6.15.5 Visual impact assessment (Day time)

The visual impact assessment for each of the representative viewpoints surrounding the Southern Extension Area are discussed below.

6.15.5.1 Views from Castlereagh Highway adjacent to the Southern Extension Area

As shown in **Plate 6.2**, from the Castlereagh Highway it is currently possible to get filtered and transient views of the following components and activities associated with the existing Invincible operations:

- sealed access road
- haul roads
- Mine Infrastructure Area
- administration buildings
- overburden emplacement areas
- rehabilitation areas
- laydown areas
- existing highwall
- main storage dam
- coal stockpiles
- Invincible CPP.

In addition to the features identified above, the following components of the Southern Extension Project may be visible from cars travelling along Castlereagh Highway:

- exposed highwalls and drilling rigs
- active overburden emplacement area including machinery operating on it (trucks, dozers etc)
- active mining area
- shaped and topsoiled areas ready for rehabilitation
- areas in the process of being rehabilitated.

It is unlikely that direct views into the Southern Extension Area will be possible from the Castlereagh Highway, however there may be partial or filtered views of mining operations for vehicles for the section of the highway adjacent to the Southern Extension Area. Views from cars travelling along the highway will be heavily screened by the vegetation between the road and the Southern Extension Area. It is considered that there will be a moderate visual impact from the Castlereagh Highway as a result of the Southern Extension Project however views will be filtered and transient given most vehicles will be travelling at close to 100 km/h where the views are most prominent.

While the Southern Extension Project will increase visual impacts to the east of the highway in areas close to the Southern Extension Area, views of the West Pit area (refer to **Figure 2.1**) for vehicles travelling north and views of existing operations from locations between the Invincible access road and Cullen Bullen will improve as a result of the ongoing rehabilitation of these areas.

6.15.5.2 Visual impact assessments from key viewpoints

As discussed in **Section 6.15.4**, four visual assessment locations were chosen to be assessed as representative of localities that have the highest potential for views of the Southern Extension Area. Visual amenity assessments for each of these locations are provided below.

VP1 Ben Bullen State Forest

Figure 6.26 illustrates the radial analysis from a location within the Ben Bullen State Forest to the east of the Southern Extension Project. This viewpoint is located close to the Trig Station located to the east of Invincible and can only be accessed by foot, and captures the view for recreational bushwalkers within the Ben Bullen State Forest.

The viewshed from this location provides for representative worst case view from within the State Forest; the visual location is expected to have a prominent view of the Southern Extension Project when looking west. The analysis and viewshed presented in **Figures 6.26** and **6.27** illustrate the following:

- **Existing View** – extensive views of the existing Invincible surface workings and associated infrastructure including:
    - sealed access road
    - haul roads
    - Mine Infrastructure Area
    - administration buildings
    - overburden emplacement areas
    - existing rehabilitation areas
    - laydown areas
    - existing longwall
    - dam
    - stockpile location
    - Invincible CPP
    - Existing surface workings.

Visual impacts are most prominent in topdressed shaped overburden areas which have not yet been vegetated, and topsoil stockpiles. The topsoils are typically light in colour and offer greater contrast to vegetated areas than overburden emplacement areas which are typically darker in colour. This contrast is observable in the southern areas of disturbance shown in **Figure 6.27** which are topdressed areas of the former Cullen Main open cut mined in the 1940s. The contrast against the darker overburden located between the nearest vegetation and the mine infrastructure area is less contrasting due to its darker colour. The West Pit mining area, which is in the process of being rehabilitated, can also be seen to the north-west. The vegetation in this area was planted in 2012 and, at four years of age, the vegetation establishing in this area is mitigating the visual impact associated with this former mining area.

Extensive views of Cullen Bullen and rural areas to the west of Ben Bullen State Forest are also visible from this location.

- **Mine Plan Stage 2** – extensive views of mining operations in the Southern Extension Area will be visible from VP1. These views will be over a distance of approximately 0.3 to 1.1 km. Views to the south-west will change over the course of the Southern Extension Project with views in the early stages including views into the active pit area (refer to **Figure 6.27**). As the pit progresses to the south, views into the pit will be reduced due to natural terrain features and the development of the final landform progressively behind the active working area. Visual impacts are likely to be most prominent following topdressing of shaped overburden areas and will be similar to the southern areas of existing disturbance shown in **Figure 6.27**.

  As mining progresses, previous disturbance areas to the west and north-west of VP1 will be reshaped and will be in various stages of rehabilitation. Visual impacts associated with these areas will improve as mining progresses south and vegetation in rehabilitated areas becomes more established.

  Overall, the visual impacts from VP1 associated with Invincible and the Southern Extension Project will remain prominent for the duration of the Southern Extension Project and years following through to completion of rehabilitation of the Southern Extension Area. The impact will be similar to that of existing Invincible operation from this location (refer to **Figure 6.27**).

  It is noted that this location is only representative of views from near the top of the pagoda formations and is not representative of views from all areas of the State Forest to the east of the Southern Extension Area which will be limited by screening from topography and vegetation in these areas.

VP2 Portland Cullen Bullen Road

Figure 6.28 illustrates the radial analysis from a location on Portland Cullen Bullen Road north-west of the Southern Extension Project and west of Cullen Bullen. The viewshed from this location provides a representative view from the road for residents, and others, travelling along Portland Cullen Bullen Road. Based on the radial analysis, sections of the Southern Extension Area may be visible which, in the Stage 2 mine plan, would include limited sections of active overburden emplacement areas and topdressed shaped overburden areas (shaped not seeded) on the eastern side of the Southern Extension Area. The analysis and viewshed presented in **Figures 6.28** and **6.29** illustrate the following:

- **Existing View** – a distant filtered view of the high wall in the Renown/South Pit area and the visually prominent topsoil and stockpiled salvaged timber located at the top of the highwall and rehabilitation associated with the existing Invincible mining disturbance area (predominantly the West Pit Area) is visible from this location. While the views of the existing operations are partly screened by vegetation located closer to the operations, **Figure 6.29** shows the existing mining areas are in close proximity to the visually prominent pagoda formations located to the east of the existing disturbance footprint. The smaller pagoda formations located to the south (east of the Southern Extension Area) are not

noticeable at this location and distance due to their lower height, screening by vegetation close to the pagodas and distance. Also noticeable from this location is the rehabilitation of the Ivanhoe North open cut operations located west of the Castlereagh Highway opposite the Southern Extension Area.

- **Mine Plan Stage 2** –Whilst the radial analysis indicated there are potential views of the eastern extent of active overburden emplacement area and sections of the shaped not seeded landform associated with the Southern Extension Project at VP2, these views are at a distance of approximately 4.6 km and are partly screened by vegetation to the west of the Castlereagh Highway. No significant views of the Southern Extension Project are predicted from this location and the existing views of Invincible will be improved as these areas are rehabilitated over the life of the Southern Extension Project. The progressive rehabilitation of Invincible and the Southern Extension Area will significantly improve the visual amenity in this area as a result of removing the contrast between mining areas and the prominent escarpment features further east.

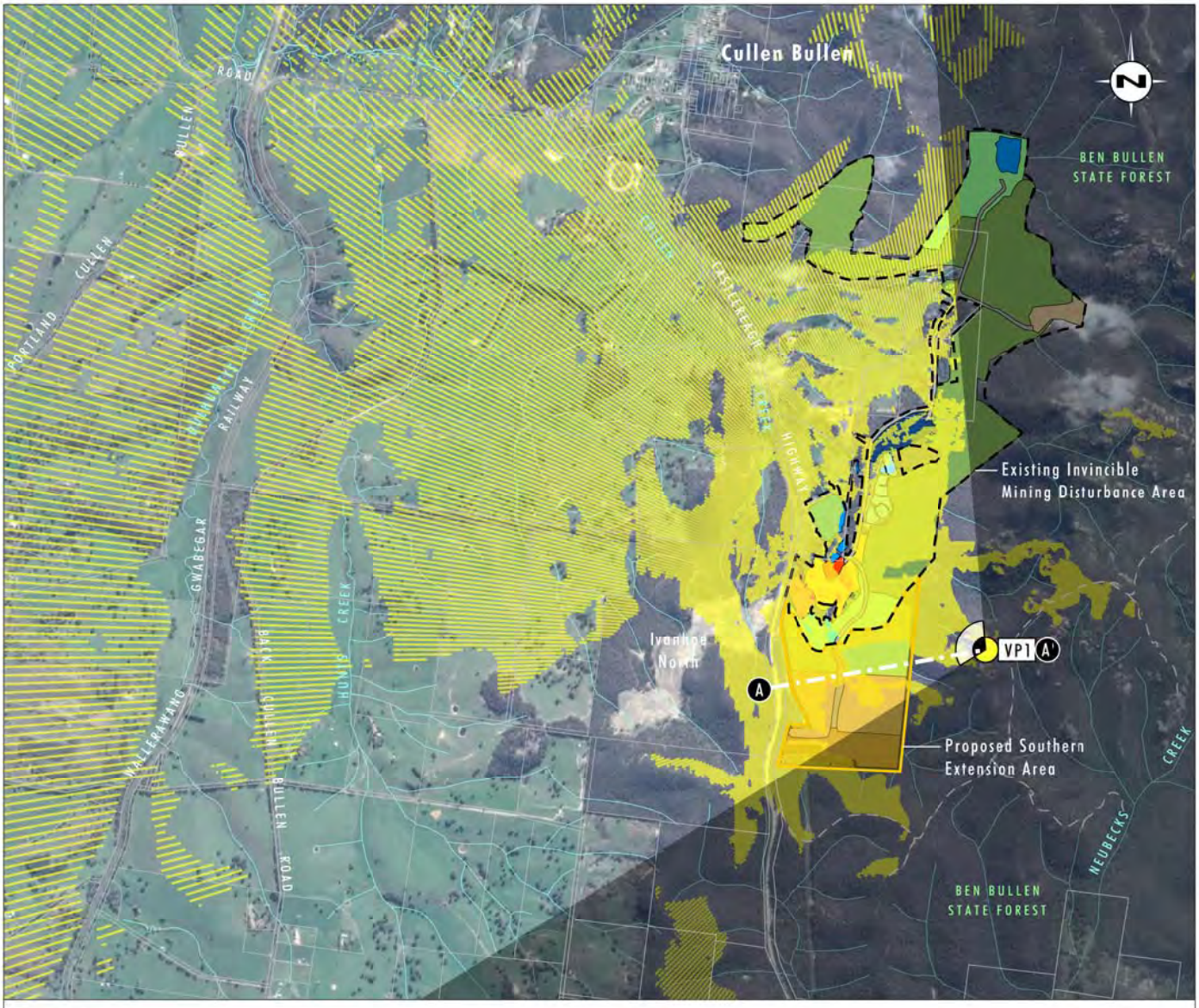
VP3 Carson Siding Road

Figure 6.30 presents the radial analysis from a location on Carson Siding Road located to the north-north-west of the Southern Extension Project, west of Cullen Bullen. The viewshed from this location is representative of views from vehicles travelling east along this section of Carson Siding Road towards Cullen Bullen. Based on the radial analysis, limited areas of the Southern Extension Area may be visible including sections of the active overburden emplacement area and shaped not seeded sections on the eastern side of the Southern Extension Area. The analysis and viewshed presented in **Figures 6.30** and **6.31** illustrate the following:

- **Existing View** –Views of the high wall in the existing Renown/South Pit area and the visually prominent topsoil and stockpiled salvaged timber located at the top of the existing highwall are currently visible from this location. As with viewpoint VP2, the existing mining areas are in close proximity to the visually prominent pagoda formations located to the east of the existing disturbance footprint (refer to **Figure 6.31**). The smaller pagoda formations located to the south (east of the Southern Extension Area) are not noticeable at this location due to their lower height, screening by vegetation close to the pagodas and distance.

- **Mine Plan Stage 2** – Vegetation located on elevated sections of the terrain between this vantage point and the Southern Extension Area mean little more than filtered views of the active overburden emplacement area, sections of the shaped not seeded landform and limited sections of pre strip and active mining areas associated with the Southern Extension Project will be visible. These views will be at a distance of approximately 3.3 km from vehicles travelling along this road.

  No significant views of the Southern Extension Project are predicted from this location and the existing views of Invincible will be improved as these areas are rehabilitated. The progressive rehabilitation of Invincible and the Southern Extension Area will significantly improve the visual amenity in this area as a result of removing the contrast between mining areas and the prominent escarpment features further east.



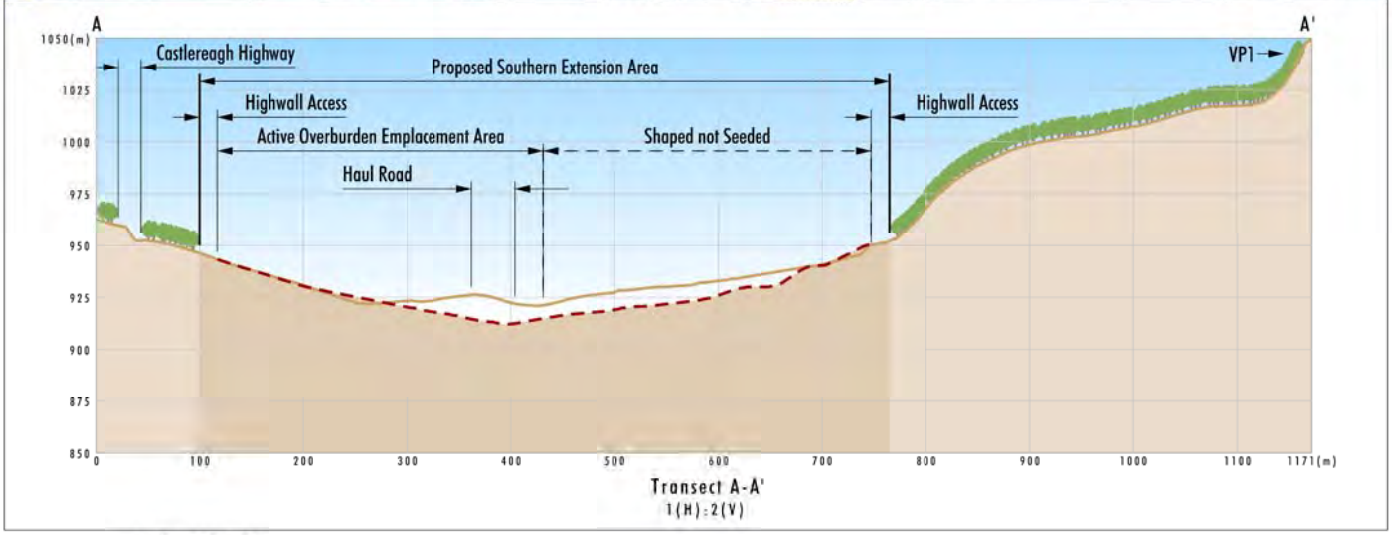


Image Source: Google Earth - CNES/Astrium (May 2014)
Data Source: LPI (2016)

0 0.5 1.0 2.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Viewpoint Location
- Visual Transect Location
- Visible Terrain
- Existing Surface
- Active Mining Surface
- Active Mining
- Active Overburden Emplacement Area
- Pre Strip
- Rehabilitation - Vegetated
- Shaped Not Seeded
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Haul Road / Access Road
- Sealed Access Road
- Infrastructure / Laydown Area
- MIA Administration
- Water Management Area

FIGURE 6.26

Viewing Location 1
Trig Station - Ben Bullen State Forest
Facing West - Stage 2 Mine Plan

File Name (A4): R02/3622_052.dgn
20160915 17.15

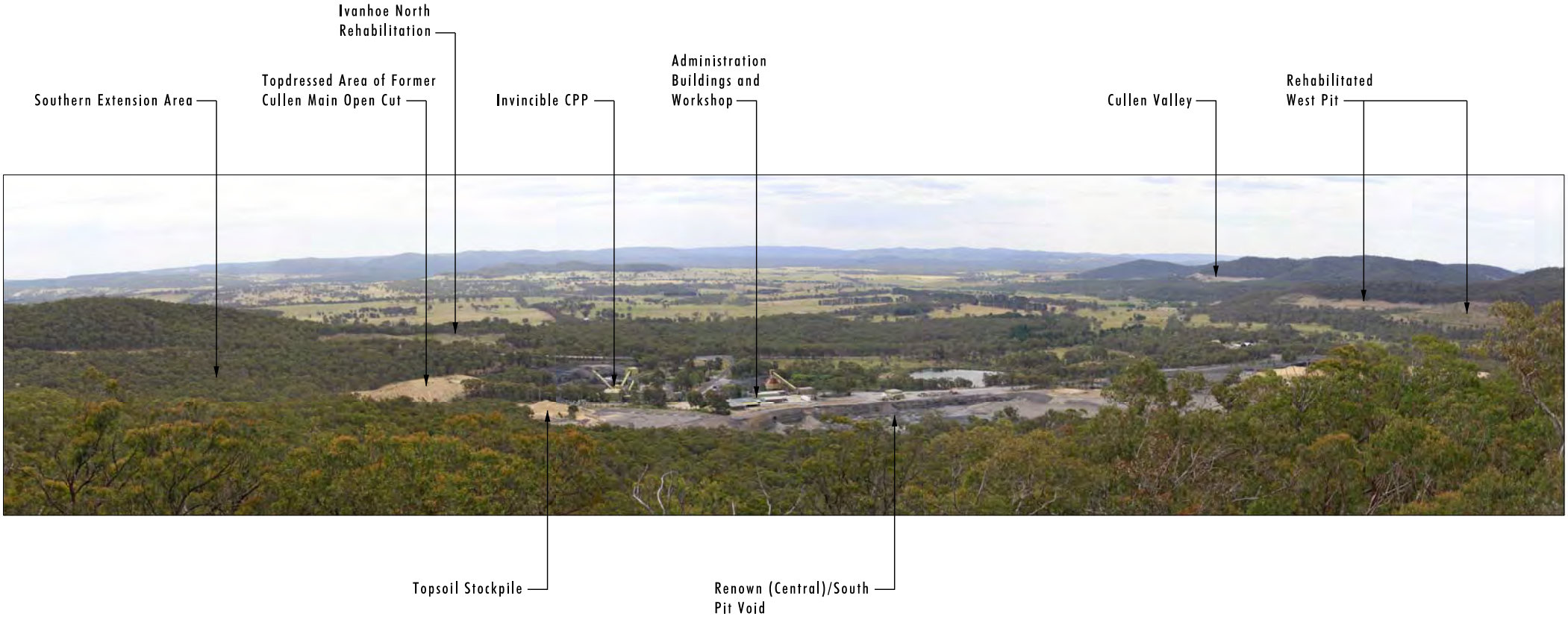
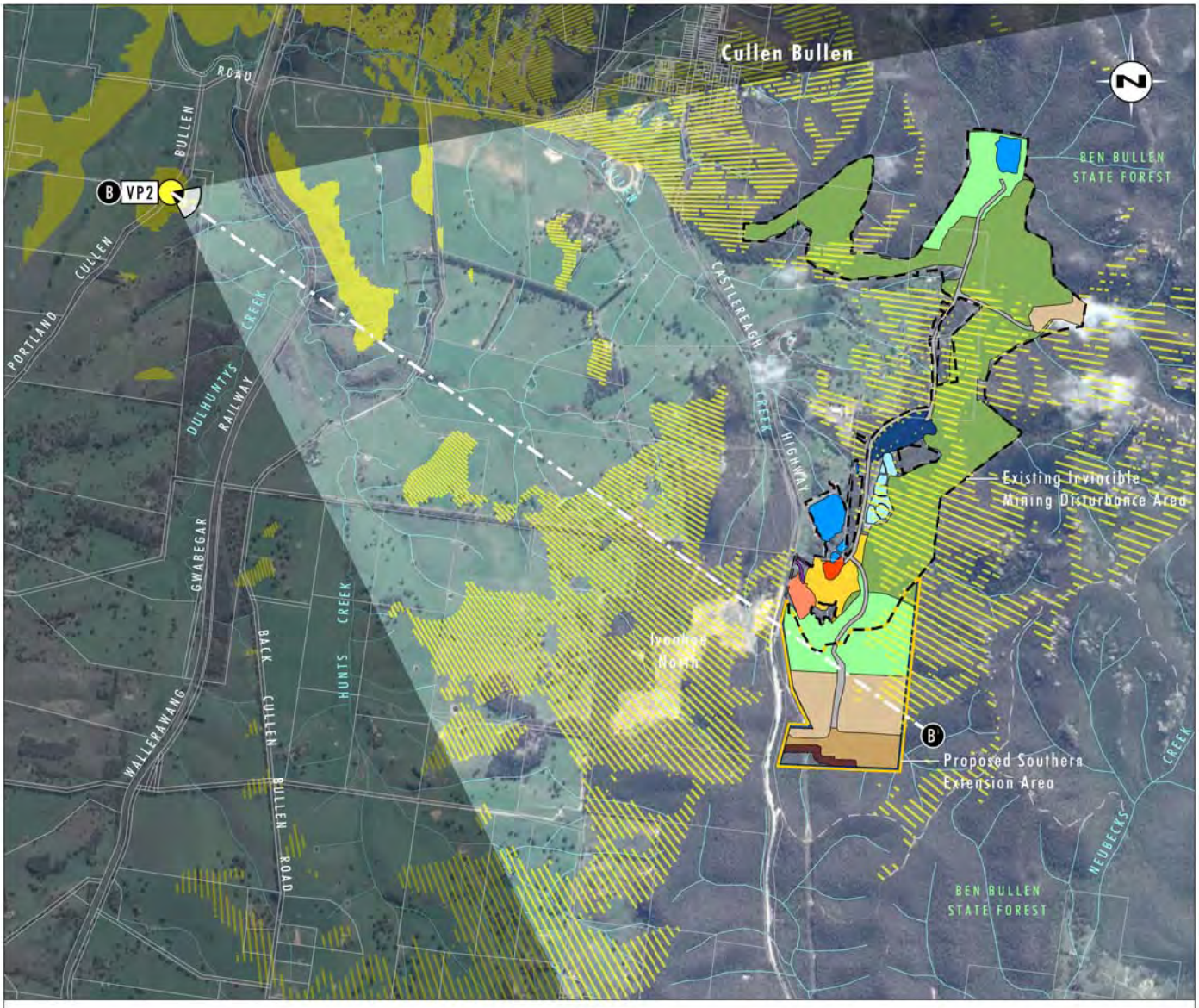


FIGURE 6.27

Panoramic Viewpoint 1
Trig Station in Ben Bullen State Forest
Looking West



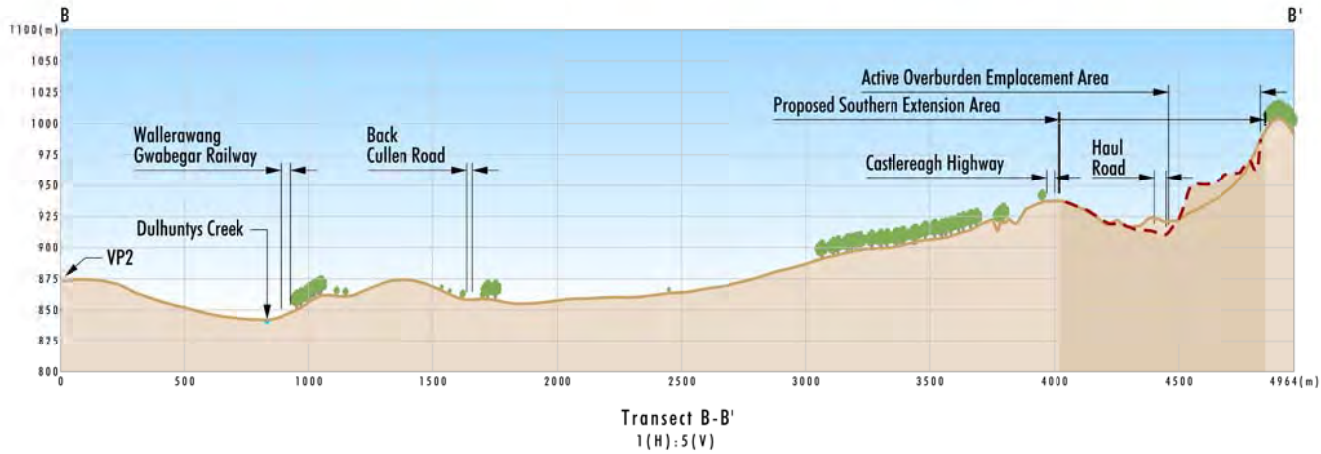


Image Source: Google Earth - CNES/Astrium (May 2014)
Data Source: LPI (2016)

0 0.5 1.0 2.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Viewpoint Location
- Visual Transect Location
- Visible Terrain
- Existing Surface
- Active Mining Surface
- Active Mining
- Active Overburden Emplacement Area
- Pre Strip
- Rehabilitation - Vegetated
- Shaped Not Seeded
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Haul Road / Access Road
- Sealed Access Road
- Infrastructure / Laydown Area
- MIA Administration
- Water Management Area

FIGURE 6.28

Viewing Location 2
Portland Cullen Bullen Road
Facing South East - Stage 2 Mine Plan

File Name (A4): R02/3622_053.dgn
20160915 17.20

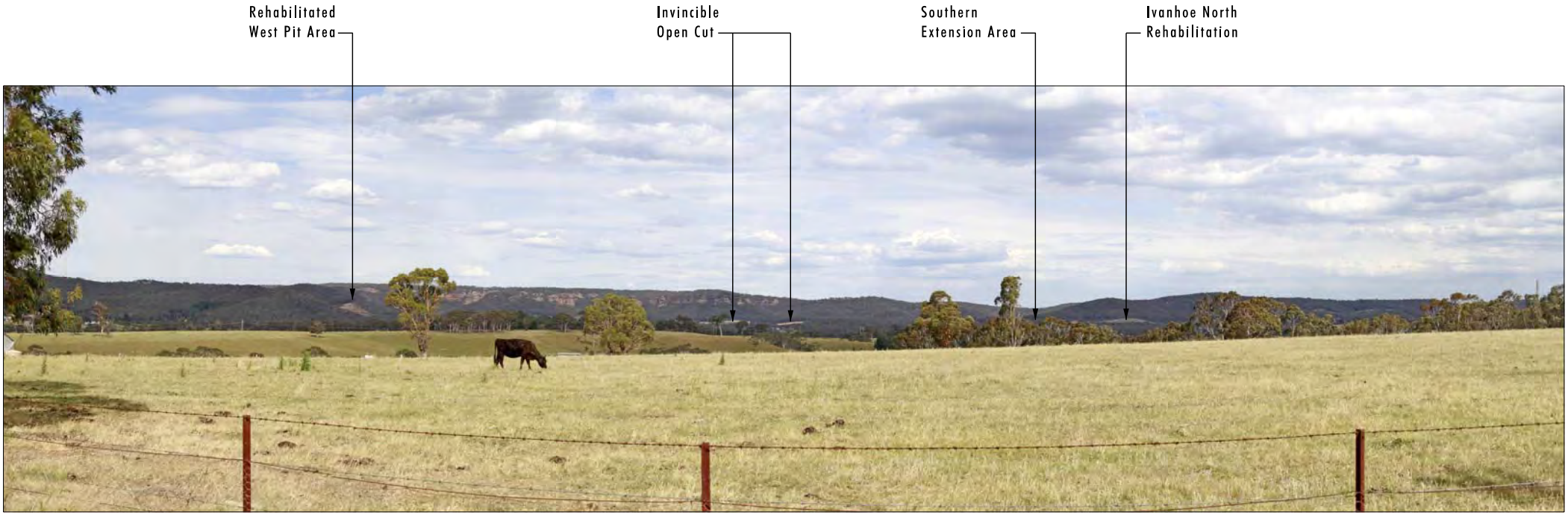
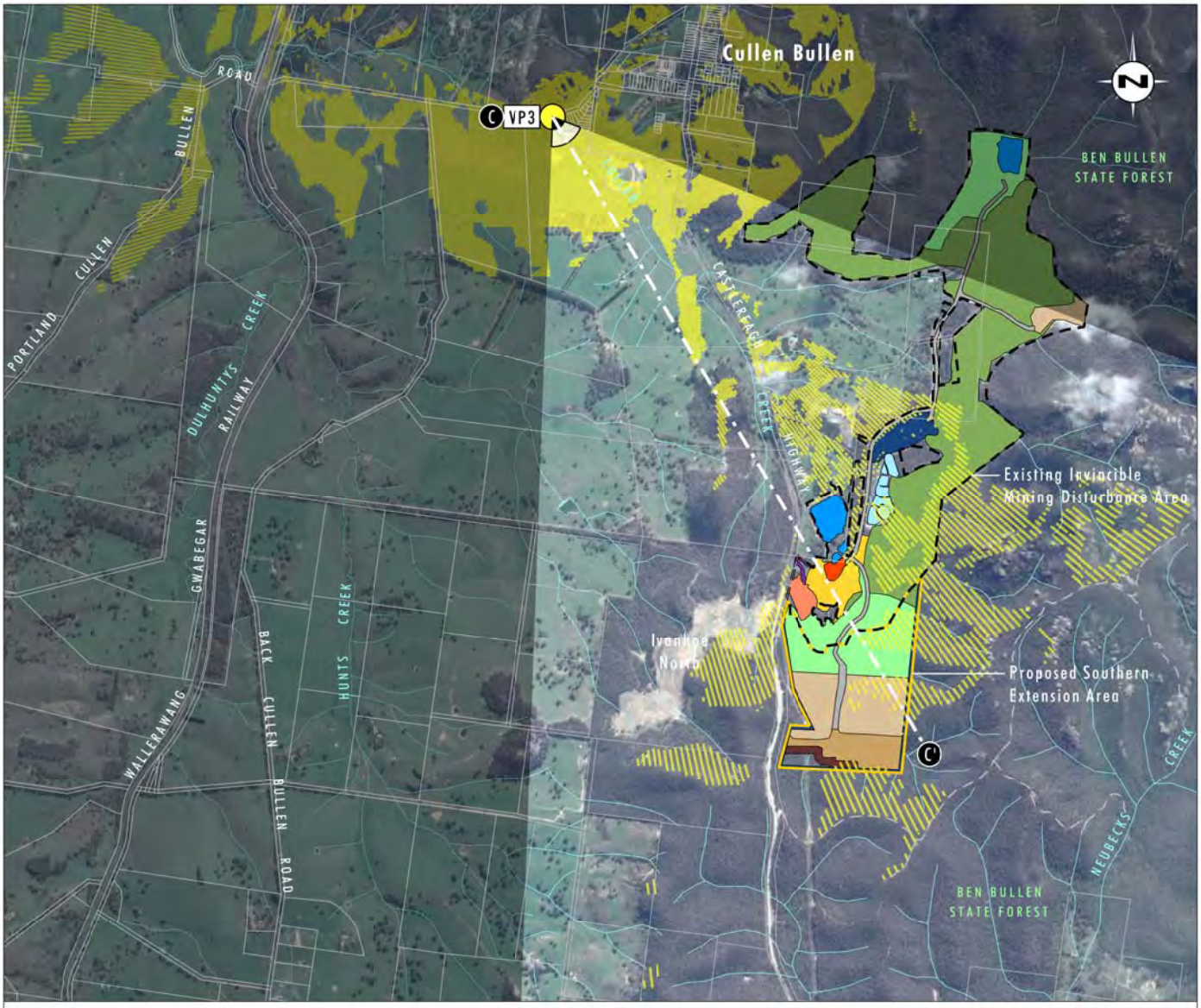


FIGURE 6.29

Panoramic Viewpoint 2
Portland Cullen Bullen Road
Looking East



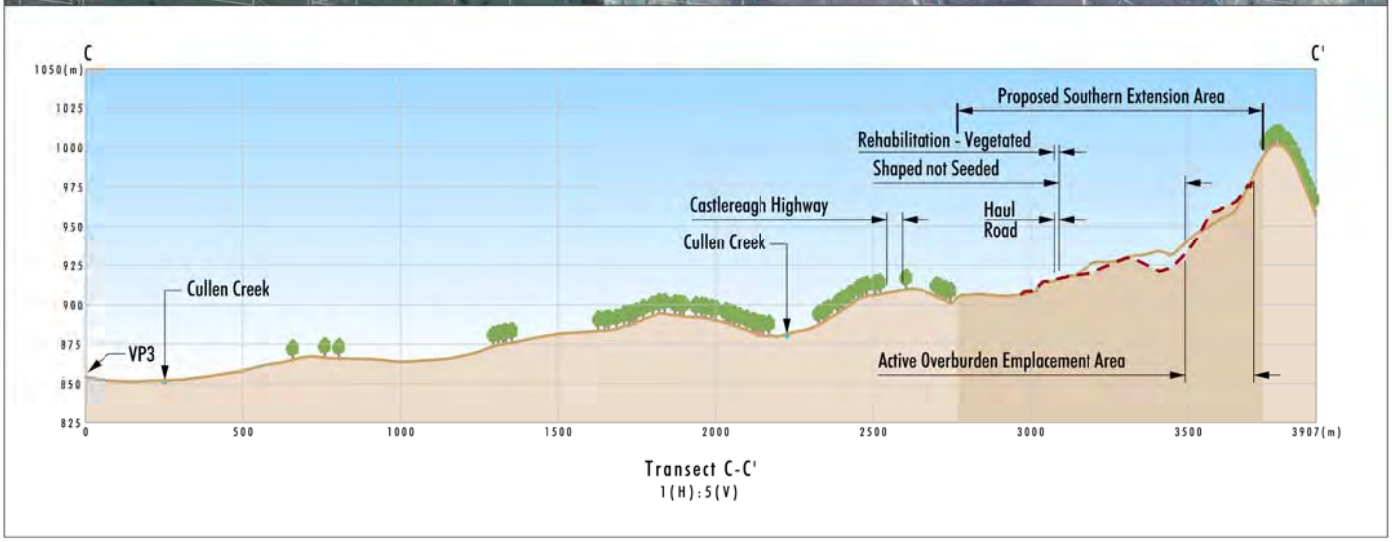


Image Source: Google Earth - CNES/Astrium (May 2014)
Data Source: LPI (2016)

0 0.5 1.0 2.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Viewpoint Location
- Visual Transect Location
- Visible Terrain
- Existing Surface
- Active Mining Surface
- Active Mining
- Active Overburden Emplacement Area
- Pre Strip
- Rehabilitation - Vegetated
- Shaped Not Seeded
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Haul Road / Access Road
- Sealed Access Road
- Infrastructure / Laydown Area
- MIA Administration
- Water Management Area

FIGURE 6.30

Viewing Location 3
Carsons Siding Road
Facing South East, Stage 2 Mine Plan

File Name (A4): R02/3622_054.dgn
20160915 17.22

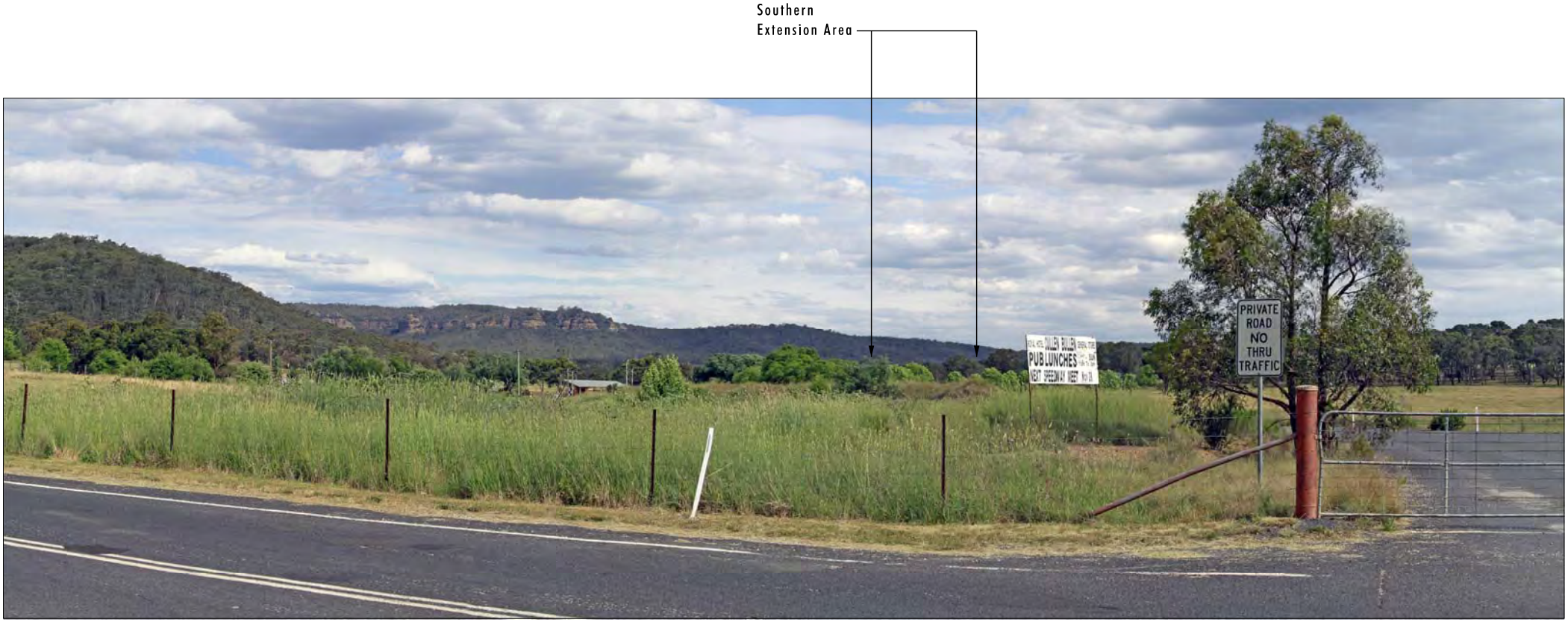


FIGURE 6.31

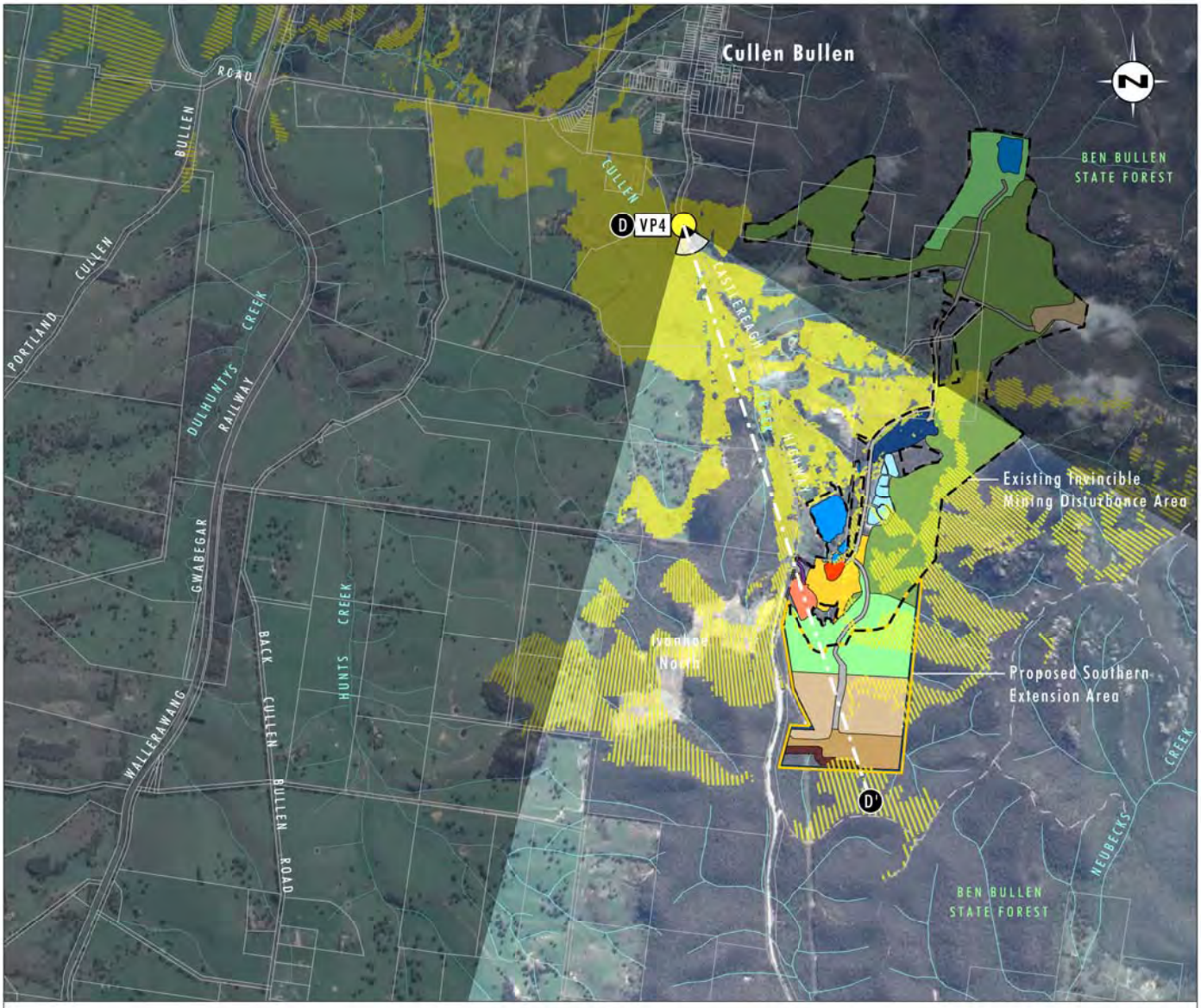
Panoramic Viewpoint 3
Carsons Siding Road
Looking South East

VP4 Castlereagh highway south of Cullen Bullen

Figure 6.32 presents the radial analysis from a location on Castlereagh Highway south of Cullen Bullen. The viewshed from this location provides a representative view from the road for residents, and others, travelling south along the Castlereagh Highway. Views of the Southern Extension Area and rehabilitation of existing disturbance areas will be over a distance of approximately 2.1 to 2.8 km and from vehicles generally travelling 50 km/h at this location. From this location the radial analysis indicates that sections of vegetated rehabilitation, topsoiled and shaped landform, active overburden emplacement areas and a small section of the highwall will be visible. Unlike viewpoints VP2 and VP3, vegetation will not completely screen views of either the rehabilitation of existing disturbance areas or operations in the Southern Extension Area. **Figure 6.33** illustrates both the existing views and the likely views associated with the Stage 2 mine plan for the Southern Extension Project. **Figure 6.33** illustrates the following:

- **Existing View** – filtered views of existing established rehabilitation areas and infrastructure associated with the existing Invincible site is visible from this location. The large pagoda formations to the east of the existing operations which are visible from Viewpoints VP2 and VP3 are screened by vegetation at this location. The pagodas east of the Southern Extension Area are not visually prominent at this point on the highway. It is noted that the powerline easement through the centre of the Southern Extension Area cannot be seen from this vantage point, indicating the extent of screening of the Southern Extension Area provided by vegetation and terrain from this location.

- **Mine Plan Stage 2** – The rehabilitated areas identified in **Figure 6.32** as being visible from this location are in fact screened by roadside vegetation and vegetation closer to the mine. The most visually prominent aspects of the Southern Extension Project are the 'shaped, not seeded' areas where the lighter colour topsoil and salvaged timber provide a stark contrast against the darker vegetation and overburden areas behind (refer to F**igure 6.33**). The overburden areas are not as visually prominent as the topsoiled areas or the highwall behind due to their darker colour. The visual prominence of the topsoiled areas is of relatively short duration as vegetation in these areas established through rehabilitation will reduce the visual impacts. The area of the viewshed affected by mining is relatively small and overall it is considered that there will be no more than moderate visual impact during this phase of the Southern Extension Project from this location.



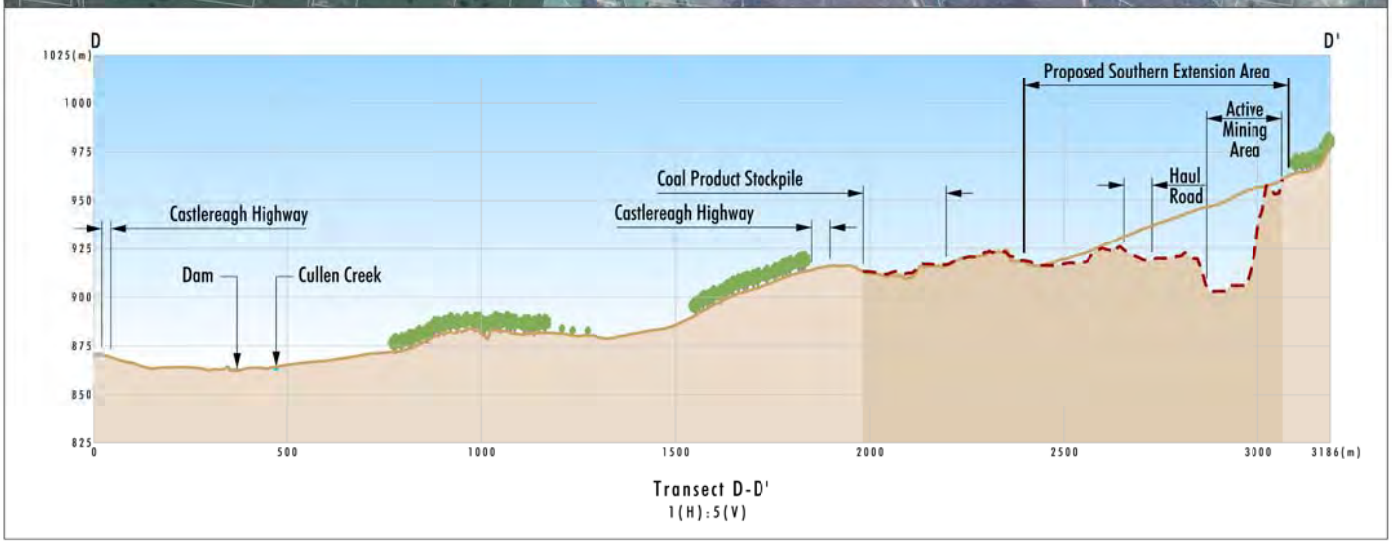


Image Source: Google Earth - CNES/Astrium (May 2014)
Data Source: LPI (2016)

0 0.5 1.0 2.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Viewpoint Location
- Visual Transect Location
- Visible Terrain
- Existing Surface
- Active Mining Surface
- Active Mining
- Active Overburden Emplacement Area
- Pre Strip
- Rehabilitation - Vegetated
- Shaped Not Seeded
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Haul Road / Access Road
- Sealed Access Road
- Infrastructure / Laydown Area
- MIA Administration
- Water Management Area

FIGURE 6.32

Viewing Location 4
Castlereagh Highway
South-bound, Stage 2 Mine Plan

File Name (A4): R02/3622_055.dgn
20160915 17.25

FIGURE 6.33

Panoramic Viewpoint 4
Castlereagh Highway south of Cullen Bullen
Looking South

6.15.5.3 Night-time scenic quality

During winter periods (and parts of late autumn and early spring) when the days are shorter, the end of the day shift period will involve operations after sunset (i.e. periods when the sun sets prior to 6.00 pm). During these times, some mobile equipment lights and mobile lighting plants will be used and may be visible. Any mobile lighting associated with mining activities will be switched off by 7.00 pm each night.

Coal loading activities may continue until 9.30 pm and maintenance activities may continue until 10.00 pm. These activities will require lighting at the mine infrastructure area and workshops (refer to **Figure 2.3**). This lighting will be turned off by 10.30 pm each night except where required for security or safety purposes.

Lighting will be kept to the minimum required for operational needs and safety. All permanent lights will have shields and all lighting will be directed down onto working areas to ensure that fugitive light emissions are limited. All lighting associated with the Southern Extension Project will be installed and maintained in accordance with the relevant Australian Standard (*Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*).

6.15.6 Impacts associated with progressive rehabilitation

A number of community members raised concerns regarding the visual impact associated with wattles in existing rehabilitation areas at Invincible (and the nearby Cullen Valley Operations). These concerns predominantly relate to the visual prominence of wattles when they are flowering. As discussed in **Section 6.18**, wattles form an important ecological role in the successful establishment of woodland communities in rehabilitated areas of Invincible. Importantly, wattles help improve soil nutrient levels through relationships with soil biota; research in other areas of Australia has shown that the establishment of native woodland communities is severely hindered without the use of pioneer species like wattles in the establishment phase. Wattles are also important for invertebrate fauna such as ants in rehabilitation areas which also play an important role in the establishment of woodland communities. Flowering wattles will also encourage other insects, birds and animals which are important seed vectors.

The wattles used in the rehabilitation at Invincible are locally endemic species. Typically, these wattles are the key pioneer species and are only dominant during the establishment/recovery stages following disturbance. These pioneer species typically die out or reduce in dominance as the vegetation approaches maturity and other canopy species become more dominant (refer to **Section 6.18**). Accordingly, whilst it is acknowledged that wattle species in rehabilitation areas can be visually prominent during the flowering season, they play a critical role in the successful rehabilitation of disturbance areas. The dominance of wattles is also short lived and within 10 years of planting other canopy species are likely to be more dominant and the visual prominence of the wattles during flowering is significantly diminished. The impact can be mitigated by including a higher proportion of other pioneer species and canopy species in the seed mix, however, experience at other sites in NSW indicates that canopy species have a lower survival rate where succession species such as wattles do not form a major component of the seed mix. Success rates for canopy species in rehabilitation areas at Invincible will be assessed to determine whether lower percentages of acacia species or increased percentages of other potential pioneer species can be used in the rehabilitation seed mix without compromising the timely establishment of woodland communities in the rehabilitated landform; wattles will however remain a key component of the rehabilitation seed mix used for the Southern Extension Project.

The visual impacts associated with flowering wattles in rehabilitation areas is therefore considered to be an unavoidable short term impact associated with the rehabilitation of mining areas to woodland communities associated with existing Invincible Operation and the Southern Extension Project.

6.15.7 Impact summary

The visual assessment has indicated that locations surrounding the Southern Extension Project which are accessible to the public currently have views of the existing Invincible surface operations. Views of existing operations are set against a backdrop of an escarpment dominated by pagodas and the disturbance associated with mining is in significant contrast to this visually prominent landscape. The Southern Extension Area is largely shielded from view by terrain and vegetation at most publicly accessible locations in the area. Two publicly accessible locations, VP1 and VP4, have been identified as having views of disturbance associated with the Southern Extension Project. In both instances, the views of the Southern Extension Area are not set against the visually prominent pagoda formations or escarpment features. In the case of the views from VP1, the views are not dissimilar to those of the existing operations due west from this location and are considered to be a comparatively lower impact than the views of the existing operations to the north from this location where the mining disturbance contrasts with the natural pagoda features.

Views from the Castlereagh Highway from VP4 and immediately adjacent to the Southern Extension Area will be largely screened by vegetation and will be short term in nature given that these views will be available from cars travelling between 50 km/h and 100 km/h. In addition, site inspections confirmed that direct views to the existing Invincible site, and Southern Extension Area are limited due to vegetation screening in proximity to the closest private residences (residence ID 394 and 393) despite their elevated position.

Other than from the view north from the powerline easement from the access track to the Ben Bullen State Forest located south of the Southern Extension Area, the views of mining in the Southern Extension Area will not be set against pagoda formations. The views from within the easement are currently significantly impacted by clearance and erosion associated with the easement itself and views to the south from this location are dominated by the Mt Piper Power Station.

Overall, the Southern Extension Project is not predicted to have a significant visual impact on surrounding publicly accessible areas. It is acknowledged that the majority of the Southern Extension Area can be seen from an elevated position in Ben Bullen State Forest to the east, however this view is not more significant than that of the existing approved operations at this location. While the project will extend the period of visual impact in the area, these impacts will reduce over the life of the Southern Extension Project as the existing operations and Southern Extension Area are progressively rehabilitated.

6.15.8 Management and mitigation commitments

Controls are proposed to manage the potential visual impacts of the Southern Extension Project including views of mining operations and infrastructure from the Castlereagh Highway, night-lighting and the appearance of the emplacement areas.

- Castlereagh Coal has committed to a number of project design features to assist in minimising the visual impacts of the Southern Extension Project, including:
    - appropriate design, construction and rehabilitation of the emplacement areas to minimise visual impacts during construction and to blend into the surrounding landform (refer to **Section 6.18**)
    - topsoiled areas will be vegetated as soon as practicable to minimise the period of lighter coloured material being visible
    - progressive rehabilitation will be undertaken of all shaped and topdressed areas to reduce the duration of visible soil exposure

- planting of appropriate vegetation or other screening to reduce views of mining infrastructure where required to reinforce existing vegetation screening
- activities in periods of the year when day shift extends beyond dusk will be managed to limit lighting impacts
- all lighting associated with mining operations will be turned off by 7.00 pm unless required for emergency, security and/or safety purposes
- all lighting associated with the MIA will be turned off by 10.30 pm unless required for emergency, safety and/or security reasons
- success rates for canopy species in rehabilitation areas at Invincible will be assessed to determine whether lower percentages of acacia species or increased percentages of other potential pioneer species can be used in the rehabilitation seed mix without compromising the timely establishment of woodland communities in the rehabilitated landform
- ongoing management of mobile lighting to reduce the impacts of lighting at dusk, including the use of shields as required and the ongoing implementation of procedures about the appropriate placement of mobile lighting plant
- night lighting will be kept to the minimum needed for operational management and safety to limit the extent of night lighting glow
- all lighting associated with the Southern Extension Project will be installed and maintained in accordance with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

6.16 Waste management

This section provides a summary of the proposed waste management measures for the Southern Extension Project. No new waste streams are predicted, nor are waste quantities expected to exceed those from the existing approved operations.

6.16.1 Predicted waste stream

The waste that will be generated during the construction and operation of the Southern Extension Project will fall into the following waste classes (DECCW 2009 Waste Classification Guidelines):

- General Solid Waste (putrescible and non-putrescible) including construction waste, general office waste and domestic waste
- Liquid Waste, of which ablution (e.g. waste water from bathhouses, sinks etc) and operational wastes (e.g. oils and coolant fluids following maintenance) are included
- Hazardous Waste, which includes aspects of construction and operational waste (e.g. coal tar or containers that have previously contained a substance of Class 1 or 5 under the definition of the Transport of Dangerous Goods Code) (National Transport Commission 2011)
- Special Waste, e.g. waste tyres, clinical/first aid and asbestos (potentially present in old buildings on site).

6.16.2 Ongoing waste management

- Castlereagh Coal has committed to a number of project design features to assist in minimising the visual impacts of the Southern Extension Project, including:
    - appropriate design, construction and rehabilitation of the emplacement areas to minimise visual impacts during construction and to blend into the surrounding landform (refer to **Section 6.19**)
    - topsoiled areas will be vegetated as soon as practicable to minimise the period of lighter coloured material being visible.
    - progressive rehabilitation will be undertaken of all shaped and topdressed areas to reduce the duration of visible soil exposure
    - planting of appropriate vegetation or other screening to reduce views of mining infrastructure where required to reinforce existing vegetation screening
    - activities in periods of the year when day shift extends beyond dusk will be managed to limit lighting impacts
    - all lighting associated with mining operations will be turned off by 7.00 pm unless required for emergency, security and/or safety purposes
    - all lighting associated with the MIA will be turned off by 10.30 pm at night unless required for emergency, safety and/or security reasons
    - success rates for canopy species in rehabilitation areas at Invincible will be assessed to determine whether lower percentages of acacia species or increased percentages of other potential pioneer species can be used in the rehabilitation seed mix without compromising the timely establishment of woodland communities in the rehabilitated landform
    - ongoing management of mobile lighting to reduce the impacts of lighting at dusk, including the use of shields as required and the ongoing implementation of procedures about the appropriate placement of mobile lighting plant
    - night lighting will be kept to the minimum needed for operational management and safety to limit the extent of night lighting glow
    - all lighting associated with the Southern Extension Project will be installed and maintained in accordance with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

6.17 Hazard

6.17.1 Dangerous goods and explosives

SEPP 33 requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. A hazard assessment is required for potentially hazardous development to assist the consent authority to determine acceptability.

The project will use a range of hazardous substances on site for mining operations and coal processing. This includes the utilisation of various explosive materials as part of the Southern Extension Project. Explosive

materials will either be delivered directly to Invincible on an as needs basis from the licensed supplier or will be stored at a magazine located at Cullen Valley in accordance with the existing approvals (refer to **Figure 2.2**). Explosives stored at the Cullen Valley mine will be transported to Invincible when required for use. The transport, storage and handling of explosives will all be undertaken in accordance with the Australian Code for the Transport of Dangerous Goods, the Australian Code for the Transport of Explosives and relevant NSW legislation.

Other hazardous materials stored on site, and managed by Castlereagh Coal, include small quantities of flammable gases in cylinders and Class C1 combustible liquids, e.g. diesel and hydraulic oils. The Southern Extension Project will use existing diesel storage facilities including a 40,000L underground diesel storage tank and 75,000L bunded diesel storage tank (refer to **Figure 2.2**). The siting and use of the facilities is already approved under the existing Invincible Project Approval and, other than their ongoing use for the life of the Southern Extension Project, no change to the location or use of these facilities is sought as part of the current modification application.

A range of existing control measures, safeguards and procedures will continue to be implemented as part of the Southern Extension Project to eliminate or mitigate the level of risk associated with the management of hazardous materials, including:

- storage of dangerous goods in dangerous goods compliant stores (in accordance with relevant Australian Standards) and appropriate segregation of incompatible dangerous goods
- all personnel entering explosive storage facilities will be authorised and trained in the relevant procedures for loading, transport and preparation of hazardous substances
- diesel storage tanks will be refilled by a fully licensed contractor
- explosives will be delivered to Invincible by a licensed supplier
- existing relevant Invincible management plans will be updated
- explosives will be utilised in accordance with site procedures and he requirements of *AS/NZS 2187 – 1998: Explosives – Storage, Transport and Use (Standards Australia, 1998)*, *the Explosives Act 2003*, the *Explosive Regulation 2005*, the *Coal Mines Health and Safety Act 2002* (CMH&S), the CMH&S *Regulations 2006* and other relevant codes.
- ongoing implementation of appropriate hot work/safe work procedures for works in the vicinity of hazardous materials.

6.17.2 Public safety

Castlereagh Coal is committed to providing a safe environment for the employees, visitors to the site and the surrounding landowners and community. Invincible is a controlled site with all visitors required to report to the reception areas on arrival and complete an induction process to ensure all safety requirements are addressed. This includes access control structures, including berms along the boundaries of existing and proposed mining areas to limit access from the surrounding area.

Safe operation of all mining equipment and processes will be in accordance with updated Invincible management plans particularly in relation to the use and storage of hazardous substances and blasting activities which have specific safety requirements and controls to ensure the safety of the employees and the public.

As discussed in **Section 6.8**, blasting activities will be undertaken in accordance with the updated Blast Management Plan which includes the following key safety procedures:

- a minimum blasting exclusion zone of 500 m from blast locations
- pre-blast inspections are undertaken to ensure that no persons, property or livestock are at risk from blasting
- sentries are posted on key access points to ensure that there is no possible access to the blasting exclusion zone
- notification of the blasting times are provided to the residences located within 3 km of the mine (on request)
- for blasts within 500 m of the Castlereagh Highway, road closure procedures will be implemented, which include prominent signs located on the highway to notify of blast periods.

6.18 Rehabilitation

As discussed in **Section 3.0**, the Southern Extension Project includes the rehabilitation of the existing disturbance areas associated with Invincible and the Southern Extension Area. The existing rehabilitation strategies employed at Invincible have largely been successful to date in meeting the objectives of the approved rehabilitation plan for Invincible and these practices will be applied to the Southern Extension Project with appropriate modifications as necessary.

The detailed land use objectives and completion criteria for Invincible are contained in the existing Land Management Plan. These objectives and criteria will be refined to reflect the Southern Extension Project and the commitments made in this EA. As with the existing approved development, the detailed rehabilitation strategy for the Southern Extension Project will be contained in the Mining Operations Plan (MOP).

The MOP must be prepared in accordance with guidelines developed by DRE. The guidelines require that the MOP identifies rehabilitation objectives which are specific, measurable and demonstrate that proposed outcomes are achievable and realistic within a given timeframe. The MOP must identify the rehabilitation activities that will be undertaken during the term of the MOP and identify measurable performance indicators and completion/relinquishment criteria for each of the key stages of rehabilitation (Active Mining, Decommissioning, Growth Medium Development, Landform Establishment, Ecosystem and Land Use Establishment Ecosystem and Land Use Sustainability and Relinquished Lands). The MOP must also identify hazards or threats to achieving the rehabilitation objectives and include trigger action response plans (TARPs) which set out contingency strategies to be implemented in the event that nominated completion criteria aren't achieved. MOPs are reviewed by DRE and must be approved before works can be undertaken under the mining lease. Security held by DRE is linked to the rehabilitation set out in the MOP.

Mine sites are required to report against compliance with the MOP and progress against criteria in the Annual Environmental Management Report (AEMR) / Annual Review required under the development consent and Mining Leases. Castlereagh Coal will continue to meet these requirements over the life of the Southern Extension Project.

Section 3.5.9 provides a general description of the rehabilitation activities that will be undertaken as part of the Southern Extension Project. **Section 6.18.1** identifies the rehabilitation objectives for rehabilitation to be completed as part of the Southern Extension Project. **Section 6.18.2** identifies the risks relating to the successful rehabilitation of the site and the mitigation and management practices that will mitigate and manage these risks.

6.18.1 Rehabilitation objectives

The primary objective of site revegetation and regeneration is to create a stable final landform with acceptable post-mining land use and suitability.

6.18.1.1 Conceptual final landform and land use

Figure 3.4 shows the conceptual final landform for Invincible following rehabilitation of existing disturbed areas and the Southern Extension Area. Due to bulking factors associated with overburden (broken rock material occupying a larger space than the *in situ* rock material), it will be possible to recreate a landform that is similar to that which existed pre-mining, despite the removal of coal. The final landform will not contain any mining voids. **Figures 6.35** to **6.37** show cross sections of the conceptual rehabilitation strategy shown in **Figure 6.34**.

The post-mining land use goal is to emulate the pre-mining environment including the reestablishment of forest and woodland habitat generally consistent with the vegetation communities present in the area impacted by mining. **Figure 6.34** shows the conceptual revegetation strategy for the Southern Extension Project which will build upon the existing rehabilitation undertaken to date across the Invincible site and integrate with areas of retained native vegetation. The proposed rehabilitation strategy will enhance local and regional ecological linkages across the site and with proximate areas and continue to focus on promoting biodiversity and the establishment of habitat for local threatened flora and fauna species, where practical.

Rehabilitation areas are to be established progressively once mining operations recommence and will be managed in accordance with the Landscape Management Plan. In the long term, rehabilitation areas are to become integrated with adjacent native vegetation communities. Rehabilitation areas are to be monitored on an annual basis and will be managed until self-sustaining.

Figures 3.2 and **3.3** show the progression of rehabilitation as the Southern Extension Project is completed. Rehabilitation processes implemented at Invincible will continue to be undertaken generally in accordance with the 'Strategic Framework for Mine Closure' (ANZMEC MCA 2000) and the 'Mine Rehabilitation' and 'Mine Closure and Completion' handbooks developed as part of the Leading Practice Sustainable Development Program by the Department of Industry, Tourism and Resources.

The planning for and implementation of rehabilitation activities at Invincible, including the Southern Extension Area, will be based on the existing management measures already in place and proven to be effective at Invincible. The rehabilitation objectives for the Southern Extension Project will remain the same as the existing approved development with the commitments extended to the Southern Extension Area. Revegetation works will use local provenance species wherever possible.

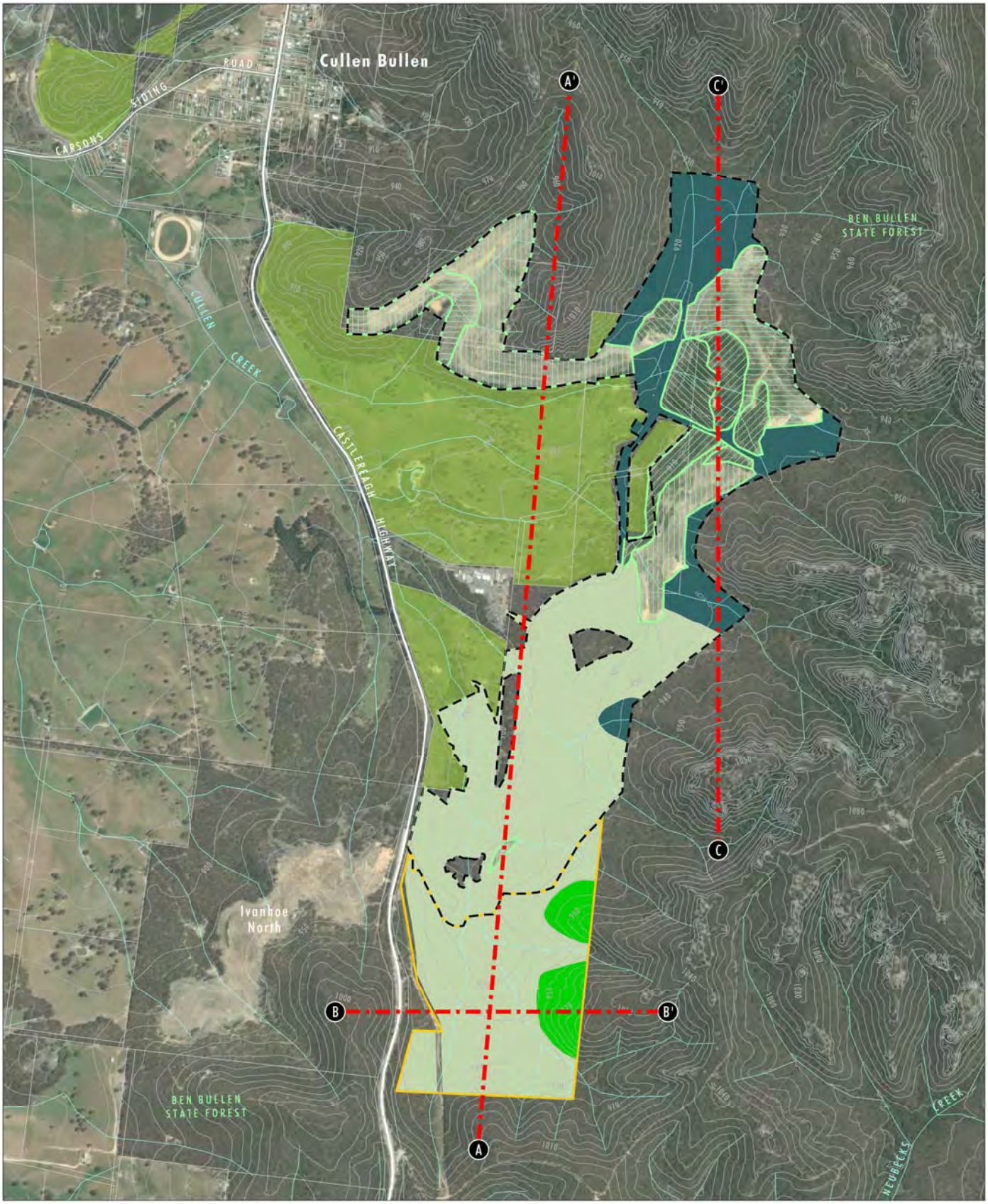


Image Source: Google Earth - CNES/Astrium (Nov 2015)
Data Source: LPI (2016)
Note: Contour Interval 10m

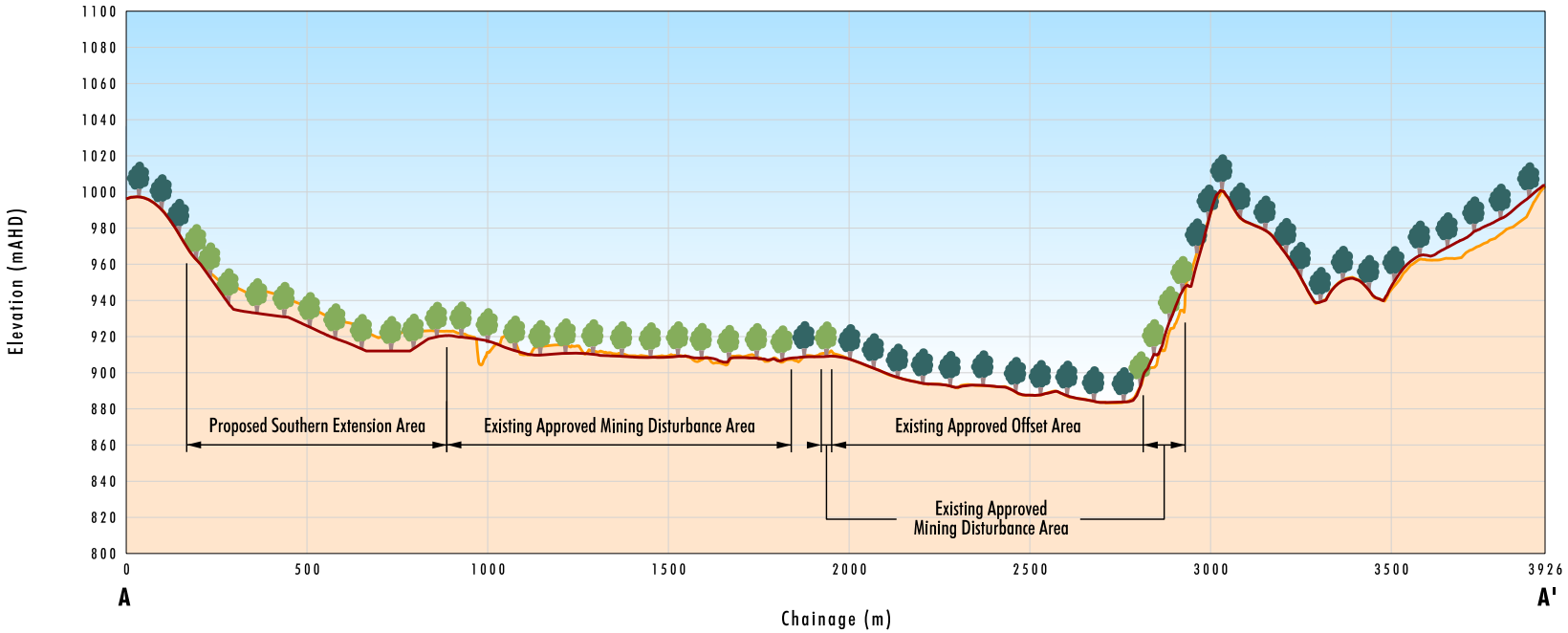
Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Existing Conservation and Offset Areas
- Tableland Gully Ribbon Gum- Blackwood - Apple Box Forest
- Tableland Gully Mountain Gum Broad Leaved Peppermint Grassy Forest
- Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland
- 2008 Established Rehabilitation
- 2010 Established Rehabilitation
- 2011 Established Rehabilitation
- 2012 Established Rehabilitation
- Section Location

FIGURE 6.34

Southern Extension Project
Conceptual Rehabilitation Plan

File Name (A4): R02/3622_100.dgn
20160916 8.55



Legend

- Existing Surface
- Proposed Surface
- Woodland/Forest (rehabilitation/regeneration)
- Woodland/Forest/Offset Area

0 50 100 200m
Vertical Scale

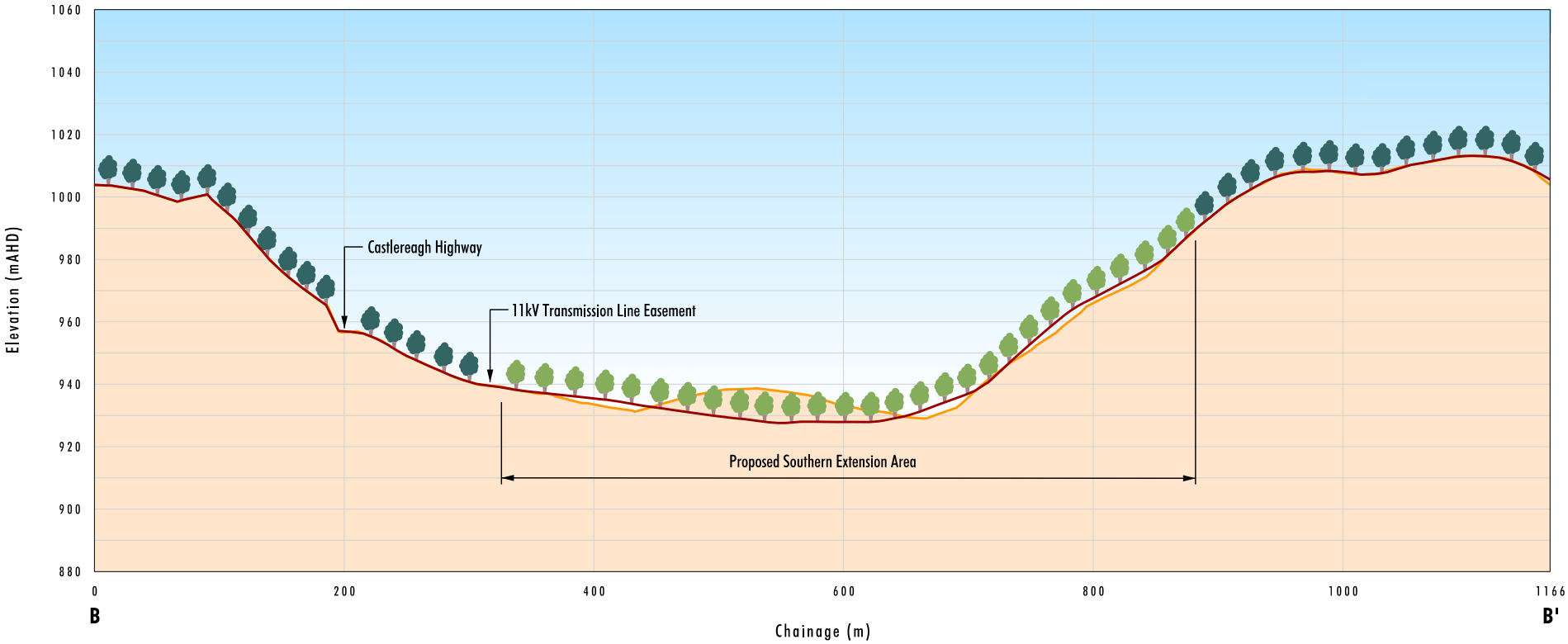
0 0.25 0.5 1.0km
Horizontal Scale

Note: Vertical exaggeration 1:5

FIGURE 6.35

Conceptual Final Landform
Cross Section A-A'

File Name (A4): R02/3622_096.dgn
20140214 9.05



Legend

- Existing Surface
- Proposed Surface
- Woodland/Forest (rehabilitation/regeneration)
- Woodland/Forest (existing)

0 20 40 80m
Vertical Scale

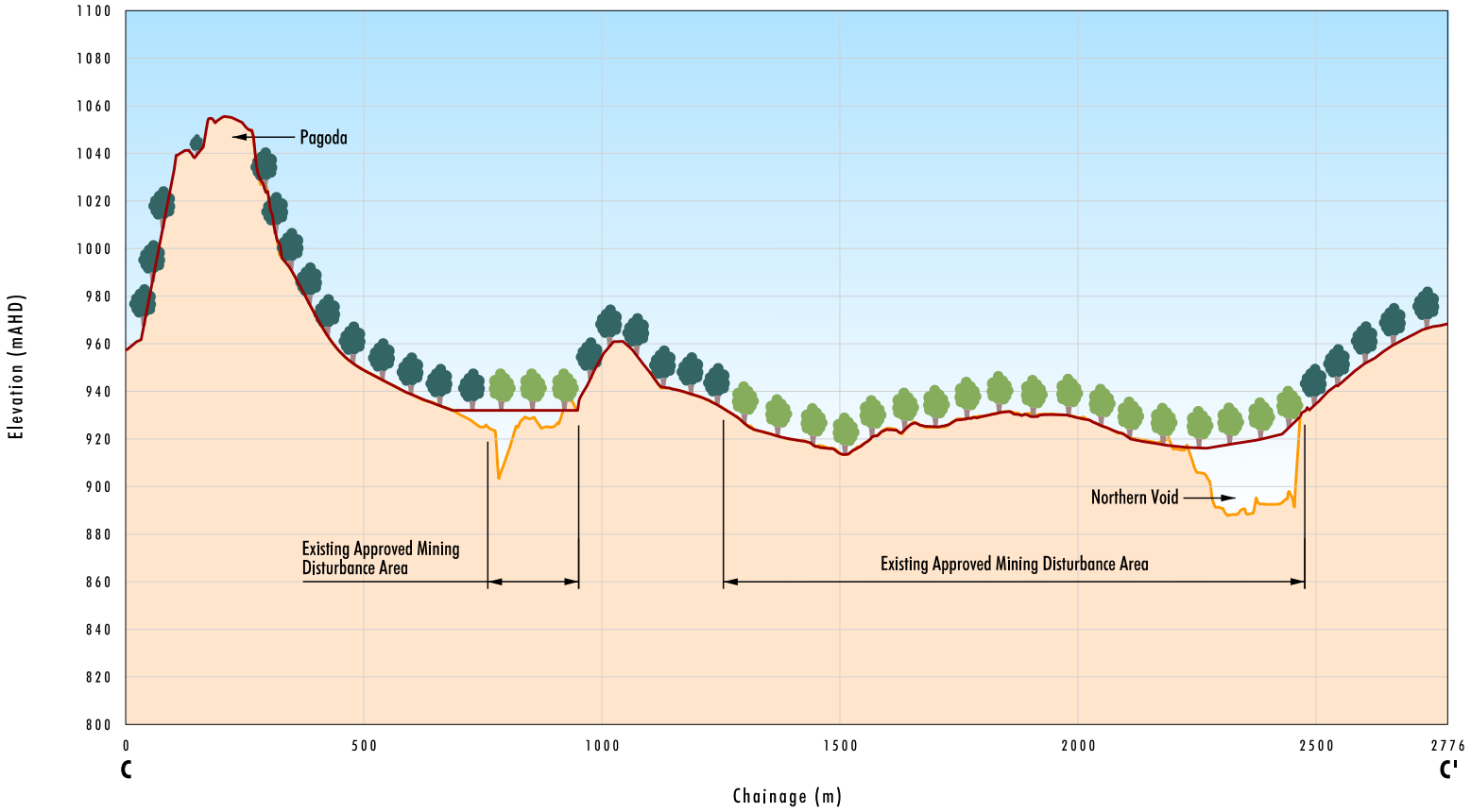
0 50 100 200m
Horizontal Scale

Note: Vertical exaggeration 1:2.5

FIGURE 6.36

Conceptual Final Landform
Cross Section B-B'

File Name (A4): R02/3622_097.dgn
20140214 9.05



Legend

- Existing Surface
- Proposed Surface
- Woodland/Forest (rehabilitation/regeneration)
- Woodland/Forest (existing)

0 50 100 150m
Vertical Scale

0 250 500 750m
Horizontal Scale

Note: Vertical exaggeration 1:5

FIGURE 6.37

Conceptual Final Landform
Cross Section C-C'

File Name (A4): R02/3622_098.dgn
20140214 9.05

6.18.1.2 Rehabilitation objectives for management domains

The current approved MOP identifies primary and secondary management domains for environmental management and rehabilitation purposes. The rehabilitation objectives for the current primary and secondary management domains for Invincible are outlined in **Table 6.37**.

If the Southern Extension Project is approved, the MOP will be updated to include the Southern Extension Area. Parts of the Southern Extension Area and existing disturbance areas will be assigned to Primary and Secondary domains and depending on the stage that area will be in during the term of the MOP.

Table 6.37 Domain rehabilitation objectives

Code	Domain	Description
Primary domains (operational)		
1	Administration Area	All buildings, infrastructure and services to be removed prior to mine closure. Hazardous and/or contaminated material to be removed and land remediated as required. Disturbed landform to be graded and shaped to reflect natural landforms and drainage contours. Revegetation to be undertaken through seeding and/or tubestock planting compatible with the proposed final land use.
2	Mine Infrastructure	All equipment, infrastructure and services to be removed prior to mine closure. Hazardous and/or contaminated material to be removed and land remediated as required. Disturbed landform to be graded and shaped to reflect natural landforms and drainage contours. Revegetation to be undertaken through seeding and/or tubestock planting compatible with the proposed final land use.
3	Unshaped emplacement areas	Potentially acid forming material to be capped using inert overburden material. Surface layers to be treated, where required, to neutralise potentially acid-forming materials. Slopes to be less than 18 degrees and to be consistent with the proposed post-mining land use suitability.
4	Mine voids and pits	Clean water to be diverted around operational mining areas and directed through the water management system. Open cut excavations to be managed in accordance with the Landscape Management Plan and Water Management Plan until stabilised and rehabilitated. No voids will remain in the final landform.

Code	Domain	Description
5	Water Management Structures	Clean water to be diverted around operational mining areas and directed through the water management system. Mine affected water and sediment laden water from bare ground surfaces to be captured and diverted to sediment ponds and dams for treatment prior to discharge from the site in accordance with the EPL. Water retained in sediment pods and dams to be used in mining operations including dust suppression. Water management structures to be maintained and monitored in accordance with the Water Management Plan. Water management structures to be retained in place until rehabilitation is complete and post-mining landforms achieve stability and land use suitability. Water management structures to be retained within the post-mining landform are to be decontaminated and suitable for use as clean water dams.
6	Tailings storage facility	Clean water to be diverted around operational mining areas and directed through the water management system. Tailings dams to be managed in accordance with the Landscape Management Plan and Water Management Plan until stabilised and rehabilitated
Secondary domains (post-mining)		
A	Shaped and topsoiled emplacement areas	Clean water to be diverted around bare ground surfaces and directed through the water management system. Disturbed landform to be graded and shaped to reflect natural landforms and drainage contours. Revegetation to be undertaken through seeding and/or tubestock planting compatible with the proposed final land use. Post-mining landforms to be geotechnically stable and non-polluting consistent with the proposed post-mining land use suitability.
B	Rehabilitation areas	Rehabilitation areas to be established progressively and managed in accordance with the Landscape Management Plan. Rehabilitation areas to be managed to become integrated with adjacent native vegetation communities. Rehabilitation areas to be monitored on an annual basis and managed until self-sustaining.
C	Established rehabilitation areas	Established rehabilitation areas to be monitored on an annual basis and managed until self-sustaining. Final rehabilitation areas to achieve rehabilitation completion criteria.

6.18.2 Rehabilitation criteria

Rehabilitation performance and completion criteria are set out in the approved Landscape Management Plan. However, experience from the previous Invincible and from Cullen Valley Mine has shown that there is no single indicator which unequivocally demonstrates that a rehabilitated ecosystem will be sustainable (Global Soil Systems, 2007). Accordingly, a range of indicators will be measured over the period of rehabilitation to provide feedback on the implementation of rehabilitation across the Invincible site.

6.18.3 Risks to successful rehabilitation and proposed management and mitigation commitments

6.18.3.1 Geological and geochemical risks

The geology of the area is described in **Section 3.3**. The following sections outline the geological and geochemical issues relevant to the successful rehabilitation of Invincible.

Material prone to spontaneous combustion

There are no known occurrences of spontaneous combustion at Invincible. Experience to date in mining at Invincible has demonstrated that the waste material, stockpiled coal and other relevant materials have a low propensity to spontaneously combust. There are therefore no potential adverse impacts expected as a result of spontaneous combustion at Invincible.

Material prone to generating acid mine drainage

A geochemical assessment was undertaken for the Consolidation Project (RGS Environmental 2011) and considered the geochemical properties and constraints associated with overburden and coal reject material at Invincible. The key findings of the report are summarised below:

Overburden

- Overburden materials are likely to be non-acid forming (NAF) and have a high factor of safety with respect to potential acid generation. Most overburden samples tested had negligible total sulphur content and a low-moderate acid neutralising capacity (ANC)

- The concentration of total metals in overburden solids is well below applied guideline criteria for soils and is unlikely to present any environmental issues associated with revegetation and rehabilitation

- Most overburden material will generate pH neutral, low salinity runoff and seepage following surface exposure. The major ion chemistry of initial surface runoff and seepage from overburden materials is likely to be dominated by sodium and sulphate with lesser amounts of bicarbonate and chloride.

- The concentration of dissolved trace metals in initial and ongoing runoff and seepage from overburden materials is unlikely to present any significant environmental issues associated with surface and ground water quality as a result of the Southern Extension Project

- Overburden materials below 10 m depth are likely to be non-sodic and may be suitable for revegetation and rehabilitation activities (in final surfaces or as a growth medium).

Coal Reject

- Most coal reject materials are likely to be NAF and have an elevated factor of safety with respect to potential acid generation

- Some coal reject materials have uncertain geochemical characteristics or are potentially acid forming (PAF). The few PAF coal reject materials appear to be associated with the Lithgow Seam and particularly coarse reject materials. In contrast, tailings materials generated from processing the Lithgow Seam appear to be NAF

- The concentration of total metals in potential coal reject solids is well below applied guideline criteria for soils and is unlikely to present any environmental issues

- Most NAF potential coal reject materials will generate pH neutral and relatively low-salinity runoff and seepage following surface exposure. However, PAF coarse reject materials from the Lithgow Seam may generate acidic and more saline runoff and seepage if exposed to oxidising conditions

- The major ion chemistry of initial surface runoff and seepage from NAF coal reject materials is likely to be dominated by sodium and sulphate, with lesser amounts of bicarbonate and chloride

- For PAF coarse reject materials, the initial concentration of soluble sulphate in surface runoff and seepage is expected to be relatively low, although further exposure to oxidising conditions may lead to increased sulphate conditions.

The concentration of dissolved metals in initial runoff and seepage from NAF coal reject materials is unlikely to present any significant environmental issues associated with surface water and groundwater quality as a result of the Southern Extension Project. For PAF coarse reject materials, there is some potential for the concentration of dissolved metals in surface runoff and seepage to increase over time, if not managed appropriately. The greatest risk is posed by coarse reject. Additionally, while the geochemical results indicate that fine tailing generated from the Lithgow Seam appear to be NAF, seepage from the existing tailings drying facilities reporting to the Environmental Dam has been shown to be acidic. Accordingly, dry tailings will be treated as being PAF.

Coarse reject material (PAF and NAF) will be codisposed with overburden within the void. All coarse reject material will be emplaced within the void of the open cut in such a manner that it does not encroach on *in situ* coal seams (i.e. emplaced 5 m away from exposed *in situ* coal seams). In addition to this, course reject material will be buried at a minimum 5 m depth below the final surface. This management measure is intended to significantly reduce the risk of any potential acid generating material entering the underlying water table, due to the coal seam being permeable. Dry tailings not sold as product will be disposed of with overburden in the same manner as coarse reject material.

6.18.3.2 Mine subsidence

The Southern Extension Project will re-mine areas currently affected by subsidence from the former Ivanhoe underground workings. Parts of this area are currently affected by subsidence from these old workings as a result of pillar collapses. The Southern Extension Project will remove all future subsidence risks from this area and reinstate a landform that does not present any subsidence risks.

There are no other areas of the former open cut mine workings that will be affected by subsidence risks in the future.

6.18.3.3 Soil type and slope management

The soils and their physical and chemical constraints are described in **Section 6.2.1**. The topsoil from the Deep Orange Clay Loam and Shallow Brown Sandy Loam soils are both suitable for stripping and use in rehabilitation. These soils are typically deficient in nutrients including nitrogen, phosphorus and potassium. During the seeding process, chemical fertilizers will be added to increase soil nutrients and promote greater seed germination within the rehabilitated landscape.

The depth or thickness of soil materials suitable for recovery in the Southern Extension Area was assessed as part of the Soil and Land Capability Assessment undertaken by Ecobiological in 2011. Based on previous assessments, the recommended topsoil stripping depths are shown in **Table 6.38**.

Table 6.38 Recommended Topsoil Stripping Depths

Soil Unit	Recommended stripping Depth (cm)	Ha (within Southern Extension Area)
Deep Orange Clay Loam	15 – 20	42
Shallow Brown Sandy Loam	10 – 15	8.9
Skeletal Sandy Loam	Not suitable for stripping	2.8

These soil units will be generally replaced in terrain areas similar to that from which they were recovered with Shallow Brown Sandy Loam being used in areas where skeletal Sandy Loam was present. There is considered to be sufficient soil stockpile resources for rehabilitation purposes.

Erosion has been observed on some slopes in existing Invincible rehabilitation areas. This has primarily occurred on the steeper slopes in the reshaped West Pit area (refer to **Figure 2.1**). Revegetation of these areas has been hampered by difficulties associated with spreading topsoil over steep slopes.

Rectification of erosion in the West Pit areas will be undertaken in accordance with the existing MOP. Germination and plant establishment rates will continue to be monitored in the West Pit area (and elsewhere at Invincible) and infill seeding/planting undertaken where necessary to achieve the target stem density criteria identified in the Land Management Plan.

The final landform developed for the Southern Extension Area and remaining areas of the existing open cut areas will take into account learnings from the rehabilitation in west pit and will avoid slope designs which pose problems for topsoil spreading. Contour banks will be established on slopes to prevent runoff from reaching high velocities that may cause erosion.

6.18.3.4 Erosion and sediment control

Section 6.3 contains details regarding surface water and erosion risks associated with the Southern Extension Project. The Surface Water Management Plan (including an erosion and Sediment Control Plan) will be updated to reflect changes associated with the Southern Extension Project. Details regarding changes to the Surface Water Management Plan are provided in **Section 6.3**.

6.18.3.5 Surface water

There are changes to surface water management associated with the Southern Extension Project. Other than the additional monitoring associated with water levels in the spoil discussed in **Section 6.3**, surface water will be monitored and managed in accordance with the approved Water Management Plan (refer to **Section 6.3** and **Appendix 4**).

6.18.3.6 Groundwater

As discussed in **Section 6.3** the aquifers in the Illawarra Coal Measures intercepted as part of the Southern Extension Project are largely limited to the Lithgow Seam. Past mining of this seam in the area has led to the depressurisation of this aquifer with the water table level predicted as being below the lowest point of mining in the Southern Extension Area. As discussed in **Section 6.3,** it is unlikely that there will be any groundwater seepage from the Lithgow Seam into the Southern Extension Area.

Potential impacts of the Southern Extension Project on groundwater will be monitored and managed in accordance with the approved Water Management Plan (refer to **Section 6.3**, **Appendix 4** and **Appendix 5**). This management plan will include a Trigger Action Response Plan related specifically to the management of risks associated with decant from the open cut void.

6.18.3.7 Contaminated land

There are no known areas of land contamination at Invincible. The areas with potential for land contamination are areas around the workshop, refuelling areas and any maintenance undertaken in-pit. The primary risk in these areas are associated with fuel and other hydrocarbon spills.

All fuel and oil storage areas on site are contained within bunded areas to Australian standards or are contained within concreted workshop areas serviced by fuel and oil separation facilities. Any material contaminated by hydrocarbons will be remediated to OEH criteria or standards (or as considered appropriate).

Spill management procedures will be identified in the MOP which will be updated for the Southern Extension Project. Prior to closure, an assessment of potentially contaminated areas will be undertaken. All contaminated soils will be managed in accordance with the MOP.

6.18.3.8 Bushfire

Bushfire poses a risk to the existing infrastructure on site as well as the successful establishment of vegetation communities in rehabilitated areas. A number of measures and safeguards have already been implemented at Invincible to minimise bushfire risk in accordance with the Landscape Management Plan. These include:

- Fitting fire extinguishers to all earthmoving and mining equipment
- Fitting and maintaining efficient exhaust systems and spark arresters to mobile equipment
- Advising NSW Rural Fire Service, regulatory authorities and neighbours of any burning-off operations
- Ensuring that vehicles with low level exhaust systems do not leave defined tracks in locations and conditions likely to lead to ignition of combustible plant material
- Maintaining, at the request of NSW Forestry Corporation, existing fire trails or access roads at the extremities of the mine disturbance area, which serve as access for fire fighting services as well as establishing a fire break to the limits of operations at the open cut.

These measures will be updated to reflect the Southern Extension Project.

6.18.3.9 Weeds and feral animals

Weeds pose a potential problem for the successful establishment of vegetation in rehabilitation areas. A weed spraying contractor is employed to monitor and control noxious weed infestations on the site. Some spraying for Blackberry and St Johns Wort will be required with particular attention being paid to fringe areas and rehabilitation surfaces. Weed control will be undertaken during the life of the Southern Extension Project and during the establishment of vegetation in rehabilitation areas as required.

Feral animals such as rabbits, goats and pigs can pose problems for the successful establishment of vegetation in rehabilitation areas. Feral cats, wild dogs and foxes can prey on native fauna and delay the reestablishment of key biodiversity values in rehabilitated areas. Monitoring of cleared and thinned vegetation and areas where tracks have been formed within Invincible will be conducted on an as needs basis. Pest control measures such as trapping and baiting may be employed in consultation with the appropriate government agency and / or controlling authority.

6.18.3.10 Threats to Vegetation Establishment

Table 6.39 Threats to Vegetation Establishment

Potential Threat	Potential Impact	Management Measure
Erosion and sedimentation	Washout of vegetation and/or inability of vegetation to establish on eroded surfaces	Regular site inspections and maintenance/repair of erosion and sedimentation controls as required in accordance with the Water Management Plan (Erosion and Sediment Control Plan).
Failure of seed to establish	Poor vegetation cover and plant densities	Use of recommended rehabilitation seed mix and adjustment of seed mix as required. Annual monitoring and management in accordance with the Landscape Management Plan and Environmental Monitoring Program. Reseeding failed areas as required.
Dieback of established vegetation	Poor vegetation cover and plant densities	Annual monitoring and management in accordance with the Landscape Management Plan and Environmental Monitoring Program. Reseeding/replanting failed areas as required.
Over-dominance of species and low species diversity	Inappropriate vegetation structural diversity	Annual monitoring and management in accordance with the Landscape Management Plan and Environmental Monitoring Program. Use of recommended rehabilitation seed mix and adjustment of seed mix as required.
Weed encroachment	Weed establishment outcompeting native plant species	Regular site inspections and annual monitoring and management in accordance with the Landscape Management Plan and Environmental Monitoring Program. Regular weed control by a licensed weed spraying contractor.
Bushfire	Loss of vegetation and structural diversity	Maintenance of fire-fighting equipment and reduction of fuel loads in consultation with NSW Rural Fire Service.

The rehabilitation of areas disturbed by mining should have regard to the natural succession pathways of the communities being established. Succession is the ecological process of ecological communities moving from one state to another. This may involve the recovery of a community from an impact (such as fire or a major storm event) to the natural evolution from one community type to another over time as a result of changes in external forces (such as changes in fire regimes or climate change). Unfortunately, there is little published research regarding the succession pathways in vegetation communities in the western coal fields, either from disturbed environments such as mine sites, derived grassland communities resulting from agricultural clearing or even from one community to another as a result of changes in fire patterns. Despite the lack of published research, there is no reason to suspect that the succession pathway for these communities differs significantly from other eucalypt woodland communities in eastern Australia.

Figure 6.38 (adapted from research by Connell & Slatyer, 1977 and Wikipedia Contributor, 2016) graphically illustrate the succession pathway that would be expected for a eucalypt woodland recovering from a major disturbance event. During the early stages of recovery from a disturbance, ground storey species (forbs and grasses) initially flourish, however these are replaced by fast growing pioneer species such as acacias which typically dominate the mid strata and canopy in the early to mid stages of recovery. These pioneer species typically have soil biota relationships which increase soil nutrient levels, particularly nitrogen (Nussbaumer et al, 2012). During this mid stage, it is not uncommon for there to be low densities of shrubs and ground layer species. The acacia species typically die back and thin out within 5 to 15 years, depending on the species, with some lasting for several decades. The senescence and decline of these species results in increased soil carbon levels and returns nutrients to the soils. As the pioneer species thin out, other canopy species, such as the eucalypts, grow, increase in dominance and occupy a greater percentage of canopy. The existence of the pioneer species during the early years of canopy species growth also encourages the eucalypt and other canopy species to grow in height.

As illustrated in **Figure 6.38**, in rehabilitated areas (and heavily disturbed environments), until pioneer species have started to die back, there is little light available in the lower storeys and typically a consequential low species richness in ground and shrub layers; as the pioneer species die out and canopy height increases, an increased species richness can be expected to develop in the understorey (this can be seen in **Plates 2.1** and **2.2** where the understorey is sparse under a reasonably dense overstorey of acacias and eucalypts in existing parts of rehabilitation.

As shown in **Figure 6.38,** the floristic and structural composition of the vegetation changes over the course of the succession process with grasses and pioneer species such as acacias initially dominating and then declining in abundance as canopy species increase in dominance and obtain a competitive advantage in terms of access to light and nutrients. The early succession stages (dominated by grasses and shrubs) help establish the soil structure, healthy soil biota, nutrient levels through soil biota relationships and organic matter levels necessary for the canopy species to establish and survive (Nussbaumer *et al*, 2012). These early succession processes are particularly important in primary succession (e.g. rehabilitation of disturbed overburden spoil) where there is likely to be little organic material or soil biota present in the growing medium and nutrients may be in a form which is unable to be easily accessed by plants. In secondary succession environments (e.g. recovery from fire or clearing), many of the key ingredients for successful establishment of canopy species may already be present, however early stage succession species still play an important role in the recovery of these communities through erosion control, improved water filtration, soil aeration, nutrient cycling, improving organic matter levels and providing protection to canopy species from predation during their juvenile stages. These lower canopy height but relatively species rich and dense floristic environments also provide habitat for pioneer fauna species.

As illustrated in **Figure 6.38**, early stages of succession have high species richness, sometimes greater than that present in the mature communities. The primary reason for this is the increased abundance of short lived but fast growing species and a corresponding increase in pioneer fauna species such as ants and other insects, small mammals and birds which feed on the fruits and often softer leaves of the pioneer species.

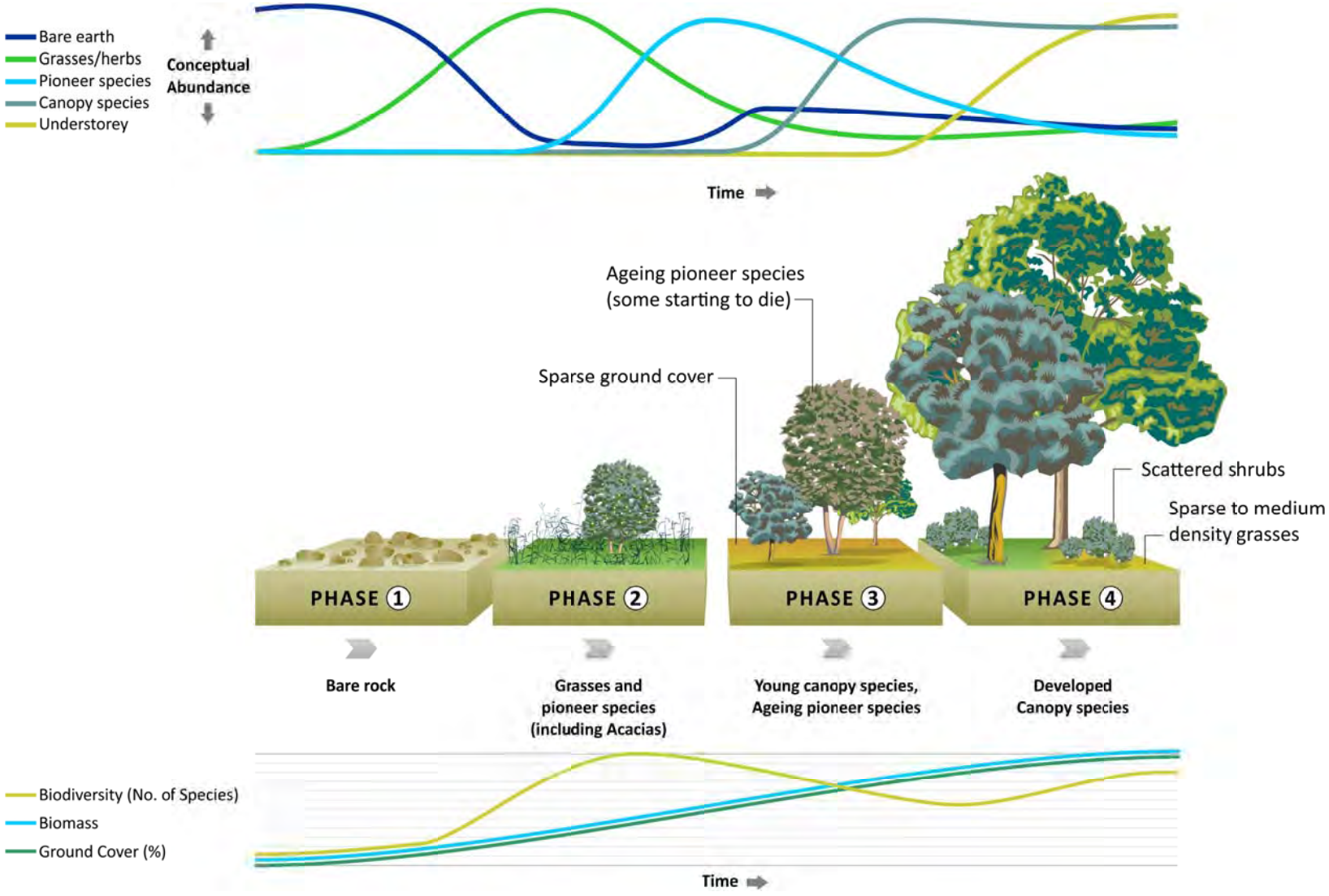


FIGURE 6.38

Conceptual Succession Process in Open Forest with Scattered Understorey

Image Source: Connell & Slatyer (1977) and Wikipedia Contributor (2016)

There can also be a corresponding, but delayed, increase in predator fauna species which increase in numbers in response to the increased food source in these early successional phases. Many of the fauna and flora species which are abundant in early successional phases are less abundant or even absent in mature communities.

As noted above, the rehabilitation objective for Invincible is the establishment of sustainable woodland and forest communities consistent with those present in the area. Achieving these objectives will require the establishment of species from all functional groups typically present in these communities.

The seed mix currently used at Invincible includes a mixture of locally endemic species with a focus on key successional species (predominantly *Acacia spp* and *Dodonea spp*) and target canopy species. The Southern Extension Project will target three key vegetation communities:

- Tableland Gully Ribbon Gum - Blackwood – Apple Box Forest (Northern Gullies)
- Tableland Gully Mountain Gum, Broadleaved Peppermint Grassy Forest (Southern Gullies) and
- Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland (Exposed Slopes).

The location of these communities in the final landform has been identified from past vegetation surveys of the area, including historical vegetation mapping of existing disturbance areas and is shown on **Figure 1.2**. Indicative seed mixes for each community are set out in **Table 6.40** and are based on species found in the target communities. These seed mixes identify species for which seed is readily available for purchase and should be supplemented by other species from the target communities if seed becomes available.

Table 6.40 Seed mix for vegetation communities to be re-established on disturbed areas of Invincible

Species	Common name	Tableland Gully Ribbon Gum-Blackwood – Apple Box Forest	Tableland Gully Mountain Gum, Broadleaved Peppermint Grassy Forest	Exposed Blue Mountains Sydney Peppermint-Silvertop Ash Shrubby Woodland
Acacia buxifolia	box-leaved wattle		**X**	**X**
Acacia dealbata	silver wattle		**X**	
Acacia deanei	green wattle		**X**	
Acacia falcata				
Acacia falciformis		**X**	**X**	
Acacia gunnii	ploughshare wattle		**X**	**X**
Acacia longifolia	Sydney golden wattle		**X (eastern gully only)**	
Acacia melanoxylon		**X**		
Acacia obtusifolia			**X**	
Acacia terminalis	sunshine wattle			**X**
Acacia ulicifolia	prickly moses		**X**	
Aristida vagans			**X**	
Bursaria spinosa	native blackthorn		**X**	
Carex inversa		**X**		
Cassinia arcuata	sifton bush		**X**	

Species	Common name	Tableland Gully Ribbon Gum-Blackwood – Apple Box Forest	Tableland Gully Mountain Gum, Broadleaved Peppermint Grassy Forest	Exposed Blue Mountains Sydney Peppermint-Silvertop Ash Shrubby Woodland
Chrysocephalum apiculatum	common everlasting		X	
Clematis aristata	old man's beard		X	
Clematis glycinoides			X	
Cymbonotus lawsonianus		X	X	
Daviesia ulicifolia	gorse bitterpea		X	
Dianella caerulea			X	
Dianella revoluta var. revoluta			X	X
Dianella revoluta			X	
Dichondra repens	kidney weed	X	X	
Entolasia stricta				X
Eucalyptus albens	white box			
Eucalyptus amplifolia	cabbage gum		X (eastern gullies only)	
Eucalyptus blakelyi	blakely's red gum		X (eastern gullies only)	
Eucalyptus bridgesiana	apple box	X	X	
Eucalyptus cameronii	diehard stringybark		X	
Eucalyptus dalrympleana	mountain gum		X	
Eucalyptus dives	broad-leaved peppermint		X	
Eucalyptus mannifera	brittle gum		X	X
Eucalyptus meliodora	yellow box		X	
Eucalyptus pauciflora			X	
Eucalyptus piperita	sydney peppermint			X
Eucalyptus polyanthemos		X		
Eucalyptus punctata		X		
Eucalyptus radiata	narrow-leaved peppermint		X	
Eucalyptus rossii	inland scribbly gum		X	X

Species	Common name	Tableland Gully Ribbon Gum-Blackwood – Apple Box Forest	Tableland Gully Mountain Gum, Broadleaved Peppermint Grassy Forest	Exposed Blue Mountains Sydney Peppermint-Silvertop Ash Shrubby Woodland
Eucalyptus sclerophylla				**X**
Eucalyptus sieberi	silvertop ash			**X**
Eucalyptus sparsifolia	narrow-leaved stringybark	**X**		
Eucalyptus viminalis	ribbon gum	**X**	**X**	
Glycine clandestina	twining glycine	**X**	**X**	
Glycine tabacina			**X**	
Hakea dactyloides				**X**
Hardenbergia violacea	false sarsaparilla		**X**	
Hibbertia obtusifolia	hoary guinea flower		**X**	
Hypericum gramineum	small St Johns wort		**X**	
Indigofera australis	Australian indigo		**X**	
Lepidosperma laterale			**X (eastern gully only)**	
Leptospermum juniperinum	prickly tea-tree		**X**	
Leptospermum polygalifolium			**X**	
Leptospermum trinervium				**X**
Leucochrysum albicans subsp. albicans c			**X**	
Lomandra confertifolia			**X**	**X**
Lomandra filiformis		**X**	**X**	**X**
Lomandra longifolia		**X**	**X (eastern gullies only)**	**X**
Lomandra multiflora subsp. Multiflora		**X**		
Melichrus urceolatus	urn-heath		**X (Drainage lines)**	
Mentha satureioides		**X**		

Species	Common name	Tableland Gully Ribbon Gum-Blackwood – Apple Box Forest	Tableland Gully Mountain Gum, Broadleaved Peppermint Grassy Forest	Exposed Blue Mountains Sydney Peppermint-Silvertop Ash Shrubby Woodland
Microlaena stipoides var. stipoides		X	X	
Patersonia glabrata				X
Pattersonia sericea	laurel geebung			X

As noted above, the early successional species cope well with the poor chemical and physical soil conditions, particularly where overburden is mixed with topsoil in the growing medium. The seed mixes should therefore include a high proportion of species which would typically be more abundant in early successional phases. Target canopy species should also be included in the initial seed mix with mix ratios dependant on relative abundance found in local communities. Ground and understorey species prevalent in mature communities are not essential to include in the initial seed mix as many of these are not early succession phases and seeds germinating in the early succession phases may not successfully establish and reproduce due to competition from pioneer species and soil conditions not yet conducive to establishment. These species may, however, naturally colonise into rehabilitation areas through natural vectors such as wind, water and fauna. This scenario is likely given the proximity of rehabilitation areas to Ben Bullen State Forest.

As soil conditions improve, later successional species will be expected to increase in abundance. Ongoing monitoring of rehabilitation and comparison with analogue sites will continue to be undertaken and the MOP and Landscape Management Plan will include TARPs which cover unexpected deviations from the expected successional pathways in regeneration and rehabilitation areas, including the requirement for infil seeding or planting and selective thinning.

SECTION 7.0

Management and Mitigation Commitments

7.0 Management and Mitigation Commitments

The proposed environmental management and monitoring measures, highlighting commitments included in the EA, have been consolidated below. Castlereagh Coal will commit to the following controls.

7.1 General

- Castlereagh Coal will mine up to 1.2 Mtpa ROM Coal
- Castlereagh Coal will produce up to 1.2 Mtpa Product Coal
- Mining operations will be undertaken up to 8 years from date of approval. Rehabilitation activities and the ongoing use of the Invincible Mine Infrastructure Area may continue beyond this date
- Castlereagh Coal will operate between 7:00 am and 10.00 pm Monday to Saturday (excluding public holidays). Mining and coal washery operations will not occur between 6.00 pm and 10.00 pm (operations limited to truck loading and maintenance activities only during this period)
- Castlereagh Coal will only undertake coal transportation between 7.00 am and 9.30 pm Monday to Saturday up to the following limits. There will be no coal haulage on Sundays and public holidays.
    - No more than 146 laden coal truck movements from the site per day (averaged over a week)
    - No more than 16 laden coal truck movements per hour.

7.2 Water resources

The key management measures for the Southern Extension Project in regard to surface water are the Invincible WMS and associated erosion and sediment control measures. The existing Invincible Water Management Plan will be updated to reflect the changes to the WMS and recommendations described in **Appendix 4** and **Appendix 5**.

The existing monitoring programs at Invincible will be updated as part of the Water Management Plan for the Southern Extension Project, including development of specific triggers around water quality and water levels in former underground workings and open cut spoil. These programs will be documented in the Invincible Water Management Plan as detailed in the commitments below.

The Water Management Plan will be updated to guide the overall management of water as part of the Southern Extension Project.

- Castlereagh Coal will monitor the water level in the former Ivanhoe No. 2 Underground workings and estimate the volume of water that will need to be removed to safely mine the Lithgow Seam in the Southern Extension Area prior to any dewatering of these workings.
- Castlereagh Coal will ensure any water discharged from discharge point (LDP002) meets the relevant requirements of EPL 1095.

- Castlereagh Coal will obtain appropriate water licences for all take from surface and groundwater systems as required for the Southern Extension Project. The Water Management Plan will outline a licensing strategy developed in consultation with DPI-Water to ensure that water access licences are obtained to account for take through the life of the Southern Extension Project.

- Castlereagh Coal will inspect the settlement ponds and sediment basins on a regular basis, or following rainfall of >25mm/24 hours, and clean out the sediment basins of consolidated sediment once capacity reduced by 20per cent.

- Castlereagh Coal will excavate temporary sumps within the open cut area to capture rainfall and runoff within the open cut.

- Castlereagh Coal will monitor water quality and volume of water released from licensed discharge point LDP002 within 24 hours of commencement of discharge and / or as specified on EPL 1095.

- Castlereagh Coal will monitor water quality within the Main Water Storage Dam at least monthly.

- Castlereagh Coal will monitor the quality of any water in the former Ivanhoe No. 2 Underground workings that may need to be dewatered to enable mining in the Southern Extension Area prior to dewatering.

- Castlereagh Coal will install standpipe monitoring bores into the former Invincible Underground workings for the purposes of monitoring water levels and water quality in the former workings.

- Castlereagh Coal will install a standpipe monitoring bore into the spoil near the potential decant point at the northern end of the open cut workings.

- Castlereagh Coal will monitor the water level and water quality in the Northern Void, monitoring bore in spoil near potential decant point and the monitoring bores in the former Invincible underground workings at least monthly.

- The WMS will be updated to include Trigger Action Response Plans related to the management of water levels in the underground workings and open cut spoil and the risk of decant.

- Castlereagh Coal will locate the dewatering discharge point to the Main Water Storage Dam from the Northern Void/Invincible Underground workings and Ivanhoe No. 2 workings on a float towards the middle of the dam to assist mixing.

- Castlereagh Coal will cease pumping and dewatering from Northern Void or underground workings to the Main Water Storage Dam in the event of observed ferrous iron oxidation or signs of other contamination. Pumping may recommence if monitoring of water quality in the underground workings indicates that the water is unlikely to exceed water quality criteria specified in the EPL.

Hydrocarbon management

- Castlereagh Coal will securely store all hydrocarbon products

- Castlereagh Coal will refuel all but the less mobile mining equipment (which would be refuelled within the open cut area), within designated areas

- Castlereagh Coal will direct all water from wash-down areas and workshops to oil/water separators and containment systems. Castlereagh Coal will store potentially hydrocarbon contaminated water in the oil/water separator for regular removal from site by a licensed contractor

- Castlereagh Coal will ensure all fuel storage tanks are either self bunded tanks or bunded with an impermeable surface and have a capacity to contain a minimum 110 per cent of the largest storage tank capacity

- Castlereagh Coal will implement a 3-phase remedial action plan, consistent with the Pollution Incident Response Management Plan, in the event of a major hydrocarbon spill as follows:

    - Phase 1 - Initial Recovery: Recover as much as possible at the source by pumping free hydrocarbon from the surface and excavating hydrocarbon-contaminated materials

    - Phase 2 - Source Control: Begin hydraulic control of the source to prevent spreading of contamination

    - Phase 3 - Recovery: If necessary, install boreholes to remove and treat contaminated groundwater.

- Castlereagh Coal will identify spill management procedures in the Mining Operations Plan which will be updated for the Southern Extension Project.

7.3 Biodiversity

- Castlereagh Coal is committed to the design and implementation of a comprehensive strategy to mitigate adverse impacts during the Southern Extension Project. This includes specific measures to manage potential impacts on fauna species in the Southern Extension Area during vegetation clearing activities including:

    - update the existing Landscape Management Plan in accordance with the requirements of the modified Invincible Project Approval to minimise impacts on biodiversity values

    - surveying and marking the boundaries of the areas of disturbance on the ground prior to any vegetation clearing

    - a robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees. The tree felling procedure is designed to minimise impacts to hollow-dependent fauna, particularly the squirrel glider and hollow-dependent micro-bats (refer to **Appendix 6**)

    - tree hollows felled during clearing will either be stockpiled for use as habitat in rehabilitation areas or relocated to areas within the biodiversity offset areas which will not be disturbed by the project

    - felled trees and branches will be stockpiled for use in stabilising slopes and for habitat in the rehabilitated landform. Some trees and branches may be mulched for use in soil amelioration and stabilisation

    - targeted weed management measures including regular weed inspections and weed control and eradication techniques such as herbicides, physical removal and prompt revegetation of bare areas

    - erosion and sedimentation control in accordance with management procedures for the Southern Extension Project as defined in the SWMP

    - employee education and training including inductions for staff, contractors and visitors to the site will be conducted to inform personnel of the biodiversity issues present at the site and so they know their role and responsibilities in relation to the protection and/or minimisation of impacts to native biodiversity

- areas of biodiversity value outside the Southern Extension Area will be fenced or signposted, where appropriate, to prevent any unnecessary disturbance during mining.

- Castlereagh Coal will undertake the following management measures to minimise the potential impacts and spread of weeds during the Southern Extension Project:
  - the limits of ground disturbance will be clearly demarcated and no unnecessary disturbance will be undertaken outside of these areas
  - rehabilitation will be undertaken on disturbed areas as soon as practical following disturbance. This may include respreading of topsoil, seeding and/or planting of natives
  - regular inspections will be undertaken in the Southern Extension Area and adjacent areas to monitor the spread of weed species
  - training of environmental personnel on the identification of target weed species.
- Castlereagh Coal will control and eradicate any outbreak of noxious weeds as required under the Noxious Weeds Act 1993, and as required by the Local Land Services and other relevant authorities. Weed control and eradication techniques may include:
  - spraying with herbicides
  - physical removal e.g. chipping
  - minimisation of area available for weed infestation, through prompt revegetation of bare areas.
- Castlereagh Coal will monitor the presence of pest species and additional pest control measures will be implemented in consultation with the appropriate government agency or controlling authority as required.
- Castlereagh Coal will update the existing Invincible Landscape Management Plan, the overarching plan to guide future rehabilitation. The Land Management Plan will also include details regarding the management of noxious weeds and feral animals.

<u>Biodiversity offset strategy</u>

- Castlereagh Coal is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Southern Extension Project. Fulfilling offset requirements under the NSW *Biodiversity Offset Policy for Major Projects* will be undertaken using one or a combination of the following offset strategies:
  - securing required credits through the open credit market, off site
  - offsetting through a land-based offset site secured by a BioBanking Agreement
  - if suitable offsets are unavailable, contributing funds to supplementary measures in accordance with relevant conservation or recovery actions relevant to the species
  - contributing to the Offsets Fund.

Castlereagh Coal will investigate a range of available options in the locality that contain the appropriate biodiversity features to offset the impacts of the Southern Extension Project. The application of the FBA Variation Rules may be required if it is demonstrated that the appropriate ecosystem or credit-species credits are unavailable for use in the Invincible Biodiversity Offset Strategy. Detailed rehabilitation commitments are set out in **Section 7.15**.

7.4 Aboriginal heritage

7.4.1.1 Aboriginal parties recommendations

The recommendations presented below were provided by registered Aboriginal party representatives participating in the survey of the Southern Extension Project and through comments on the draft ACHAA (refer to **Appendix 7**).

- The scarred tree (IC ST) needs to be recovered from the pile at the windrow and stored in a weather sheltered location, elevated off the ground. The tree could be trimmed either side of the scarred section as part of this process. WVWAC further recommended that IC ST be recovered and moved to a safe storage location on site and stored under cover on reinforced steel racking support not on the ground or on concrete to minimise any future damage.

- The artefact scatters and isolated finds (IC 1, IC 2, IC 3, IC 4, IC 5, 45-1-0069, 45-1-0070, 45-1-2708 and 45-1-2714) need to be collected, if they are to be impacted

- Any salvaged artefacts need to be returned to a secure keeping place on country, potentially a shipping container within the Southern Extension Area / Invincible site that can be accessed by the registered Aboriginal parties

The recommendations above will be adopted for the Southern Extension Project as detailed in **Appendix 7**. Castlereagh Coal will continue to engage with the registered Aboriginal parties through the preparation of the revised ACHMP for Invincible.

7.4.1.2 Archaeological Management Measures

- The ACHMP for the Invincible Project Approval will be revised in consultation with the registered Aboriginal parties. The revised ACHMP will be updated, in consultation with registered Aboriginal parties to reflect the outcomes of the current assessment and will include the management activities listed below. Consideration will also be given in the ACHMP to ongoing consultation mechanisms such as regular consultation meetings with Aboriginal parties, as requested by WVWAC.

- Prior to any impacts, surface collection of sites IC 1, IC 2, IC 3, IC 4**,** IC 5, 45-1-0069, 45-1-0070, 45-1-2708 and 45-1-2714 will be undertaken in accordance with the methodology provided in **Appendix 7**

- Prior to any further impacts, the scarred tree (IC ST) will be salvaged in accordance with the methodology recommended by the registered Aboriginal parties (refer to **Section 7.4.1.1**) and detailed in **Appendix 7**

- Rock shelter 45-1-2712 is located outside the Southern Extension Area, and outside any predicted areas of blasting impacts. Baseline recording and ongoing periodic monitoring of the shelter will be undertaken to ensure that there are no incidental impacts to the site. The methodology and requirements for monitoring will form part of the revised ACHMP and will be subject to consultation with the registered Aboriginal parties

- The rock formations known as pagodas are outside the Southern Extension Area and will not be subject to direct or indirect impacts from the Southern Extension Project. However, given that these formations have been identified as having high Aboriginal cultural value, registered Aboriginal parties will be provided with an opportunity to be part of monitoring at these locations (refer to **Section 6.8**). This monitoring will form part of the revised ACHMP and will be subject to consultation with the registered Aboriginal parties

- Should any Aboriginal objects be identified during works (other than the sites referenced above), all works in the immediate vicinity of the objects will cease until such time as an appropriate strategy for their management has been developed in consultation with the registered Aboriginal parties and OEH.

- In the unlikely event that a potential burial site or potential human skeletal material is exposed within the Proposed Disturbance Area, the following procedure will be followed in accordance with the Policy Directive – Exhumation of Human Remains (NSW Department of Health 2008), Skeletal Remains – Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977 (NSW Heritage Office 1998) and the Aboriginal Cultural Heritage Standards and Guidelines Kit (NPWS 1997):

    - as soon as remains are exposed, work in the immediate area is to halt immediately to allow assessment and management

    - contact local police, OEH and the Heritage Division

    - a physical or forensic anthropologist will inspect the remains *in situ*, and make a determination of ancestry (Aboriginal or non-Aboriginal) and antiquity (pre-contact, historic or forensic)

    - if the remains are identified as forensic the area is deemed as a crime scene

    - if the remains are identified as Aboriginal, the site is to be secured and OEH and all registered Aboriginal parties are to be notified in writing

    - if the remains are non-Aboriginal (historical) remains, the site is to be secured and the Heritage Division is to be contacted.

    The above process functions only to appropriately identify the remains and secure a site. From this time, the management of the remains is to be determined through liaison with the appropriate stakeholders (NSW Police Force, forensic anthropologist, OEH, Heritage Division, registered Aboriginal parties etc) and in accordance with the *Public Health Act 1991*.

- Castlereagh Coal will maintain existing controls and protection of site "Invincible 0S1" in accordance with existing requirements of the Invincible Project Approval

- Castlereagh Coal will inform all site personnel and provide training to relevant employees on the presence of all known Aboriginal sites potentially affected by operations at the site and their obligations under the NPW Act and the Invincible Project Approval

- Castlereagh Coal will conduct a Cultural Heritage Awareness Induction Course for all staff on site and any contractors who will be working at Invincible and may be undertaking surface disturbance works, blasting or tree felling activities.

Measures to manage potential blast impacts on heritage items are identified in the **Section 7.7**.

7.5 Historic heritage

- Castlereagh Coal will implement historical heritage management measures for the Southern Extension Project including:
    - In the unlikely event that unexpected archaeological remains or potential heritage items not identified as part of this assessment are discovered during the Southern Extension Project, all works in the immediate area will cease, the remains and potential impacts will be assessed by a qualified archaeologist or heritage consultant and, if necessary, the Heritage Division, Office of Environment and Heritage (OEH) notified in accordance with Section 146 of the *Heritage Act 1977* (NSW).
    - In the unlikely event that a potential burial site or potential human skeletal material is exposed within the Southern Extension Area, the process detailed in **Section 7.4** will be implemented.

Measures to manage potential blast impacts on heritage items are identified in **Section 7.7**.

7.6 Air quality

- Castlereagh Coal will prepare and implement an Air Quality Management Plan for the Southern Extension Project. The plan will incorporate a range of proactive and reactive dust control strategies. The controls to be implemented include the following key measures:
    - Proactive air quality management would involve the planning of activities in advance of potentially adverse conditions. Specifically, the pro-active air quality management approach will include:
        - implementation of a system to provide environmental personnel with a daily forecast of expected dust conditions in the vicinity of the operation
        - discussion of the dust forecast at daily pre-shift meetings
        - modifying the planned mining activities, as appropriate, to minimise or avoid the potential dust impacts.
    - Reactive air quality management will including modification or suspension of activities in response to identified triggers including:
        - visual conditions, such as visible dust from trucks above wheel height
        - meteorological conditions, such as dry, windy conditions, with winds blowing towards sensitive receptors.
- Castlereagh Coal will implement a range of dust management measures for the key dust generating activities including:
    - watering of haul routes
    - water injection, dust curtains
    - enclosure
    - watering / moist travel routes

- water sprays
- partial rehabilitation / stabilisation.

- Castlereagh Coal will minimise clearing ahead of construction and operational activities.
- Castlereagh Coal will review and consolidate the air quality monitoring currently operating to meet the needs of the Southern Extension Project. Specifically, the locations and types of monitoring will consider the location of sensitive receptors, prevailing meteorological conditions, and location of mining activities. The air quality monitoring program will form part of the Air Quality Management Plan to be developed for the Southern Extension Project.

7.7 Blasting

- Castlereagh Coal will update the existing Blast Management Plan in consultation with relevant authorities and infrastructure owners to include the following management and monitoring:
  - blasting will be undertaken between 9.00 am and 5.00 pm (EST) Monday to Saturday
  - no more than 2 blasts per day or 5 blasts a week averaged over any 12 month period will be undertaken
  - Castlereagh Coal will offer structural inspections of any residence within 2 km of the Southern Extension Area to provide baseline assessment of the condition of these structures prior to blasting occurring
  - Castlereagh Coal will continue to notify landowner / occupier of all residences (who register to be notified) within a 3 kilometre radius of the Southern Extension Project of the blasting schedule
  - Castlereagh Coal will publish the planned blast schedule and associated road closures on the Castlereagh Coal website at least a week in advance of the planned blasts
  - Castlereagh Coal will provide emergency services with details of planned road closures
  - Castlereagh Coal will provide emergency services with the contact details for relevant people at the mine site to enable blasts to be delayed or rescheduled in the event that emergency access along the Castlereagh Highway is required during a planned closure period
  - Castlereagh Coal will continue to undertake blasting activities in accordance with the Blast Management Plan which includes controls to ensure safety to people and property, control vibration and airblast emissions, minimise dust and fume emissions and minimise the cumulative effects of blasting.
  - Castlereagh Coal will provide relevant environment groups and recreation groups with regular updates regarding proposed mining activities that may impact on access to parts of Ben Bullen State Forest. This engagement would include information about accessing details of the proposed blast schedule and associated exclusion zones and periods.

- Castlereagh Coal will update the existing Blast Management Plan to include the following controls relating to the Pagodas:
    - Castlereagh Coal will undertake a detailed structural integrity assessment of pagoda structures prior to undertaking any blasting within 500m of a pagoda. This is to provide a baseline reference for ongoing monitoring and inspection of these sites over the life of the Southern Extension Project
    - Castlereagh Coal will commit to the ongoing monitoring of blast vibration levels at the closest pagoda sites and regular inspections to provide an ongoing assessment of structural integrity and condition over the life of the Southern Extension Project
    - An appropriate system of flyrock monitoring will be developed as part of the Blast Management Plan, including strict quality control measures during blast design and loading stages and adequate procedural requirements.
- Castlereagh Coal will update the existing Blast Management Plan to include the following controls relating to the ground vibration:
    - Use of appropriate MIC design, i.e. avoid overcharging holes
    - Use of an appropriate initiation sequence to minimise the possibility of hole interactions thus avoiding a build-up in wavefront reinforcement.
- Castlereagh Coal will update the existing Blast Management Plan to include the following controls relating to airblast:
    - Use of appropriate MIC design, i.e. avoid overcharging holes and the use of insufficient stemming column
    - Use of an appropriate initiation sequence to minimise the possibility of hole interactions thus avoiding a build-up in wavefront reinforcement
    - Ensure appropriate blast design around identified geological features to avoid face burst
    - Application of an appropriate quality stemming material and stemming height to enable correct confinement of explosives to minimise airblast emission
    - Maintain appropriate burden specification for the front row holes (to avoid face burst)
    - Use pre-blast procedure (including meteorological conditions review) to avoid blasting in unfavourable weather conditions.
- Castlereagh Coal will update the existing Blast Management Plan to include the following controls relating to flyrock:
    - Ensure appropriate blast design around identified geological features to avoid face bursts and potential flyrock incidents
    - Application of an appropriate quality stemming material and stemming height to enable correct confinement of explosives to minimise the possibility of stemming ejection / flyrock incidents
    - Maintain appropriate burden specifications for the front row holes (to avoid face bursts and related flyrock incidents).

- Castlereagh Coal will implement a Blast Monitoring System including:
    - Monitoring system for private residences will consist of two permanent monitoring stations:
        - The first station will be located at the closest residence to the north-west (i.e. Residence ID 394) to represent the Cullen Bullen community
        - An additional monitoring station will be installed to provide adequate and representative coverage for the area (either of the residences ID 392 or ID 426)
        - The existing blast monitor located at BO1 in the south of Cullen Bullen village will be maintained during the early stages of proposed mining and removed if it is demonstrated that monitoring at ID 394 is effective in monitoring impacts at further locations.
    - Periodic vibration monitoring of the pagodas and cliff line, including crack behaviour monitoring and surveys of the area, in particular of the damaged section of the cliff line (caused by inferred surface subsidence) will be required when blasting is within a 500m metre radius of these sites
    - Periodic monitoring of infrastructure, including the transmission towers and Castlereagh Highway, will be required when blasting within 250m with a MIC in excess of 130 kg, that is when vibrations are expected to be 10 mm/s or above, or when blasting within 100 m irrespective of the MIC.
- Castlereagh Coal will develop a pre-blast assessment protocol as part of the Blast Management Plan that minimises the impacts on the surrounding area
- Castlereagh Coal will incorporate the existing Invincible weather monitoring station into the pre-blast assessment protocol
- Castlereagh Coal will prepare a Road Closure Protocol in consultation with the relevant road authorities.

7.8 Noise

- Castlereagh Coal will consider implementing the following general noise management measures where feasible and reasonable:
    - consideration of noise minimisation when selecting new plant and equipment
    - the maintenance of product stockpiles in strategic locations, where practicable, shielding product trucks and product loading equipment
    - the use of broad band reversing alarms instead of beeper style alarms on all mobile equipment
    - the management of mobile machines during adverse weather conditions when wind conditions enhance the noise propagation towards sensitive receiver locations. In order to minimise noise impacts, this would likely include:
        - where possible, not operating a dozer for shaping during rehabilitation at the northernmost emplacement site under adverse weather conditions
        - moving extraction activities to locations deeper in the pit during adverse weather conditions

  - shut down of some equipment and activities during adverse weather conditions, if required, in particular haulage of overburden to the emplacement areas.

- Castlereagh Coal is committed to ensure the ongoing effective operation of these noise control measures through:
  - regular inspection and maintenance of noise management processes (as informed by ongoing regular noise monitoring (refer to **Section 6. 10.9.3**)
  - implementation of a process for periodic review of noise performance of equipment. This process will be outlined in a Noise Management Plan to be prepared for the Southern Extension Project (refer to **Section 6.10.9.2**).
- If during the course of operations, individual residential receivers are found to exceed their PNTLs, in addition to the management of operational noise levels outlined above, additional management procedures that can be implemented include:
  - prompt response to any issues of concern raised by community
  - additional targeted noise monitoring on-site and within the community
  - Castlereagh Coal will refine on-site noise mitigation measures and plant operating procedures where practical, specific to the transmission of noise to the affected receiver.
- Castlereagh Coal will develop and implement an updated Noise Management Plan (NMP) for the Southern Extension Project. The NMP will detail the implementation of environmental management controls to be utilised to manage potential noise impacts associated with site operations. The NMP will, at a minimum, include:
  - noise objectives and targets consistent with the Invincible Project Approval and EPL
  - noise mitigation measures, referencing relevant operating procedures with documented controls. The suitability of the noise management controls is to be assessed on an annual basis as part of ongoing review of operational risks to the Southern Extension Project
  - provision of general noise awareness training for operational staff, which identifies site specific objectives and targets for noise management, potential noise impacts, environmental commitments for the colliery and obligations in respect of noise management
  - noise monitoring processes to be implemented over the life of the Southern Extension Project to provide for ongoing noise performance monitoring and determination of compliance with relevant noise criteria provided in the Invincible Project Approval and EPL (refer to **Section 6.10.1**)
  - mechanisms for stakeholder consultation
  - complaint handling processes including maintenance of a 24 hr Community Contact Line which will be in operation during operating hours
  - a roles and responsibilities matrix, with responsibilities being clearly defined through all levels within the operation as this relates to the control and management of noise.

- Castlereagh Coal will develop and implement a noise monitoring program on a quarterly basis comprising of day time operations and if/when undertaken, evening operations. Noise monitoring locations will be developed based on suitability and available land access, however, would ideally assess noise impacts at a number of the nearest sensitive receivers (for example, 393, 394 and 392). The monitoring program will include:
    - attended noise monitoring to measure ambient noise levels in the surrounding region and determination of the Southern Extension Project's contribution to measured noise levels
    - comparison of the attended noise monitoring results with predicted noise levels from the Southern Extension Project under similar meteorological conditions, and relevant Invincible Project Approval and EPL noise limits
    - assessment of performance of noise control measures and recommendations for additional measures if required.

7.9 Social

- Castlereagh Coal will undertake the following monitoring commitments in relation to the SIOA, including:
    - key areas of predicted impact, including perceived and experienced social impacts, through consultation with neighbouring and other nearby landowners, to monitor if experienced impacts are in line with predicted impacts
    - evaluation of actions and investments to assess the outcomes of key projects and programs arising from:
        - Commitments made within the SIOA
        - Any wider community development or partnership programs at an operational or corporate level
        - Voluntary Planning Agreement (VPA) for the Southern Extension Project.
    - Development of a program for monitoring any other social impacts predicted in the current assessment and identification of any unforeseen social impacts, should they occur
    - Consideration of SIOA outcomes in the preparation of the site specific engagement strategy so that relevant stakeholders, including neighbouring and nearby landholders, are properly informed regarding current and future operations.

7.10 Traffic

- Castlereagh Coal will require truck loading to occur in the Invincible Mine Infrastructure Area, with a wheel wash operated to wash tyres, where required, prior to leaving the site
- Castlereagh Coal will educate staff regarding the need to travel in a safe manner through the regional road network as an extension of the broader safety programs in place at Invincible
- Castlereagh Coal will undertake all transport activities strictly in accordance with the project approval

- Castlereagh Coal will minimise truck movements during periods when buses carrying school children are travelling on the section of road between the Invincible Colliery and Mt Piper Power Station

- Castlereagh Coal will undertake all deliveries of "oversize" loads in accordance with RMS and Council restrictions on transport hours and safety / warning requirements

- Castlereagh Coal will ensure all truck drivers operate in accordance with a Transport Policy and Code of Conduct

- Castlereagh Coal will obtain a Workplace Health and Safety Management Plan and a "Code of Conduct" for all drivers from each transport contractor

- Castlereagh Coal will enforce a covered load policy to all trucks transporting coal from the Invincible Colliery

- Commitments in relation to the management of road closure impacts are detailed in **Section 7.7**.

7.11 Greenhouse gas and energy

- Castlereagh Coal will implement a range of measures found to be both technically feasible and financially reasonable to minimise GHG emissions. Other than fugitive emissions, Scope 1 emissions are primarily associated with diesel consumption. Accordingly, there are financial drivers for undertaking operations in a manner which reduces diesel consumption. Matters implemented in the mine design consideration which contribute to lower diesel consumption (and Scope 1 emissions) include:

    - limiting the length of material haulage routes

    - optimising ramp gradients

    - improving rolling resistance of haul roads

    - optimising payload size

    - reducing idling times (dependent on weather conditions)

    - scheduling activities so that equipment and vehicle operation is optimised

    - utilising fuel efficient equipment and

    - working machines to their upper design performance.

- Castlereagh Coal will continue to investigate options for improving the efficiency of operations through the life of the Southern Extension Project. Castlereagh Coal will also investigate options for use of alternative fuels such as biodiesel, where reasonable and feasible.

7.12 Bushfire

- Castlereagh Coal will update the Landscape Management Plan to incorporate the following bushfire management controls for the Southern Extension Project in consultation with the RFS, neighbouring landholders and the community and Lithgow City Council:

    - Fitting fire extinguishers to all earthmoving and mining equipment

- Advising NSW Rural Fire Service, regulatory authorities and neighbours of any burning-off operations

- Ensuring that vehicles with low level exhaust systems do not leave defined tracks in locations and conditions likely to lead to ignition of combustible plant material.

- Maintaining, at the request of NSW Forestry Corporation, existing fire trails or access roads at the extremities of the mine disturbance area, which serve as access for fire fighting services as well as establishing a fire break to the limits of operations at the open cut.

7.13 Visual

- Castlereagh Coal has committed to a number of project design features to assist in minimising the visual impacts of the Southern Extension Project, including:

  - appropriate design, construction and rehabilitation of the emplacement areas to minimise visual impacts during construction and to blend into the surrounding landform (refer to **Section 6.19**)

  - topsoiled areas will be vegetated as soon as practicable to minimise the period of lighter coloured material being visible

  - progressive rehabilitation will be undertaken of all shaped and topdressed areas to reduce the duration of visible soil exposure

  - planting of appropriate vegetation or other screening to reduce views of mining infrastructure where required to reinforce existing vegetation screening

  - activities in periods of the year when day shift extends beyond dusk will be managed to limit lighting impacts

  - all lighting associated with mining operations will be turned off by 7.00 pm unless required for emergency, security and/or safety purposes

  - all lighting associated with the MIA will be turned off by 10.30 pm at night unless required for emergency, safety and/or security reasons

  - success rates for canopy species in rehabilitation areas at Invincible will be assessed to determine whether lower percentages of acacia species or increased percentages of other potential pioneer species can be used in the rehabilitation seed mix without compromising the timely establishment of woodland communities in the rehabilitated landform

  - ongoing management of mobile lighting to reduce the impacts of lighting at dusk, including the use of shields as required and the ongoing implementation of procedures about the appropriate placement of mobile lighting plant

  - night lighting will be kept to the minimum needed for operational management and safety to limit the extent of night lighting glow

  - all lighting associated with the Southern Extension Project will be installed and maintained in accordance with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

7.14 Waste

- Castlereagh Coal will develop and implement a site specific Waste Management System to manage waste generated by the Southern Extension Project and will include details regarding:
    - waste streams and their disposal requirements
    - storage and treatment requirements
    - re-use, recycling and waste minimisation opportunities
    - mechanisms for monitoring waste volumes and performance
    - training and induction requirements
    - reporting requirements
    - incident and complaint management
    - accountabilities for waste management.
- Castlereagh Coal will detail the methods for monitoring waste volumes in the Waste Management System and will include measurable indicators and targets for waste reduction as part of the Southern Extension Project.

7.15 Rehabilitation

- Castlereagh Coal will blend the created landforms with the surrounding landscape including existing and former foothills leading to the adjacent pagoda formations. No voids will remain in the final landform
- Castlereagh Coal will adopt a progressive approach to rehabilitation to ensure that completed areas are shaped and vegetated to provide a stable landform
- The final landform developed for the Southern Extension Area and remaining areas of the existing open cut areas will take into account learnings from the rehabilitation in the west pit and will avoid slope designs which pose problems for topsoil spreading. Contour banks will be established on slopes to prevent runoff from reaching high velocities that may cause erosion
- The Southern Extension Project will target three key vegetation communities:
    - Tableland Gully Ribbon Gum- Blackwood – Apple Box Forest (Northern Gullies)
    - Tableland Gully Mountain Gum, Broadleaved Peppermint Grassy Forest (Southern Gullies) and
    - Exposed Blue Mountains Sydney Peppermint- Silvertop Ash Shrubby Woodland (Exposed Slopes).

    The general location of these communities in the final landform is shown on **Figure 6.34.**

    Indicative seed mixes for each community are set out in **Table 6.38**. This exact seed mix used in different areas will depend on aspect, drainage and availability of seed at the time of sowing. Pioneer species may make up a large component of early seeding with subsequent seeding and infill planting used to establish species less suited to early successional phases.

- Castlereagh Coal will update the approved Rehabilitation Management Plan/MOP and Landscape Management Plan to include the Southern Extension Area and reflect the updated commitments for the Southern Extension Project

- Castlereagh Coal will commission an annual inspection of rehabilitation success against objectives such as ground cover, biodiversity , weed invasion, erosion and sedimentation, and general condition

- Castlereagh Coal will undertake annual monitoring of rehabilitation success. This will include regular inspections by the CCC, where requested, to provide for ongoing community input

- Ongoing monitoring of rehabilitation will continue to be undertaken annually and the Rehabilitation Management Plan/MOP and Landscape Management Plan will include TARPs which cover unexpected deviations from the expected successional pathways in regeneration and rehabilitation areas

- Castlereagh Coal will undertake annual inspection of compensatory conservation areas and report on recommended improvements.

Material prone to generating acid mine drainage

- Castlereagh Coal will ensure coarse reject material is emplaced within the void of the open cut in such a manner that it does not encroach on *in situ* coal seams (i.e. emplaced 5m away from exposed *in situ* coal seams)

- Castlereagh Coal will ensure course reject material is buried at a minimum 5m depth below the surface. This management measure is intended to significantly reduce the risk of any potential acid generating material entering the underlying water table, due to the coal seam being permeable. Dry tailings not sold as product will be disposed with overburden in the same manner as coarse reject material

- In addition to the above measures, coal rejects will be placed at least 5m from the exposed highwall to minimise any potential for acid mine leachate to enter the subsurface water system via the exposed interburden or coal seam.

Contaminated Land

- Castlereagh Coal will remediate any material contaminated by hydrocarbons to OEH criteria or standards or as considered appropriate through site decommissioning

SECTION 8.0

Conclusion

8.0 Conclusion

This section provides a conclusion discussing the justification for the Southern Extension Project, taking into consideration the environmental impacts of the proposed modification and the suitability of the site, to assist the consent authority to determine whether or not the Southern Extension Project is in the public interest.

8.1 Environmental impacts

As discussed in **Section 6.0**, the potential environmental impacts of the Southern Extension Project have been identified and are the subject of a detailed environmental assessment based on:

- assessment of the site characteristics (existing environment)
- focused consultation with all relevant government agencies
- extensive engagement with local community and other stakeholders
- comprehensive environmental risk analysis
- application of the principles of ecologically sustainable development, including the precautionary principle, inter-generational equity and conservation of biological diversity and ecological integrity
- expert technical assessment.

The results of the detailed assessments undertaken for the Southern Extension Project are detailed in **Section 6.0** and the Appendices to this document.

Whilst there are many complex aspects which must be read in their entirety to fully understand these assessments, **Table 7.1** provides a broad overview of the key outcomes of the environment and community impact assessment.

Table 8.1 Summary of the Key Environmental and Social Impact Assessment Findings

Environmental / Social Issue	Overview of Potential Impacts
Land Use	The Southern Extension Project is an extension of an existing mine in an area that has a long history of mining. The Southern Extension Area is located in Ben Bullen State Forest and is not used for agricultural purposes. The Southern Extension Area will have negligible to no impact on agricultural productivity. A Site Verification Certificate confirming there are no areas of BSAL in the part of the Southern Extension Area where a new mining lease is required was granted in 2014. The forestry resources in the Southern Extension Area are largely limited to firewood and the removal of vegetation in this area will have negligible impact on the forestry value of the land as most of the easily accessible firewood resources have already been removed from this area due to its close proximity to the Castlereagh Highway.

Environmental / Social Issue	Overview of Potential Impacts
	The Southern Extension Area is also occasionally used for trail bike riding and is located near tracks providing access to Ben Bullen State Forest to the east of the Southern Extension Area. The Southern Extension Area is located within the area proposed by conservation groups as a State Conservation Area as part of the Gardens of Stone Stage 2 proposal. The key conservation values associated with the Gardens of Stone Stage 2 proposal are located to the east of Southern Extension Area. Mining is a permissible land use (with a mining lease) within a State Conservation Area and the impacts of the Southern Extension Project on conservation values are similar to those of the existing Invincible open cut operations, much of which are also located in the area proposed as a State Conservation Area.
Water Resources	Water will be required for coal washery processes, dust suppression and other operational purposes. Water removed from the former Ivanhoe underground workings in the Southern Extension Area will be transferred into the former Invincible underground working and void space associated with the existing Invincible open cut. Any water in excess of storage space or operational needs may need to be discharged to Cullen Creek in accordance with relevant approvals and licences. Detailed assessments of potential impacts on surface water and groundwater have been completed. The Southern Extension Project is not predicted to have a significant impact on downstream water users or environment. Aquifers in the local area been largely depressurised as a result of historical open cut and underground mining. The Southern Extension Project is not predicted to have any discernible impact on any groundwater resources. The Southern Extension Project includes transfer from and between water stored in former underground workings, surface storages and waterways. Net take from surface and groundwater systems will be licensed in accordance with the water sharing plans applicable to these surface water and groundwater systems in consultation with DPI Water.
Ecology	The Southern Extension Project includes specific design features to avoid and minimise potential impacts on biodiversity, The Southern Extension Project will result in the removal of an additional approximately 50 hectares of vegetation over that already disturbed or approved to be disturbed. The Southern Extension Project will not impact on any threatened ecological communities. A detailed Biodiversity Assessment Report has been completed in accordance with the NSW Framework for Biodiversity Assessment (FBA) and all biodiversity impacts associated with the Southern Extension Project will be offset in accordance with the FBA. Castlereagh Coal has committed to implement a biodiversity offset strategy as part of the Southern Extension Project to meet the requirements of the FBA.

Environmental / Social Issue	Overview of Potential Impacts
Aboriginal Cultural Heritage	A comprehensive Aboriginal Cultural Heritage and Archaeological Assessment were completed for the Southern Extension Project in consultation with 6 registered Aboriginal parties. This assessment considered the potential impacts on Aboriginal cultural heritage within and outside the Southern Extension Area. The Southern Extension Project will impact on six Aboriginal sites located in the Southern Extension Area, consisting of isolated finds and artefact scatters. Management measures developed in consultation with the registered Aboriginal parties will be implemented in relation to these sites as well as any additional sites which may be identified during the life Southern Extension Project. The Southern Extension Project is not predicted to impact on any sites located outside of the Southern Extension Area.
Historic Heritage	No items of historic heritage are located within the Southern Extension Area and the Southern Extension Project is not predicted to have an impact on any heritage items in the local area.
Air Quality	A detailed Air Quality Impact Assessment was undertaken for the Southern Extension Project. The Southern Extension Project is not predicted to result in any exceedance of air quality criteria at any private residences or sensitive receivers.
Blasting	A detailed Blasting Impact Assessment has been completed for the Southern Extension Project. An assessment of the stability of pagodas and cliff lines in proximity to the Southern Extension Area to blasting impacts has also been completed. The assessment has found that the impacts from blasting in the Southern Extension Area can be effectively managed though blast design to avoid impacts to pagodas and cliff lines. Blasts impacts can also be managed through blast design to ensure vibration and overpressure impacts do not exceed relevant criteria at all private residences, including Cullen Bullen, private and public infrastructure, heritage sites and other structures. Castlereagh Coal will use a variety of notification methods to advise users of the Castlereagh Highway and nearby areas of Ben Bullen State Forest of planned blasts to minimise any impacts associated with temporary road closures and access restrictions during blast periods.
Noise	A detailed Noise Impact Assessment has been undertaken for the Southern Extension Project. Project design features have been included as part of the Southern Extension Project which has resulted in predicted noise impacts being lower than currently authorised under the existing Invincible Project Approval. No privately owned residences are predicted to exceed the acquisition criteria set under the existing Invincible Project Approval. One property, which currently has acquisition rights under the Invincible Project Approval, is predicted to qualify for voluntary mitigation rights under the application of the NSW Voluntary Land Acquisition and Mitigation Policy.
Traffic	The Southern Extension Project will result in similar traffic movements to and from Invincible as the currently approved operations and will not increase operational coal haulage or employee traffic above levels currently authorised under the Invincible Project Approval. A detailed Traffic Impact Assessment has been undertaken for the Southern Extension Project to assess the impact of the Southern Extension Project on traffic flows which takes

Environmental / Social Issue	Overview of Potential Impacts
	into account traffic growth since the previous assessment of impacts associated with maximum production rates. The Southern Extension Project is not predicted to have a significant impact on traffic in terms of performance (including at key intersections), infrastructure or road safety.
Visual	Views of mining in the Southern Extension Area will be possible from a number of vantage points along the Castlereagh Highway and elevated areas to the east of Invincible in Ben Bullen State Forest. The locations within Ben Bullen State Forest where mining in the Southern Extension Area would be visible are not readily accessible. The existing Invincible operations are currently visible from these locations and views of mining in the Southern Extension Area will be similar to those of the existing operations. Vegetation and topography will screen views of the Southern Extension Area from most locations to the west of the Castlereagh Highway and there is unlikely to be any views of the Southern Extension Area from any residences. The Southern Extension Project includes the progressive rehabilitation of both the existing Invincible open cut mining area and the Southern Extension Area. This rehabilitation will reduce the visual impacts associated with mining at Invincible.
Rehabilitation	Castlereagh Coal will adopt a progressive approach to rehabilitation to ensure that completed areas are shaped and vegetated to provide a stable landform. The created landforms will blend with the surrounding landscape. No voids will remain in the rehabilitated final landform. Rehabilitation will return the majority of Invincible site to native woodland and forest generally consistent with ecological communities that would have historically occurred in the area.
Social and Economic	Detailed assessments of social and economic impacts have been undertaken for the Southern Extension Project. The additional employment generated by the Southern Extension Project will have both social and economic benefits in the local area which is currently experiencing the effects of closures (temporary and permanent) of a number of large employers in the region. This was seen as a key issue for the local community as part of extensive community consultation completed as part of the Southern Extension Project. The Southern Extension Project will have benefits to Manildra's Shoalhaven Starches Plant though improved reliability of energy supply and lower energy costs. These benefits are significant as they assist this large regional employer in maintaining international competiveness. The Southern Extension Project estimated to have economic benefits for the State of NSW of $79.7 million in net present value terms.

The impacts of the Southern Extension Project have been kept to a minimum through:

- appropriate design and siting of the Southern Extension Project to avoid and minimise potential environmental and community impacts including locating at distance from surrounding private residences and Cullen Bullen, and the incorporation of appropriate setbacks and design controls to minimise impacts on landscape features to the east and north of the Southern Extension Area (refer to **Section 3.0**)

- obtaining a detailed understanding of the issues and impacts by extensive scientific evaluation and stakeholder engagement

- a comprehensive assessment of project alternatives based on consideration of resource recovery efficiency and detailed analysis of potential environmental and community impacts (refer to **Section 3.7**)

- active engagement with stakeholders, including the neighbouring community and environmental and recreational groups, to identify key concerns and issues early in the project design and environmental assessment process. Importantly, the mine has been designed to minimise potential amenity impacts (particularly noise, air quality and visual impacts) and biodiversity impacts as these are recognised as key stakeholder concerns

- commitment to proactive and appropriate strategies to avoid, minimise, mitigate, offset or manage a range of potential environmental impacts (refer to **Section 6.0**).

8.2 Suitability of the site

Invincible is located in an area historically characterised by coal mining and includes a number of existing open cut and underground mining operations. The Southern Extension Project is an extension of the existing open cut mining area at Invincible, into an area that that has previously been mined through underground mining methods. As detailed in **Sections 3.6** and **3.7**, location and design of the Southern Extension Project to the south of the existing Invincible operations seeks to avoid and minimise potential environmental impacts, particularly associated with avoidance of impacts on biodiversity (relative to areas to the north and east of Invincible) and minimising amenity impacts on the community.

The existing land uses of the Southern Extension Area and surrounds are described in **Section 6.2**. A detailed analysis of potential off-site impacts is provided in **Section 6.0** and an overview of environmental impacts is provided in **Table 8.1**. Extensive management, mitigation and offset measures have been incorporated into the Southern Extension Project to minimise impacts.

The area to the east of Invincible contains pagoda landform features which are a prominent component of the landscape. These landforms are recognised for their scenic and high biodiversity value; the latter of which is predominantly associated with the variety of vegetation communities and habitat located within a relatively small area as a result of incised gullies between the exposed pagoda rock outcrops. The pagodas to the east of the Southern Extension Area are less prominent in the landform than pagodas further to the north. The Southern Extension Project will not result in any surface disturbance in areas between pagoda formations. Furthermore, appropriate setbacks from pagoda formations have been incorporated into the Southern Extension Project taking into account potential biodiversity and indirect (blasting) impacts to these structures.

The Southern Extension Area is located within the area proposed as part of the Gardens of Stone Stage 2 proposal previously put forward by environmental groups. The areas of Invincible open cut and mine infrastructure area located within Ben Bullen State Forest are also located within the area proposed as a State Conservation Area under the Gardens of Stone Stage 2 Proposal. While it is understood there is no formal NSW Government proposal to convert Ben Bullen State Forest to a State Conservation Area, it is noted that, mining is still permitted in State Conservation Areas in accordance with the provisions of the Mining SEPP and NPW Act. The Southern Extension Area is located on the western edge of the area proposed for conservation and does not contain the landscape features which are the primary focus of the conservation proposal. The Southern Extension Area is significantly impacted by subsidence from past mining and is divided by a power line easement. This area is not considered to have the level of

conservation value similar to the areas of Ben Bullen State Forest located to the east and north of the Southern Extension Area.

As described in **Section 6.19**, the approach to site rehabilitation, including the removal of voids and extensive revegetation, will create a final landform that is consistent with existing (and former) areas of Invincible and the Southern Extension Area and the surrounding Ben Bullen State Forest.

As discussed in **Appendix 13** the use of this land for coal mining purposes provides by far the highest economic returns from the land relative to any other identified permissible uses of the land.

8.3 Ecologically sustainable development

Ecologically Sustainable Development (ESD) is one of a number of objectives of the EP&A Act and is defined by Section 6(2) of the Protection of the Environment Administration Act 1991. This section provides an assessment of the Southern Extension Project in relation to the principles of ESD.

To justify the Southern Extension Project with regard to the principles of ESD, the benefits of the Southern Extension Project in an environmental and socio-economic context should outweigh any negative impacts. The principles of ESD encompass the following:

- the precautionary principle
- inter-generational equity
- conservation of biological diversity
- valuation and pricing of resources.

Essentially, ESD requires that current and future generations should live in an environment that is of the same or improved quality than the one that is inherited.

These principles application to the Southern Extension Project are discussed further in **Sections 8.3.1** to **8.3.4**.

8.3.1 The precautionary principle

The EP&A Regulation defines the precautionary principle as:

> *'if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*
>
> *(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
> *(ii) an assessment of the risk-weighted consequences of various options.*

Environmental assessment involves the prediction of potential environmental outcomes of a development. The precautionary principle reinforces the need to take risk and uncertainty into account, especially in relation to threats of irreversible environmental damage. In order to achieve a level of scientific certainty in relation to potential impacts associated with the Southern Extension Project, this EA includes an extensive evaluation of all the key components of the Southern Extension Project. Detailed assessment of all key

issues and necessary management procedures has been conducted and is comprehensively documented in this EA.

A preliminary environmental risk analysis was undertaken for the Southern Extension Project to identify key areas for further impact assessment. The results of the risk assessment are summarised in **Section 6.1**. The review of appropriate mitigation measures and strategies was also undertaken as a part of the detailed impact assessment process. The Precautionary Principle has therefore been applied to the assessment of the Southern Extension Project by seeking to minimise the potential for serious irreversible environmental damage through:

- careful design and review of the Southern Extension Project design
- identification of the potential impacts and the likelihood and consequences of these impacts
- identification of management and mitigation measures that are designed to address the potential environmental impacts of the Southern Extension Project
- implementation of monitoring and reporting mechanisms for the Southern Extension Project.

Where uncertainty in the data used in the assessment has been identified, a conservative worst-case analysis has been undertaken and contingency measures have been identified to manage that uncertainty. A validation program has also been proposed to measure predicted against actual impacts of the Southern Extension Project (refer to **Section 6.0**), so that contingency measures, if required, can be implemented in a timely and pro-active manner.

Detailed mitigation and monitoring measures will be set out in the management plans which will be implemented as part of the Southern Extension Project (refer to **Sections 6.0** and **7.0**).

8.3.2 Intergenerational equity

The EP&A Regulation defines the principal of intergenerational equity as:

> *'that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.'*

Intergenerational equity is based on the principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. The principles of intergenerational equity are addressed by the Southern Extension Project through:

- the efficient recovery of resources by maximising resource utilisation and use of existing infrastructure, thus minimising environmental impacts
- the development and implementation of management and mitigation measures that are designed to address the potential environmental impacts of the Southern Extension Project.

The Southern Extension Project will remove legacy issues associated with past mining activities and establish a final landform that is rehabilitated and returned to vegetation communities consistent with those that occurred prior to mining disturbance. In this regard the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations while the economic and employment benefits of the Southern Extension Project are enjoyed by the current generations.

8.3.3 Conservation of biological diversity

The EP&A Regulation identifies that the principal of conservation of biological diversity and ecological integrity should be a fundamental consideration in the decision making process. The conservation of biological diversity refers to the maintenance of species richness, ecosystem diversity and health and the links and processes between them. All environmental components, ecosystems and habitat values potentially affected by the Southern Extension Project are described in this EA (refer in particular to **Section 6.4** and **Appendix 6**). Potential impacts are also outlined in the EA (refer to **Section 6.4**) and measures to ameliorate any negative impact are outlined in **Section 6.4** and **7.3**.

The NSW Framework for Biodiversity Assessment Policy (FBA) has been designed to ensure that development in NSW is undertaken in a manner that conserves biodiversity. The FBA encourages impacts on biodiversity to be avoided but, where impacts are unavoidable, establishes a process for offsetting residual impacts. The Biodiversity Assessment Report prepared for the Southern Extension Project (refer to **Appendix 6**) identifies the offsetting requirements for the Southern Extension Project which will be implemented should the project be approved.

8.3.4 Valuation and pricing of resources

The goal of improved valuation of natural capital has been included in Agenda 21 of Australia's Intergovernmental Agreement on the Environment. The principle has been defined in the EP&A Regulation as:

> *'that environmental factors should be included in the valuation of assets and services, such as:*
> - *(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
> - *(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
> - *(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems'*

The efficient and non-wasteful management of resources to maximise the welfare of society, both now and for future generations is central to ESD.

The FBA and associated biobanking process is designed to improve the valuation of biodiversity values. The FBA establishes a regulatory framework which objectively establishes the biodiversity values that will be impacted by a project and a system for offsetting those impacts. The FBA inherently values impacts on higher value biodiversity resources by both taking into account the values of the land being impacted and identifying offset requirements that will be more difficult to locate for rarer or more threatened communities. In doing so, the FBA process encourages proponents to minimise impacts on higher value biodiversity values by imposing greater restrictions (and potential costs) on larger or more significant impacts.

Impacts on the extraction of water resources (surface water and groundwater) are similarly priced through the licensing regime under the *Water Management Act 2000*.

Ultimately, the pricing and valuation of resources is largely achieved through regulatory processes applying to the approval and ongoing operation of the development, however, operational efficiencies are also associated with improved environmental outcomes (e.g. efficient haul routes reduce total noise and dust emissions as well as reduce diesel use (with associated particulate and greenhouse gas and emission reductions) and tyre and equipment wear).

The Southern Extension Project also optimises the valuation and pricing of the coal resources with minimal impact by:

- optimising available use of the existing coal processing and transportation infrastructure (coal loading and unloading infrastructure and road upgrades specifically developed around the movement of coal between Invincible and Mt Piper power station) to wash coal and to transport product coal to existing markets

- maximises the efficient use and extraction of resources through maximising resource utilisation and the recovery of coal that is not otherwise planned for extraction.

8.4 Conclusion

As outlined in **Section 8.3**, the Southern Extension Project has been assessed against the principles of ecologically sustainable development as required by the EP&A Act. This assessment has indicated that the Southern Extension Project is consistent with the principles of ecologically sustainable development.

The Social Impact and Opportunities Assessment (refer to **Appendix 11**) and the Economic Assessment (refer to **Appendix 13**) describe a range of positive benefits from the Southern Extension Project that will result at a local, regional and State level. These benefits include:

- employment of up to approximately 35 full time equivalent employees as part of the Southern Extension Project

- an estimated increased population in the local area of 16 people (dependent on location of employees)

- net benefit to NSW of $79.7 million (in Net Present Value Terms (NPV) using a 7% discount rate) consisting of $55.0 million of direct benefits to the State and $26.8 indirect benefits with indirect costs of $2.2 million and

- net benefit of $8.8 million to the Lithgow-Mudgee local area in NPV terms, consisting mainly as economic benefits of $4.85 million to employees and $4.15 million to suppliers located in the local area with indirect costs of $0.25 million.

The revenue, expenditure and employment associated with the operation of the Southern Extension Project will stimulate economic activity in the regional economy, as well as for the broader NSW economy. The Southern Extension Project will also have economic benefits for Manildra's Shoalhaven Starches Plant through improved reliability of energy supply and lower energy costs. These benefits are significant as they assist this large regional employer in remaining competitive in domestic and international markets and continuing the economic benefits that operation provides to NSW and the South Coast regional economy.

On this basis, it would be reasonable to consider that with the implementation of the management, mitigation and offset measures proposed by Castlereagh Coal, the Southern Extension Project will result in a substantial net benefit to the local, regional and NSW community.

SECTION 9.0

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SECTION 10.0

Abbreviations and Glossary

10.0 Abbreviations and Glossary

10.1 Abbreviations

AEMR	Annual Environmental Management Report
AGO	Australian Greenhouse Office
AHIMS	Aboriginal Heritage Information Management System
AHD	Australian Height Datum
AHIP	Aboriginal Heritage Impact Permit
BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BBCC	BioBanking Credit Calculator
BCM	Bank cubic Metres
BSAL	Biophysical Strategic Agricultural Land
BVT	Biometric Vegetation Type
CCC	Community Consultative Committee
CCL	Consolidated Coal Lease
CEEC	Critically Endangered Ecological Community
CHPP	Coal Handling and Preparation Plant
CIC	Critical Industry Clusters
CPP	Coal Preparation Plant
DA	Development Application
DEC	Former Department of Environment and Conservation (now OEH)
DECCW	former Department of Climate Change and Water (now, OEH)
DP&E	NSW Department of Planning and the Environment
DPI	Department of Primary Industries
DRE	Division of Resources and Energy (a division of DTIRIS)

EA	Environmental Assessment
EEC	Endangered Ecological Community
EPA	Environment Protection Authority of NSW
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
EPL	Environment Protection Licence
EMS	Environmental Management System
ESD	Ecologically Sustainable Development
FBA	Framework for Biodiversity Assessment
FTE	Full-time equivalent
GHG	Greenhouse gas
GHG Protocol	Greenhouse Gas Protocol 2004
GL	Gigalitre
ha	Hectares
HVAS	High Volume Air Sampler
IPCC	Intergovernmental Panel on Climate Change
ISWMS	Integrated Site Water Management System
kV	Kilovolt (1000 volts)
kt	Kilotonnes
ktpa	Kilotonnes per annum
LEP	Local Environmental Plan
LGA	Local Government Area
m	metres
m/s	metres per second

MGA	Map Grid of Australia
MIA	Mine Infrastructure Area
ML	Megalitres
ML	Mining Lease
MLA	Mining Lease Application
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
MSB	Mine Subsidence Board
Mt	Million tonnes
Mtpa	million tonnes per annum
NEPM	National Environment Protection Measures
NPW Act	National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service
NT Act	Native Title Act 1993
OEH	Office of Environment and Heritage
PA	Project Approval
PAC	Planning Assessment Commission
PM	Particulate Matter
PM10	Particulate matter less than 10 micro metres in diameter
PM2.5	Particulate matter less than 2.5 micro metres in diameter
POEO Act	Protection of the Environment Operations Act 1997
RFS	Rural Fire Service
RMS	Roads and Maritime Services
ROM	Run-of-mine
SAT	Spot Assessment Technique
SEARS	Secretary's Environmental Assessment Requirements

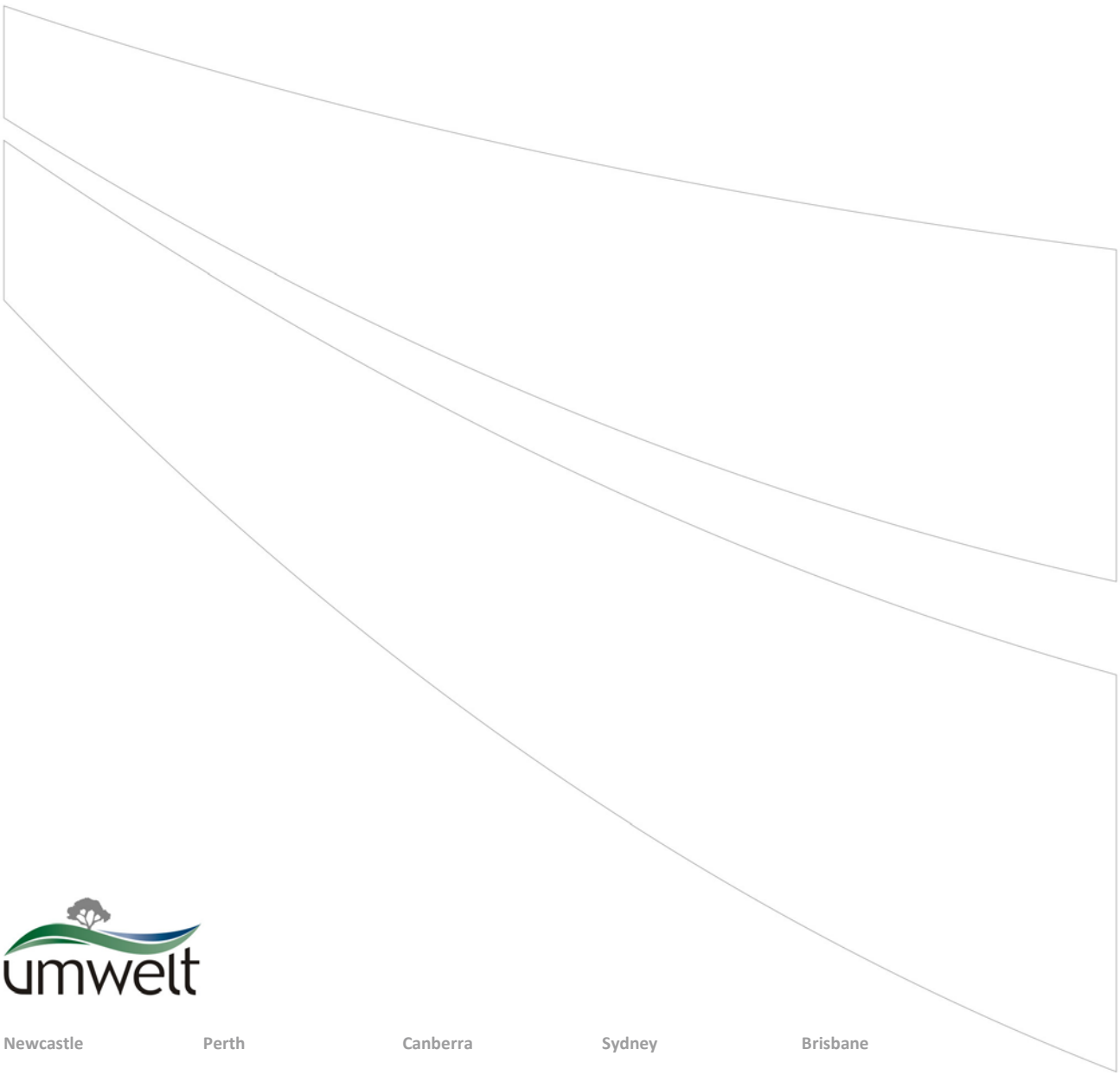
SEPP	State Environmental Planning Policy
SRD	State and Regional Development
SRLUP	Strategic Regional Land Use Plan
SWMS	Site Water Management System
TDS	Total Dissolved Solids
tpa	Tonnes per annum
TSC Act	Threatened Species Conservation Act 1997
TSP	Total suspended particulate matter, usually in the size range of zero to 50 micrometres
TSS	Total Suspended Solids
Umwelt	Umwelt (Australia) Pty Limited
WBCSD	World Business Council for Sustainable Development
WM Act	Water Management Act 2000
WMS	Water Management System
WRI	World Resources Institute
WSP	Water Sharing Plan
°C	Degrees Celsius
µg	micrograms
%	per cent

10.2 Glossary

Amenity	An agreeable feature, facility or service which makes for a comfortable and pleasant life.
Aquifer	A water-bearing rock/sediment formation.
Archaeological	Pertaining to the study of culture and description of its remains.
Attenuation	The reduction in magnitude of some variable in a transmission system, for example, the reduction of noise with distance as it travels through air.
Catchment Area	The area from which a river or stream receives its water.
Coal Reserves	Those parts of the Coal Resources for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken.
Coal Resources	All of the potentially useable coal in a defined area, based on geological data at certain points and extrapolations from these points.
Coarse Reject	Lumps of carbonaceous shale up to 200 mm in size separated in the coal preparation process.
Conservation	The management of natural resources in a way that will preserve them for the benefit of both present and future generations.
Down dip	The direction in which rock strata is inclined.
Ecology	The science dealing with the relationships between organisms and their environment.
Ecosystem	Organisms of a community together with its non-living components through which energy and matter flow.
Environmental Planning and Assessment Act 1979	NSW Government Act to provide for the orderly development of land in NSW.
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.
Fauna	All vertebrate animal life of a given time and place.
Floodplain	Large flat area of land adjacent to a stream which has been deposited during previous stream flow events and is inundated during times of high flow.
Flora	All vascular plant life of a given time and place.
Geology	Science relating to the earth, the rocks of which it is composed and the changes it undergoes.
Groundwater	Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table.

Habitat	The environment in which a plant or animal lives; often described in terms of geography and climate.
Indigenous	Native to, or originating in, a particular region or country.
In situ	In its original place.
kL (Kilo litre)	One thousand litres.
kV (Kilo Volt)	One thousand volts.
LA90 Noise Level	The noise level, measured in dB(A), exceeded for 90 per cent of the time, which is approximately the average of the minimum noise levels. The L90 level is often referred to as the 'background' noise level and is commonly used to determine noise criteria for assessment purposes.
LAeq Noise Level	The equivalent continuous noise level, measured in dB(A), during a measurement period.
Land Capability	The ability of a parcel of land to be used in a sustainable manner (that is without permanent damage) for a given land use.
Landform	Sections of the earth's surface which have a definable appearance (e.g. cliff, valley, mountain range, plain, etc).
Mean	The average value of a particular set of numbers.
Megalitre (ML)	One million litres.
Meteorology	Science dealing with atmospheric phenomena and weather.
Mitigate	To lessen in force, intensity or harshness. To moderate in severity.
Native	Belonging to the natural flora or fauna in a region.
Outcrop	Bedrock exposed at the ground surface.
Overburden Emplacement	An area for placing overburden or waste rock, removed from above and between the coal seams.
Particulates	Fine solid particles which remain individually dispersed in gases.
pH	Scale used to express acidity and alkalinity. Values range from 0-14 with seven representing neutrality. Numbers from seven to zero represent increasing acidity whilst seven to fourteen represent increasing alkalinity.

Protection of the Environment Operations Act 1997	NSW legislation administered by the EPA that regulates discharges to land, air and water.
Radial Analysis	Radial analyses are developed using 3D topographic information and electronic data files relating to the proposed Project to identify what can theoretically be seen from particular vantage points. The radial analysis illustrates what is visible from a height of 1.7 metres at that location (i.e. from average eye height).
Rehabilitation	The process of restoring to a condition of usefulness. In regard to mining, relates to restoration of land from a degraded or mined condition to a stable and vegetated landform.
Revegetation	The process of re-establishing vegetation cover.
Run-of-mine (ROM)	Bulk material extracted from a mine, before it is processed in any way.
Salinity	A measure of the concentration of dissolved solids in water.
Seam	An identifiable discrete coal unit.
Sedimentation	Deposition or settling of materials by means of water, ice or wind action.
Sediment Dam	A dam built to retard dirty runoff to allow sediment to settle out before allowing clean water discharge.
Site Specific	Relating to conditions existing at a particular location.
Socio-economic	Combination of social and economic factors.
Spontaneous Combustion	Spontaneous ignition of some or all of a combustible material.
Subsidence	The vertical movement of a point on the surface of the ground as it settles above a coal panel extracted by underground mining.
Surface Infrastructure	Any manmade object, facility or structure on the surface of the land.
Tailings	Fine residual waste material separated in the coal preparation process.
Thermal Coal	Includes medium to high ash, low sulphur coals used for domestic power generation and medium to low ash energy coals which are exported.
Topography	Description of all the physical features of an area of land and their relative positions, either in words or by way of a map.
Total Dissolved Solids (TDS)	A measure of salinity expressed in milligrams per litre (mg/L).
Total Suspended Particulates (TSP)	A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre (µg/m3) for air.
Woodland	Land covered by trees that do not form a closed canopy.



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