BULLI SEAM OPERATIONS

SECTION 2
PROJECT DESCRIPTION

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2 PROJECT DESCRIPTION

2.1 EXISTING MINING OPERATIONS

ICHPL (a wholly owned subsidiary of BHP Billiton Pty Limited) owns and operates the longwall mining operations at the Appin Mine and West Cliff Colliery. The extent of ICHPL's completed and current underground mining areas at the Appin Mine and West Cliff Colliery are shown on Figure 2-1.

The operations at the current underground mining areas are supported by three pit tops (i.e. West Cliff, Appin East and Appin West) (Figures 2-2, 2-3 and 2-4, respectively) and other supporting infrastructure (Figure 2-5).

The Project Application Area (Attachment 2) incorporates the existing mining operations. The Project underground mining areas, relative to the existing mining operations, are defined by the extent of longwall mining area shown on Figure 2-1, however subject to detailed design, underground mine development workings (i.e. non-subsiding) may also occur outside of the extent of longwall mining area.

ICHPL also owns and operates the Dendrobium Mine located approximately 10 km north-west of Wollongong (Figure 1-1) in accordance with Development Consent (DA 60-03-2001) granted by the NSW Minister for Urban Affairs and Planning on 20 November 2001.

2.1.1 Underground Mining Operations

A summary of the existing underground mining operations at the Appin Mine and West Cliff Colliery is provided below.

Appin Mine

Mining tenements CCL 767 and CL 388 are held by ICHPL's subsidiary Endeavour Coal Pty Ltd at the Appin Mine.

ICHPL is currently conducting underground mining at the Appin Mine within Appin Area 7 (Figure 2-1). The Appin Mine includes the Appin East and Appin West pit tops, Appin No.1 and No.2 shafts, Appin No.3 shaft and the Douglas North Electricity Supply Substation (Figure 2-1).

Underground mining is undertaken using longwall methods in accordance with SMP Approval for Longwall 409 (Figure 2-1) within Appin Area 4 (approved by the DPI-MR on 13 November 2007) and Longwalls 701 to 704 within Area 7 (approved by the DPI-MR on 1 November 2006).

ICHPL has separately lodged an SMP application (approval pending) for Longwalls 705 to 710 within Appin Area 7 (Figure 2-1) with the DPI–MR.

Current longwall widths at the Appin Mine are 320 metres (m) (rib to rib) with chain pillars of up to 45 m in width.

ROM coal extracted from the underground longwall mining operation is transferred by conveyor to the Appin East pit top (Figure 2-3). ROM coal from the Appin East pit top is either temporarily stockpiled or loaded directly into trucks for transport via road to the West Cliff Washery. Some ROM coal is also transported via the public road network to the Dendrobium Washery in Port Kembla (Figure 1-1).

West Cliff Colliery

ICHPL has been conducting underground mining at the West Cliff Colliery since April 1997; prior to 1997 the mine was owned and operated by CRA Limited. Underground mining at the West Cliff Colliery is currently undertaken using longwall methods in accordance with approval under Section 138 of the *Coal Mines Regulation Act, 1982* and SMP Approval for Longwalls 29, 30 and Part Longwalls 31 to 33 (Figure 2-1) within West Cliff Area 5 (approved by the DPI-MR on 24 December 2003) and the remainder of Part Longwalls 31 to 33 (approved by the DPI-MR on 7 November 2006).

ICHPL has also obtained SMP Approval for Longwalls 34 to 36 (Figure 2-1) within West Cliff Area 5 (approved by the DPI-MR on 13 May 2009).

Current longwall widths at the West Cliff Colliery are 305 m (rib to rib) with chain pillars of up to 45 m in width.

ROM coal extracted from the underground longwall mining operation is transferred by conveyor and winder to the West Cliff pit top.

Further description of the longwall mining methods and ROM coal handling at the Appin Mine and West Cliff Colliery is provided in Section 2.5.2.

Further information on the approvals held by ICHPL is presented in Section 7.

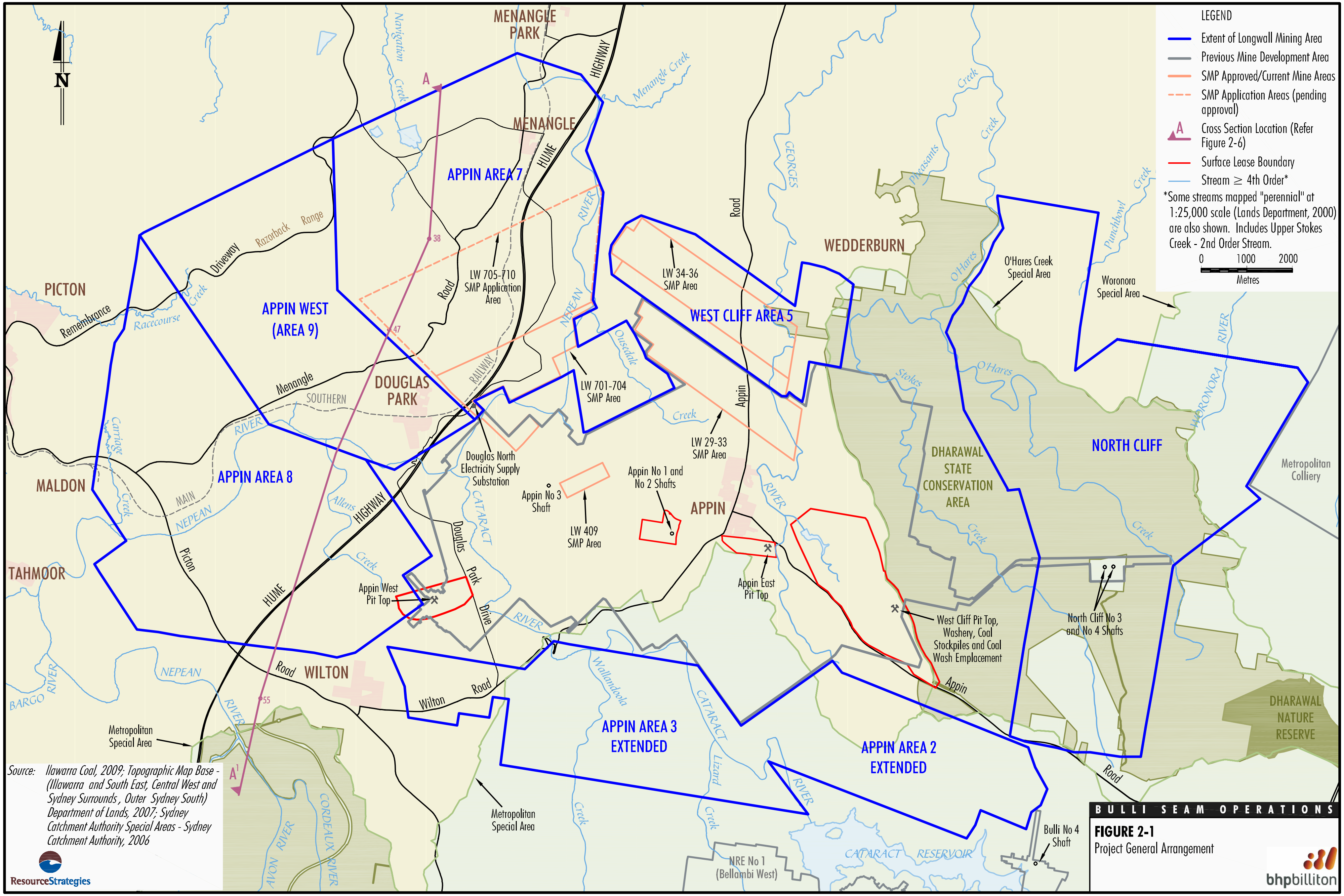


FIGURE 2-1
Project General Arrangement

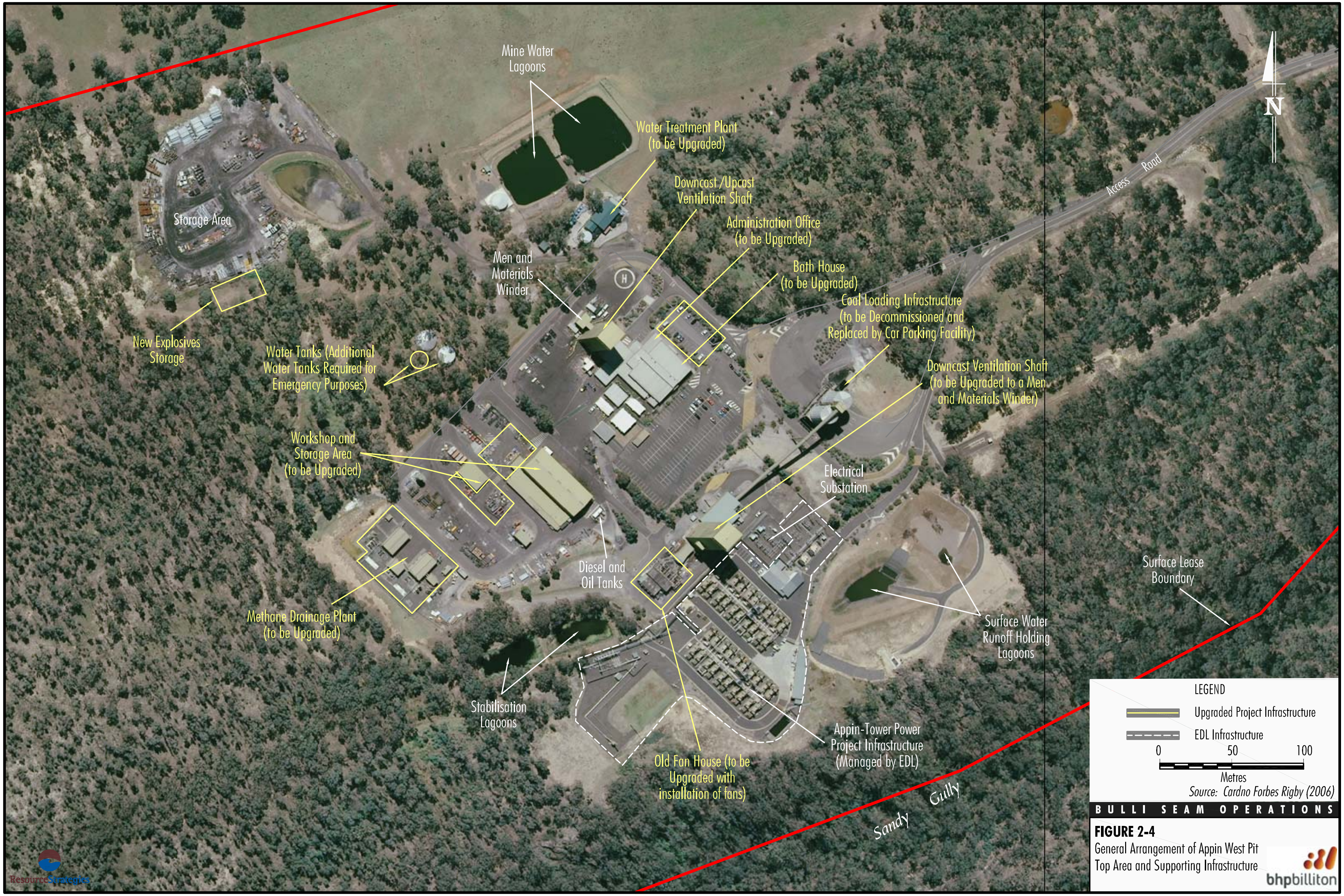
Source: *Illawarra Coal, 2009; Topographic Map Base - (Illawarra and South East, Central West and Sydney Surrounds, Outer Sydney South) Department of Lands, 2007; Sydney Catchment Authority Special Areas - Sydney Catchment Authority, 2006*

BHPIC-07-01 EA Section 2_110N

FIGURE 2-2
General Arrangement of West Cliff Pit Top Area and Supporting Infrastructure

BHPIC-07-01 EA Section 2_112J

FIGURE 2-3
General Arrangement of Appin East Pit Top Area and Supporting Infrastructure



BULLI SEAM OPERATIONS

FIGURE 2-4
General Arrangement of Appin West Pit Top Area and Supporting Infrastructure

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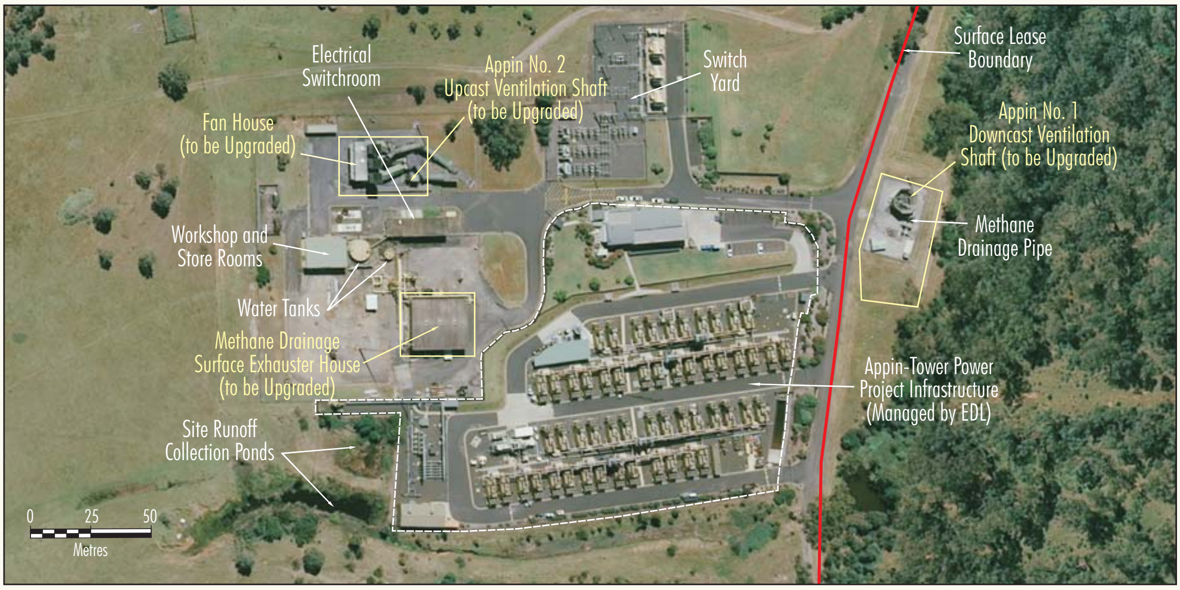
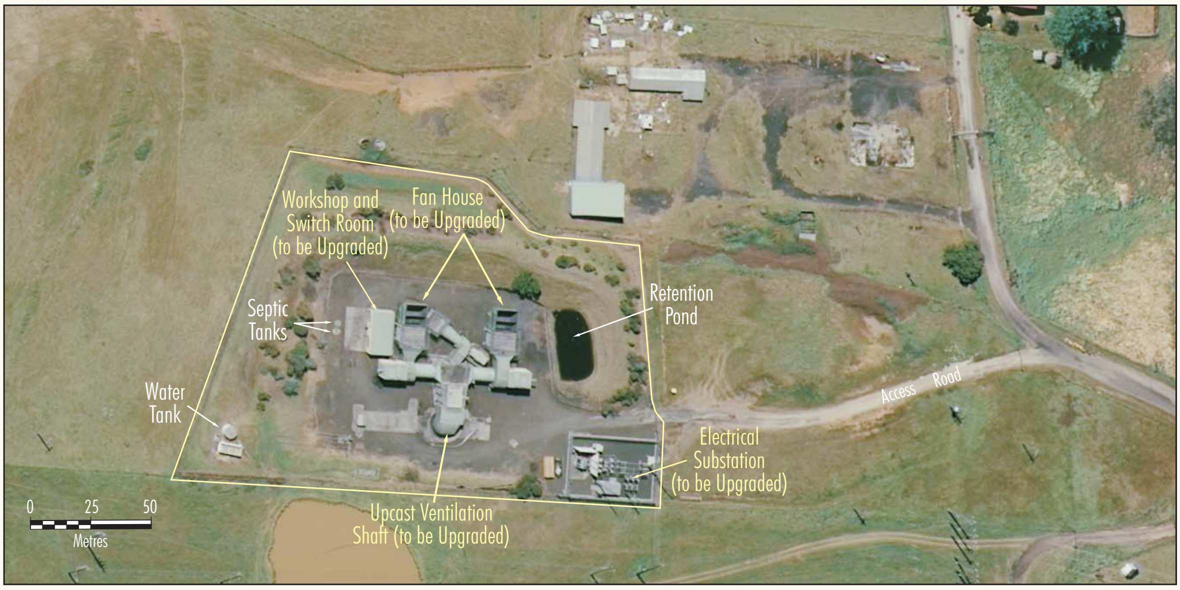


Appin No 1 and No 2 Shafts



Appin No 3 Shaft

North Cliff Shafts

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FIGURE 2-5
General Arrangement of Appin and North Cliff Shafts and Supporting Infrastructure

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2.1.2 Pit Tops and Supporting Infrastructure

West Cliff Pit Top

The existing West Cliff pit top is located off Appin Road to the south-east of Appin village (Figure 2-1). Existing surface infrastructure at the West Cliff pit top includes the following (Figure 2-2):

- drift portal;
- upcast ventilation shaft (No. 1) and fan house;
- downcast ventilation shaft (No. 2) and winder building;
- gas drainage, capture and beneficiation equipment; including WestVAMP;
- coal drift and conveyor;
- product coal bins;
- ROM and product coal stockpiles and handling areas;
- Coal Preparation Plant (CPP) and associated conveyors, transfer points and buffer bins;
- coal wash emplacements;
- product coal road transport loading facilities;
- internal haul roads;
- administration offices and bath house;
- stores and workshop facilities; and
- other ancillary infrastructure (e.g. diesel/oil tanks/storage, pumps and pipelines, compressors, gasometer structure and electrical substations).

Existing water management infrastructure at the West Cliff pit top includes the following:

- Brennans Creek Dam;
- water treatment ponds;
- water collection and settlement ponds and tanks;
- irrigation area;
- water diversions; and
- water reticulation systems (e.g. tanks, pumps and pipelines).

Further description of the existing water management system at the West Cliff Colliery and Appin Mine is provided in Section 2.10.1.

Appin East Pit Top

The existing Appin East pit top is located off Appin Road to the south-east of Appin village (Figure 2-1).

Existing surface infrastructure at the Appin East pit top includes the following (Figure 2-3):

- men and materials drift and winder;
- downcast ventilation and main coal drift and drive house;
- coal handling infrastructure (e.g. conveyors, hoppers and bins);
- ROM coal bins, stockpile area and truck loading facilities;
- administration complex and bath house;
- workshop facilities, stores and storage areas;
- water management/treatment facilities (e.g. ponds/lagoons, dams, filter and dosing plants);
- internal haul roads; and
- other ancillary infrastructure (e.g. water/waste water/diesel/oil tanks, pumps and pipelines, compressors, electricity substation and explosives storage).

Appin West Pit Top

The existing Appin West pit top is located off Douglas Park Drive approximately 4 km south of Douglas Park township (Figure 2-1).

The Appin West pit top currently provides access to the underground mining operations at Appin Area 7 (Figure 2-1) for underground personnel and mine equipment and supplies. Surface facilities at the Appin West pit top include the following (Figure 2-4):

- men and materials winder;
- two downcast ventilation shafts;
- administration office;
- employee facilities and bathhouse;
- workshop and storage areas;
- coal loading infrastructure (currently not in use);
- methane drainage plant including gas pipe system and exhauster house;
- water management/treatment infrastructure (e.g. water treatment plant; water tanks; surface water runoff holding lagoons; and mine water and stabilisation lagoons);

- other ancillary infrastructure (e.g. diesel/oil tanks; pumps and pipelines; compressors; and electrical substation); and
- components of the Appin-Tower Power Project infrastructure (managed by EDL).

Appin No.1 and No.2 Shafts and Fan Site

The Appin No. 1 and No. 2 shafts and fan site is located approximately 2 km west of the Appin East pit top (Figure 2-1) and consists of the following infrastructure (Figure 2-5):

- downcast ventilation shaft (Appin No.1);
- upcast ventilation shaft (Appin No. 2) and fan house;
- gas drainage plant including gas drainage pipe system and surface exhauster house;
- workshop and store rooms;
- water management infrastructure (e.g. water tanks and site runoff collection ponds); and
- electrical switchroom and switchyard.

Components of the Appin-Tower Power Project infrastructure are located adjacent to the Appin No. 1 and No. 2 shaft and fan site (Figure 2-5). There is a connecting gas pipeline from West Cliff pit top to the Appin-Tower Power Project components adjacent to the Appin No. 1 and No. 2 shafts and fan site. The Appin-Tower Power Project generates electricity by utilising coal bed methane drained from the underground mining area. The Appin-Tower Power Project consists of 94 gas engines, each capable of generating 1 megawatt (MW) of electricity. Components of the Appin-Tower Power Project are also located adjacent to the Appin West pit top. The Appin-Tower Power Project is one of the most significant greenhouse gas abatement projects in Australia.

Appin No.3 Shaft and Fan Site

The Appin No. 3 shaft (former Tower No. 3) and fan site is located approximately 4 km west of Appin village (Figure 2-1) and consists of the following infrastructure (Figure 2-5):

- upcast ventilation shaft and fan houses;
- workshop and switch room;
- water management/treatment infrastructure (e.g. water tank, septic tanks and retention pond); and
- electrical substation.

North Cliff Shafts Site

The existing North Cliff shafts are located approximately 5 km east of the West Cliff pit top (Figure 2-1) and consist of the following infrastructure (Figure 2-5):

- two shafts (No. 3 and No. 4) and associated winder houses;
- access and internal roads;
- shed; and
- spoil stockpile and sediment dam.

The existing surface mobile equipment fleet at each of the three pit tops described above is provided in Table 2-1. The equipment fleet list in Table 2-1 is indicative only and varies to meet production requirements.

Table 2-1
Existing Surface Mobile Equipment Fleet

Fleet Item	Pit Top Location		
	West Cliff*	Appin East	Appin West
Dozers	2	-	-
Grader	1	-	-
Vibratory Roller	1	-	-
Excavators	1	-	-
Haul Trucks	8	-	-
Water Trucks	1	-	-
Front End Loaders	8	1	1
Fork Lift	-	-	1
Bob Cats	2	1	-
Utilities	4	2	2

Source: ICHPL (2009)
* Number also includes mobile equipment fleet for construction of the approved West Cliff Stage 3 Coal Wash Emplacement (refer Section 2.8.3).

Bulli Shafts Site

The Bulli Shafts site is located in the south-east of CCL 767 in lands managed by the SCA and consists of four (Bulli Shafts No.1 to No.4) disused (sealed) shafts (Figure 1-1). These shafts have previously been sealed to DPI-MR standards. Management and rehabilitation of the shafts is described in Section 6.

2.1.3 ROM Coal Transport, Reclaim and Washing

Combined total ROM coal production capacity at the existing Appin Mine and West Cliff Colliery is up to approximately 7.5 Mtpa.

ROM coal from the Appin East pit top is either temporarily stockpiled or loaded directly into trucks for transport via road to the West Cliff Washery. Some ROM coal is also transported via the public road network to the Dendrobium Washery in Port Kembla (Figure 1-1).

ROM coal is either temporarily stockpiled and reclaimed or delivered directly to be crushed, screened and washed at the West Cliff Washery. The West Cliff Washery currently has a throughput capacity of approximately 6 Mtpa (product coal). Coal wash material from the West Cliff Washery and the Dendrobium Washery (Figure 1-1) is emplaced at the West Cliff Coal Wash Emplacement (Figure 2-2).

2.1.4 Product Coal Stockpiling and Road Transport

The Appin Mine and West Cliff Colliery currently produce up to approximately 5.4 Mtpa of product coal (combined) for domestic and export markets. Product coal is either temporarily stockpiled at the West Cliff Colliery or loaded directly from the product coal bins into trucks.

Product coal from the West Cliff Washery is transported by road to PKCT or to the BlueScope Steelworks. The transport of product coal to PKCT would increase to 24 hours a day, seven days a week. Some product coal is also transported via road to the Illawarra Coke Company's Corrimal and Coalcliff Coke Works. The transport routes from the West Cliff Washery are shown on Figure 1-1.

2.1.5 Coal Wash Management

Coal wash is produced from the processing of ROM coal in the CPP at the West Cliff Washery (Section 2.6) and is separated from the product coal stream. Up to approximately 1 Mtpa of coal wash is produced by the West Cliff Washery.

Coal wash produced from the West Cliff Washery and the Dendrobium Washery is currently emplaced at the West Cliff Stage 2 Coal Wash Emplacement (Figure 2-2).

Over the life of the Project, it is estimated that up to approximately 46 million tonnes (Mt) of coal wash would be produced from the Project. Combined with the estimated coal wash production from the approved Dendrobium Mine, a total of approximately 73 Mt of coal wash would be produced and require emplacement/ management at ICHPL's mining operations. Further details are provided in Section 2.8.

ICHPL received a Notice of Staged Development Approval for the development of the West Cliff Stage 3 Coal Wash Emplacement on 20 December 2007. The currently approved extent of the West Cliff Coal Wash Emplacement is shown on Figure 2-2.

2.1.6 Electricity Supply and Distribution

Electricity is supplied to the Appin Mine and West Cliff Colliery by the Integral Energy Network via existing 66 kilovolt (kV) powerlines. Power is then transformed at the 66 kV/11 kV substations located at Douglas North (Figure 2-1) and the electrical substations located adjacent to the three pit tops (Figures 2-2, 2-3 and 2-4). As described in Section 2.1.2, the Appin-Tower Power Project consists of 94 gas engines, each capable of generating 1 MW of electricity from coal bed methane drained from the underground mine workings. Components of the Appin-Tower Power Project are located adjacent to the Appin West pit top and the Appin No. 1 and No. 2 shafts and fan site (Figures 2-4 and 2-5). Electricity generated by the Appin-Tower Power Project is supplied to the Integral Energy Network.

WestVAMP (commissioned in September 2007) also generates electricity which is used at the West Cliff Colliery. WestVAMP consists of a steam turbine capable of generating up to 6 MW of electricity from mine ventilation air from the West Cliff Colliery.

Douglas North Electricity Supply Substation – Appin Mine

The NSW Minister for Planning approved the Douglas North Electricity Supply Substation at the Appin Mine on 6 July 2007 (Project Approval 06_0287). Once fully developed, the Douglas North Electricity Supply Substation will provide up to 25 MegaVolt Amperes (MVA) to be delivered via two boreholes at 11 kV from the surface to the underground mining operations at the Appin Mine.

The location of the approved Douglas North Electricity Substation and associated infrastructure is shown on Figure 2-1.

2.1.7 Historical Mining Areas

Underground mining undertaken in the Bulli Seam at the Tower Colliery, Appin Mine and West Cliff Colliery has included mining beneath a range of man-made and natural features over a number of decades. Previous mining areas are shown on Figure 2-1.

The history of the Tower Colliery, Appin Mine and West Cliff Colliery is further discussed in the Non-Aboriginal Heritage Assessment (Appendix H). Monitoring and remediation/rehabilitation activities would continue to be undertaken by ICHPL in the historical mining areas.

2.2 COAL RESOURCE, MAJOR GEOLOGICAL FEATURES AND EXPLORATION ACTIVITIES

The Project is located in the NSW Southern Coalfield within the southern portion of the Permo-Triassic Sydney Basin.

Underground mining currently occurs at the Appin Mine and West Cliff Colliery in the Bulli Seam of the Late Permian Illawarra Coal Measures. The Illawarra Coal Measures contain a number of workable seams throughout the Southern Coalfield, but of these coal seams, only the Bulli Seam is presently considered to be of economical significance at the Appin Mine and West Cliff Colliery.

In the Project extent of longwall mining area, the Bulli Seam is located between approximately 300 m (in the south-east) and 850 m (in the north-west) below the surface and is the uppermost seam of the Illawarra Coal Measures. It has a regional dip to the north-west of about 1 in 30 and reflects the synclinal structure of the Douglas Park and Camden Synclines within the Project area. The stratum around the Bulli Seam provides good conditions for longwall mining and in particular the floor is hard and competent (NSW Department of Mineral Resources [DMR], 2000). The immediate roof can range from mudstone, interbedded siltstone and sandstone, to sandstone (DMR, 2000).

Above the Bulli Seam, the stratigraphy of the area consists of a sequence of sandstone, shale and claystone units within the Narrabeen Group, which are in turn, overlain by the Hawkesbury Sandstone.

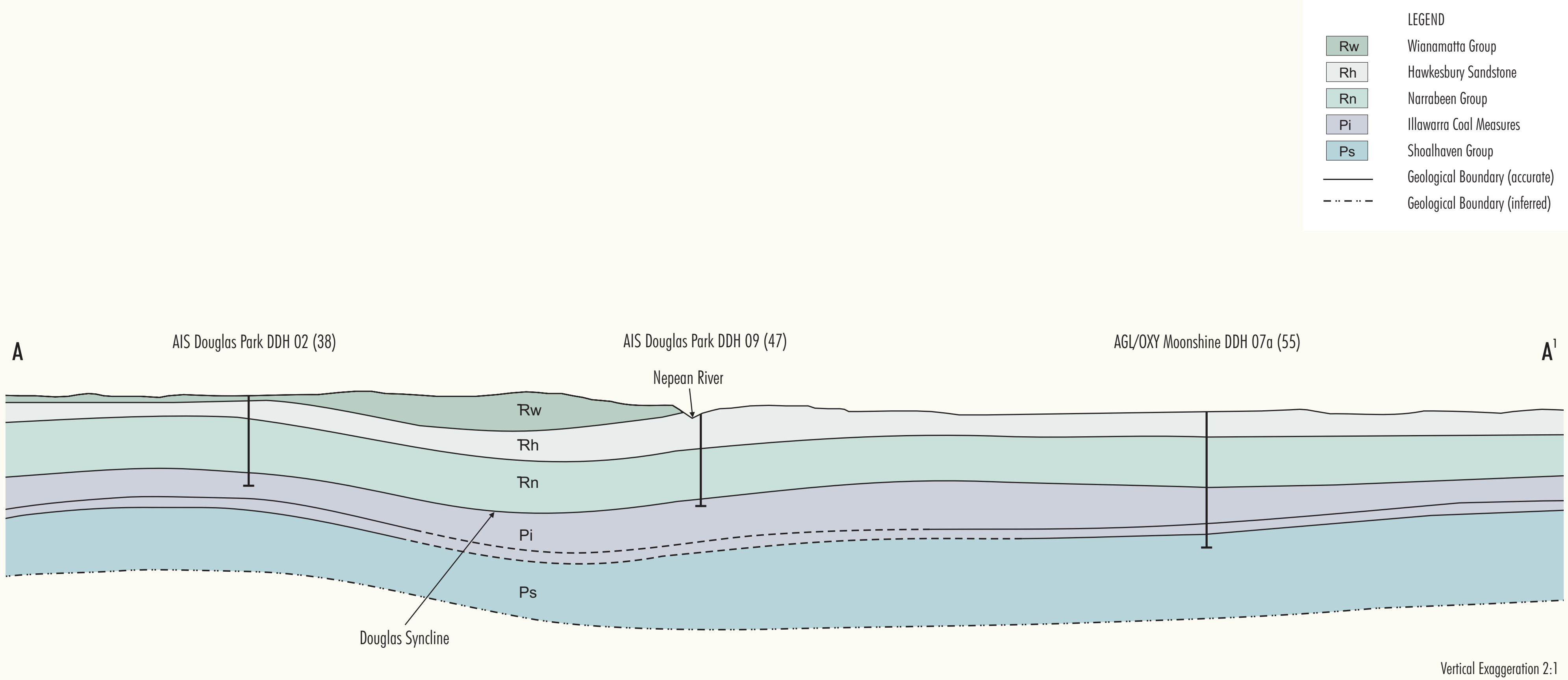
The Wianamatta Group is stratigraphically located above the Hawkesbury Sandstone and has been eroded for a significant portion of the Southern Coalfield. However, within the Project area the Wianamatta Group outcrops generally north-west of the Nepean River and Georges River and ranges in thickness up to greater than 150 m across the Razorback Range (Figure 2-1).

Typical stratigraphic sections of the Project area are shown on Figures 2-6 and 2-7.

ICHPL Exploration continues to develop a geological model across the Project area that is progressively updated with the most recent and reliable data.

There are a number of known major structures (e.g. faults or fault systems) in the vicinity of the Project extent of longwall mining area including the following (ICHPL, 2009):

- Nepean Fault Zone;
- O'Hares Fault;
- J-Line Fault;
- Area 7 series (A7F6 to A7F13);
- Stokes Fault System;
- Hakea Fault System;
- Scarborough Fault;
- Dahlia Fault;
- Pig Farm Fault; and
- Cobbong Fault.



Stratigraphic Cross Section A - A1 (Refer Figure 2-1 for Plan View)

Source: NSW Government (1999)

BULLI SEAM OPERATIONS

FIGURE 2-6
Stratigraphic Cross Section

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MEDIAN THICKNESS ACROSS PROJECT AREA (m)	FORMATION	GROUP
Varies*		WIANAMATTA
169	Hawkesbury Sandstone	HAWKESBURY SANDSTONE
13	Newport Formation	NARRABEEN
3	Garie Formation	NARRABEEN
25	Bald Hill Claystone	NARRABEEN
173	Bulgo Sandstone	NARRABEEN
17	Stanwell Park Claystone	NARRABEEN
33	Scarborough Sandstone	NARRABEEN
31	Wombarra Claystone	NARRABEEN
16	Coal Cliff Sandstone	NARRABEEN
2.5	**Bulli Seam**	ILLAWARRA COAL MEASURES
8	Loddon Sandstone	ILLAWARRA COAL MEASURES
		ILLAWARRA COAL MEASURES
7	Wongawilli Seam	ILLAWARRA COAL MEASURES
13	Kembla Sandstone	ILLAWARRA COAL MEASURES

*Note: Thickness of the Wianamatta Group across the Project Area varies significantly i.e. from 0 m (east) to >150 m (west)

Source: Heritage Computing (2009)

BULLI SEAM OPERATIONS

FIGURE 2-7
Indicative Stratigraphic Section - Project Area

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BHPIC EA Section 2_008D

In addition to the surface based exploration, the underground mining operations at Appin Mine and West Cliff Colliery undertake in-seam drilling in advance of mining. In-seam drilling is undertaken in order to identify minor geological structures and drain the gas from the Bulli Seam (and adjacent strata). The in-seam drilling has been undertaken since the 1970s to prevent outbursts (gas driven ejection of coal from the active mining face) which have caused fatalities in the Southern Coalfield (ICHPL, 2009).

In the year ending June 2009, Appin Mine and West Cliff Colliery had drilled 194,819 m (89,634 m and 105,185 m respectively) of in-seam holes and this is typical of the level of drilling undertaken each year in advance of ICHPL's operations (ICHPL, 2009).

The locations of the known major structures listed above are provided in Appendix A (Subsidence Assessment). Efforts are directed towards redesign of the longwall extraction plans around geological structures where the displacement is greater than 5 m (ICHPL, 2009).

Few intrusions of significance are known within the Project area. There is a tendency for intrusions to be associated with synclinal structures (e.g. the Douglas Park and Camden Synclines). Igneous dykes and sills have been mapped on the surface at various sites across the Project area. No diatremes have been identified in the Project area (ICHPL, 2009).

In general, individual structural features located within or near the Bulli Seam have not been identified at the surface despite focussed searches over several decades, nor have individual surface features been found to project to the Bulli Seam at depth (ICHPL, 2009).

Faults and dykes have the potential to adversely affect underground longwall mine development and extraction and would require specific management measures (e.g. dyke extraction by road header and installation of additional ground support or grouting).

The recoverable coal reserve for the Project based on the planned maximum production rate is approximately 306 Mt of ROM coal.[1]

During the life of the Project, mine exploration activities (including in-seam and surface-to-seam drilling) would continue to be undertaken ahead of the underground mining operations to investigate geological structures, seam gas content and composition and seam morphology as input to detailed mine planning and engineering studies. This data, in combination with surface exploration and underground mapping data would be used to build robust and accurate geological models upon which detailed mine plans can be developed.

Mine exploration activities would generally require only small surface areas and would involve the use of surface drilling rigs and supporting equipment, low-impact seismic acquisition, surface mapping and airborne and ground-based geophysical surveys.

Surface exploration activities would continue to be undertaken across the Project area.

There are areas within the Project extent of longwall mining that future exploration data may result in coal sterilisation (e.g. due to the presence of geological structures or anomalies). Such potential areas have been included in the Project extent of longwall mining by ICHPL on the basis that insufficient exploration data currently exists to justify their removal. ICHPL also recognises that mining technology will advance over the life of the Project, influencing the determination of the ultimate coal reserves.

[1] Accounting for coal sterilisation associated with potential geological structures and anomalies (based on historical coal sterilisation analysis [ICHPL, 2009]).

2.3 PROJECT GENERAL ARRANGEMENT

The Project general arrangement is shown on Figure 2-1 and for the purposes of the environmental assessment herein has been shown on Figures 2-8 to 2-11, namely:

- West Cliff Area 5 and Appin Area 7 (northern domains - contiguous with the current operations);
- North Cliff (eastern domain);
- Appin West (Area 9) and Appin Area 8 (western domains); and
- Appin Areas 2 and 3 Extended (southern domains).

These general arrangements show the proposed future development of the mining operations.[2]

The general arrangement of the Project utilises the existing infrastructure at the Appin Mine and West Cliff Colliery.

The main activities associated with the development of the Project would include:

- continued development of underground mining operations within existing coal leases and new mining leases to facilitate a total ROM coal production rate of up to 10.5 Mtpa;
- ongoing exploration activities within existing exploration tenements;
- upgrade of the existing West Cliff Washery to support the increased ROM coal production;
- continued mine gas drainage and capture for beneficial utilisation at the WestVAMP and Appin-Tower Power Project;
- continued generation of electricity by the existing Appin-Tower Power Project (owned and operated by EDL) utilising coal bed methane drained from the underground mine workings;
- upgrade of existing surface facilities and supporting infrastructure (e.g. service boreholes, ventilation shafts, gas drainage equipment, sumps, pumps, pipelines, waste water treatment and waste water disposal);
- continued and expanded placement of coal wash at the West Cliff Coal Wash Emplacement;
- continued road transport of ROM coal from the Appin East pit top to the West Cliff Washery;
- continued road transport of ROM coal via the public road network from Appin East pit top and West Cliff pit top to the Dendrobium Washery at Port Kembla;
- continued road transport of product coal from the West Cliff Washery via the public road network to BlueScope Steelworks, PKCT, Corrimal and Coalcliff Coke Works and other customers;
- ongoing surface monitoring and rehabilitation (including rehabilitation of mine related infrastructure areas that are no longer required) and remediation of subsidence effects; and
- other associated minor infrastructure, plant, equipment and activities.

The Project would extend the life of the current operations at the Appin Mine and West Cliff Colliery by approximately 30 years.

It is anticipated that the Project Approval would consolidate existing approvals for the existing activities at the Appin Mine and West Cliff Colliery that would form part of this Project. The existing Development Consent (DA 60-03-2001) for the Dendrobium Mine would not be modified or superseded by this Project Approval.

Over the life of the Project, the mining layout may vary from that shown on Figures 2-8 to 2-11 to take account of: localised geological features; mine economics; market volume requirements; detailed mine design considerations; and adaptive management. The mining layout over any given period would be documented in the relevant Mining Operations Plan (MOP) and SMP as required by the DPI-MR, or Extraction Plans (Section 7.3.1).

Should the mining layout vary, the Project general arrangement (Figure 2-1) may also vary to take into consideration detailed design aspects for Project infrastructure components.

[2] Subject to detailed design, underground mine development workings (i.e. non-subsiding) may also occur outside of the extent of longwall mining area shown on Figures 2-8 to 2-11.

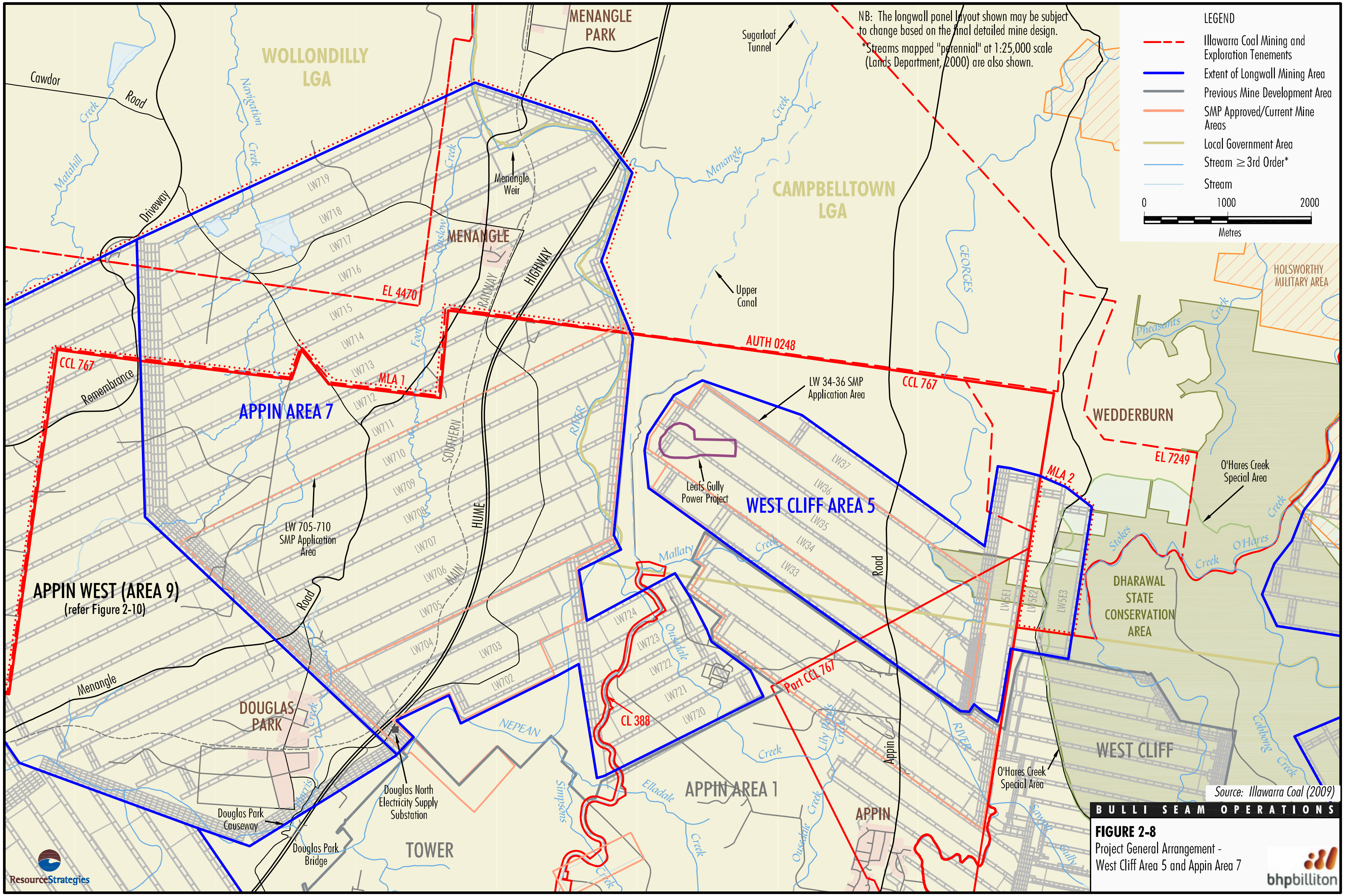

FIGURE 2-8
Project General Arrangement - West Cliff Area 5 and Appin Area 7

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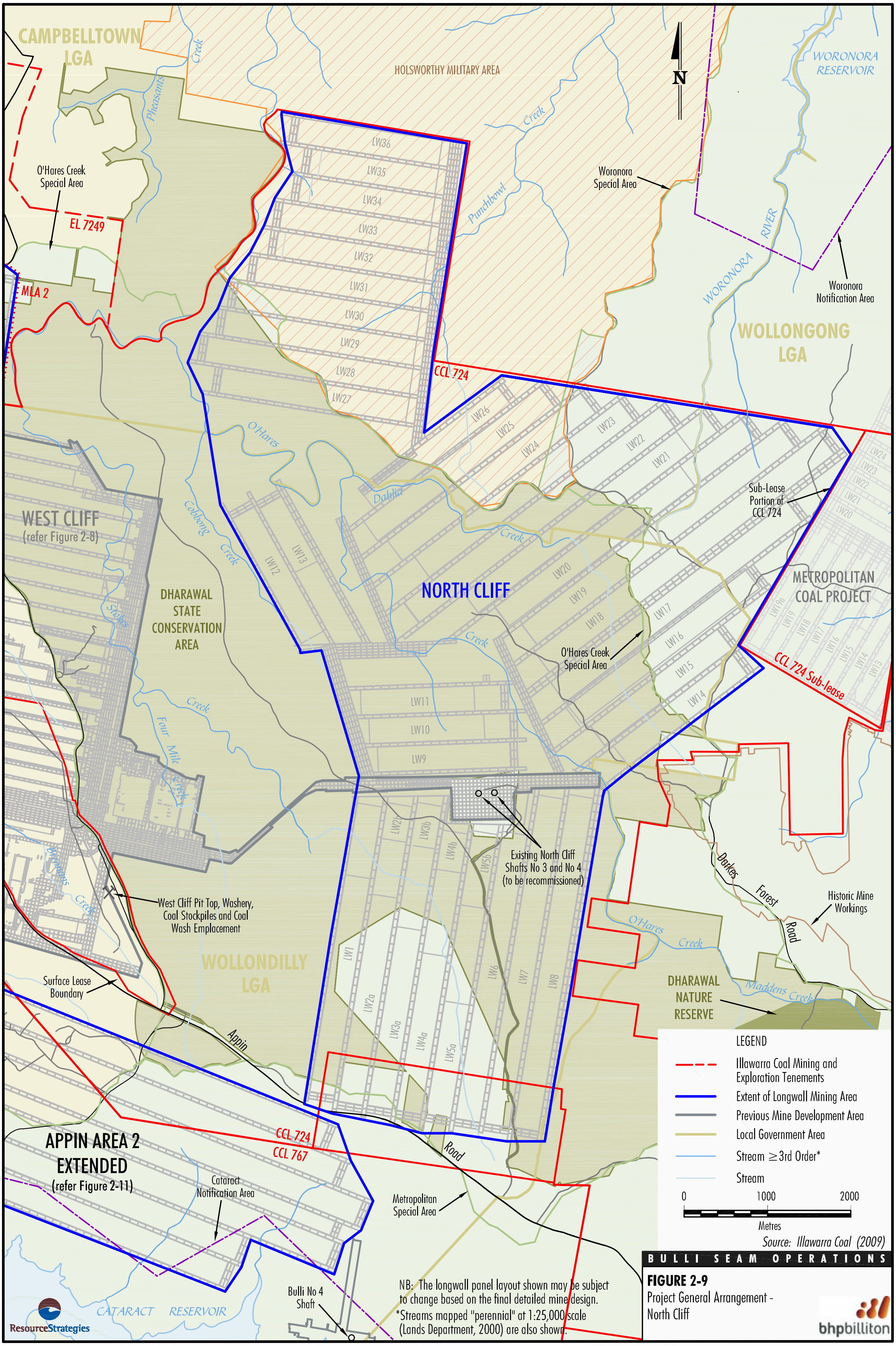

BULLI SEAM OPERATIONS

FIGURE 2-9
Project General Arrangement - North Cliff

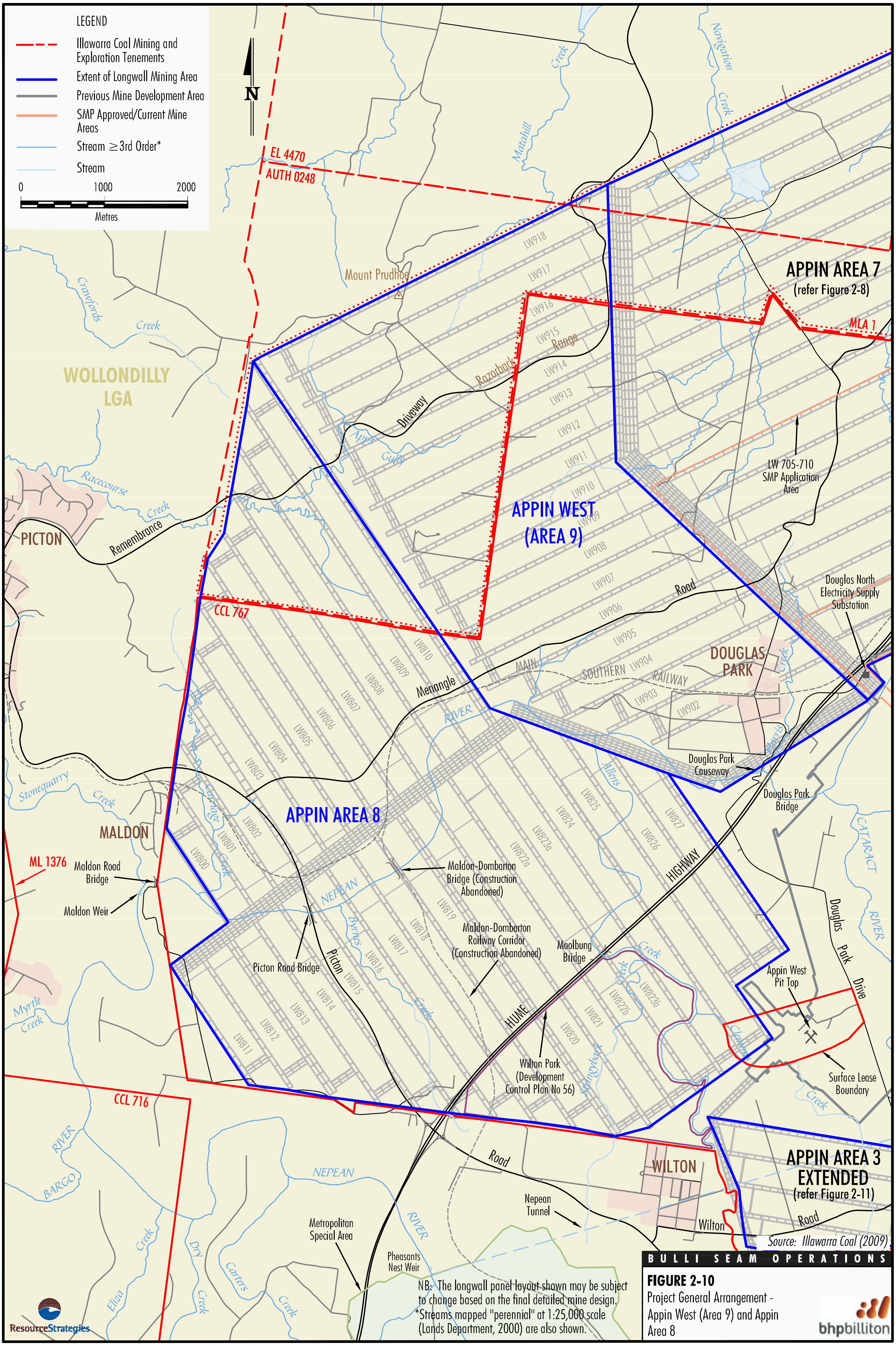

FIGURE 2-10
Project General Arrangement - Appin West (Area 9) and Appin Area 8

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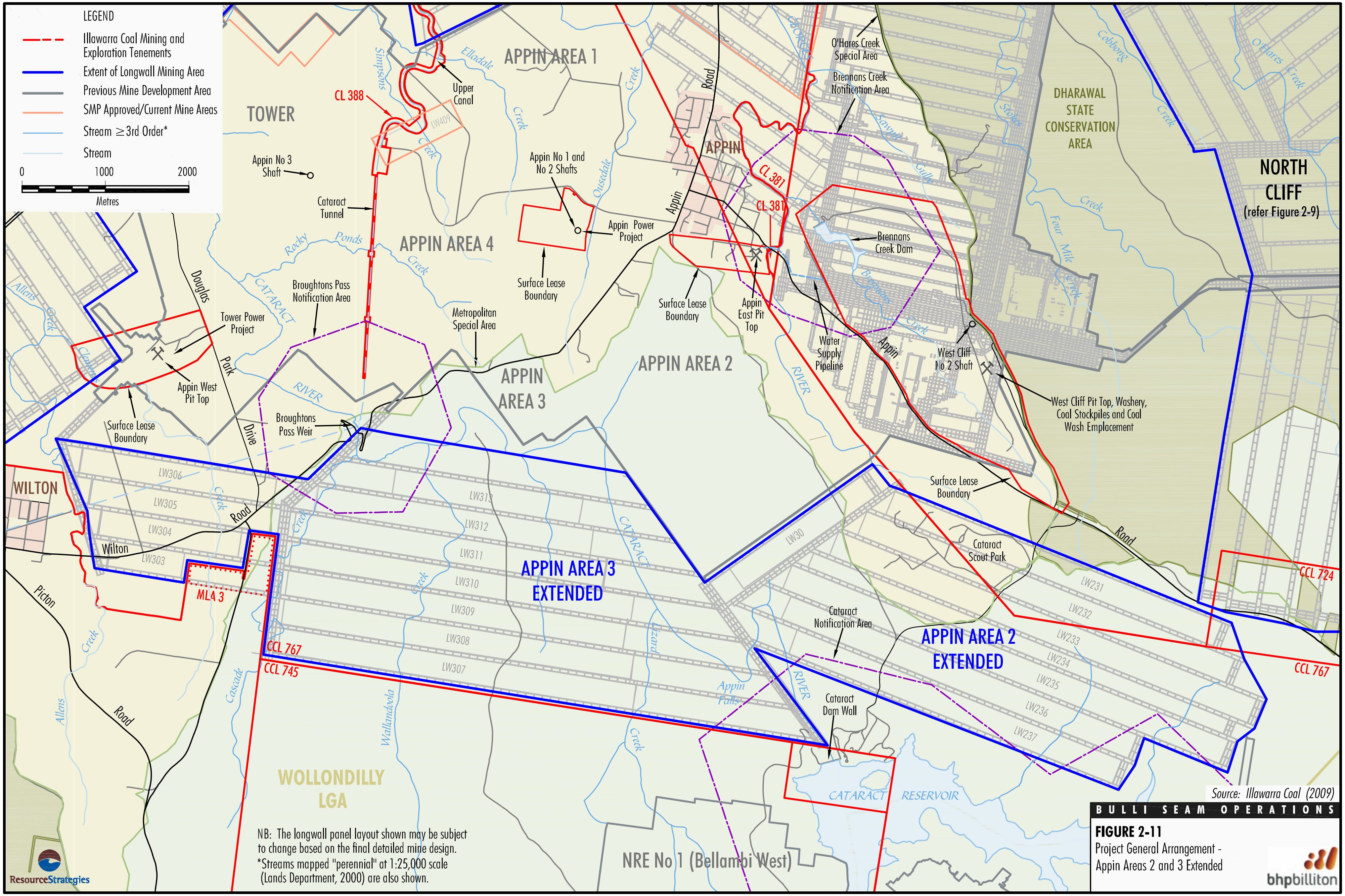


BULLI SEAM OPERATIONS

FIGURE 2-11
Project General Arrangement - Appin Areas 2 and 3 Extended

BHPIC-07-01 EA Section 2_1030

2.4 PROJECT CONSTRUCTION/ DEVELOPMENT ACTIVITIES

The Project utilises existing pit tops and supporting infrastructure. Additional infrastructure upgrades to existing infrastructure which are required to support the Project would be progressively developed in parallel with ongoing mining operations, including:

- longwall mining machinery upgrades;
- upgrades of the underground materials handling and transport systems;
- upgrades to ROM coal, product coal and coal wash stockpiles;
- upgrade of the existing West Cliff Washery (incorporating the West Cliff CPP Reliability Improvement Project) to support the increased ROM coal production; and
- upgrades of the existing surface facilities and supporting infrastructure.

The above activities are described in more detail below.

Surface construction/development activities would generally be undertaken during daytime hours up to seven days per week. Additional mobile equipment would be required for short periods during the Project construction/development activities including mobile cranes, excavators, loaders and delivery trucks. The number and type of equipment would be expected to vary depending on the activity being undertaken. Further details are provided in the Noise Impact Assessment (Appendix I).

2.4.1 Longwall Mining Machinery Upgrades

The Project would include upgrades of the longwall machinery to increase the coal cutting rate in line with ROM coal production at each longwall operation.

Over the life of the Project it is anticipated that a range of underground mining equipment would be replaced or upgraded as a component of general maintenance or to increase efficiency.

2.4.2 Materials Handling and Transport System Upgrades

ROM coal from the underground mining operations is conveyed to the surface at the Appin East pit top (for transport via road to the West Cliff Washery for stockpiling and later reclaim) or to the West Cliff pit top (for direct feed to the West Cliff Washery or temporarily stockpiled for later reclaim). Some ROM coal is transported to the Dendrobium Washery (Figure 2-12).

The existing capacity of the underground materials handling system would be increased in line with ROM coal production through replacement or upgrades of conveyors, sizers, drives, winders and supporting systems. The upgrade works would be undertaken progressively during the life of the Project.

Truck movements between the Appin East pit top and the West Cliff Washery would increase in line with the ROM coal production rate from the underground longwall operation.

2.4.3 West Cliff Washery Reliability Improvement Project

The Project would increase the capacity of the West Cliff Washery (incorporating the West Cliff CPP Reliability Improvement Project) in line with ROM coal production. The Project is generally within its current disturbance footprint and would replace or add components during the life of the Project. A schematic flowsheet of the West Cliff CPP, including the major processing components that would be replaced or added as part of the Project is provided on Figure 2-13.

The Reliability Improvement Project was approved by the Director-General of the DoP on 17 August 2009 (DA 08_0243) and includes (Figure 2-13):

- installation of additional components including:
  - rotary breaker and screen house;
  - coarse and fine coal storage bins;
  - triple roll crusher;
  - small coal circuit modules (e.g. desliming screens, primary and secondary cyclones, centrifuges);
  - flotation cells and installation of a teetered bed separator;
  - coal and tailings thickeners; and
  - belt filters and tailings presses;

- replacement of the existing Baum jig with a dense medium drum;
- upgrades of existing conveyor systems and other structural elements including piping, pumps, sumps, safety and auxiliary systems to support the additional throughput capacity; and
- upgrades of power supply systems to provide additional capacity and back-up supply.

The upgrades as part of the Reliability Improvement Project are included and shown on Figure 2-13.

Prior to upgrading the West Cliff Washery, detailed feasibility and design work would be undertaken to confirm the capacities and number of equipment required. These upgrades to the West Cliff Washery would increase the current throughput in line with ROM coal production (i.e. 10.5 Mtpa) and improve coal recovery and efficiency.

2.4.4 Surface Facilities and Supporting Infrastructure Upgrades

The major upgrades to the surface facilities and supporting infrastructure areas are shown on Figures 2-2 to 2-5. These would generally be within the current disturbance footprint as they would involve replacement, upgrade or addition of existing components during the life of the Project. The upgrades may include, but would not necessarily be limited to the following:

- extensions of bath houses (e.g. change rooms) and administration buildings;
- extensions of workshops and storage areas (e.g. sheds);
- new contractor areas (e.g. laydown areas);
- additional supporting infrastructure for shaft upgrades (e.g. for man riding/materials handling capabilities and installation of fans for airflow improvement);
- development of an explosives storage facility at Appin West pit top;
- bin and coal loader upgrades at Appin East pit top;
- decommissioning of existing coal loading infrastructure;
- additional car parking facility at Appin West pit top;
- water treatment facility upgrades for additional water supply capacity;
- upgrades of the methane drainage plants at Appin West pit top and Appin No.1 and No.2 shafts and fan site;
- improvements to site security arrangements (e.g. installation of boom gates); and
- extensions of personal emergency device (PED) communications systems.

Depending on the actual scheduling and timing of the longwall operations over the life of the Project, the underground operational workforce access may, at times, vary between the three pit tops, including being centralised around the Appin West pit top. Upgrades of the Appin West pit top surface facilities would therefore be undertaken during the life of the Project to accommodate the additional workforce.

Upgrades/extensions of existing coal seam gas management and surface ventilation infrastructure and systems are described in Sections 2.5.5 and 2.5.6, respectively.

2.5 UNDERGROUND MINING OPERATIONS

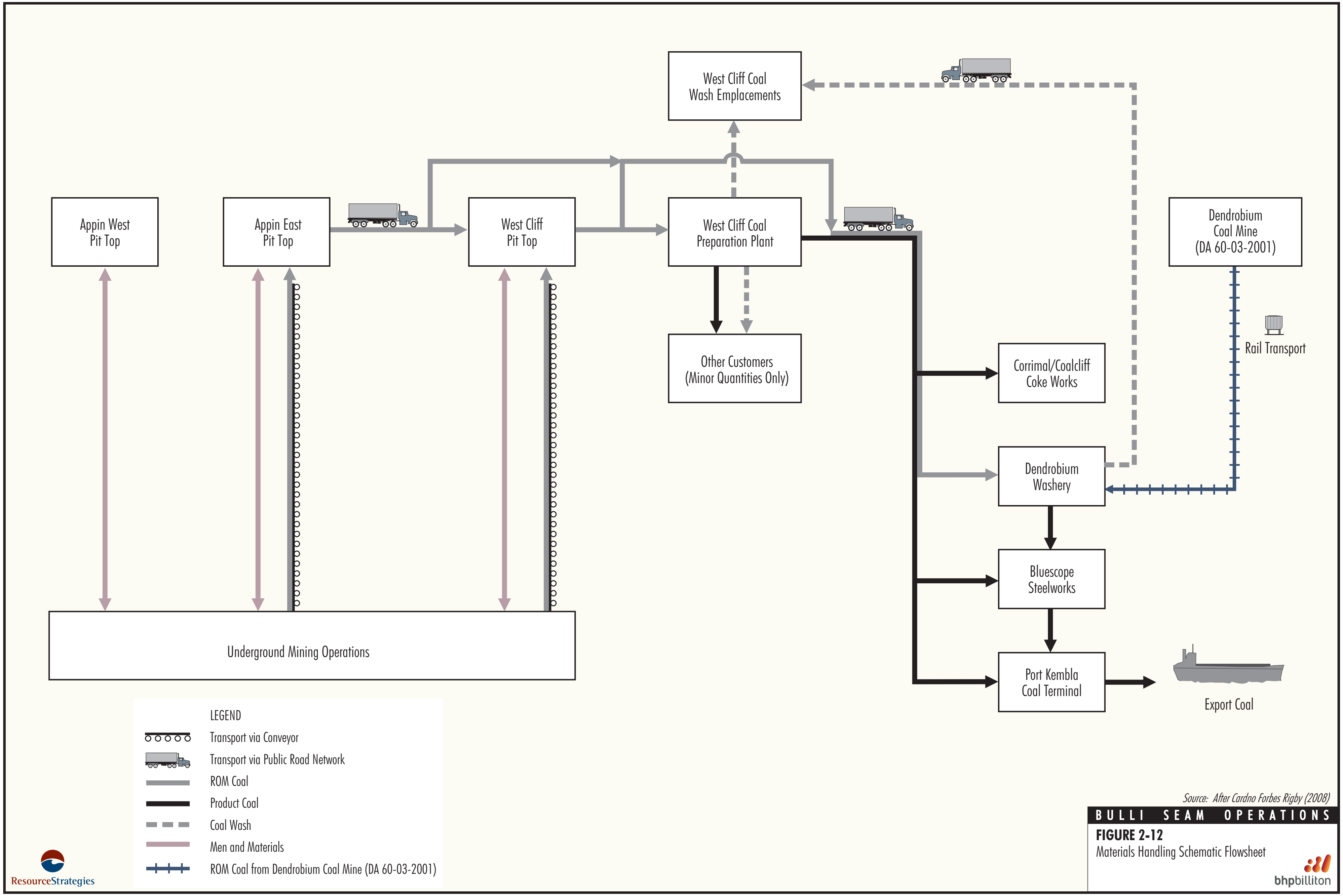
ICHPL is currently mining Longwall 33 at West Cliff Area 5 and Longwall 409 at Appin Area 4 in accordance with SMP approvals by the DPI-MR.

Underground mining operations would continue at the Appin Mine and West Cliff Colliery with development to extend to the north (Appin Area 7 and West Cliff Area 5), east (North Cliff), west (Appin West [Area 9] and Appin Area 8) and south (Appin Areas 2 and 3 Extended) (Figures 2-1 and 2-8 to 2-11).

Underground mining operations would be conducted 24 hours per day, seven days per week.

2.5.1 Indicative Mine Schedule

The indicative mine schedule for the Project presented in Table 2-2 is based on the planned maximum ROM coal production rate of up to 10.5 Mtpa. The actual timing and mining sequence however may vary to take account of: localised geological features; coal quality characteristics; detailed mine design; mine economics; market volume requirements, and/or adaptive management requirements.



Source: After Cardno Forbes Rigby (2008)

BULLI SEAM OPERATIONS

FIGURE 2-12
Materials Handling Schematic Flowsheet

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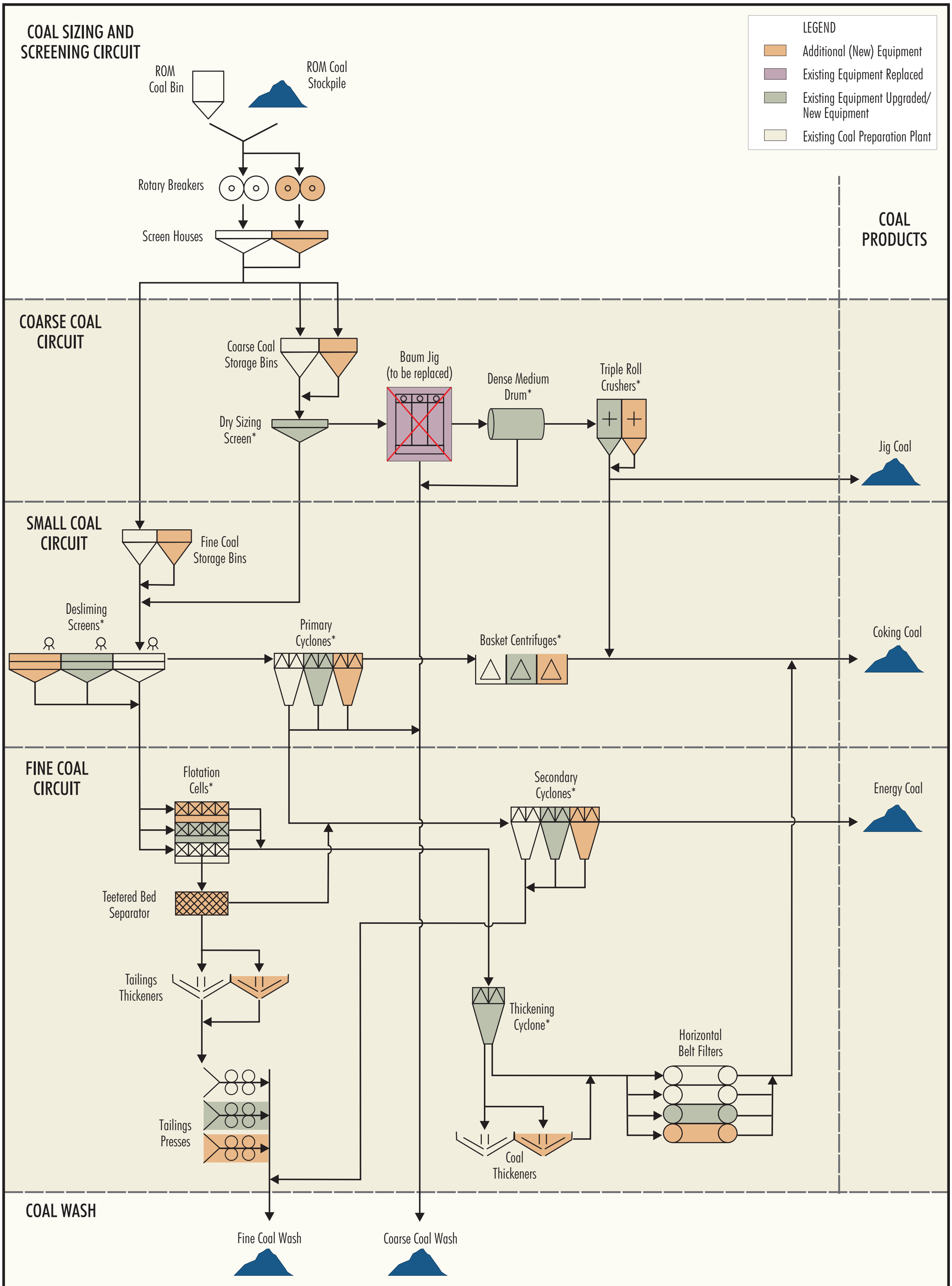

After: Cardno Forbes Rigby (2008)

BULLI SEAM OPERATIONS

FIGURE 2-13
West Cliff CPP Schematic Flowsheet

* Including upgrades as part of the Reliability Improvement Project

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A summary of the boundaries for each of the extent of longwall mining areas is provided below:

- ***West Cliff Area 5*** (Figure 2-8) – The proposed longwalls are located to the north and east of the current West Cliff Area 5 workings and are bounded by known geological fault zones which extend along the northern boundary of CCL 767.
- ***Appin Area 7*** (Figure 2-8) – The Appin Area 7 proposed longwalls are contiguous with Appin Longwalls 701 to 704 and include Longwalls 705 to 710 that are currently awaiting SMP approval by the DPI-MR. The proposed longwalls would continue to extend to the north into AUTH 0248 and EL 4470. The Nepean River is located towards the eastern extent of Appin Area 7. To the west, the proposed longwalls extend to the main headings of the Appin West (Area 9) longwalls (refer below). A series of longwalls on the south-east side of the Nepean River are also proposed as part of Appin Area 7 and are bound by the historic Appin Area 1 workings and the current West Cliff Area 5 workings in the south and east, respectively.
- ***Appin West (Area 9)*** (Figure 2-10) – The proposed longwalls at Appin West (Area 9) are located north of the Nepean River and immediately west of Appin Area 7. The main headings for the proposed longwalls are contiguous with Appin Area 7. The proposed longwalls extend to the west, immediately adjacent to Appin Area 8.
- ***Appin Area 8*** (Figure 2-10) – The proposed longwalls at Appin Area 8 are located to the south-west of Appin West (Area 9). The proposed longwalls extend both north and south of the Nepean River to the western and southern boundaries of CCL 767, respectively. The historic Tower workings are to the east of the proposed longwalls located south of the Nepean River.
- ***Appin Area 2 and 3 Extended*** (Figure 2-11) – The proposed longwalls extend south of the historic Appin Areas 2, 3 and 4 mine workings. The proposed longwalls generally extend to the southern boundary of CCL 767. The proposed longwalls do not extend beneath the Cataract Reservoir.
- ***North Cliff*** (Figure 2-9) – The proposed longwalls are located to the north and south of the existing development drives and North Cliff shafts. The longwalls to the south extend to the southern and eastern boundaries of CCL 724. The longwalls to the north are bound by the northern boundary of CCL 724 and extend to the east to the adjacent Metropolitan Coal Project (owned and operated by Helensburgh Coal Pty Ltd). The western boundary of the North Cliff longwalls is largely constrained by known geological structures including the Stokes Fault System, Hakea Fault System, O'Hares Fault and Cobbong Fault.

The longwall layout design objectives based on the surface features within each of the extent of longwall mining areas are further described in Section 2.5.2.

2.5.2 Coal Mining and Subsidence Effects

The operational methodology and equipment currently in use at the Appin Mine and West Cliff Colliery would also be employed for the Project, subject to equipment upgrades as described in Section 2.4.

The Bulli Seam varies in thickness from approximately 2.0 to 3.5 m within the Project extent of longwall mining area (increasing from the south to the north-west) and it is expected that its full thickness would be extracted during the Project underground operations.

Longwall Mining Operation and Subsidence Effects

Longwall mining involves extraction of rectangular panels of coal defined by underground roadways constructed around each longwall (Figure 2-14). The longwall mining machine travels back and forth across the width of the coal face progressively removing coal in slices from the panel. Once each slice of coal is removed from the longwall face, the hydraulic roof supports are moved forward, allowing the roof and a section of the overlying strata to collapse behind the longwall machine (referred to as forming the 'goaf') (Figure 2-14).

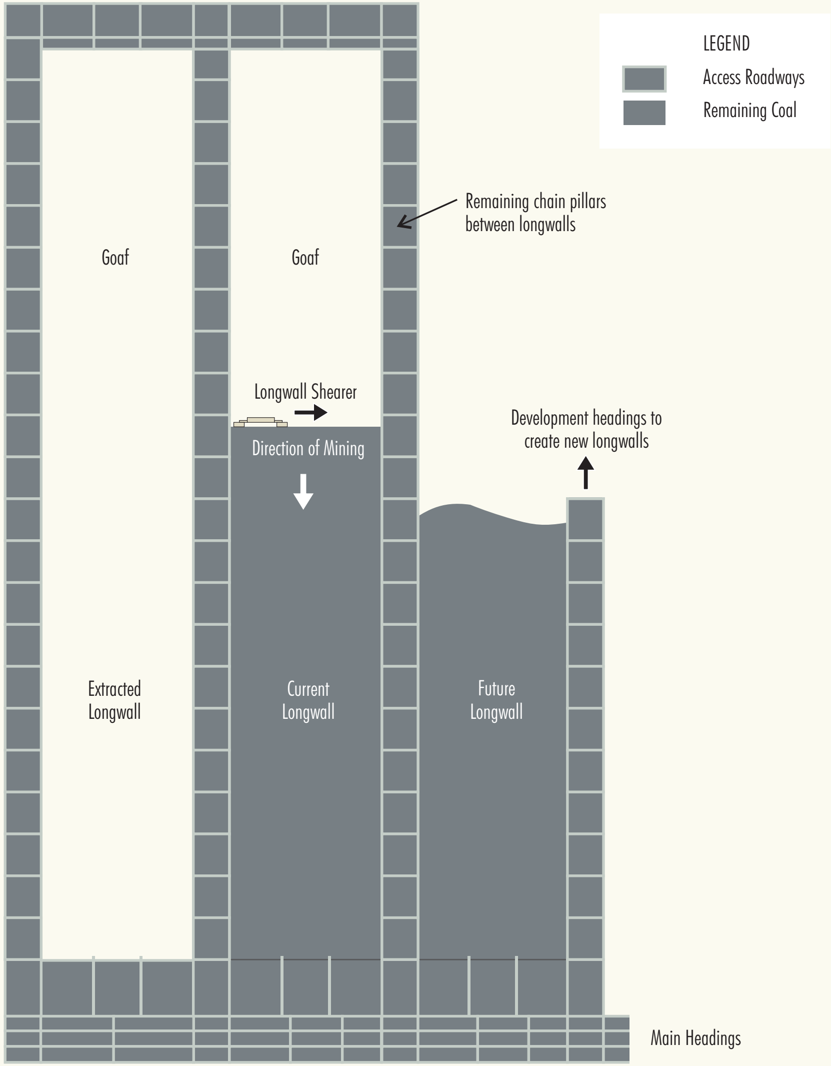
Extraction of coal by longwall mining methods results in the vertical and horizontal movement of the land surface. The land surface movements are generically referred to as subsidence effects. The type and magnitude of the subsidence effects is dependant on a range of variables (e.g. mine geometry, topography and geology) and are described in detail in the Subsidence Assessment (Appendix A) and in Section 5.4.

Table 2-2
Indicative Mine Schedule

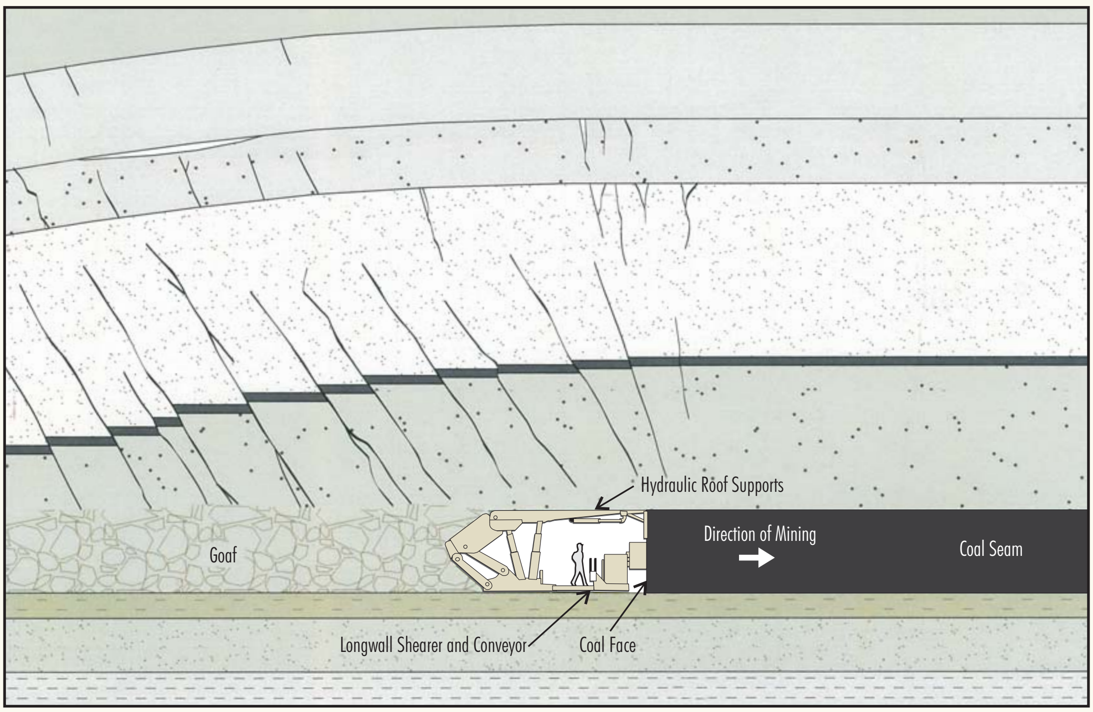
Year	Total ROM Coal (Mtpa)[1]	Project Coal Wash Production (Mtpa)	Total Product Coal (Mtpa)
1	7.5	1.2	6.3
2	10.5	1.2	9.3
3	10.5	1.3	9.2
4	10.5	1.4	9.1
5	10.5	1.4	9.1
6	10.5	1.4	9.1
7	10.5	1.5	9.0
8	10.5	1.6	8.9
9	10.5	1.6	8.9
10	10.5	1.6	8.9
11	10.5	1.5	9.0
12	10.5	1.7	8.8
13	10.5	1.7	8.8
14	10.5	1.7	8.8
15	10.5	1.9	8.6
16	10.5	1.9	8.6
17	10.5	1.5	9.0
18	10.5	1.4	9.1
19	10.5	1.6	8.9
20	10.5	1.8	8.7
21	10.5	1.9	8.6
22	10.5	1.6	8.9
23	10.5	1.7	8.8
24	10.5	1.6	8.9
25	10.5	1.5	9.0
26	10.5	1.5	9.0
27	10.5	1.6	8.9
28	10.5	1.5	9.0
29	10.5	1.5	9.0
30	4.9	0.7	4.2
Total	306.4	46.0	260.4

Source: ICHPL (2009)

[1] The total ROM coal quantities include ROM coal associated with development and longwall extraction and accounts for sterilisation of the coal resource (based on historic coal sterilisation analysis).



Plan View



Section View

Source: After Hansen Consulting (2008)

BULLI SEAM OPERATIONS

FIGURE 2-14
Longwall Mining Method - Conceptual Cross Section and Plan

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Subsidence effects are described in this EA as follows (Appendix A):

- ***Systematic Subsidence Movements***
  - *Subsidence* – usually refers to vertical movement of a point at the surface and is expressed in units of millimetres (mm). In the Southern Coalfield it is generally accepted that the maximum subsidence is up to approximately 65% of the extracted seam thickness (for single seam operations).
  - *Tilt* – is the change in the slope of the land surface as a result of differential subsidence and is expressed in units of millimetres per metre (mm/m) or a change in grade where 1 mm/m = 0.1%.
  - *Curvature* – is the rate of change of tilt over distance (or bending of the land surface) and is expressed in units of 1/km or is inverted to obtain the radius of curvature expressed in units of km. Locations that experience 'hogging' curvature are more likely to experience tensile strains and locations that experience 'sagging' curvature are more likely to experience compressive strains. A multiplication factor of 15 to the curvature provides a reasonable estimate for the average tensile and compressive strains.
  - *Tensile Strain* – is the change in horizontal distance between two points at the surface where the distance increases (i.e. stretching) and is typically expressed in units of mm/m. The strain is typically measured over a standard bay length.[3]
  - *Compressive Strain* – is the change in horizontal distance between two points at the surface where the distance decreases (i.e. squeezing) and is typically expressed in units of mm/m. The strain is typically measured over a standard bay length.[3]
  - *Horizontal Movement* – is the absolute horizontal movement of a point at the surface and is expressed in units of mm.

The above systematic subsidence movement parameters vary during and following longwall extraction, and can be influenced by previously extracted (historic) longwalls, and are therefore defined as follows:

- *Travelling* – transient strains, tilts and curvatures which occur as the longwall extraction face mines directly beneath a point on the surface.
- *Incremental* – additional subsidence, strains, tilts and curvatures as a result of extraction of an individual longwall.
- *Cumulative* – accumulated subsidence, strains, tilts and curvatures as a result of the extraction of a group of longwalls.
- *Total* – accumulated subsidence, strains, tilts and curvatures which occur as a result of previously extracted (historic) longwalls and the extraction of all the Project longwalls.

- ***Non-Systematic Subsidence Movements***
  - *Valley Related Movements* – are commonly observed along stream alignments in the Southern Coalfield and are natural phenomena resulting from the formation and ongoing development of valleys. These movements can be accelerated by mining.
    - *Upsidence* – is the reduced subsidence, bulging or relative uplift movement within the base of a valley and is typically expressed in units of mm. Upsidence typically results from the dilation or buckling of near surface-strata in the base of the valley.
    - *Closure* – is the reduction in the horizontal distance between the valley sides and is expressed in units of mm.
    - *Compressive Strain* – occurs within the valley as a result of valley closure movements and is calculated as the decrease in horizontal distance over a standard bay length, divided by the original bay length[3].
  - *Irregular Subsidence Movements* – can result from near surface geological structures (e.g. faults) and abrupt changes in geology. The presence of these features near the surface can result in anomalies in the subsidence profile resulting in locally variable tilts and strains.

3 As a standard for comparison of strains with other locations in the Southern Coalfield, bay lengths are equal to the depth of cover (between the surface and the seam) divided by 20.

- ***Far-Field Horizontal Movements***

Far-field horizontal movements have been observed in the Southern Coalfield at considerable distances (km) from extracted longwalls. Far-field horizontal movements are typically small (only detected by precise survey); tend to be movements towards the extracted longwall area; and are accompanied by low levels of strain (e.g. <0.1 mm/m).

- ***Sub-Surface Strata Movements***

Sub-surface strata movements as a result of longwall extraction have been described by a number of different authors using varying terminology. For the purposes of this EA, the following zones have been adopted:

– *Caved or Collapsed Zone* – comprises loose blocks of rock detached from the roof strata occupying the cavity formed by mining.

– *Disturbed or Fractured Zone* – comprises *in-situ* material lying immediately above the caved or collapsed zone which have sagged downwards and consequently suffered bending, fracturing, joint opening and bed separation.

– *Constrained or Aquiclude Zone* – comprises confined rock strata above the disturbed or fractured zone which have sagged slightly but, because they are constrained, have absorbed most of the strain energy without suffering significant fracturing or alteration to the original physical properties. Some bed separation or slippage can be present as well as discontinuous vertical cracks, usually on the underside of thick competent stratum.

– *Surface Zone* – comprises unconfined strata at the ground surface in which mining induced compressive and tensile strains may result in the formation of surface cracking or ground heaving.

An analysis of the likely height of each of the above zones overlying the extracted longwalls is provided in Appendix A.

The types and magnitudes of each of the above systematic, non-systematic and sub-surface strata movements are used in determining a range of potential subsidence effects as follows:

- displacement (e.g. total subsidence and horizontal movements);
- surface cracking (e.g. total compressive and tensile strains);
- fracturing of rockbars/bedrock in streams (e.g. valley closure);
- changes in stream/swamp bed gradients (e.g. total tilt);
- erosion/scouring (e.g. incremental and total tilt and curvature);
- changes in stream alignment (e.g. total tilt and curvature);
- increased ponding/flooding (e.g. total subsidence); and
- depressurisation of groundwater aquifers (e.g. sub-surface strata movements).

Assessment of the environmental consequences of the subsidence effects described above on groundwater resources, surface water resources, aquatic ecology, terrestrial flora, terrestrial fauna, Aboriginal cultural heritage, non-Aboriginal heritage and visual character are provided in Sections 5.5 to 5.11 and Section 5.19, respectively.

Longwall Layout Design Objectives

The Project underground mining areas have been divided into several domains corresponding to the extent of longwall mining areas.

The longwall layouts shown on Figures 2-8 to 2-11 are herein referred to as the EA Base Plan Longwalls. The longwall layout shown on Figures 2-8 to 2-11 has been designed to meet specific impact minimisation criteria for streams, cliffs and major infrastructure items. The objectives of these impact minimisation criteria are further described below.

There are a number of alternative longwall layouts which may also meet these design objectives. Sensitivity analyses of alternative longwall layouts are included in the Subsidence Assessment (Appendix A). The final detailed design of the longwall layouts would be subject to review and approval as a component of future Extraction Plans developed in consultation with the relevant authorities and to the satisfaction of the Director-General of the DoP (Section 7.3.1).

West Cliff Area 5

Stream impact minimisation criteria have been applied to two streams in West Cliff Area 5, namely the Georges River and Stokes Creek.

The longwall layout at West Cliff Area 5 would be designed to avoid significant fracturing of rockbars that could result in the draining of associated pools along Georges River and Stokes Creek. Achievement of this criteria would also result in a significant reduction of subsidence effects on sections of the streams between each rockbar feature (Appendix A).

Stream mapping including the identification of rockbars along the Georges River and Stokes Creek is provided in the Stream Risk Assessment (Appendix P).

Appin Area 7

Stream impact minimisation criteria have been applied to the Nepean River in Appin Area 7. The longwall layout would be designed not to directly undermine the Nepean River. This would result in a reduction in potential subsidence effects (Appendix A).

The longwall layout at Appin Area 7 would be designed to minimise impacts such as cliff falls along the Nepean River by applying a minimum setback distance of (i.e. whichever gives the greater distance from the Nepean River) (Appendix A):

- 50 m from the top of mapped cliff lines; and
- 50 m from the transition from steep slope to the Nepean River alluvium/colluvium zone.

Minimum setback distances of a 35 degree (^{o}) angle of draw from the Menangle Weir and road/rail bridges across the Nepean River would also be applied to the longwall layout to maintain the structural integrity of the weir and road/rail bridges. Further details are provided in Appendix A.

Appin West (Area 9)

Stream impact minimisation criteria have been applied to the Nepean River at Appin West (Area 9).

The longwall layout in Appin West (Area 9) would be designed to avoid significant fracturing of rockbars that could result in the draining of associated pools along the Nepean River upstream of the inundation area associated with the Douglas Park Causeway (i.e. upstream of the Allens Creek confluence). Achievement of this criteria would also result in a significant reduction of subsidence effects on sections of the Nepean River between each rockbar feature (Appendix A).

Stream mapping including the identification of rockbars along the Nepean River is provided in the Stream Risk Assessment (Appendix P).

The longwall layout at Appin West (Area 9) would be designed to minimise impacts such as cliff falls along the Nepean River, by applying a minimum setback distance of 50 m from the top of mapped cliff lines.

A minimum setback distance of a 35^{o} angle of draw from the Douglas Park Twin Bridges (where the Hume Highway crosses the Nepean River) would also be applied to the longwall layout design to maintain the structural integrity of the bridge. Further details are provided in Appendix A.

Appin Area 8

Stream impact minimisation criteria have been applied to the Nepean River in Appin Area 8.

The longwall layout at Appin Area 8 would be designed to avoid significant fracturing of rockbars that could result in the draining of associated pools along the Nepean River, upstream of the inundation area associated with the Douglas Park Causeway (i.e. upstream of the Allens Creek confluence). Achievement of this criteria would also result in a significant reduction of subsidence effects on sections of the Nepean River between each rockbar feature (Appendix A).

Stream mapping including the identification of rockbars along the Nepean River is provided in the Stream Risk Assessment (Appendix P).

The longwall layout at Appin Area 8 would be designed to minimise impacts such as cliff falls along the Nepean River, by applying a minimum setback distance of 50 m from the top of mapped cliff lines.

A minimum setback distance of a 35^{o} angle of draw from the Moolbung Bridge[4] (where the Hume Highway crosses Allens Creek) has also been applied to the longwall layout design to maintain the structural integrity of the bridge. Further details are provided in Appendix A.

Appin Areas 2 and 3 Extended

Stream impact minimisation criteria have been applied to three streams in Appin Areas 2 and 3 Extended, namely the Cataract River, Lizard Creek and Georges River.

The longwall layout at Appin Areas 2 and 3 Extended would be designed to avoid impacts such as significant fracturing of rockbars that could result in the draining of associated pools along the Cataract River and Lizard Creek. Achievement of this criteria would also result in a significant reduction of subsidence effects on sections of the streams between each rockbar feature (Appendix A).

The longwall layout would also be designed not to directly undermine the headwater reach of the Georges River (i.e. labelled as “perennial” on 1:25,000 topographic mapping [Lands Department, 2000]. This would result in a reduction in potential subsidence effects in this reach of the Georges River (Appendix A).

Stream mapping including the identification of rockbars along the Cataract River, Lizard Creek and Georges River is provided in the Stream Risk Assessment (Appendix P).

The final detailed design of the longwall layouts which extend into the Cataract and Broughtons Pass Notification Areas (Figure 2-11) would conform to the requirements of the Dams Safety Committee (DSC), including appropriate setback distances from the Cataract Reservoir dam wall and the Broughtons Pass Weir to maintain the structural integrity of the dam wall and weir.

ICHPL would seek separate DSC approval prior to mining within the notification areas. Further details are provided in Appendix A.

North Cliff

Stream impact minimisation criteria have been applied to three streams in North Cliff, namely O’Hares Creek, Stokes Creek and Woronora River.

The longwall layout at North Cliff would be designed to avoid significant fracturing of rockbars that could result in the draining of associated pools along O’Hares Creek and Stokes Creek downstream of Longwall 5a (Figure 2-9). Achievement of this criteria would also result in a significant reduction of subsidence effects on sections of the streams between each rockbar feature (Appendix A).

The longwall layout would also be designed not to directly undermine the headwater reach of the Woronora River (i.e. labelled as “perennial” on 1:25,000 topographic mapping [Lands Department, 2000]. This would result in a reduction in potential subsidence effects in this reach of the Woronora River (Appendix A).

Stream mapping including the identification of rockbars along O’Hares Creek, Stokes Creek and Woronora River is provided in the Stream Risk Assessment (Appendix P).

2.5.3 Underground Mine Access, Development Works and ROM Coal Handling

Underground Mine Access and Development Works

Men and materials access to the underground mining operations would continue to be via main drifts and shafts located at the West Cliff, Appin East and Appin West pit tops (Figures 2-2 to 2-4).

In order to shorten the distance required for underground coal transport, additional drift extensions would be developed during the life of the Project including underground linkages between the Appin Mine and West Cliff Colliery.

In December 2005, Illawarra Coal separately lodged a Project Application and Preliminary Assessment with the DoP for the Endeavour Project Surface Components (the Endeavour Project) at the West Cliff Colliery.

4 Also known as Moolgun Bridge.

The Endeavour Project included (Figure 2-2):

- a drift portal;
- conveyor head end structure;
- winder house;
- workshop;
- electrical switchroom and substation; and
- coal handling area including coal conveyors, transfer bins, and coal stockpiles.

The Director-General issued EARs for the Endeavour Project (Application Number 05_0201) on 20 January 2006[5].

The Endeavour Project would enable coal that would otherwise surface at the Appin East pit top (and require road haulage to the West Cliff pit top) to be conveyed directly to the surface adjacent the West Cliff Washery.

As the underground mining operations progress into the new mining domains over the life of the Project, Illawarra Coal would review the need for the Endeavour Project. Notwithstanding, the Endeavour Project is subject to separate assessment and approval and is not included as part of this Project.

Underground main roads would be developed for the new longwalls (i.e. for access, ventilation and coal conveyors).

Each longwall would be formed by developing gate roads (the tail gate and main gate roads). To construct the gate roads, two roadways (headings) would be driven parallel to each other using continuous miners (Figure 2-14). The two headings that form the gate roads would be connected by driving a ‘cut-through’ from one heading to another at regular intervals (e.g. at 130 m spacings). This leaves a series of pillars of coal along the length of the gate road which support the overlying strata (Figure 2-14).

ROM Coal Handling

ROM coal from the underground longwall operation would be conveyed to the surface at either the Appin East or West Cliff pit tops.

No ROM coal would be brought to the surface at the Appin West pit top (Figure 2-12).

The ROM coal conveyed to the surface at the Appin East pit top would be transferred directly to the ROM coal bin (or stacked to the temporary ROM coal stockpile) and loaded into the trucks to haul the ROM coal to the West Cliff Washery and/or transported to the Dendrobium Washery.

ROM coal from the underground mining operations conveyed directly to the West Cliff pit top would be transferred to the West Cliff Washery (i.e. ROM coal bin) or temporarily stockpiled for later reclaim, and/or transported to the Dendrobium Washery.

2.5.4 Major Underground Equipment

The existing major underground equipment (e.g. shearers, continuous miners, augers, bins) and mobile fleet (e.g. load haul dump, drill rigs, shuttle cars, drift runners, mining vehicles) at the longwall mining operations would be upgraded or replaced over the life of the Project in line with the increased ROM coal production.

2.5.5 Coal Seam Gas Management

The Appin-Tower Power Project would continue to be used for the Project. The Appin-Tower Power Project is operated by EDL and involves the extraction of coal bed methane gas ahead of mining and capturing in a set of gas engines to provide a maximum of 94 MW of power to the NSW state grid.

To reduce the gas content in the Bulli Seam to the target range for longwall operations at the Appin Mine and West Cliff Colliery, the gas is pre-drained by drilling in-seam (i.e. horizontal) boreholes with lengths of up to approximately one kilometre into the Bulli Seam in advance of mining.

Experience has shown that strata relaxation caused by the retreating underground longwall face liberates significant volumes of gas into the mine workings from the underlying Wongawilli Seam (Figure 2-7), which is approximately 20 m below the Bulli Seam.

To capture this gas, cross-measure boreholes are also drilled from the mine workings into the Wongawilli Seam. These boreholes are designed to collect the gas at its source or to intercept gas before it migrates into the mine workings.

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5 The date of expiration of the EARs for the Endeavour Project was 20 January 2008.

The coal bed methane collected from the in-seam and cross-measure boreholes would continue to be drawn by vacuum to the gas drainage plants at the Appin West, Appin East and the West Cliff pit tops.

The existing underground gas pipeline network would be retained and augmented as necessary to support the Project. The existing 6.8 km long gas pipeline linking the Appin No.1 and No.2 shafts site and the West Cliff pit top would be maintained for the Project. Construction of any additional surface gas pipeline infrastructure would be subject to separate assessment and approval.

Surface Goaf Gas Drainage

Illawarra Coal has obtained a separate Part 3A Project Approval for the West Cliff Colliery Surface Goaf Gas Drainage Project. The Surface Goaf Gas Drainage Project involves the extraction of gas from the goaf area during and following the extraction of Longwalls 32 to 34, to ensure safe (gas concentration and outburst management) operations and maintain the rate of longwall mining operations at the West Cliff Colliery. The gas liberated via surface goaf gas drainage would be flared and/or vented to the atmosphere.

Illawarra Coal has also separately lodged an application under Part 3A of the EP&A Act to the DoP with an accompanying Preliminary Environmental Assessment for the Appin Mine Area 7 Goaf Gas Drainage Project (Cardno Forbes Rigby, 2008b). The Appin Mine Area 7 Goaf Gas Drainage Project is currently subject to separate assessment and approval.

The implementation of surface goaf gas drainage techniques may also provide significant safety and efficiency benefits for longwall mining operations during the life of the Project. However, given the variable gas quantities and the wide range of topography, vegetation cover and land ownership/access constraints across the Project area, the specific locations of goaf drainage boreholes and associated temporary surface infrastructure would be defined as a component of future detailed mine planning, engineering and feasibility studies.

A process for the environmental assessment and management of impacts associated with the potential implementation of surface goaf gas drainage during the life of the Project is described below.

If required, the installation of surface goaf gas drainage boreholes and associated surface infrastructure would be subject to preparation of supplementary specialist environmental assessment studies. These studies and any associated management measures would be detailed in a Surface Goaf Gas Drainage Management Plan. The Surface Goaf Gas Drainage Management Plan would be prepared to the satisfaction of the Director-General of the DoP.

The preparation of a Surface Goaf Gas Drainage Management Plan would include:

- Obtaining suitable landholder agreement or easements over land (where required) for the gas drainage sites, surface infrastructure and associated vehicular access.
- Targeted noise and air quality assessments to assess compliance with applicable construction and operational noise and air quality criteria at the nearest sensitive receptors (e.g. private residences). In the event that compliance with applicable construction and operational noise and air quality criteria cannot be met at a sensitive receptor, Illawarra Coal would: reach a negotiated agreement with the interested party; or commit to additional attenuation measures to ensure compliance with the relevant criteria; and/or relocate the proposed drainage site to ensure compliance with the relevant criteria. A copy of any relevant agreements formed with interested parties would be provided to the Director-General as a component of the Surface Goaf Gas Drainage Management Plan.
- Targeted visual impact assessment, and where required, implementation of management measures to minimise visual impacts at nearby affected sensitive receptors.

- A Vegetation Management Protocol that minimises any potential disturbance of natural vegetation. Surveys would be conducted of potential drainage sites for threatened flora species and endangered ecological communities (EECs). If any threatened flora species are identified, the proposed drainage site would be relocated so as to avoid any associated impacts. Clearing of EECs would be avoided apart from some minor clearing in the widely distributed Shale/Sandstone Transition Forest EEC and the Moist Shale Woodland in the Sydney Basin Bioregion EEC (mapped as P2 – Cumberland Shale Sandstone Transition Forest and P514 – Cumberland Moist Shale Woodland respectively, in Section 5) in which clearing would be kept to a minimum of 9 hectares (ha) and 3 ha, respectively. To minimise impacts to these two EECs, the Vegetation Management Protocol would include the following measures:
  - On-site validation that the vegetation present represents the relevant EEC mapped.
  - Consideration of re-locating infrastructure to avoid validated EECs, where practicable.
  - Consideration of locating infrastructure along existing landholder access tracks or existing disturbed portions of validated EECs.
  - If clearing is required, implement appropriate management measures (e.g. pre-clearance surveys, demarcation of clearance zone to constrain clearance to a minimum, implementation of erosion and sediment control works, progressive rehabilitation works, etc.).
- Design of erosion and sediment control and site water management measures in accordance with applicable guidelines.
- Site-specific Aboriginal and non-Aboriginal heritage inspections, and if required, relocation of the proposed drainage sites so as to avoid known Aboriginal and non-Aboriginal heritage sites.
- Progressive rehabilitation of the surface goaf gas drainage disturbance areas, such that only a practical minimum area is disturbed at any one time.

Following the DoP approval of a Surface Goaf Gas Drainage Management Plan, suitable surface mining leases or easements over the surface would be obtained from the DPI-MR (where required) for the drainage sites and associated vehicular access.

Where required, gas drainage infrastructure would continue to be installed over operational areas and consist of a gas extraction plant (including generator and fuel tank), gas flares, compressors as well as drill rigs and trailer to install the infrastructure.

The above assessment and approval approach would not be applied for any surface goaf gas drainage proposals in the Dharawal State Conservation Area. Such a proposal in the Dharawal State Conservation Area would be subject to a separate Part 3A assessment and approval process.

In portions of the Project area where the above requirements are not satisfied, mining would proceed without the implementation of this surface goaf gas drainage technology and/or separate environmental assessment and approval process would be embarked upon.

2.5.6 Ventilation Systems

The existing ventilation systems at the Appin Mine and West Cliff Colliery consist of:

- five operational downcast ventilation shafts and associated air inlet arrangements;
- three operational upcast ventilation shafts including fan houses (i.e. West Cliff No.1, Appin No. 2 and Appin No.3);
- two disused ventilation shafts (North Cliff No.3 and No.4); and
- surface to seam access points located at the three pit tops.

As described in Section 2.1.2, four disused shafts (Bulli Shafts No. 1 to No.4) also exist in the south-east of CCL 767.

Each of the operational upcast ventilation shaft fans currently vent to atmosphere at a rate of approximately 330 to 370 cubic metres per second (m^3/s).

WestVAMP would continue to utilise up to approximately 20% of the available mine ventilation air to achieve a reduction in greenhouse gas emissions of approximately 250,000 tonnes (t) carbon dioxide equivalent (CO_2-e) per year.

Additional ventilation shafts and associated surface infrastructure would be installed during the life of the Project to maintain a safe working environment within the underground mine. For example, the North Cliff No.3 and No.4 ventilation shafts would be recommissioned as upcast and/or downcast ventilation shafts prior to commencement of longwall operations within the North Cliff domain.

Depending on ventilation requirements and location of the longwall operations over the life of the Project, the existing ventilation shafts and access points may also switch from upcast to downcast ventilation shafts or be upgraded to higher air flow rates. Approval of upgrades/changes to existing ventilation shafts described above is being sought as part of the Project.

Development of additional ventilation shafts and associated surface infrastructure would be subject to separate assessment and approvals.

2.5.7 Mine Dewatering

Whilst the volume of groundwater that is expected to report to the underground mine workings would be minor (Section 5.5), water used for underground dust suppression and cooling of underground mining equipment would continue to accumulate in sumps/drains (or stored in previous underground workings) and then be pumped to the surface tanks/lagoons for later treatment and re-use. The Project water management system is provided in Section 2.10.

Underground water management systems would be upgraded and extended to return accumulated mine water to the surface for treatment and re-use.

2.6 ROM COAL RECLAIM AND WASHING

ROM coal from the Appin East pit top would continue to be transported via road to the West Cliff Washery for processing or stockpiling and later reclaim, and/or transported to the existing Dendrobium Washery (Figure 2-12).

ROM coal from the underground mining operations would also continue to be conveyed directly to the West Cliff Washery (i.e. ROM coal bin) or temporarily stockpiled for later reclaim, and/or would be transported to the Dendrobium Washery (Figure 2-12).

A summary description of the operation of the West Cliff Washery is provided below.

2.6.1 Coal Sizing and Screening Circuit

ROM coal is reclaimed and conveyed to a rotary breaker that reduces the top size of the coal (Figure 2-13). The sized coal is screened into fine and coarse material which is stored in separate coal bins prior to processing in the West Cliff CPP (Figure 2-13).

2.6.2 Coal Preparation Plant

The existing CPP comprises a range of components that can be generally classified into three major circuits, the coarse coal, small coal and fine coal circuits (Figure 2-13).

Each of these circuits include components that separate coal materials on the basis of size (e.g. screens) and on the basis of material type (e.g. cyclones, flotation cells, jig/drum). Each circuit has links to each of the other circuits for recycling of undersize or oversize material (Figure 2-13).

The small coal and fine coal circuits also include components that are used to dewater coal products (e.g. centrifuges) and the fine coal circuit includes components that are used to dewater coal and coal wash (e.g. thickeners, filters and tailings presses).

The existing CPP produces three main product streams (comprising jig coal, coking coal and energy coal) and two coal wash streams (comprising coarse coal wash and fine coal wash) (Figure 2-13). Each of these product and coal wash streams exit the CPP via conveyor and are stockpiled separately (Figure 2-13).

As described in Section 2.4.4, the CPP would be upgraded to increase the capacity of the plant in line with ROM coal production.

The Project would include upgrades of the CPP by replacing, upgrading or adding components, but would not substantially alter the operation of the existing CPP as described above. A schematic flowsheet of the CPP, including the major processing components that would be replaced, added or upgraded is provided on Figure 2-13.

2.7 PRODUCT COAL STOCKPILING, RECLAIM AND TRANSPORT

The product coal schedule in Table 2-2 is based on the planned maximum production rate.

Product coal from the Appin Mine and West Cliff Colliery is stockpiled prior to being transported off-site by road (Section 2.1.4). As a component of the Project, transport of coal products would increase with saleable (washed) coal production to increase from 5.4 Mtpa up to approximately 9.3 Mtpa (Table 2-2).

Product coal from the West Cliff Washery would continue to be transported by road to PKCT or to the BlueScope Steelworks (Figure 2-12). Minor quantities of product coal would also continue to be transported via road to the Illawarra Coke Company's Corrimal and Coalcliff Coal Works. Minor quantities of product coal from the Dendrobium Washery would continue to be transported by internal road to the PKCT (Figure 2-12).

The transport routes from the West Cliff Washery are shown on Figure 1-1. No changes to existing transport routes are proposed. Trucking of product coal and ROM coal would continue to be undertaken by an independent transport contractor.

2.8 COAL WASH MANAGEMENT

2.8.1 Coal Wash Production

Approximately 46 Mt of Project coal wash would be produced over the life of the Project. Table 2-3 provides an indicative schedule of the coal wash produced annually.

Whilst the total coal wash quantities are based on planned maximum production (Section 2.5.1), the actual quantity produced in any one year may vary to take account of localised geological features, detailed mine design and the actual mine development sequence.

2.8.2 Coal Wash Physical Characteristics

Coal wash generally consists of a mixture of carbonaceous shale and mudstone with minor quantities of sandstone. Small quantities of low quality coal can also be present (Cardno Forbes Rigby, 2007a).

Three coal wash products are generated at the Washery (Cardno Forbes Rigby, 2007a):

- coarse coal wash (large particle size by-product from the coal washing process);
- finer graded coal wash (produced from washery filter/belt equipment and generally has a higher moisture content); and
- coal wash sludge (small quantities of sediment from site water treatment ponds and sumps).

The typical size fraction and moisture content of coal wash from the West Cliff Washery is provided in Table 2-4.

2.8.3 West Cliff Coal Wash Emplacement

The overall planning concept for the West Cliff Coal Wash Emplacement is to provide a facility which will accept large quantities of coal wash over an extended period of time. The facility has been designed to progress gradually down the valley within the contained Brennans Creek Dam catchment.

The active emplacement area is kept to a practicable minimum and as each section of fill reaches the designed height and landform, topsoil is applied and revegetation works are commenced.

During the Project, the Dendrobium Mine would produce in the order of 27.2 Mt of coal wash (Cardno Forbes Rigby, 2008c) which would also require emplacement at the West Cliff Coal Wash Emplacement.

Table 2-3
Indicative Coal Wash Production Schedule

Year	Project Coal Wash Production (Mt)	Dendrobium Mine Coal Wash Production (Mt)[1]	Cumulative Coal Wash Production (Mt)
1	1.2	1.7	2.9
2	1.2	1.7	5.8
3	1.3	1.7	8.8
4	1.4	1.7	11.9
5	1.4	1.7	15.0
6	1.4	1.7	18.1
7	1.5	1.7	21.3
8	1.6	1.7	24.6
9	1.6	1.7	27.9
10	1.6	1.7	31.2
11	1.5	1.7	34.4
12	1.7	1.7	37.8
13	1.7	1.0	40.5
14	1.7	1.0	43.2
15	1.9	1.0	46.1
16	1.9	1.0	49.0
17	1.5	1.0	51.5
18	1.4	1.0	53.9
19	1.6	0.8	56.3
20	1.8	-	58.1
21	1.9	-	60.0
22	1.6	-	61.6
23	1.7	-	63.3
24	1.6	-	64.9
25	1.5	-	66.4
26	1.5	-	67.9
27	1.6	-	69.5
28	1.5	-	71.0
29	1.5	-	72.5
30	0.7	-	73.2
Total	46.0	27.2	73.2

Source: ICHPL (2009)

[1] Approximation based on the limits of approval (5.2 Mtpa) stipulated in Condition 5, Schedule 2 of the Notice of Modification approved by the Minister for Planning on 8 December 2008 for DA 60-03-2001 and the total yield estimates as provided in the *Environmental Assessment for Modification to Dendrobium Area 3* (Cardno Forbes Rigby, 2008c).

Table 2-4
Typical Size Fraction and Moisture Content of Coal Wash from the West Cliff Washery

Size Fraction/Moisture Content	Coal Wash Bin	Coal Wash Belt
Size Fraction: 0 to 0.15 mm	3.0 %	92.9 %
Size Fraction: 0.15 to 0.6 mm	6.8 %	5.7 %
Size Fraction: 0.6 to 37.5 mm	76.4 %	1.4 %
Size Fraction: 37.5 to 200 mm	13.8 %	0.0 %
Moisture Content (approximate)	7.2 %	33.8 %

Source: Cardno Forbes Rigby (2007a)

A description of the current status, actual and proposed design capacities of Stages 1 to 4 of the West Cliff Coal Wash Emplacement is provided below.

Stage 1 Coal Wash Emplacement

Stage 1 of the West Cliff Coal Wash Emplacement commenced in 1976. Stage 1 was completed in 2001 and is currently undergoing rehabilitation. Stage 1 of the coal wash emplacement had a capacity of 4.6 Mt and covered an area of approximately 21 ha (Figure 2-2).

Stage 2 Coal Wash Emplacement

Stage 2 of the West Cliff Coal Wash Emplacement commenced in 2000 and currently operates in accordance with a section 100 approval issued under the *Coal Mines Regulation Act, 1982*. Stage 2 of the coal wash emplacement has a design capacity of 17 Mt and covers an area of approximately 29 ha (Figure 2-2).

At the current coal wash deposition rates, it is anticipated that Stage 2 will reach its final emplacement landform in 2009/2010. Progressive rehabilitation of completed sections of the Stage 2 Coal Wash Emplacement has commenced.

Stage 3 Coal Wash Emplacement

ICHPL obtained a Notice of Staged Development Approval on 20 December 2007, for the development of the West Cliff Stage 3 Coal Wash Emplacement in accordance with the requirements of the Development Consent (DA 60-03-2001) for the Dendrobium Mine (Section 2.1.5).

Stage 3 of the West Cliff Coal Wash Emplacement has a design capacity of 33.5 Mt and covers an area of approximately 66 ha (Figure 2-2). The maximum design height for Stage 3 is approximately 353 m Australian Height Datum (AHD).

Based on the maximum planned production rate, coal wash produced by the Project during the first ten years (Table 2-3) would be placed at the approved West Cliff Stage 3 Coal Wash Emplacement in accordance with the Stage 3 Coal Wash Emplacement Management Plan (Cardno Forbes Rigby, 2007a).

Stage 4 Coal Wash Emplacement

Coal wash produced by the Project would be placed at the West Cliff Stage 4 Coal Wash Emplacement (Figure 2-15).

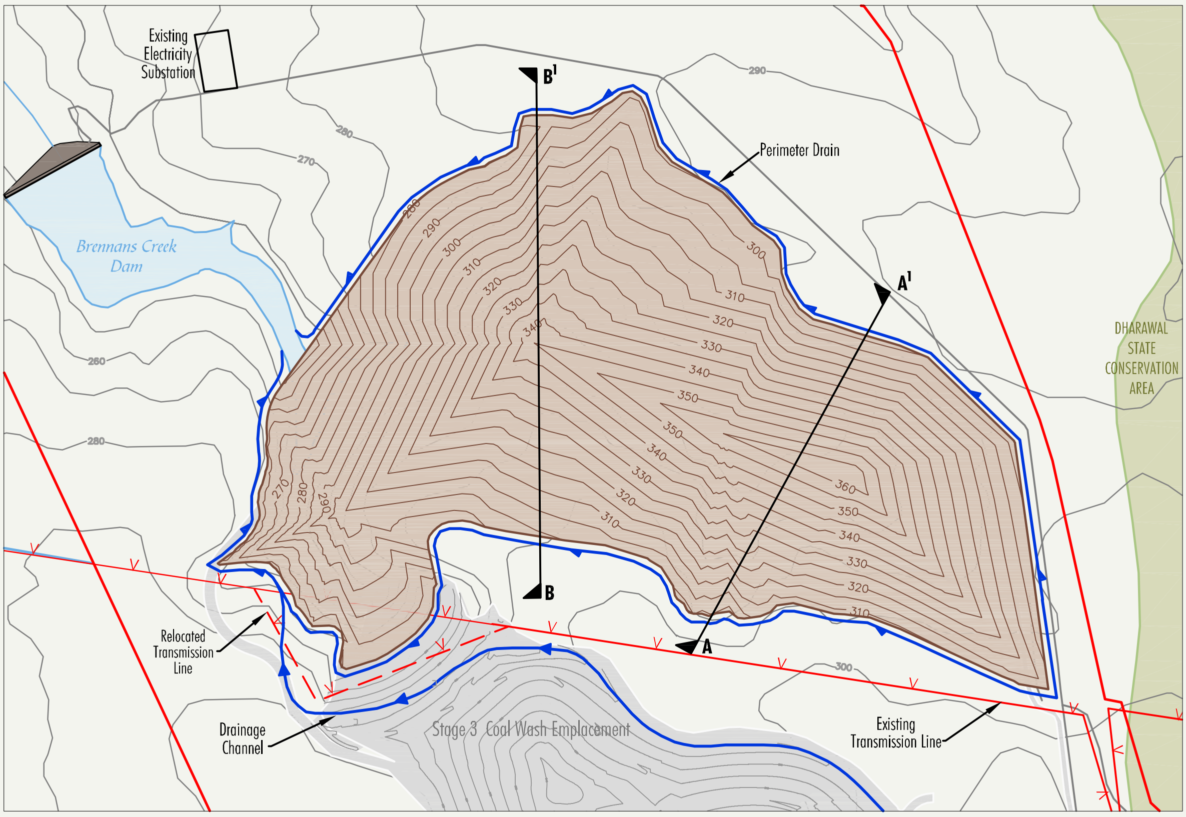
The West Cliff Stage 4 Coal Wash Emplacement is considered the most viable coal wash management option for the following reasons (Cardno Forbes Rigby, 2009):

- Stage 4 is located entirely within the West Cliff Colliery surface lease, the conditions of which state that surface emplacement of coal wash is a permitted landuse.
- Stage 4 is close to the existing washery on-site at the West Cliff pit top.
- Stage 4 is logistically feasible for transportation of coal wash from the Dendrobium Washery. Currently, coal wash is transported from the Dendrobium Washery to the West Cliff pit top in trucks on the return trip from delivering product coal to PKCT.
- The Stage 4 area comprises steeply incised deep valleys, which optimises emplacement capacity per hectare. For example a flatter site would require vegetation clearing and disturbance over a larger area to accommodate similar volumes of coal wash.

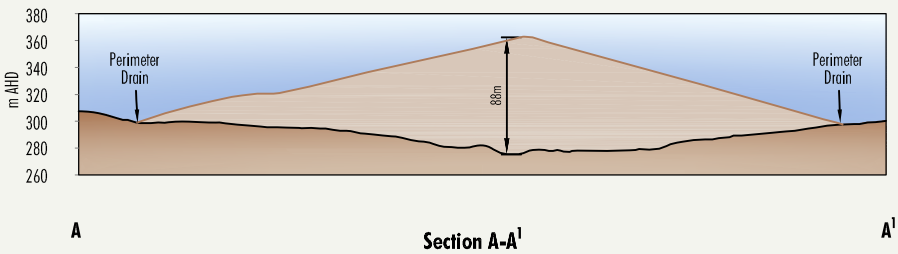
Stage 4 of the coal wash emplacement has a design capacity of 40 Mt[6] and covers an area of approximately 76 ha (Figure 2-15). The maximum design height for Stage 4 is approximately 365 m AHD, with a maximum valley fill depth of approximately 88 m. A cross-section of the conceptual design of the Stage 4 Coal Wash Emplacement is shown on Figure 2-15.

Water management requirements associated with the construction of Stage 4 Coal Wash Emplacement are described in Section 2.10.3.

[6] Assuming an 'as emplaced' density of 1.7 tonnes per cubic metre (t/m^3), the available Stage 4 emplacement volume is 24 million cubic metres (m^3).



Plan View - Stage 4 Coal Wash Emplacement



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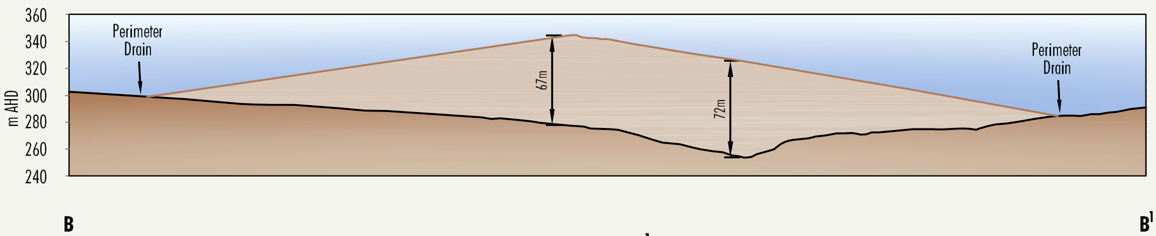

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Source: After Cardno Forbes Rigby (2009)

BULLI SEAM OPERATIONS

FIGURE 2-15
West Cliff Stage 4 Coal Wash Emplacement- Conceptual Cross Section and Plan

Resource Strategies

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The existing mobile equipment fleet used for the Stage 3 Coal Wash Emplacement would be retained for construction of the Stage 4 Coal Wash Emplacement. The existing mobile equipment fleet includes:

- eight haul trucks;
- two dozers;
- one excavator;
- one grader;
- one vibratory roller; and
- one water truck.

The mobile equipment fleet would be altered over the life of the Project to meet the production requirements.

2.8.4 Underground Emplacement Pilot Trial

Within five years of the grant of Project Approval, ICHPL would fund and commence development of a pilot-scale research and development trial for underground coal wash emplacement technology at the Project. The trial would draw upon available information/technical data from similar investigations and trials in the Southern Coalfield and internationally.

The results of the trial would be used to inform a value analysis of the feasibility of a portion of the coal wash being emplaced underground at the Project. The value analysis would include consideration of aspects such as:

- practical application and mine safety for underground emplacement at the Project design volumes/rates;
- infrastructure requirements (including supporting equipment) for underground emplacement;
- water and other materials consumption/use requirements; and
- consideration of benefits/costs of underground emplacement versus ongoing surface emplacement at the West Cliff pit top.

Infrastructure required for the pilot-scale trial would be subject to future separate approvals. The future underground emplacement of coal wash would also be subject to future separate approvals should the value analysis warrant its further development.

2.8.5 Ongoing Consideration of Alternative Coal Wash Management Options

As part of the assessment process for approval of the West Cliff Stage 3 Coal Wash Emplacement, an assessment of alternative uses for coal wash was undertaken by ICHPL (Cardno Forbes Rigby, 2007b). A range of options were examined including:

- optimisation of the existing emplacement site;
- underground disposal;
- coal wash brick making;
- road pavement;
- using coal wash as fuel for power generation; and
- civil fill applications and site rehabilitation.

It was concluded in the assessment that the West Cliff Stage 3 Coal Wash Emplacement remained the only viable short to medium term option for coal wash disposal, supplemented by a range of possible re-use opportunities negotiated on a project-by-project basis.

ICHPL has however committed to, and would continue to (Cardno Forbes Rigby, 2007b):

- research and consider alternatives to coal wash emplacement;
- pursue the use of coal wash as an engineering fill material;
- negotiate with owners of suitably located and available sites that could be used as alternative emplacement sites to extend the life of the West Cliff Stage 3 Coal Wash Emplacement; and
- report progress of these actions to the NSW Government in the Annual Environmental Management Report (AEMR).

2.9 REHABILITATION ACTIVITIES AND REMEDIATION WORKS

The Project includes ongoing rehabilitation activities and rehabilitation at mine closure.

Further details of the Project rehabilitation and mine closure activities are provided in Section 6 (Rehabilitation and Mine Closure).

2.10 WATER MANAGEMENT

The existing water management system would be progressively augmented as water management requirements change over the life of the Project. Figure 2-16 provides a schematic of the water management system.

A detailed description of the Project water management system is provided in the Surface Water Assessment (Appendix C).

2.10.1 Existing Water Management System

The existing water management system schematic is shown on Figure 2-16.

The surface facilities which support the underground mining operations at the Appin Mine and West Cliff Colliery are subject to three existing Environment Protection Licences (EPLs):

- EPL 2504 (West Cliff pit top);
- EPL 758 (Appin East pit top); and
- EPL 398 (Appin West pit top).

These EPLs include conditions pertaining to environmental monitoring, discharge of waters offsite and details of Pollution Reduction Programs (PRPs) in place at each of the pit tops.

A description of the existing water management at the West Cliff, Appin East and Appin West pit top surface facilities (Figures 2-2, 2-3 and 2-4 respectively) is provided below.

West Cliff Pit Top

The West Cliff pit top area is contained within the catchment of Brennans Creek, a tributary of the Georges River. The Brennans Creek Dam, a 311 megalitres (ML) capacity water storage dam, has been constructed on Brennans Creek in its lower reaches downstream of the West Cliff pit top surface facilities.

A number of smaller settlement ponds also form part of the West Cliff pit top site water management system.

Water from Brennans Creek Dam is used (after chlorination) as the main supply to the West Cliff Colliery underground mining operations, and as supply to the North (Water) Tank. Water supplied to the West Cliff Colliery underground mining operations is used for equipment cooling and dust suppression. The majority of the water supplied to the underground mine returns to the surface, with losses occurring to ventilation and to coal moisture. Water from the North Tank is used to provide water for fire fighting capacity, to supply make-up requirements for the West Cliff CPP, to supply the methane gas plant, for semi-trailer wash down and to supply the South (Water) Tank. The South Tank is used to provide water for fire fighting capacity and to supply bath house and vehicle wash down requirements at the administration offices.

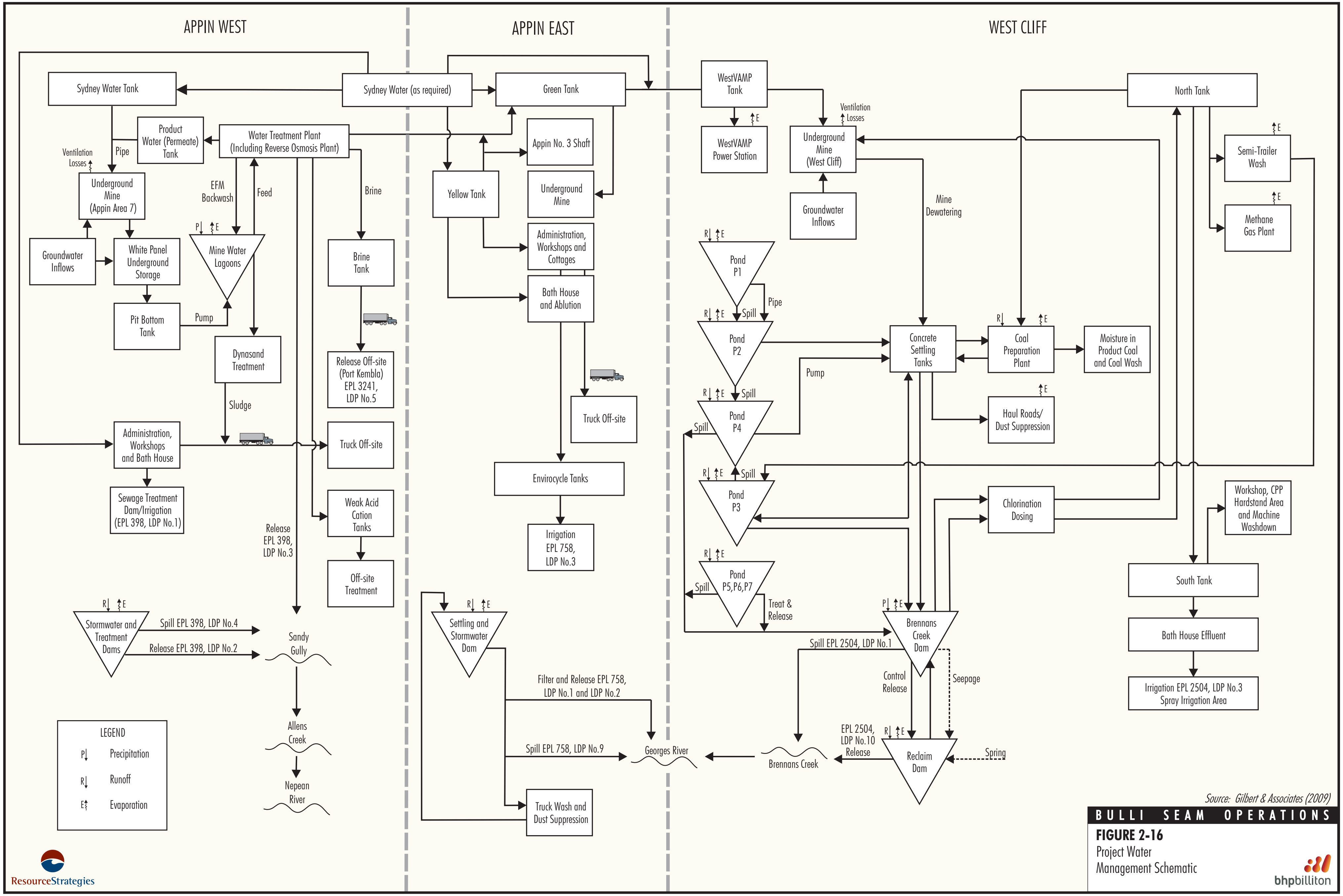
Treated bath house effluent is irrigated over a dedicated vegetated irrigation area, in accordance with EPL 2504.

The West Cliff pit top has three DECC licensed discharge points (LDPs) under EPL 2504 for release of excess water from the site, namely for discharge through the spillway of Brennans Creek Dam (LDP No.1), LDP No.10 at the outlet from the Reclaim Dam (a small sump constructed at the downstream toe of Brennans Creek Dam) and LDP No.3 for irrigation of treated effluent. The locations of the LDPs are provided in Appendix C.

Water for the WestVAMP power station cooling is drawn from a tank at the power station which is supplied either from the Green Tank at the Appin East pit top or Sydney Water (as required). The Green Tank is in turn supplied by water produced from the Appin West Water Treatment Plant (WTP) located at the Appin West pit top.

Water from the WestVAMP power station tank can also be used as supplementary supply to the West Cliff Colliery underground mining operations (Figure 2-16). In this way treated water from Appin West WTP can be used to supply the West Cliff Colliery underground mining operations.

Overall, the West Cliff pit top site water management system relies largely on harvesting water from Brennans Creek Dam and efficiently reusing, treating and re-circulating this water on-site.



BULLI SEAM OPERATIONS

FIGURE 2-16
Project Water Management Schematic

Appin East Pit Top

Surface water runoff and water supplies are generally separate at Appin East pit top (Figure 2-3). Surface water runoff reports to settling and stormwater dams where the water is treated by filtration and then released to the nearby Georges River via EPL 758 LDP No.1 and LDP No.2. EPL 758 conditions limit LDP No.1 and LDP No. 2 discharge to no more than 3 megalitres per day (ML/day). During high rainfall events the settling and stormwater dams may spill to the Georges River and such spill is licensed via EPL 758 LDP No.9. Water harvested from the stormwater dam is used on-site for truck wash and dust suppression.

Two tanks provide the remainder of the Appin East pit top site water requirements. The 600 kilolitre (kL) capacity Yellow Tank provides water for surface requirements including: bath house and ablutions; supply to the existing mine-owned dwellings; supply to workshops and administration facilities; and supply water requirements at the Appin Shafts (via pipeline). The Yellow Tank is supplied by Sydney Water.

The 1,400 kL Green Tank provides water to the Appin Mine underground mining operations – this forms a relatively minor portion of the overall Appin Mine underground requirements, the majority of which are supplied from the Appin West pit top (refer below). The Green Tank is supplied by water produced from the Appin West WTP or from Sydney Water. Treated site effluent is irrigated in a dedicated area (EPL 758 LDP No.3) or is trucked off-site.

Appin West Pit Top

Surface water runoff and water supplies/ underground dewatering are managed separately at Appin West pit top (Figure 2-4). Surface water runoff reports to stormwater and treatment dams where the water is treated by filtration and then released to the nearby Sandy Gully via EPL 398 LDP No.2. During high rainfall events the dams may spill to Sandy Gully and such spill is licensed via EPL 398 LDP No.4. Sandy Gully is a tributary of Allens Creek which in turn flows into the Nepean River.

Water supplied to the Appin Mine underground mining operations is used for equipment cooling and dust suppression. The majority of the water supplied to the underground mine returns to the surface, with losses occurring to ventilation and to coal moisture.

The Appin Mine underground mining operations are continually dewatered as a result of mining process water make and minor groundwater ingress.

Underground mine water make/inflow is pumped to an underground goaf storage known as White Panel (Figure 2-16). The White Panel has an estimated storage volume of approximately 480 ML. Water from White Panel is pumped via underground storage tanks to the Mine Water Lagoons at the Appin West pit top (Figure 2-4). The Appin West WTP includes a Reverse Osmosis (RO) component where the product water is reduced in salinity to typically less than 600 microSiemens per centimetre (μS/cm).

Treated product water from the Appin West WTP is used to supply a product water tank which is a recycle supply to the Appin Mine underground mining operations. Water supply to the Appin Mine underground mining operations is supplemented by Sydney Water as required.

Backwash and other waste water (EFM – shown on Figure 2-9) from the Appin West WTP is returned to the Mine Water Lagoons. Brine from the Appin West WTP RO process is trucked off-site for licensed discharge at Port Kembla (Figure 2-16). Sludge from the Appin West WTP Dynasand filter is also trucked off-site.

Treated product water from the Appin West WTP also provides supply to the Green Tank at Appin East pit top. When the treated product water from the Appin West pit top is in excess of the Appin Mine supply and the Green Tank requirements, water is released to Sandy Gully via EPL 398 LDP No.3. EPL 398 conditions limit LDP No.3 discharge to no more than 3 ML/day.

Potable water is purchased from Sydney Water for administration, workshops and bath house at the Appin West pit top. Treated sewage is either irrigated on-site (EPL 398 LDP No.1) or trucked off-site to an appropriate facility.

A Water Savings Action Plan was completed for the Appin West pit top in 2006 (ICHPL, 2006a). As a consequence, in 2007 ICHPL won the Largest Volume Reduction Award from Sydney Water for reducing water consumption by 660 kilolitres per day (kL/day) at the Appin Mine.

West Cliff Colliery Water Supply Pipeline

The Minister for Planning approved the West Cliff Colliery Water Supply Pipeline on 26 September 2007 (Project Approval 06_0288). The pipeline provides for a reliable high quality water supply for West Cliff Colliery of up to 3.15 ML/day to be used on-site (e.g. cooling water for WestVAMP). The location of the water supply pipeline and associated infrastructure is shown on Figure 2-11.

2.10.2 Project Water Management System

The Project water management system would generally be based on the existing water management system (Figure 2-16).

Upgrades and augmentations to the existing water management system would be undertaken over the life of the Project (e.g. installation of additional water tanks [Figure 2-4], site water pond capacity increases [de-silting] and upgrades of the water treatment plant [Figure 2-4]) to continue to increase the efficiency of water use, minimise the requirement for make-up water supply from Sydney Water and minimise off-site water releases. The upgrades and augmentations would be undertaken in accordance with EPLs at each pit top and documented in the AEMR.

A predictive assessment of the performance of the Project water supply system (including the predicted site water management system water release/spills and make-up requirements for the Project maximum production rates for a range of different climatic scenarios) is presented in Appendix C.

2.10.3 Stage 4 Coal Wash Emplacement

The Stage 4 Coal Wash Emplacement would result in the available Brennans Creek Dam storage capacity being reduced by approximately 15% (from 311 to 267 ML). The reduced storage capacity has been considered in the Surface Water Assessment (Appendix C).

High density polyethylene pipe is currently used for underground drainage for the West Cliff Coal Wash Emplacement. ICHPL has considered potential engineering options (e.g. reinforcement installation or steel pipes) for underdrainage water management for the increased emplacement height. ICHPL would prepare a West Cliff Stage 4 Coal Wash Emplacement Management Plan that would detail the preferred underdrainage water management system for the Stage 4 Coal Wash Emplacement.

2.11 INFRASTRUCTURE AND SERVICES

The existing surface infrastructure and services would continue to be utilised throughout the life of the Project, with additions and upgrades.

Surface infrastructure and services would continue to operate 24 hours per day, seven days per week.

ICHPL may in the future consider developing a new pit top within the mining area. However, a new pit top is not currently considered as a component of this Project and is not assessed in this EA. If required in the future, any new pit top would be subject to a separate assessment, public consultation and approval process.

2.11.1 Administration Buildings, Bathhouse, Workshops and Surface Facilities

The existing administration buildings, bathhouses, workshops and stores at the three pit tops would continue to be used during the development of the Project with some minor upgrades as necessary (Section 2.4.4).

2.11.2 Access Roads and Haul Roads

The existing access roads to the Appin West, Appin East and West Cliff pit tops would continue to be used for the Project.

Wherever possible, existing internal gravel roads would be used to service the Project facilities. New internal roads would be constructed where necessary. The use of these internal access roads would be restricted to mine personnel only.

The Project would require the progressive construction of internal haul roads between the West Cliff Washery, West Cliff Coal Wash Emplacement and ROM/product coal stockpiles. Existing haul roads would be used, where practicable.

ROM coal would continue to be hauled from the Appin East pit top to the West Cliff Washery via the public road network (Appin Road) (Section 2.7).

2.11.3 Electricity Supply and Distribution

The total maximum power supply requirement for the Project when washing 10.5 Mtpa ROM coal (i.e. fully operational) is approximately 80 MW. It is expected that up to approximately 40 MW would be required for underground mining and coal handling, 20 MW for the West Cliff Washery and 20 MW for other miscellaneous electricity usage (e.g. pit top and ventilation facilities).

Electricity generated by the Appin-Tower Power Project and WestVAMP would continue to be used for the Project (Section 2.1.6) subject to future contract negotiations and ongoing economical viability. The Appin-Tower Power Project and WestVAMP are two of the most significant greenhouse gas abatement projects in Australia (Section 5.14).

The Project electrical supply would be delivered by the existing 66 kV powerlines. As the mining operations progress, additional powerlines and/or substations (e.g. for down-hole electricity supply to the advancing longwall operations and surface facilities) would be required and would be subject to separate assessment and approvals.

Power would be transferred either by overhead cable or underground cable where necessary. Standard electrical safety laws and practices (including vehicle clearance considerations) would apply.

2.11.4 Service Boreholes

Services including compressed air, diesel and water supply to the advancing longwall operations would continue to be delivered from the surface via down-holes located at existing surface infrastructure areas.

As the mining operations progress, additional service boreholes would be installed and would generally be located adjacent other surface infrastructure areas (e.g. Douglas North electricity supply substation) resulting in minimal additional disturbance.

If required, the installation of service boreholes and related surface infrastructure would be subject to preparation of supplementary specialist environmental assessment studies. These studies and any associated management measures would be detailed in a Service Borehole Management Plan.

The Service Borehole Management Plan would be prepared to the satisfaction of the Director-General of the DoP and would adopt a similar approach for environmental assessment and management as that described in Section 2.5.5 for surface goaf gas drainage.

2.11.5 Site Security and Communications

Existing site security measures would be retained for the Project with upgrades (e.g. installation of boom gates) as necessary. Additional security fencing for the Project would be erected where necessary.

The existing communications systems at the surface facilities and underground mining operations would be retained for the Project with augmentations as necessary. The existing PED emergency communication system would also be retained for the Project with extensions to the PED antenna cable. The PED system uses ultra low frequency signals to transmit information directly through rock strata (through-the-earth signalling).

If required, surface works associated with the installation of the PED system would be subject to preparation of supplementary specialist environmental assessment studies. These studies and any associated management measures would be detailed in a PED System Management Plan. The PED System Management Plan would be prepared to the satisfaction of the Director-General of the DoP and would adopt a similar approach for environmental assessment and management as that described in Section 2.5.4 for surface goaf gas drainage.

2.11.6 Potable Water

The potable water supply for the Project would continue to be purchased from Sydney Water. The existing potable water supply network would continue to service the Project with minor changes.

2.12 WASTE MANAGEMENT

The Project would generate waste streams that would be similar in nature to those generated at existing Appin Mine and West Cliff Colliery. The key waste streams would continue to comprise:

- coal wash (as described in Section 2.8);
- sewage and effluent;
- recyclable and non-recyclable general wastes; and
- other wastes from mining and workshop activities (e.g. waste oils, scrap metal and used tyres).

ICHPL would continue to apply general waste minimisation principles (i.e. reduce, re-use and recycling where practicable) to minimise the quantity of wastes that require off-site disposal. No on-site rubbish disposal or landfill is proposed.

2.12.1 Sewage Treatment and Effluent Disposal

Sewage and waste water from ablution facilities would continue to be managed at the pit top facilities as follows:

- West Cliff (Figure 2-2) – operation of the sewage treatment plant and effluent treatment pond with polypipe for effluent irrigation on-site at EPL 2504 LDP No.3 and No.4.
- Appin East (Figure 2-3) – operation of the sewage treatment system (Envirocycle) and spray irrigation system on-site at EPL 758 LDP No.3.
- Appin West (Figure 2-4) – operation of the sewage treatment plant and two clay-lined stabilisation lagoons with polypipe for effluent irrigation on-site at EPL 398 LDP No.1.

Sewage from the underground mining operations would continue to be removed by a licensed contractor.

2.12.2 Recyclable and Non-Recyclable General Domestic Wastes

All recyclable and non-recyclable general domestic waste (i.e. putrescible or non-putrescible General Solid Waste[7]) would continue to be collected regularly and managed by a licensed waste contractor. A register of waste collected by the licensed waste contractor would be maintained.

Where licensed waste contractors handle waste, those contractors would be required to comply with their own licence agreements with the DECC. Waste would be disposed of at a DECC approved waste facility that is licensed under the *Protection of the Environment Operations Act, 1997* (PoEO Act).

[7] Described or pre-classified waste in *Waste Classification Guidelines Part 1: Classifying Waste* (DECC, 2008a).

2.12.3 Other Waste Types

Other waste types likely to be produced over the life of the Project include those listed in Table 2-5.

2.13 MANAGEMENT OF DANGEROUS GOODS

The transportation, handling and storage of all dangerous goods at the Appin Mine and West Cliff Colliery is conducted in accordance with the requirements of the *Storage and Handling of Dangerous Goods – Code of Practice 2005* (WorkCover, 2005).

Hydrocarbon Storage

Hydrocarbons used on-site for the Project would include fuels (diesel and petrol), oils, greases, degreaser and kerosene).

Diesel and oil would continue to be stored at the West Cliff, Appin East and Appin West pit tops (Figures 2-2, 2-3 and 2-4, respectively). All existing hydrocarbon storage facilities would continue to be operated in accordance with Australian Standard (AS) 1940-2004 *The Storage and Handing of Flammable and Combustible Liquids.* All new hydrocarbon storage tanks for the Project (above-ground and underground) would be located in facilities designed to comply with Australian standards and relevant DECC guidelines (i.e. *Guidelines for implementing the POEO (Underground Petrol Storage Systems) Regulation 2008*).

The diesel storage facility and refuelling station at the West Cliff pit top is currently being upgraded in accordance with Project Approval 08_0151 granted by the Minister for Planning on 4 March 2009 under Part 3A of the EP&A Act. An Environmental Assessment for the Proposed Diesel Storage Facility and Refuelling Station at BHPBIC West Cliff Colliery was separately prepared and submitted in November 2008 (Cardno Forbes Rigby, 2008d).

Procedures have been developed at the existing mining operations for the handling, storage and disposal of workshop hydrocarbons (i.e. oils, greases, degreaser and kerosene). Waste hydrocarbons are collected, stored and removed by licensed waste contractors on a periodic basis. Workshop hydrocarbon spills and leaks are contained by purpose-built oil/water separator systems which are inspected and maintained on a regular basis.

Table 2-5
Other Wastes Likely to be Generated by the Project

Example of Waste	Indicative Waste Type[1]	Management Method
Tyres.	Special	Temporarily stored on-site prior to removal from site by appropriately licensed contractor.
Asbestos materials (if present in some existing structures).		
Used oils/hydrocarbons.	Liquid	
Explosives, lead acid batteries, containers that have not been cleaned and that have contained dangerous goods, oxidising chemicals from damaged self-rescuers.	Hazardous	
Building and demolition wastes.	General Solid Waste (non-putrescible)	
Glass, plastic, rubber, plasterboard, ceramics, bricks, metal, paper, cardboard, etc.		
Workshop wastes (e.g. drained oil filters and rags and oil-absorbent materials that only contain non-volatile petroleum hydrocarbons and do not contain free liquids.		
Sewage treatment plant sludges.	Liquid	
Water treatment plant by-products including weak acid cation regenerant and backwash sludge.	Liquid	

Source: ICHPL (2009)
1 Described or pre-classified waste in *Waste Classification Guidelines Part 1: Classifying Waste* (DECC, 2008).

Explosives Storage

Explosives would continue to be stored on-site in accordance with the requirements of AS 2187-1998 *Explosives – Storage Transport and Use – Storage*. As described in Section 2.4.4, an explosives storage facility would be developed at the Appin West pit top (Figure 2-4).

Material Safety Data Sheets and Chemical Storages

No chemical or hazardous material would be permitted on-site unless a copy of the appropriate Material Safety Data Sheet (MSDS) is available on-site or, in the case of a new product, it is accompanied by an MSDS.

All chemicals brought on-site for use in the mining operations would be recorded in the existing inventory register which identifies the type of product, dangerous goods class, liquid class, hazchem class and the quantity held on-site. The register also identifies the emergency response procedures in the event of a spill.

Chemical storages would be provided within existing workshop and storage buildings (Figures 2-2, 2-3 and 2-4) and would be separated according to chemical type and storage requirements.

2.14 WORKFORCE

The existing mining operations at Appin Mine and West Cliff Colliery have a combined operational workforce (including ICHPL staff and on-site contractor's personnel) of approximately 875 people. The operational workforce would be augmented during the Project with increases in efficiency allowing the proposed increases in ROM and product coal production. At full development (producing 10.5 Mtpa ROM coal), the Project would employ in the order of 1,170 people. This would include a mixture of Illawarra Coal staff and on-site contractor's personnel.

The current shift arrangements at the Appin Mine and West Cliff Colliery underground mining operations and the West Cliff Washery would generally be retained. During the life of the Project alternative shift configurations would be required to meet operational and industry best practice requirements.

It is anticipated that during the initial development of the Project and for upgrades of surface and underground infrastructure during the Project, an additional construction workforce of up to 100 people would be required for short periods. Surface construction/ development activities would generally be restricted to daylight hours. Underground construction works would be undertaken up to 24 hours per day.

Operation of the Project would generally be required 24 hours a day, seven days a week.

A summary of the initial development and operational phase workforce is provided in Table 2-6.

Table 2-6
Initial Development and Operational Workforce

Activity	Initial Development and Existing Mining Operations	Project at Full Development (Producing 10.5 Mtpa ROM Coal)
Appin Mine - Underground Mining Operators, Maintenance Supervisors and Management	473	653
West Cliff Colliery - Underground Mining Operators, Maintenance Supervisors and Management	321	429
West Cliff Washery - Personnel and Maintenance Staff	81	88
Project Construction/Development Activities	100	-
Total	**975**	**1,170**

Source: After ICHPL (2009)