2.0 Overview of Existing Operations

2.1 Mine History

Austar Coal Mine is an amalgamation of several older mines and operates within a number of mining leases under 12 separate development consents issued by Cessnock City Council between 1974 and 2012. Additionally, Austar operates under development consent DA 29/95 granted by the NSW Minister for Urban Affairs and Planning in 1996 and Project Approval 08_0111 granted by the Minister for Planning in 2009. DA 29/95 was modified in 2006, 2008, 2009, 2010 and 2012 to provide for LTCC mining in Stage 1 and 2 areas and changes to the longwall layout. Underground longwall mining has been completed in the Stage 1 and 2 areas, and commenced operation in the Stage 3 area in 2013.

Austar Coal Mine and its associated infrastructure has a long and productive history. A chronology of mining within the Greta Coal Seam at the site and related activities is presented in **Table 2.1**. The locations of previous underground workings in the area are shown on **Figure 2.1**. The location of infrastructure currently used in the handling and processing of coal from the Austar Mine Complex is also shown on **Figure 1.2**.

Table 2.1 – History of Mining Activities at Austar Coal Mine

Year	Historical Details
1916	Underground mining commenced at Pelton Colliery.
1921	Underground mining commenced at Cessnock No. 1 (Kalingo) Colliery.
1960/1961	Pelton CHPP constructed.
1961	Underground mining ceased at Cessnock No. 1 Colliery.
Late 1960s	Cessnock No. 1 Colliery amalgamated into Pelton Colliery.
1975	1975 development consent for Ellalong Colliery granted under Part X11 of the *Local Government Act 1919.*
1978	Underground mining commenced at Ellalong Colliery with coal being delivered by overland conveyor to the coal preparation plant, raw and washed coal handling systems and train loading facilities at Pelton Colliery.
1983	Longwall production commenced at Ellalong Colliery.
1992	Underground mining ceased at Pelton Colliery.
1994	High levels of gas (primarily carbon dioxide) encountered in the underground workings at Ellalong Colliery, preventing further mining of additional seams to the south-east.
1995	Pelton Open Cut Coal Mine established.
1996	DA 29/95 approved by the Minister for Urban Affairs and Planning and underground operations from the Ellalong Colliery extended into the Bellbird South Colliery area.
1998	Ellalong and Pelton Collieries amalgamated with Bellbird South Colliery and re-named Southland Colliery.
2003	Spontaneous combustion event resulting in a fire in the underground workings in Bellbird South. Mine placed in 'care-and-maintenance' for approximately 18 months.
2004	Yancoal purchased Southland Colliery and changed the name to Austar Coal Mine.
2005	Austar recommenced underground mining in the former Bellbird South Colliery area.
2006	DA 29/95 modified to allow Austar to commence underground mining using LTCC technology in the Stage 1 area.
2008	DA 29/95 modified to allow Austar to commence underground mining using LTCC technology in the Stage 2 area.

Table 2.1 – History of Mining Activities at Austar Coal Mine (cont.)

Year	Historical Details
2009	DA 29/95 modified to increase the size and dimensions of Longwalls A4 and A5 in the Stage 2 area.
2009	PA 08_0111 for underground mining using LTCC in the Stage 3 area approved by the Minister for Planning.
2010	DA 29/95 modified to allow Austar to extract one additional longwall panel (Longwall A5a) using LTCC technology in the Stage 2 area.
2010	PA 08_0111 wording of Condition 1 of Schedule 3 modified.
2012	PA 08_0111 modified to reorient Stage 3 longwalls and increase chain pillar width.
2012	DA 29/95 modified to increase the length of Longwall A5a.
2013	Mining completed in Stage 2 area.
2013	First workings variation to Longwall A7 to retract from dyke at commencing end
2013	Kitchener Surface Infrastructure Site ventilation shafts, services borehole, and services completed, and underground longwall mining commenced in Stage 3 area in Longwall A7.

As set out in **Table 2.1**, underground mining commenced at Pelton Colliery in 1916. Pelton Coal Handling Preparation Plan (CHPP) was constructed in about 1960/1961 for the washing of Pelton Colliery coal. Pelton Colliery was amalgamated with the neighbouring Cessnock No. 1 Colliery in the late 1960s.

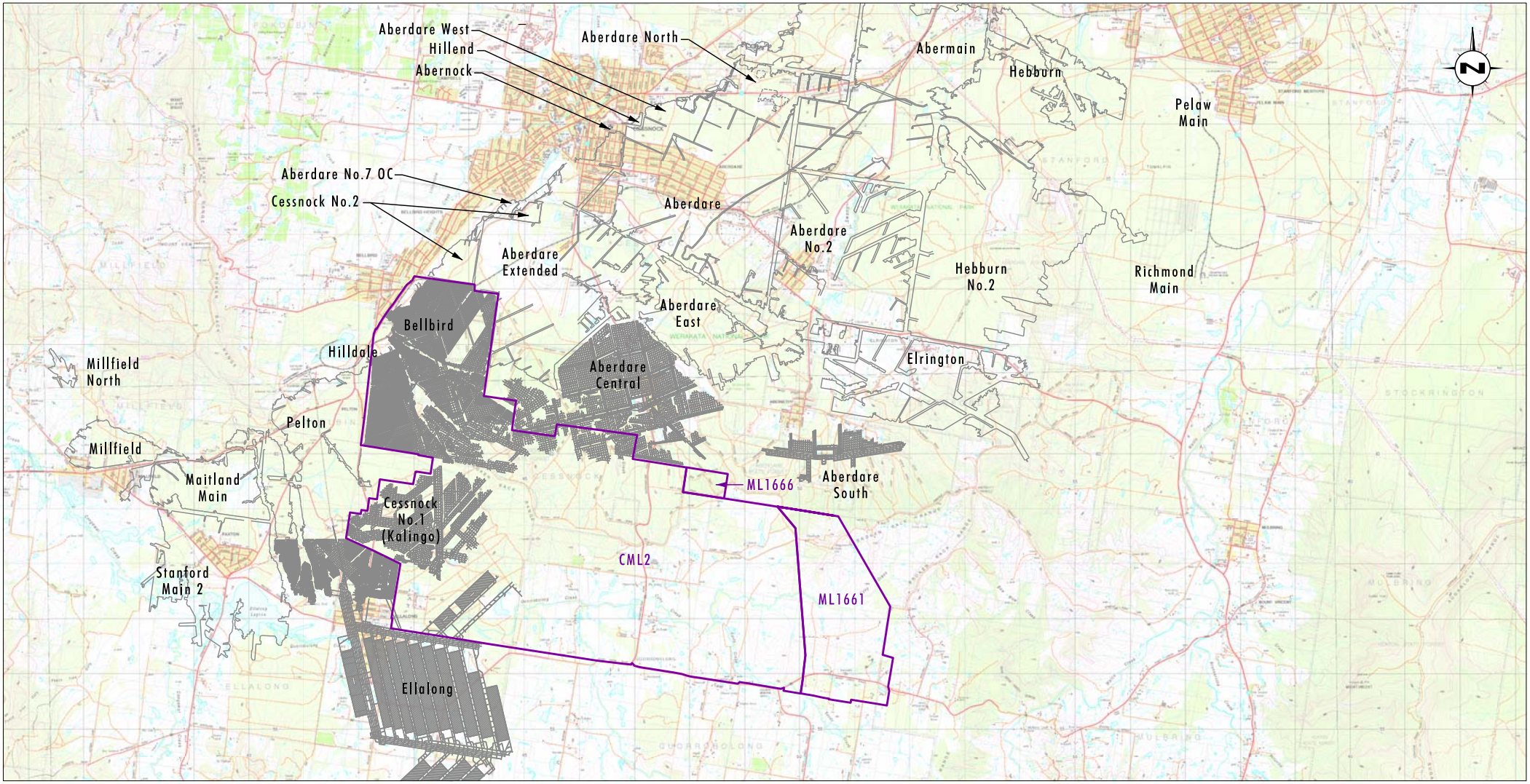
In 1975 development consent for Ellalong Colliery was granted under Part X11 of the *Local Government Act 1919* and the mine was officially opened in July 1979. The 1975 development consent envisaged that coal from Ellalong Colliery would be transported by conveyor from the Ellalong Drift and Pit Top to Pelton CHPP. Longwall production commenced at Ellalong Colliery in 1983.

In early 1994 high gas levels were encountered in the southern part of Ellalong Colliery. In 1996 development consent (DA 29/95) was granted by the Minister for Urban Affairs and Planning to extend Ellalong Colliery to the north-east into the Bellbird South area to allow development in an area not affected by high levels of coal seam gas. DA 29/95 allowed for mining within CML2 by conventional retreat longwall mining producing up to 3 million tonnes per annum (Mtpa) of product coal. The approved mining area that formed part of DA 29/95 is shown in **Figure 2.2**.

In 1998 Southland Coal Pty Limited acquired Ellalong and Pelton Collieries and amalgamated them with Bellbird South Colliery. Ellalong, Pelton and Bellbird South Collieries became known as the Southland Colliery. Southland Colliery was operated until 2003 when spontaneous combustion resulted in the mine ceasing operations and being placed on care and maintenance for a period of 18 months.

Southland Colliery and its associated infrastructure was acquired by Yancoal in December 2004 and was renamed Austar Coal Mine.

Mining proceeded in the reconfigured Stage 1 area (consisting of LW A1 and A2 as shown on **Figure 1.2**) following a modification in 2006 of DA 29/95 to allow for the extraction of coal to a height of 6.5 metres using LTCC technology. A further section 96 Modification (Stage 2) was approved by the Minister for Planning in 2008 to allow LTCC extraction of Longwalls A3 to A5 in Stage 2 (see **Figure 1.2**). A third minor section 96 (1a) modification to vary the length and widths of Longwalls A4 and A5 was approved in 2009, and a fourth modification under Section 75W of the EP&A Act adding Longwall A5a to the Stage 2 area was approved in November 2010. Modification 5 was approved on 27 April 2012 to lengthen Longwall A5a.



Data Source: Topo Maps: LPI NSW, Mine Workings: Austar Coal Mine

0 1.25 2.5 5km

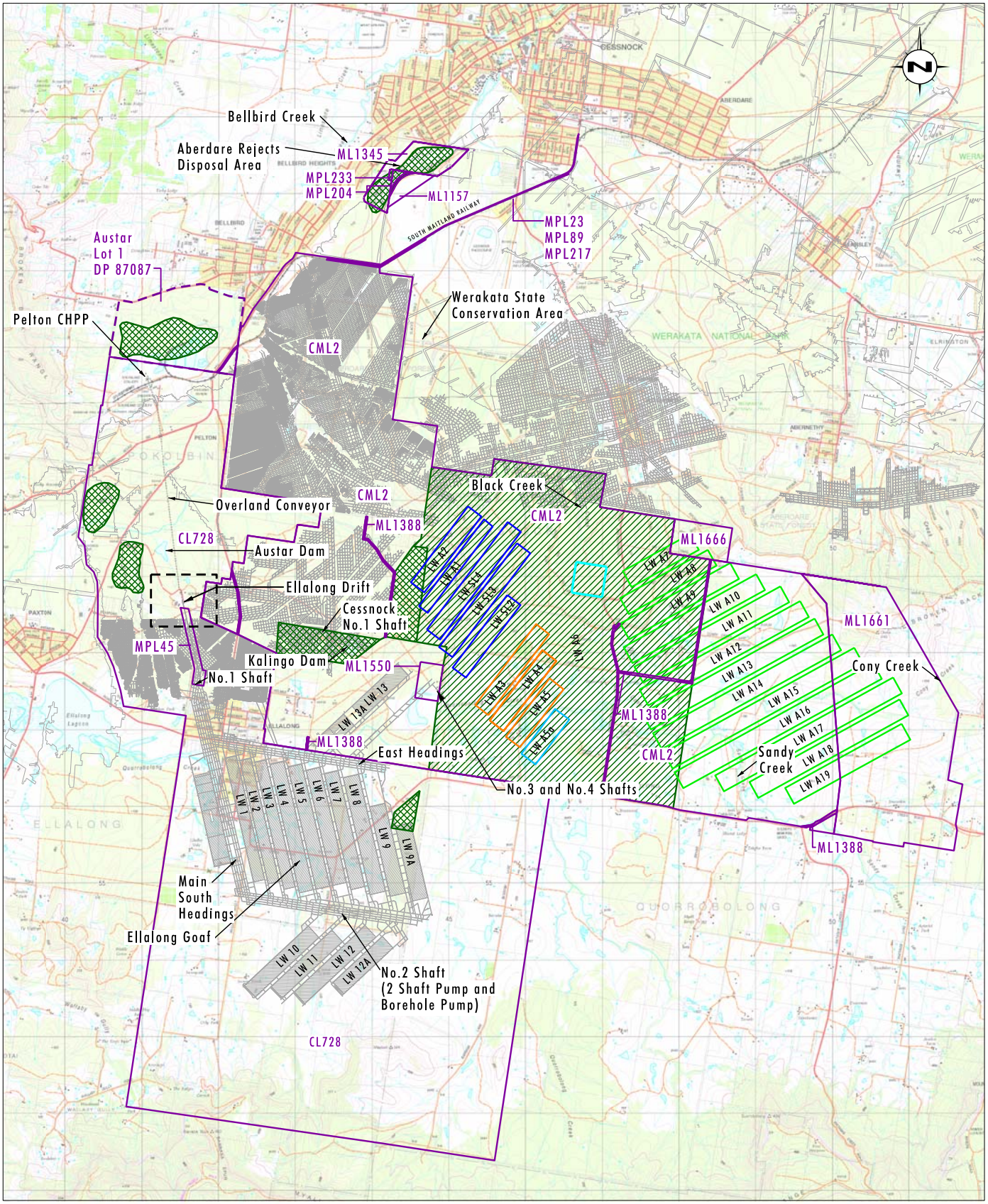
1:100 000

Legend

- Mining Lease Boundary
- Previous Underground Workings

FIGURE 2.1

Previous Underground Workings



Data Source: Topo Maps: LPI NSW, Longwall Layouts: Austar Coal Mine

0 1 2 3 km

1:70 000

Legend

- Layout for Stage 1 Longwall Panels
- Layout for Stage 2 Longwall Panels
- Layout for Stage 2 Extension Longwall Panel
- Layout for Approved Stage 3 Longwall Panels
- Surface Infrastructure Site
- Old Workings
- Mining Lease Boundary
- Austar owned CHPP Land
- Surface Application Area (DA 29/95)
- Subsurface Application Area (DA 29/95)

FIGURE 2.2

Mining Area Approved under DA 29/95

Underground longwall mining has since ceased in the Stage 2 mining area with the completion of LW A5a in February 2013.

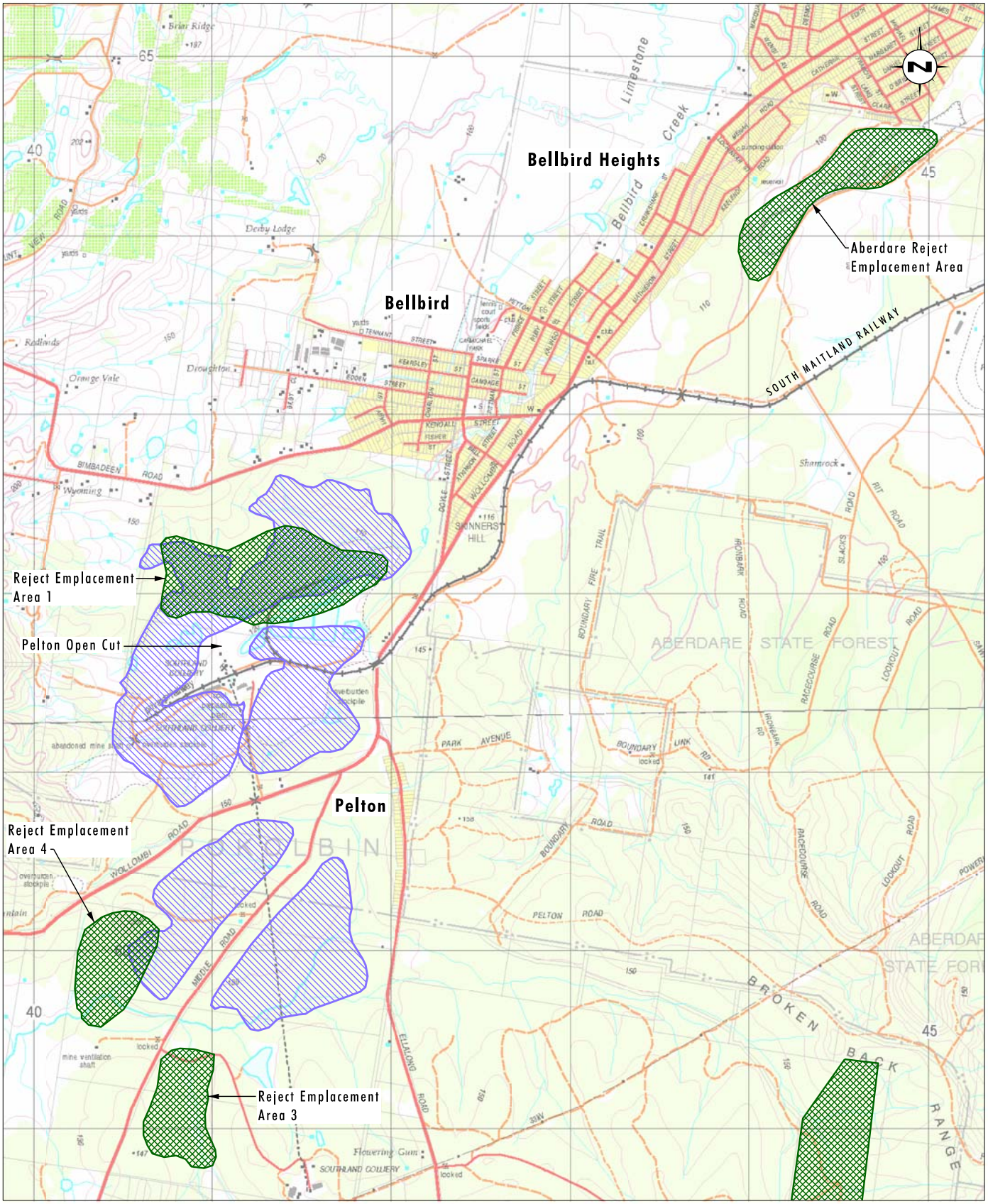
A new Project Approval was granted by the Minister for Planning in September 2009, enabling longwall mining using LTCC technology in the Stage 3 area and construction and operation of a new Surface Infrastructure Site and access road south-west of Kitchener (refer to **Figure 1.2**). Shaft construction at the Kitchener Surface Infrastructure Site was substantially completed in June 2013, with underground longwall mining also commencing in the Stage 3 area in June 2013. Longwall mining is currently occurring in Longwall A7. A further description of the activities approved under the Stage 3 Project Approval is set out in **Section 2.2.1**.

2.2 Current Approved Stage 3 Mining Operations – Project Approval 08_0111

Austar received approval for the Austar Coal Mine Project – Stage 3 in 2009 under Project Approval 08_0111. The description of the project approved under Project Approval 08_0111 is set out in **Table 2.2** below.

Table 2.2 – Austar Coal Mine – Stage 3 Project Description As Approved

Project	Stage 3 of the Austar Coal Mine, which involves: • extraction of up to 3.6 million tonnes of run of mine (ROM) coal a year until 31 December 2030 using Longwall Top Coal Caving technology from Longwall Panels A7 to A19; and • construction and operation of new pit top facilities off Quorrobolong Road south of Kitchener including an access road, upcast and downcast ventilation shafts, main ventilation fans, winder house, bathhouse, workshop, electricity substation and distribution line, service boreholes, potable and reticulated sewerage services, telecommunication services, offices and store.
Operation of the Austar Mining Complex	The Project uses the existing and approved infrastructure and facilities at the existing Austar Mining Complex to handle, process and transport ROM coal from longwalls A7 to A19. These activities involve the continued operation of: • the Ellalong Drift and associated infrastructure; • the Pelton Coal Handling Preparation Plant for the washing and handling of coal; • the Austar Railway Line which links to South Maitland Railway to transport up to 3 million tonnes of product coal per annum; • the water management system as described in the Site Water Management Plan; • road transport of up to 60,000 tonnes of specialty coal product per annum; and • emplacement of reject material from Austar's mining operations at Pelton Open Cut and other sites as approved in the Mining Operation Plan (refer to **Figure 2.3**).
Stage 3 Project and Austar Mine Complex Areas	• Stage 3 area including the proposed Stage 3 mining area and the Kitchener Surface Infrastructure Site which is located 6 to 8 kilometres south of Cessnock. The location of Stage 3 area is shown on **Figure 1.3**; and • the Austar Mine Complex as shown on **Figure 1.2** which includes the existing infrastructure and facilities that will be used by the project.



Legend

- Reject Emplacement Area (DA 29/95)
- Reject Emplacement Area (DA 74/75/79)

FIGURE 2.3

Reject Emplacement Areas

Coal from the current approved Stage 3 mining area is bought to the surface approximately six kilometres to the west of the LWA7–A10 Modification Area at the Ellalong Drift and Pit Top via an underground conveyor through the Ellalong East and South Headings. Coal is then conveyed to the Pelton CHPP via an overland conveyor system, processed and handled at Pelton CHPP and railed to the Port of Newcastle via Austar Rail Line, the South Maitland Railway and the Main Northern Rail Line. Up to 60,000 tonnes of specialty coal product is also transported by road from Pelton CHPP.

Reject from Pelton CHPP is emplaced at approved emplacement areas at Pelton CHPP and Aberdare Extended Open Cut Voids. The location of current project emplacement areas is shown on **Figure 1.2**. Additional approved reject emplacement areas are shown on **Figure 2.3**.

2.3 Environmental Management of Existing Operations

The environmental management of existing operations at Austar Coal Mine is undertaken within the framework of the Austar MOP (Austar 2008), a suite of environmental management and monitoring plans including the Site Water Management Plan, and the Environment Protection Licence for the mine (EPL 416). This section provides an overview of the environmental management framework at Austar Coal Mine and its current environmental performance.

2.3.1 Austar Mining Operations Plan

All aspects of current Austar operations, including environmental management and rehabilitation, are managed in accordance with the current Austar MOP (Austar 2008), which was approved by the Department of Primary Industries (now the Division of Resource and Energy, a part of the NSW Department of Trade and Investment) in May 2008. The current MOP covers all mining operations at Austar over a seven year period from 2008 to 2015. The MOP encompasses all mining activities within Austar's mining leases including:

- underground mining;
- activities at Ellalong Drift and Pit Top;
- overland transport of ROM coal from Ellalong Drift to Pelton CHPP;
- processing and handling of coal at Pelton CHPP;
- reject management and emplacement activities;
- water management;
- use and management of Austar's remote infrastructure sites (No. 1, 2, 3 and 4 shafts and the Kalingo site); and
- rehabilitation activities.

Review and reporting of Austar's performance against the MOP is provided through Annual Environmental Management Reports (AEMR) and DRE inspections.

2.3.2 Environmental Management and Monitoring

Current environmental management and monitoring plans for the Austar Coal Mine provide a methodical and integrated approach to fulfilling Austar's environmental objectives and ensuring the ongoing management of the site in accordance with the principles of ecologically sustainable development. An independent environmental audit of the Austar Coal Mine undertaken in 2011 found that Austar's Environmental Management Strategy provides a sound basis for the management of environmental aspects of the Austar project's activities and operations (AEMC 2011). It also found that Austar has generally demonstrated a high degree of compliance with conditions of consent and approval under DA29/95 and Project Approval 08_0111 (AEMC 2011).

Current Austar environmental management and monitoring plans include:

- Environmental Management Strategy;
- Environmental Monitoring Program;
- Subsidence Management Plans for the Stage 1 and Stage 2 areas including:
  - Property Subsidence Management Plans;
  - Public Safety Subsidence Management Plan;
  - Infrastructure Subsidence Management Plans; and
  - Subsidence Monitoring Strategy;
- Extraction Plan/Subsidence Management Plan for Stage 3 LWA7 to LWA10 including:
  - Subsidence Monitoring Program;
  - Land Management Plan;
  - Biodiversity Management Plan;
  - Built Features Management Plan;
  - Heritage Management Plan; and
  - Public Safety Management Plan;
- Noise and Vibration Management Plan;
- Air Quality and Greenhouse Gas Management Plan;
- Site Water Management Plan;
- Bushfire Management Plan;
- Pollution Incident Response Management Plan;
- Aboriginal Cultural Heritage Management Plan;
- Historic Heritage Management Plan;
- Stage 2 Ecological Monitoring Program;
- Stage 3 Surface Infrastructure Site – Traffic Management Plan;

- Stage 3 Surface Infrastructure Site – Shaft Construction Environmental Management Plan; and

- Stage 3 Surface Infrastructure Site – Landscape Management Plan Kitchener Surface Infrastructure Site.

Austar's environmental management plans have been prepared in accordance with the conditions of DA 29/95 or Project Approval 08_0111 where appropriate to the satisfaction of the Director-General of Planning.

Review and reporting of environmental performance is provided through the Annual Environmental Management Report/Annual Review process.

2.3.2.1 Subsidence Management and Monitoring

The monitoring, management and mitigation of subsidence is an integral component of the current Austar mining operations and requirements of the existing Austar Extraction Plans and Subsidence Management Plan (SMP).

There are a range of subsidence monitoring procedures implemented (in consultation with landholders) by Austar, which will continue to inform refinement of subsidence prediction and management as mining progresses, as informed by the monitoring program and ongoing consultation with stakeholders. These measures include:

- subsidence monitoring lines to be located as determined as part of the EP process;

- visual assessment of all natural features and items of surface infrastructure before, during and following longwall mining to detect subsidence impacts such as surface cracking, irregularities in the subsidence profile, erosion, damage to structures, changes in drainage patterns or loss of water from drainage structures;

- assessment of building structures by a structural engineer before and after longwall mining; and

- verification and revision of subsidence predictions as mining progresses.

Verification and ongoing refinement and calibration of the subsidence predictive model are critical components of subsidence management. As the coal resource is extracted, verification of the model is undertaken by assessing measured subsidence against predictions. This monitoring information may then be incorporated into future iterations of subsidence predictions. This allows a continual refinement process for the assessment and management of subsidence impacts as operations progress.

In June 2013, Austar completed an end of panel report for Stage 2 LW5a, which demonstrated that monitored cumulative subsidence levels (1210mm) were within predicted subsidence levels (1490mm). In addition, monitoring of subsidence parameters and impacts for the mining of two Top Coal Caving panels in Stage 1 confirmed Maximum Predicted Subsidence to be an accurate prediction of actual subsidence. The same observation has been recorded for extraction of A3, A4, and A5 in the Stage 2 mining area. Minimal physical impacts were observed in Stage 1 and in the recently completed Stage 2.

The results of the Subsidence Monitoring Program are communicated on a regular basis to a range of stakeholders, including landholders over the mining area, the Austar Community Consultative Committee, infrastructure owners, and Government agencies such as DP&I and DRE. In addition results are regularly published on the Austar website, and formally reported on an annual basis through the Annual Environmental Management Report (AEMR). This

has included regular communication of subsidence monitoring results for Stage 3 (LWA7) since Stage 3 longwall mining commenced in June 2013.

Austar will continue to communicate with surrounding stakeholders regarding the subsidence impact assessment, potential subsidence impacts, monitoring and management considerations using protocols established in the Extraction Plan (EP) and Built Features Management Plan process during the course of the Project.

3.0 Description of Proposed LWA7–A10 Modification

Austar proposes to modify the currently approved Stage 3 mine plan shown in **Figure 1.3**. The proposed modification includes extending longwalls A7 to A10 further to the west (refer to **Figure 1.4**). Specifically:

- the finishing position of longwall A7 will be extended approximately 100 metres to the west;
- the finishing position of longwall A8 will be extended approximately 300 metres to the west;
- the finishing position of longwall A9 will be extended approximately 200 metres to the west; and
- the finishing position of longwall A10 will be extended approximately 170 metres to the west.

The proposed westerly extension to these four longwalls provides access to an additional 1.05 million tonnes of ROM coal.

Approval is also sought from the Director General in accordance with Condition 3 Schedule 3 of Project Approval 08_0111, to retract the starting position of longwall A8 approximately 185 metres.

As shown on **Figure 1.4**, the proposed modifications to longwalls A7 to A10 will result in minor changes to the area of landform impacts from subsidence associated with the approved Stage 3 Project. As noted in **Section 1.3.2**, the net increase in area affected by subsidence is 1.8 per cent, when compared to the currently approved Stage 3 area. The effect of extending longwalls A7 to A10 to the west is to move the position of maximum tilt and strain further to the west and extend the subsided landform to the west. However, the maximum predicted subsidence parameters for the LWA7–A10 Modification Area are similar to the maximum predicted subsidence parameters for the approved Stage 3 Project. The potential impacts of this minor change to the area of landform impacts from subsidence are discussed in further detail in **Section 6.2**.

No other changes to the approved Stage 3 mining operations are proposed as part of the modification, including no change to the approved rate of extraction or life of the operation and no changes to any interactions of the Stage 3 Project with the operations of the Austar Mining Complex.

The existing approved Extraction Plan for Longwalls A7 to A10 (Austar 2013a) and associated management plans will be updated to reflect the LWA7-A10 Modification.

3.1 Modification Timing and Life of Operation

Approval for the modification is sought by early December 2013, allowing for the continuation of mining within LW A7 during December 2013. No change is proposed to the life of the approval, which will expire on 31 December 2030 in accordance with Project Approval 08_0111.

The indicative longwall mining schedule for underground mining in the modified Stage 3 mining area is outlined in **Table 3.1**. Longwall mining commenced in 2013 and will continue until approximately 2028.

Table 3.1 – Indicative Longwall Mining Schedule

Longwall	Start	Finish
LWA7	June 2013	January 2014
LWA8	April 2014	January 2015
LWA9	March 2015	June 2016
LWA10	August 2016	August 2017
LWA11	October 2017	November 2018
LWA12	December 2018	March 2020
LWA13	April 2020	July 2021
LWA14	August 2021	December 2022
LWA15	January 2023	March 2024
LWA16	May 2024	May 2025
LWA17	July 2025	June 2026
LWA18	August 2026	May 2027
LWA19	June 2027	January 2028

4.0 Planning Context

This section provides details of the relevant Commonwealth and State legislation and planning provisions and a discussion of their application to the proposed modification.

4.1 Commonwealth Legislation

4.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

Under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (EPBC Act), approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (DSEWPAC) is required for any action that may have a significant impact on matters of national environmental significance.

These matters are:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Threatened Species and Ecological Communities;
- Migratory Species;
- Nuclear Actions;
- Commonwealth Marine Areas;
- Great Barrier Reef Marine Park; and
- Water Resources.

If an 'activity' is likely to have a significant impact on a matter of national environmental significance then it may be a 'controlled action' and should be referred to the Commonwealth Minister for consideration.

The provisions of the EPBC Act which are relevant to this modification application are those which relate to potential impacts on migratory species, threatened species and/or ecological communities listed under the EPBC Act as well as impacts on water resources.

The water resources trigger is a relatively new matter relating to protection of water resources from impacts of coal seam gas and large coal mining projects. According to Draft Significant Impact Guidelines prepared by DSEWPAC (2013), an action is likely to have a significant impact on a water resource if there is a real chance or possibility that it will directly or indirectly result in:

- a substantial change to the hydrology of a water resource; or
- a substantial change in water quality of a water resource.

A detailed assessment of the potential for the Proposed LWA7-A10 Modification to have a significant impact on a water resource has been prepared and is provided in **Sections 6.3** and **6.4**. The water resources impact assessment was undertaken using the key aspects of hydrology change listed by DSEWPAC (2013).

On the basis of the detailed subsidence assessment, water resources assessment and ecological assessment undertaken for the Proposed LWA7–A10 Modification, it is considered that this Proposed LWA7-A10 Modification will not have a significant impact on any of the matters of National Environmental Significance listed above. Details of the subsidence, water resources and ecological assessments undertaken for the Stage 3 Project are provided in **Sections 6.1**, **6.5** and **6.3** respectively.

As part of previous assessments undertaken for the broader Stage 3 Project, it was concluded that the Stage 3 Project would not have a significant impact on any matters of National Environmental Significance, and therefore approval under the EPBC Act was not required (Umwelt 2008a and 2011a).

4.1.2 *Native Title Act 1993*

The Commonwealth *Native Title Act 1993* (NT Act) prescribes certain rights and interests in relation to the protection and recognition of native title. Amongst other things it also establishes mechanisms for determining claims for native title. The National Native Title Tribunal is responsible for maintaining a National Native Title Register (NNTR) of native title claimants and bodies to whom native title rights have been granted. These native title holders and claimants must be consulted prior to the granting of a mining lease over land to which the native title claim or right applies.

The process is designed to ensure that indigenous people who profess an interest in the land (or any part thereof) have the opportunity to express this interest formally, and to negotiate with the Government and the applicant about the proposed grant or renewal, or consent to access native title land.

The *Mining Act* 1992 must be administered in accordance with the NT Act. The primary effect of the NT Act on exploration and mining approvals is to provide native title parties with 'rights to negotiate' about the grant (including the grant of some renewals) by governments of exploration and mining titles. This process has already occurred with the grant of mining leases CML 2 and ML 1666.

A search of the NNTR was conducted to determine whether land and waterways within the LWA7–A10 Modification Area may be affected by a native title determination, application or indigenous land use agreement (ILUA).

One Native Title application has been registered with the National Native Title Tribunal which covers the LWA7–A10 Modification Area. The registered claimants are the Awabakal and Guringai People. A second unregistered Native Title application also covers the LWA7–A10 Modification Area, from Scott Franks and Anor on behalf of the Plains Clan of the Wonnarua People.

A search of the NNTR confirms that there are no native title determinations or ILUAs covering the LWA7-A10 Modification Area. The NT Act provides that the question of whether native title survives can only be determined on a claim-by-claim basis, and is ultimately subject to an 'approved determination' being made by the Federal Court of Australia.

The NT Act, where applicable, will be complied with in relation to the granting and renewal of any necessary mining tenements associated with the Austar Coal Mine.

4.2 NSW State Legislation

4.2.1 *Environmental Planning and Assessment Act 1979*

As outlined in **Section 1.0**, a modification to Project Approval 08_0111 is sought under Section 75W of the EP&A Act. The Project Approval was granted under Part 3A of the EP&A Act and although Part 3A has been repealed, Schedule 6A provides transitional arrangements for the continued use of Section 75W to modify the project approvals granted under Part 3A.

Section 75W is therefore the appropriate approval pathway for the LWA7–A10 Modification.

Permissibility

Environmental planning instruments, other than SEPPs, do not apply to projects assessed under Section 75W of the Act, except as regards to permissibility.

The LWA7–A10 Modification Area is located within the Cessnock local government area (LGA). Hence, the *Cessnock Local Environment Plan (LEP) 2011* is relevant to the permissibility of this modification. Under the LEP the LWA7–A10 Modification Area is zoned RU2 Rural Landscapes and E1 National Parks and Nature Reserves (refer to **Figure 4.1**). Under the LEP, mining is permissible with consent on land zoned RU2. Uses authorised under the *National Parks and Wildlife Act 1974* are permissible without consent within the E1 zone.

The land within the LWA7-A10 Modification Area that is zoned E1 is comprised of land within the Werakata State Conservation Area. Although the provisions of the *Mining Act 1992* apply to lands within a State Conservation Area, Section 47J of the *National Parks and Wildlife Act 1974*, provides that a mining interest shall not be granted in respect of lands within a State Conservation Area without the concurrence of the Minister. Given that Austar already holds mining leases CML 2 and ML 1666 over the LWA7-A10 Modification Area such approval is not required for the purposes of this modification application.

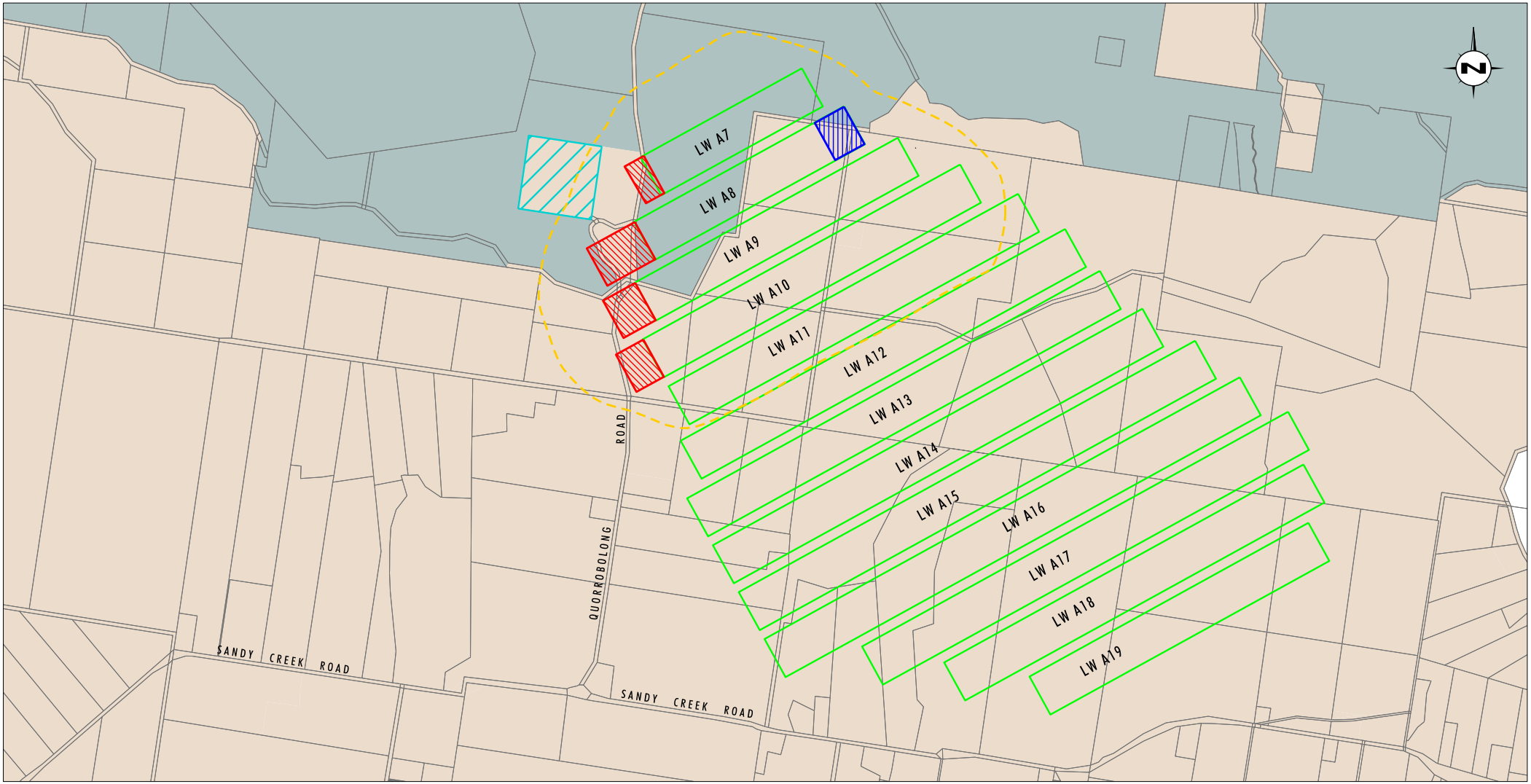
In any event, the permissibility provisions of *SEPP (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) are relevant to this Project. Section 7(1)(a) of the Mining SEPP specifies that 'underground mining carried out on any land' is permissible with development consent. Consequently, the Project is permissible with development consent under the Mining SEPP, and the Minister may approve the Project regardless of permissibility under the relevant LEPs.

Landowners Consent

Austar has met with the relevant National Parks and Wildlife state conservation area personnel and lodged a request for landowners consent for the modification application, for that part of the Proposed Modification that is located beneath the SCA. A copy of the landowners consent will be provided to DP&I prior to determination.

Other Approvals

Because a Project Approval has already been granted in respect of the Austar Coal Mine the following approvals, which may otherwise have been relevant, will not be required to carry out the project (refer to **Table 4.1**).



Data Source: Cadastre: LPI NSW, Zoning: Cessnock LEP 2011, Longwall Layout: Austar Coal Mine

0 0.5 1.0 1.5km
1:30 000

Legend

- Layout for Approved Stage 3 Longwall Panels
- Proposed LW A7-A10 Modification Area
- Proposed Retraction of Longwall A8 Start Position
- Proposed Extension of Longwalls A7 to A10 Finish Position
- Approved Surface Infrastructure Site
- E1 National Parks and Nature Reserves
- RU2 Rural Landscape

FIGURE 4.1

Cessnock LEP 2011 Zoning Map

File Name (A4): R02/3264_012.dgn
20131010 13.30

Table 4.1 – Approvals Legislation which does not apply

Act	Approval
Fisheries Management Act 1994 (FM Act)	Permit for works or structures within a waterway
Heritage Act 1977 (Heritage Act)	Disturbance to an item listed on State Heritage Register or Interim Heritage Order; Excavation permit
National Parks & Wildlife Act 1974 (NP&W Act)	s90 Aboriginal Heritage Impact Permit
Native Vegetation Act 2003	Consent for the clearing of native vegetation
Water Management Act 2000 (WM Act)	Water use approval, water management work approval or activity approval

Approvals Legislation to be Applied Consistently

Similarly, because a Project Approval has already been granted in respect of the Austar Coal Mine under Part 3A of the EP&A Act, the following approvals, which will be required for the Project, must be issued in a manner that is substantially consistent with the terms of the Project Approval (refer to **Table 4.2**).

Table 4.2 – Approvals/Legislation to be applied consistently

Act	Approval	Authority
Protection of the Environment Operations Act 1997 (PoEO Act)	Environmental Protection Licence	NSW Environment Protection Authority (EPA))
Roads Act 1993 (Roads Act)	Permit to impact on a public road	RMS, LMCC or Department of Lands depending on the type of road
Mine Subsidence Compensation Act 1961	Development within Mine Subsidence District	Mine Subsidence Board
Mining Act 1992	Mining Lease	Department of Trade and Investment
Pipelines Act 1967	Licence	Department of Trade and Investment

4.2.2 Other State Legislation and Environmental Planning Instruments

A summary of the other State environmental and planning legislation potentially relevant to the Project is provided in **Table 4.3**.

Table 4.3 – Summary of State Legislation and Relevance to the Project

Act	Comment	Further Approval Required for Proposed Modification
Mining Act 1992	Under this Act a ML is required before any mining or specified mining purpose can be carried out on the land. Austar currently holds mining leases CML 2 and ML1666 over the LWA7–A10 Modification Area. All mining operations must be subject to a Mining Operations Plan (MOP) and Subsidence Management Plan.	No approvals required, however, Austar will be required to revise the existing approved MOP and Subsidence Management Plan.
Coal Mine Health and Safety Act 2002	The principal aim of the *Coal Mine Health and Safety Act 2002* is to secure the objectives of the *Work Health and Safety Act 2011* in relation to coal operations. It does this by imposing certain specific safety requirements on coal mines. This includes the requirement to comply with minimum barriers for underground mining workings and the requirement to obtain consent from the Minister for Mineral Resources for the establishment of emplacement areas. No new emplacement areas will be required as a result of the Project. Clause 88 of the *Coal Mine Health and Safety Regulation 2006* imposes a requirement to obtain approval for secondary workings (including extraction by longwall methods) as that which existed previously in Section 138 of the *Coal Mines Regulation Act 1982*.	Yes, approval will be required under clause 88 for secondary extraction within the Modification Area.
Protection of the Environment Operations Act 1997 (PoEO Act)	The PoEO Act is administered by the EPA and requires licences for environmental protection including waste, air, water and noise pollution control. Austar currently holds Environment Protection Licence (EPL) 416. No changes to surface operations, noise emissions, dust emissions or surface water management are proposed as a result of the Proposed LWA7-A10 Modification.	No
Roads Act 1993	The *Roads Act 1993* is administered by Roads and Maritime Services (RMS), local council or the Department of Lands depending on the classification of the road; the RMS has jurisdiction over major roads, the local council over minor roads, and the Department of Lands over Crown roads and Crown road reserves. The Act requires that applications for the closure of Crown roads be made to the Minister. Consent under Section 138 of the *Roads Act 1993* is required in order to undertake works within a road reserve. Subsidence remediation works may be necessary along sections of Quorrobolong Road, Sandy Creek Road, Nash Lane and Coney Creek Lane and approval for these works will be required from Cessnock City Council under s138 of the *Roads Act 1993*. If any works are required, any required approvals would be obtained prior to such works being undertaken.	Yes

Table 4.3 – Summary of State Legislation and Relevance to the Project (cont.)

Act	Comment	Further Approval Required for Proposed Modification
Crown Lands Act 1989	The Act provides for the administration and management of Crown land in the eastern and central divisions of the State. Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by this Act or the *Crown Lands (Continued Tenures) Act 1989*. The northern portion of the Stage 3 mine plan extends underneath the Werakata State Conservation Area and Crown land. The approval of the Department of Primary Industries – Crown Lands Division may be required for any surface works within these areas. Should subsidence remediation works be required within these areas, the required approvals would be obtained prior to such works being undertaken.	Yes, if any surface remediation works required within Crown land
Water Management Act 2000	This Act regulates the taking, interception, storage and use of surface water and groundwater within areas subject to water sharing plans. The Hunter Unregulated and Alluvial Water Sources Water Sharing Plan (Hunter Unregulated and Alluvial WSP) commenced on 1 August 2009 and applies to the 'Water Sources', as defined in the Hunter Unregulated and Alluvial WSP within the Modification Area. Therefore, the surface waters and any alluvial waters within the Modification Area are governed by the WM Act, whilst the groundwater associated with the hard rock aquifers (i.e. coal seams) remain governed by the *Water Act 1912* (Water Act). As discussed in **Table 4.1**, the following approvals are not required under the WM Act for this Project: water use approval; water management work approval; or activity approval.	No
Water Act 1912	This Act has been repealed by the *Water Management Act 2000*; however, some of the licensing provisions remain in force where the water source is not covered by a water sharing plan under the WM Act. Austar currently holds Part 5 licences under this Act for the interception and extraction of groundwater as part of its mining operations. No change to this licence is anticipated as a result of the proposed modification.	No
Environmentally Hazardous Chemicals Act 1985	The EPA is granted power under the *Environmentally Hazardous Chemicals Act 1985* to assess and control chemicals and declare substances to be chemical wastes. A licence is required for any storage, transport or use of prescribed chemicals. The modification will not result in any changes to the storage, transport or use of prescribed chemicals.	No

Table 4.3 – Summary of State Legislation and Relevance to the Project (cont.)

Act	Comment	Further Approval Required for Proposed Modification
Mine Subsidence Compensation Act 1961	Under this Act, the approval of the MSB is required for the erection or alteration of improvements within a mine subsidence district. The erection or alteration of improvements is not proposed as part of the modification and the LWA7–A10 Modification Area is currently not a Declared Mine Subsidence District. Therefore approval under Section 15 of the *Mine Subsidence Compensation Act 1961* does not apply.	No
Dams Safety Act 1978	The *Dams Safety Act 1978* requires that large dams that may constitute a hazard to human life and property must be periodically reviewed by the NSW Dams Safety Committee. These dams are known as prescribed dams and are listed in Schedule 1 of the Act. The modification will not require the construction of any new dams. No approvals will be required under this Act.	No
National Parks and Wildlife Act 1974	Section 47(J) defines 'mining interests' as, among other things, any ML under the *Mining Act 1992* and specifies that a mining interest shall not be granted in respect of lands within a SCA without the concurrence in writing of the Minister. A renewal of, or extension of the term of a mining interest in respect of lands within a SCA (other than an existing interest) shall not be granted under the *Mining Act 1992* without the concurrence in writing of the Minister. These provisions require that should Austar wish to apply for a new ML or renew an ML, the concurrence of the Minister for Environment and Heritage will be required. Austar currently hold the MLs required for approved and proposed mining operations within the SCA.	No

Table 4.4 outlines the relevant State Environmental Planning Policies (SEPP) required to be considered in relation to the LWA7-A10 Modification.

Table 4.4 – Relevant SEPPs for Consideration in Relation to the Project

NSW Legislation – Environmental Planning Instruments		
Planning Provision	**Comment**	**Relevance**
State Environmental Planning Policy (State & Regional Development) 2011	The Austar Stage 3 Extension Project approved under 08_0111 is of a class of development listed in the SEPP and would have been categorised as State significant development if s75W did not apply to the proposed modification.	The Project is categorised as State Significant Development but for the application of section 75W of the EP&A Act via schedule 6A of the EP&A Act.
State Environmental Planning Policy (Mining, Petroleum Production & Extractive Industries) 2007	Regulates the permissibility of mining and related development and specifies matters that must be considered in assessing mining developments requiring consent under Part 3A (repealed) and Part 4 of the EP&A Act.	The proposed modification is permissible with consent.
State Environmental Planning Policy 33 (Hazardous & Offensive Development) 1992	SEPP No. 33 requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. A preliminary hazard analysis is completed for potentially hazardous development to assist the consent authority to determine acceptability.	The existing Austar operations are not considered as hazardous or offensive. The Project will not result in any changes to the existing Austar operations which would alter this classification. No further consideration of SEPP No. 33 is required.
State Environmental Planning Policy 44 (Koala Habitat Protection)	SEPP No. 44 restricts a Council from granting development consent for proposals on land identified as core koala habitat without preparation of a plan of management.	No core or peripheral koala habitat has been identified within the Modification Area. The provisions of SEPP 44 do not apply and koala plan of management is not required for the modification.
State Environmental Planning Policy 55 (Remediation of Land)	SEPP 55 restricts a consent authority from granting consent for the carrying out of development on land unless the consent authority has considered any potential contamination issues.	No potential contamination issues have been identified within the LWA7–A10 Modification Area.

Table 4.5 outlines the relevance of other NSW strategic policies in relation to the Proposed LWA7-A10 Modification.

Table 4.5 – Potentially Relevant NSW Strategic Policies

NSW Strategic Policies		
Policy	**Comment**	**Relevance**
Upper Hunter Strategic Regional Land Use Plan	The Upper Hunter Strategic Regional Land Use Plan (Upper Hunter SRLUP) contains the detailed policy direction for assessing and managing strategic land use decisions in the Upper Hunter Valley. The stated objective of the Upper Hunter SRLUP is to balance the strong economic growth in Regional NSW with the protection of valuable agricultural land and the sustainable management of natural resources. In particular, the Upper Hunter SRLUP identifies the importance of minimising the land use conflicts arising from the rapid growth of coal mining activities and the recent emergence of the coal seam gas industry. Key to the implementation of the Upper Hunter SRLUP is the assessment of impacts from mining and coal seam gas development on land identified as being strategic agricultural land.	The Proposed LWA7-A10 Modification Area is not located in the boundary of the Upper Hunter SRLUP, accordingly this plan does not apply to the Proposed LWA7-A10 Modification.
Aquifer Interference Policy	The Aquifer Interference Policy requires mining activities to consider 'Minimal Impact Considerations' with respect to groundwater sources.	Predicted groundwater impacts associated with the Proposed LWA7-A10 Modification have been assessed against the Aquifer Interference Policy as part of this EA. This assessment concludes that the potential for the Proposed LWA7-A10 Modification to impact on groundwater sources is considered negligible (refer to **Section 6.4.3**).

5.0 Stakeholder Consultation

5.1 Agency Consultation

During the preparation of this EA, the following government agencies were consulted to assist in identifying matters to be addressed in the EA:

- Department of Planning and Infrastructure (DP&I);
- NSW National Parks and Wildlife Service (NPWS);
- Cessnock City Council (CCC); and
- Department of Trade and Investment – Division of Resource and Energy (DRE).

The proposed approach to the environmental assessment, preliminary findings of relevant studies was discussed, and the approach to completing the assessment was confirmed. The approach to updating relevant management plans was also discussed during this consultation process.

In relation to that part of the proposed modification located beneath the Werakata State Conservation Area, a meeting was held with the Acting Area Manager and other relevant National Parks and Wildlife Service personnel, to provide a briefing on the proposed modification and the associated land owners consent process. No specific issues or concerns were raised at the meeting and the process of obtaining land owners consent for the SCA areas was commenced.

The approval path and scope of the EA was confirmed by the DP&I on 10 October 2013 (refer to **Appendix 2**).

Table 5.1 sets out the key issues to be addressed by the Environmental Assessment as confirmed by the DP&I.

Table 5.1 – Key Environmental and Community Issues

Issue	EA Reference
Subsidence	**Section 6.2**
Water Resources	**Sections 6.3** and **6.4**
Ecology	**Section 6.5**
Heritage	**Sections 6.6** and **6.7**

5.2 Stakeholder and Community Consultation

Austar maintains close relationships with neighbouring private landholders as well as nearby communities as part of normal business. As well as operating the Austar Community Consultative Committee, Austar regularly conduct formal and informal consultation with individual residents who live in areas potentially affected by the mine. Regular correspondence is provided to landholders giving updates of underground mining operations within the Stage 2 and Stage 3 areas and the results of subsidence and environmental monitoring (Austar 2012).

A community consultation program has been implemented for the Proposed LWA7–A10 Modification and has involved correspondence to, and follow up offers for meetings with individual private landholders within the LWA7–A10 Modification Area. In addition, Austar has consulted with the Chair of the Austar Community Consultative Committee to discuss the modification and provide specific briefing materials for the Community Consultative Committee. Ongoing consultation with affected landholders will be linked to the existing Built Features Management Plan process described in **Section 5.2.1** below.

Consultation is also being undertaken with the Registered Aboriginal Parties for Stage 3 in relation to the Preliminary Aboriginal Cultural Heritage and Archaeological Assessment the for the Proposed LWA7-A10 Modification and associated amendment to the Austar Aboriginal Cultural Heritage Management Plan (Umwelt 2013a). Further information in relation to this consultation process is provided in **Appendix 5**.

5.2.1 Built Features Management Plan Process

Consultation in relation to the management of subsidence induced impacts on built features is undertaken in accordance with the LWA7–A10 Built Features Management Plan (Austar 2013c). The LWA7–A10 Built Features Management Plan requires individual Built Features Management Plans to be developed progressively during extraction in consultation with the relevant infrastructure owner, prior to subsidence effects occurring at each built feature. Each individual Built Feature Management Plan is submitted to the Director-General DP&I.

A Built Feature Management Plan is currently being finalised with Cessnock City Council in relation to the management of subsidence induced impacts on Quorrobolong Road. Austar have finalised Built Feature Management Plans with Ausgrid, Telstra and NPWS.

Austar is also in consultation with a number of the private landholders within the LWA7-A10 Modification Area in relation to formalising Built Features Management Plans for built features on private properties, including houses, water tanks, poultry sheds, rural sheds, dams, private access roads and fences. This consultation will be ongoing as mining progresses within the Proposed LWA7-A10 Modification Area.

6.0 Environmental Assessment

6.1 Environmental Risk Analysis

A preliminary environmental risk analysis was undertaken for the proposed modification to identify the key issues that required detailed assessment as part of the EA process. As detailed within **Section 2.0**, the Proposed LWA7–A10 Modification is limited to a change in the underground longwall layout of LW A7 to A10. No other aspects of the approved Stage 3 Project or the current, approved Austar Mining Complex, will change as a result of the LWA7–A10 Modification. The key issues requiring assessment therefore relate to the potential impacts associated with changes to the longwall layout and resultant changes in subsidence impacts at the surface. The identification of the key environmental issues that require assessment was based on consideration of:

- the scale and potential impact of the modification;
- outcomes of the previous and current stakeholder consultation;
- the planning and environmental context of the modification; and
- the findings of the previous Stage 3 EAs (Umwelt 2008a and 2011a) and ongoing environmental monitoring of the existing Austar operations.

The outcomes of the preliminary environmental risk analysis are provided in **Table 6.1**. The following sections provide a detailed assessment of the key issues associated with the Proposed LWA7–A10 Modification.

Table 6.1 – Potential Environmental Impacts Associated with the LWA7–A10 Modification

Aspect	Environmental Assessment
Subsidence	Minor changes to the previously assessed subsidence impacts will occur as a result of the Proposed LWA7–A10 Modification. A detailed subsidence impact assessment has been undertaken for the Proposed LWA7–A10 Modification and has been included as **Appendix 3**. Generally, the nature of predicted subsidence levels remains consistent with current approved mining, with an increase in the extent of the area affected by subsidence impacts. A summary of the findings of the subsidence assessment is provided in **Section 6.2**. The subsidence assessment provides the predicted subsidence as a result of the changes to mining in LW A7 to LW A10 and details the management measures proposed to be implemented to manage subsidence from the modification.

Table 6.1 – Potential Environmental Impacts Associated with the LWA7–A10 Modification (cont.)

Aspect	Environmental Assessment
Water Resources	The Proposed LWA7-A10 Modification is unlikely to cause significant changes to flow regimes or flooding from that approved under Project Approval 08_0111 due to the minor nature of the change in subsidence impact and the location of the Proposed LWA7-A10 Modification in the upslope areas of the catchment, away from the floodplain. A review of the potential impacts of the Proposed LWA7-A10 Modification on the flooding and drainage regime was undertaken and the existing Austar flood model amended to incorporate the cumulative effects of the modification. The results of the flooding and drainage assessment are provided in **Section 6.3**. A comprehensive groundwater assessment for the Austar Mining Complex was prepared by Ian Forster of Connell Wagner in October 2007. No material changes are expected in relation to groundwater impacts as a result of the Proposed LWA7–A10 Modification. Further detailed assessment of potential groundwater impacts is therefore not considered warranted, however a summary of the results of the previous groundwater assessment and recent groundwater monitoring relevant to the Proposed LWA7–A10 Modification is provided in **Section 6.4**.
Ecology	Minor changes are anticipated to the area of subsidence impact. Given the previous ecological survey, assessment and monitoring undertaken within the area of the Proposed LWA7-A10 Modification, a targeted ecological survey and assessment has been undertaken focussed on confirming the results of previous assessments and identifying any potential threatened species within the proposed additional Modification Area. The ecological assessment is provided as **Appendix 4**, with the results summarised in **Section 6.5**.
Aboriginal Archaeology and Cultural Heritage	Minor changes are anticipated to the area of subsidence impact. Given the previous archaeological survey and assessment undertaken within the area of the Proposed LWA7–A10 Modification, an assessment of potential Aboriginal Archaeology and cultural heritage impact has been undertaken. The Preliminary Aboriginal Cultural Heritage and Archaeological Assessment is provided as **Appendix 5**, with the results summarised in **Section 6.6**.
Historic Heritage	Six potential historic heritage items have been previously identified within the Proposed LWA7–A10 Modification Area, however all have been assessed as having no heritage significance. One additional potential heritage item has been identified within the Proposed LWA7–A10 Modification Area. The Proposed LWA7–A10 Modification is predicted to change the previously assessed maximum subsidence levels at these locations therefore a desktop review of the potential impacts and adequacy of proposed management measures has been undertaken and provided in **Section 6.7**.
Land Resources and Agriculture	Mining of the Proposed LWA7–A10 Modification will result in changes to the landform when compared to those previously assessed and approved under 08_0111. Subsidence impacts on land resources and agricultural use of the land were identified as having a low risk of significant environmental impacts given predicted subsidence is within the range previously predicted within the approved Stage 3 area and is consistent with the levels of subsidence previously demonstrated to be compatible with existing land uses within the Austar mining complex. Further assessment of potential landform and land use impacts due to subsidence is provided in **Section 6.2**.

Table 6.1 – Potential Environmental Impacts Associated with the LWA7–A10 Modification (cont.)

Aspect	Environmental Assessment
Vibration	Underground mining has the potential to create vibration events as the land subsides. The potential impacts of vibration from mining in the LWA7–A10 Modification Area are considered to be consistent with those previously assessed and approved under project approval 08_0111. Vibration from underground mining in longwalls A7 to A10 is currently monitored using two continuous vibration monitors located at 345 Quorrobolong Road, Quorrobolong and 159 Coney Creek Lane Quorrobolong. Monitoring results from mining within longwall A7 to date indicate ready compliance with both human response and structure damage ground vibration criteria. The existing vibration monitoring network is considered sufficient to monitor the potential vibration impacts of the Proposed LWA7–A10 Modification. As the potential impacts of vibration from mining in the Proposed LWA7–A10 Modification Area are considered to be consistent with those previously assessed and approved under Project Approval 08_0111, management measures to be implemented for the Proposed LWA7–A10 Modification will be consistent with those outlined in the Austar Noise and Vibration Management Plan. Based on this preliminary assessment, no further assessment of vibration impacts has been undertaken.
Noise	The Proposed LWA7–A10 Modification is limited to changes in the layout of underground workings and will not result in any changes to the existing approved Austar surface facilities or operations. Subsidence impacts on the land surface from underground mining are not predicted to require significant surface remediation. The Proposed LWA7–A10 Modification is therefore not predicted to result in any noise impacts. Noise management measures to be implemented for the Proposed LWA7–A10 Modification will be consistent with those outlined in the Austar Noise and Vibration Management Plan. Based on this preliminary assessment, no further assessment of noise impacts has been undertaken.
Air Quality	The Proposed LWA7–A10 Modification is limited to changes in the layout of underground workings and does not involve any changes to Austar surface facilities, operations or production rates. Therefore the Proposed LWA7–A10 Modification will not change air quality impacts associated with these facilities (e.g. coal handling and transportation, ventilation shafts etc.). Based on this preliminary assessment, no further assessment of air quality impacts has been undertaken.
Traffic	Traffic volumes, coal transport and access arrangements are consistent with the approved operations. The Proposed LWA7–A10 Modification will not result in any changes to the production levels, employee numbers, transport arrangements or volumes of the approved operations and as such no further assessment of traffic impacts has been undertaken.

Table 6.1 – Potential Environmental Impacts Associated with the LWA7–A10 Modification (cont.)

Aspect	Environmental Assessment
Greenhouse Gas	Greenhouse gas emissions and energy use will be consistent with the approved Austar operations as the overall life of the Project will not change and the seam to be mined is the same seam as mined by the current operations. The additional 1.05 million tonnes to be mined as a result of the Proposed Modification will make a negligible contribution to national greenhouse gas contributions. Based on this preliminary assessment, no further assessment of greenhouse gas and energy has been undertaken.
Visual Amenity	The nature of the modification (i.e. underground long wall mining) and the nature of the existing undulating landform means there is very limited potential for visual impacts to occur. Potential visual impacts are limited to views of subsidence within the additional area of subsidence impact associated with the Proposed LWA7–A10 Modification and are consistent with the impacts previous assessed and approved under 08_0111. Based on this preliminary assessment, no further assessment of potential visual impacts has been undertaken.
Socio-Economic	Due to the nature of the Proposed LWA7–A10 Modification, there will be no changes to employment and no changes to Austar existing surface facilities, the modification is unlikely to result in significant socio-economic impacts. By providing for business continuity, extraction of an additional 1.05 million tonnes of ROM coal, the Proposed LWA7-A10 Modification will have a positive economic benefit. No further assessment has been undertaken.

6.2 Subsidence

An assessment of the potential impacts of the Proposed LWA7-A10 Modification compared to the previously approved subsidence predictions and impact assessments prepared by MSEC (2011) for the Stage 3 Project is presented in detail in **Appendix 3**. This section provides a summary of the main findings of the subsidence assessment.

The study area for the subsidence assessment has been defined as the zone where the predicted subsidence parameters based on the modified LWA7-A10 layout is different to those predicted based on the approved layout.

6.2.1 Subsidence Parameters

MSEC has utilised the Incremental Profile Method to predict the conventional subsidence parameters for LWA7 to A10 associated with the Proposed LWA7-A10 Modification. This method has also been previously used for assessment of the approved LWA7-A10 layout.

The predicted incremental subsidence contours due to extraction of the modified LWA7 to A10 layout are shown in **Figure 6.1**, while the predicted total subsidence contours due to the incorporation of the modified LWA7-A10 layout into the remainder of the approved layout for LWA11-A19 are shown on **Figure 6.2**.

A comparison of the predicted maxima for conventional subsidence parameters of the approved mine plan with the Proposed LWA7-A10 Modification is provided in **Table 6.2**.

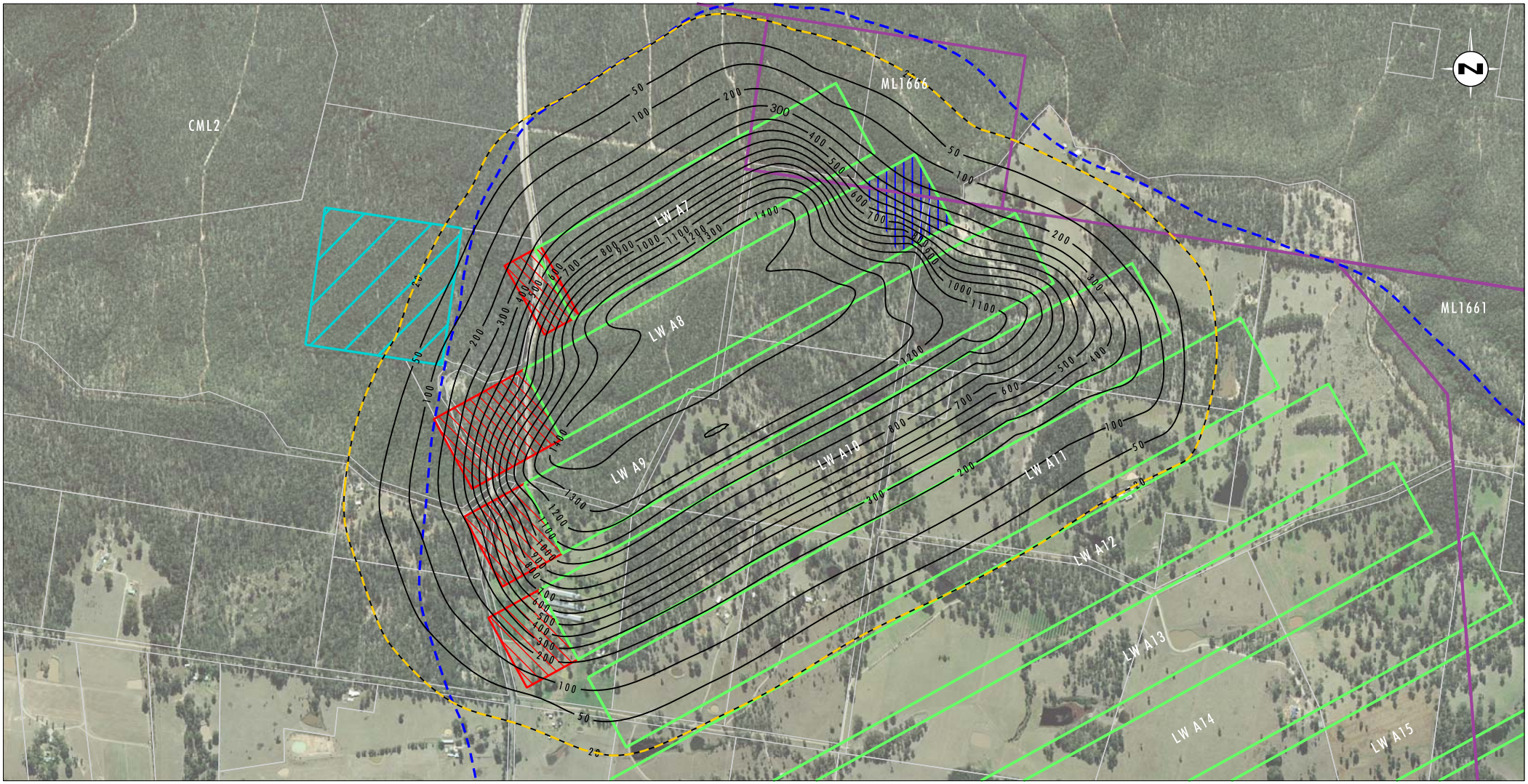


Image Source: AAM Hatch (2006),
Data Source: Austar Coal Mine (2013), LPI NSW (2010)

0 200 400 800m
1:16 000

Legend

- Layout for Approved Stage 3 Longwall Panels
- 20mm Subsidence Contour for Approved Stage 3 Longwall Layout
- LW A7-A10 20mm Incremental Subsidence Contour (Proposed LW A7-A10 Modification Area)
- Approved Surface Infrastructure Site
- Mining Lease Boundary
- Proposed Retraction of Longwall A8 Start Position
- Proposed Extension of Longwalls A7 to A10 Finish Position

FIGURE 6.1

Predicted Incremental Subsidence LW A7 to LW A10

File Name (A4): R02/3264_039.dgn
20131010 14.06

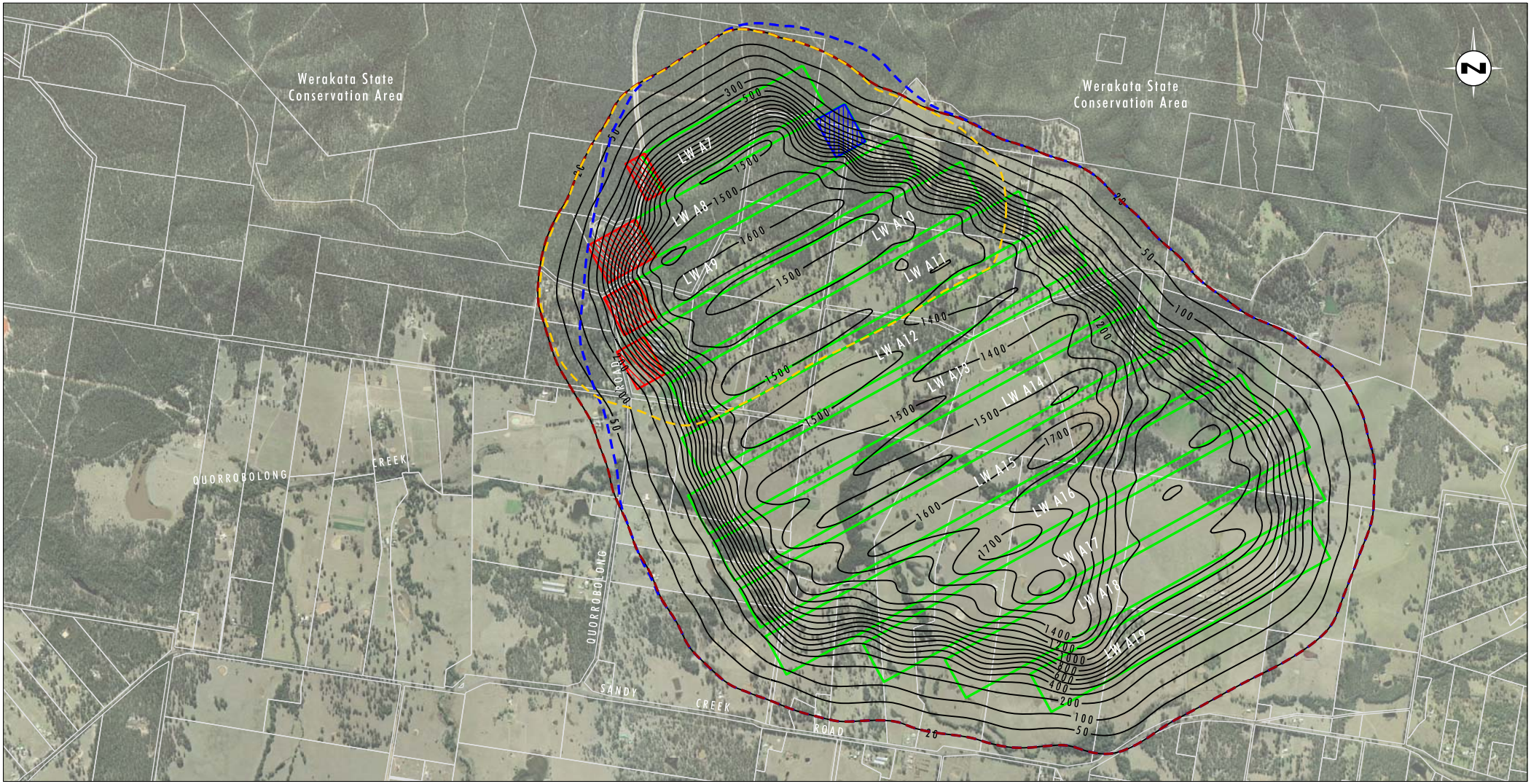


Image Source: AAM Hatch (2006)
Data Source: Austar Coal Mine (2013), LPI NSW (2009)

0 0.5 1.0 1.5km
1:30 000

Legend

- Layout for Approved Stage 3 Longwall Panels
- 20mm Subsidence Contour for Approved Stage 3 Longwall Layout
- LW A7-A10 20mm Incremental Subsidence Contour (Proposed LW A7-A10 Modification Area)
- Revised 20mm Subsidence Contour for Modified Stage 3 Longwall Layout
- Proposed Retraction of Longwall A8 Start Position
- Proposed Extension of Longwalls A7 to A10 Finish Position

FIGURE 6.2

Total Predicted Subsidence LW A7 to LW A19

File Name (A4): R02/3264_040.dgn
20131016 11.12

Table 6.2 – Comparison of Maximum Predicted Conventional Subsidence Parameters for Approved and Proposed Layout in the Study Area

Extents	Mine Plan	Max. Predicted Total Subsidence (mm)	Max. Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
LWA7-LWA10	Approved	1,500	5.5	0.04	0.09
	LWA7-A10 Modification	1,500	6.0	0.05	0.09
LWA7-LWA19	Approved	1,650	6.0	0.04	0.09
	LWA7-A10 Modification	1,675	6.0	0.05	0.09

Table 6.2 indicates that maximum predicted subsidence parameters for the Proposed LWA7-A10 Modification layout are similar to or slightly greater than those based on the approved Stage 3 mine plan. The difference in the predicted maxima is considered to be within the limits of accuracy of the method of prediction.

While the predicted maxima are found to be reasonably similar, MSEC notes that the locations of the predicted maxima change as a result of the modification. Further detailed assessment of the predicted subsidence impacts of the Proposed LWA7-A10 Modification on the surface and built features within the study area has therefore been completed. The results of this assessment are summarised in the following sections.

6.2.2 Subsidence Prediction Model Calibration

The Incremental Profile Method has previously been used to predict the conventional subsidence parameters, including subsidence, tilt, curvature and strain, for longwall mining in the Stage 2 and Stage 3 mining areas. A comparison of the observed versus predicted subsidence has been used by MSEC to calibrate and determine the accuracy of the model. The model was found to predict ground movement reasonably similar to that observed and is considered to provide adequate predictions of the mine subsidence movements for Stage 2 LWA3 to A5a. Further comparison to the observed ground movements for mining in Stage 3 LWA7 is not possible at present as mining has resulted in only low levels of subsidence to date.

6.2.3 Predicted Impacts

As the maximum predicted subsidence parameters for the Proposed LWA7-A10 Modification are reasonably similar to those based on the approved Stage 3 mine plan, the nature of mining induced ground deformation impacts predicted to arise from the Proposed LWA7-A10 Modification are expected to be similar to those of the approved Stage 3 Project. These impacts are discussed in MSEC (2011) and include the following key aspects:

- due to the depth of mining (455 to 575 metres), surface cracking resulting from the extraction of the proposed longwalls is expected to be of a minor nature, which can be easily remedied; and

- the height of the fractured zone above longwall panels is predicted to be approximately 245 to 285 metres. With a minimum depth of cover of 455 metres, it is unlikely that the fractured zone would extend up to the surface.

6.2.3.1 Watercourses

Water courses within the Proposed LWA7-A10 Modification Area are ephemeral first and second order streams, characterised by shallow incisions into the ground surface. Maximum predicted subsidence parameters for the drainage lines in this area are shown in **Table 6.3**.

Table 6.3 – Maximum Predicted Conventional Subsidence Parameters for Drainage Lines in the Study Area – LWA7 to LWA19

Maximum Predicted Total Subsidence (mm)	Max. Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
1,675	6.0	0.05	0.09

The results presented in **Table 6.3** are similar to those predicted for drainage lines located in the remainder of the approved Stage 3 mining area. Therefore, the potential for surface cracking along the drainage lines is similar to that reported for the approved Stage 3 mining area, as reported by MSEC (2011), that is, with the continued implementation of the existing approved management strategies, it is unlikely that there would be any adverse impacts on watercourses as a result of the Proposed LWA7-A10 Modification.

Discussion on the potential impacts of predicted subsidence on flooding patterns is provided in **Section 6.6**.

6.2.3.2 Steep Slopes

For the purposes of the assessment, steep slopes are defined as land with a natural gradient greater than 33 per cent or an angle to the horizontal of 18°. Compared to the approved Stage 3 layout, the proposed modification includes some additional areas of steep slopes directly above the proposed extension to LWA8 in the Werakata State Conservation Area. It is noted, however, that the total area of steep slopes directly above LWA8 is reduced as a result of the proposed modification, due to the shortening of the commencing end of LWA8 (refer to **Appendix 3**, Drawing No: MSCE650-04). No cliff lines are located within the Proposed LWA7-A10 Modification Area.

Maximum predicted subsidence parameters for steep slopes in the study area are shown in **Table 6.4**.

Table 6.4 – Comparison of Maximum Predicted Conventional Subsidence Parameters for Steep Slopes in the Study Area

Mine Plan	Max. Predicted Total Subsidence (mm)	Max. Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
Approved	1,525	5.0	0.04	0.09
LWA7-A10 Modification	1,600	5.5	0.05	0.09

Note: This data represents combined data from LWA7 to LWA19, to take into account data from the approved layout.

The results presented in **Table 6.4** indicate that maximum subsidence at steep slopes as result of the Proposed LWA7-A10 Modification, will be similar to but slightly greater than that based on the approved mine plan. The difference in the predicted maxima is considered to be within the limits of accuracy of the method of prediction.

The potential for surface cracking on the steep slopes is considered similar to that of the approved mine plan. Monitoring within the Stage 2 mining area has not identified any significant cracking along steep slopes within the Werakata State Conservation Area, and no fracturing of rock outcrops or rock falls have been identified.

With the continued implementation of the existing approved management strategies, it is unlikely that there would be any long term impacts on steep slopes as a result of the Proposed LWA7-A10 Modification.

6.2.3.3 Houses

Four private houses are likely to experience changes in predicted subsidence impacts as a result of the Proposed LWA7-A10 Modification (refer to **Appendix 3**, Drawing No: MSCE650-05), including two houses that were previously located outside the 20 millimetre subsidence contour. Maximum predicted subsidence parameters are shown in **Table 6.5**.

Table 6.5 – Comparison of Maximum Predicted Conventional Subsidence Parameters for Houses in the Study Area

Reference	Mine Plan	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
A09a	Approved	<20	<0.5	<0.01	<0.01
	LWA7-A10 Modification	35	<0.5	<0.01	<0.01
A12a	Approved	875	5.5	0.04	< 0.01
	LWA7-A10 Modification	925	4.5	0.03	0.01
A16a	Approved	175	1.5	0.01	< 0.01
	LWA7-A10 Modification	250	2.5	0.02	< 0.01
A52a	Approved	< 20	< 0.5	< 0.01	< 0.01
	LWA7-A10 Modification	60	0.5	0.01	< 0.01

Note: This data represents combined data from LWA7 to LWA19, to take into account data from the approved layout.

The potential for impacts on houses is more dependent on differential subsidence parameters such as tilt, curvature and ground strain, as opposed to vertical subsidence. Changes in vertical subsidence have the potential to affect flooding potential. This issue is discussed in further detail in **Section 6.6**.

Table 6.5 indicates that predicted maximum vertical subsidence is slightly greater than that predicted for the approved mine plan, experiencing differences in the order of 15 to 75 millimetres. Predicted tilts and curvatures are similar to the approved mine plan. Experience from longwall mining indicates that tilts of less than 7 mm/m generally do not result in any significant impacts to houses. It is noted that the predicated maximum tilt associated with the Proposed LWA7-A10 Modification is 4.5 mm/m.

An assessment of the probability of impacts to the four private houses as a result of the Proposed LWA7-A10 Modification indicated similar levels of risk to the approved Stage 3 mine plan. The distribution of the assessed impacts is provided in **Table 6.6**.

Table 6.6 – Assessed Impacts for Potentially Affected Houses in the Study Area

Reference	Repair Category			
	No Claim or R0	R1 or R2	R3 or R4	R5
A09a	95%	4%	1%	<0.1%
A12a	87%	11%	2%	<0.5%
A16a	90%	9%	1%	<0.5%
A52a	95%	4%	1%	<0.1%

With the continued implementation of the existing approved management strategies, it is unlikely that there would be any adverse impacts on the safety and serviceability of the four houses as a result of the Proposed LWA7-A10 Modification.

In accordance with the existing Built Features Management Plan, the management of impacts on private houses will be the subject of an individual Built Features Management Plan to be developed in consultation with individual landholders prior to subsidence impacts occurring.

6.2.3.4 Rural Structures and Land Uses

Rural structures on three private properties are likely to experience changes in the predicted subsidence impacts as a result of the Proposed LWA7–A10 Modification (refer to **Appendix 3**, Drawing No: MSCE650-05), including two private properties that were previously located outside the 20 millimetre subsidence contour. The structures include farm sheds, garages, poultry shreds and other non-residential structures. Maximum predicted subsidence parameters for these rural structures are shown in **Table 6.7**.

Table 6.7 – Comparison of Maximum Predicted Conventional Subsidence Parameters for Rural Structures in the Study Area

Property	Mine Plan	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
A09a	Approved	<20	<0.5	<0.01	<0.01
	LWA7-A10 Modification	25	0.5	<0.01	<0.01
A12	Approved	925	6.0	0.04	< 0.01
	LWA7-A10 Modification	1,250	5.0	0.04	0.01
A16	Approved	225	2.0	0.01	< 0.01
	LWA7-A10 Modification	300	2.5	0.02	< 0.01
A52	Approved	< 20	< 0.5	< 0.01	< 0.01
	LWA7-A10 Modification	60	0.5	0.01	< 0.01

Note: This data represents combined data from LWA7 to LWA19, to take into account data from the approved layout.

The potential for impacts on rural structures is dependent on differential subsidence parameters such as tilt, curvature and ground strain, as opposed to vertical subsidence. Data presented in **Table 6.7** show that predicted tilts and curvatures for the Proposed LWA7–A10 Modification are similar to the approved mine plan. Based on the predicted subsidence

parameters for these rural structures, it is expected that all will remain in a safe and serviceable condition and the ongoing use of these structures will not be adversely impacted.

The predicted movements for the rural structures set out in **Table 6.7** are also similar to those observed in the Stage 2 mining area, where there were no reported impacts on the 14 rural structure located above LWA3 to LWA5a as a result of mining. In all cases, rural building structures have remained in safe and serviceable conditions.

With the continued implementation of the existing approved management strategies, it is unlikely that there would be any long term impacts on rural structures and associated rural land uses as a result of the Proposed LWA7-A10 Modification.

6.2.3.5 Farm Dams

Modelling indicates a reduction in predicted subsidence for farm dams located near the commencing end of LWA8, while an increase in subsidence movements is predicted for those located near the finishing ends of LWA9 and LWA10. Dams located near the finishing ends of LWA9 and LWA10 may experience the full range of predicted movements up to maxima detailed in **Table 6.2** for subsidence (1650 mm) and tilt (6.0 mm/m). Further, predicted changes in freeboard for the dams are less than 500 millimetres, which is considered unlikely to have an adverse impact on the storage capacity of the dams.

Maximum predicated curvature and strains are similar to that predicted for farms dams outside of the Proposed Modification Area (i.e. in the approved Stage 3 area). As such, potential for surface cracking is similar to that predicted for the approved Stage 3 Project.

With the continued implementation of the existing approved management strategies, it is unlikely that there would be any long term impacts on farm dams as a result of the LWA7-A10 Modification.

6.2.3.6 Local Roads

A number of local roads are located within the Proposed LWA7–A10 Modification Area (refer to **Appendix 3**, Drawing No: MSCE650-05), including Quorrobolong Road, Big Hill Road, Coney Creek Lane and Nash Lane.

Maximum predicted subsidence parameters for these local roads are shown in **Table 6.8**.

Table 6.8 – Comparison of Maximum Predicted Conventional Subsidence Parameters for Local Roads in the Study Area

Location	Mine Plan	Max. Predicted Total Subsidence (mm)	Max. Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
Quorrobolong Road	Approved	325	2.0	0.01	<0.01
	LWA7-A10 Modification	1,250	5.0	0.02	0.07
Big Hill Road	Approved	1,625	5.0	0.02	0.05
	LWA7-A10 Modification	1,675	5.0	0.03	0.05
Coney Creek & Nash Lanes	Approved	1,550	5.0	0.02	0.03
	LWA7-A10 Modification	1,550	5.0	0.02	0.03

Note: This data represents combined data from LWA7 to LWA19, to take into account data from the approved layout.

The results presented in **Table 6.8** show an increase in the subsidence parameters predicted for Quorrobolong Road when compared to the approved mine plan. Subsidence associated with the Proposed LWA7–A10 Modification in likely to result in minor cracking in the road surface, typically less than 25 millimetres in width, and potentially localised heaving of the road surface. The predicted subsidence parameters and impacts on Quorrobolong Road are similar to those typically experienced in the Southern Coalfield where there is extensive experience in mining beneath bitumen sealed local roads. This experience indicates that the road could be maintained in safe and serviceable conditions using normal road maintenance techniques.

It is recommended that an additional ground monitoring line be established along Quorrobolong Road so as to measure actual ground movement and that periodic visual inspections be carried out during active subsidence.

Appropriate management strategies for Quorrobolong Road are currently being formalised in consultation with Cessnock City Council in the form of a Built Features Management Plan for Quorrobolong Road. No change to the scope of these management strategies is considered necessary as a result of the Proposed LWA7-A10 Modification. With the implementation of these standard management strategies, it is expected that Quorrobolong Road could be maintained in safe and serviceable conditions at all times.

Table 6.8 also indicates that predicted maximum subsidence for Big Hill Road, Coney Creek and Nash Lanes are similar to or slightly greater than that predicted for the approved mine plan. No additional management or monitoring measures to those approved are required for these unsealed roads.

6.2.3.7 Electrical Infrastructure

There are 11 kV powerlines and lower voltage residential supply powerlines located within the Proposed LWA7–A10 Modification Area. Maximum predicted subsidence parameters for the 11 kV powerline alignments are shown in **Table 6.9**.

Table 6.9 – Comparison of Maximum Predicted Conventional Subsidence Parameters for 11 kV Powerlines in the Study Area

Mine Plan	Max. Predicted Total Subsidence (mm)	Max. Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
Approved	1,625	5.0	0.02	0.05
LWA7-A10 Modification	1,675	5.0	0.03	0.05

Note: This data represents combined data from LWA7 to LWA19, to take into account data from the approved layout.

The results presented in **Table 6.9** are similar to or slight greater than that predicted for the approved mine plan. The predicted movements for powerlines shown in **Table 6.9** are also similar to those observed in the Stage 2 mining area, where no adverse impacts on powerlines were observed. With the continued implementation of the existing approved management strategies, it is unlikely that there would be any long term impacts on powerlines as a result of the Proposed LWA7-A10 Modification.

6.2.3.8 Telecommunications Cables

Buried copper telecommunication cables are located along the alignments of Quorrobolong Road, Coney Creek Lane and Nash Lane. As such, the cables are predicted to experience mine subsidence movements similar to those predicted for these roads, with results shown in **Table 6.10**.

Table 6.10 – Comparison of Maximum Predicted Conventional Subsidence Parameters for Telecommunications Cables in the Study Area

Mine Plan	Max. Predicted Total Subsidence (mm)	Max. Predicted Total Tilt (mm/m)	Max. Predicted Total Hogging Curvature (km^{-1})	Max. Predicted Total Sagging Curvature (km^{-1})
Approved	1,625	5.0	0.02	0.05
LWA7-A10 Modification	1,675	5.0	0.03	0.05

Note: This data represents combined data from LWA7 to LWA19, to take into account data from the approved layout.

The results presented in **Table 6.10** are similar to or slight greater than that predicted for the approved mine plan. Whilst the maximum predicted subsidence parameters do not change significantly, the telecommunications cable located adjacent to Quorrobolong Road is predicted to experience greater movements.

The predicted movements for the telecommunications cables are similar to those typically experienced within the Southern Coalfield, where there is extensive experience managing mining beneath telecommunications cables and impacts are extremely rare and readily repairable.

With the continued implementation of the existing approved management strategies, it is unlikely that there would be any long term impacts on telecommunications cables as a result of the Proposed LWA7-A10 Modification.

6.2.3.9 Aboriginal Archaeology

Five Aboriginal sites have potential to experience changes in predicted subsidence impacts as a result of the Proposed LWA7-A10 Modification, including one scar tree, artefact scatters and isolated finds. Surface cracking resulting from mining is expected to be minor and isolated and not result in adverse impacts on trees or directly impact artefact scatters or isolated finds. With the continued implementation of the existing approved management strategies, it is unlikely that there would be any adverse impacts on Aboriginal sites as a result of the LWA7-A10 Modification.

A detailed assessment of the potential impacts of the Proposed LWA7–A10 Modification on Aboriginal cultural heritage is provided in **Section 6.6**.

6.2.3.10 Historical Sites

Six previously identified historical sites have potential to experience changes in predicted subsidence impacts as a result of the Proposed LWA7-A10 Modification, including culverts, fencing and quarries. With the continued implementation of the existing approved management strategies, it is unlikely that there would be any adverse impacts on historic sites as a result of the LWA7-A10 Modification. One additional potential historic heritage site was identified in the Proposed LWA7-A10 Modification Area. An assessment of the potential

impacts of the Proposed LWA7–A10 Modification on historic heritage is provided in **Section 6.7**.

6.2.3.11 Summary and Management Recommendations

An assessment of the maximum predicted subsidence parameters for the Proposed LWA7–A10 Modification indicates that predictions are similar to or slightly greater than those based on the approved mine plan. In all cases the differences are considered to be within the limits of accuracy of the method of prediction. Maximum predicted subsidence parameters for the natural and built features within the Proposed Modification Area are similar to those of the approved mine plan, with impacts slightly less for features near the commencing end of LWA8, and slightly greater for features near the finishing ends of LWA7-A10.

Subsidence from the Stage 3 Project is currently managed in accordance with the existing approved LWA7 to A10 Extraction Plan (Austar 2013a). As the predicted impacts of ground movements associated with the Proposed LWA7–A10 Modification on natural and built features are expected to be similar to those of the approved mine plan, no change is proposed to the existing approved management strategies for natural and built features. Additional monitoring of subsidence along Quorrobolong Road is recommended to assist in implementation of appropriate management measures. The LWA7 to A10 Extraction Plan (Austar 2013a) will be amended to reflect the Proposed LWA7-A10 Modification and additional monitoring recommendation for Quorrobolong Road.

With the continued implementation of these existing approved management strategies, it is unlikely that there would be any adverse impacts as a result of the Proposed LWA7-A10 Modification.

6.3 Surface Water and Drainage

6.3.1 Flood Modelling Methodology

To assess the potential impacts of the Proposed LWA7–A10 Modification on flooding and drainage, an assessment was completed which builds on the findings of previous flooding and drainage assessments undertaken for the Stage 2 and Stage 3 mining areas (Umwelt 2007; 2008b; 2010a; 2011b; 2012). The methodology used to undertake the flooding and drainage assessment included:

- review and modification of the previously developed RMA-2 flood models for Stage 2 and Stage 3 to account for predicted changes to the landform due to subsidence from mining in accordance with the Proposed LWA7-A10 Modification. To achieve this the digital terrain models used in the RMA-2 flood models were modified to reflect the MSEC (2013) modified LWA7 - LWA10 subsidence predictions; and

- investigation of the impacts of the Proposed LWA7–A10 Modification on flooding and drainage for 1 in 100 year Average Recurrence Interval (ARI) flood events for a range of landform scenarios including:

    - pre-mining landform. As mining in the Stage 2 area is now complete, the subsided Stage 2 landform was taken to represent the pre-mining landform;
    - transient Proposed LWA7–A10 Modification landform, being the subsided landform at the end of mining in longwall A10;

- approved post-mining landform, being the subsided landform at the end of mining in longwall A19, without the LWA7-A10 Modification; and
- proposed post-mining landform, being the subsided landform at the end of mining in longwall A19, with the LWA7-A10 Modification.

The thematic mapping that is used to present the results of the flood depth modelling has been updated since 2012 and now uses approximately twice the number of flood model points to create the thematic maps. The updated mapping method provides a much higher spatial detail and accuracy in regard to flood depths compared to previous flood mapping methods. As can be seen in **Figure 6.3**, the refined mapping algorithms have resulted in a reduction in the mapped maximum modelled flood extent for Stage 2 within the vicinity of residence A16a (previously referred to as A102a). As can be seen from **Figure 6.3**, whilst the previous modelling (Umwelt 2012) indicated that residence A16a was likely to be subject to minor flooding during the 100 year ARI event, the improved flood mapping algorithms indicate that residence is located just outside of the maximum modelled flood extent for the 100 year ARI event.

6.3.2 Changes to Surface Flows and Flooding

The Proposed LWA7–A10 Modification Area is located within the catchment areas of Black Creek and Cony Creek (refer to **Figure 1.6**). Longwalls A7 and A8 are predominantly located within the upper reaches of an ephemeral tributary of Black Creek, while longwalls A9 and A10 are located on an upslope section of Cony Creek catchment.

Subsidence predictions for the Proposed LWA7–A10 Modification indicate that the associated subsidence impacts occur outside the maximum modelled 1 in 100 year ARI flood extent for Black Creek and Cony Creek. The Proposed LWA7–A10 Modification is therefore considered to have a negligible impact on flooding in these catchments.

A comparison of the maximum modelled 1 in 100 year ARI flood depths within the approved Stage 3 mining area (refer to **Figure 6.4**) and the Proposed LWA7–A10 Modification (refer to **Figure 6.5**) also indicate that the proposed modification does not significantly alter the approved flood impacts within the broader Cony Creek catchment area.

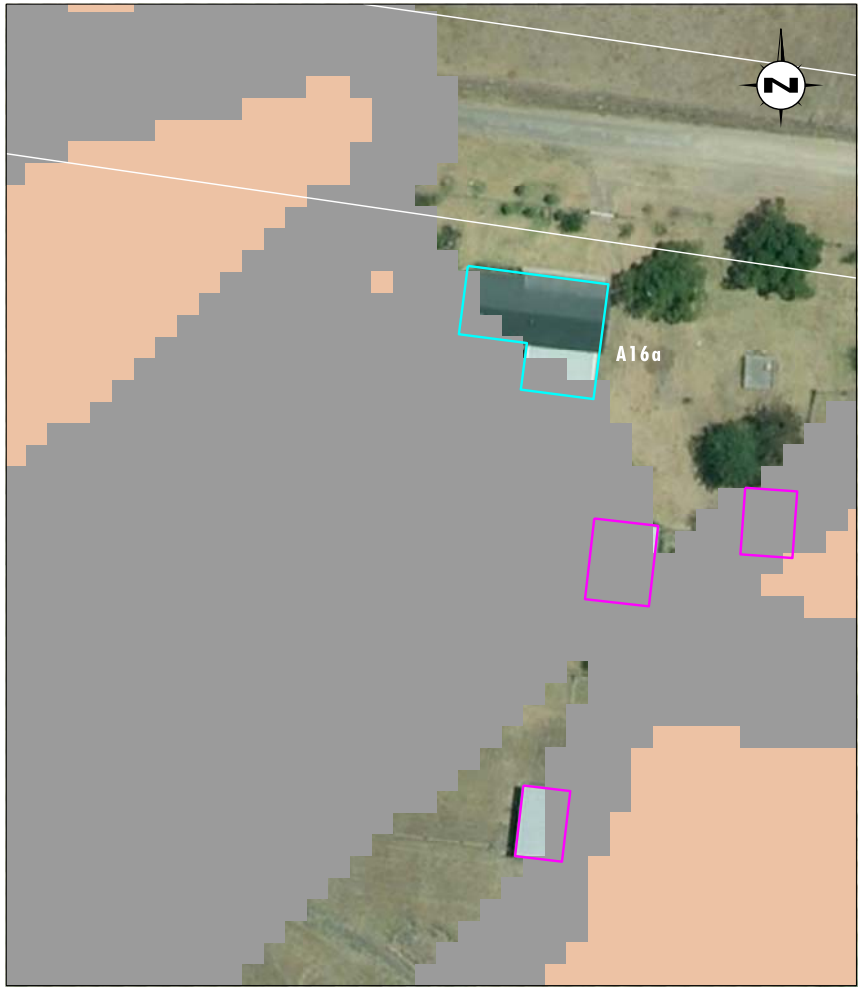
6.3.3 Flood Depths at Dwellings

Subsidence modelling undertaken by MSEC (2013) indicates that the Proposed LWA7–A10 Modification could have the potential to alter the flood impacts in the vicinity of a single dwelling (A16a) with all other dwellings outside area of potential change to flooding impacts.

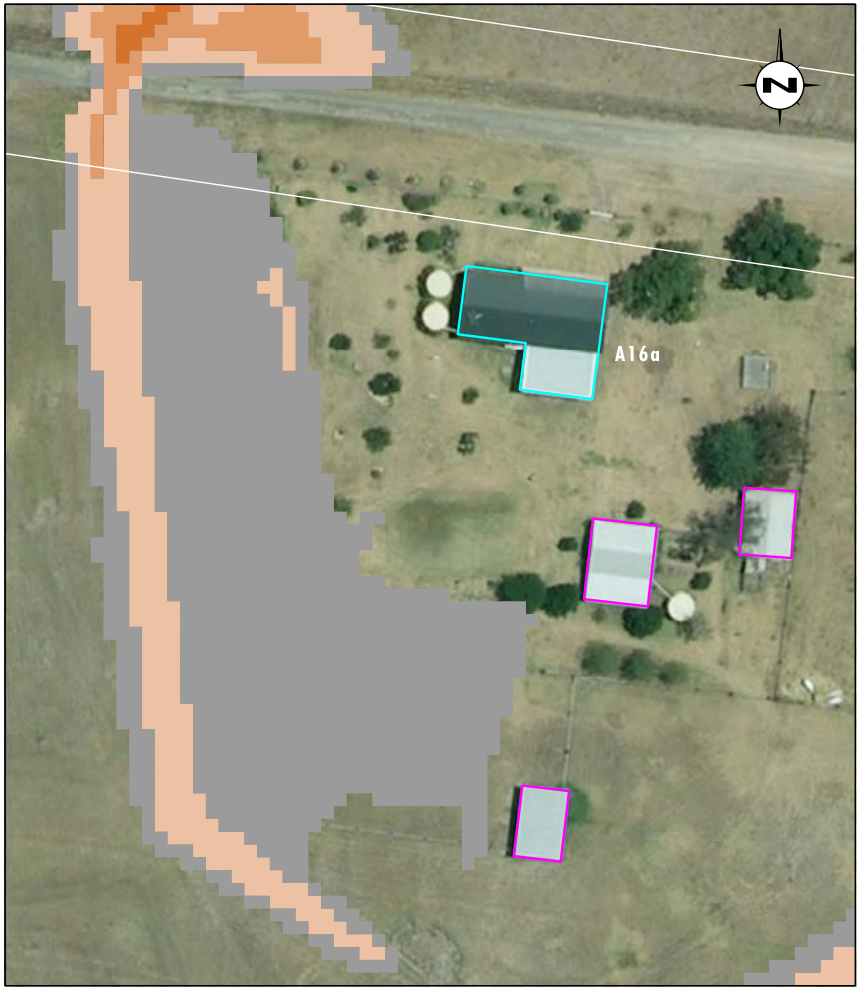
Dwelling A16a (formerly A102a) is located on the southern side of Cony Creek Road approximately 90 metres south of the proposed extension to longwall A10. As shown on **Figure 6.3** this dwelling is located outside of the maximum modelled 1 in 100 year ARI flood extent.

The RMA-2 hydrodynamic flood model previously used to model the flooding impacts associated with Stage 2 (Umwelt, 2012) and Stage 3 (Umwelt 2011b) was extended to include additional topographic details within the vicinity of dwelling A16a. The extended model was then modified to include the predicted subsidence associated with the Proposed LWA7-A10 Modification.

To ensure consistency with previous modelling results, the extended RMA-2 model was used to model the flood response of the Quorrobolong Valley to the 100 year ARI critical duration design storm event for the subsided landform associated the recently completed Stage 2



Umwelt 2012



Updated Mapping Algorithm

Image Source: Google Earth (2009)
Data Source: LPI - Cadastral Boundaries

0 10 25 50m
1:1000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary

Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [1.900 : 8.000]

FIGURE 6.3

Maximum Modelled Flood Depths, Approved Stage 2 Modification A16 Residence

File Name (A4): R02/3264_035.dgn
20131009 17.05