- realignment of the eastern end of Dapper Road, after about Year 8, which will involve reconstruction to a similar standard of road and will maintain the connection with Spring Ridge Road; and

- realignment of a section of Brooklyn Road to keep Suzanne Road connected to Corishs Lane. This will provide a new alignment for Brooklyn Road along the northern side of the rail spur and a road underpass of the rail spur to provide access to the south.

The above closures and realignments are shown in Figure 3.14.

Southern site access (for light vehicle traffic only) will be maintained via the existing Spring Ridge and Laheys Creek Roads. The existing Brooklyn Road (west) connection to Spring Ridge Road will remain via Laheys Creek Road (north), which will incorporate a road underpass for Laheys Creek Road (north) under the rail spur about 2 km east of Spring Ridge Road.

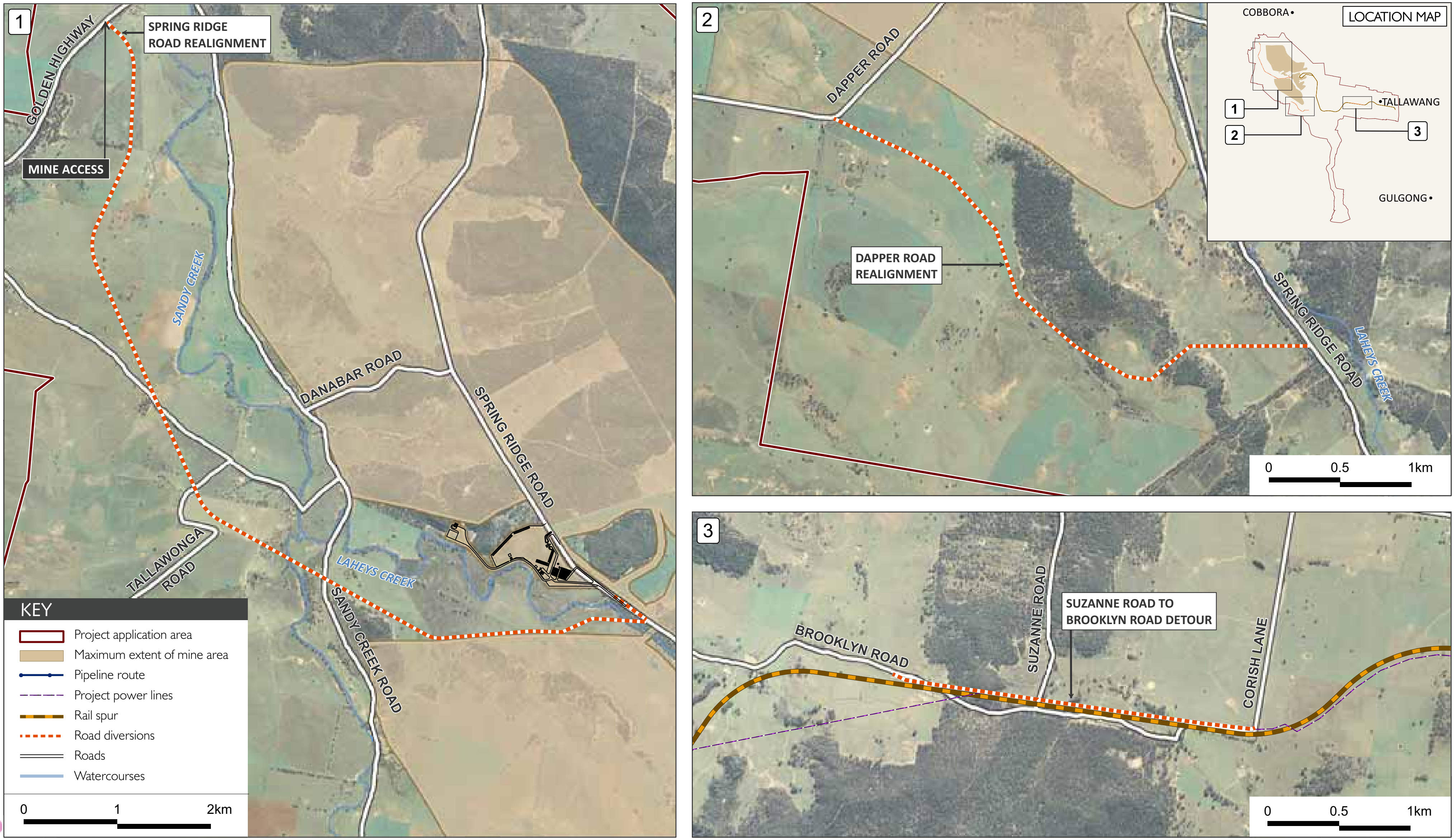
As well as the road realignments, any necessary road widening or additional road traffic management works will be undertaken.

3.12 Buildings and structures

The following buildings and structures will be built, generally within the main infrastructure area, as part of the Project:

- workshop, including areas for equipment maintenance repair, tyre change and storage;
- bathhouse, first aid room and administration area;
- hardstand area with buried lines for compressed air, hydraulic oils, water and electricity for mine machinery parking bays;
- bulk storage building and external storage (lay-down) area;
- fuel station with diesel pumps, petrol pumps and fuel/lubricant storage;
- main office building;
- operations building and change-house;
- parking;
- helipad;
- bulk ammonium nitrate storage;
- explosives magazine;
- washdown bays for heavy and light vehicles; and
- radio and communication facilities.

An indicative infrastructure area layout is provided in Figure 3.15. A pump station that the NSW Office of Water (NOW) has approved will be built next to the Cudgegong River at the southern end of the main water supply pipeline; a switching station will connect into existing electricity lines close to the Castlereagh Highway.



Integrated Design Solutions | 030518 Cobbora Coal Project - EA F3-14 Rev B - 19 September 2012

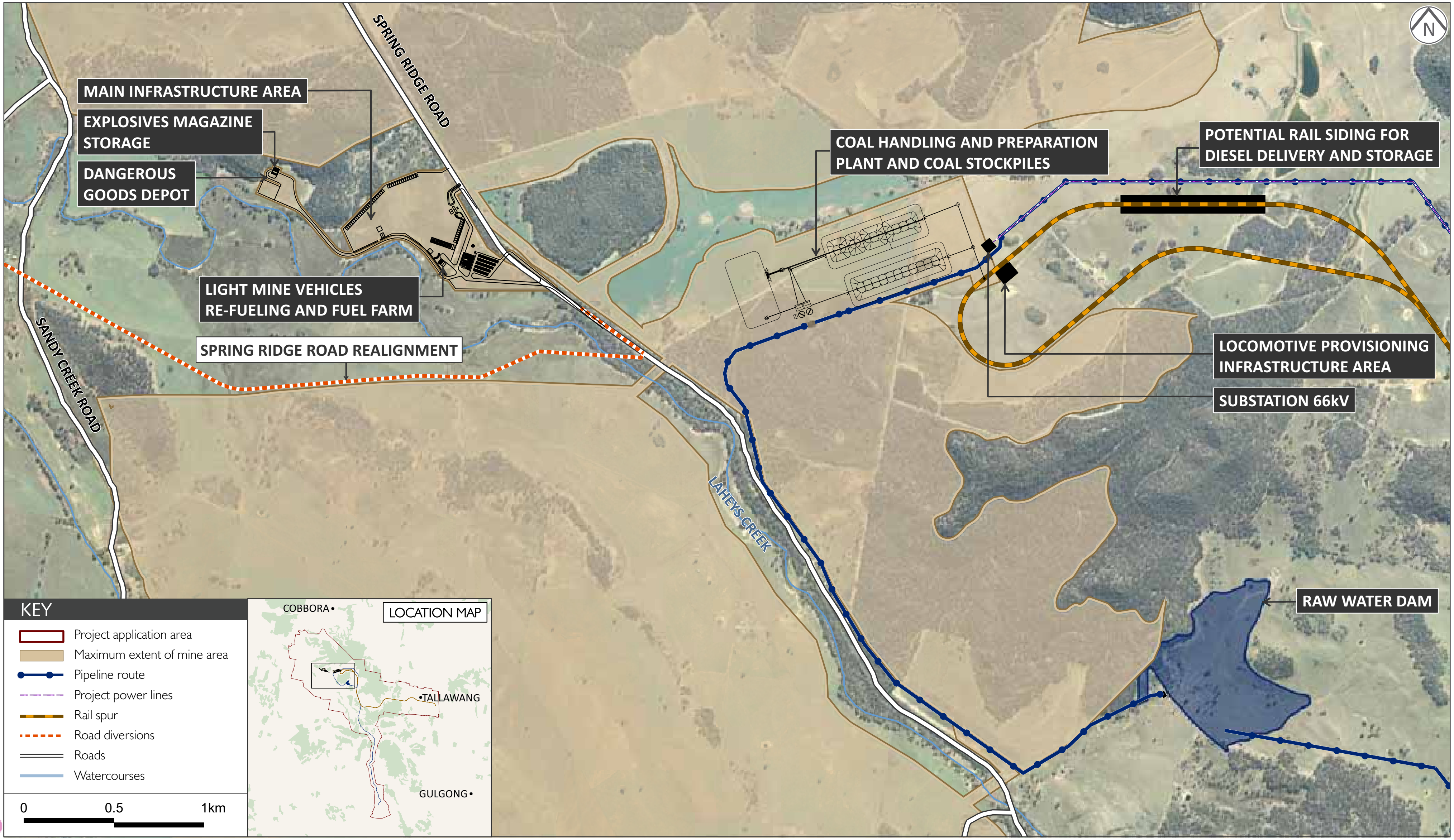
EMM

Cobbora Holding Company Pty Limited

Proposed Road Detours and Realignments

Cobbora Coal Project - Environmental Assessment

Figure 3.14



Integrated Design Solutions | 030518 Cobbora Coal Project - EA F3-15 Rev B - 19 September 2012

EMM

Cobbora Holding Company Pty Limited

Indicative Infrastructure Area Layout

Cobbora Coal Project - Environmental Assessment

Figure 3.15

3.12.1 Workshop

The workshop and warehouse complex will be a steel frame, metal-clad building with a floor area of about 5,500 m^2. The workshop will have separate facilities for mechanical and electrical work, and be serviced by a pair of overhead travelling cranes. An external covered storage bay will be provided with apron slabs and cantilevered awnings at all doorways. A vehicle washdown facility will be provided in a separate structure to the workshop.

3.12.2 Hardstand area

Hardstand areas will be provided next to the workshop to park vehicles requiring maintenance and for vehicles ready for operation.

3.12.3 Bulk storage building and external storage (lay-down) area

Tyre handling and lubrication facilities will be in a structure adjoining the workshop.

3.12.4 Fuel station

Most mobile plant will be powered by diesel. Above-ground storage tanks with a capacity up to 2 ML will be provided in the main infrastructure area and will be bunded (in accordance with AS 1940-2004).

A diesel dispensing facility will be built next to the workshop and connected to the storage tanks via above-ground pipelines. The area will have a roof and will drain to the workshop oil separator system.

3.12.5 Main office building

There will be a single storey office building with an area of about 650 m^2, which will provide working areas for management, technical and administrative staff. The building, which will be of steel or other construction material with coated steel roof sheeting, will have a main reception area, partitioned offices for about 35 staff, meeting rooms, a library, storerooms, and male and female toilets (including toilets for the disabled).

3.12.6 Operations building and change-house

The operations building and change-house will be a multifunction single storey building. One part will have changing rooms for male and female staff. The other part will be a central operations room. The building will be about 2,000 m^2 in area and built of brick or other construction material and coated steel roofing.

3.12.7 Parking

A sealed car park will be provided for mine staff and visitors.

3.12.8 Bulk ammonium nitrate storage

The ammonium nitrate store will be built in accordance with Australian Standard 2187.1, 1998 – Explosives - Storage, Transport and Use, Part 1: Storage (AS2187.1-1998).

3.12.9 Explosives magazine

Explosives used in blasting will be delivered as needed and stored in an explosives magazine. Ancillary devices, such as detonators, fuses and ignition systems, will be stored in accordance with AS 2187.1-1998.

3.12.10 Washdown bays

Washdown facilities will be built for light and heavy vehicles. Wastewater will drain to the oil separator system before being recycled. Silt will also be removed and the water recycled.

3.12.11 Radio and communication facilities

The communications system will be based on the existing infrastructure in the area and will comprise a fibre and wireless IP platform for all mine systems, including:

- voice and video communications;
- production, maintenance and fleet planning and management; and
- enterprise resource planning systems and safety, security and environmental management.

CHC will work with communications carriers (eg NBNCo, Telstra and Optus) to improve coverage in the area. This will also increase coverage for the local community and emergency services.

3.12.12 Chemicals management

Synthetic flocculants and coagulants will be supplied to the coal preparation plant in powder or liquid form. Where liquids are used, the chemicals will be delivered as hydrocarbon emulsions or in aqueous solutions. Appropriate storage and handling facilities and procedures will be established for flocculants, coagulants and chemicals used for pH control. Portable dosing rigs may be used at times to meet short-term intermittent requirements, especially for flocculent and coagulant trials. Safety and environmental procedures for handling and using all chemicals will be applied.

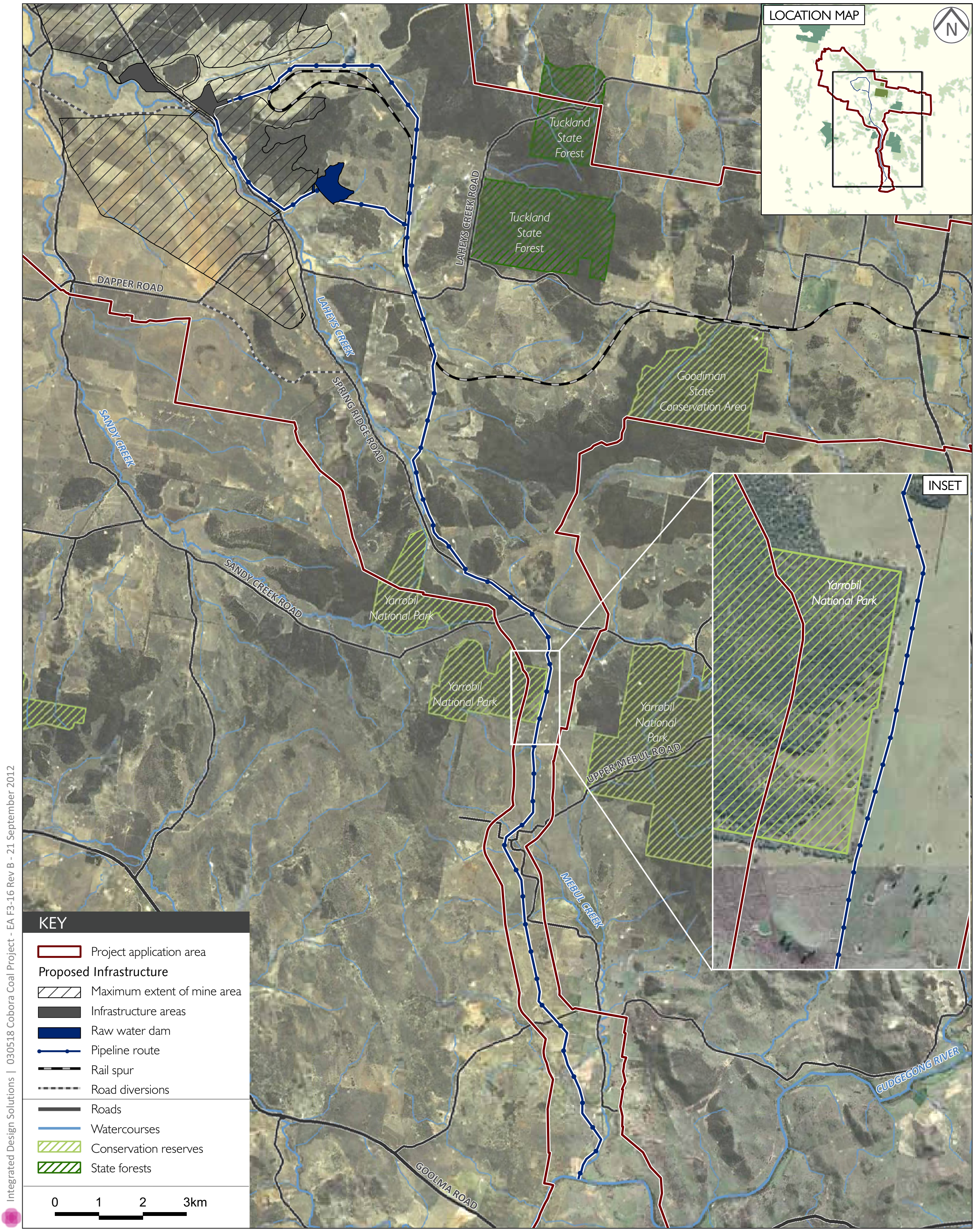
3.13 Water management

3.13.1 Mine water supply

The Project will require water, mainly for the CHPP and to suppress dust. The preferred sources in order will be surface water runoff captured in sedimentation and other permitted dams; groundwater that enters the pits; and, finally, water from the Cudgegong River (Figure 3.16). Pre-existing high security water access licences have been bought for the Project to extract up to 3,310 ML of water from this 'regulated' river.

The pump station's intake system on the Cudgegong River will include self-cleaning suction screens with a maximum mesh size of 1.9 mm and an intake velocity of 0.15 m/s, to reduce aquatic fauna entrainment.

The 300 to 700 mm diameter high-density polyethylene water supply pipeline will be buried about 1 m deep and have a capacity of 24 ML/d. CHC will allow affected landholders along the pipeline route to take water for stock and domestic purposes.



EMM
Cobbora Holding Company Pty Limited

Pipeline Route

Cobbora Coal Project - Environmental Assessment

Figure 3.16

3.13.2 Water storage

Various dams and structures will be built to manage (and separate) clean, overburden, pit, infrastructure and process water.

Sedimentation dam design has been based on a 'settling zone' to capture runoff from the 95th percentile 5-day duration storm event. Pit/infrastructure water dams have been sized based on various criteria, depending on the runoff source. The dams have been designed to maintain an appropriate freeboard with no overflow, based on historic meteorological data. However, a spillway will be provided for any emergency overflow. High wall dams for clean water have been sized to capture runoff from the 100-year average recurrence interval (ARI) 24-hour storm event.

The components of the water management system will be built progressively as required during the mine life. Managing the surface water runoff and water supply of the mine over its 21-year life will require five pit/infrastructure water storage dams, four mine water dams, 38 sedimentation dams, one raw water dam and nine high wall dams.

3.13.3 Dewatering

The pit water system will include small sumps in the pit floor, pit dewatering pumps and associated pipelines, mine water and pit water storage dams, and a return water pump and pipeline system to deliver pit water for use at the CHPP, MIA or water truck filling stations. Groundwater seepage into pits is expected to be:

- Year 1 – 38 ML/yr;
- Year 4 – 886 ML/yr;
- Year 12 – 1,549 ML/yr;
- Year 16 – 1,341 ML/yr; and
- Year 20 – 248 ML/yr.

Generally, the pit dewatering system will maintain dry pits, but in-pit flooding during extended wet periods may occur and it would interupt mining.

3.13.4 Surface water control and disposal

i Clean water

Clean water (ie low salinity/low turbidity runoff from undisturbed areas) will be diverted around the mine site and into nearby creeks or will be collected in a series of catch dams. Laheys Creek or Sandy Creek will not be diverted as part of mine operations. However, some minor temporary works may be required in creeks during construction (eg coffer dams).

ii Overburden water

Overburden water (ie low salinity/elevated turbidity runoff from the out-of-pit emplacements, topsoil stockpiles and other disturbed areas) will be diverted to sedimentation dams to allow the solids to settle. The decant water will be re-used on site. If necessary (eg under prolonged wet weather conditions), water may be displaced from sedimentation dams into the nearby creek system to maintain the capacity of the dams or provide flow in the creeks.

iii Pit/infrastructure water

Pit/infrastructure water (ie potentially elevated salinity/turbidity/trace metals runoff from the open pits, CHPP and MIA, as well as groundwater seepage into the open pits) will be stored on site for mine operations to re-use. Pit/infrastructure water will be used as a priority to meet demands so as to minimise the volume of stored water and the risk of off-site discharge. Imported raw water will only be used to meet mine water demands when there is a pit/infrastructure water deficit or high quality water is required (eg for potable applications). During extended wet periods, surplus pit/infrastructure water will be stored in-pit once the mine water and pit/infrastructure water dams have reached capacity.

iv Process water

Process water (ie water used in the CHPP, including return water from the reject emplacement areas) will be continuously recycled in the system. Nevertheless, make-up water will be required to replace water that is lost from the process.

3.13.5 Groundwater management

Small sumps in the pit floor will collect and contain groundwater seepage and rainwater. Pit dewatering sump pumps and associated dewatering pipelines will transfer pit water to the nearest mine water dam, via a small staging dam if necessary. Although not currently envisaged, CHC will periodically assess the need to install dewatering bores ahead of overburden removal.

3.13.6 Potable water

Potable water will be sourced initially from a local town supply and trucked to site and the construction camp. The preferred long-term option, contingent on electricity supply, is to use a Class A potable water treatment plant to produce potable water from the clean water dam.

3.13.7 Water reticulation

A reticulation system will be installed to transfer water between site dams and to mine facilities while keeping clean, overburden, pit, infrastructure and process water separate as appropriate.

3.13.8 Sewerage system

During operations, a sewage treatment system will manage the effluent from toilets, bathhouses, kitchen sinks and hand wash basins. Treatment may be by aeration, sedimentation and evaporation, with excess water dispersed to land by spray irrigation, or direct soil infiltration.

3.13.9 Flood detention basin

A dry detention basin will be constructed on Flyblowers Creek so that baseline peak flows at the Golden Highway culvert do not exceed baseline conditions. The low dam will be about 400 m long, the basin will cover some 5 ha and hold up to about 70 ML.

3.13.10 Fire fighting system

Buildings will be constructed in accordance with the relevant provisions of the Australian Standard 3959 – 2009 Construction of Buildings in Bushfire Prone Areas (AS 3959–2009) and the *Building Code of Australia* (Australian Building Codes Board 2011). A range of measures also will be in place to reduce the risk of the Project starting a bushfire. For example, water, gas and electricity services will be located and installed in a manner that reduces their potential to contribute to fire hazard. Mine water carts will be fitted with water cannons and used to supplement fire-fighting vehicles if there is a fire.

3.14 Operations waste management

Operations wastes from the Project will include waste rock, coarse rejects, tailings, general waste, hazardous waste and sewage. These will be managed in accordance with the *Waste Avoidance and Resource Recovery Act 2001* and the *Protection of the Environment Operations Act 1997*. Waste will be classified according to the Waste Classification Guidelines (DECCW 2008a).

Waste rock management is described in Section 3.5.5, coarse reject and tailings management in Section 3.5.5 and sewage management in Section 3.13.8.

The standard waste management hierarchy will be applied to all waste: avoidance; reduction; reuse; recycling or reclamation; waste treatment; and disposal. This means priority will be given to avoiding waste generation rather than options to reuse or recycle.

General waste is likely to include workshop, office and domestic waste. This will be segregated and will be regularly removed by a licensed contractor for recycling or disposal at a licensed waste facility in accordance with relevant Environment Protection Authority (EPA) guidelines. Operations waste volumes are estimated in Table 3.7.

Table 3.7 Estimated operations waste

Waste stream	Source	Annual total (t)
Absorbents	Workshop	5
Air filters	Workshop	5
Batteries and chemicals	Workshop	10
Commingled recyclables	Generated by personnel – this includes beverage containers	20
Contaminated rags – hydrocarbons	Workshop	20
Effluent	Bathhouse and office areas	150
Empty drums (contaminated, that are not returned to suppliers)	Workshop	1
General waste (putrescibles waste, plastic packaging)	Workshop and office areas	500

Table 3.7 Estimated operations waste *(Cont'd)*

Waste stream	Source	Annual total (t)
Oil, grease and resin	Workshop	300
Paper and cardboard	Normal operations	20
Tyres	Expended tyres from vehicle fleet	130

Hazardous wastes will include hydrocarbons (eg oils, grease and degreasers), coolants, paints and batteries. Hydrocarbon wastes will generally be generated in the MIA, particularly in the workshop, and in interceptor traps that separate oil and water from pit/infrastructure water. All hazardous wastes will be stored in appropriate containers in bunded areas and will be regularly removed by a licensed contractor for recycling or disposal to a licensed landfill where they cannot be recycled.

There will be no on-site disposal of general or hazardous wastes.

Waste management procedures will be detailed in a waste management plan.

3.15 Electricity supply

The Project will have an average power demand of about 25 MVA. This will be delivered to the mine infrastructure area from the existing power distribution network at Tallawang via a powerline running parallel to the rail spur.

The main site supply (11 kV) will be from a small switching station close to the Castlereagh Highway that will be connected to Essential Energy's existing 66 kV system. A substation in the mine infrastructure area will distribute electricity to substations at areas such as the CHPP and workshop. Discrete transformers and switch rooms will distribute the power to the individual construction and operations infrastructure.

The electricity required for the Cudgegong Pump Station (1 MVA) will be provided from a separate local 22 kV feed. This connection will be a simple transformer and switch room facility.

Existing powerlines made redundant by the Project will be decommissioned.

3.16 Workforce and operating hours

The proposed mine operation workforce will be about 300 people during the first two years of full production in 2016 and 2017. This will increase steadily over the next ten years to reach a peak of about 590 people between 2027 and 2030.

Mine operations will occur up to 24 hours per day, seven days per week and 52 weeks per year.

3.17 Project schedule

Some coal will be extracted towards the end of the construction period and product coal delivery will begin in mid-2015 and continue until 2036. Section 3.18.1 describes the construction schedule.

3.18 Construction

3.18.1 Construction schedule

Construction will take about 2.5 years, across a number of sites, primarily the mine infrastructure area, the rail spur, the water pipeline and the road realignments. Construction will be staged, and will be completed about one year after coal production starts creating a small overlap of construction and operations between mid-2015 to mid-2016. However, due to the relatively slow build-up of the mine operations, which will not reach peak until about 2027, the peak combined mine workforce during this overlap period (543 people) will still be lower than either the peak mine construction (550 people) or the peak mine operations (579 people) workforces. The mine construction workforce will average 350 people. During the peak construction period, in about September and October 2014, a total workforce of about 550 people will be distributed around the four main worksite areas — mine area, mine infrastructure area, rail spur and water supply pipeline.

Mine construction is expected to occur up to 12 hours per day, six days per week. However, construction may occur up to 24 hours per day at times (eg during major concrete pours).

3.18.2 General construction activities

For each Project component, construction activities will include the following activities:

- site preparation – site surveys; pre-clearance environmental surveys; installing sediment and erosion control measures; establishing site security (including fencing); clearing vegetation; stripping and stockpiling topsoil; establishing laydown and bunded storage areas; and installing construction facilities (eg site offices, lunchrooms, material storage and amenities);
- bulk earthworks – cut and fill to provide level surfaces; earth compaction below pavements and structural areas; re-use excavated material for road base or other earthworks;
- structural works – preparing foundations (eg concrete) and erecting buildings and infrastructure;
- commissioning – testing all equipment, supporting infrastructure and control and safety systems; and
- rehabilitation – removing temporary construction facilities and rehabilitating temporary construction areas that are no longer used.

These activities will occur during the construction of each major component. Specific additional activities for each component are described below.

3.18.3 Mine infrastructure area and CHPP

Apart from the typical construction activities described in Section 3.18.2 interim electricity supply will be needed. It is anticipated that during this period power will be supplied by the nearby 11 kV supply and/or on-site diesel generators.

3.18.4 Rail spur

The rail spur will be built using standard techniques which include the general activities described in Section 3.18.2. Additional specific activities will be:

- site preparation – establishing a rail construction yard (less than 4 ha) south of the rail spur alignment and about 50 m west of the Castlereagh Highway; establishing a temporary intersection on the highway to provide access to the rail construction yard; and establishing an access road along the rail spur alignment;
- bulk earthworks – establishing the stable surface on which the track will be built;
- structural works – drainage and bank stabilisation works; preparing the structural layer; adding the capping and ballast layers; laying rail and sleepers; and installing rail infrastructure (including points and signalling); and
- commissioning – de-stressing and adjusting the newly installed track to the correct level and grade; installing the turnout; stabilizing ballast; rail grinding where required; and resurveying the track.

Rock hammers or blasting may be required to remove hard rock; geotechnical surveys will determine if this is necessary.

The rail spur will pass through a cutting under the Castlereagh Highway (ie a road over rail bridge). Roadwork will be required when constructing the cutting, with temporary roadwork speed restrictions along around 1 km of the highway for about six months. However, the Castlereagh Highway will remain open throughout construction. Temporary diversions on the Castlereagh Highway will be built to allow safe traffic flow at 90 kilometres per hour (km/h) but speed limits at roadworks will be 80 km/h. The final level of the highway over the cutting will similar to its current level.

The rail spur will cross Laheys Creek Road on a bridge with a clearance from the road surface of about 5 m. The rail spur construction will also require realigning a section of Brooklyn Road 2.7 km long. Access along these roads will be maintained during construction although temporary roadwork speed restrictions will apply.

3.18.5 Roads and intersections

The road realignments, upgrades and intersections will be constructed using standard techniques. As well as the general activities described in Section 3.18.2, construction and commissioning will include:

- site preparation – installing roadworks safety measures; and
- structural works – road surfacing.

The surface of the road realignments (ie sealed or unsealed) will, as a minimum, match the surface of the road section that they are replacing.

Procedures for dedicating and closing public roads will involve the relevant councils, RMS and Crown Lands. The timing of changes to the road network will be influenced by the staged development of the Project, the councils' requirements and the RMS.

The northern section of Spring Ridge Road will remain open to the public during most of construction period. Some sections will be upgraded to cater for the increased construction traffic (see Chapter 12 'Road transport'). The Spring Ridge Road diversion (see Figure 3.14) will be completed and opened for public use before the northern section of Spring Ridge Road is closed.

It is anticipated that Dapper Road will have to be realigned after Year 8 to allow the southern section of mining area B to develop. The diversion will be completed and opened before the current alignment of Dapper Road is closed.

3.18.6 Water pipeline

The water pipeline will be built in a corridor 100 m wide, with the final alignment determined as part of detailed design. Construction will require disturbing a corridor or 'construction spread' about 5 m wide, which will be rehabilitated afterwards. A spread is the vehicles, plant, equipment and personnel required to sequentially excavate a trench and bury the pipeline. As well as the general activities described in Section 3.18.2, construction and commissioning will include:

- site preparation – surveying and marking the centreline of the pipeline and easement boundaries;
- bulk earthworks – removing trench spoil using trenching methods that will depend on geotechnical conditions found along the alignment;
- structural works – laying pipe lengths end-to-end along the construction alignment; welding the pipe sections; progressively laying the pipe in the trench if it is welded outside of the trench; adding padding material (sand or sifted subsoil) under and over the pipe; and backfilling the trench with stockpiled spoil, including burying marker tape in the trench; and
- commissioning – confirming pipeline integrity (before burial) by pressure testing; repairing any failed welds or damaged pipe and re-testing; installing pipeline marker posts over the pipeline centreline; and registering the location of the pipeline with Dial Before You Dig.

The pipeline will require temporary (less than six weeks) roadworks on Spring Ridge Road, Mebul Road and Woodburn Road so as to place it in a trench beneath the road and reinstate the road surface.

3.18.7 Construction accommodation village

The temporary construction accommodation village will house the construction workforce for the construction period. The village will provide up to 400 beds (singles quarters). Forty staff (preferably sourced from the local area and not staying in the camp) will work in the village each day. These are likely to include:

- a site manager (1);
- kitchen staff (25 – morning and evening meals);
- grounds maintenance (5);
- cleaners (6); and
- security staff (3).

Amenities will include a laundry, toilet block, office and recreation building, plus internal road and footpath infrastructure, car and bus parking (230 car spaces, bus bay and bus shelters), landscaping and general infrastructure works for water, sewage, electricity and telecommunications. About four potable water tankers per day will supply water, with grey water used for irrigation where possible. For the lifetime of the construction camp, waste water will be pumped from storage tanks by a licensed contractor and disposed of in an existing town sewage treatment facility. All solid waste will be removed from site for disposal at a licensed facility at a rate of about one garbage truck per week, with waste sorted for recycling. Generators will provide electricity initially, reticulated power will be connected when it becomes available. Vehicle movements to and from the camp will reflect the 12-hour (6.00 am to 6.00 pm), seven days per week construction schedule. There will be a rolling change of personnel during the week, with a maximum personnel change of 75% in a given day. Buses will transport workers to and from Dubbo. There will be about 10 delivery trucks per day over the seven-day week as required. Buses or light vehicles will transport workers to the construction sites in the PAA.

3.18.8 Construction waste management

Construction waste will include timber and packaging, domestic waste, scrap steel, green waste, asphalt and concrete. All construction waste will be managed in accordance with the waste hierarchy. Facilities will be provided for the segregation of wastes.

Solid construction waste will be re-used or recycled where possible. Licensed contractors will collect, transport and dispose of other wastes at an appropriate off-site facility in accordance with relevant EPA guidelines.

Existing rural structures and fencing that are no longer required will be removed in advance of infrastructure construction. All materials from demolition will be screened to identify any materials that require disposal through licensed facilities.

Estimated construction waste volumes are given in Table 3.8.

Table 3.8 Estimated operational waste streams from the project

Waste stream	Source	Annual total (t)
Scrap metal	Workshop and general excess materials during construction (eg electrical wire)	300
	Demolition of existing on-site dwellings and structures	40
Timber	Construction wastes (eg off-cuts, concrete formwork and timber fencing)	300
	Demolition of existing on-site dwellings and structures	100
Recyclables	Generated by personnel (eg drink cans and paper)	20
Effluent	Accommodation village	70
General waste	Accommodation village (eg putrescible waste and plastic packaging)	300

3.19 Rehabilitation

3.19.1 Overall rehabilitation objective

The overall long-term mine rehabilitation objective is to leave a landform that is safe, low maintenance, geotechnically stable, and blends in with the surrounding topography. This will be achieved through progressive rehabilitation during operations and planned closure towards the end of the mine life.

3.19.2 Progressive rehabilitation objectives

The following will be undertaken to maximise short-term progressive rehabilitation:

- clearing and vegetation disturbance will be kept to the smallest area required for operations;
- operations, including waste rock emplacement, shaping and revegetation, will be scheduled to allow rapid rehabilitation of disturbed areas no longer required for operations;
- topdressing material (topsoil/subsoil) will be applied to the rehabilitated landform based on soil availability and the post-mining Rural Land Capability classification to be achieved (see Section 9.5.4);
- all earthworks, drainage lines and disturbed areas will be stabilised to minimise erosion and sedimentation; and
- vermin, feral animals and noxious weeds will be controlled.

The progressive rehabilitation schedule is described below and details of soils and progressive rehabilitation are provided in Section 9.4. Long-term rehabilitation objectives are described in Section 3.20.3. The detailed rehabilitation strategy is provided in Appendix F.

3.19.3 Progressive rehabilitation schedule

The progressive formation of the post-mining landform and the establishment of a vegetative cover will reduce the amount of disturbed land at any one time and reduce the visibility of mine-related activities from surrounding properties and roads. Early re-profiling and revegetation of the external embankments and slopes of the emplacements will be a priority. Disturbed mining areas will generally be reshaped within one year of the final waste rock placement and will be rehabilitated so they are stable and suitable for the proposed final land use (see Section 3.20.4). The progressive rehabilitation schedule for the mining areas based on the proposed final land use is summarised in Table 3.9.

Table 3.9 Progressive rehabilitation – mining area

Rehabilitation	Land use	Land capability	Area	
Year	Type	Class	ha	%
2 to 4	Woodland	IV	240	6
	Woodland	VI	170	5
	Subtotal		*410*	*11*
4 to 8	Woodland	IV and VI	115	3
	Grazing	IV	0	0
	Cropping	III	100	3
	Subtotal		*215*	*6*
8 to 16	Woodland	IV and VI	250	7
	Grazing	IV	300	8
	Cropping	III	380	10
	Subtotal		*930*	*25*
16 to 21 (end of mine life)	Woodland	IV and VI	1,425	38
	Grazing	IV	285	7
	Cropping	III	425	11
	Subtotal		*2,135*	*56*
22 to 29	Cropping	III	95	2
	Subtotal		*2,135*	*56*
	TOTAL		**3,785**	**100**

At closure, 3,785 ha of the disturbed area will be rehabilitated and 165 ha will be left as voids or high walls (see Section 3.20.6).

Figures 3.3 to 3.9 illustrate the progressive rehabilitation of the site for years 2, 4, 8, 12, 16, 20 and closure (Year 21), with the annual rehabilitation sequencing as follows:

- Year 1: no rehabilitation other than for the short-term stabilisation of disturbed areas;
- Years 2 to 4: rehabilitation of about 410 ha of land, which includes all of the eastern operations area and some land in the east of the southern operations area;
- Years 4 to 8: rehabilitation of about 215 ha of land, which includes land in the east of the southern operations area, and south and south-west of the northern operations area;
- Years 8 to 16: rehabilitation of about 930 ha of land, which includes land in the north and east of the southern operations area, and land in the south and south-west of the northern operation area;
- Years 16 to 21: rehabilitation of about 2,135 ha of land, which includes all remaining land in the operations area with the exception of the final tailings emplacement area (TEA3); and
- Years 22 to 29: drying TEA3 and rehabilitation of about 95 ha of land above this tailings emplacement.

3.20 Mine Closure

3.20.1 Mine closure timing

It is proposed to complete mining in Year 21. At this stage, 391 Mt of coal will have been extracted from the total currently measured and indicated resource of 745 Mt. In the years leading up to Year 21, the present decision to cease mining at Year 21 will be reviewed and it is possible that it may change. Key factors in the review process will be: the demand for coal from the Project; operating and development costs compared to the price of coal; and whether continued operations are likely to be approved. Any proposal to extend mining beyond Year 21 would require separate approvals including a new closure plan. This EA is based on closure at Year 21 and prior to this the following activities will be undertaken:

- Years 1 to 14: progressive rehabilitation and conceptual mine closure planning;
- Year 14: review of potential for mining beyond Year 21 and decisions made about the need for a new mine plan and subsequent regulatory approvals;
- Year 15: prepare detailed closure plan assuming planned closure in Year 21 remains in place;
- Year 16 to 20: mine operations conducted to enable closure in Year 21 as detailed in this EA; and
- Year 21: mine closure.

3.20.2 Mine closure planning

As specified in the DGRs, mine closure planning has considered the *Strategic Framework for Mine Closure* (ANZMEC 2000) and the *Mine rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia 2006a). It also considers international good practice as given in *Planning for Integrated Mine Closure: Tool Kit* (ICMM 2008). Based on ANZMEC (2000), rehabilitation and mine closure should:

- be consistent with the environmental assessment which formed the basis of approval;
- be based on mine closure criteria and rehabilitation outcomes developed through stakeholder consultation;
- integrate rehabilitated native vegetation with undisturbed native vegetation to provide for large contiguous areas and wildlife corridors;
- be suitable for an agreed subsequent land use that is, as far as possible, compatible with the surrounding land fabric and land use requirements;
- address limitations on the use of rehabilitated land;
- provide sustainable land uses;
- produce stable and permanent landforms, where soils, hydrology and ecosystems need no greater maintenance than in the surrounding land;
- securely and safely contain waste substances that have the potential to affect land use or result in pollution;

- not present a hazard to persons, stock or native fauna;
- address threatened species issues;
- address heritage issues;
- leave a final landform that is clean and free of derelict equipment and structures, except for heritage and other agreed features; and
- not result in unacceptable air and water pollution, or other environmental effects outside the disturbed area.

A conceptual mine rehabilitation strategy based on the above objectives has been prepared and the main stages are described below. The strategy will be refined and further developed over the life of the mine as the date of closure approaches.

a. Rehabilitation strategy

Preparing the Mine Rehabilitation Strategy is the first step in closure planning. It:

- describes the existing environment;
- outlines short and long-term rehabilitation objectives;
- describes the post-mining landform and conceptual final landform design;
- provides the post-mining landform's Rural Land Capability classification, Agricultural Suitability classification and proposed land use;
- describes revegetation and habitat re-establishment proposals and how the areas concerned will be linked to surrounding areas;
- details actions to manage soil resources for use in the rehabilitation process;
- details the planned progressive revegetation of the site;
- provides the objectives and preliminary success criteria for mine closure;
- details a monitoring program to assess rehabilitation performance;
- outlines the principles of the final void management plan; and
- provides recommendations for regular review of the mine rehabilitation strategy.

The existing environment (as it relates to rehabilitation), management of soil resources, progressive rehabilitation and monitoring is summarised in Chapter 9; short-term rehabilitation objectives are described in Section 3.19.1; the proposed final land form and land use are described in Section 3.20.4; and success criteria are described in Section 3.20.8.

ii Conceptual mine closure planning

The conceptual mine closure plan described in this EA will be refined as mining operations progress. The refinement process will include consultation with stakeholders including the Community Consultative Committee. Final decisions about any fundamental changes to the conceptual plan will be made following the review conducted in Year 15.

iii Detailed mine closure planning

Detailed closure planning will commence in Year 15. It will include detailed assessment of post-mining landform stability and ground and surface water conditions. Prior to finalisation, the plan will be independently reviewed by a suitably qualified expert (or experts) and any necessary modifications will be incorporated. Once completed the final plan will be submitted for regulatory approval.

iv Rehabilitation bond

All mining lease holders are required to lodge a security deposit to ensure that the people of NSW do not incur a financial liability as a result of inadequate rehabilitation of mine sites. The security deposit must cover the state government’s full costs to rehabilitate a site in the event of default by the titleholder. The value of the security deposit is based on the activities needed to meet the success criteria. An initial security deposit will be lodged by CHC and the amount of the deposit will be periodically reviewed as the disturbance and rehabilitated areas change. The value of the security deposit will be adjusted accordingly, being based on the balance between disturbed and rehabilitated land.

The following aspects are considered by DRE when determining whether to release a security deposit at the completion of a project:

- whether the requirements of the rehabilitation and closure plan have been met (the titleholder must demonstrate that rehabilitation has met the required standards and the agreed post-mining land use);
- whether all other legal obligations relating to environment and safety have been met; and
- any responsibility for ongoing management of the site.

3.20.3 Mine closure objectives

Long-term rehabilitation objectives for the Project are to:

- re-establish cropping, pasture and native woodlands and grasslands in the areas disturbed by the Project;
- conserve remnant and degraded native vegetation and/or habitat corridors;
- provide habitat for fauna and corridors for fauna movement in the final landform;
- ensure the quality of runoff from rehabilitated areas is such that it will not cause environmental harm;
- ensure the water quality of residual water bodies is suitable for the nominated use and does not have the potential to cause environmental harm; and

- contribute to a regional biodiversity improvement through the biodiversity offset strategy.

Rehabilitation success will be monitored based on physical, chemical and biological parameters as described in Section 9.6.

3.20.4 Final land use and landform

The following final land uses are currently proposed:

- agriculture:
  - cropping on Rural Land Capability Class III land; and
  - grazing on Rural Land Capability Class IV–VI land;
- conservation:
  - habitat protection and management for threatened species and ecological communities; and
  - provision of wildlife corridors.

The final land uses are shown in Figure 3.17 and are summarised in Table 3.10.

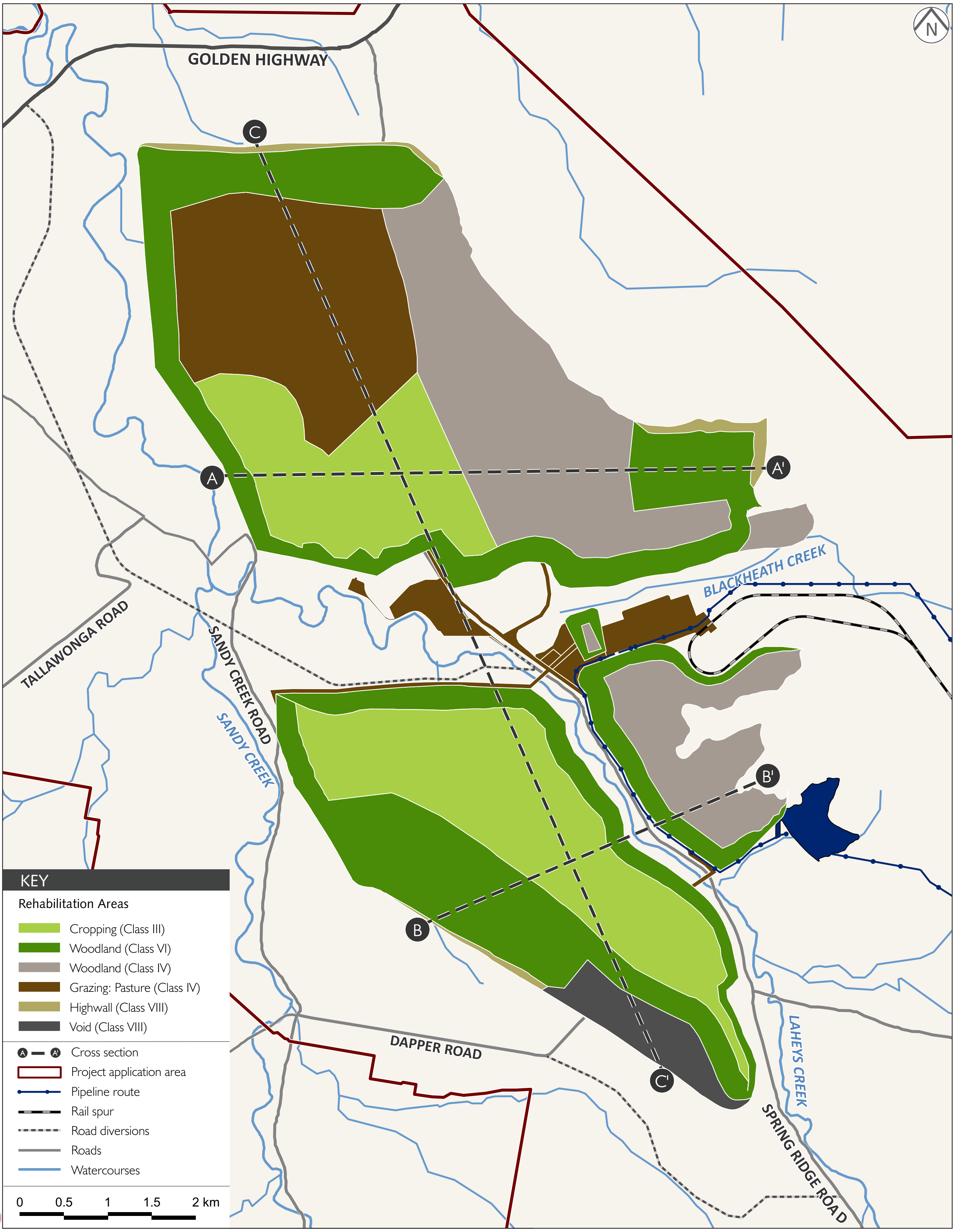
Table 3.10 Final land use

Final land use	Rural land capability class	Landform	Area	
			ha	%
Cropping	III	Flat to gently sloping land	1,000	25
Grazing	IV	Flat to gently sloping land	585	15
Woodland	I, V and VI	Flat to steeply inclined land	2,200	56
Final void and high walls	VIII	Steeply inclined or inundated	165	5
Total			**3,950**	**100**

Source: Appendix F.

The final landform design is based on consideration of the following factors:

- the bio-physical needs of the planned final land uses;
- landform stability;
- erosion minimisation; and
- landform compatibility with the surrounding environment.



Integrated Design Solutions | 030518 Cobbora Coal Project - EA F3-17 Rev B - 12 September 2012

EMM

Cobbora Holding Company Pty Limited

Final Land Use

Cobbora Coal Project - Environmental Assessment

Figure 3.17

During closure the majority of Project infrastructure will be decommissioned (see Section 3.20.5).The main remaining elements will be: rehabilitated waste rock emplacements, high walls, a final void, realigned roads, the raw water dam and potentially other infrastructure that could be used after closure such as the rail spur, water pipeline and electricity infrastructure. The mine pits will be largely backfilled with waste rock and reshaped in accordance with the landform design. Final slopes around the margin of the elevated landform will generally be 10° or less and will not exceed 18°. While the final landform will be similar to the pre-mining landform, it will not attempt to replicate it (Figure 3.18). Nearly all of the land affected by mining and infrastructure, except for the rail spur, high walls and voids, will be able to support agricultural and conservation similar to those existing pre-mining land uses.

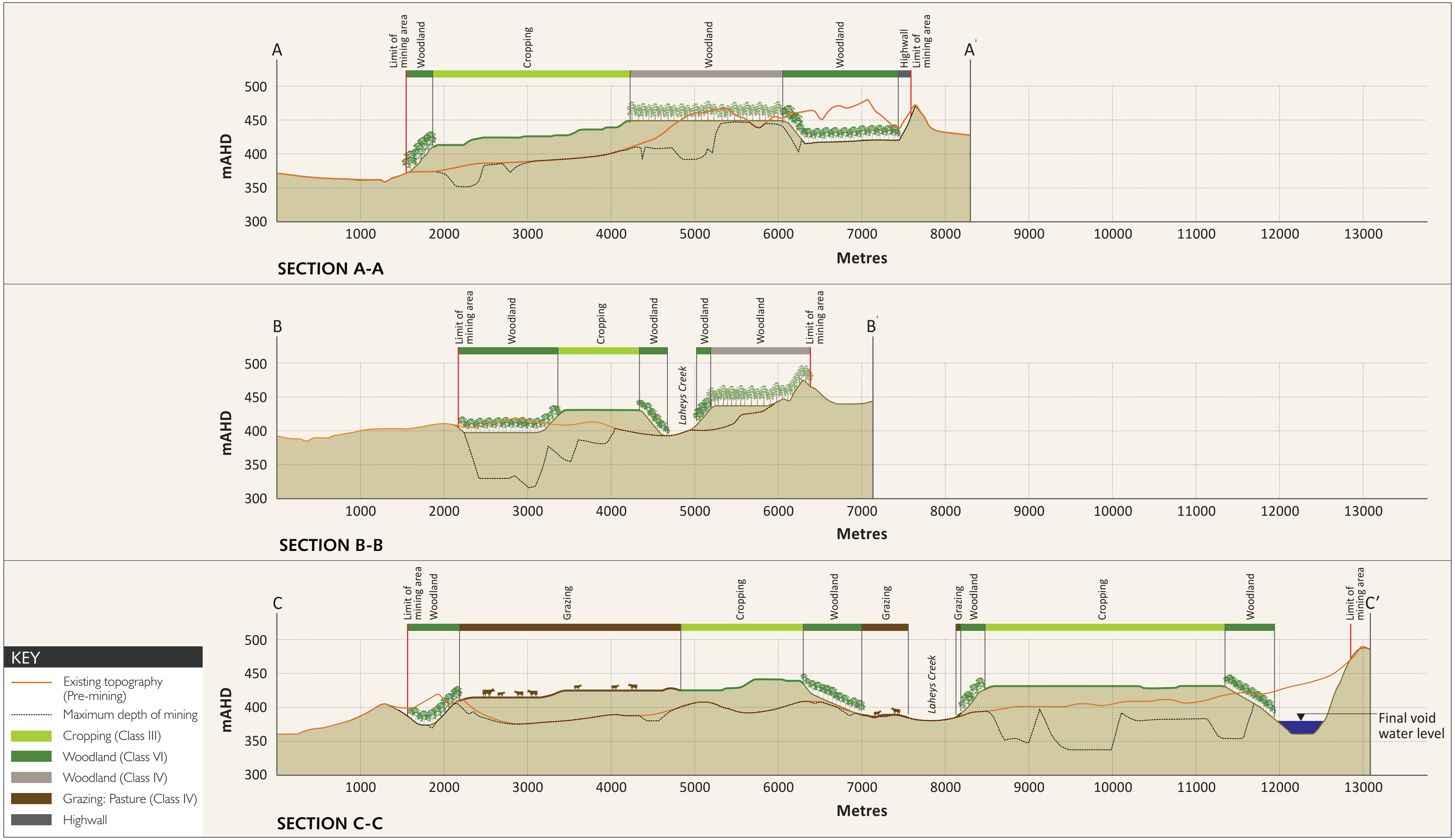
The reshaped mining areas A and C will be elevated flat to gently inclined landforms with some steeper fringing slopes on the northern and western perimeters. The maximum height of the landforms will be about 60 m above the pre-mining landform. There will be free draining rehabilitated depressions in the north and west (both consisting of a high wall and revegetated base and low wall).

The reshaped mining area B will be an elevated landform that is flat to gently inclined with some steeper fringing slopes. The maximum height of the landform will be about 30 m above the pre-mining landform. There will be a partially filled void in the south-east which will contain a lake.

The reshaped B-OOP emplacement area will be an elevated landform that is generally flat to gently inclined with some steeper western fringing slopes. The eastern slopes will be adjacent to the naturally steeper land to the east. The maximum height for the elevated landform will be about 40 m above the pre-mining landform.

The final landforms will incorporate contour-graded banks installed during rehabilitation. The spacing and dimensions of these banks will be based on the slope and catchment area. Where slope angles exceed 10^{o}, linear contour bank spacing will generally be between 50 and 80 m to enhance erosion and sediment control and revegetation works will target groundcover establishment.

The last tailings emplacement to be used, TEA3, will be decommissioned and rehabilitated after the CHPP is shut down. The tailings emplacement will be allowed to dry for approximately five years and will then be capped. After drying it will be covered with waste rock that has been stockpiled close by for this purpose. As for the waste rock emplacements, a layer of soil or suitable top dressing will be placed at the top of the profile to facilitate revegetation. The profile above the tailings emplacement will comprise at least 1 m of capping material, 1.2 m of waste rock forming a 'capillary break' and 0.3 m of soil or suitable top dressing. The final landform above TEA3 will have a slope of 0 to 3^{o} and will be rehabilitated to Rural Land Capability Class III.



EMM Cobbora Holding Company Pty Limited

Final Landform Cross-sections

Cobbora Coal Project - Environmental Assessment

Figure 3.18

3.20.5 Decommissioning

A range of techniques will be employed during decommissioning. These are summarised in Table 3.11.

Table 3.11 Closure decommissioning strategy

Project component	Decommissioning strategy
Mining operations area	Waste rock will be shaped to provide a stable landform consistent with the surrounding environment and proposed post-mining land use. The final void area will be minimised. Haul roads will be reshaped to blend with the surrounding landform and will be revegetated with appropriate species. The final tailings emplacement, TEA3, will be allowed to dry, be capped, covered and re-vegetated.
Mine infrastructure areas	Infrastructure will be removed, embankments and cuttings regraded, and landform reshaped to be similar to pre-mining landform.
Water supply pipelines	The preferred option will be to reach an agreement with the landholders to leave the water supply pipeline in place, operated by a third party to provide additional water to local users. Should an agreement not be reached, all above-ground infrastructure will be removed and underground infrastructure capped and covered. Embankments and cuttings will be regraded where required and the landform reshaped so it is similar to the pre-mining landform.
Rail line and rail siding	If, after consultation with the regulators, the rail spur is no longer required, all rails, sleepers and ballast will be removed. Embankments and cuttings will be left. The bridge supporting the Castlereagh Highway above the rail spur will be removed such that future maintenance is not required and the road will be reinstated.
Power easement	If, after consultation with the regulators, the electricity infrastructure is no longer required, all infrastructure, apart from 66 kV assets, will be removed.
Roads	Upgraded and realigned roads will be retained.
Raw water dam	The raw water dam will be left in place.

3.20.6 Rehabilitation of final active mining areas

i Mining areas A and C

The final active areas in mining areas A and C will be backfilled with waste rock so that the base of the rehabilitated depression is at least 3 m above the final water table in area A and at least 5 m above the final water table in area C. A stabilised high wall will remain that will not have a productive final land use (Rural Land Capability Class VIII).

The final low walls will be a continuation of the post-mining landform sloping down into a gently inclined base. The slope of these final low walls will be determined by a qualified geotechnical engineer to ensure their long-term stability. The slope angles of the low walls will generally be around 10° with a maximum slope of 18°. The low walls will be re-vegetated to woodland; that is Rural Land Capability Class VI.

Runoff and erosion control structures will be installed on the rehabilitated low walls as for the other areas of emplaced waste rock. Runoff entering the rehabilitated depression in mining area A will flow west and enter Sandy Creek while runoff entering the base of rehabilitated depression in mining area C will flow to the south-east entering Blackheath Creek.

The final high walls in mining areas A and C will comprise undisturbed rock strata of varying strengths or states of weathering. The slopes of the high walls will be determined by a geotechnical engineer to ensure slope failure risks are properly managed. It is anticipated that the high walls will have a slope of approximately 45°. The high walls will be Rural Land Capability Class VIII.

ii Mining area B

Mining area B will be partially backfilled so that about 50% is at least 3 m above the final water table. The remaining portion will be a void that will fill with saline water forming a groundwater sink. It will be rehabilitated and left so that it is stable, safe and does not cause unacceptable environmental impacts. The water level in the void will initially rise steeply, but reach an equilibrium where it does not overtop and will not affect nearby surface water bodies.

The final low and high walls of mining area B will be treated in the same manner as those in other mining areas.

iii Final land form safety

The high walls and final void will be made safe to humans, livestock and wildlife. This will include:

- ensuring the that the high and low walls are stable;
- covering exposed coal seams with water (in mining area B) or inert material to prevent ignition either from spontaneous combustion, bushfires or human interference;
- constructing trenches and/or berms to prevent vehicle access to the top of the high walls or areas where driving is unsafe; and
- fencing areas where there is a safety risk (including the pit lake) with signs prohibiting public access.

iv Summary

Rehabilitation of the final active mining areas is summarised in Table 3.12.

Table 3.12 Rehabilitation of final active mining areas

Mining area	Maximum high wall height (m)	Description
A	28	The final high wall will be the only part of mining area A that will be not be rehabilitated to Rural Land Capability Class VI or better. The final mining area will be back-filled with waste rock to form a rehabilitated depression with a base that is at least 3 m above the final water table level. The rehabilitated depression will be shaped so that it is free draining to Sandy Creek to the west. The base and low wall will be rehabilitated to Rural Land Capability Class VI with a cover of woodland.

Table 3.12 Rehabilitation of final active mining areas *(Cont'd)*

Mining area	Maximum high wall height (m)	Description
B	82[1]	The north-west of the mining area will be back-filled with waste rock to form a rehabilitated depression with a base at least 3 m above the final water table. This area will be rehabilitated to Rural Land Capability Class VI with a cover of woodland. The south-east of the mining area will not be back-filled and a void will remain with a base at 346 m AHD. This void will fill with water over time; the water level will initially rise steeply, but then reach equilibrium. The lake will not overtop and will not impact nearby surface water bodies. The void will be a groundwater sink with evaporation causing the water to become saline. However, no saline water will migrate from the lake and there will be no impacts to groundwater (see Section 7.5.1).
C	30	The final high wall will be the only part of Mining Area C that will be not be rehabilitated to Rural Land Capability Class VI or better. The final mining area will be back-filled with waste rock to form a rehabilitated depression with a base that is at least 5 m above the final water table level. The rehabilitated depression will be free draining to Blackheath Creek in the south. The base and low wall will be rehabilitated to Rural Land Capability Class VI with a cover of woodland.

Notes: 1. Of this, 48 m (vertical) will be above the final lake surface.

3.20.7 Post-mining environmental impacts

Post-mining environmental impacts are considered in the following sections:

- Groundwater – Sections 7.5.5 (level) and 7.5.4 (quality);
- Surface water – Section 8.5.5;
- Soils and agriculture – Sections 9.5.2 to 9.5.6; and
- Ecology – Section 10.3.3.

3.20.8 Success criteria

Progressive and final rehabilitation will be monitored against success criteria (also called closure criteria), to determine the success of rehabilitation. Rehabilitation monitoring is discussed in Section 9.6 and detailed in Appendix F. Success criteria for rehabilitation of land in the mining area to Rural Land Capability Class III (for post-closure cropping) are provided in Table 3.13. The success criteria for the rehabilitation of all other land rehabilitated to Rural Land Capability Classes IV to VIII (for grazing or conservation) are provided in Table 3.14.

Table 3.13 Success criteria: Class III land

Element	Indicator	Success criteria
Landform stability	Slope gradient	Less than 3%
	Erosion control	Erosion control structures are installed commensurate with the slope of the landform
	Surface-water drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins
Soil	Soil depth	Class III land: minimum of 300 mm subsoil and 200 mm topsoil
	Soil structure	Structural attributes to be on par or better relative to the control site. The target attribute is pedality and it is predicted that optimal structure will be represented by 'moderate structure', evidenced by presence of moderate peds
	Salinity (electrical conductivity)	Soil salinity is <0.5 dS/m (<500 µS/cm)
	pH	Soil pH is between 5.5 and 8.5
	Sodicity	Soil exchange sodium percentage (ESP) is <6%
	Nutrient cycling	Macro- and micro-nutrients similar to a reference site. These include nitrogen, phosphorous and cation exchange capacity and sulfur
		Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts
Vegetation	Land use	Land is useable as a functioning agricultural system as per the Class III Rural Land Capability parameters
Soil fauna	Species composition	Representation of a range of soil species such as earthworms, springtails and fungi relative to the control site

Table 3.14 Preliminary rehabilitation success criteria: Class IV to VIII land

Item	Rehabilitation Element	Indicator	Success criteria
1	**Mining area, excluding final void**		
1.1	Landform stability	Slope gradient	At least 75% of the area has overall slopes ≤18^{o} Where the slopes are steeper, additional water management structures will be installed as required
		Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform
			Average soil loss per annum is <40 t/ha/yr (sheet erosion)
			Dimensions and frequency of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics
		Surface water drainage	Contour banks and diversion drains are used to direct water into stable areas or sediment control basins
			All landforms are free-draining except where specific structures (i.e. dams) have been constructed for the storage of water as required for sediment and erosion control or some post-mining land use

Table 3.14 Preliminary rehabilitation success criteria: Class IV to VIII land *(Cont'd)*

Item	Rehabilitation Element	Indicator	Success criteria
1.2	Water quality	Water quality	Runoff from rehabilitation areas has water quality limits within an acceptable range
1.3	Soil	Soil depth	Class IV land: minimum of 300 mm
			Class VI land: minimum of 200 mm
		Salinity (electrical conductivity)	Soil salinity content is <0.6 dS/m (<600 µS/cm)
		pH	Soil pH is between 5.5 and 8.5
		Sodium content	Soil ESP is <15%
		Nutrient cycling	Nutrient accumulation and recycling processes are occurring, as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts
			Adequate macro and micro-nutrients are present
1.4	Vegetation: woodland	Land use: woodland	Area accomplishes and remains as a healthy stand of shrubs, trees and grass species
			The site can be managed for its designated land use without any greater management inputs than other land in the area being for a similar purpose
		Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present)
			No bare surfaces >20 m2 in area or >10 m in length down slope
		Species composition	A mixture of native trees, shrubs and grasses representative of regionally occurring vegetation are present subject to proposed land use
			Vegetation communities are developed to attract and support recolonisation by native flora and fauna species found in the area
		Resilience to disturbance	Established species survive and/or regenerate after disturbance
			Weeds do not dominate native species after disturbance or after rain
			Pests do not occur in substantial numbers or visibly affect the development of native plant species
		Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing; evidence of second generation of shrub and understorey species
			Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons
			More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead

Table 3.14 Preliminary rehabilitation success criteria: Class IV to VIII land *(Cont'd)*

Item	Rehabilitation Element	Indicator	Success criteria
1.5	Vegetation: grazing agricultural land	Land use	Land is useable as functioning agricultural system as per the applicable Rural Land Capability Class
			The site can be managed for its designated land use without any greater management inputs than for land in the area being used for a similar purpose
		Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present)
			No bare surfaces >20 m2 in area or >10 m in length down slope
		Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring vegetation where possible
			Grazing lands are developed to attract and support the re-colonisation of target pasture grasses
		Resilience to disturbance	Established species survive and/or regenerate after disturbance
			Weeds do not dominate native species after disturbance or rain
			Pests do not occur in substantial numbers or visibly affect the development of native plant species
		Sustainability	Grass species are capable of setting viable seed, flowering or otherwise reproducing; evidence of second generation of shrub and understorey species
			All surfaces are regraded to the agreed landform and revegetated to a self-sustaining condition similar to vegetation in comparable local areas and to a standard consistent with data obtained from pre-mining baseline environmental studies
1.6	Fauna: woodland	Vertebrate species	A range of representative species characteristics from each faunal assemblage group (e.g. reptiles, birds and mammals) are present, based on pre-mine fauna lists and fauna sighted within the three-year period preceding mine closure
			The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure
		Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes
		Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants.
			Evidence of active use of habitat provided during rehabilitation such as nest boxes and logs, and signs of natural generation of shelter sources including leaf litter
1.7	Visual	Visual amenity	Long-term visual impact is minimised by creating acceptable landforms, preferably compatible with adjacent landscape

Table 3.14 Preliminary rehabilitation success criteria: Class IV to VIII land *(Cont'd)*

Item	Rehabilitation Element	Indicator	Success criteria
1.8	Safety	Physical	Excavations are rendered safe
			All drill holes, pits, open cuts and other openings are securely capped, filled or otherwise made safe
			Access by members of the public and livestock is restricted as appropriate to site conditions
			No rubbish remains at the surface, or is at risk of being exposed through erosion
2	**High walls and final void**		
2.1	Landform stability	Stability	Inspection undertaken by a qualified geotechnical engineer to ensure that there is no subsidence or slipping of the pit walls present or that is a threat to the long-term stability of the pit abandonment bunds
2.2	Safety	Risk assessment	Risk assessment undertaken in accordance with relevant guidelines and Australian Standards and risks at levels agreed with the stakeholders
		Physical	As per Item 1.8
3	**Mine and auxiliary infrastructure areas**		
3.1	Landform stability	Slope gradient	Regraded batters consistent with surrounding area
		Erosion control	Erosion mitigation measures have been applied. Average soil loss per annum per domain unit is <40 t/ha/yr (sheet erosion)
		Surface water drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins
3.2	Water quality	Water quality	As per Item 1.2
3.3	Soil	Soil depth Salinity (electrical conductivity) pH Sodium content Nutrient cycling	As per Item 1.3
3.4	Vegetation: agricultural land use	Land use Surface cover Species composition Resilience to disturbance Sustainability	As per Item 1.5
3.5	Visual	Visual amenity	As per Item 1.7
3.6	Safety	Physical	As per Item 1.8

3.21 Project alternatives

The DGRs require that alternatives to the proposed mine layout are considered in the EA. The final Project design is the result of technical analysis conducted over a number of years. This process has incorporated consideration of the following constraints:

- physical, such as the location of coal and landscape elements;
- environmental, such as ecological sensitivities;
- social, such as the community's expectations and concerns; and
- economic, such as constraints on economic extraction and processing of the coal.

This section describes the alternatives that were considered, rejected or accepted during this process.

3.21.1 Alternatives considered

i Project location

The coal resource is located within EL 7394. The geology and orientation of the coal resource are fixed and were primary considerations governing the Project design, particularly the mining area layout. However, since the Project's inception, the design has been refined to minimise potential environmental impacts.

There is no alternative to locating the mine in EL 7394 as there are no other mining titles in NSW dedicated to domestic coal supply. However, this location provides a number of benefits compared with sourcing coal for NSW power stations from other areas in NSW:

- most of the coal from the resource in EL 7394 cannot be economically extracted for export but is an economic supply for NSW power stations. Therefore, the Project represents an opportunity for NSW to maximise the benefits it realises from the export of coal from other mines that would otherwise be used domestically;
- only a small area of high quality agricultural land is situated on the resource and it will be avoided. No Rural Land Capability Class I or II land will be disturbed as a result of the Project while about 780 ha of Class III land will be removed temporarily and replaced by about 1,100 ha of Class III land (see Section 9.5.3 'Soils and agriculture');
- there are no towns in the PAA and the population is sparsely distributed;
- most impacts can be contained within land owned by CHC;
- the Golden Highway is close enough to the Project to minimise Project-related traffic from using local roads but is far enough away that there is no requirement to alter the alignment of the highway; and
- only a small number of local roads will need to be closed and alternative roads can be provided.

ii Mining method

Coal is generally mined using open cut or underground mining methods or a combination of both. It is proposed to develop an open cut mine as the strip ratio (ie the thickness of overburden:coal) averages 2.5:1, which is low compared to many coal mines in NSW. It would not be economic to extract the coal by underground mining methods. Further, with this low strip ratio there would be substantial subsidence if an underground mine was developed.

iii Project design

Since its inception in 2009, the Project's design has continued to be refined to meet its customers' requirements, to minimise its environmental impacts, and in response to stakeholder concerns.

The alternatives considered during Project design are documented in a series of reports (ERM 2009, EMM 2011a and EMM 2012a) which are available on the DP&I website. The evolution of the design is described in these reports and is summarised below.

a. Original 2009 proposal

The original Project description was provided in the *Preliminary Environmental Assessment* (ERM 2009). The original mine layout was based on a single large mine pit covering about 3,900 ha. The pit was to begin with a central box cut and progress from east to west. The mine was between Laheys and Sandy creeks and included diverting these creeks. A rail spur 28 km long was proposed.

A ROM coal extraction rate of up to 30 Mtpa was originally proposed.

b. Updated 2011 proposal

The design was updated in 2011, as described in the *Project Update Report* (EMM 2011a) to:

- decrease its scale, including the mining rate and total volume of coal mined;
- reduce the extent of the mining area;
- avoid the requirement to divert Laheys and Sandy creeks;
- avoid sensitive environmental areas, including riparian areas and agriculturally valuable land;
- remove delivery of coal to the Mt Piper and Wallerawang power stations along the Gwabegar line, which passes through Mudgee, Kandos and Rylestone;
- improve the efficient recovery of coal by optimising the pit design relative to overburden stripping ratios; and
- address the concerns of neighbouring landowners and other stakeholders in relation to visual and noise impacts.

The updated design contained four pits around the mine infrastructure area. The extraction rate was reduced from 30 Mtpa to 20 Mtpa of run ROM coal. These changes remain part of the Project.

It was originally proposed to transport product coal from the CHPP to a train loader on the rail spur balloon loop using a short conveyer (ERM 2009).

In early 2011, the design was amended to include a rail spur 10 km long from the Dunedoo–Gulgong Railway and an overland conveyor 12 km long. A ROM hopper in the centre of the mine infrastructure area was to feed the coal conveyor. The conveyor would have transported coal to a ROM coal stockpile west of Suzanne Road. The CHPP, train loader and rail loop would have been built in this area. In late 2011, more detailed information on the potential environmental impacts of the overland conveyor option became available. The environmental impacts were found to be higher, particularly as a result of the fragmentation of sensitive ecological habitat (see Section 3.19.1 (iiiv) below).

Consequently, CHC redesigned the Project to replace the overland coal conveyor with an extended rail spur line. As a result, the product coal stockpile will be moved back to the mine infrastructure area. The extended rail spur line will run to the south of the Tuckland State Forest in a semi-circular arc, then back up into the mine infrastructure area.

It was originally proposed that around 4,000 ML of water would be used annually in the CHPP and for dust suppression. The following water sources were proposed:

- surface water and groundwater entering the pit (large annual groundwater inflows to the pit were predicted);
- Cudgegong River from high security water licences and a pipeline 25 km long; and
- a pipeline 50 km long using excess groundwater mine inflows from the Ulan Coal Mine.

The updated (and current) design requires less make-up water than the original proposal principally because of reduced mining and coal preparation rates. Water sources for the Project will be:

- surface water and groundwater that enters the mine pit; and
- a pipeline 25 km long from the Cudgegong River to convey 3,310 ML of water annually from high security water access licences that CHC has bought.

The Project will not divert Sandy or Laheys creeks and the annual groundwater inflows are much less than the original proposal.

The pipeline that runs for 50 km from the Ulan Coal Mine is not viable and was removed from the Project to avoid construction impacts and uncertainties associated with the ongoing supply of water from the Ulan Mine.

The locomotive provisioning facility owned and operated by a third party was also added to the Project to allow improved fuelling and servicing efficiency for trains carrying coal from the Project.

c. Updated 2012 proposal

The Project design was updated in 2012 as described in the *Project Update* (EMM 2012a) to:

- remove the conveyor that is 12 km long, as described above in Section 3.19.1 (iii b);
- move the CHPP and associated coal stockpiles about 1 km to the east to be next to the rail loop and away from Laheys Creek;
- include road diversions to replace sections of roads that will be removed;
- include the temporary construction village; and

- refine the water pipeline corridor from the Cudgegong River to minimise archaeological impacts and to avoid unavailable land.

These elements remain part of the proposed Project.

iv Alternatives to proposed mine layout and infrastructure footprint

The mining area has been developed to efficiently extract the coal while providing multiple mining pits to provide operational flexibility. The factors considered in the configuration of the layout, including the use of three mining areas are described in Section 3.4. The alternative mine layouts and infrastructure footprints to avoid or minimise impacts are described below.

a. Agricultural land

The extent of the mining areas has been reduced to avoid Rural Land Suitability Class II agricultural land west of Mining Area C and to minimise the area of Rural Land Suitability Class III within the disturbance footprint (see Figure 9.1 in Chapter 9 'Soils and agriculture').

b. Creeks and riparian zones

The extent of the mining areas has been reduced to avoid creek diversions by reducing the scale of the Project and reconfiguring the mining area. This has minimised:

- clearing riparian vegetation;
- impacts to large areas of terrestrial and aquatic threatened ecological communities; and
- impacts to threatened species habitat, particularly for the freshwater catfish population.

c. Threatened flora species and EECs

There are a number of areas containing threatened flora species or Endangered Ecological Communities (EECs) in the mining area, mine infrastructure area and surrounds. Alternatives considered to avoid impacts to these are summarised in Table 3.15.

Table 3.15 Alternatives to avoid or minimise impacts to threatened flora species and EECs

Project component	Alternative[1]	Comment
Footprint at the southern end of AC-OOP and north of the mine infrastructure area	Economically optimised design	A sub-population of Ingram's zieria containing the largest number of individuals in the PAA (340 individuals) is immediately south of AC-OOP, in the footprint of part of the previously proposed coal conveyor, and mine infrastructure area (sub-population 3 in Figure 10.8 — see Chapter 10, 'Ecology'). This sub-population would need to be removed to construct the most economically efficient design.
	Reconfigured design to avoid sub-population of Ingram's zieria	The AC-OOP and mine infrastructure area was redesigned to avoid this sub-population. This will avoid removing 340 Ingram's zieria.

Table 3.15 Alternatives to avoid or minimise impacts to threatened flora species and EECs *(Cont'd)*

Project component	Alternative[1]	Comment
B-OOP E location and design	**Centrally located out-of-pit emplacement for Mining Area C (B-OOP E)**	B-OOP E will be used when developing Mining Area B. The out-of-pit emplacement will be used when mining starts in the eastern side of the area to extract the shallowest coal first. The out-of-pit emplacement has been redesigned to minimise the removal of Ingram's zieria. However, given that the majority of the sub-populations of Ingram's zieria are in the centre of B-OOP E, it is not possible to avoid the majority of individuals (sub-populations 8, 9 and 10 in Figure 10.8 — see Chapter 10, 'Ecology') without completely relocating the out-of-pit emplacement. It is not possible to develop Mining Area B without placing B-OOP E in its proposed location (see rows below). Offsets will be provided to compensate for the Ingram's zieria sub-populations removed.
	Expanded out-of-pit emplacement for Mining Area C (B-OOP W)	The size of B-OOP W has been maximised to minimise the footprint of B-OOP E. It cannot be expanded further because it is constrained by the requirement to protect the riparian zone along Laheys Creek to the east and by active mining areas to the west. Therefore, this is not a feasible alternative to reduce impacts to Ingram's zieria in the footprint of B-OOP E.
	Placing out-of-pit emplacement for Mining Area C west of Mining Area C	It is not economically feasible to place the out-of-pit emplacement on the eastern side of Mining Area B because of haul distances. Placing out-of-pit emplacements here would also sterilise coal resources.
Footprint of Mining Area A, Mining Area C, AC-OOP and mine infrastructure area	Economically optimised design	There are sub-populations of Ingram's zieria (sub-populations 1, 2, 4, 5, 6, 7 and 15 in Figure 10.8 — see Chapter 10, 'Ecology') in the footprint of Mining Area A, Mining Area C, AC-OOP and mine infrastructure area. There are 50 ha of EECs within these areas. Removal of these sub-populations of Ingram's zieria and areas of EEC could only be avoided if Mining Area C was not developed.
	Reconfigured design to minimise impacts to threatened flora species and EECs	Impacts to Ingram's zieria sub-population 2 have been avoided by reconfiguring the mine infrastructure area footprint. Impacts to Ingram's zieria sub-population 1 have been minimised by reconfiguring the south-western extent of Mining Area A footprint. The western and northern extent of Mining Area A, Mining Area C, and AC-OOP have been reduced to avoid or minimise impacts on EECs.

Table 3.15 Alternatives to avoid or minimise impacts to threatened flora species and EECs ***(Cont'd)***

Project component	Alternative[1]	Comment
Footprint of Mining Area B and B-OOP W	Economically optimised design	There are two sub-populations of *Tylophora linearis* in the centre of the northern section of the footprint of Mining Area B (see Figure 10.8 — see Chapter 10, 'Ecology'). There are 20 ha of EECs within the footprint of Mining Area B and B-OOP W. Removal of these sub-populations of *Tylophora linearis* and areas of EEC could only be avoided if much of Mining Area B was not developed.
	Reconfigured design to minimise impacts to threatened flora species and EECs	Mining Area B has been reconfigured to avoid removing EECs west of the area.

Notes: 1. The proposed alternative is highlighted in ***bold****.*

The economically optimised mine and mine infrastructure area layout have been reconfigured to minimise impacts on threatened flora species or EECs. Large areas of the mine would have to remain undeveloped if further impacts are to be avoided.

d. Aboriginal heritage

The distribution of Aboriginal sites has been an important consideration in mine planning. The extent of the mining areas has been reduced, particularly along creeks and riparian areas where the majority of Aboriginal sites were found during archaeological surveys. The design has been modified to avoid known sites where possible, particularly along Sandy Creek (see Chapter 18, 'Aboriginal heritage').

e. Historic heritage

The extent of the mining areas has been reduced to avoid Laheys Creek cemetery, Dapper Union Church, the Potential Cobb and Co stopping place, and a brick clamp (see Chapter 19, 'Historic heritage') that would have been removed as part of the original Project design.

v Final landform

The proposed final land uses following rehabilitation are agriculture and conservation. The final landform has been designed accordingly with progressive back-filling of active mining areas from Year 16. The result will be free draining rehabilitated depressions in mining areas A and C, and partial filling and a small water filled void in mining area B.

a. Tailings management

The advantages and disadvantages of the alternative tailings management methods considered during Project design are described in Table 3.16.

Table 3.16 Alternative tailings management methods

Method	Advantages	Disadvantages
Conventional tailings thickening and placement Tailings are thickened at the CHPP and pumped to a tailings emplacement at about 35% solids (see Section 3.6.5) Drying is by recovery of decant water for use in the CHPP and evaporation	Ease of operation Lower capital and operating costs Proven method	Lower water reuse than some methods Dam seepage is potentially greater Longer rehabilitation period due to drying time
Co-disposal A mixture of tailings and coarse rejects is pumped to a co-disposal emplacement at about 40 to 45% solids Water is decanted to a decant dam for subsequent reuse in the CHPP in a similar proportion to conventional tailings thickening and placement	Potentially faster rehabilitation time as the tailings dry out faster Reduce reject truck fleet	Significantly larger emplacements required to hold coarse reject and tailings Emplacements need to be close to the CHPP due to pumping limitations High costs as frequent maintenance required due to high wear rates of pipes and pumps High electrical power consumption and water use to convey combined reject material Pipe blockages can cause spills or and require standby methods for coarse reject and tailings emplacement Intensive dam management required Coarse rejects needs to be less than about 2 cm to allow it to be pumped
Paste disposal Thickened tailings are pumped to a tailings emplacement at about 50% solids Water is recycled from the CHPP thickeners and from the emplacement area	Higher water recovery than a conventional tailings thickening and placement Smaller disposal sites due to higher solids content	More complex pumping systems are required for paste tailings Rehabilitation is more difficult as the paste is difficult to further dewater Paste thickening of coal tailings is uncommon because of the difficulties resulting from the comparatively low specific gravity of the coal tailings compared to tailings from metalliferous mines
Super flocculation Thickened tailings are pumped to a tailings emplacement at about 35% solids Tailings are thickened using additional flocculent to about 40 to 50% solids before emplacement This method can be retrofitted to a conventional tailings dam	Higher water recovery than conventional tailings thickening and placement Smaller disposal sites due to higher solids content disposal Super flocculation at the tailings emplacement area avoids problems associated with paste pumping	Rehabilitation is more difficult as the thickened tailings is difficult to further dewater Very high flocculent consumption and cost Success dependant on the tailings properties
Dry tailings Thickened tailings are dried at the CHPP with a belt press or similar The dry tailings are mixed with coarse rejects and transferred to the reject bin, where it is trucked to an in-pit dump	High water recovery No tailings emplacements are required Proven method	High capital cost High operational and maintenance costs Rehabilitation success sensitive to variation in tailings moisture content Success dependant on tailings properties and the presence of clays

Conventional tailings thickening and placement is proposed (see Section 3.6.5) based on consideration of the environmental impacts (including water recovery and rehabilitation); construction and operation of the tailings management facilities; and capital and operating costs of each tailings management option.

vi Coal conveyor

As discussed in Section 3.21.1, an alternative Project design with a coal conveyor 12 km long and a rail spur 10 km long was examined. This option would have:

- required clearing part of the largest sub-population of Ingram's zieria recorded in the PAA (sub-population 3);
- required clearing a corridor in woodland areas, some of which contain threatened fauna species, and clearing 6 ha of EEC. The corridor would have passed between the two sections of Tuckland State Forest, degrading this wildlife corridor;
- the ROM coal stockpile, CHPP and rail loop located within about 1,500 m of 11 residences on Suzanne Road and would have required more acquisitions to ensure noise and dust criteria were not exceeded at private residences;
- the conveyor and ROM coal stockpile extended above the ridge that prevents views of the Project from the north, increasing the visual impacts of the Project; and
- the conveyor and ROM coal stockpile located in the catchment of Tuckland Creek, increasing the number of water subcatchments potentially disturbed by the Project.

The coal conveyor is no longer part of the Project.

vii Rail spur

The 28 km long rail spur route was selected to minimise woodland clearance and avoid two properties that CHC could not purchase. The rail spur will pass through largely cleared agricultural areas (Agricultural Suitability Class 3 and 4). It was moved to the north to avoid impacts on Ausfeld's wattle (*Acacia ausfeldii*) growing on the northern boundary of Goodiman State Conservation Area (SCA).

A rail bridge (viaduct) and rail cutting were considered for crossing the Castlereagh Highway. A viaduct would avoid the need to alter the surface of the Castlereagh Highway. A viaduct could be removed at the end of the mine life (if the rail spur is removed) without affecting the highway. A viaduct would require a clearance from the road surface of 6.5 m and therefore would be about 2.2 km long. Raising the rail spur on a viaduct would increase noise levels from trains at some six residences (residences 3021, 3022, 3024, 3035 3043 and 4026) within 1 km of the viaduct. The viaduct would be visually intrusive in an area where, otherwise, there will be no significant visual impacts from the Project.

The proposed rail cutting under the Castlereagh Highway will minimise noise and visual impacts. The responsibility for the bridge supporting the highway will have to be demarcated between CHC and RMS, including after mine closure.

viii Roads

A series of alternatives were considered for mine access, including access from the south along Spring Ridge Road and from the north along the Spring Ridge Road realignment. Workforce recruitment (and therefore accommodation) will be largely from the west and south-west of the mining area. Therefore, the road upgrades and realignments have been designed to accommodate Project-related traffic accessing the mine from the Golden Highway.

Alternative access from the south along Spring Ridge Road would not meet the requirements of the Project, would require widening the southern sections of Spring Ridge Road and would require much more travel along local roads rather than along the Golden Highway and purpose-built Spring Ridge Road realignment. The verges of the southern sections of Spring Ridge Road contain native vegetation, including EECs in many of the areas. Widening Spring Ridge Road would require clearing vegetation on one or both sides of the road.

Three road realignments will be constructed to replace sections of Spring Ridge Road, Dapper Road and Brooklyn Road (see Section 12.5.5). A range of alternative realignments was considered that either widened existing local roads or created new road sections. Given that the verges of existing local roads often contain remnant vegetation, including EECs, new road diversions will be constructed in preference to widening existing local roads.

ix Water supply

As discussed in Section iii, a series of water supplies alternatives were considered as the Project design progressed. The selected water supply arrangement will ensure the mine has enough water to continue operations in all but extreme dry years. It will maximise on-site water reuse to minimise water discharge requirements and will not reduce the water availability to other uses, including town, and stock and domestic supplies.

3.21.2 No project alternative

As discussed in Chapter 2, 'Project need', there are no other mining titles in NSW dedicated to domestic coal supply. If the Cobbora resource is not developed:

- the NSW electricity generators will be more exposed to the volatile thermal coal price on the international market;
- electricity generation in NSW will become increasingly dependent on interstate electricity transfers, with attendant higher environmental and financial costs; and
- substantial social costs would occur if NSW experiences disproportionate increases in electricity prices compared to other parts of Australia or its peer economies internationally.

3.21.3 Project optimisation

There are no alternatives to developing the Project in EL 7394 and its development in this area will be in the public interest - it will provide many benefits over sourcing coal for electricity generation from other areas in NSW that are more suited to the export market. As the mine design progressed, a wide range of alternatives were considered to efficiently extract the coal while avoiding or minimising disturbance to native vegetation, habitats, creeks, high value agricultural land and cultural heritage. The Project, as described in this chapter is optimised to meet these constraints.