given infrequent flows (<30 days per year) and that these streams do not support significant riparian ecosystems or surface water users
• surface water quality (including additional parameters such as aquatic invertebrate community composition) in dams and creeks to enable a baseline to be assessed and performance indicators and management triggers to be determined	Surface water sampling in dams and creeks is currently conducted in accordance with the Surface Water Monitoring Program (see condition 33 of Schedule 4) Aquatic fauna monitoring, including macro-invertebrate monitoring, is currently conducted in accordance with the Flora and Fauna Monitoring Program (see condition 48 of Schedule 4)
Additional monitoring and management measures may include:	
• regular review and updates to the numerical groundwater model to validate predictions and inform ongoing monitoring and management measures	The performance of the numerical groundwater model's predictions is reviewed annually as part of the Annual Review (see condition 5 of Schedule 6)
• additional groundwater monitoring locations in Area 4 and Area 3 to monitor groundwater levels within areas of subsidence, including determination of groundwater level and quality requirements of GDEs	WCPL has committed to revising the Groundwater Monitoring Program (condition 34 of Schedule 4) to address the action and allow for collection of baseline data prior to commencing mining in Areas 3 and 4
• nested piezometers to the west and south of South Wambo Dam to monitor the high salinity zone observed in monitoring bores P114 and P116	WCPL has committed to revising the Groundwater Monitoring Program (condition 34 of Schedule 4) to include the action, including the installation of nested piezometers in 2017
• groundwater sampling to include metals and other potential contaminants of concern	The Groundwater Monitoring Program (condition 34 of Schedule 4) includes sampling for metals and other contaminants
• surface water sampling for metals and ionic composition including development of trigger values associated with ecotoxicological effects, and required response actions where triggers are exceeded	Surface water sampling is currently conducted in accordance with the Surface Water Monitoring Program (see condition 33 of Schedule 4)
• upgrading surface water gauges and updating the surface water model with recent data to achieve adequate calibration and inform ongoing management strategies	WCPL replaced two flow monitoring stations (FM7 and FM8) on Stony Creek in 2015. WCPL has also committed to reviewing flow monitoring along Wambo Creek in 2016
• further consideration of the three unnamed drainage lines to the south east of the proposal that drain to Wollombi Brook, including the potential use of continuous data loggers	The Department does not consider installation of gauging stations along the unnamed tributaries above Area 3 is warranted, given infrequent flows (<30 days per year) and that these streams do not support significant riparian ecosystems or surface water users
• geochemical testing of coal reject, waste rock and tailings materials to characterise and inform ongoing management strategies	Geochemical testing of the coal seams and coal rejects has been conducted for the coal seams proposed to be mined under the action
• ecological monitoring in Wollombi Brook, downstream of discharge sites and in persistent pools of ephemeral creeks for	Riparian monitoring of North Wambo, Wambo and Stony Creeks and the North Wambo Creek Diversion

aquatic biota as biomonitors of ecological responses to altered flows (especially low flows) and water quality	is conducted in accordance with the Flora and Fauna Monitoring Program (see condition 44 of Schedule 4)

The Department is satisfied that existing monitoring and remediation measures (see **Sections 5.2.1**, **5.2.2** and **5.2.3**) are appropriate and adequate to mitigate these potential subsidence impacts.

- *Conclusions Concerning IESC Advice*

The Department has carefully considered the advice provided by the IESC in regards to the action and is satisfied that the action can be undertaken:

- using the existing surface water and groundwater models, and future revisions, which are considered appropriate and fit for purpose;
- without causing significantly greater impacts in regards to depressurisation, drawdown, stream leakage and flows, GDEs and other vegetation, fauna (including aquatic biota), hydraulic connectivity and flooding; and
- without causing additional impacts to the significant water resource of Wollombi Brook.

5.2.5 Conclusion

Overall, the Department is satisfied that:

- predicted inflows are able to be appropriately managed by WCPL, using existing management practices;
- the proposed modification would have a negligible impact on regional hard rock water levels and there would be either no discernible or else negligible additional drawdown in any alluvial aquifer when compared to the approved mining layout;
- there would be no discernible impact on stream baseflow or natural river leakage for Wollombi Brook, North Wambo Creek, Wambo Creek or Stony Creek beyond the effects of the approved mining layout;
- there would be no significant impact on the quality of groundwater or surface water in the vicinity of the proposal and there is no potential for increased flux of more saline water from the Permian strata to the alluvium; and
- no privately-owned registered bores in alluvium or regolith would be significantly affected by drawdown beyond the effects of the approved mining layout.

Nevertheless, the Department recognises that both the existing and modified mine layout would result in subsidence-induced fracturing and increased hydrological connectivity. Under the existing consent, WCPL is required to address these impacts through ongoing surface and groundwater monitoring (ie conditions requiring management and monitoring plans, as well as the Extraction Plan process) and the development of a Surface and Groundwater Response Plan, including trigger values and impact response plans.

The Department is satisfied that the modification would not significantly change the surface and groundwater impacts of the approved development and that any incremental impacts can be managed through the existing management and response plans, as may be revised following the modification (see condition 6 of Schedule 6), and under Extraction Plans.

5.3 Biodiversity

The EA includes a Flora Assessment undertaken by FloraSearch and a Fauna Assessment undertaken by EcoLogical. The proposed modification requires 21 ha of vegetation clearing. Of this total, 12.9 ha are approved for clearing under the existing approval, leaving 7.9 ha of vegetation clearing requiring approval from the NSW perspective. This clearing is considered to be small in scale and isolated and patchy in nature, since it arises from the location of ventilation shafts and gas management infrastructure. Only a relatively small proportion of the proposed clearing is directly relevant for Commonwealth purposes (see **Tables 11** and **12**, and **Section 5.3.6**).

The modification area also includes 185 ha located directly above the proposed relocated/realigned longwalls but not yet approved for disturbance (or approximately 300 ha within the angle of draw). Commonwealth interest in respect of disturbance in the longwall mining areas is limited to Areas 1 and 3 which contain an area of 170 ha for Central Hunter Valley Eucalypt Forest and Woodland and 188 ha of potential habitat for the Regent Honeyeater (see **Table 12**).

5.3.1 Threatened Flora

A total of 13 vegetation communities have been mapped in the proposed modification area. The area contains a diversity of Central Hunter Valley vegetation including shrubby woodlands dominated by gum and ironbark species on the lower footslopes, and floodplains containing mixed native/exotic

derived grassland. The vegetation condition varies from poor to excellent. Most has been assessed as in good condition, despite historical disturbance for agriculture and grazing.

Threatened flora within the proposed modification area includes:

- three endangered populations listed under the *Threatened Species Conservation Act 1995* (TSC Act): *Acacia pendula, Eucalyptus camaldulensis* and *Cymbidium canaliculatum*;
- two Critically Endangered Ecological Communities (CEECs) listed under the EPBC Act: *Central Hunter Valley Eucalypt Forest and Woodland* and *Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley*;
- one Vulnerable Ecological Community (VEC/CEC) listed under the TSC and EPBC Act: *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion*;
- six Endangered Ecological Communities (EECs) listed under the TSC Act: *Central Hunter Grey Box – Ironbark Woodland, Central Hunter Ironbark – Spotted Gum – Grey Box Forest, Hunter Floodplain Red Gum Woodland, Hunter Lower Redgum Forest, Hunter Valley Weeping Myall Woodland,* and *Warkworth Sands Woodland*; and
- 19 threatened flora species listed under the TSC and/or EPBC Act that are either likely to, or may potentially, occur.

5.3.2 Threatened Fauna

Thirteen threatened fauna species listed under the TSC and/or EPBC Act were recorded during a field survey of the proposed modification area. This includes:

- eight birds: Speckled Warbler, Spotted Harrier, Brown Treecreeper, Grey-crowned Babbler, Varied Sittella, Little Lorikeet, Painted Honeyeater and Hooded Robin; and
- five microbats: Large-eared Pied Bat, Eastern Freetail-Bat, Yellow-bellied Sheathtail Bat, Greater Broad-nosed Bat and Eastern Cave Bat.

A desktop literature review and a field survey of the site's characteristics by EcoLogical also identified an additional 32 threatened fauna species listed under the TSC and/or EPBC Act that are likely to, or have potential to, occur within the proposed modification area.

5.3.3 Assessment of Impacts

Direct Impacts

The proposed surface infrastructure area would require clearance of 7.9 ha of vegetation (see **Table 11**), of which 1.5 ha is listed as threatened vegetation communities under the TSC Act, as follows:

- 0.4 ha of *Hunter Lowland Redgum Forest*;
- 0.2 ha of *Hunter Floodplain Red Gum Woodland*; and
- 0.9 ha of *Hunter Valley Footslopes Slaty Gum Woodland.*

Vegetation clearance results in total loss of the vegetation affected and may cause community and habitat fragmentation, increased erosion, and weed and feral animal incursion. However, due to the small scale and patchy nature of the clearing and the existing fragmentation of the vegetation in the area affected, it is unlikely that habitat connectivity would be significantly reduced by the proposal.

Vegetation clearing also results in disturbance of habitat for threatened fauna species including diurnal birds, forest owls and microbats. This may affect the breeding patterns of those species, as well as their ability to establish new territories or to migrate to new areas. The Department considers the scale of these impacts to be minor in nature, due to the abundance of similar or better habitat surrounding the modification area as well as the small scale and patchy nature of the clearing and the existing fragmentation of vegetation communities.

Indirect Impacts

The surface area located above the proposed longwalls would be subject to some surface and sub-surface subsidence impacts. Although subsidence impacts are predicted to be generally less than currently approved, the proposed modification would result in an additional 185 ha (or ~300 ha including land within the angle of draw) of surface area being exposed to subsidence impacts (see **Table 11**). Subsidence impacts could include surface cracking of soils and topographic depression causing water ponding, erosion and hydrological changes (including groundwater drawdown on vegetation communities, see **Section 5.2**).

WCPL predicts that small amounts of ponding may occur in wooded areas which would result in some loss of woodland vegetation (see **Section 5.2.2**). However, these impacts are predicted to be limited to a few individuals of various species. The losses are less than those predicted under the existing approval.

Potential GDEs were included within the Commonwealth referral and determination. These GDEs are associated with the riparian zone associated with Wambo Creek and the riparian, floodplain and alluvial zones on Wollombi Brook. As discussed in **Section 5.2**, the proposed modification would cause either no discernible or else negligible additional drawdown in either the alluvium or the regolith.

The IESC raised concern over whether potential impacts to groundwater quality could affect GDEs and stygofauna (if present). HydroSimulations concluded that there are no simulated risks of reduced beneficial uses of the alluvium as a result of the proposed modification.

The Department notes that the only high priority GDE near Wambo Mine is Parnell Spring, located approximately 9 km southwest of the proposed longwalls. On this basis, the Department accepts that there would be no significant impacts to GDEs or stygofauna (if present).

5.3.4 Avoidance, Mitigation and Management

To avoid impacts to flora and fauna, WCPL has limited the extended surface infrastructure area to the smallest practicable extent, within technical constraints. The specific location of gas management infrastructure would be determined during post-approval mine planning and engineering studies. WCPL emphasises that this flexibility would allow for the avoidance of impacts on threatened flora and fauna.

Where impacts to flora and fauna cannot be avoided, WCPL has proposed mitigation and management measures in accordance with the site's Flora and Fauna Management Plan (as required by condition 44 of Schedule 4), including:

- a vegetation clearance protocol, including pre-clearance surveys and procedures;
- collection of habitat features for reinstatement in rehabilitation areas;
- ongoing management of weeds and pest animals;
- rehabilitation of temporary infrastructure sites;
- remedial works for impacts to creek lines arising from subsidence; and
- monitoring of riparian and revegetated areas.

The existing Flora and Fauna Management Plan has been prepared in accordance with conditions of consent and contains requirements for its implementation, provisions for fauna and flora monitoring and corrective measures in the event of adverse impacts.

5.3.5 Offsets

The Department considers that WCPL's design of the extended surface infrastructure and its proposed management and mitigation measures would limit impacts on vegetation communities and on endangered flora and fauna. Notwithstanding, the Department considers that the loss of 7.9 ha of native vegetation and potential subsidence impacts on the modification area should be further mitigated through the application of an appropriate offset strategy. The modification has been assessed in accordance with OEH's principles for the use of biodiversity offsets in NSW (OEH, 2016).

Under its existing development consent, WCPL has implemented a Remnant Woodland Enhancement Program (RWEP) which aims to conserve regional biodiversity, whilst enhancing habitat available to flora and fauna. The Department notes that WCPL is currently in the process of finalising agreements to conserve the RWEP areas via a Voluntary Conservation Agreement (VCA) under the *National Parks and Wildlife Act 1974*, in accordance with the existing consent.

WCPL has proposed to expand the RWEP by an additional 41.6 ha to offset the proposed modification's impacts on biodiversity. It is proposed that this additional offset would be included in the VCA. Consequently, the Department has recommended an amended condition of consent extending the timeframe in which to enter into the VCA.

A comparison of the vegetation communities directly affected by the proposed modification and the proposed offset area is provided in **Table 11** below.

Table 11: *Vegetation communities relevant to the State approval in the proposed development footprint (beyond those already approved for impact) and proposed offsets*

Vegetation Community	Veg Cmty No	TSC Act equivalent (CEEC, EEC, VEC)	Direct Disturbance (ha)	Indirect Disturbance (Above Longwalls) (ha)	Indirect Disturbance (Angle of Draw) (ha)	Offset Area (ha)
Forest Red Gum Lowland Forest	2	EEC	0.4	4	6	9.1

River Red Gum woodland	3	EEC	0.2	0	0	0
Spotted Gum Narrow-leaved Ironbark – Grey Box Woodland*	5	EEC	0	17	34	0
Narrow-leaved Ironbark – Grey Box Woodland*	6	EEC	0	87	147	1.1
Narrow-leaved Ironbark – Grey Box Woodland Disturbed*	6a	EEC	0	0	0	11.9
Bull Oak Grassy Woodland	7	n/a	1.8	5	6	0
Sandstone Riparian Scrub	9	n/a	0.1	<0.1	0.3	0
Melaleuca decora Low Forest	10	n/a	0.1	0	0.1	0
Grey Box – Slaty Box Woodland*	11/11a	VEC	0.9	4	28	5
Derived Native Grassland	13	n/a	4.5	68	78	14.5
TOTAL threatened vegetation communities			1.5	112	2151	27.1
TOTAL all vegetation communities			**7.9**	**185**	**299.4**	**41.6**

corresponds to EPBC listed Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community (see **Table 12 and **Section 5.3.6** below)*

***Table 12:** Controlling provisions relevant to the Commonwealth approval in the proposed development footprint and proposed offsets*

Vegetation Community	Direct Disturbance (ha)	Indirect Disturbance (Above Longwalls) (ha)	Indirect Disturbance (Angle of Draw) (ha)	Offset Area (ha)
Central Hunter Valley Eucalypt Forest (CEEC)	0.9	96	170 (14 of which has been previously subsided)	18.3
Regent Honeyeater	3.4	105	188 (20 of which has been previously subsided)	27.7

It is noted that the EA's assessment was conservatively based on 3.4 ha of potential Regent Honeyeater habitat (ie all of the woodland to be disturbed by the modification rather than just the *Central Hunter Valley Eucalypt Forest* community – refer to **Table 11**). The direct and indirect impacts to controlling provisions and the offsets required under the Commonwealth approval (ie **Table 12**) are discussed further in **Section 5.3.6**).

Table 11 shows that an exact like-for-like match is not provided for all threatened communities to be disturbed by the surface development area. However, the offset provides more than 20 times the area of *Forest Red Gum Lowland Forest*, and more than five times the area of *Grey Box – Slaty Box Woodland*. Overall the proposed offset is five times the area of impact. For threatened vegetation communities, the offset is more than 10 times the area subject to clearance.

OEH is satisfied that the proposed modification meets the 'like-for-like or better' requirement of Offset principle 6. This is because the proposed offset package includes a much larger area of other affected threatened vegetation communities, it contains habitat for a range of threatened species affected by the proposed works, and it is adjoining a larger area of land also being managed by WCPL for conservation. WCPL has also offered to secure the proposed offset for this modification under a Conservation Agreement as discussed above.

The Department is satisfied that WCPL has designed the proposed modification in a manner that avoids impacts on biodiversity values so far as it is reasonable and feasible. However, the modification would still disturb 7.9 ha of native vegetation. Following its assessment the Department is satisfied that these impacts can be adequately offset and that the modification can be undertaken in a manner that would improve or at least maintain the biodiversity values of the locality over the medium to long term.

The existing conditions already contain performance measures to offset potential subsidence impacts on certain vegetation communities, Wollemi National Park and other threatened species, populations or communities. Should these performance measures be exceeded and it is not reasonable or feasible to remediate the impact or environmental consequence, or remediation measures have failed to satisfactorily do so, then WCPL must provide a suitable offset to compensate for the impact or environmental consequence.

5.3.6 Matters of National Environmental Significance

Direct Impacts

DoEE found in its review of WCPL's referral documentation that the action was likely to cause significant impacts on the *Central Hunter Valley Eucalypt Forest Woodland* (CHVEFW CEEC) and the Regent Honeyeater. These two potential biodiversity impacts were components of the Commonwealth's decision to declare the proposed modification as a controlled action. Two additional Commonwealth-listed threatened species, the Vulnerable Painted Honeyeater and Large-eared Pied Bat, were recorded at the proposed modification site. However, DoEE informed the Department that these species were not considered likely to be significantly impacted.

The Department firstly notes that the Regent Honeyeater has not been recorded during field surveys for the proposed modification. It has also not been recorded during previous field surveys undertaken in 2003 for the original development application, or for the subsequent 14 modification applications, or for other WCPL approvals or during ongoing monitoring.

The CHVEFW CEEC is equivalent to a number of vegetation types as listed under the TSC Act (see **Table 11**). The proposed surface infrastructure area would require clearing of 0.9 ha of this woodland community (see **Table 12**), which would result in a decrease in the overall community extent. Some tree species comprising this community provide key foraging habitat for the Regent Honeyeater, and clearing could therefore affect availability of habitat, nesting patterns and species dispersion opportunities, notwithstanding that surveys have not recorded its presence on the site since at least 2003.

On this basis, EcoLogical's Fauna Assessment noted that only 0.6 ha of the 0.9 ha to be cleared contains nectar-bearing trees which may be potential foraging habitat for the Regent Honeyeater. However, all other areas of nectar bearing trees were also conservatively considered as potential foraging and/or breeding habitat. On this basis, all 3.4 ha of native forest and woodland proposed to be cleared were conservatively assumed to be Regent Honeyeater habitat (see **Table 12**).

The Regent Honeyeater is a highly mobile species and the proposed modification area is surrounded by similar contiguous and suitable habitat. As such, it is unlikely that the small area of clearing would affect the size, occupancy, survival and breeding of the Regent Honeyeater population within the Hunter Valley and nationally.

The proposed clearance of CHVEFW CEEC represents 11% of vegetation to be cleared for the proposed surface infrastructure. Due to this small scale of clearing and the existing fragmented nature of the local community, it is unlikely that removal of 0.9 ha would have a discernible impact on habitat connectivity for the community at either the regional or national scale.

Indirect Impacts

The action area also includes 156 ha of CHVEFW CEEC located above the proposed longwalls that has not been previously undermined or approved for subsidence impacts. The Department notes that 14 hectares of CHVEFW CEEC is already subsided by the Homestead Mine (ie a total of 170 ha of CHVEFW CEEC exists above the action Area 3). There is also an additional 18 ha of woodland vegetation (of which 6 ha has previously been subsided) that could provide potential Regent Honeyeater Habitat (see **Table 12**). Underground mining has the potential to impact the woodland community by disrupting hydrological processes, triggering erosion, and changing soil structure and chemistry. Disruption to the woodland community could also decrease the population of the Regent Honeyeater by reducing the abundance of foraging habitat.

WCPL predicts that the subsidence impact most likely to affect the CHVEFW CEEC is topographic depression, resulting in ponding. Ponding can cause tree death and conversion of dryland sites to ephemeral wetlands. However, ponding is predicted to affect only a small part of the plant population on site (ie a few individuals of particular species). As noted in **Section 5.2.2**, the predicted areas of topographic depressions (ie ponding areas) generally do not coincide with areas of mapped CHVEFW CEEC.

Soil cracking also has some potential to affect sub-surface water flows. However, this would be unlikely to affect more than a few individuals of particular species due to the predicted wide spacing of surface cracks. As such, it is likely that the extent of the impacts to this community would be localised to small areas or to individuals within the study area that would be unlikely to impact the regional population in any way.

CHVEFW CEEC is a dryland vegetation community that would be unlikely to be significantly adversely affected by groundwater drawdown. WCPL also contends that the limited impact of subsidence cracking is demonstrated by the continued health of native vegetation on parts of the proposed mining area that have been undermined for the Whybrow and Wambo seams at shallower depths of cover.

Management, Mitigation and Offsets

The Department is satisfied that the proposed modification has applied appropriate avoidance principles. The underground mining methods proposed avoid the need for large scale surface disturbance, and the majority of the proposed surface infrastructure area which would be cleared consists of derived grassland (4.5 ha). This leaves only a small amount (3.4 ha) of native forest and woodland to be cleared, of which only 0.9 ha is CHVEFW CEEC. In addition, WCPL has proposed to conduct surveys of proposed gas management infrastructure locations so that threatened species and habitat can potentially be further avoided. Under the existing conditions of approval WCPL must undertake a range of management measures under a specific Vegetation Clearance Protocol which includes requirements for progressive clearing, pre-clearance surveys and clear delineation of areas to be cleared (see condition 45).

More generally, the modification would be undertaken in accordance with WCPL's Flora and Fauna Management Plan which applies appropriate mitigation measures for potential impacts. This includes the vegetation clearance protocol, weed and pest management strategies, monitoring requirements and details on implementing remediation works. The Department notes that the Flora and Fauna Management Plan would be revised to fully reflect the proposed modification.

To offset the clearing impacts, WCPL has proposed to expand the RWEP by an additional 41.6 ha, of which 18 ha would be commensurate with CHVEFW CEEC (see **Section 5.3.5** and **Table 12**). In addition, the offset proposes 1.1 ha of *Narrow-leaved Ironbark – Grey Box Woodland* which is classified as key foraging habitat for the Regent Honeyeater. This area was considered to be suitable based on its relationship to the existing offset area, the vegetation composition in comparison to the proposed modification, available land tenure and regional conservation priorities. The offset area was assessed against the OEH Offset Principles (OEH, 2014) as well as the Commonwealth's EPBC Act Offset Principles (DoE, 2012). **Table 13** demonstrates how the proposed offset strategy is reconciled against the EPBC Act Offset Principles.

Table 13: *Reconciliation of the proposed offset strategy against the EPBC Act Offset Principles*

EPBC Act Offset Principle	Comment
Offsets must: 1. deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action;	The proposed offset would protect and enhance 18 ha of CHVEFW CEEC, compared to the 0.9 ha that would be impacted (ie an offset ratio of 20:1). The offset would be fenced to exclude livestock and managed to control weeds and feral animals.
2. be built around direct offsets but may include other compensatory measures;	The offset is an addition of 41.6 ha to the existing RWEP of which almost half comprises CHVEFW CEEC and 27.1 ha comprises potential habitat for the Regent Honeyeater. The offset would be secured in perpetuity through a Voluntary Conservation Agreement with the NSW National Parks and Wildlife Service (condition 41 of Schedule 4).
3. be in proportion to the level of statutory protection that applies to the protected matter;	The modification is proposed to impact 0.9 ha of CHVEFW CEEC and 3.4 ha of potential habitat for the Regent Honeyeater. The statutory protection level of Critically Endangered for both merits a strong offset response. The proposed offset meets this expectation with the reservation of 18 ha of CHVEFW CEEC and 27.1 ha of Regent Honeyeater habitat.
4. be of a size and scale proportionate to the residual impacts on the protected matters;	

5. effectively account for and manage the risks of the offset not succeeding;	The proposed offset expands the RWEP, thereby resulting in a much larger conservation area that would likely be more viable in the long-term. The offset would be managed under the Flora and Fauna Management Plan (condition 44 of Schedule 4) which includes details on how all identifiable threats to offsets would be managed, monitored and reported on. It also includes strategies for ensuring that the expected levels of habitat improvement are achieved, including strategic planting if necessary.
6. be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action);	The proposed offset strategy is beyond existing requirements.
7. be efficient, effective, timely, transparent, scientifically robust and reasonable; and	The offset would be secured in perpetuity through a Voluntary Conservation Agreement with the NSW National Parks and Wildlife Service (condition 41 of Schedule 4).
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	The offset would be managed under the Flora and Fauna Management Plan (condition 44 of Schedule 4).

The Department is satisfied that the proposed offset meet or exceed the EPBC Act Offset Principles, including improving or maintaining the viability of the aspect of the environment that is protected, being built around direct offsets, being additional to what is currently required and being of a size and scale proportionate to the residual impacts on the protected matters.

The EA's assessment against the EPBC Offset Principles was conservatively based on 3.4 ha of potential Regent Honeyeater habitat (ie all of the woodland to be disturbed by the modification). The proposed offset would provide 27.1 ha of potential habitat for the Regent Honeyeater. As such, the proposal would result in the secure retention of foraging habitat for the Regent Honeyeater.

Due to the large size of the offset in comparison to the area of impact, as well as the location of the proposed offset site adjacent to the existing RWEP, the risk of the offset area not being able to successfully compensate for the impact is very low. The Department is therefore confident that the proposed offset can be achieved.

The OEH was satisfied with the proposed offset and advised that the offset meets 'like-for-like or better' requirements. Under existing conditions, WCPL must secure this offset in perpetuity via a conservation agreement.

The proposed modification and its impacts are not inconsistent with approved Recovery Plans for both the Large-eared Pied Bat and CHVEFW CEEC. In this respect WCPL's application and the Department's assessment have considered the approved Conservation Advices for both the Regent Honeyeater and Painted Honeyeater (see **Appendix F** for further detail).

The Department is satisfied that the proposed modification would avoid or minimise significant impacts to the Regent Honeyeater and CHVEFW CEEC and that appropriate mitigation and offsets have been proposed for the modification's limited level of impact. The modification would result in minor residual effects from subsidence on listed threatened species and EECs, however the Department is satisfied with WCPL's proposed offset and management measures. The Department concludes that impacts on Commonwealth listed threatened species and EECs are acceptable.

5.4 Other Impacts

The Department is satisfied that the other impacts of the proposed modification are likely to be minor. The assessment of other impacts is summarised in **Table 14** below.

Table 14: *Assessment of other impacts*

Issue	*Consideration and Assessment*	*Recommendation*
Aboriginal Heritage	• A Cultural Heritage Impact Assessment (CHIA) was undertaken by RTS Australia Pty Ltd.	The existing conditions require WCPL to obtain consent from

Issue	***Consideration and Assessment***	***Recommendation***
	• A total of 87 Aboriginal sites have been identified in the modification area, comprising 35 that were already registered and 52 previously unrecorded and found during field work. • Of these 87 sites, 78 have the potential to be impacted by subsidence. Only 9 would be disturbed by vegetation clearing. • There are two existing approved Aboriginal Impact Permits (AHIP) that cover a large portion of the proposed modification area (Consent 222 and AHIP C0001474). A new AHIP would be required for any sites to be impacted that lie outside of the existing approved AHIPs. • WCPL concluded that the risk of adverse subsidence impacts on the Aboriginal sites was either unlikely or very unlikely. Given the generally low risk of potential impacts to artefact scatters and isolated finds, WCPL intends to leave these sites *in situ*, subject to subsidence monitoring. In the event of any subsidence remediation works in the vicinity of these surface artefact sites and PADs, then the artefacts would be collected in accordance with AHIP conditions. • The Registered Aboriginal Parties (RAPs) present at the field inspection recommended that artefact scatters and isolated finds not be salvaged unless required. OEH supported this recommendation. • Prior to commencing any longwall mining in the proposed modification area, all grinding groove and grinding surface sites would be archivally recorded. Also, baseline recording of confirmed possible scarred trees would be undertaken by an archaeologist and/or qualified surveyor. • OEH supported all 10 recommendations proposed by WCPL to conserve and mitigate potential impacts to Aboriginal heritage sites. • The Department is therefore satisfied that the modification's potential impacts to Aboriginal objects would be appropriately managed by amending WCPL's existing Heritage Management Plan and the AHIP process.	OEH under the relevant legislation to destroy Aboriginal sites and objects on the site.
Air Quality and Greenhouse Gases	• An Air Quality and Greenhouse Gas Review was undertaken by Todoroski Air Sciences. • The proposed modification would generate dust emissions through construction activities (ventilation shafts, gas management infrastructure and an additional access road), operations (underground ROM production rate increase and additional ventilation shafts) and transport of product coal. • Dust emissions associated with the proposed modification were compared to those of the approved operations. It was estimated that total dust emissions from the proposed modification would be 56% to 87% less than currently approved. This is due to the proposed increase in underground ROM production and reduced open cut mine ROM production. • The proposed modification would generate greenhouse gas (GHG) emissions through the combustion of diesel fuels, consumption of electricity and release of gases within the coal seam. However, under a predicted worst-case scenario, it is estimated that the modification would result in a lower annual average of GHGs (1.84 Mt CO2-e) than the existing approved prediction (2.16 Mt CO2-e). • To minimise dust generation and potential off-site impacts, WCPL proposes continued mitigation measures in accordance with the existing Air Quality and Greenhouse Gas Management Plan. • The Department accepts that, due to the predicted reduction of dust emissions and GHGs, the proposed modification is unlikely to cause any significant impacts at surrounding receptors, relative to approved operations.	No additional conditions necessary.

Noise	• A Noise Review for the proposed modification was undertaken by SLR Consulting.
	• The proposed modification would not change approved operating hours at the mine, nor would it alter CHPP or rail transport operations, as there would be no increase in the maximum ROM coal production rate.
	• However, potential noise impacts could arise from:
	  o changes to coal handling activities – conveying ROM coal to a stockpile area before it would be delivered by truck to the CHPP for processing; and
	  o construction and operation of five ventilation shafts – an additional four ventilation shafts over that currently approved.
	• Sound power levels were estimated for three indicative years over the modified mine life (2019, 2023 and 2028). These estimates showed
		No additional conditions necessary.

Issue	***Consideration and Assessment***	***Recommendation***
	that total sound power levels for the overall modified Wambo operations in these three scenarios would be lower than the total sound power level for the existing approved operations. • Predictions were also provided for impacts on receivers located to the south of the site in close proximity to one of the proposed ventilation systems. These predictions are substantially lower than the noise impact assessment criteria within the existing development consent. • WCPL currently implements a comprehensive range of noise mitigation measures on site, which would be maintained for the proposed modification. In addition, the existing Noise Monitoring Program incorporates both operator-attended and real-time monitoring at properties surrounding the site. • The Department is satisfied that noise impacts of the proposed modification would be negligible and that the existing noise controls implemented by WCPL are sufficient to manage all noise impacts.	
Agriculture	• The Department has considered relevant provisions of the *SEPP (Mining, Petroleum Production and Extractive Industries) 2007* and notes that the modification area does not contain Biophysical Strategic Agricultural Land and is approximately 0.6 km south of the nearest mapped Viticulture Critical Infrastructure Cluster land. • Potential impacts on agricultural resources in the modification area are likely to be associated with surface disturbance in the surface infrastructure extension area and subsidence-related impacts. • Approximately 4.5 ha of the surface development extension area consists of derived grassland which is used for pasture and beef production. This land has been assessed as Class 4 & 5 Land Soil Capability (LSC), and has a gross productivity margin for beef cattle grazing of approximately $61.33 per hectare per annum. • The proposed extension of the RWEP could be considered to sterilise 15 ha of agricultural land. Nevertheless, the Department notes the abundance of agricultural land available in the general area and considers that the biodiversity benefits resulting from extension of the RWEP outweigh the potential loss of a small amount of low-productivity agricultural land. • WCPL notes that this surface extension area would be rehabilitated over time to woodland or mixed pasture suitable for grazing. Also, land capability would be returned to a class similar to that existing prior to the commencement of mining. • The proposed modification's subsidence impacts are predicted to be generally similar to or less than those of the approved mine layout. WCPL has proposed to implement mitigation and management measures to minimise potential risks to soil resources including remediation of surface cracks, regrading hill steepness and water erosion hazards, stabilisation of surface fissuring and drainage works and rehabilitation of subsidence troughs. • The Department is satisfied that the agricultural impacts of the modification are minimal and can be managed under the Extraction Plan process and the consent's Erosion and Sediment Control Plan.	No additional conditions necessary.
Historic Heritage	• There are two historic heritage items in the proposed modification area. These are the: o Wambo Homestead Complex (WHC), which is listed within the *Singleton Local Environmental Plan* and the NSW Heritage Inventory; and o Abandoned Stoney Cottage (ASC) which was considered to have minor local significance by EJE Architecture (2003) and is not locally or state listed. • The proposed modification would not result in any direct disturbance to the WHC and there are no predicted subsidence impacts on the main homestead building. However, the Mounting Yard and Horse Boxes are predicted to experience low levels of additional vertical subsidence (30 mm and 60 mm respectively) and strain (2 mm/m tensile and compressive). • The Heritage Council requested clarification on how additional subsidence to the Mounting Yard and Horse Boxes would affect the WHC, particularly in understanding cumulative impacts on the heritage item. It was recommended that this advice be provided by a qualitied heritage architect and structural engineer. • In its RTS, WCPL noted that condition 57 of Schedule 4 of the existing consent requires an application to be submitted and approved by the	No additional conditions necessary. WCPL has committed to submit a written and photographic report of the ACS site to the Heritage Council.

Issue	***Consideration and Assessment***	***Recommendation***
	Heritage Council under Section 60 of the *Heritage Act 1977*, prior to the commencement of any development within the boundary of the WHC. • This application requires WCPL to demonstrate negligible impact on the WHC's heritage value. WCPL has committed that this application would contain advice from a qualitied heritage architect and structural engineer. This approach was supported by the Heritage Council. • As the predicted subsidence impacts on the Mounting Yard and Horse Boxes are of low levels, and the existing condition of consent requires WCPL to ensure negligible subsidence impacts on the WHC, in consultation with the Heritage Council, the Department is satisfied that any additional subsidence impacts to this item can be effectively mitigated and managed. • The ASC would be subject to subsidence effects from the proposed mine layout. However, the item is currently subject to subsidence effects from the existing layout and it is predicted that impacts from the modification would be similar to those already approved. • WCPL has committed to providing a photographic and written record of the ASC site to the Heritage Council. The Department is satisfied that any subsidence impacts to the ASC would be negligible.	
Surface Infrastructure	• The modification would require the construction and operation of: o five ventilation shafts (an additional four ventilation shafts compared to approved operations); o gas management infrastructure including two centralised gas plants and gas drainage boreholes (progressively constructed, operated and decommissioned); o access tracks; o an extended ROM coal facilities area, including an office complex and bathhouse; and o water management infrastructure. • WCPL provided a conceptual layout of gas drainage boreholes but proposed that the exact locations would be later confirmed in the relevant Extraction Plan. This would allow the company to undertake further surveying to avoid potential impacts to threatened flora and fauna species. • Surface disturbance associated with the proposed gas drainage boreholes was included as vegetation to be cleared within the Flora and Fauna Impact Assessment. As such, the proposed offset strategy accounts for this impact. • The Department is satisfied that impacts associated with the extension of surface infrastructure can be effectively mitigated and managed through existing conditions of consent.	Locations of gas management infrastructure would be provided in the Extraction Plan and Flora and Fauna Management Plan, prior to commencement of operations under MOD 12.
Rehabilitation	• WCPL implements a rehabilitation program in accordance with its approved Flora and Fauna Management Plan. • WCPL is also required to prepare and implement a separate rehabilitation management plan to the satisfaction of DRE. • WCPL notes that the modification would: o not require a material change to the rehabilitation program presented in the *Wambo Development Project Environmental Impact Statement (WCPL, 2003);* and o not alter the rehabilitation schedule for tailings disposal facilities. There would also be sufficient storage capacity for the additional coal rejects generated by the modification. • DRE requested that information be provided, specific to MOD 12, including target vegetation community type, final landform design, proposed mine layout and scheduling. • In its RTS, WCPL notes that its Mining Operations Plan (MOP), which is approved by DRE, contains completion criteria for target vegetation communities and a post-mining final landform design, and that further detail required for MOD 12 rehabilitation can be provided as part of the Extraction Plan and MOP review process. • WCPL notes that although the modification seeks a formal amendment to the life of the open cut mine, the mine layout and progression would be consistent with the approved MOP. • The Department notes that condition 6 of Schedule 6 of the consent requires WCPL to review and revise (if necessary) its management plans following approval of any modification. • Upon review of the draft notice of modification, DRE made a number of suggestions regarding rehabilitation conditions. The Department	The Department has considered DRE's recommendations and has recommended the Rehabilitation Management Plan contain a: • detailed tailings management strategy; and • plan that describes the grazing carrying capacity in the post-mining landscape.

Issue	Consideration and Assessment	Recommendation
	carefully considered these recommendations, along with DRE's previous submissions and concluded that the recommendations were generally captured by existing conditions of consent, apart from two recommended changes (see column to the right). • The Department is satisfied that rehabilitation of the Wambo Coal Project can be effectively mitigated and managed through existing conditions of consent, subject to this recommendation.	
Social and Economic Impacts	• The modification would use the existing operational workforce and equipment fleet to optimise coal recovery, with minor additional impacts on nearby receivers. The Wambo workforce currently consists of approximately 670 employees and contractors. • The modification would recover an additional 5.4 Mt of ROM coal, provide continued employment for Wambo underground mine's employees and contractors, provide continued State and Commonwealth royalties and taxes, and efficiently recover State-owned mineral resources that would otherwise be sterilised. • Importantly, this modification would avoid a 3-year gap between the end of mining in the South Bates Underground Mine and the commencement of mining in the South Wambo Underground Mine, which would provide employment continuity for the existing underground workforce. • However, The Australian Institute raised concern regarding the modification's economic assessment. In particular, it was considered that the estimated operating surplus, project value and coal prices were unrealistic and high, and the assessment had not included a wage premium and an adequate local effects analysis. • In its RTS, WCPL argued that Peabody's market value does not reflect the value of the Wambo Mine and provided the key benefits and costs used to calculate the net producer surplus for the modification. WCPL further noted that coal prices used in the economic assessment were comparable to the range quoted by DRE in its submission. WCPL also argued that the Local Effects Analysis was undertaken in accordance with the Economic Guideline. • The Department considers that, overall, the modification would enable the benefits of the project to be realised without any significant adverse social or economic impacts to the local community.	No additional conditions necessary.
Waste Material	• The modification would produce an additional 7.3 Mt of coarse rejects and 3 Mt of tailings. In line with approved arrangements, the tailings would be pumped as slurry to dedicated emplacement areas and encapsulated in open cut voids. The coarse rejects would be co-disposed in the open cut voids or used as bulk fill to cap the mine's tailings emplacement areas. • WCPL noted that there would be sufficient storage capacity for the additional coal rejects generated by the modification and no alteration of rejects or tailings management measures would be required.	No additional conditions necessary.

5.5 Changes to Existing Conditions

WCPL requested a number of changes to existing conditions of consent (see Table 14 of Section 5 of the EA). The Department has considered these requests in **Table 15** below.

Table 15: *Proposed modifications to the development consent*

Proposed modification	WCPL's Justification	Department's recommendation
In Schedule 1, replace the reference to Bowfield Seam with Woodlands Hill Seam.	The proposed modification would carry out mining in the Woodlands Hill Seam rather than the Bowfield Seam.	The Department recommends removal of reference to 'Bowfield Seam' and its replacement with 'Woodlands Hill Seam'.
Insert the proposed modification into condition 2 of Schedule 2 and include a reference to supplementary information provided as part of MOD 15.	-	The Department has recommended conditions to this effect.
Extend the life of mining operations permitted from 2025 to 2032.	The modification application involves an extension to the mine life of 7 years.	The Department has recommended conditions to this effect.

Remove conditions 11 and 12 of Schedule 3.	The most recent Independent Environmental Audit confirmed compliance with these conditions and recommended their removal.	The Department is satisfied that these were 'one off' conditions that have been complied with and has therefore recommended their removal from the consent.
Delete the Kannar, Fisher, Hawkes and Haynes properties from Table 1 in Schedule 4 and the Kannar property from Table 10 in Schedule 4.	The properties have been purchased by WCPL.	The Department does not consider removal of these properties necessary and has instead recommended inclusion of a note acknowledging the purchase of these properties and that they are now mine-owned.
Remove condition 28A of Schedule 4.	The Chitter Dump Dam would be dewatered and decommissioned as part of construction of the approved CHPP box cut, meaning this condition is no longer relevant.	The Department is satisfied that this condition is no longer required and has recommended its removal.
Amend condition 28C of Schedule 4 to remove the words 'fully, or substantially' and add the words 'to the satisfaction of DSC'.	The South Wambo Dam may not be required to be fully drained for mining of the Woodlands Hill Seam and Arrowfield Seam, due to the greater depth of cover. Management measures for South Wambo Dam would require the agreement of the DSC during the Extraction Plan process.	The Department is satisfied that this condition can be amended without removing the intent and purpose it served and has recommended a condition to this effect.
Amend condition 37 of Schedule 4 to remove the requirement for an independent subsidence audit prior to each Extraction Plan	The requirement for an independent subsidence audit prior to each Extraction Plan requires significant resources and duplicates the Independent Environmental Audit requirement in condition 7 of Schedule 6.	The Department has recommended amending this condition requiring an independent subsidence audit prior to an Extraction Plan in any coal seam not previously subject to second workings within the relevant longwall domain. The Department considers that this would provide ongoing confidence to the relevant regulators.
Remove condition 72 of Schedule 4.	Pinegrove Road was closed with Singleton Shire Council's approval under the *Roads Act 1993* and acquired by WCPL in 2012. Therefore, this condition is no longer relevant. All affected landowners were purchased by WCPL prior to the formal closure of Pinegrove Road.	The Department has not recommended removal of this condition as it was not provided with evidence that they had been complied with, ie an independent audit. Given that it was relatively recently acquired, the Department considers that there could be compliance issues that may arise or need to be audited and therefore the condition is best retained. Furthermore, the condition required preparation of a Road Closure Management Plan which could contain ongoing commitments. Without having reviewed this plan as part of the modification application, the Department does not consider it appropriate to remove this condition. Leaving the condition in place is not considered to present any additional burden to WCPL.
Revision of conditions 74 to 78 of Schedule 4.	The rail coal loader was commissioned in May 2006, and WCPL does not currently transport product coal on public roads. Therefore, these conditions are no longer relevant.	The Department has recommended removal of conditions 74, 76, 77 and 78 and has recommended condition 75 be revised to ensure all product

		coal is transported by rail except in emergencies.
Replace Appendices 1 and 5 with updated versions.	-	The Department has recommended conditions to this effect.

6. RECOMMENDED CONDITIONS

The Department has drafted a recommended notice of modification (see **Appendix G**) and a consolidated version of the consent as it is proposed to be modified (see **Appendix H**). These conditions strengthen the existing rehabilitation objectives, in line with DRE's request.

WCPL does not object to the recommended conditions.

7. CONCLUSION

The Department has assessed the merits of the proposed modification in accordance with the requirements of the EP&A Act. This assessment has shown that, with the implementation of minor amendments to existing conditions, coupled with WCPL's proposed mitigation measures and required amendments to existing management plans, the proposed modification can be carried out with limited and acceptable environmental impacts.

The proposed underground longwall mining can be carried out economically and is a relatively straightforward variation to the existing approved underground operations at Wambo.

The Department is therefore satisfied that the proposed modification is in the public interest and should be approved, subject to conditions.

8. RECOMMENDATION

It is recommended that the Planning Assessment Commission, as delegate of the Minister:

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

Howard Reed 14.10.16

Howard Reed
Director
Resource Assessments

17/10/16

Oliver Holm
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